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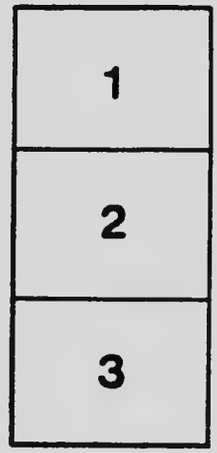

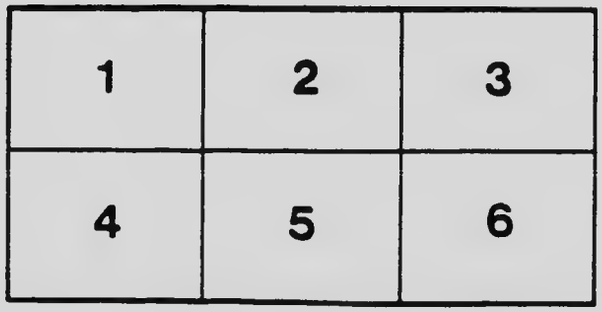

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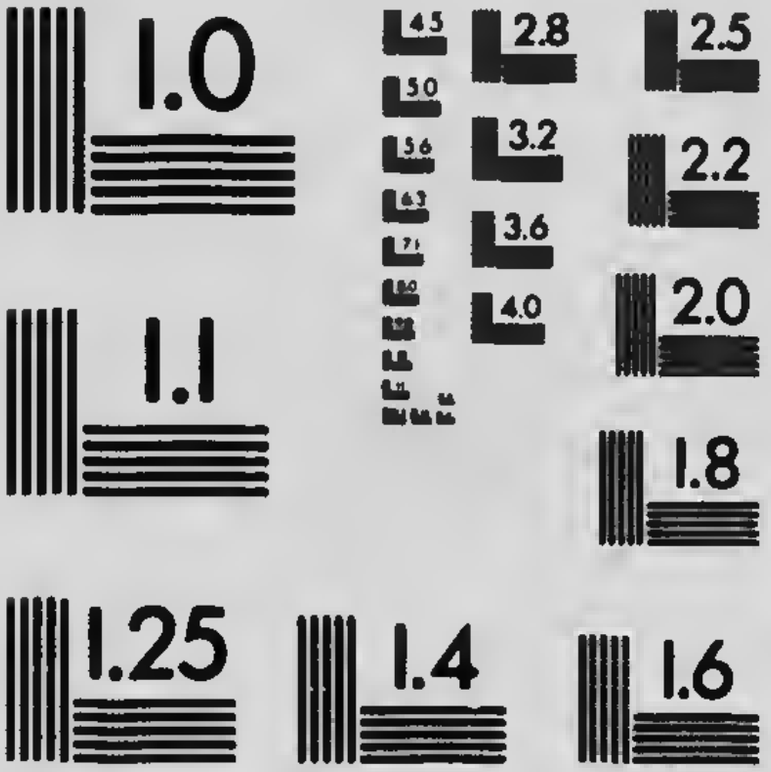

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ACUTE ABDOMINAL DISEASES

ACUTE ABDOMINAL DISEASES

INCLUDING

ABDOMINAL INJURIES AND THE COMPLICATIONS OF EXTERNAL HERNIA

BY

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PREFACE

DURING our periods of office as Resident Assistant Surgeon and Resident Assistant Physician respectively to St. Thomas's Hospital, we had an unique opportunity of seeing, and in many cases of treating, a very large number of acute abdominal conditions. In this book we have endeavoured to set forth the results of our experiences, and our object has been to discuss, compare and contrast all the various acute diseases and injuries to which the abdomen and its contents are liable, treating these conditions from the point of view of both physician and surgeon. We are not acquainted with any single book written on these lines, though the surgical aspect of the subject has been effectively dealt with by Mr. Battle in his admirable "Lectures on the Acute Abdomen," recently published in book form. We would here acknowledge the valuable help which we have obtained from the numerous text-books and monographs which we have consulted during the preparation of this book.

While treating all these conditions together, our aim has been to make the account of each separate disease complete in itself; in Chapter V, for instance, intestinal obstruction is considered as an acute abdominal disease, and then some fourteen varieties of obstruction are discussed in detail. We trust that the advantages may outweigh the disadvantages of this plan.

There being no precise definition of an "acute abdominal disease," we have had considerable difficulty in deciding on a frontier between acute and chronic disorders, and we are

aware that our decision to include some, or to exclude other, conditions may be open to criticism.

In many instances we have illustrated our account of a disease by brief notes of typical cases; such of these as occurred in hospital practice have already been published in the "St. Thomas's Hospital Reports," and we have to express our thanks to the physicians and surgeons of St. Thomas's Hospital for permission to refer to them. Our thanks are also due to the proprietors of the *Lancet* and of the *British Medical Journal* for the loan of blocks, and to the proprietors of the *Practitioner* for permission to republish the section on Intussusception. Mr. Rouquette has given us valuable assistance in the reading of proof-sheets. Finally, we wish to acknowledge the courtesy and consideration with which we have been treated by our publishers, Messrs. Baillière, Tindall and Cox.

JOSEPH E. ADAMS.
MAURICE A. CASSIDY.

LONDON, W.
May, 1913.

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ACUTE ABDOMINAL DISEASES

CHAPTER I

ANATOMY

It seems desirable to devote the first chapter of this book to a consideration of gross anatomy, so far as it interests the clinician and the operating surgeon.

The Abdominal Cavity

The topography of the abdominal viscera has been simplified by the division of the cavity into nine regions by four arbitrary planes, two of which are horizontal, and two vertical. The upper horizontal plane passes through the lowest part of the tenth costal cartilages, and is termed the *infra-costal plane*. The lower horizontal plane passes through the tubercles of the iliac crests, and is termed the *inter-tubercular plane*. These two lines of demarcation divide the abdominal cavity into upper, middle, and lower zones. These three zones are again divided by two *lateral vertical planes*, which on either side pass through a point midway between the anterior superior spine of the ilium and the symphysis pubis. These planes usually cut the costal margin at the tip of the ninth costal cartilage. The three horizontal zones are thus divided each into three smaller compartments, the upper including the epigastric and right and left hypochondriac regions, the middle zone the umbilical and right and left lumbar regions, and the inferior zone the hypogastric and right and left iliac regions.

The infra-costal plane passes through the upper part of the third lumbar vertebra. The inter-tubercular plane passes through the body of the fifth lumbar vertebra. Addison has suggested that the horizontal plane separating the

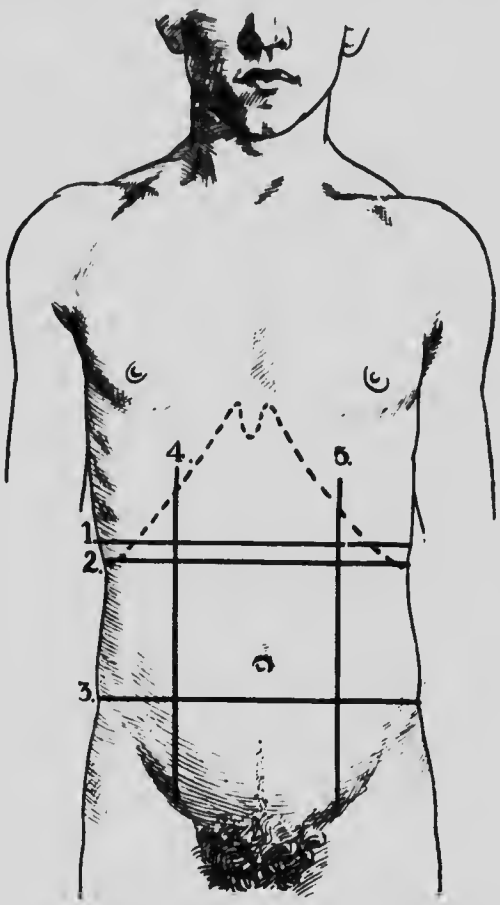


FIG. 1.—Abdominal topography; 1, Trans-pyloric plane; 2, Infra-costal plane; 3, Inter-tubercular plane; 4, Right lateral vertical plane; 5, Left lateral vertical plane.

middle and upper abdominal zones should be that line which passes through a point midway between the epi-sternal notch and the pubic symphysis. Posteriorly this plane

strikes the lower border of the body of the first lumbar vertebra, whilst, as it almost constantly passes through the pylorus, it is termed the *trans-pyloric plane*. It lies almost midway between the xiphi-sternal junction and the umbilicus, the former of which is on a level with the disc between the ninth and tenth dorsal vertebræ, while the latter is on the same plane as the disc between the third and fourth lumbar vertebræ. If the trans-pyloric plane be preferred to the infra-costal as the line of division between the upper and middle abdominal zones, the size of the umbilical and right and left lumbar regions becomes greatly increased, but anatomists are united in retaining the names allotted to these regions, though their relative extent is not constant. The point at which the trans-pyloric plane cuts the middle line of the body has been termed the "central point" of the abdomen, and the distance between this "central point" and the upper margin of the symphysis pubis is bisected by the inter-tubercular plane. The lateral vertical plane described above passes through Poupart's ligament well on the inner side of its centre.

The Alimentary Canal

The Stomach.—The situation of the cardiac orifice is marked on the surface of the abdomen by a point on the seventh costal cartilage half an inch from the left border of the sternum. The seventh costal cartilage forms the upper lateral boundary of the *epigastric triangle*, as it is the lowest of the costal cartilages which articulate directly with the body of the sternum. This orifice of the stomach is on a level with the eleventh dorsal vertebra, and is usually some four inches from the surface of the abdomen. The pyloric orifice, when the stomach is empty, lies just to the right of the middle line on the trans-pyloric plane, which, as mentioned above, passes through the first lumbar vertebra. The lesser curvature may be mapped out on the abdominal wall by a curved line, with convexity to the left,

uniting these two points. The position of the greater curvature varies with the state of distension of the stomach; with the stomach moderately distended it ascends from the cardiac orifice to the level of the lower border of the fifth costal cartilage in the mammary line, and then curves downwards cutting the costal margin at some part of the ninth cartilage, and reaches the pylorus by describing a curve which passes within two inches of the umbilicus. When the stomach is distended with food the pylorus may pass as far to the right as three inches from the middle line, while the greater curvature may descend about an inch below the level of the umbilicus. If these limits are exceeded the stomach is pathologically enlarged.

The Duodenum.—This portion of the alimentary canal is ten inches long, and has been divided into three parts. The first part is situated in the right half of the epigastrium, and lies behind the eighth costal cartilage, on the inner side of the gall bladder. Its length is two inches, and behind it lie the gastro-duodenal vessels, whilst it is covered in front and above by the quadrate lobe of the liver. In direction it passes a little upwards from the pylorus to the right side of the first lumbar vertebra. This portion of the duodenum forms the lower boundary of the "Foramen of Winslow," to which we will pay attention later.

The second part of the duodenum, some four inches in length, descends from the first to the third lumbar vertebra, a little to the right of the median vertical plane. It lies in front of the hilum and the lower portion of the inner border of the right kidney. It is crossed about its middle by the attachment of the transverse meso-colon.

The third part of the duodenum is from four to five inches in length and is divided into a transverse and an ascending portion. The former passes horizontally across the body of the third lumbar vertebra, about two inches above the intertubercular plane, while the latter ascends almost vertically to reach the duodeno-jejunal flexure on the left side of the body of the second lumbar vertebra, just below the

transpyloric plane, and about an inch and a half to the left of the median vertical plane. Behind the commencement of this part of the duodenum is the right ureter.

The Duodeno-Jejunal Flexure is the most fixed part of the small bowel, and is a most important surgical landmark. It marks the commencement of the small intestine proper, and may be located, after the abdomen is opened, by one or other of the following methods: (*a*) if the omentum and transverse colon be turned upwards and pulled out through the wound towards the right side of the abdomen the posterior layer of the transverse meso-colon will be exposed to view, and passing from it on the left side of the second lumbar vertebra will be seen a more or less vertical fold of peritoneum, termed the *meso-colic band*, which passes on to the first part of the jejunum. Traction on the transverse meso-colon as a rule tightens this band and brings the commencement of the jejunum readily into view. It is probable that this fold, which appears to be constantly present, though of variable size and direction, has for its function the maintenance of a free passage through the duodeno-jejunal flexure by preventing kinking of the jejunum, which tends to fall to the right or left according as the patient lies on his right or left side. If this band be identified the surgeon may be quite sure that the bowel to which it leads is the first part of the jejunum; (*b*) if the hand be passed through the laparotomy wound on the deep aspect of the abdominal wall to the left flank, and further, till the surface of the left kidney is reached, then when the hand is brought forward it should grasp a piece of small bowel, and this, from its fixity, may be identified as the commencement of the jejunum. The former method is undoubtedly the better, and is applicable in all cases where the surgeon is operating through an upper abdominal incision; where there is need for such identification through a lower abdominal wound the second method will be found reliable. It may also be noted that the wall of the first part of the jejunum is thicker than that of the remainder of the small intestine,

and, when healthy bowel is examined, this jejunal region has less peritoneal polish than the coils below it. The mesentery here contains very little fat.

Small Intestine.—This is about twenty-three feet in length ; its upper two-fifths constitute the jejunum and its lower three-fifths the ileum. The wall of the jejunum is for the most part thicker than that of the ileum on account of its valvulæ conniventes, but in a state of distension it is difficult to tell jejunum from ileum. The commencement of the jejunum can be determined in the manner described above, and the terminal loop of the ileum can often be pulled up into an abdominal wound by passing the finger below the cæcum over the inner border of the psoas muscle and the external iliac vessels, as this loop usually descends into the pelvis before rising to the level of the ileo-cæcal valve. It is difficult to ascertain the exact position in the intestinal canal of any loop of small bowel exhibited in a wound, and one is guided by the position of the wound, the thickness of the bowel wall, and its proximity to the fixed points, the duodeno-jejunal flexure, and the ileo-cæcal valve. The upper and lower ends of an isolated loop may be identified by peristalsis if this is active, or by noting carefully its relation to the mesentery. The root of the mesentery of the small intestine is from six to eight inches in length and passes from the left side of the second lumbar vertebra downwards to the level of the right sacro-iliac synchondrosis. When a loop of the bowel is stretched and held outside the abdomen parallel to this line of mesenteric attachment the finger may be passed first over the upper right surface of the mesentery and then over the bowel and along the left inferior surface to the mesenteric root. If the mesentery is then felt to be flat and free from twists the portion of the gut to the left of the wound is its upper end. If folds are felt in the mesentery the bowel must be rotated till these are undone and the mesentery presents two free flat surfaces ; the direction of peristalsis will then be from left to right. It may not always be easy to reach the root of the mesentery,

but this method will still serve as a useful guide in determining the proper direction of an exposed loop of either jejunum or ileum.

Meckel's Diverticulum.—This patent remnant of the proximal part of the Vitelline duct is found in nearly two per cent. of bodies. When present it arises from the anti-mesenteric border of the ileum between two and three feet above the ileo-cæcal valve, and the lumen of the ileum is usually narrowed at the point where the diverticulum joins it. The length of this blind canal is commonly two inches, and its distal end may be free ; if it is adherent to abdominal structures it becomes a potential source of danger by causing intestinal obstruction.

The Ileo-cæcal Valve lies on the level of the inter-tubercular plane, and its situation is fairly accurately marked out on the abdominal wall at the point where this plane is cut by the right lateral vertical plane.

The Cæcum is some two and a half inches in length, and its long axis is directed downwards, forwards, and inwards. It lies below the level of the inter-tubercular plane in the right iliac fossa, and comes into contact with the anterior abdominal wall immediately above the outer third of Poupart's ligament. When empty it is more or less completely covered by coils of small intestine. It is easily recognised by its situation and its longitudinal muscular bands, the anterior of which is the best guide to the base of the appendix.

The Vermiform Appendix.—The opening of the appendix into the cæcum is marked on the surface of the abdomen by a point just below and internal to the junction of the right lateral vertical and the inter-tubercular planes. This orifice, as well as that of the ileo-cæcal valve, lies on the postero-internal aspect of the cæcum. The length of the appendix is very variable, and the direction in which it points is also inconstant ; it may pass upwards and inwards behind the lower end of the ileum, or downwards and inwards, overhanging the iliac vessels at the pelvic brim, or, less often,

it may be directed upwards behind the ascending colon. These are the three common positions described by anatomists, but the surgeon not infrequently finds that it has passed behind the cæcum to reach its outer aspect. The anatomical position of the appendix has an important bearing on the results of appendicitis, and the last-mentioned position is usually regarded as the most favourable. At times, however, neither the appendix nor cæcum are present in the right iliac fossa, and search must then be made in the right hypochondrium, where the cæcum may occupy a subhepatic position. The cæcum is developed beneath the liver just to the left of the middle line, and normally it passes to the right and downwards till it reaches the right iliac fossa, but it may be arrested in any part of its descent and is said to lie in the "fœtal" position when it is beneath the liver.

The Ascending Colon lies deeply in the right lumbar region, passing upwards from the inter-tubercular plane to the level of the ninth costal cartilage. It lies, for the most part, outside the right lateral vertical plane, and rests upon the quadratus lumborum and right kidney.

The Hepatic Flexure is on a level with the ninth right costal cartilage, and lies to the right of the gall bladder, between the liver and the anterior aspect of the lower pole of the right kidney. It occupies the lowest part of the right hypochondrium.

The Transverse Colon, as it passes from the hepatic to the splenic flexure, about the level of the second lumbar vertebra, commonly forms a U-shaped, or a V-shaped, loop, and the lowest part of this may pass below the level of the umbilicus. It crosses the second part of the duodenum.

The Splenic Flexure lies in the left hypochondrium at the level of the eighth costal cartilage behind the greater curvature of the stomach. It is separated from the lower portion of the spleen by the costo-colic fold of peritoneum.

The Descending Colon passes almost vertically downwards to the outer side of the left lateral vertical plane in front of the lower half of the outer border of the left kidney

to the level of the posterior part of the iliac crest. Here the iliac colon begins.

The Iliac and **Pelvic** portions of the **Colon** lie respectively in the left iliac fossa and the true pelvis. The former passes downwards and inwards from the iliac crest to the inner border of the psoas at the pelvic brim, parallel to Poupart's ligament. It can often be felt through the abdominal wall, and is provided with an incomplete mesentery so that it does not vary greatly in position. The pelvic colon, on the other hand, has a complete mesentery, which allows the gut to form a large loop passing from the left to the right side of the pelvic brim, where it turns backwards to the level of the third piece of the sacrum. It crosses the left ureter and the bifurcation of the left common iliac vessels.

The Rectum.—This extends, in the median plane, from the level of the third sacral vertebra to the anal orifice, which is placed about two inches below the tip of the coccyx. The last inch and a half of the rectum is directed backwards to reach the anus, and is termed the *anal canal*. The peritoneum usually descends on the anterior aspect of the rectum as far down as the level of the middle of the fifth piece of the sacrum, about three inches above the anus, where it is reflected on to the bladder in the male, and the upper part of the posterior vaginal wall in the female.

The Liver.—The lower or anterior border of the liver lies on the trans-pyloric plane in the middle line, and the edge can sometimes be palpated through the abdominal wall as it passes from the eighth left to the tip of the ninth right costal cartilage. In the right mid-axillary line the lower border of the liver lies just below the level of the tenth costal cartilage; it then cuts the twelfth rib and ascends to the plane of the eleventh dorsal spine. From the left costal boundary of the epigastric triangle this border ascends to meet the left extremity of the liver at the level of the fifth interspace in the mammary line. The *ligamentum*

teres passes from a notch on this border, just to the right of the middle line, to the umbilicus.

The upper limit of the liver is indicated by a line starting in the fifth left inter-space three and a half inches from the middle line and ascending a little to cut the sixth right chondro-sternal articulation, the upper border of the fifth costal cartilage in the right lateral vertical plane, and the sixth rib in the mid-axillary line, and then passing below the angle of the scapula towards the eighth dorsal spine. The *falciform ligament* of the liver lies, usually, a little to the right of the median vertical plane.

The Gall-Bladder.—As a rule the fundus of the gall bladder projects against the posterior surface of the abdominal wall in the angle between the ninth costal cartilage and the outer border of the right rectus muscle. This is just outside the point where the right lateral vertical plane cuts the right costal margin. Clinically it is identified by making the patient raise himself in bed by the action of the abdominal muscles; the right rectus will then be rendered prominent and the angle between it and the costal margin readily recognised. Another guide to it is a line drawn from the left anterior superior iliac spine obliquely through the umbilicus to the right costal margin; this it usually strikes at the outer border of the rectus on the level of the ninth costal cartilage. The *cystic duct* is an inch and a half in length and commences with a sharp curve as it leaves the neck of the gall-bladder. It joins the hepatic duct at an acute angle. This curve, and the spiral folding of its mucous membrane, account for the difficulty which is experienced in passing a probe from the gall-bladder along a normal cystic duct. The *common bile duct*, formed by the union of the cystic and hepatic ducts, is three inches in length, and its upper third lies, together with the hepatic artery and the portal vein, in the free lateral border of the gastro-hepatic omentum. Of these structures the duct is furthest to the right, and it may be drawn forwards for exploration by passing the finger through the Foramen of Winslow, gained

by proceeding backwards and then inwards along the neck of the gall-bladder. The duct can then be felt on the palmar aspect of the finger. The portal vein lies behind and to the left of the common bile duct, and the hepatic artery still further to the left. The middle third of the common duct passes behind the first part of the duodenum, about half an inch from the pylorus, to the right of the gastro-duodenal artery. The lower third of the duct passes downwards and to the right behind the head of the pancreas, in which it is more or less embedded, and opens on the posterior and inner aspect of the duodenum, in its second part, some four inches from the pylorus. Before terminating in the biliary papilla there is a dilatation of the duct, termed the *ampulla of Vater*, almost in the wall of the duodenum, and

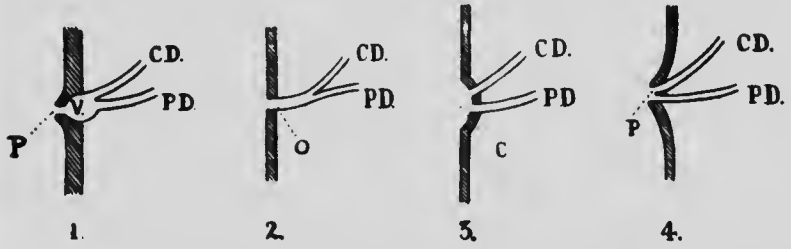


FIG. 2.—Diagram of four methods by which the common bile duct and duct of Wirsung may enter the duodenum. C.D., Common bile duct; P.D., Pancreatic duct; V, Ampulla of Vater; O, Common orifice; C, Cup-shaped lepression on the duodenal wall; P, Papilla. 1, represents the normal arrangement (after Robson and Cammidge).

at this point it is joined by the main pancreatic duct. The two ducts then usually pass to the papilla to open by a common orifice into the duodenum, but they may each have a separate opening on the papilla, or, again, the pancreatic duct may terminate in the floor of the ampulla of Vater. In any case a biliary calculus impacted in the ampulla causes obstruction to the flow of pancreatic secretion.

The Pancreas.—The head of the pancreas, occupying the concavity formed by the duodenum, lies on a level with the second lumbar vertebra. The neck lies a little higher, in the trans-pyloric plane, and crosses the mesial

plane, while the body is a little higher still, and terminates in the tail, which is placed against the hilum of the spleen. As the body passes from right to left it crosses the crura of the diaphragm, the inferior mesenteric vessels, the inferior vena cava, aorta, left kidney, and supra-renal capsule. The portal vein is formed behind its neck. The main duct of the pancreas, or canal of Wirsung, runs in the substance of the gland from tail to head rather nearer its upper than its lower border; when it reaches the head of the pancreas it is joined by a number of small ducts from the lobules of the head. Not infrequently there is an accessory duct (canal of Santorini), which passes from the main duct to open into the duodenum at a slightly higher level than the duct of Wirsung, the termination of which has already been described. The body of the pancreas occupies the upper two-thirds of the space between the trans-pyloric and the sub-costal planes.

When the abdomen is opened the pancreas is best exposed by making a vertical slit in the gastro-colic omentum; the lesser sac is then entered, and if the stomach be pushed upwards the pancreas is exposed, covered only by the anterior layer of the transverse meso-colon.

The Spleen is situated in the left hypochondrium, and its long axis corresponds to the tenth rib. It extends upwards as high as the upper border of the ninth rib, and downwards to the lower border of the eleventh rib. The upper pole lies nearly two inches distant from the tenth dorsal spine, while the lower or anterior pole just reaches the left mid-axillary line. The spleen lies behind the cardiac end of the stomach, and its upper pole lies one inch below the highest part of this viscus. The upper third of the organ is covered by the base of the left lung, separated from it by the pleura and diaphragm; this portion, therefore, cannot be defined by percussion. The reflection of the costal pleura on to the diaphragm takes place at the level of the lower pole of the spleen. In this connection we may call attention to the *semilunar space* of *Traube*, an area which yields a

low-pitched tympanitic note on percussion. It is bounded above by the lower margin of the left lung, and below by the costal margin; to the right is the left lobe of the liver, posteriorly and to the left are the anterior border and basal angle of the spleen. The costo-diaphragmatic reflection of the pleura bisects this space horizontally, and its area of resonance is diminished by pleural effusion, or enlargement of the liver or spleen.

The Kidneys.—These two retro-peritoneal organs lie against the upper lumbar spine fairly close to the middle line. They are not symmetrically placed, for the left kidney is fully half an inch higher than the right. Each kidney is 4½ inches in length, 2½ inches in breadth, and 1½ inches in thickness. The hilum of the right kidney is 2 inches from the median vertical plane, while that of the left lies 1½ inches from this line. The left hilum is just below the level of the trans-pyloric plane, while the right is still half an inch lower. The long axis of the kidney is oblique, so that the upper pole is rather less than 2 inches from the middle line, and the lower pole rather more than 2 inches distant from it. The hilum of the left kidney lies just internal to the anterior extremity of the ninth costal cartilage, and its upper pole midway between the sterno-xiphoid and the trans-pyloric planes. Its lower pole corresponds to the infra-costal plane. The lower pole of the right kidney lies on, or a little above, the umbilical plane.

Posteriorly the kidneys may be taken to occupy a space between the horizontal planes of the eleventh dorsal and the third lumbar spines, their upper poles lying about an inch from the median line. Each kidney possesses its own fibrous capsule, which is closely applied to its cortical substance, but can be readily stripped off a healthy organ; outside this is the fatty capsule, composed of canary-yellow fat, which is noticeably soft, but which has embedded in it a dense layer of fibrous tissue to which the name of *fascia renalis* has been applied. This surrounds the kidney and a large portion of its fatty capsule as a loose sheath having

anterior and posterior walls, which meet above the kidney, but are open below and internally. The anterior layer of this sheath passes across the middle line to blend with the sheath of the opposite kidney, and bands of connective tissue pass between it and the fibrous capsule. This sheath plays an important part in keeping these organs in their proper places. Outside this sheath again there is more soft fat, and this has been termed the *para-renal fat.* In exposure of the kidney, therefore, through a lumbar incision, after the division of the muscular and aponeurotic layers, one encounters the para-renal fat, the fascia renalis, the peri-renal fat or fatty capsule, and, lastly, the fibrous capsule.

The Ureters.—These are some ten inches in length, and pass nearly vertically downwards from the hilum of each kidney to the bifurcation of the common iliac arteries. This occurs at the junction of the upper and middle thirds of a line drawn from a point half an inch below and to the left of the umbilicus (the termination of the abdominal aorta) to another point midway between the anterior superior iliac spine and the symphysis pubis. The rest of the course of the ureter lies in the cavity of the true pelvis. Posteriorly, the course of the ureter is represented by a line drawn vertically from the level of the second lumbar spine to the posterior superior iliac spine.

The Supra-renal Capsules lie on either side of the spine in the epigastric region, each surmounting the upper pole of the corresponding kidney. The right one is triangular in outline, while the left has a semilunar shape. Each is placed opposite the inner extremity of the eleventh intercostal space.

The Abdominal Wall

Although we do not propose to discus the anatomy of the hernial regions, there are a few points which may well be emphasised as regards the constituents of the abdominal wall.

Superficial Fascia.—This is rather more elastic than

in other parts of the body, and from midway between the umbilicus and pubes it is divided into two layers, a superficial fatty layer, the fascia of Camper, and a deep membranaceous layer, the fascia of Scarpa, this latter being continuous with the fascia of Colles met with in the perineum.

Muscles and Aponeuroses.—There are five pairs of muscles, which, together with their tendinous aponeuroses, constitute the protective sheath over the abdominal viscera. The most important of these from the surgical point of view is the *rectus abdominis*, which lies on either side of the *linea alba* (a fibrous avascular band formed by the fusion of the sheaths of the two recti), and extends from the pubic crest to the surface of the fifth, sixth and seventh costal cartilages. Its outer border is slightly convex, but corresponds very nearly with the lateral vertical plane. The muscle is usually some three inches in width in the adult, and occupies half the distance between the umbilicus and the anterior superior iliac spine. The *pyramidalis* is a small triangular muscle, which lies upon the lowest part of the rectus, and passes from the front of the pubes to the linea alba, of which it is supposed to be a tensor.

External to the rectus the three muscles of the abdominal wall are the external oblique, internal oblique, and transversalis; the fibres of the first run obliquely downwards and inwards, those of the second obliquely upwards and inwards, while the transversalis fibres, as the name of the muscle implies, are horizontal. The effect of this alternating direction of muscle fibres is to strengthen the abdominal wall considerably, and the course of the fibres must be recollected in making laparotomy incisions.

The Sheath of the Rectus.—The aponeuroses of the three lateral muscles of the abdominal wall unite as they approach the middle line to form a fibrous sheath for the rectus. This is not, however, complete, and the posterior surface of the muscle rests upon the costal margin and a portion of the transversalis muscle above, while, from half-way

between the umbilicus and pubes downwards there is only transversalis fascia intervening between the muscle and the peritoneum. The posterior layer of the sheath in this situation has a well-defined sharp concave edge termed the *semilunar fold of Douglas*. In front of this the deep epigastric artery passes upwards and inwards to enter the rectus sheath. The anterior layer of the sheath is adherent to the muscle usually in three situations, at the site of tendinous intersections, one at the level of the umbilicus, another at the level of the ensiform cartilage, and the third midway between these points. A fourth intersection may be present below the umbilicus. There are no adhesions between the posterior surface of the rectus muscle and its sheath.

The Linea Semilunaris.—This is a curved linear depression corresponding to the outer border of the rectus muscle from pubic spine to costal margin, visible as a white line on the surface of the external oblique aponeurosis ; it corresponds to the termination of the fleshy fibres of the internal oblique at the outer border of the rectus sheath.

Blood Vessels of the Abdominal Wall

The superficial vessels are mainly the terminal portions of the aortic intercostal arteries, which have lateral branches appearing in the flanks, and also anterior terminal twigs which pass through the anterior layer of the rectus sheath. There are also superficial vessels derived from the common femoral artery which supply the anterior abdominal wall. The *superficial circumflex iliac* runs along Poupart's ligament and ends in the region of the anterior superior iliac spine ; the *superficial epigastric* crosses over Poupart's ligament and sends branches in the superficial fascia as high as the umbilicus. The blood from these two arteries is returned to the internal saphenous vein. There are also terminal branches from the *superior* and *deep epigastric* arteries in the upper abdominal wall. These two arteries are of some importance. The *deep epigastric*, a branch of the external

iliac, arises about a quarter of an inch above Poupart's ligament on the inner side of the internal abdominal ring. It is placed at first deep to the transversalis fascia, between it and the peritoneum; it then pierces the fascia, and taking a direction towards the umbilicus, passes in front of the semilunar fold of Douglas to reach the rectus sheath between the muscle and the posterior layer of its sheath. The *superior epigastric* artery is one of the two terminal branches of the internal mammary, and reaches the rectus sheath on the deep aspect of the muscle by passing through a gap between the costal and sternal origins of the diaphragm. Some ascending branches of the *deep circumflex iliac* artery may be encountered in incisions through the oblique muscles behind the anterior superior spine of the ilium.

Nerves of the Abdominal Wall

Passing between the transversalis and the internal oblique to gain the sheath of the rectus are the anterior portions of the *lower six intercostal* nerves, which supply cutaneous branches as they run between the muscles. Their lateral cutaneous twigs come off midway between the spine and the linea alba. They also give off muscular branches to the obliques and transversalis in their course. The last dorsal nerve runs a similar course and is destined to supply the pyramidalis muscle. The *first lumbar* nerve gives off a branch, the *hypogastric*, which supplies the skin just above the external abdominal ring.

After entering the rectus sheath the lower six intercostal nerves run between the muscle and the posterior lamella of the sheath; they then enter the substance of the muscle to innervate it, and piercing the anterior sheath supply the skin over the rectus. The level at which each of these nerves is distributed to the skin is worthy of attention. From the ensiform to the umbilicus we find branches of the seventh, eighth, and ninth, and from umbilicus to pubes the skin is supplied by the tenth, eleventh, and twelfth thoracic nerves.

Lymphatics of the Abdominal Wall

From the umbilicus and below it the superficial lymphatics pass to the superficial inguinal glands. From the umbilicus and above it they pass to the axillary glands. The deep lymphatics pass to the lateral lumbar glands, and above to the glands of the anterior mediastinum.

Blood Vessels of the Abdomen

The **Abdominal Aorta** passes vertically downwards from the twelfth dorsal vertebra to the lower part of the left side of the body of the fourth lumbar vertebra. Its commencement is one inch above the trans-pyloric plane and its termination about half an inch below and to the left of the umbilicus. In the whole of its course it lies just to the left of the median vertical plane. Its first important branch is the *cœliac axis*, which arises at the level of the twelfth dorsal vertebra, and divides, after a course of half an inch, into *hepatic*, *splenic*, and *coronary*, or *gastric* arteries. These are distributed as follows: The *hepatic artery* is distributed to the liver, gall-bladder, pyloric half of the stomach, the upper part of the head of the pancreas and the adjacent duodenum, and the great omentum. The *splenic artery* supplies the spleen, the pancreas, and the cardiac portion of the greater curvature of the stomach. The *coronary artery* sends branches to the lower end of the œsophagus, to the cardiac end of the stomach, and along its lesser curvature. The *superior mesenteric artery* arises on a level with the disc between the twelfth dorsal and the first lumbar vertebræ, *i.e.* just above the trans-pyloric plane, and supplies the lower part of the head of the pancreas, with the adjacent part of the duodenum, the whole of the jejunum and ileum, and the colon as far as the splenic flexure. The vessels supplying the intestine inosculate to a considerable extent in the wall of the gut, hence if even an inch of the bowel loses its blood supply it is capable of retaining its vitality. The vermiform appendix has a special single artery of supply, a branch of

the posterior cæcal artery derived from the ileo-colic division of the superior mesenteric. In the female, however, it is said to have an additional twig from the right ovarian. The *inferior mesenteric* takes its origin from the left side of the aorta, at the level of the third lumbar vertebra, about an inch and a half above its bifurcation. It supplies the descending colon and the rest of the large bowel to within a short distance of the anal canal. Its terminal portion, which runs in the meso-rectum, is called the *superior hæmorrhoidal.*

The remaining visceral branches of the abdominal aorta are the *middle capsular* arteries, arising on the same plane as the superior mesenteric, and passing backwards to the supra-renal capsules; the *renal* arteries, which come off just below the trans-pyloric plane; and the *spermatic* or *ovarian* arteries, which arise a little below the renal vessels. The parietal branches are the *inferior phrenics*, the *lumbar* arteries (five pairs), and the *middle sacral* artery.

The **Common Iliac Arteries** are of interest as landmarks, and each corresponds to the upper third of a line drawn from a point half an inch below and to the left of the umbilicus to a second point midway between the anterior superior iliac spine and the symphysis pubis. The *external iliacs* correspond to the lower two-thirds of such lines.

The **Inferior Vena Cava** is formed on the right side of the body of the fifth lumbar vertebra by the junction of the two common iliac veins, an inch below and half an inch to the right of the umbilicus. It pierces the diaphragm at the level of the eighth dorsal vertebra, and enters the right auricle of the heart opposite the innermost part of the right fifth intercostal space. Its tributaries as it passes upwards are the five paired *lumbar* veins, the *spermatic* or *ovarian* vein of the right side, the *renal* veins, the *right capsular* vein, the *hepatic* veins, and the *inferior phrenic* veins.

The Portal Vein.—This is about three inches in length, and commences behind the head of the pancreas on a level with the first lumbar vertebra, by the junction of the *splenic*

and *superior mesenteric* veins. It passes upwards and a little to the right behind the first part of the duodenum, then between the layers of the gastro-hepatic omentum close to its free border, to end by bifurcating in the transverse fissure of the liver. At its origin it lies a little to the left of the inferior vena cava. The *superior mesenteric vein* returns blood from the small intestine and the ascending and transverse part of the colon, together with a portion of the gastric blood supply. The *inferior mesenteric vein* returns blood from the upper part of the rectum and colon below the splenic flexure; it terminates in, or near, the angle between the splenic and superior mesenteric veins. The *splenic vein* receives the blood from the spleen, the stomach, and the pancreas. The *pyloric vein* returns blood from the lesser curvature of the stomach, and so also does the *coronary vein*. All this blood is returned to the portal system, which contains no valves.

Lymphatics of the Abdominal Viscera

The *lymphatics of the stomach* pass to the glands along its lesser curvature; from both lesser and greater curvatures the lymphatics mostly end in the cœliac glands. Some of the lymphatics unite with those which drain the spleen.

The *lymphatics of the spleen* terminate in the cœliac glands after passing through the small splenic glands, which lie against the tail of the pancreas.

The *lymphatics of the pancreas* enter the upper cœliac glands.

The *lymphatics of the liver*.—The superficial lymphatics of the liver pass to the anterior mediastinal glands, to the cœliac glands, to glands on the inferior vena cava, and in the transverse fissure. The deep lymphatics pass from the transverse fissure to the cœliac glands in the substance of the lesser omentum.

The lymphatics of the intestinal canal, or *lacteals*, pass to the intestinal lymphatic trunk to reach the thoracic duct, *viâ* the mesenteric glands, which are numerous but small.

Only at the upper part of the small bowel and at the termination of the ileum do they form a mass of any considerable size in health. The largest mass lies in the angle between the ileum and the ascending colon, and these are termed the *ileo-colic glands*.

The rectal lymphatics end in the sacral glands.

The *lymphatics of the kidneys* and *supra-renal capsules* terminate in the median lumbar glands, which overlie the renal vessels.

The lymphatics of the uterus and its appendages terminate in the internal iliac and lumbar glands, and the glands on the lower part of the aorta and inferior vena cava. There are also a few lymphatics which pass along the round ligament and reach the superficial inguinal glands, and to these glands pass also the lymphatics of the lower part of the vagina.

Female Pelvic Organs

When the abdomen is opened and the coils of small bowel are displaced upwards from the pelvis, the fundus of the uterus is seen, directed forwards and upwards, resting upon the postero-superior aspect of the bladder. Between the uterus and the rectum is that portion of the peritoneal cavity which is called the *pouch of Douglas*, which normally contains the pelvic colon and the lower part of the ileum. From each lateral border of the uterus stretches the double peritoneal fold of the broad ligament, the superior border of which is occupied on either side by the Fallopian tube, while at a lower level two folds project from the surface of the broad ligament; one, directed backwards just below the external iliac vessels contains the ovary between its layers, the other, directed forwards, contains the round ligament of the uterus. When the vermiform appendix overhangs the brim of the pelvis, its tip frequently lies against the right ovary. Below and internal to the round ligament, where it leaves the pelvis at the internal abdominal ring, is the deep epigastric artery.

The course of the ureter in the female pelvis is of importance. It crosses the pelvic brim in front of the bifurcation of the common iliac artery. This, on the abdominal wall, corresponds to a point at the junction of the outer and middle thirds of a line connecting the anterior superior iliac spines. After passing from without inwards across the iliac vessels the ureter curves downwards and forwards behind the peritoneum of the postero-lateral wall of the pelvis behind the Fallopian tube and ovary. It then passes downwards, forwards and inwards, beneath the lower part of the broad ligament, and runs close to the upper part of the lateral wall of the vagina about three-quarters of an inch from the lateral aspect of the cervix uteri.

The uterine artery, a branch of the internal iliac by its anterior division, at first runs downwards and forwards, a little external to the ureter; at the level of the internal os it curves inwards in front of the ureter and divides into uterine and vaginal branches.

The ovarian artery, a branch of the abdominal aorta, enters the pelvis in a fold of the broad ligament passing from the lateral pelvic wall to the lower pole of the ovary.

The Peritoneum

We do not propose to give any detailed account of the peritoneum and the manner in which it invests the abdominal contents, but to call attention to certain anatomical points which are of practical importance in connection with abdominal lesions.

The peritoneal cavity is a large and complicated lymph sac, which, on account of its extensive surface, is capable of great absorption, and, when irritated, of the secretion of a large amount of fluid. It comprises two sacs, a greater and a lesser, the latter of which lies partly within and partly behind the former. These two sacs communicate through the *foramen of Winslow*, which is identified by passing the finger from the fundus along the neck of the gall-bladder; here,

the finger, if passed to the left, will slip behind the gastro-hepatic omentum into the foramen. The boundaries of this foramen are, above, the caudate lobe of the liver; below the duodenum and hepatic artery; in front, the right free border of the gastro-hepatic omentum containing the portal vein, the common bile duct, and the hepatic artery; behind, the inferior vena cava, and the right crus of the diaphragm, covered by the transverse meso-colon. The lesser sac extends downwards into the great omentum, upwards to the posterior surface of the Spigelian lobe of the liver, and to the left as far as the spleen. Its most important visceral relations are, in front, the stomach, and behind, the pancreas. Inflammation in the lesser sac is usually due to a lesion of one of these two organs, and the sac is most easily entered through the gastro-colic omentum.

The peritoneal cavity is further divided into four compartments by the most important reflections of the peritoneum, viz.: (1) That between the transverse meso-colon and the diaphragm; (2) that between the transverse meso-colon and the mesentery of the small bowel; (3) that between the mesentery and the true pelvis; (4) that in the true pelvis. The first of these compartments includes the lesser sac, which may be regarded as a diverticulum arising from it.

The transverse meso-colon is attached to the posterior abdominal wall at the level of the second lumbar vertebra, crossing the right kidney, the second part of the duodenum, the head of the pancreas, and then following the anterior inferior margin of the pancreas. It ascends slightly as it passes from right to left. This forms the floor of the upper peritoneal compartment, which is roofed in by the diaphragm, and includes the upper part of the great sac, and behind it, the larger portion of the lesser sac. This portion of the peritoneum is associated with the liver, with the gall-bladder and bile ducts, the stomach and part of the duodenum, the spleen, the pancreas, the upper portions of the kidneys, and the supra-renal capsules. Localised suppuration in connection with any of these organs is likely to give rise to

a subphrenic abscess, or a sub-hepatic abscess in the greater or lesser sac. The former is best approached by a trans-pleural route with incision of the diaphragm, while the latter may be reached through the abdominal wall, either in front, or in the loin below the twelfth rib. The compartment between the transverse meso-colon and the mesentery of the small intestine is in relation with the small bowel, the cæcum and vermiform appendix, the ascending colon, the ureter and lower part of the right kidney. Suppuration arising from lesions of these organs thus occupies at first the right lumbar region, but it may extend along the course of the colon into the subdiaphragmatic region, or downwards into the true pelvis.

The third sub-division is related to the duodeno-jejunal junction, the major part of the small intestine, part of the transverse colon, the left ureter and lower portion of the left kidney, the lower part of the abdominal aorta and the common iliac arteries. Suppuration in this area has a tendency to spread downwards and form a pelvic abscess. Pelvic suppuration can readily be reached through the anterior abdominal wall, and, in the female, through the roof of the vagina.

In spite of these arbitrary sub-divisions of the peritoneal cavity it should still be remembered that this lymph sac is a single one, and the inflammatory processes occurring in any part of it are influenced by gravity; therefore, with the patient in the upright position all inflammatory exudate, before the formation of localising adhesions, tends to sink into the pelvis. This, together with the fact that the power of absorption by the peritoneum increases as we approach the upper part of the cavity, and is most strongly in evidence on the inferior surface of the diaphragm, affords the *rationale* for the treatment of peritoneal lesions by what is known as the "Fowler position," in which the patient is kept as nearly upright as possible.

Peritoneal Fossæ

Some attention must be given to the special folds and fossæ, which are occasionally of pathological importance.

Fossæ in connection with the Duodenum and Jejunum.—

1. The *inferior duodenal fossa*, or *fossa duodeno-jejunalis of Treitz*.—This is present in 70 per cent. of all bodies. It is situated at the level of the third lumbar vertebra on the left side of the ascending portion of the duodenum. Its orifice looks upwards and its apex usually extends a little way down on the fourth lumbar vertebra. It is bounded in front by the inferior duodenal fold of peritoneum.

2. The *Superior Duodenal Fossa*.—This also lies on the left side of the ascending portion of the duodenum. It is said to exist in 45 per cent. of bodies examined. Its orifice looks downwards, and its apex reaches to the body of the pancreas. The anterior boundary of this fossa is formed by the superior duodenal fold, which joins with the descending meso-colon very close to the inferior mesenteric vein.

FIG. 3.—Duodeno-jejunal fossa (Moynihan).

These two, superior and inferior, duodenal folds may blend at their outer margins so as to make a large oval orifice common to the two fossæ.

3. *Para-duodenal Fossa*.—This pouch is made by the peritoneal fold raised by the inferior mesenteric vein. Its orifice looks downwards and to the right. It is placed at some distance to the left of the ascending limb of the duodenum.

Some other fossæ have been described in the neighbourhood of the duodeno-jejunal junction, one of which, the *inter-mesocolic fossa*, is in relation with the meso-colic band, which we have already described as passing from the meso-colon to the commencement of the jejunum.

Fossæ in the neighbourhood of the Cæcum and Appendix.—When the cæcum and appendix are normally situated, and do not linger in the "fœtal position," there are three primary folds of peritoneum to be observed :—

1. *Anterior*, or *Ileo-colic*, raised up by a branch of the ileo-colic artery, running over the anterior aspect of the junction between ileum and cæcum to the base of the appendix.

2. *Posterior*, or *meso-appendicular*, raised up by the appendicular branch of the posterior division of the ileo-colic artery. Its right border is attached to the postero-internal aspect of the colon and then to the cæcum ; its inferior border is attached to the appendix.

3. *Intermediate*, or *ileo-appendicular*, usually non-vascular, and therefore termed the "bloodless fold" by Treves. It may, however, contain the ileo-appendicular artery. It stretches from the lower border of the ileum to the anterior aspect of the meso-appendix ; its right border is attached to the inner aspect of the cæcum and to the base of the appendix.

Three fossæ are described in connection with these folds, and they are all best seen in young subjects, a rule which applies to nearly all the peritoneal pouches.

1. *Ileo-colic* or *superior ileo-cæcal fossa*.—This is situated between the ileo-colic fold and the mesentery of the ileum, the ileum itself, and the inner part of the cæcum. Its orifice is directed to the left, and its extent is limited externally by the attachment of the ileo-colic fold to the anterior aspect of the cæcum. When the meso-appendix is formed, as it sometimes is, by a continuation of the ileo-colic fold, this fossa becomes much enlarged.

2. *Ileo-appendicular fossa*.—This lies between the ileo-appendicular fold and the meso-appendix. Its orifice looks

to the left, and it is bounded above by the posterior surface of the ileum and part of its mesentery, in front and below by the ileo-appendicular fold, and behind by the upper part of the meso-appendix.

3. *Retro-colic* or *retro-cæcal fossa.*—If the cæcum be turned upwards, a fossa long enough to contain the index finger may be found, bounded by an outer and upper, and a lower and inner fold, passing from the cæcum to the posterior abdominal wall. This fossa may be represented only by a shallow dimple.

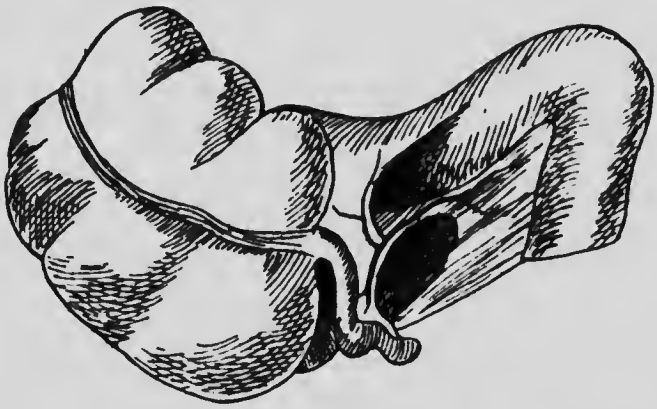


FIG. 4.—The Meso-appendix and the intermediate ileo-appendicular fold and fossa (Moynihan).

A fourth fossa is occasionally present, lying behind the appendix.

Fossæ in connection with the Sigmoid Colon.—*Inter-sigmoid Fossa.*—This lies at the place where the iliac becomes the pelvic colon, and is present in about 70 per cent. of all bodies. Its posterior wall is adherent to the common iliac artery, and through it can be seen the ureter as it crosses this vessel. In depth it may extend for three inches. Its orifice looks downwards, and is best demonstrated by pulling the loop of the pelvic colon upwards and a little to the right. The intestinal vessels run in its free edge. It is rarely seen in persons over fifty.

Pelvic Peritoneum

In the male the bottom of the recto-vesical pouch lies about three inches above the anus, or one inch above the base of the prostate ; in some cases, however, the peritoneum passes from the anterior aspect of the rectum on to the base of the prostate. The lateral boundaries of this pouch are formed by folds of peritoneum raised on either side by the

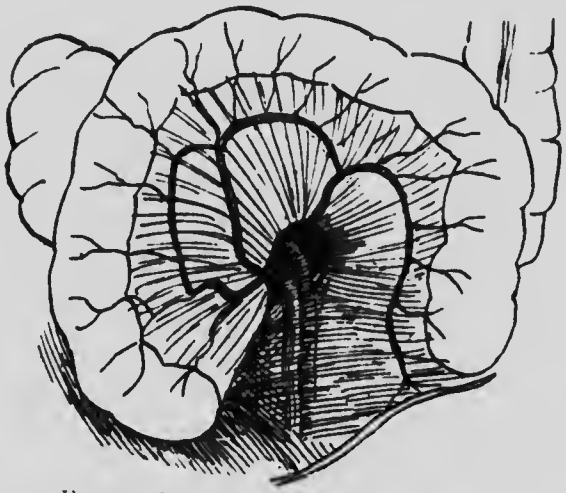


FIG. 5.—Intersigmoid Fossa (Moynihan).

obliterated hypogastric arteries. The ureters and the superior vesical arteries also run in these folds. The postero-superior aspect of the bladder is thus covered by peritoneum, which, as it reaches the summit of this viscus, is carried on to the posterior surface of the abdominal wall by the urachus. There is usually a space of nearly two inches between the pubes and the lower limit of the anterior layer of the peritoneum when the bladder is distended. In the female pelvis the peritoneum leaves the rectum at about the same level as in the male, but it passes on to the posterior wall of the vagina, covering its upper third. It then covers the uterus completely and descends on its anterior aspect to invest its upper

three-fourths and is again reflected on to the posterior surface of the bladder.

The fundus of the peritoneal cavity in the female is termed the *pouch of Douglas*, lying between the rectum and the posterior aspect of the uterus. From the uterus to the bladder the peritoneum is conducted as in the male along the line of the obliterated hypogastric arteries, and its relation to the bladder and the anterior abdominal wall is similar to that found in the male.

The lateral expansions of the peritoneum from the body of the uterus in the form of the broad ligaments have already been described in connection with the female generative organs.

The utero-vesical pouch is much shallower than the recto-vaginal, or pouch of Douglas, and the latter is often slightly deeper on the left than on the right side.

CHAPTER II

THE INVESTIGATION OF ACUTE ABDOMINAL CASES

History

THE importance of taking a careful and complete history of every case of acute abdominal disease can hardly be over-estimated: the information gained thereby is at least equal to that derived from the physical examination of the patient, and in many instances it is of greater value. Many correct diagnoses can be made from the history alone; the majority of diagnostic errors are due to carelessness in history-taking. Consider for example the following case: a man aged eighteen was brought up to hospital with a history of a severe attack of pain in the right iliac fossa of eight hours' duration; he had vomited twice at the onset. On inquiry it was discovered that he had been laid up previously with similar attacks of right-sided abdominal pain. His temperature was 101·2, pulse 120, respiration 28; his tongue was slightly furred and his expression anxious. There was definite tenderness over the right iliac fossa, most intense in the vicinity of McBurney's point, and associated with local muscular rigidity. The obvious diagnosis was made and immediate operation advised. A perfectly healthy appendix was discovered. A subsequent X-ray examination revealed a calculus in the pelvis of the right kidney. Then, and only then, was elicited the fact that two of the previous attacks of pain had been associated with the passage of smoky urine, and that the pain of the earlier attacks had been definitely

lumbar in origin; information which, obtained in the first instance, would have saved the man an entirely unnecessary operation.

The importance of the concrete physical signs and their interpretation is obvious, so obvious in fact that it is apt to blind one to the relative value of the abstract symptoms, the interpretation of which is often a matter of far greater difficulty. The consequence is a temptation to subordinate the interrogation of the patient to the physical examination, an error which will, sooner or later, lead to diagnostic disaster. In hospital practice many of the patients are so ill as to be unable to give a history of any value; in such cases, unless the desired information is supplied by the patient's relatives or friends, we have to diagnose as best we can on the physical signs alone.

The patient's **Family History** will probably not yield information of any particular value; a strong family history of tuberculous disease, however, should not be neglected and might put the inquirer on the track of that bugbear of the diagnostician, tuberculous peritonitis.

The **Past History** must be elucidated carefully; any story of indigestion must be gone into in detail, and, of course, all past attacks of abdominal pain must be noted and surmises as to their possible nature formulated. Any abnormal diarrhœa or constipation should be inquired into; and in the case of a woman a complete account of her menstrual history and of any pregnancies is essential. A past history of hæmaturia, dysuria or pyuria is not always volunteered by the sufferer from these symptoms, so that it is well to direct inquiries in this direction. The patient's occupation is occasionally of interest, especially should it bring him into contact with lead.

Passing now to the **History of the Present Illness,** one should ascertain the exact day, and, if possible, hour, of the onset of abdominal pain; if the patient was in perfect health previously, and if not, what his symptoms were; where precisely the pain was first localised, and

where later on, the nature of the pain, "griping" and paroxysmal, or "gnawing" and continuous, or "throbbing"; and when the patient first took to his bed. If vomiting has occurred, it is important to ascertain if it synchronised with the onset of the pain; if the vomiting was repeated, inquiry should be made as to how many times on each day of the illness, as to whether the vomiting occurred apart from the taking of food and as to the appearance, quantity, and odour of the vomit. A complete account of the action of the bowels must never be omitted, paying particular attention to the date on which the bowels were last opened, to the passage of flatus and to the presence of diarrhœa at any stage of the illness. One should ask also if anything like "matter," "blood," or "jelly," has been observed in the stools. Pain or difficulty in micturition is an important symptom which is sometimes not mentioned by the patient unless inquiries are made as to this point. Retention of urine is common, and may be either a reflex or a paralytic phenomenon. Finally, in certain cases it is well to ascertain if there have been any rigors or sweats, any expectoration (possibly rusty), any headache, or pains in the limbs or back. A vaginal discharge, hæmorrhagic or purulent, is always a suggestive symptom, but it must be remembered that the normal menstrual flow is often "brought on" a few days earlier by any acute abdominal lesion occurring during the week before menstruation is expected. Especially is this the case with appendicitis; we have often seen a comparatively mild attack induce menstruation as long as a week before the normal date.

Of all these symptoms, **pain** is the most constant, and the one which should yield the most valuable information to the clinician; but, unhappily for him, the amount of such information usually varies directly with the intelligence of the patient, for often patients of the hospital class either cannot or will not localise their pain with sufficient certainty to help us very much. On the other hand an intelligent patient will frequently indicate the exact area of his original

pain and recount any changes in its subsequent distribution, thereby giving evidence of the greatest value. It is important to remember that visceral pain is almost certainly a "referred pain"; that pain is not felt in a viscus itself, but in the area of distribution of those spinal nerves whose nuclei are in close connection with the spinal nuclei of the afferent sympathetic fibres from that viscus. The fact that these spinal nerves frequently supply the skin and muscles over the particular viscus with which they are indirectly associated is apt to give rise to the erroneous impression that the pain and tenderness are in the viscus itself. Dr. James Mackenzie has ably demonstrated the great diagnostic value of localised pain, tenderness, and reflex muscular rigidity, and to his book, "Symptoms and their Interpretation" (Shaw & Sons, 1909), the reader is referred for a complete and lucid account of this interesting subject. He has pointed out that painful sensations derived from the gastro-intestinal tract tend to be referred to a mesial area which extends from the middle of the sternum to the symphysis pubis; of this area the hypogastric portion is associated with the large bowel and the umbilical portion with the small bowel; gastric pain is referred to the epigastric portion and œsophageal pain to the sternal portion. Moreover, he has made out a very strong case for a further sub-division of these areas. The pain of a gastric ulcer, he states, is often sharply limited to a small area; should this area be over the ensiform cartilage, the ulcer is probably at the cardiac end of the stomach; if the painful area is near the sub-costal plane a pyloric ulcer is indicated; and when the painful area is in the centre of the epigastrium the ulcer is probably midway between the cardia and pylorus. The importance of these observations is evident; it is the clinician's duty to diagnose not only the fact of gastric perforation, but also, if possible, the site of the perforation. In many cases it is possible to indicate, with some degree of accuracy, the site of a gastric perforation if the patient be able to describe—

(i) An area of constant pain before perforation.

(ii) The exact spot at which pain was felt at the moment of perforation; in the case of a cardiac ulcer this spot

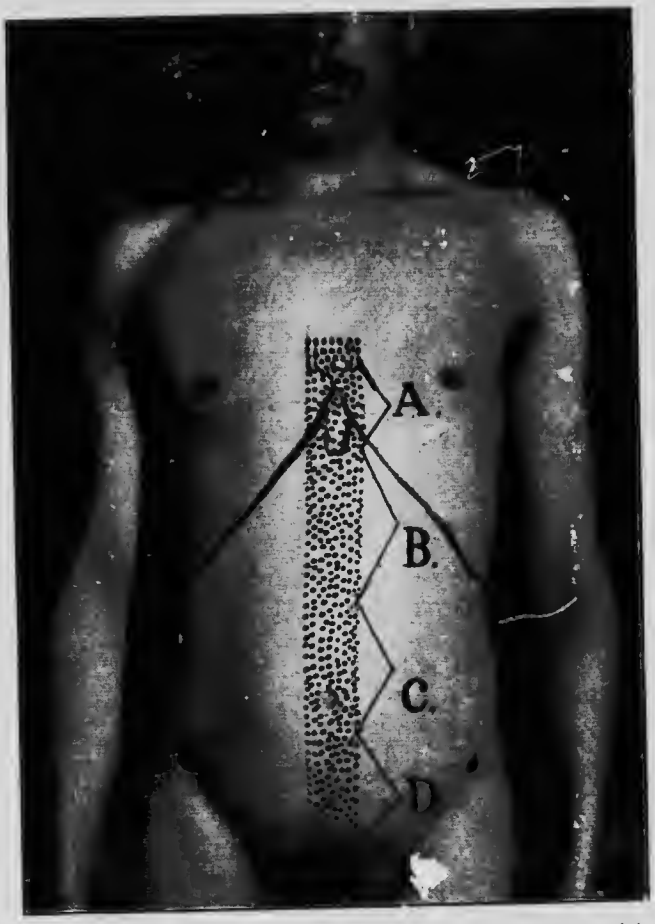


FIG. 6.—Areas of referred visceral pain (after Mackenzie). A. œsophagus; B. stomach; C. small intestine; D. large intestine.

is usually well to the left of the middle line, whereas the "perforating pain" of a pyloric or duodenal ulcer is felt close to the mid-line, or even to its right side.

The areas of pain and tenderness commonly associated

with diseases of the various viscera will be fully described in subsequent chapters; we shall now only call attention to the occasional reference of hepatic pain to the top of the right shoulder; to the frequent association of testicular pain and tenderness with renal colic; to the abdominal pain sometimes found with pleurisy or pneumonia; and to the reference of uterine pain to the sacral region.

Peristaltic pain, or colic, is associated with violent intestinal peristalsis, whether due to organic intestinal obstruction or not. It is characterised by its paroxysmal nature and usually by its severity. Between bouts of agonising "griping" pain the patient may be more or less comfortable, even entirely free from pain. Oddly enough, gastric peristalsis, however vigorous, is almost invariably painless. The pain of peritonitis is constant; but there may, of course, be a super-added peristaltic pain evidenced by exacerbations of "griping." The pain due to an abscess in the abdomen, as elsewhere, is often described as "throbbing"; and the pains associated with gall-stones are sometimes said to be "stabbing" pains, *i.e.* shooting straight through from the front to the back, as contrasted with renal pain which passes from back to front round the body.

Vomiting is an important symptom and should be considered as a danger-signal; the combination of abdominal pain with repeated vomiting must always be regarded with suspicion. Ætiologically we may distinguish three kinds of vomiting in abdominal disease, viz.:—

(i) Vomiting associated with lesions of the stomach, *e.g.* catarrh, ulcer, dilation or pyloric obstruction.

(ii) Vomiting associated with shock, *e.g.* intra-peritoneal perforations, intestinal or ovarian strangulations, biliary or renal colic and acute pancreatitis.

(iii) Vomiting associated with intestinal obstruction in its later stages—vomiting may eventually become fæculent (the mechanism is discussed in Chapter V.). The fæcal vomiting of general peritonitis is included under this

heading, referable as it is to intestinal paralysis and consequent obstruction. The vomiting which often occurs at the onset of appendicitis may come under either type (i) or type (ii).

Other well-known causes of vomiting, such as Addison's Disease, Uræmia, Cerebral Compression, Pregnancy, and Glaucoma must be remembered.

In general peritonitis, the act of emesis is almost effortless and frequent; in obstruction, the vomit is copious and is ejected with such force that the term "projectile" is often applied to this type of vomiting. In the vomiting of shock on the other hand, nausea, violent retching and a scanty vomit are the prominent features; they are usually accompanied by other phenomena of shock, such as pallor, sweating, and sub-normal temperature. Some information may be gleaned from an inspection of the vomit; thus, if the vomit consists of bile-stained mucous, or of almost pure bile, one infers that there has been frequent vomiting previously. The so-called fæcal vomit is dark in colour and has a fæcal odour. True fæcal vomiting (*i.e.* the return of obvious fæcal matter by the mouth) is exceedingly rare. Hæmatemesis may occur in appendicitis and peritonitis without a co-existing gastric or duodenal ulcer, but in our experience this is rare. In the later stages of general peritonitis black vomit, due to altered blood pigment, is not uncommon. The vomit of chronic gastrectasis has a characteristic sour odour.

Action of the Bowels.—Constipation is the rule in peritonitis, but diarrhœa may occur either early or late; in the latter case it is sometimes termed "septic diarrhœa." Early and profuse diarrhœa is a characteristic of pneumococcal peritonitis. The combination of diarrhœa and vomiting at the onset of appendicitis is usually indicative of a severe attack. When constipation is present the passage of flatus is a reassuring sign that there is probably no gross intestinal obstruction.

The stools should be examined for blood, pus and

mucus. Blood in the stools is often suggestive of an intussusception; but, like hæmatemesis, it may occur in very toxic cases of peritonitis. The commoner explanations of the passage of blood per rectum, *e.g.* hæmorrhoids or any ulcerative condition of the bowel, must not be forgotten. Appendix abscesses occasionally ulcerate into the bowel, the event being signalled by a sudden fall of temperature and the appearance of pus in the stools. We need hardly say that in such a case surgical drainage of the abscess should be postponed, provided of course that the condition of the patient is otherwise satisfactory.

Hiccough is a common and distressing symptom of peritonitis.

Physical Signs.

While obtaining the history we should notice the **decubitus** and **facial aspect** of the patient; the mental effort entailed in remembering the details of his illness diverts his attention to a certain extent from his sufferings and the natural expression and most comfortable decubitus will be adopted. A nervous patient not infrequently lies quietly in bed, with an almost placid expression, during his interrogation; his restless demeanour and anxious expression before and after it may be quite out of proportion to the gravity of his lesion. The appearance of the face is of invaluable assistance; how often has the fact that "the patient looked ill" discounted his clean tongue, normal temperature or slow pulse! The face becomes a still more important index when the patient is seen more than once, so that slight changes for the better or the worse can be observed. The complete change in facial aspect which can take place in a few hours after the rupture of an appendix abscess into the peritoneal cavity, for instance, is sometimes very striking; such rapid changes in physiognomy are of more serious import than all the other physical signs together. A facial aspect characteristic of peritonitis has long been recognised; the expression is anxious and

eloquent of pain; the eyes are sunken, the cheeks hollow and the nose pinched—appearances due to the loss of fluid from the subcutaneous tissues. The complexion is sallow at first; in fatal cases it becomes ashy, whilst the skin is cold and moist. An icteric appearance is also of evil omen. Jaundice of slight intensity is easily missed; by artificial light it may be impossible to detect it. The sclerotics should always be examined in a good light.

While insisting on the value of the face as an index to the gravity of an abdominal lesion, we must admit that under certain circumstances it should be interpreted with caution. Especially is this the case at the extremes of life and after the administration of morphia at any age. In young children the face is too sensitive an index; a characteristic "abdominal facies" may be associated with merely a brisk attack of diarrhœa and vomiting. Conversely, in elderly people it is only the more gross abdominal lesions which are reflected on the physiognomy, and the abdominal facies may appear only when the peritonitis has become general.

In Lobar Pneumonia the face is flushed and the respiration rapid; the alæ nasi are occasionally active in peritonitis, but it is uncommon to meet with respirations over 30 per minute, and the excursions of the alæ nasi are not so obvious as in the case of pneumonia. In pneumonia the lateral decubitus is far more common than in peritonitis.

A flushed face associated with a dull, stupid expression, and possibly with slight deafness, is suggestive of typhoid fever, meningitis, or intracranial abscess.

After the administration of opium a placid expression is quite compatible with diffuse peritonitis.

Decubitus.—As a rule the patient suffering from peritonitis lies on his back with his knees drawn up; by this means the abdominal muscles are relaxed and the knees act as an extemporised cradle, keeping the weight of the bed-clothes off the abdomen. In the case of appendicitis the right knee only may be flexed, and the patient

sometimes lies on his right side. In the early stages of peritonitis the sufferer commonly lies quite still, well knowing that the least movement will aggravate his pain; should general peritonitis supervene he becomes restless; in fatal cases incessant purposeless movements are frequently seen. Restlessness is also associated with profuse hæmorrhage, *e.g.* from a ruptured ectopic gestation or a bleeding ulcer, in which case the lips and conjunctivæ become progressively blanched.

The Breath.—An odour of acetone is frequently met with after incessant vomiting whatever the cause. In children the combination of incessant vomiting with an odour of acetone would suggest the disease known as "cyclical vomiting." In peritonitis unassociated with incessant vomiting, the breath often has a peculiar sweetish smell; we have several times noticed the appearance of this odour shortly after the onset of perforative peritonitis.

The Tongue.—It is customary to describe with some minuteness the appearances of the tongue associated with peritonitis of varying grades of severity; thus in catarrhal appendicitis the tongue is said to be moist and covered with a creamy white fur; if a spreading peritonitis ensues, this fur becomes thick and brown; and finally, as the peritonitis becomes widespread, the tongue becomes dry, cracked and covered with sordes. While not attempting to deny that in many cases this sequence of events may be, roughly speaking, true, we would submit that the state of the tongue is perhaps the most fallacious of all the signs of peritonitis. Oral hygiene is an important factor; a good nurse is frequently able to convert, in a few hours, the typical peritoneal tongue of the text-books into a comparatively healthy-looking organ. An almost clean tongue, therefore, no more negatives peritonitis than does a foul one indicate it.

The Pulse.—As in the case with the facies, but little information can be derived from the pulse in the very young or the very old. It is common knowledge that a comparatively trivial ailment may cause a very considerable

acceleration of a child's pulse; a pulse rate of 120 for example, need not necessarily cause any alarm. In the aged, on the other hand, the circulatory system may be incapable of responding to the stimulus of an acute infection, so that a pulse of 80 is not uncommon with general peritonitis in a man over 60 years of age. In a majority of patients, however, the pulse gives valuable information. In every case of acute abdominal disease the pulse should be taken and recorded at frequent intervals; it should be taken before the patient is examined or disturbed in any way, and several counts of sixty seconds should be made. One count of fifteen seconds is, as a rule, worse than useless. Any case with a pulse rate over one hundred should be regarded with suspicion and a pulse of over 120 is usually a call for surgery, as also is a rising pulse rate associated with a falling temperature. The typical pulse of general peritonitis is rapid (usually over 120), of small volume and low tension; the vessel feels hard and "wiry," probably owing to a somatic vaso-constriction in order that a maximal splanchnic circulation may be attained.

In the stage of shock consequent on a perforation or strangulation ("peritonism") the pulse is rapid, but has not the wiry characteristic of the peritonitis pulse; as the stage of peritoneal shock passes away the pulse often becomes slower and of larger volume, but later it increases in rapidity and decreases in volume *pari passu* with the peritonitis consequent on the initial lesion. A rapid pulse is met with also in intra-peritoneal hæmorrhage from any cause; in this condition the rapidity is often extreme, so that the pulse soon becomes "running" or uncountable. In uncomplicated intestinal obstruction it is not common to find any appreciable increase in the pulse rate.

Pyrexia.—The information yielded by the thermometer is meagre in comparison with that derived from the pulse. Pyrexia is, of course, suggestive of an infective lesion, but one must remember that the most virulent infections may be apyrexial, owing to complete lack of any reaction on the

part of the tissues ; thus a fulminating appendicitis may be apyrexial throughout, though it is exceptional to find appendicitis unassociated with pyrexia at some stage of its course. With chronic intestinal obstruction there is little, if any, fever, unless a secondary peritonitis complicates matters. In the condition of peritonism previously alluded to the temperature is usually subnormal until the stage of consecutive peritonitis, which is commonly associated with pyrexia. Rigors are occasionally met with at the onset of appendicitis, and they are common in renal and biliary colic. Repeated rigors are usually indicative of portal pyæmia.

Inspection

Retraction of the anterior abdominal wall is frequently met with in intestinal colic, and shortly after a gastric or duodenal perforation ; it is also common after profuse diarrhœa and vomiting (especially in children), and in meningitis.

Abdominal distension may vary in degree from a barely perceptible fulness to a gross distension with an enormously dilated peritoneal cavity and a tense and glistening skin. The lesser grades of distension may be chiefly local, involving, for example, the right iliac fossa, the hypogastrium or the epigastrium. Abdominal distension is usually due to intestinal dilatation, but it may be caused by the presence of free gas after a perforation ; in some such cases the gas is under great tension and escapes with considerable force when the peritoneum is incised. Peritoneal exudate may be in part, at any rate, responsible for a considerable degree of distension, and we have more than once seen the peritoneal cavity tensely distended by blood derived from a ruptured viscus. Other causes of distension worth remembering are acute gastrectasis, pregnancy, a large ovarian cyst, and diffuse abdominal growths. The obese abdominal wall should rarely lead to errors.

Local prominence of the anterior wall may be caused by

gastric or intestinal outlines, or by subjacent tumours or inflammatory masses; the outlines of an enlarged gall-bladder are occasionally visible in the right hypochondriac and lumbar regions, and a distended urinary bladder is the most frequent explanation of a visible hypogastric tumour.

Respiratory Movements.—If the abdominal wall is motionless during quiet respiration, the patient should be asked to take a few deep breaths; if the movements are not thus elicited, it is advisable to ask the patient to try to "blow out his stomach as he breathes." These suggestions are necessary owing to the fact that a few individuals habitually adopt the costal type of respiration; in such individuals abdominal respiratory movements are normally slight or absent, a phenomenon which might be erroneously interpreted. With reflex abdominal rigidity little if any respiratory excursion is possible even on voluntary attempts to move the wall. The respiratory excursions may be entirely suppressed, or they may be diminished in extent, over the whole, or over a limited area, of the abdomen; any of these signs are of considerable diagnostic importance, pointing as they do to a diffuse or local rigidity.

Visible Peristalsis.—In order to observe peristalsis a good light is essential, and the abdomen must be carefully and patiently scrutinised from different points of view. Three distinct types can be recognised, namely gastric, small intestine, and large intestine, peristalsis;

Gastric Peristalsis is evidenced by a series of big peristaltic waves which pass slowly from left to right across the upper half of the abdomen; it is invariably painless, whereas the appearance of intestinal peristalsis is always associated with pain, the pain being more acute in the case of the small bowel peristalsis.

Peristaltic prominences caused by the **small intestine** are situated centrally; the sudden and temporary appearance of a "step-ladder pattern" in the umbilical region is quite characteristic. The prominences are usually small

and transient and their movements are rapid; at the same time it must be remembered that the coils of small intestine may be dilated to a diameter of two or three inches, in which

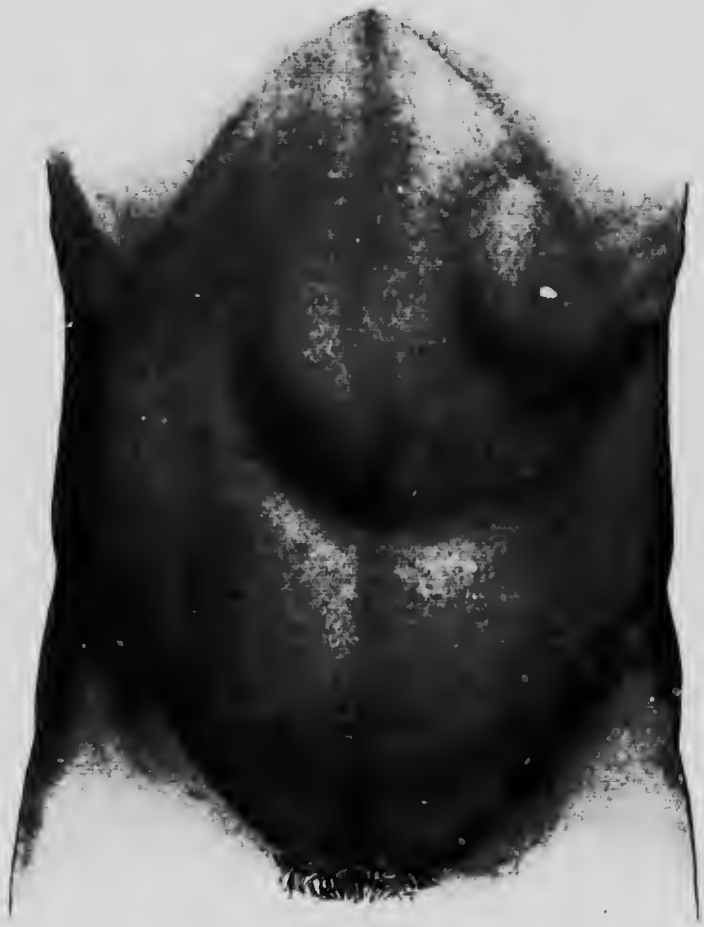


FIG. 7.—Gastric peristalsis.

case the peristaltic prominences may be of such a size that it is difficult to appreciate the fact that small bowel is subjacent. Small bowel peristalsis is nearly always associated with obstruction at or above the cæcum; it is unusual

for this type of peristalsis to be seen in cases of large bowel obstruction. Possibly in many cases the small intestine peristalsis is masked by the general abdominal distension

FIG. 8.—Small intestine peristalsis.

and by the relatively gigantic prominences caused by the cæcum and colon.

The prominences caused by peristaltic large intestine

appear and subside more deliberately, and they are more apt to "stand out" abruptly on the abdominal wall; they are situated peripherally rather than centrally, but, since

FIG. 9.—Large intestine peristalsis.

the dilated transverse colon frequently extends to the hypogastric region and the pelvic colon occasionally extends to the epigastric or hypochondriac regions, it is clear that large bowel outlines may appear on any part of the anterior

abdominal wall. The cæcum and ascending colon usually stand out more prominently than the rest of the large bowel even when the site of obstruction is in the iliac colon or rectum; so that large intestine peristalsis confined to the right half of the abdomen is not pathognomonic of a high obstruction, as is sometimes stated.

If peristalsis is not visible in a case of suspected intestinal obstruction, it can often be elicited by firm abdominal palpation. A hot drink is another form of stimulus which is frequently successful. Visible peristalsis is caused by the temporary contraction of a loop or segment of the intestine, the outlines of which are visible on the superjacent abdominal wall so long as the contraction lasts. This loop or segment may move as a whole, but peristaltic waves passing along the course of the intestine are seen through very thin abdominal walls only, and then usually apart from any obstruction. Visible peristalsis is frequently observed in subjects with very thin and lax abdominal walls, quite apart from any abnormal intestinal activity. When seen in well-nourished subjects it is usually diagnostic of intestinal obstruction. In rare instances, it may be evidence merely of very energetic peristalsis; for example, a dose of castor-oil was given to a well-nourished child aged three, suffering from gastro-enteritis; such well-marked small bowel peristalsis was observed shortly afterwards that small bowel obstruction was diagnosed. After two very copious stools, however, the visible peristalsis ceased abruptly and the child made a rapid recovery. In this case there was no reason to suppose that a fæcal impaction had caused a true obstruction.

The abdominal inspection should include an examination of the groins, umbilicus, and scrotum for hernial swellings; and any abnormal appearances such as pigmentation, dilated cutaneous veins, laparotomy scars, an umbilical fistula or tumour of the abdominal wall should not pass unnoticed.

Epigastric Pulsation is a phenomenon frequently

encountered, and it is often so pronounced as to arouse suspicions of an abdominal aneurysm. It is important to remember that an aneurysm is the least common explanation of epigastric pulsation; prominent and visible aortic pulsation is extremely common in nervous subjects, particularly women, and a hypertrophied or dilated right ventricle is another common factor in the production of epigastric pulsation. True expansile pulsation of the liver, a somewhat uncommon condition, is indicative of tricuspid regurgitation. Pulsation may of course be transmitted to the skin by a tumour overlying the aorta.

Palpation

For successful abdominal palpation it is essential to eliminate as far as possible all voluntary rigidity, to gain which end several important points must be attended to. The patient should lie on the back with one pillow under the head and shoulders; in some cases it may be necessary to have the hips and knee-joints flexed. Palpation of a patient in the Fowler position is usually most unsatisfactory. The palpating hand must be warm; it must be laid very gently and quite flat on the abdominal wall, after which light pressure may be exerted by flexing the fingers a little at the metacarpo-phalangeal joints. A cold hand roughly pushed into the wall makes accurate palpation impossible, not only at the moment of application but also for some time subsequently; palpation with the finger-tips alone is an equally objectionable method. After pressure has been exerted the hand should be removed from the wall as gently and deliberately as it was applied to it, and the same manœuvre may be repeated elsewhere over the abdomen.

Having palpated the abdomen during ordinary quiet respiration the patient should be asked to breath more deeply and through the mouth; by this means greater relaxation of the abdominal muscles may be attained and

the mobility of any mass felt may be studied. But it is important to examine the abdomen first during quiet respiration, as matters may be made worse by the patient's voluntary efforts at respiration. In the case of a crying child the hand must be held passively on the abdominal wall during expiration, awaiting the momentary relaxation of voluntary rigidity during inspiration.

It is a good rule always to palpate the most painful area last and to begin palpation as far as possible away from it. In appendix cases we make it a routine to palpate first from the left loin towards the umbilicus, next from the left hypochondrium towards the umbilicus; next from the right costal margin downwards; finally the right loin and right iliac fossa are investigated.

Bimanual abdominal palpation is often useful, particularly when investigating lumbar swellings. The secret of bimanual palpation is that the anterior hand must be passive while the posterior hand exerts pressure on the loin. Bimanual examination per vaginam or per rectum is of even greater utility, and in children a large part of the abdomen can be explored bimanually per rectum, a method which is very valuable in doubtful cases of intussusception. In no case of suspected acute abdominal disease should a rectal examination be omitted; in many female cases a vaginal examination should be made in addition. If possible the rectal examination should be made with the patient on his back; inconvenient though this posture is, we consider it unnecessary in most cases to adopt the lateral decubitus and thereby risk a spread of peritoneal infection. A rectal examination may reveal an unsuspected pelvic abscess or other tumour; the apex of an intussusception may be felt or intra-pelvic tenderness may be elicited. When making a vaginal examination any discharge—purulent or bloody—and any abnormal fulness or tenderness of the vaginal fornices should be noticed. The position and degree of mobility of the uterus and the condition of the os uteri should be investigated; if any pelvic

tumour is discerned its relation to the uterus must be investigated.

During abdominal palpation attention should be directed towards the following points :—

(i) **Cutaneous Hyperalgesia,** elicited by the lightest touch on the affected skin area.

(ii) **Deep Hyperalgesia,** elicited by gentle but firmer pressure. These painful impulses are probably derived in part from the abdominal muscles, and in part from the tissues immediately adjacent to the peritoneum ; clinically we have not found it possible to distinguish between the two varieties of deep tenderness, as has been done by some writers.

(iii) **Muscular Hypertonus**.—This, when extreme, is referred to as " rigidity," whereas hypertonus of milder degree should be classed as " resistance " ; this is a nomenclature of some importance and it should be strictly adhered to. Muscular hypertonus may be voluntary or reflex, and it is essential that the clinician should be able to recognise with which variety he is dealing. Voluntary resistance or rigidity has but little significance ; it may be eliminated by distracting the patient's attention and carrying out palpation on the lines which have been previously suggested. The " viscero-motor reflex " is not, of course, a phenomenon confined to the muscles of the anterior abdominal wall ; the reflex rigidity of an inflamed joint, the intercostal rigidity of pleurisy and the lumbar rigidity of renal colic are strictly comparable to the rigidity of peritonitis. Nor is abdominal rigidity pathognomonic of peritonitis ; the most extreme grades of rigidity may be associated with a simple colic, for example.

Any areas of tenderness, resistance or rigidity should be carefully defined and noted down for comparison with the results of subsequent examinations of the patient. In appendix cases the tender area may be mapped out with an aniline pencil, so that slight changes in its extent may be recognised with certainty. It has been asserted that the

sudden disappearance of cutaneous hyperalgesia in appendicitis is a sign of evil omen, but this statement we have been unable to verify.

(iv) **Œdema** of the abdominal wall is occasionally found over inflammatory masses and is evidenced by "pitting" after palpation. It is a valuable sign of subjacent suppuration.

(v) **Intra-Abdominal Masses,** physiological or pathological. Of the former the *pregnant uterus* is diagnosed by the history and by examination of the vagina and breasts; the *distended bladder* by the results of catheterisation; scybalous masses are characterised by their doughy consistency, their mobility, and their change of position, or disappearance, after the administration of an enema. *Inflammatory masses* may of course be encountered in any part of the abdomen. They are usually, but by no means invariably, extremely tender, and their outlines may often be indefinite: the superjacent skin may feel hotter than elsewhere, and it may be œdematous. It is occasionally possible to obtain fluctuation over such a mass, but it is hardly necessary to point out that palpation over any mass of suspected inflammatory origin should be conducted with extreme caution.

Hepatic Tumours.—Riedel's lobe of the liver is an occasional source of error. This linguiform subcostal extension of the liver is not a congenital abnormality, but is the result either of hepatoptosis (dexter-version or anteversion of the liver), or of constriction of the right lobe by tight lacing. This amount of knowledge as to the etiology of Riedel's lobe should be a sufficient safeguard from mistakes, since hepatoptosis can be recognised by an investigation of the area of liver dulness, and by palpation of the edge of the left lobe, and since evidence of tight-lacing is usually manifest.

Tumours of the *gall-bladder* are usually pyriform or cylindrical in shape and they frequently exhibit lateral mobility round a fixed point in the vicinity of the ninth

costal cartilage. "Gall-stone crepitus" may occasionally be obtained from a gall-bladder which is distended with biliary calculi. A floating right kidney may very closely imitate a distended gall-bladder; the latter tumour always feels close to the abdominal wall, however, and if displaced towards the loin tends to return to the anterior abdominal wall. Moreover, it is impossible to displace a gall-bladder downwards. The combination of a distended gall-bladder lying on a dropped kidney is extremely puzzling and may well be mistaken for a cystic renal tumour. In exceptional cases the gall-bladder may be so greatly dilated as to be mistaken for an ovarian cyst.

Renal Tumours are characterised by their rounded margins and their property of "filling up the loin," *i.e.* no space can be demonstrated between the posterior border of a renal tumour and the erector spinæ; moreover the large intestine is usually placed in front of a renal tumour, where it can be demonstrated by percussion or palpation. Respiratory mobility is usually not a prominent feature of renal tumours, as is the case, for example, with hepatic and splenic swellings. "Renal enlargements never involve the pelvis, rarely reach the median line, and are frequently separated from the hepatic dulness by a resonant area" (Morris). Even when a renal tumour attains a large size it seldom causes more than a little fulness of the loin; a lumbar swelling which causes a visible prominence posteriorly is suggestive rather of a perinephric abscess. Finally, a left-sided varicocele is said to be more frequently associated with left renal than with splenic tumours.

A Splenic Enlargement can usually be recognised by the following characteristics: it does not "fill up the loin," so that a space can be recognised by palpation, and possibly also by percussion, between its posterior border and the erector spinæ; the anterior border is sharp, directed downwards and inwards from the left costal margin, and notches can often be felt along its course; it usually moves freely with respiration and no bowel can be demonstrated in front

of it. An enlarged and tender spleen may be associated with such a degree of abdominal resistance as to mask many of these characteristics; we have known a leukæmic spleen to imitate an inflammatory mass so closely that the true nature of the case was decided by a blood count only.

Gastric Tumours.—Occasionally, as a consequence of pyloric stenosis or spasm, the stomach may be so tensely distended with fluid as to form a cystic tumour in the upper abdomen, a condition which is easily recognised after the passage of an œsophageal tube. Gastric carcinomata, when palpable, usually have hard irregular outlines; free respiratory movement is not uncommon, and they are often very tender.

Pancreatic Tumours.—When the pancreas is affected by carcinoma, or by inflammatory change, it may occasionally be palpable as a narrow, transversely disposed and deeply situated, tumour just above the umbilicus. The so-called pancreatic cysts (the majority of which have little if any connection with the pancreas), form smooth, rounded and commonly tense tumours, which may or may not feel definitely cystic, situated in the epigastric region and frequently extending more to the left than to the right of the middle line. They may exhibit slight vertical mobility and are usually separated from the liver and spleen by a resonant area. The percussion note over the cyst is generally dull, but occasionally gastric, or less commonly colonic, resonance may be obtained over it.

Intestinal Tumours.—In most cases of acute intestinal obstruction due to carcinoma the abdominal distension is so great that the primary growth, unless accessible per rectum, cannot be palpated; nevertheless, careful palpation should be made along the course of the colon, and the method known as "dipping" will sometimes reveal a small tumour even in a distended abdomen. Secondary deposits, *e.g.* in the omentum or mesentery, are more liable to be detected. The characteristics of intussusception tumours

are fully described in Chapter V. Peristaltic coils are frequently palpable, even when not giving rise to visible peristalsis, and valuable information can thus be gained as to the size of such coils and as to the intensity of the peristaltic movements. A volvulus sometimes evidences itself as a palpable tumour which is tense and resonant.

Ovarian and Uterine Tumours can be recognised as such only by means of a combined abdominal and pelvic examination, and even then difficulties occasionally arise; for example, a small ovarian cyst with a long and narrow pedicle may cause an abdominal tumour whose pelvic connections may easily be missed; again, it is notoriously difficult to diagnose between a right-sided salpingitis and a pelvic appendicitis.

Retroperitoneal Tumours apart from those of renal or pancreatic origin are fortunately not common; we have known a large retroperitoneal sarcoma to be diagnosed as a twisted ovarian cyst, and it is on record that a retroperitoneal lipoma has been mistaken for an ovarian cyst.

Tuberculous Masses are always a fertile source of error. In a majority of cases the slightly distended abdomen, the walls of which have a very characteristically elastic resistance to palpation (in such cases the wall is often, but quite erroneously, described as being "doughy"), together with, possibly, evidence of a little ascites, and perhaps also of one or two deeply seated masses of indefinite outline, helps to make a clinical picture which is unmistakable. But in many cases this characteristic elastic resistance to palpation may be absent, as also may be the distension and ascites. The masses met with in tuberculous peritonitis may be due to collections of enlarged lymphatic glands, to rolls of tuberculous omentum, to encysted collections of fluid or to areas of adherent coils of intestine. Tuberculous "rolls" are not infrequently mistaken for intussusceptions, which they may imitate very closely; as a rule they do not exhibit the mobility of an intussusception, nor do they vary in consistency from time to time. Other

tuberculous lumps may be mistaken for inflammatory swellings, or even for carcinomata in later life, as they may be met with even in the aged. A more dangerous mistake is to diagnose an inflammatory mass arising in consequence of the perforation of a tuberculous intestinal ulcer as a tuberculous mass.

(vi) **External Evidence of Carcinoma** in the shape of carcinomatous glands in the groins, neck, or axillæ, or of carcinomatous nodules in the abdominal wall; induration around, and fixation of, the umbilicus is often valuable evidence of intra-abdominal carcinoma.

(vii) **Fluid Thrill.**—This is elicited by gently flicking the abdominal wall in the loins with one finger, the characteristic thrill being felt by the other hand, which is placed lightly, and flat, on the anterior abdominal wall. In doubtful cases an assistant should be instructed to place his hand edgeways on the abdominal wall between the flicking finger and the palpating hand, in order to damp off vibrations passing round in the wall itself. This is a sign of peritoneal exudate which is of very doubtful value; for when an unequivocal fluid thrill is obtained, the fluid is usually present in sufficient amount to be easily demonstrable by percussion alone; on the other hand an indefinite fluid thrill should be entirely disregarded.

(viii) **Hernia.**—The hernial orifices should be palpated in every case, and, if a hernial protrusion be found, its reducibility and impulse on coughing must be investigated. In addition, the contents of the scrotum ought to be examined for varicocele, tuberculous disease or growths.

Percussion

Light percussion only should be employed; the percussed finger should be held rather firmly against the abdominal wall and should be struck in a staccato manner. The percussing hand should move from the wrist only; percussion *viâ* the elbow joint is a heinous offence.

Tenderness on light percussion is always suggestive of peritonitis and is a valuable sign ; the abdomen of intestinal colic, for example, may be extremely tender to palpation, whereas percussion is usually quite painless ; in peritonitis, however, percussion-tenderness is very rarely absent. The whole abdominal wall should be percussed and any dull areas carefully defined. Particular attention should be paid to the flanks and to the area of liver dulness. Definite dulness in the flanks, is, of course, suggestive of fluid, and if this dulness can be demonstrated to move with change in the posture of the patient, the evidence of peritoneal exudate becomes still stronger. In most cases, however, we consider that it is unwise, if not altogether unjustifiable, to roll a patient suspected of having peritonitis from one side to the other, and thereby risk a further spread of peritoneal infection. A large peritoneal exudate is easily diagnosed without the demonstration of shifting dulness, and the signs of small effusions are so notoriously fallacious that the information gained by moving the patient from side to side seems hardly commensurate with the risks run by so doing.

Percussion over appendix abscesses frequently gives valuable evidence as to the proximity of the abscess to the surface, and the surgeon should plan his incision in accordance with any area of dulness present ; but sometimes an appendix abscess contains gas as well as pus, in which case a resonant or tympanitic note may be obtained over the abscess even though the latter is well shut off from the rest of the peritoneal cavity. We have already referred to the importance of the relationship of colon dulness to lumbar tumours. In intestinal obstruction a coil of tensely distended gut may give rise to a localised area of high pitched tympany, which is sometimes suggestive. Attempts to map out the area of gastric resonance are usually most unreliable.

The normal area of liver dulness extends from the sixth rib to the costal margin in the right nipple line. This

area may be diminished by emphysema of the lung, or by a right-sided pneumothorax; by diminution in the size of the liver in acute yellow atrophy or cirrhosis; by intestinal distension; or lastly, by the presence of free gas in the peritoneal cavity. The only positive evidence of the last-named condition is the demonstration of a progressive diminution of the liver dulness from below upwards, *in the absence of abdominal distension*. This is a sign of the greatest value, pointing as it does to the perforation or rupture of the stomach or intestines; it is frequently met with after gastric or duodenal perforation or rupture, but it is quite exceptional to find it associated with appendicular perforation. While emphasising the great value of this sign as defined above, we would lay stress on the fact that reduction, or even absence, of the liver dulness when there is much abdominal distension should be disregarded; with a flat abdomen an area of resonance or tympany above the right costal margin arouses suspicions of the presence of free gas in the peritoneum; if this area of resonance can be demonstrated to have extended upwards on a second examination we have further evidence that these suspicions were correct.

Auscultation

Peristaltic noises, audible without a stethoscope, indicate merely abnormal peristaltic activity; thus they may be associated with an attack of diarrhœa or with intestinal obstruction, and they are also a familiar neurotic manifestation. Abdominal auscultation sometimes gives useful information; for instance, continuous and absolute silence all over the abdomen is evidence of complete intestinal paralysis, such as occurs in paralytic ileus, or in diffuse peritonitis. Local silent areas, too, are suggestive of a subjacent peritonitis; on auscultation over the normal cæcum peristaltic tinkling should be heard at frequent intervals, and, consequently, prolonged silence in this area suggests a local peritonitis.

Splashing noises are elicited by a sudden and deep palpation when the abdominal wall is lax. Splashing is most commonly found with gastric dilatations, but it is sometimes met with in intestinal obstruction, especially if the small bowel is distended.

Examination of the Urine and Blood

The Urine should be examined as a routine for albumen, sugar, pus and blood. If the urine is turbid it should be examined microscopically. Indicanuria is constantly present in diffuse peritonitis and in intestinal obstruction; it is also found with chronic constipation, and in various other conditions.

The Blood.—When it was the practice to treat appendicitis on expectant lines and to resort to surgery only in cases where gangrene, suppuration, or a spreading peritonitis was suspected, the physician in his perplexity often had recourse to the hæmatocytometer. Now that the policy of immediate operation has been adopted in the majority of acute cases, it is seldom that the necessity for investigating the leucocytes arises. In a limited number of cases, however, it is expedient to make a white count, remembering always that the degree of leucocytosis in any particular case depends not only on the virulence of the infecting organisms, but also on the immunising response on the part of the patient. Absence of leucocytosis may be associated with a virulent and diffuse peritoneal infection; thus a low white count occurring in a case which is obviously serious is a grave prognostic sign. Conversely a pronounced leucocytosis may be an indication merely of an adequate immunising response to a comparatively mild and localised infection. It is in the subacute cases with a definite mass in the right iliac fossa that we have found the white count most useful, but even when dealing with this type of case it is well to remember that Bloodgood ("Progress of Medicine," December 1901), found no leucocytosis in 26 per cent. of appendix

abscess cases. It seems certain that repeated white counts should be made, if the information derived therefrom is to be of any real value; a well-marked leucocytosis, which on subsequent examinations is found to be maintained, or to be increasing in magnitude, is usually evidence that surgical treatment is necessary.

It is in the diagnosis between the inflammatory and the non-inflammatory intra-abdominal lesions that the white count is most often useful. Thus, whereas some degree of leucocytosis is found in the majority of cases of appendicitis, pyosalpinx, cholangitis, cholecystitis, acute pancreatitis, perinephric abscess, perforative peritonitis, or pneumococcal peritonitis, no leucocytosis is found in such conditions as intestinal colic, renal or biliary colic (provided that no secondary infection has occurred), in the early stages of intestinal obstruction, in Dietl's crises, or in hysteria.

It is important to remember that a low white count is characteristic of uncomplicated typhoid fever. Occasionally cases of peritonitis (usually consequent on appendicitis) are characterised by profound toxæmic features, so that their resemblance to typhoid fever may be very close; in such cases a definite leucocytosis would exclude the diagnosis of uncomplicated typhoid fever. A leucocytosis may afford valuable confirmatory evidence of intestinal perforation in typhoid fever, provided that other complications, such as thrombosis or pneumonia, can be excluded. Even in the absence of any evidence of such complications, implicit reliance cannot be placed on the results of a white count. Thayer, for instance (John Hopkins Hospital Reports, vol. viii.), investigating eight cases of typhoid perforation, found a well-marked leucocytosis (16,000–23,000) in only three cases, a slight leucocytosis (10,400–11,200) in two cases, and no leucocytosis in three cases. Thayer also reported four cases in which symptoms suggesting perforation and accompanied by leucocytosis led to laparotomy, and yet no perforation was found. In half the cases of intestinal hæmorrhage complicating typhoid fever a

leucocytosis was found. In this connection we would point out that Cabot found white counts varying between 12,000 and 24,000 in 27 per cent. of cases of bleeding gastric ulcers, a point which is worth remembering when employing the white count for the purpose of confirming a diagnosis of perforated gastric ulcer.

When typhoid fever is suspected, a Widal reaction should be performed; it should not be considered as complete unless good agglutination occurs within 30 minutes with a dilution of 1 in 50, at room temperature. If the Widal reaction is negative a blood culture in ox-bile medium should be made; for this purpose it is not necessary to open a vein, as sufficient blood can be obtained from the fingers, which must, of course, be previously cleansed. This ox-bile test is frequently positive at an earlier stage of the disease than is the Widal reaction.

CHAPTER III

LAPAROTOMY

In acute abdominal diseases such as we propose to deal with in this book, the possible need for operation should present itself at the earliest period to the mind of the medical attendant. Accurate diagnosis may at times be impossible, but even so, we are called upon to decide whether a case is one in which medical treatment is likely to succeed, or whether there are symptoms of lesions which only surgical interference can deal with. In these cases the physician and surgeon should be early in consultation so that each may have the benefit of the other's experience, and the patient and his friends will then be guided more readily by the combined medical verdict. The policy of delay, which in acute cases is always fraught with danger, is more often due to the arguments and hopes of the patient and the patient's relations than to lack of observation or skill on the part of the medical practitioner; if there is a strong medical "party" from the beginning of the case the opposition will be guided into the way of medical and surgical wisdom. In some doubtful cases it may be right to take as criteria the result of purgatives or enemata where obstruction is suspected, or the onset of rigidity of the abdominal wall, or the rising of the pulse rate, where peritoneal inflammation is probably present, but where such a course as this is adopted a definite line of action should be laid down and this should be made clear to the patient and his friends.

In those cases where the need for operation has been decided upon there should be no delay. All preparations that are possible should be made in the house where the

patient is first seen. In the case of patients of the hospital class their removal should be effected even while the condition is still doubtful, but in the wealthier class of patients removal to nursing homes for operation is not desirable if it can be avoided, and, as a general rule, a patient does better in his own home than elsewhere. Although the operative procedures in these cases may sometimes be extensive, provided that the rules of surgical cleanliness can be observed, there is no reason why they should not be carried out in a cottage if sufficient light, space and assistance can be obtained. It is most important not to attempt to operate in the presence of the shock which often accompanies the onset of acute abdominal lesions. This is not to be seen in the case of acute gastric and duodenal perforations, where, although the surgeon's efforts to close the perforation as soon as possible, it will do well to wait, sometimes for several hours, until the incipient shock has been treated by rest in a well-warmed bed, with the patient's extremities firmly bandaged from below upwards and the administration of saline in severe cases. The saline should be a 0·9 per cent. solution of sodium chloride in boiled water at a temperature of 108° F. and it may be given per rectum, subcutaneously, or into a vein. Adrenalin, or pituitary extract, may be given subcutaneously or in the saline, but general opinion is rather against strychnine in pure cases of shock, as this is accompanied by dilatation of the splanchnic vessels, and it is not good to stimulate the musculature of a more or less empty heart. But all these measures to some extent fail to treat the cause of the shock, which is acceptedly due to stimulation of peripheral afferent nerves, and it is the pain of this stimulation from which the patient suffers most acutely; if therefore the pain is relieved, the shock diminishes and consequently these patients improve under the influence of morphia or an anesthetic. Morphia, however, is a most dangerous drug in the treatment of acute abdominal diseases, and is a foe to accurate diagnosis, since it inhibits peristalsis and favours relaxation of the abdominal wall in those peritoneal lesions

where rigidity is one of the best clinical signs. In our opinion, then, ***morphia has no place in the treatment of peritonitis, and should only be given in other acute abdominal lesions when it has already been decided to operate, or where it is certain that operative interference will not be required.*** Even under these circumstances not more than gr. $\frac{1}{6}$ to gr. $\frac{1}{4}$ of the tartrate or hydrochloride should be given as a dose.

It is desirable that the stomach, the rectum, and the bladder should be empty before the anesthetic is administered. The first is of greatest importance in cases of intestinal obstruction, as there is considerable danger of vomiting occurring during the induction of anesthesia, or during the course of the operation, when the laryngeal reflex may be abolished: there are thus risks of suffocation, or, where the patient escapes this, of aspiration pneumonia, if the vomit enters the respiratory passages. Irrigation of the stomach is therefore advisable as a preliminary measure in all cases of acute obstruction, especially where the vomiting is frequent, as in small bowel lesions. The rectum will probably have been emptied before operation has been decided upon, but, if not, there is no need to delay for the administration of an enema, and indeed the peristalsis which it induces is not desirable. If the patient is unable to pass water satisfactorily it is well to pass a catheter before the operation is begun, and in the female the bladder should always be emptied by catheterisation; by this means the risk of encountering the bladder in a low abdominal incision is avoided, and if pelvic disease is present, the operation is rendered much easier by having the bladder quite flaccid.

The Anæsthetic.—In this country chloroform is the anæsthetic usually selected for urgent abdominal surgery, and the main reasons for its use are: (1) that it requires very little apparatus; (2) that it gives the surgeon the maximum of comfort by producing full relaxation of the abdominal muscles and quieting the respiratory movements of the abdomen and its contents; (3) that it is less liable to incite vomiting than ether, or to be followed later by aspiration

pneumonia. In America, and in many parts of Europe, however, ether is the anæsthetic of choice, and it has the advantage that it causes less depression of the respiratory and circulatory centres than chloroform. Since the introduction of morphia, scopolamine and atropine as a preliminary to general anæsthesia, ether, by the open method, has been steadily gaining in popularity. The interests of the patient must in all cases be the first consideration, and therefore no hard and fast rules should be laid down, but a rapid yet complete examination of the respiratory, circulatory and urinary systems should be made before the anæsthetic is commenced. Within the last year or two a new method of inducing anæsthesia has been introduced, namely, by intravenous administration of ether or hedonal (a derivative of urethane). Such a method has its advantages, one of which is the rarity of pulmonary sequelæ, but it also has its drawbacks, and at present, it is not especially suited to abdominal surgery, but rather to that of the head and neck.

We have at the present day a choice of at least four methods of rendering the necessary steps of an operation painless; these are, by inhalation, intravenous infusion, spinal injection, or local infiltration, and there is no doubt that in most cases the oldest, by inhalation anæsthesia, is still preferred both by patient and surgeon. In acute abdominal diseases the scope of the operation is rarely quite certain, and to operate on a conscious patient without a definite plan of action is neither expedient for the patient nor convenient for the surgeon; at the same time it must be admitted that this increase in the possibilities of anæsthesia does enable one to operate with a reasonable chance of success on desperate cases which formerly would have been allowed to die unrelieved. Spinal anæsthesia has many advantages, not the least of which lies in the direction of the prevention of shock due to the operation itself, but it should only be used in urgent cases by those who have ample experience of it in less serious operations. Infiltration of the skin and subcutaneous tissues with novocain in saline,

or eucaine and adrenalin, is quite satisfactory for laparotomy incisions, but it is difficult to do all that is necessary with this form of anæsthesia, although the visceral peritoneum is insensitive when it is not inflamed; therefore we consider that local analgesia is only suitable in those cases where the surgeon knows beforehand exactly what he has to do and that it will only take a few minutes, such as will suffice for the performance of colostomy or for herniotomy, but even then the psychological condition of the patient is often best treated by the administration of some anæsthetic by inhalation. Although the visceral peritoneum is insensitive, the parietal has quite the opposite character, and traction on the omentum or mesentery is often painful and productive of shock. It is necessary to wait for some fifteen minutes after infiltration to obtain the maximum anæsthetic effect, and it is difficult to render the parietal peritoneum insensitive, so that just before the peritoneal incision is the time for the administration of a little chloroform in these cases. Local anæsthetics do not produce muscular relaxation, and this constitutes a serious disadvantage.

Operative Procedure.—The room prepared for the operation should be warm, at a temperature of between 65° and 70° F. The table should also be warmed by the use of hot-water bottles and the patient's body should be wrapped up warmly in cotton wool. The area of skin disinfected must not be limited to the abdomen, but it must be shaved and cleansed from nipples to pubes, and the flanks must not be forgotten in the process. The method of disinfection will depend on the custom of the surgeon, but in our own practice we have found the iodine method entirely satisfactory. We give preference to a 3 per cent. solution of iodine in chloroform, but others use 2 per cent. in rectified spirit. The former causes less staining of the skin and does not give rise to peeling of the epidermis as occasionally happens after the use of the alcoholic solution. The usual practice is to apply one coat of the iodine solution, *without washing the skin*, one hour before the commencement of the

operation, and another just before the incision is made, but perfectly good results are to be obtained by one painting, and in acute cases there can be no question that this method has many advantages. Special attention must, of course, be paid to the regions of the umbilicus and pubes, and, if any pustules or eczematous patches are present on the abdominal wall they should be treated by the application of a little pure carbolic and covered with collodion before the painting with iodine; the skin incision should be placed as far from such areas as possible. Before the operation is commenced the abdomen should either be covered with a sterilised towel, having a hole through which the incision can be made, or with a large piece of sterilised muslin, in which a hole can be cut to expose the skin at the desired spot.

When once the peritoneal cavity is opened strict aseptic technique is essential, whatever method of disinfection of the abdominal wall and instruments is preferred, for antiseptics not only irritate, but also damage the peritoneum and cause the death of many useful endothelial cells and leucocytes. Some hot (105–110° F.) sterilised physiological saline should therefore be at hand, and the sterilised dressings should include abdominal plugs eight inches wide and two feet in length, made of plain gauze, or abdominal pads of the same material, both to prevent the prolapse of intestine through the wound and to cover any coils that it may be necessary to have outside the abdomen; these pads should be wrung out in the hot saline before being applied to any exposed coils of bowel. Attention to these details, and a care of the general warmth of the patient, does much to minimise the risk of post-operative pneumonia, a not uncommon cause of death in acute abdominal diseases which have been otherwise successfully dealt with by the surgeon.

As a general rule one capable assistant is all that is needed by the operator, but where extensive or difficult procedures are likely to be necessary a second assistant will be of great value, and much time may be saved by having plenty of

well-organised help. Appendix cases rarely call for more than one assistant, but the suture of a deeply placed perforated gastric or duodenal ulcer is often facilitated by a third pair of hands; a second helper can save much time in the threading of needles and the tying of ligatures, as it is difficult to have all needles threaded before the incision is made, since the scope of the operation is often not known until the abdomen is opened. All the hands which come into contact with the instruments, ligatures, or the wound, should be covered with rubber gloves, which are now obtainable with a rough outer surface enabling the operator to manipulate even slippery intestine quite easily. Clothing the hand by an impervious rubber glove is the only method by which it can be rendered a sterile instrument, and in cases of peritonitis it is most essential that they should be worn to protect the surgeon from infection. In non-infective cases they are perhaps not so necessary, for the peritoneum is not very readily infected by the hand, and in cases, such as those of intussusception in young children, where the success of the operation appears to bear a direct relation to the rapidity of its performance, we prefer to dispense with gloves and save a little time, which is of such value to the patient. Here, however, the assistant should still wear gloves, and if in the course of an operation the surgeon removes his gloves he should be careful to wash his hands again to get rid of the sweat that collects beneath the impervious rubber. Some surgeons state that their sense of touch is impaired by the use of these gloves, and they find difficulty in the manipulation of the coils of intestine while wearing them, but, while admitting that such manipulation takes just a little longer in rubber gloves than with bare hands, we believe that a very little practice will remove the first objection, and the lessened risk both to the patient and the surgeon is ample compensation for the very slight loss of time. The gloves with roughened outer surfaces give a very good grip, especially if they are sterilised by dry heat instead of being boiled.

The position of the patient is of considerable importance, and though in operations on the pelvic organs, and in those where much shock is likely to occur, it may be desirable to have the head low, we prefer in all cases of peritonitis to have the patient lying with the body at an angle of 30 degrees to the horizontal; by this means pus will be encouraged to gravitate into the pelvis where least absorption occurs, and we shall know which part of the peritoneum to mop out last in the dry sponging which plays a part in the modern treatment of peritonitis.

The Abdominal Incision

The peritoneal cavity is opened either for the purpose of clearing up a doubtful diagnosis, or in order to carry out some definite operative procedure on the abdominal contents, or the same operation may be in the first place exploratory, and in the second executive. In any of these procedures the ideal incision is one which will cause least disturbance to the texture of the abdominal wall, and will at the same time enable the surgeon to reach such of the viscera as may be necessary by the shortest route. The opposing obliquity of the majority of the muscle fibres of the abdominal wall is a source of strength, and this must be remembered in making the incision. The middle line, or *linea alba*, and the outer margin of the rectus sheath, or *linea semilunaris*, are both eschewed by surgeons on account of their poor vascularity, and their liability to form weak scar tissue with a tendency to the subsequent formation of a hernia through the scar. The accepted rule is that the abdomen is best opened by splitting muscles in the course of their fibres, or by displacing them temporarily, so that they may form part of the barrier against hernia when they are allowed to return to their place and cover the deep part of the incision; the skin incision must then be in the same direction as that of the fibres of the immediately subjacent muscle. Skin incisions outside the rectus sheath should be oblique, from above downwards and inwards,

whereas those made over the rectus should be vertical. Where the nature of the lesion is uncertain, and abdominal exploration has to be carried out, the incision should be made

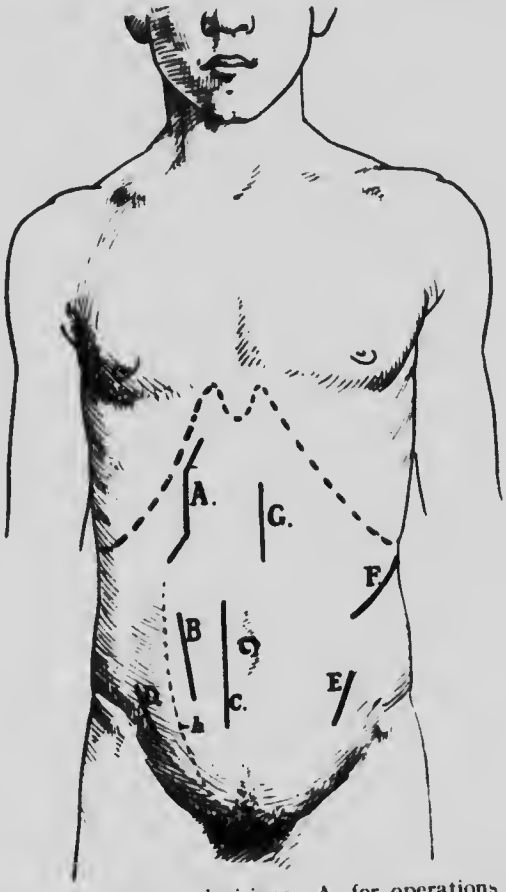


FIG. 10.—Laparotomy incisions. A, for operations on bile passages; B, for inward-displacement of rectus; C, right lower paramedian; D, McBurney muscle-splitting; E, for iliac colostomy; F, for left hypochondriac abscess; G, left upper paramedian; *h*, linea semilunaris.

near the middle line and near the centre of the abdomen, for then it will be possible for the hand to be passed through the wound to all parts of the peritoneal cavity. The incision

in these cases should be either through one of the recti, or, nearer to the *linea alba*, the anterior layer of the sheath may be divided and the inner edge of the rectus muscle retracted outwards with division of the posterior layer of the sheath behind the muscle. Either of these methods yields a better scar than an incision through the *linea alba*, though it must be admitted that a median ventral hernia is not often seen in supra-umbilical incisions and that the firmness of a laparotomy scar depends to a great extent on obtaining aseptic healing of the wound. This incision by displacement outwards of the rectus muscle is called " paramedian," and it involves no division of motor nerves, and in this respect has the same merit as is possessed by a truly median wound, but it must be afterwards sutured in layers, so that, if rapidity be essential, it is quicker to go through the rectus muscle than to displace it. The objection to incisions through the outer part of the rectus sheath, whether the muscle be displaced or split, is that it is extremely difficult to avoid division of some of the terminal portions of the intercostal nerves which supply the muscle, and their division is sometimes followed by atrophy of portions of this segmented muscle ; as a matter of fact this result is not very common and the advantages obtained in free access to the abdominal cavity and the rapidity of the method outweigh these objections. We are of opinion then, that, whenever a rectus incision is likely to give the access required, it should be preferred to any other means of entering the abdomen ; if speed is essential, the incision should be deepened by splitting the muscle fibres vertically, but when more time can be allowed the muscle is better displaced outwards or inwards according as the incision is nearer the median or the lateral vertical plane. There is no difficulty in draining wounds or abscesses through an incision by displacement of rectus, and if the drainage tube is removed early the muscle will cover the aperture through which it passed. Right rectus incisions give good access to the appendix, gall-bladder, duodenum, and lower part of the small intestine, together

with the ascending colon and the pyloric portion of the stomach; left rectus incisions are best for the greater part of the stomach, the jejunum, and the lower part of the colon; operations on the pelvic organs can be best performed by displacement of one or other rectus away from the middle line. Muscle-spanning, oblique, or "gridiron" incisions are excellent for the drainage of localised intra-peritoneal abscesses, but they yield a very small opening into the peritoneal cavity and should very rarely be used for exploratory operations, as it is not often possible to get an opening which will allow more than two fingers to be passed into the abdomen. As a general rule exploratory incisions are best made through the right rectus on the inner side of its centre with two-thirds of their length below the umbilical level: this enables one to approach the cæcum and appendix, the ileo-cæcal valve, the pelvic organs and the pelvic colon with ease, and the condition of the cæcum is a valuable criterion in the differentiation between small and large bowel obstruction; this incision can be enlarged upwards to explore the region of the liver and stomach, or downwards to facilitate pelvic operations. One of the objects of the surgeon, however, should be to plan his exploratory incision so that he will be able to do all that is necessary through one wound, and this may in some cases determine the selection of a left rectus incision where the probable lesion is in connection with the stomach or lower part of the colon. If laparotomy wounds have to be reopened it is best to excise the old scar, but this must be done with caution, as there is likelihood that there will be adhesions beneath it between visceral and parietal peritoneum.

Technique of Incision.—The length of the skin incision will depend on whether the operative procedure requires to be exploratory in the first instance or not, but in all abdominal operations an endeavour should be made to judge the required length of incision beforehand, as too short an incision hampers the operator, and too long an incision, while it gives free access to the interior of the abdomen, also

favours the prolapse of bowel and tends thus to produce shock during the operation ; a short incision may be lengthened, but time is often wasted by trying to work through too small a wound, though at the same time a small opening has the merit of not readily allowing the intestinal coils to protrude, and of being more quickly sewn up at the end of the operation. The vessels in the subcutaneous tissue should be carefully secured before dividing the muscular or aponeurotic layer, and the artery forceps may be left on until the operation is completed. Deeper vessels of the muscular plane, or in the rectus sheath, should be ligatured as soon as they are divided, and this applies especially to those incisions where the deep epigastric artery has to be severed. If possible the accompanying nerves should be retracted so as to avoid their division, but if this means operating through a very small opening in the peritoneum the nerves must be sacrificed.

When the skin and subcutaneous tissue have been divided, it is a good plan to clamp the towels or muslin covering the abdominal wall to the skin edges, as by this means the possibility of prolapsed bowel coming in contact with the skin of the abdominal wall is prevented, and also the hands of the operator and the assistants will then touch only sterilised cloths. There are a number of patterns of forceps devised for this purpose, and the best are those which take up the least room and lie flat on the abdominal wall. In most operations it is unnecessary for the operator to touch the patient's skin with his hands, and this applies especially to abdominal surgery.

As soon as the peritoneum is opened (where this is sufficiently lax it should be held up with forceps before cutting, to avoid injury to the visceral peritoneum) there is a tendency for bowel to protrude, except in those cases where the peritoneal cavity is full of fluid or the coils of intestine are matted together with pus and lymph. This protrusion must be prevented by pressing the bowel back with the wide gauze plugs or pads mentioned above ; we

prefer plugs, for their free ends can be secured with heavy artery forceps, and the risk of their being left in the abdomen is thus minimised. These plugs should also be counted as they are put in, so that as the operation proceeds it will be known how many have to be withdrawn. Some surgeons have cords of silk with glass beads fastened to the end of their abdominal pads, and this is undoubtedly a good plan ; but if the operation is performed systematically and the surgeon alone puts in the plugs, he should know how many he has used and where he has placed them. If the assistant then secures the free end of each plug with artery forceps there will be a double check on the number used, and both surgeon and assistant should know how many have to be removed before the abdomen is closed. If free fluid escapes on incising the peritoneum, its nature should be noted since it often forms a valuable guide to diagnosis. In cases of injury, or ruptured tubal pregnancy, free blood may be met with. In acute obstruction, especially of the small bowel, the fluid is usually serous and slightly tinged with blood, the degree of blood-staining being proportional to the duration of the obstruction ; sero-sanguineous fluid is also met with in acute hæmorrhagic pancreatitis and in twisted ovarian pedicle. This fluid has no odour. Serous fluid with flakes of lymph in it is usually present in cases of perforated gastric and duodenal ulcer, and the fluid often has a somewhat sour odour. Purulent fluid is met with in many diseases, but when due to a perforative lesion of the bowel it has an offensive odour ; this smell is often due to the presence of the *bacillus proteus* or allied organisms, and not the *bacillus coli* itself. By far the commonest perforative disease is appendicitis, but the pus present in these cases is sometimes odourless, even when one is dealing with a localised abscess. Non-offensive pus is met with in pneumococcal peritonitis, where fibrin is usually abundant, and in peritonitis due to salpingitis. Purulent fluid should not be left behind in the peritoneal cavity, and, as a rule, time is well spent in removing it with dry sterilized gauze. This

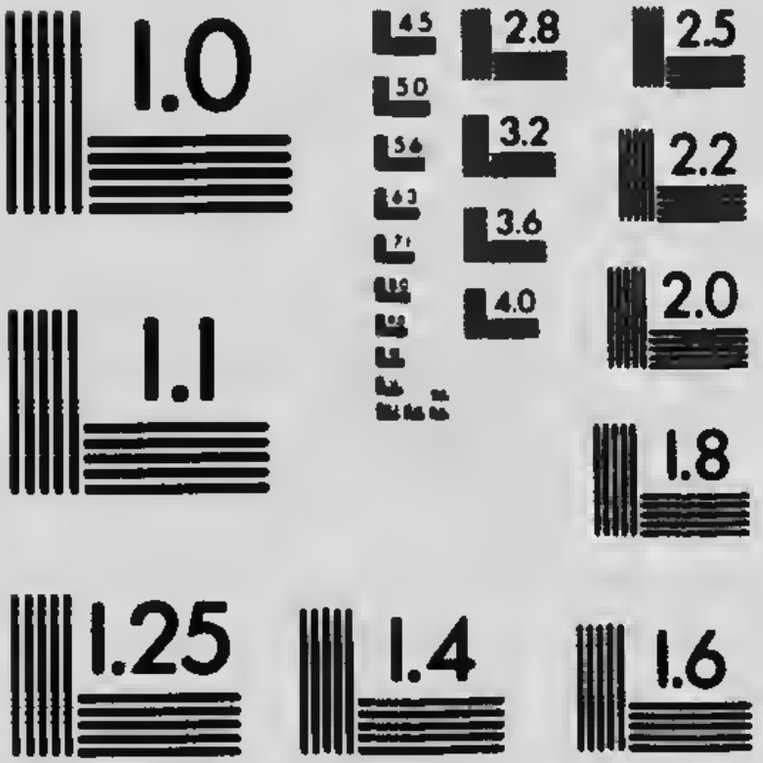
must be done with gentleness, and, if the head-elevated position we have recommended above for operation on cases of peritonitis be adopted, most of the sponging will be required in the pelvis. It is possible that sponges just moistened with saline do less damage to the peritoneal surfaces, and some authorities state that post-operative adhesions are less likely to occur if this method be adopted. A few surgeons use sterilized marine sponges, and if new ones are used for each case there is little objection to them.

In some instances gas escapes on incising the parietal peritoneum, and this phenomenon is of the greatest importance in pointing to a perforative lesion of the gastro-intestinal tract. In cases of perforated gastric ulcer, where the perforation is on the anterior wall of the stomach, the amount of free gas in the peritoneal cavity is often large, and it may cause a whistling noise as it escapes when the knife opens the cavity, but there may at times be only a few bubbles, and these may not be discovered till the deeper parts of the wound are explored, so that the surgeon must be alert to observe any such sign where the diagnosis is not immediately clear. It must also be remembered that gas-containing abscesses are met with occasionally in the abdomen, apart from intestinal perforation, the gas being generated in the abscess cavity by the causative organisms, sometimes the *bacillus coli*, at other times the *bacillus proteus* or *pyocyaneus*, or similar organisms.

Every bleeding vessel inside the peritoneal cavity should at once be ligatured, as the presence of blood in the peritoneum makes the operation difficult, and the risks of intra-peritoneal hæmorrhage must be avoided; this applies especially to operations on jaundiced patients as they exhibit a peculiar liability to hæmorrhage. If the bleeding point cannot be immediately secured, a plug with a pair of forceps on its free end may be pushed down to the site of the hæmorrhage and left in position till the necessary operative procedures have been carried out. It must again receive attention before the abdomen is closed.

MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)



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As far as possible the steps of the operation should be performed outside the peritoneal cavity, and the site of the operation, even in cases such as those of gangrenous appendicitis, can be shut off from the general peritoneum by making it a rule to pack off the wound from the rest of the abdomen by placing four or five wide gauze plugs around the margins of the wound into the peritoneum as soon as an opening is made into the cavity. Four plugs will as a rule suffice: one passes down into the pelvis, one into the right iliac fossa, one to the right kidney pouch, and one on the inner side of the wound; the exploring finger is then introduced between these four plugs, and the appendix brought out with the caput cæci into the space between them, which may be enlarged by retracting the bowel covered by the gauze; the risks of damage to the surrounding intestine and of diffusing infective pus are thus minimised.

With regard to the material employed for ligatures and sutures, this is largely a matter of choice, and varies with the custom of the surgeon; as a general rule it is better to use an absorbable material such as catgut in all dirty wounds, whereas silk or other less absorbable material gives excellent results in clean cases and for suture of the intestine. If the suture passes through all the coats it is discharged into the lumen of the bowel, and if it is a sero-muscular suture we find that silk becomes readily buried in the wall of the intestine, and such portions as are not absorbed probably reach the interior of the gut also.

Closure of the Abdomen.—This must be complete or incomplete according as the nature of the case demands drainage or not. Wherever possible the abdomen should be closed by suture of the wall in layers, and here again the choice of suture material should depend on the nature of the case; where the wall can be completely closed, the case may be regarded as a clean one and silk is excellent for the peritoneal and muscular layers; but if the wound is dirty, and drainage is necessary, we prefer catgut. Suture of the layers of the abdominal wall separately is one of the best

preventive measures against hernia, and only in those cases where the condition of the patient demands rapid closure of the wound, or where, as in some cases of peritonitis or obstruction with considerable distension, the peritoneum is too friable to hold the sutures, should the stitch embrace the muscular as well as the peritoneal layer, and even then the skin should be closed separately. It often happens that a patient whose condition gives rise to some anxiety improves as soon as the intestines are returned to the abdomen, and the need for hasty suture becomes less urgent. In these cases a good plan is to place an abdominal gauze pad over the bowel and secure the abdominal wall by four or five strong sutures of silk or salmon gut passed through everything but the skin by means of a naevus needle, placing forceps on the ends of these sutures, and keeping them ready so that the wound can be closed if necessary in a couple of minutes ; then the closure of the wall in layers can be proceeded with and these supporting sutures can be tied as soon as the peritoneum is closed, the gaps in the rectus sheath being closed in with a few stitches and the skin sewn up separately. The restraining pad, of course, must be gradually withdrawn as the peritoneum is closed, usually from above downwards. The best way to avoid instruments falling into the abdominal cavity is to use large ones, and they should be counted before and after the operation.

Drainage of the Peritoneal Cavity.—There are some surgeons who maintain that the peritoneal cavity cannot be adequately drained ; there are others who believe in multiple drainage through small stab wounds in the abdominal wall. Complete closure of the abdominal wall is certainly the ideal course where it is safe, as the sites of drainage tubes are potential sites of hernia, and the presence of rubber tubes among the intestinal coils predisposes to the formation of fæcal fistulæ, and, if not removed when their presence is no longer needed, these drainage tubes are a possible source of re-infection, prolonging the convalescence of the patient.

Moreover, as our knowledge of the anti-bacterial properties of the peritoneum and its secretion have advanced, the number of cases which the surgeon treats confidently by closing the wound has increased and, not infrequently, after resection of bowel in an infected area or some similar procedure, it is found that, the infective material having been largely removed, there is no obvious situation for a drainage tube. In these cases it is often the wisest course to close the abdomen and trust to the powers of the peritoneum itself to deal with the remaining organisms. The resistance of the tissues of the abdominal wall to infective organisms is undoubtedly lower than that of the peritoneum itself, and therefore drainage of the muscular planes may often be advantageously substituted for drainage of the peritoneal cavity; we have recently adopted this course in cases of acute appendicitis with encouraging success. Those surgeons who advocate complete closure of the abdomen as a routine practice in infective lesions have to acknowledge the possibility of virulent infection of the muscular planes, and we believe that this undesirable complication may be guarded against by such drainage. Where the abdomen is opened by displacement of the rectus, a rubber tube can easily be introduced beneath the muscle before its sheath is closed. We cannot, however, agree to the shutting up of an acute abscess in the peritoneum any more than we can in the case of the subcutaneous tissue, and we believe that the risks of completely closing a virulently infected peritoneal cavity are greater than the risks of damage resulting from drainage; we hold that, by operating with the pelvis low and insisting on the maintenance of this position in bed, the inflammatory exudate can be encouraged to flow down into the pelvis, and that the intra-abdominal pressure will then favour the flow of pus out through a tube which is passed through the abdominal wound into the lowest part of the pelvic basin. We are convinced that since this method of drainage has been adopted peri-splenic and sub-diaphragmatic abscesses following appendicitis with diffuse peritonitis have been

much less frequent during convalescence, although at the operation little attempt may have been made to dry the whole peritoneal cavity. If thick pus is present in the abdomen, the best means for drainage is a wide bore rubber tube, but where the peritoneal exudate is thinner it is better to combine the capillary action of gauze with the drainage tube by placing a gauze wick down the tube to reach beyond its deepest part. In the subsequent dressings the tube should be given a half turn to prevent adhesions forming between it and the adjacent coils of bowel, and the wick should be changed several times until one can be passed to the bottom of the tube without becoming soaked with fluid; the last wick should then be left *in situ*.

Dressing.—In clean dry wounds we prefer a sealed dressing of gauze and collodion, covered with a piece of wool, secured by a roller bandage, kept in its place by a few turns round the thigh; this supports the abdominal wall during any post-anesthetic vomiting that may occur. In cases where drainage is necessary, the dressings should be voluminous and retained in position by a many-tailed bandage, prevented from running up on the abdomen by two tails which pass from the back of the bandage round the thighs to the front of the abdomen. The dressings can easily be changed by merely unfastening this bandage. Where the security of the sutures in the abdominal wall is in doubt a roller bandage may be applied for the first day or two outside the many-tailed bandage.

Position in Bed.—After all abdominal operations the thorax of the patient should be raised and the pelvis low, except where it is necessary to treat shock by lowering the head of the bed; in the after treatment of peritonitis too much stress cannot be laid on the maintenance of the Fowler position from the very first. We shall have occasion to speak of this later.

In many cases the continuous administration of saline solution per rectum is invaluable; the fluid thus absorbed raises the lowered blood-pressure in cases of shock, and

FIG. 11.—Patient in correct Fowler position, with Moynihan's apparatus for continuous saline proctoclysis. Note that the whole trunk is at an angle of 45° to the horizontal plane, the patient being maintained comfortably in this position by means of a bolster, the ends of which are tucked firmly under the mattress.

in this position by means of a bolster, the ends of which are tucked firmly under the

FIG. 12.—Faulty Fowler position; the ends of the bolster have not been securely tucked in, so that the patient has slipped down, his abdomen has become horizontal, and his head and thorax are uncomfortably forced forward by the pile of pillows.

assists in the dilution and excretion of poisons in cases of toxæmia. Saline proctoclysis is of course impossible if diarrhœa be present; it is equally unsatisfactory if the rectum be loaded with fæces, so that a preliminary enema may be requisite. Perhaps the simplest and most satisfactory apparatus is that devised by Moynihan, which is depicted in figures 11 and 12 (in which are also illustrated the correct and the incorrect Fowler positions). The saline solution is contained in a large graduated flask, and its temperature is maintained at about 140° F. by means of a water-bath. The saline flows from flask to rectum by means of siphonage, which may be initiated by blowing, or pumping, air into the flask and thus filling the delivery-tube with fluid. The delivery-tube ends in a pliable pewter tube, in the bulbous extremity of which are several wide apertures; this tube may be curved round the patient's thigh, and is introduced into the rectum and passed some four inches above the anus. The rate of flow into the rectum may be regulated by raising or lowering the flask—a six to ten-inch fall is usually adequate—or by means of a screw-clamp on the rubber part of the delivery-tube; fluid run in at the rate of about a pint an hour can usually be retained with comfort. In Souttar's apparatus the water-bath is replaced by a vacuum flask.

CHAPTER IV

THE PERITONEUM AND OMENTUM

Introduction.—Before discussing in detail the clinical aspect of the various forms of peritonitis, a brief consideration of the functions of this enormous serous sac, both in health and disease, is essential. As we have already pointed out, the peritoneum forms a complete covering for the interior of the abdominal cavity and a more or less complete covering for all the intra-abdominal organs, and it is chiefly from disease of these organs that it is liable to be infected. Peritonitis may result from extra-peritoneal disease due to injury or infection, and there are cases of hæmatogenous infection; but by far the majority of peritoneal infections are derived from the organs which the peritoneum is devised to invest and protect. In health this protective function is mainly carried out by the secretion of fluid which lubricates the intestinal coils, and it is probable that the omentum plays no small part in the provision of this lubricating fluid. In disease the peritoneum forms the battle-field on which the fate of the patient is decided, but it is at all times a strongly fortified position, and, by reason of its endothelial cells and its rich supply of blood-vessels, it has the power of limiting infection by protective adhesions and of repelling the invading organisms by its legions of phagocytes. Its weakness lies in its absorptive power, for thus bacterial toxins may reach the patient before the phagocytes have been called out in force. It used to be thought that the depressions or pits seen in the peritoneum, especially in that portion which covers the inferior surface of the diaphragm, were spaces opening directly into lymphatic channels, but it is now known that the endothelial lining is everywhere

complete; yet, in spite of this, bacteria injected into the peritoneal cavity of animals may reach the general circulation in a few minutes. Herbert Durham investigated this question of absorption of bacteria as regards the glands of the thorax, into which the peritoneal lymphatics mainly empty, and he demonstrated the presence of organisms injected into the peritoneal cavity in the anterior mediastial glands within six minutes of the inoculation.

Much light has been thrown on the functions of the peritoneum and omentum by the researches of Dudgeon, Sargent, and Ross. In their book on the Bacteriology of Peritonitis (Constable, London, 1905), Dudgeon and Sargent state that the results of peritoneal infection depend on—

(*a*) The virulence of the infecting organisms;

(*b*) Their power of damaging the endothelial covering of the gut;

(*c*) The power of the patient to produce leucocytes in sufficient numbers and with active phagocytic properties;

(*d*) The ability of the body fluids to deal with the invading bacteria.

As a result of their experiments on the omentum of guinea pigs, Dudgeon and Ross express the following opinions:—

1. The staphylococcus albus is often present as a normal inhabitant of the omentum.

2. When non-bacteriological substances (sterilised normal saline or sterilised chalk in normal saline) are injected into the peritoneal cavity of animals, the staphylococcus albus can usually be recovered from the great omentum.

Furthermore, Dudgeon states that he has many times cultivated the same white coccus from the omentum in many cases in which the peritoneum was opened apart from peritonitis. In all these cases the pieces of omentum were removed aseptically and dropped into culture tubes of broth.

The importance of these investigations can hardly be over-estimated, and it may fairly be conceded that they deal a death-blow to the theory of "chemical" peritonitis. The nature of this white coccus has been further investigated

by the same observer in connection with hæmorrhage within the body, and also in the process of repair of healthy wounds; its morphological and cultural characteristics are fully described in the work to which we have referred above. Its presence within the body is held by Dudgeon and Sargent to explain the existence of so-called "aseptic traumatic fever," which has been attributed to the absorption of fibrin ferment from extravasated blood—a suggestion which was never very convincing. They successfully cultivated this organism from the blood-clot in seventeen cases of intra-peritoneal hæmorrhage due to ruptured tubal pregnancy, without a single exception, and in three traumatic cases, due to ruptures of the spleen (2) and of the liver (1), the same organism was cultivated on two occasions; in the only case where cultures were sterile a rupture of the spleen was operated on within two hours of the accident. Cultures made from the fluid blood in the traumatic cases were sterile, but in four of the tubal ruptures the same staphylococcus was obtained by culture from the peritoneal fluid encountered as soon as the abdominal cavity was opened; elaborate precautions were taken to avoid the possibility of contamination from the skin of either the patient or the operator. The presence of this organism, which is of very low pathogenicity, is thus proved both in the healthy and the injured peritoneal cavity, but its source must not be assumed to be the omentum in all cases, since its presence has been proved in blood effusions far removed from the peritoneal cavity. Working with one of us (J. E. A.), Dudgeon found this organism present in the blood effusion associated with fracture of the patella and olecranon. We investigated nineteen such cases, and in thirteen of them obtained positive cultural results; eleven of these were pure growths of the staphylococcus albus; once a diplococcus, and once a coccus intermediate between S. albus and aureus, was obtained. More than half of these fractures were due to muscular violence and only those in which the skin was absolutely sound were selected for investigation. The

negative results in six cases are probably to be explained as follows: in the first three we inoculated our tubes with only a single loop-full of blood, and these were all sterile; in two others we could obtain only 1 cubic centimetre of fluid; and in the sixth case the operation was not performed until 29 days after the accident. In all the other cases we took at least 2 cubic centimetres of blood, and the interval between the accident and the operation (in all cases for wiring the fracture) varied from four to twenty days. A control was supplied by our twentieth case in which the surgeon's gloved finger reached the effusion before our sterilised spoon; in this case there was contamination with a totally different organism.

The staphylococcus albus was also isolated by Dudgeon and Sargent from a large proportion of wounds healing by first intention, and they suggested in a paper before the Medical Society of London in 1906 that even as the colon bacillus is a normal inhabitant of the intestine and is thought to have physiological functions to perform, though under abnormal conditions it is highly pathogenic, so the ubiquitous staphylococcus albus may play an important part both in health and disease. In peritonitis at least it appears to us that Dudgeon has abundantly proved his contentions, and we shall have occasion to refer again to his exhaustive researches.

Classification of Acute Peritonitis

The ideal method of classification of diseases is that followed by the bacteriologist; but, unfortunately, in the case of peritonitis mixed infections are common, and the clinical manifestations do not in all kinds of infection vary directly according to the causative organism. However we are able to some extent to differentiate clinically pneumococcal, gonococcal, and tuberculous peritonitis from the rest, and these will be considered under separate headings. Peritonitis is sometimes spoken of as primary or secondary:

the former term includes those cases due to blood infection, such as many instances of pneumococcal and streptococcal infections. Secondary peritonitis, by far the more common, may be due to injury of, or infection from, any of the abdominal viscera; it may also spread from extra-peritoneal disease, such as acute necrosis of the pelvic or spinal bones. Disease of the appendix is responsible for at least 25 per cent. of cases of secondary peritonitis. Another method of classification is the topographical, which separates local from general peritonitis, but it is now recognised that, since the peritoneum is one large serous sac, an inflammatory lesion at one point may lead either to widespread inflammation or to infection apparently limited by adhesions; yet even beyond these protective barriers there may be some degree of infection, as is shown by the cultures obtained by Dudgeon and Sargent from the free peritoneal fluid around encysted intra-peritoneal hæmorrhage. In all the four cases out of seventeen where the staphylococcus was obtained culturally from this fluid, the local lesion had been present for over three weeks It is better to speak of these topographical forms of acute peritonitis as localised, spreading or progressive, and general or diffuse, but our purpose will be answered if we describe acute general peritonitis, and, as examples of local infection, consider special instances of suppurative peritonitis such as sub-phrenic abscess, etc. Acute diseases of the omentum will be considered separately.

Relation of Organisms to Acute Peritonitis

1. *The staphylococcus albus.*—This organism is considered by Dudgeon to be the most important of all in peritoneal infections. Some authorities have suggested that it is identical with the "staphylococcus epidermidis albus" of Welch, but it seems absurd to suggest that a coccus so frequently present in the centre of blood extravasations should have an epidermal origin, and therefore, in reference to peritonitis, we shall speak of it as the staphylococcus

albus, even though it may be identical with the organism cultivated by both Welch and Dudgeon from aseptic wounds. Both these authorities are agreed that it is probably an attenuated variety of the staphylococcus pyogenes albus.

Dudgeon and Sargent publish a table showing that they isolated this white staphylococcus in 108 out of 258 cases of peritonitis of varying nature and degree, and they attribute to the organism a protective and beneficial function, exemplified by its power of producing phagocytosis and favouring the formation of limiting adhesions. A point on which they lay some emphasis is that cultures from the free peritoneal fluid may be sterile, while those taken from the surface of the intestine will often yield positive results, and, further than this, that whilst cultures from the area of intense peritonitis may yield such virulent organisms as the colon bacillus, bacillus pyocyaneus, etc., the peritoneum at a distance may yield pure cultures of the staphylococcus albus, which is usually the first organism to appear in the course of peritoneal infection from the intra-abdominal viscera. Again, Dudgeon's experiments on guinea pigs show that intra-peritoneal inoculations with pure cultures of the staphylococcus albus obtained from cases of peritonitis do not cause death, but phagocytosis; in a few cases suppuration occurred in the abdominal wound. Simultaneous inoculations with mixed cultures of the staphylococcus albus and the colon bacillus caused death, but if the same dosage was employed and the staphylococcus was given some twelve to twenty hours' start, an artificial immunity was conferred on the animal to colonic infection. The staphylococcus albus is the first organism to appear and the last to disappear in cases of recovery from peritonitis. The protective value of this coccus is confirmed by its almost constant presence in the midst of the coagulated fibrinous exudate of recent peritoneal adhesions, but its powers of neutralising the effect of other organisms, dependent on phagocytosis, are much more limited against streptococci, the bacillus pyocyaneus, etc., than against the colon bacillus.

2. *Other varieties of staphylococcus.*—The staphylococcus aureus and staphylococcus citreus are not often present in peritonitis, but when present they do not exhibit the benign influence of the common white coccus, for indeed the presence of the staphylococcus aureus in peritoneal lesions augurs ill for the patient.

3. *Streptococci.*—Many types of streptococci have been found in cases of peritonitis, and they are nearly all virulent. It is the commonest organism in puerperal septicæmic peritonitis, and in such cases active phogocytosis is reduced to a minimum. In such infections patients may die of septicæmia before there is much change to be observed in the peritoneum itself.

4. *Bacillus coli.*—This organism occupies a position in peritoneal infection second only in importance to the staphylococcus albus. It is extremely common, and may be regarded as the most important etiological factor in perforative peritonitis. There are many strains of the colon bacillus, and its virulence depends on the state of the intestinal contents, even saprophytic forms becoming pathogenic in the presence of obstruction. The bacillus coli is often present in company with other organisms, especially the staphylococcus albus; the protective value of the latter in such instances of double infection has already been referred to. The co-existence of colon and streptococcal infection is almost invariably fatal.*

5. *Bacillus Pyocyaneus.*—This bacillus, whilst not very common, is highly pathogenic when present in the human peritoneal cavity. It is also extremely virulent when injected into the peritoneum of guinea pigs. Here again many strains are met with, for Dudgeon and Sargent state that some of their cultures when injected subcutaneously

* Mr. A. D. Gardner informs us that, working in the clinical laboratory at St. Thomas's Hospital, he has recently found streptococci present together with colon bacilli in several cases which ran a benign course; the pathogenicity of these streptococci is at present under investigation.

into guinea pigs caused a rapidly-spreading hæmorrhagic œdema and death in twenty-four hours or less, whilst other cultures caused only a localised abscess. The same variability is observed in human lesions due to this bacillus, for it may not infrequently be found in cases of localised appendix abscess. This bacillus does not produce green pus in the peritoneal cavity.

6. *Bacillus Proteus.*—This organism is not uncommon in cases of localised intra-peritoneal abscesses, especially those due to appendicitis, and the odour of such abscesses is often mainly due to the presence of this bacillus.

7. *Bacillus ærogenes capsulatus.*—This is a strict anærobe and is very rarely present in human peritonitis; in fact, Dudgeon and Sargent only met with it once in a large number of cases of appendicitis. It was then cultivated under anærobic conditions from an abscess which also contained the bacillus coli and a streptococcus. This patient made a good recovery. Experimentally the organism causes extensive hæmorrhagic œdema when inoculated subcutaneously into animals. Professors Welch and Nuttall have shown in their well-known experiment that this bacillus is the cause of "foaming liver" seen in rabbits inoculated intravenously and incubated after death. If this organism were common in peritoneal lesions, as some investigators have stated, gaseous distension of the solid viscera ought to be met with frequently in the post-mortem room, whereas it is a remarkably rare phenomenon.

8. *Other anærobic organisms.*—Cultures from intra-peritoneal abscesses of long standing, especially those due to appendicitis, resemble cultivations made from the interior of the intestine; many of the common intestinal flora, of which several are anærobes, may be met with, but there is very little evidence that these bear any direct relation to the causation of the common forms of peritonitis.

9. *The pneumococcus, gonococcus, typhoid, and tubercle bacillus.*—These organisms will be considered in relation to the clinical forms of peritonitis which they set up.

The Common Forms of Acute General Peritonitis

Morbid Anatomy.—Whatever the organisms may be which are the cause of this disease, they are in nearly all instances derived from the hollow viscera which the peritoneum invests, and we would prefer to use the term perforative peritonitis, except for the fact that there need be no gross perforation to permit the egress of organisms from the bowel to the peritoneal cavity. As we have already stated, the staphylococcus albus and the bacillus coli are by far the two most important organisms concerned in the morbid changes which we will now briefly consider. It must be remembered, however, that in those cases where toxæmia is most severe and where a fatal result rapidly ensues, very little change may be observed.

Hyperæmia and œdema of the affected peritoneum occurs as the earliest change, and distension of the gut soon follows, with loss of the normal polish of its serous coat. The coils of gut then tend to become adherent, and a sticky exudate is poured out. The amount of fluid varies considerably, and its character bears some relation to the infecting organism, for in gonococcal and pneumococcal infections abundance of fibrin is a striking characteristic. The exudate may be—

(*a*) Serous; (*b*) fibrinous; (*c*) purulent; (*d*) hæmorrhagic; (or *e*) putrid and gaseous.

In pure streptococcal infections the exudate is rarely more than serous. Gas formation may occur in the exudate apart from perforation of the gut, and is due to some of the anærobic organisms which we have already mentioned, or to the colon bacillus. The distended bowel in addition to losing some of its peritoneal polish often exhibits dark or even black areas, due to local hæmorrhages, the omentum becomes swollen and in some cases adherent, and the anterior mediastinal glands are swollen, red, and soft.

Microscopical changes.—Proliferation of endothelial cells occurs; the dilated blood-vessels are surrounded by leucocytes and the lymphatics become choked with cells and

bacteria. These are the early changes associated with acute infective inflammation, and in the peritoneum, as elsewhere in the body, resolution, granulation, or suppuration may follow, and it may be observed that inflammatory reactions of all grades evolve more rapidly in the peritoneum than in most tissues of the body. Exudate is [illegible] rapidly poured out and in most cases it possesses coagulability. The value of fibrinous exudate may be summarised as follows :—

(1) It affords a neutral ground for phagocytosis and bacteriolysis.

(2) It tends to block the lymphatics, and thus prevent absorption from the peritoneal cavity.

(3) It hinders the passage of organisms from the lumen through the wall of the intestine.

Symptoms.—The symptoms and physical signs of acute diffuse peritonitis are due to severe infective inflammation of a serous membrane capable of almost infinite absorption, to the presence of exudation, and to the secondary effects on the abdominal wall, the diaphragm, the intestines, and the bladder.

The *onset* is usually sudden, and the first sensation may be of "something giving way" in the abdomen, causing a diffuse burning pain. At this period there is usually some degree of shock, and actual fainting and loss of consciousness may occur. As recovery ensues from this initial shock, which is of variable degree, the patient complains of pain, which may be paroxysmal but not "griping," and may, after a few hours, become more or less localised to one part of the abdomen. In perforative peritonitis the pain commonly exhibits [illegible] phases ; firstly there is a vague sense of discomfort, [illegible] gnawing pain, in the region where the perforation is imminent ; secondly, there is severe diffuse burning pain associated with shock and due to the actual perforation and the contact of intestinal fluids with the peritoneum ; thirdly, the pain again becomes most severe in the neighbourhood of the perforative lesion, is paroxysmal in nature,

and due to rapidly advancing peritonitis ; fourthly, the pain loses its localisation as the peritoneal infection reaches all parts of the abdomen, and at this stage the condition of the patient is obviously grave, and often he is in a state of toxic apathy. It is well known that early peritoneal pain is often referred to the centre of the abdomen, and this occurs during the second of these four stages, being most often observed in cases of appendicular infection. The pain of peritonitis is greatly aggravated by movements, including those of respiration, micturition, and defæcation, and as we have already pointed out, inflammation of the parietal peritoneum is the main source of pain.

Vomiting occurs soon after the onset of pain, but it varies greatly in frequency and character ; it is very rarely absent, and is at first gastric, then bilious, and, lastly, in the worst cases of peritonitis, fæculent. The vomitus rarely has the strong fæcal odour of that seen in intestinal obstruction, but it becomes progressively darker in colour as paralysis of the intestine follows the diffusion of peritoneal infection. It should be remembered that in peritonitis, as in other acute toxic conditions, minute erosions of the gastric mucosa occur, and may thus lead to hæmatemesis as an additional symptom. The characteristic mode of vomiting in general peritonitis is in marked contrast with that occurring in the earlier stages of obstruction, for it is not associated with exacerbation of pain, nor is it projectile, but the patient opens his mouth to give vent without effort to quantities of offensive brown fluid.

Constipation in the earlier stages of this disease is due to the desire of nature to secure rest for the inflamed peritoneum ; later, when abdominal distension is evident, the musculature of the bowel is at fault. This symptom is, however, very inconstant, and, as we shall point out in dealing with appendicitis, acute ulcerative lesions of the bowel are apt to be characterised by transient diarrhœa ; constipation of some degree nearly always follows, but flatus may be passed, and even fæcal matter, all through the illness

where the case terminates favourably. Some of the worst forms of peritonitis are associated with toxic diarrhœa. In those cases where constipation is present, the administration of an enema will usually bring away some fæcal matter, and in this way it may sometimes be decided whether the case is one of obstruction or of peritonitis. It should be noted that enemata in peritonitis are not devoid of danger, as they may set up violent peristalsis whereby infection may be spread. The abeyance of peristalsis does undoubtedly favour the production of those adhesions which we have already stated to be of the greatest value to the patient.

Hiccough is a symptom of the gravest import in peritonitis; it is held to be due to spasmodic contraction of the diaphragm, and is most commonly present when the upper part of the abdomen is invaded. The gravity of this symptom lies in the fact that it indicates infection of that portion of the peritoneum which possesses the highest co-efficient of absorption.

Irritability of the bladder is at times a noticeable feature in peritonitis, and may be taken to indicate pelvic inflammation. Micturition is also painful in a good many cases, and the act may be postponed till distension of the bladder occurs. Frequency and pain on micturition are especially observable in cases of appendicular peritonitis where the appendix lies in the cavity of the pelvis.

Constitutional Physical Signs.—*Fever.*—The temperature is usually raised, but the degree of fever is very variable, and, at the onset of the attack, a subnormal temperature is not uncommon. *Rigors* may occur, but they are of no special significance unless they are repeated at frequent intervals, when some degree of portal pyæmia should be suspected. *Restlessness* in the early stages of peritonitis is common, but as the infection progresses the patient instinctively keeps as still as possible for fear of aggravating the abdominal pain. Occasionally restlessness is a very pronounced feature of the case, and there may also be mental confusion, or even active delirium, and in fatal cases, after

the disappearance of abdominal pain, restlessness is common. As a rule the patient affects the dorsal decubitus and lies with one or both legs drawn up, partly to keep the bed-clothes from pressing on the abdomen, and partly to relax the abdominal muscles. The *facial expression* is characteristic:—the eyes are sunken and dull, with dark lines beneath the lower lids, the cheeks are hollow, and the complexion is earthy; to this condition is applied the term "*facies Hippocratica*." The *tongue* at the earliest period is coated with brown fur, but it rapidly becomes dry, hard, and shrivelled. The mouth is dry and the breath offensive. The *skin* is usually moist and cold, and the complexion is muddy, though, at times, especially in the case of young children, there may be a flush upon the cheeks. The *respirations* are shallow, rather rapid, and of the costal type.

The *pulse* is increased in rate, and of rather high tension, but small volume; it is usually termed "wiry," but the term is hardly accurate, except in patients with thickened blood-vessels. As the infection progresses the heart fails, and in fatal cases the weakness of the pulse is a striking feature before the patient realises that the end is near.

Abdominal Physical Signs.—*Œdema* of the abdominal wall is occasionally seen, and may be attributed to a localised abscess of long standing, or fæcal extravasation.

Respiratory movement is very limited; in those cases where the source of infection is sub-umbilical, the upper abdomen may move to some extent, but where the infection is widespread, or originates high up in the abdomen, the respirations are almost entirely thoracic. *Distension* is usually present, and may be either local or general. There is no doubt that those coils in the neighbourhood of the primary lesion are the first to lose their muscular tone and to become distended with gas. Abdominal distension in some cases is due to the presence of free gas in the peritoneal cavity; the degree of distension may then be extreme. To abdominal distension the term "tympanites" is applied when the condition is due to the accumulation of gas within

the bowel; by its presence the liver dulness may be encroached upon, or even obliterated, the movements of the diaphragm are hampered, the cardiac impulse may be displaced upwards, and collapse and œdema of the bases of the lungs are favoured. In the absence of perforation, tympanites may be regarded as evidence that the peritonitis has been present for at least twenty-four hours. Intestinal paralysis is probably due to reflex nervous shock in the first instance.

Visible peristalsis is almost invariably absent in general peritonitis, but we have observed it in one or two cases where the peritonitis was of sufficiently long standing for the exudate to have caused adhesions and kinking of the small intestine.

Tenderness in peritonitis is now held to be due to implication of the parietal peritoneum and its somatic nerve supply in the inflammatory process, these nerves being present in the extra-peritoneal fatty tissue. It may be local or general, and is often elicited on rectal or vaginal examination. As regards the surface of the abdomen, tenderness is often more evident on very light percussion than when firm pressure is applied, and this clinical fact supports the view that both in health, and when inflamed, the visceral peritoneum is almost insensitive. *Rigidity* of the abdominal muscles is a very constant sign in peritonitis; it is seen in its most extreme degree at the onset of perforation, and there may even be retraction of the abdominal wall due to the spasm of the muscles. The degree of muscular rigidity not unnaturally varies with the physique of the patient, and this sign is most in evidence in strong subjects, whereas in young children, weakly women and old people it may be hardly noticeable. In relation to the type of peritonitis, it is most evident in perforative cases; it disappears under the influence of anæsthesia, and with the approach of a fatal termination. A localised mass may be palpable in general peritonitis and, in such cases as are due to appendicitis, it is usual to find an indefinite mass in the right iliac fossa; such a swelling must be carefully distinguished from

the resistance due to muscular spasm, and in peritoneal cases additional information, sometimes of a very positive character, may be obtained by palpation under an anæsthetic.

The *percussion note* varies in different regions of the abdomen; the normal area of liver dulness is usually diminished, and at times obliterated, even in cases where there is no gross perforation, with free gas in the peritoneal cavity; for distension of the intestine alone may displace the liver, or the distended gut may come to lie between this organ and the anterior abdominal wall. A tympanitic note is usually obtained over the upper and anterior part of the abdomen, due to distension of the small intestine, but local areas of dulness may be found, due to exudate, and in the flanks there is more often than not some degree of dulness due to the presence of free fluid. Water-logged coils of gut may sag down into the loins, or the pelvis, when the patient is in the dorsal decubitus, and thus percussion dulness may be present even when there is little or no free fluid, and the determination of the position of the fluid can be ascertained only by examining the patient first on his back and then lying on the side; this procedure, however, we do not consider to be in the interests of the patient, as it may favour the spread of infection from one part of the cavity to another. A so-called flat tympanitic note is often observed when percussing in the flank over distended intestine separated from the abdominal wall by a layer of fluid; in such cases very light percussion only will yield an impaired note.

Auscultation is always worth attention in cases of suspected peritonitis, for the striking absence of peristaltic sounds is strong evidence of peritoneal inflammation. Silence in both iliac fossæ when the stethoscope is applied with some degree of pressure is a very suggestive sign. Very occasionally a friction rub may be heard.

Blood changes in peritonitis.—Slight anæmia is usual; leucocytosis is commonly present; leucopenia is met with in very severe infections (*see* Chapter II.).

The urine in peritonitis.—Indicanuria is commonly present in from twelve to twenty-four hours after the onset of perforative peritonitis. With regard to bacteriology, in his Erasmus Wilson lectures for 1908, Dudgeon gave the result of examination of the urine in twenty cases of peritonitis. In only four was the colon bacillus present, and three of these patients were suffering from localised appendicular abscesses. There was no evidence of pyuria in any of the cases, so that the clinical rarity of infection of the urinary tract in peritonitis is borne out by this investigation. Typhoid bacilli are usually present in the urine of patients suffering from enteric fever, and in the same way organisms causing peritonitis may be excreted by the kidneys, but their presence does not necessarily give rise to pyuria.

Peritonitis at the Extremes of Life

The symptoms and physical signs which we have described apply essentially to the condition of patients who, before the peritoneal invasion, were of sound physique and in general good health. It is most important to remember, however, that peritonitis is a fairly common disease at all ages, due as it is to many varieties of visceral disease, and that in their equivocal clinical aspect the attacks in old people and young children bear a close resemblance to one another, and are often in striking contrast to the typical attack in a previously healthy adult. We have already spoken of the question of muscular rigidity of the abdominal wall, and noted that this depends on the sudden character of the infection, and also on the physique of the patient; in old people it is rarely well marked, and in young children the abdomen may be quite soft and yet the peritoneal cavity may be filled with pus. The pulse rate also shows much variation; in old people with weak cardiac muscle the pulse does not increase in rate so invariably as in young adults, and this is no doubt due directly to the degeneration of the heart muscle. In children the pulse is accelerated by quite

trivial indispositions. The temperature, again, is almost invariably high in peritonitis of the young, but in old people a normal, or even subnormal, temperature is very common. Pain and tenderness also are very variable signs in the young and old, and in our experience painless, or almost painless, peritonitis is not very rare in old people, whereas in children both pain and tenderness are apt to be constant and widespread; tenderness in the old is also comparatively slight and is usually localised, though not necessarily to the precise locality of the causative lesion. Vomiting is certainly more pronounced in young, as compared with old, patients. In old and emphysematous patients respiratory distress is apt to become pronounced when infection of the peritoneum occurs.

Diagnosis.—In discussing the differential diagnosis of appendicular peritonitis we shall consider the many and varied diseases from which it has to be distinguished, and the same considerations apply in the present connection. Further points of consideration will be found in Chapter XVI., and the following table affords a brief *resumé* of the possibilities in a doubtful case.

Differential Diagnosis of Acute Peritonitis

1. *Supra-diaphragmatic lesions.*—Pneumonia, pleurisy, pericarditis.

2. *Infra-diaphragmatic lesions.*—(*a*) Lead, renal, biliary, appendicular or intestinal colic; (*b*) irritant poisoning; (*c*) gastro-enteritis; (*d*) obstruction; (*e*) uterine and other pelvic disorders—(dysmenorrhœa, pregnancy—intra- or extra-uterine); (*f*) acute gastrectasis.

3. *Nervous disease.*—Gastric crises in tabes, hysteria.

4. *Renal disease.*—Uræmia.

5. *Addison's disease.*

6. *Specific fevers.*—Scarlet fever, typhoid fever, influenza.

Having made a diagnosis of peritonitis, the practitioner has next to decide upon the probable cause of the infection.

Does it depend on a lesion of the intestinal tract, or has it extended locally from an extra-peritoneal source? Or, again, is it most likely to be a blood-stream infection? The importance of these considerations cannot be denied, for the success of operative treatment depends greatly on the rapidity with which the primary focus of infection is dealt with, and multiple and large abdominal exploratory incisions are to be deprecated. The diagnosis of general peritonitis due to appendicitis is often easy, and so also is that due to perforated gastric or duodenal ulcer, but both these forms, when considered solely as types of peritonitis, belong to the perforative variety, which of course includes the greater percentage of all cases of peritonitis. In a large number of cases the medical attendant cannot be expected to get further than the diagnosis of perforative peritonitis, when he sees the patient for the first time in a grave illness. Perforative peritonitis in its widest sense is peritoneal infection due to either gross or microscopic perforation of the gut wall, the lesions being due to such organisms as we have described above. A second clinical type of general peritonitis is that which follows obstruction, and this we shall speak of as "consecutive peritonitis." Here the clinical picture is one of obstruction until quite late in the illness, when, from the increasing pulse rate, rigidity of the abdominal muscles, and the decrease of abdominal pain, together with a worse facial aspect, and easy instead of projectile vomiting, the advent of peritonitis may justly be inferred. The infection in these cases is due to the same types of organism as in perforative peritonitis, but there may be neither microscopic nor macroscopic perforation; it is infection by penetration and the area of primary infection is that where the vitality of the bowel is most impaired. Perforation does sometimes supervene on obstruction, and then the symptoms may be characteristic of perforative peritonitis, or of fæcal extravasation. The former is usually seen where there has been chronic obstruction due to stricture of the bowel, most often annular carcinoma. Stercoral ulceration occurs above

the stricture, and through the floor of this ulcer, which may or may not exhibit a gross perforation, infection reaches the peritoneum, leading sometimes to a localised abscess, and sometimes to diffuse peritonitis. In the more rapid cases, commonly those where obstruction was acute in onset, the bowel gives way, leaving a large perforation, and fæcal extravasation takes place. Cases of this type almost always exhibit extreme shock at the time of perforation; sweating, cyanosis, and respiratory distress are common, and death may ensue from shock before much evidence of peritonitis is observed. Such cases as we have seen have been uniformly fatal even where operative treatment has been carried out. Death often occurs within four hours of this sudden gross perforation of the intestine. The other forms of peritonitis are: 1. Those due to extension of infection from without, where the diagnosis can only be made if a primary site of infection is present, such as gonorrhœa, necrosis of pelvic bones, etc.; 2. Septicæmic peritonitis, which includes some cases of puerperal, and many of pneumococcal peritonitis.

Treatment.—Since the treatment of diffuse peritoneal infection has passed from the hands of the physician to those of the surgeon the outlook for the patient has greatly improved, though there is still a very high mortality, especially in those cases where no causative lesion can be diagnosed before operation. Where it is possible to estimate accurately the site in the peritoneal cavity where the infection has originated, the energies of the surgeon are best directed to this region, except in so far as cleansing and drainage of the cavity are possible. Favourable results are rarely obtained in cases where the causative lesion is not diagnosed before operation, and more rarely still when the operation does not reveal the seat of the mischief. The object of operative interference in these cases is threefold, viz. (1) to deal adequately with the primary disease, by removal, in the cases of appendicitis or salpingitis, or by sequestration in perforations of the stomach or duodenum;

(2) to remove the infective exudate ; (3) to prevent recurrent infection of the peritoneal cavity.

Pre-operative treatment.—The diagnosis of diffuse peritonitis having been arrived at, all preparations should be made for operation ; but in the meantime shock and abdominal pain may require treatment. The former, as long as it is present in any severe degree, is undoubtedly a contra-indication to operation, and must be combated by the application of warmth, by bandaging of the extremities, and by the administration of saline, adrenalin, pituitary extract, or possibly of strychnine. Pain is best relieved by the application of dry or moist heat to the abdominal wall, but care must be taken not to blister it by turpentine stupes or other counter-irritants. A small dose of morphia may be permissible ; if given shortly before operation, with or without scopolamine, it often helps the patient to stand the ordeal of operation. A hypodermic injection of morphia gr. $\frac{1}{6}$ with scopolamine gr. $\frac{1}{150}$ one hour before the beginning of the operation appears to yield the best results. Omnopon is favoured by some authorities in preference to morphia, and is given in doses of $\frac{1}{3}$–$\frac{2}{3}$ gr.

The position of the patient is of some importance, and, provided that shock is not too much in evidence, we believe that the Fowler position should be insisted on from the first, and maintained when the patient is transferred from bed to operating table.

No time should be lost in giving enemata ; they may set up objectionable peristalsis, and it is very rare for the bowels to act during anæsthetisation in these cases. Thirst may be complained of, and there is no objection to the patient having water in small quantities. Gastric lavage is indicated in those cases where the distension is great and the vomiting copious.

Operation.—*Preparation.*—Operation must be regarded as a matter of the greatest urgency, and the only indication for delay is the existence of shock in early cases ; but the medical man is sometimes called in too late for surgery to

have a reasonable chance of success. The operation should be performed with as little disturbance of the patient as possible; the surgeon must be brought to the patient, so that no more than transference from the bed to the operating table and back again is required. A thought must be given to the lighting and temperature of the room, and the latter should not be lower than 65° F. The table should be placed so that the best light is obtained, and we prefer to have it tilted so that the patient's pelvis is lower than his head; some writers urge the desirability of operating with the head low in order to lessen shock, but, on the other hand, this position favours the gravitation of infection from the lower to the upper abdomen, where absorption is at its maximum; therefore it appears to us that, unless shock is pronounced, and this is a contra-indication to the performance of the operation, the best chance for the patient is secured by maintaining the principles of the Fowler position from beginning to end of the peritoneal attack. The surgeon must have at least one reliable assistant, and a second is a great gain, since the precise steps of the operation are not known beforehand; much time may be saved by having needles threaded and ligatures cut in suitable lengths. Silk appears to us to be most suitable for intra-peritoneal manipulations, but for the abdominal wall catgut is to be preferred, inasmuch as these cases are septic, and silk in septic wounds leads to stitch sinuses. Several quarts of saline made with boiled water, and placed in scalded, or boiled, jugs and basins, should be available, for both antiseptics and plain water are harmful in the peritoneal cavity. Paul's tubes and intestinal clamps should always be included in the instruments sterilised for the operation. The method of preparation of the skin is a matter of individual choice, but there is no doubt that all the necessary requirements are fulfilled by the iodine method, when the solution is merely applied once just before commencing the operation; if a previous coat can be applied, so much the better; the iodine method certainly has the advantage of simplicity and rapidity,

and it involves less exposure of the patient's abdomen, and no risk of causing rupture of an intra-peritoneal abscess as has happened during the soap and water scrubbing of the abdominal wall. Rubber gloves should, of course, be worn by the surgeon and all his assistants.

Before the operation is begun it must be certain that the bladder is empty, and if any doubt exists a catheter must be passed.

Steps of operation.—The position of the incision will be determined by the diagnosis of the primary disease; in cases where no definite opinion has been arrived at, it should be planned so that the whole of the peritoneal cavity can be explored through the opening; in these circumstances a right paramedian sub-umbilical incision is probably the best.

The region of the initial lesion must first receive attention, and steps should be taken to remove the diseased tissue, if that is practicable, for by this means recurrent peritoneal infection is prevented, and the removal of such organs as the appendix or Fallopian tubes should be carried out as rapidly as possible. The grave condition of the patient sometimes makes one hesitate to prolong the operation, but, as a matter of experience, it has been found that if the primary focus of disease cannot be removed, the outlook for the patient is almost hopeless, so that some degree of risk must be run if the operation is to be curative; but, at the same time, in these grave cases whatever is done must be done quickly. As an example, simple ligature and amputation of the appendix should often replace the more elaborate details of routine appendicectomy.

Treatment of the exudate.—As soon as the peritoneal cavity is opened, exit is given to fluid varying in character and amount. The removal of this exudate is both desirable and essential if it can be done without damage to the endothelial tissue, and therefore it must be attempted only by the most gentle manœuvres. Absorption by dry gauze strips is the method we prefer, but it is obvious that the whole cavity cannot be reached through one incision, without

either evisceration or rough manipulation among the coils of the intestine. The first of these cannot be too strongly condemned, and all possible steps must be taken, by the insertion of gauze strips around the margins of the wound, to avoid prolapse; with regard to the second, damage to the endothelial cells of the peritoneum means damage to the patient, and the risks of spreading infection and breaking down protective adhesions are greater than the chances of removing all peritoneal effusion, which, it must be remembered, contains active phagocytes as well as infective organisms. The best results, therefore, are obtained by those who seek only to cleanse, by careful dry sponging, the area surrounding the initial lesion, and the pelvis, for if the patient be treated from the outset in the Fowler position it is here that most fluid exudate will be found. It is true that some collections of fluid may be left behind, especially in the upper part of the abdomen, but it is probable that nature is able to deal with them more successfully than the surgeon. In cases of several days standing some efforts must be made to release pus from the midst of adhesions, but the greatest care must be exercised in doing so. Lavage with saline used to be practised largely, but it is now usually limited to the area of operation, and it appears better to dispense with it, except for the cleansing of such portions of the intestine as must be withdrawn from the interior of the abdomen. An exception to this rule certainly exists where intestinal contents have escaped into the peritoneal cavity, and it is easier to remove the foreign matter present in cases of perforated gastric and duodenal ulcer by lavage than by dry sponging.

In addition to its fluid portion, whether purulent or not, peritoneal exudate usually occurs in the form of fibrin, to the value of which we have already paid some attention. This fibrin is conspicuous by its absence in pure streptococcal infections, and it is perhaps most characteristic of pneumococcal and gonococcal peritonitis, but it also exists in more or less abundance in infections due to the colon

bacillus and other organisms. Early peritoneal adhesions are composed of this fibrin and their protective value in the localisation of intra-peritoneal suppuration is perfectly obvious, and it may be taken as a general rule that the less they are interfered with the better, except for the express purpose of giving exit to loculated pus. Their removal does not prevent adhesions, but rather tends to the formation of fibrous tissue over areas of intestine denuded of endothelial cells, and an immediate, and possibly fatal, effect may result from tearing off these fibrinous plaques, in that it facilitates the passage of organisms from the lumen of the gut to the peritoneal cavity.

Drainage of the Peritoneal Cavity.—The custom of drainage in cases of peritonitis is daily becoming less common, and the reasons are twofold. In the first place acute abdominal cases now reach the surgeon earlier than formerly, and, secondly, further knowledge has increased our faith in the power of the peritoneum to work out its own salvation. Where the infection is of less than twenty-four hours' duration, and the surgeon is satisfied with the adequacy of his operative interference, drainage is rarely called for, even though the effusion may be semi-purulent in character. Even in infection of longer duration, if the operator, after the necessary steps of the operation, finds no definite area to drain, a drainage tube will probably be of no value; but if doubt exists, it is better to drain than not to drain, and, if the Fowler position is made use of, a drainage tube placed through a low abdominal incision into the pelvic basin is of considerable advantage. In cases where there is peritoneal effusion with no localisation, this latter method is the only one that seems reasonable; drainage through multiple incisions is rarely satisfactory, owing to the formation of adhesions at the sites of drainage. Multiple drainage is called for only in cases of multiple localised effusions, and, in any case, drainage of the peritoneal cavity, except where there is an abscess of some standing, must be regarded as of local and temporary benefit. Rubber

tubes of wide bore afford the best means of peritoneal drainage, and, if the fluid be not thick, a gauze wick inside the tube is of great value. The length of the cavity which it is proposed to drain should be gauged by the finger, and the tube, with gauze projecting from its end, should be passed through the wound till it just touches the bottom of the space; in the case of the pelvis the tube may have to be of considerable length.

Drainage of the Intestines.—In cases of intestinal obstruction and peritonitis, where there is extreme distension of the bowel, enterotomy may be called for in order to carry out the necessary manipulation, and such a step may be of value in the prevention of intestinal paralysis. It is usually sufficient to make a small opening into a distended coil, which can be closed, after cleansing the bowel with saline, by means of a purse-string suture. In severe peritoneal infections there may be a condition of paralytic obstruction, and, if this is present, or suspected, the safest course lies in the performance of enterostomy, the main object of which is to prevent the accumulation of gas within the lumen of the bowel. For this purpose a tube of smaller size than the smallest Paul's tube will suffice, and we have seen good results from the use of a winged rubber catheter (size 12) tied into the bowel with a purse-string suture. If desirable more than one of such tubes may be employed.

Post-operative Treatment.—In addition to the adoption of the Fowler position we must emphasise the great value of saline in peritoneal toxaemia, and we hold that in the first twenty-four hours after operation for diffuse peritonitis the rectal administration of large quantities of saline is the most important consideration. The question of aperients may usually be left till the second day, and then repeated small doses of magnesium sulphate, or calomel, are the most satisfactory. Morphia must be withheld, as it favours intestinal distension, and, for the relief of pain, hot fomentations, or an "electric poultice," covering the whole abdomen, may be applied over the dressing of the wound,

or aspirin (gr. xx) in two ounces of saline may be given *per rectum*. Hot fomentations applied in the above manner do much to increase the comfort of the patient, and they favour peristalsis, particularly in children and patients with thin abdominal walls. As simple hypnotics veronal, or veronal (gr. v.), and aspirin (gr. x.), or sulphonal (gr. xx.), are the most suitable.

Dressings of either plain or cyanide gauze must be changed frequently if there is much discharge, and gauze wicks passed down the rubber drainage tubes should be renewed each time the dressing is done. The tubes themselves should be gently rotated from time to time to prevent the formation of firm adhesions around them, and they should be gradually withdrawn and shortened from about the third day onwards. They should not be removed till the healing of the wound tends to push them out, and when there is no longer need for tube drainage their place should be taken by gauze plugs.

If the discharge from the wound is offensive the gauze dressing should be wrung out in 1-in-40 carbolic, and in many cases a damp gauze dressing is desirable, in that it favours discharge by capillarity. A charcoal poultice, consisting of dry powdered charcoal between layers of lint, is employed by some surgeons for offensive wounds, and we have occasionally found it of value. A strong faecal odour suggests the formation of a faecal fistula, and, if the suspicion is confirmed, it may be taken as an indication for the suspension of aperients by the mouth and the removal of all rubber drainage tubes. Frequent dressings will be required and, after removal of the tubes, the wound must be lightly packed with gauze each time it is dressed, great care being taken to keep the skin opening free, and not to dam back the discharge, or cellulitis of the abdominal wall may occur.

Value of sera and vaccines.—The variable results obtained from the use of sera in cases of peritonitis is only to be expected owing to the acuteness of the disease, for the

curative value of a serum depends upon its specificity and its use early in the illness, whereas in peritonitis the nature of the infection can only be accurately determined by cultural methods, and stock sera have to be employed.

We have seen good results from the use of anti-colon serum, and have administered it during the operation into the pectoral muscle, and again, once or twice during the first twenty-four hours in doses of 25 c.c. Anti-streptococcus sera may also have a favourable effect, and we have seen good results obtained where anti-colon and anti-streptococcus serum were both administered. A weak point in the use of these sera lies in the fact that they are all anti-bacterial rather than anti-toxic.

Vaccines, if they can be rapidly prepared from the patient's own organism, are unquestionably of value, and even stock vaccines yield good results. We consider that the disturbance of the operation is equivalent to an auto-inoculation, and therefore we do not use vaccines at the time of the operation. The initial dose, given not less than forty-eight hours after a severe operation, may be from a stock vaccine, and it is best followed by treatment with an autogenous preparation, but in any case the first dose should be small. The clinical aspect of the case affords a sufficiently accurate criterion as to the correct dosage without control by blood examination.

Routine inoculation of a culture tube from the fluid exudate, and from the area of most severe infection, at the time of operation, affords scientific basis for treatment by sera and vaccines, for thus the organisms can be identified and the preparation of a vaccine can be proceeded with if required. Much the best results from vaccine treatment are seen in cases where there is a phlegmonous or ulcerative condition of the abdominal wall around the wound, but this is partly explained by the visible nature of the infection, where the process of repair can be watched from day to day. On several occasions we have seen most offensive wounds become sweet and healthy within forty-eight hours

of inoculation, and it is possible that equally rapid changes may take place within the hidden peritoneal cavity.

Pneumococcal Peritonitis

Etiology and Pathology.—This form of peritoneal infection is far more common among children than adults, and this may be said of many other pneumococcal infections. Cases have been recorded in infants as young as three months. It may be described as primary, or secondary, peritonitis; in the former the infection is by the blood stream, and the point of entry of the organism is assumed to be a free mucous surface, such as the throat, or it arises after a definite localised pneumococcal disease such as pneumonia; in secondary pneumococcal peritonitis the infection spreads directly from some viscus, such as the stomach, intestine, appendix, or Fallopian tube, or, in rarer cases, through the diaphragm from disease of the pleura. Of these primary lesions, there is no doubt that salpingitis is the most common, and it is generally recognised that the disease is twice as frequent in girls as in boys; vulvovaginitis is known to be due to the pneumococcus in many cases in children, and the possibility of infection extending to the peritoneum is obvious, though the greater proportion of cases treated for pneumococcal peritonitis do not exhibit an active vaginal discharge. Pneumococcal peritonitis may also occur as one lesion in a polyserositis. Peritonitis due to the pneumococcus may be local or diffuse, and the respective incidence of these two forms is about equal. In the former case a well localised abscess may be met with anywhere in the peritoneal cavity, though most often it is situated in the pelvis, a fact which suggests a tubal infection. The pus is more or less characteristic, and possesses a greenish colour, with no odour. In diffuse pneumococcal peritonitis the exudate is abundant, but consists largely of fibrin which may be found plastered over the intestine in large sheets.

Annand and Bowen investigated thirty cases of pneumococcal peritonitis occurring in children, and found a primary focus in the lungs in twenty-two cases; in the remaining eight the infection was accounted for by sore throat (2), otitis media (3), inter-muscular abscess, not of bony origin (2), inflammation of the umbilicus following detachment, of the cord, (1).

Symptoms.—It cannot be said that there are any clinical symptoms which are peculiar to this type of peritoneal infection. Some authors recognise three types of the disease, viz.—

(1) With sudden onset, resembling appendicular peritonitis.

(2) Typhoidal type, with gradual onset.

(3) Resembling tuberculous peritonitis, with fever, abdominal pain, irregularity of the bowels, and possibly, vomiting, often ending in the formation of a localised abscess. In our experience vomiting is not a marked feature of these cases; where the onset of the illness is sudden, vomiting usually occurs, but it may cease for several days while the abdominal pain progresses. The degree of abdominal pain is very variable; it is often paroxysmal, and may be referred to any region of the abdomen, but there is no doubt that the right iliac fossa is a common site. Fever is almost always present, but the temperature rarely rises above 103° F. Delirium is seen in severe primary infections. Constipation may be present, but in many cases the bowels continue to act naturally for several days after the onset of abdominal pain. In very few cases are there symptoms of disease above the diaphragm coincident with the abdominal illness. Evidence of vaginal discharge is met with in a few cases.

Physical signs.—These are those commonly met with in peritonitis, and they may be local or general. The patient with diffuse infection usually looks very ill, and, in children at any rate, a hippocratic facies with flushed cheeks may be present. The tongue remains moist longer

than in infection by the *bacillus coli*. The abdomen is distended, and there is dulness in the flanks, with evidence of abundant peritoneal exudate. Examination of the chest does not often reveal evidence of active, or recently cured, disease. Occasionally peristalsis can be heard in spite of the diffuse peritoneal infection. If a vaginal discharge be found, very careful examination of films from the pus may show a gram-positive organism resembling the pneumococcus, but this must not be taken as conclusive evidence that the peritoneal lesion is pneumococcal, for in some described cases of pneumococcal peritonitis with co-existing vulvo-vaginitis the organism present in the vaginal discharge has resembled the gonococcus rather than the pneumococcus. Herpes labialis is occasionally present. Pelvic examination may point to disease of the Fallopian tubes.

Diagnosis.—Unless the history of the case reveals a recent pneumonia or pleurisy, the diagnosis of pneumococcal peritonitis is always difficult. At least half the cases that we have seen have been diagnosed as appendicitis, but a true pneumococcal appendicitis is very rare. The reason is that whilst there is often diffuse abdominal rigidity, the pain may be referred to the right iliac fossa, and the tenderness on palpation is then usually right-sided. We have referred above to the presence of vaginal discharge, and, though this should always be inquired into in the case of female patients, its relation to the peritoneal infection must be interpreted with caution. The typhoidal type of pneumococcal peritonitis is not very common, and it is characterised by some degree of delirium and persistent fever; in differentiating between it and enteric fever the patient's skin must be searched for spots, and the serum reaction should be examined; the slow pulse and enlarged spleen of true typhoid are not present. As regards that form of pneumococcal infection which resembles tuberculous peritonitis, there may be considerable perplexity, and the need for surgical treatment is not clear until there is a localised abscess; some of these abscesses,

if left to nature, reach the abdominal wall and discharge, leading to the formation of a fistula, which is stated to be present more often at the umbilicus than elsewhere. In the case of localised pneumococcal peritonitis, it is not to be expected that an accurate diagnosis can be made before operation, though it may be suspected in cases where the abscess is situated at some distance from the right iliac fossa, and there is a history pointing to recent pulmonary disease. The abdominal infection usually arises shortly after all signs of disease of the lungs and pleuræ have disappeared. At operation the diagnosis may be made from the character of the pus and from the presence of large quantities of coagulated fibrin, especially if no gross visceral lesion can be discovered.

Prognosis.—Diffuse pneumococcal peritonitis has a high mortality, which may be accounted for partly by the fact that the majority of the patients are young children, and partly also because the uncertain symptoms do not suggest the immediate need for surgical treatment. Local pneumococcal peritonitis may mean an infection which has been localised from the first, or it may mean that a diffuse infection has been resisted by the patient and the damage limited to one area of the peritoneal cavity. In either case, when once the abscess has been drained the outlook is favourable.

Treatment.—Localised abscesses must be opened and drained. In widespread lesions surgical intervention should be directed towards the removal of the fluid exudate, the search for a primary focus of disease, and such drainage as appears to be called for. If the exudate has the characteristics of pneumococcal peritonitis, not too much time should be spent in searching for a primary focus, but it is wise to examine the appendix, and, in female patients, the Fallopian tubes. The former nearly always exhibits inflammation of its peritoneal coat, and may be so plastered with fibrin that it falls under suspicion; if it is removed and its lumen opened, the mucosa will usually be found to

be healthy, and no great harm will be done, but the diagnosis of pneumococcal peritonitis will be strengthened. In the case of the tubes, however, removal should not be carried out unless it is certain that they are diseased. The most suitable incision in these cases is one which passes through the lower part of the right rectus muscle, for thus the appendix and the pelvic organs can be examined; if no primary lesion is discovered in the lower abdomen, and the character of the exudate strongly suggests infection by the pneumococcus, it is rarely worth while prolonging the operation to search the upper abdomen, but it must be remembered that a similar fibrinous exudate may be met with in cases of leaking gastric and duodenal ulcer, and therefore in some doubtful cases further exploration is called for. The fluid exudate should be removed by dry sponging, but the fibrinous sheets are best left alone for the reasons which we have already stated. In most cases a drainage tube may be introduced into the pelvis with advantage; the rest of the incision should be closed

It must be admitted that the value of operation in diffuse pneumococcal peritonitis lies principally in the direction of accurate diagnosis, but it does enable infective exudate to be removed and affords drainage of the cavity. In all suspected cases some of the exudate should be preserved for the preparation of microscopic films, and, if possible, of cultures.

After Treatment.—This does not differ materially from that of other forms of peritonitis; the Fowler position and rectal saline are important, and since we are dealing with a specific organism this disease ought to be amenable to vaccine treatment. Recent successes appear to show that such is the case, and a dose of vaccine may well be given forty-eight hours after the operation; there seems no doubt that the best results are to be obtained by the use of autogenous inoculation, but if this is not possible a stock vaccine may be used. If the patient does not survive for forty-eight hours after the operation, there is little

probability that immediate inoculation would have been of value, and indeed it is probable that in some cases at any rate, the auto-inoculation caused by the operative interference determines the fatal issue, but this is a danger which cannot be estimated before operation.

Diffuse Gonococcal Peritonitis

Etiology and Pathology.—This is undoubtedly a rare disease in so far as general peritonitis is concerned, though inflammation of the pelvic peritoneum is probably due solely to this organism in a good many cases. There are obvious difficulties in establishing the diagnosis of uncomplicated gonococcal peritonitis, not the least of which is a bacteriological one, for the gonococcus is a difficult organism to cultivate and reliance should not be placed absolutely on the findings of film preparations. Not all authorities are agreed that the discovery in the films of an intra-cellular diplococcus which is decolorised by Gram's stain is sufficient proof that the organism in question is the gonococcus of Neisser, but if the organism is seen both in the cells of the tissue and in the leucocytes, then it may be regarded as the gonococcus. This investigation requires more tissue than is usually available in the peritoneal exudate, so that, to make certain of the diagnosis, attempts should be made to grow the organism outside the body, and the best medium is agar to which a drop of fresh human blood is added.

The path of infection is through the abdominal ostia of the Fallopian tubes in females; it is possible that in males the infection may occur by extension from the lymphatics of the spermatic cord, but gonococcal peritonitis in the male must be regarded as a very rare event. The changes which the gonococcus causes in the Fallopian tubes are well known, and the lesion is due to an ascending endometritis which, in its turn, is secondary to a gonorrhœal vaginitis. The determining factor in this ascending infection is not accurately ascertained, but it probably depends on sexual

intercourse, or the use of forcible injections during the existence of vaginitis. Infection of the peritoneum is apparently most likely to occur shortly after menstruation or parturition, but there is no proof that a mixed bacterial infection is required.

The experiments of Wertheim in 1891 conclusively proved the power of the gonococcus to produce peritonitis in guinea-pigs and white mice. He introduced into the peritoneal cavity a pure culture of the gonococcus, grown on blood agar, together with a non-absorbable substance, namely, nutrient agar. An acute circumscribed sero-purulent peritonitis resulted, and he demonstrated the presence of gonococci in the pus on the serosa, in the subserous coat, and between the muscle bundles of the intestine. The organism was recovered from this exudate in pure culture, and he even went so far as to inoculate the human urethra with it, and produced a specific anterior urethritis. The changes seen in the human peritoneum in gonococcal infections may be very slight, but as a rule there is deep injection of the serous coat of the bowel and a deposit of yellow fibrin. This sticky fibrinous exudate may be almost universal, and in extreme cases the under surface of the liver may be covered with a fibrinous sheet, the intestinal coils may be plastered over in a similar manner, and there may be no area which suggests a primary focus of disease. Any large quantity of fluid exudate is rare, and there may be none at all. The Fallopian tubes are usually coated with fibrin, their serous coat is inflamed, but there may be nothing to point to their being the source of infection until pus is expressed from the ostia. It is almost invariably a bilateral infection, but there may be no pelvic adhesions, and the abdominal ostia are usually quite free.

Gonococcal infection of the peritoneum may, of course, lead to the formation of localised abscesses, but these are almost always in the pelvis, and will be considered in dealing with disease of the female genitalia.

Symptoms.—Since this disease may be met with in

unmarried women, the anamnesis must be accepted with caution. The patient always complains of *abdominal pain*, but its situation is variable and may not be truthfully stated; we have known of one case at least, where, before operation, the patient stated that pain and tenderness were present only in the upper abdomen whereas after its pelvic origin had been discovered by operation, she admitted that her statements were made to divert attention from the generative organs. The pain is usually of sudden onset, and may be most acute in any region of the abdomen, often the right iliac fossa, but in many cases the pain diminishes although the infection progresses; it is often severe and colicky at the onset, but this may give place to a dull aching pain, frequently felt in the back as well as the abdomen. *Constipation* is the rule, but *vomiting* is of very variable degree, and may cease soon after the acute onset of the illness. If vomiting persists it rarely becomes more than bilious, and the vomit does not become dark brown or very offensive; *nausea* is nearly always present even when vomiting is absent. *Hiccough* may be noted. *Pain* in the lower abdomen *on micturition* is not uncommon. Speaking generally, the symptoms of gonococcal peritonitis are of variable degree, but they are not, as a rule, very severe, and the temperature, if raised, is rarely above 102° F.

Physical Signs.—In this connection the most noticeable feature of acute gonococcal peritonitis is the disparity between the constitutional signs and the objective evidence of acute abdominal disease. Although there is not much initial shock, the patient may look very ill; the face is rather drawn, and the eyes sunken; the cheeks may be flushed, and there may be a good deal of restlessness. The dorsal decubitis is commonly adopted, and the thighs are flexed on the abdomen. The tongue is thickly coated, but the breath is not very offensive. Respirations are somewhat quickened. A leucocytosis of about 20,000 is usually present.

Abdominal Physical Signs.—*Distension* is of slight degree, and some amount of *respiratory excursion* is

preserved. Careful palpation of the abdomen often reveals voluntary rather than reflex rigidity, and this may be present in any region of the abdominal wall. Some degree of *tenderness* is always present, but this is very variable in its localisation; deep tenderness or resistance is not very noticeable, but the patient usually resents firm pressure. There may be some areas of *dulness on percussion*, but dulness in the flanks is not often observed; percussion dulness above the level of the pubes in the middle line is fairly often met with, but, since this form of peritonitis is commonly associated with dysuria, a catheter should be passed to make sure that the bladder is empty. Audible peristalsis may be present over some part of the abdomen.

Rectal Examination.—Although this usually affords no definite clue to the diagnosis, yet in some cases a doughy resistance may be felt in Douglas's pouch and the presence of tenderness should be noted.

Vaginal Examination.—Where gonococcal infection is suspected, a very careful examination should be made first to ascertain the presence or absence of vaginal discharge, and, if present, to obtain films for microscopy, and secondly to ascertain the state of the hymen. Complete examination of the vagina may well be postponed till the patient is under an anæsthetic.

Diagnosis.—This is usually rather uncertain, owing to the frequency with which the patient endeavours to mislead and to divert attention from the pelvis. Any attack of acute abdominal pain with severe constitutional symptoms coming on shortly after menstruation or parturition is suggestive of peritonitis arising from the pelvic organs, and if a history of recent exposure to gonorrhœal infection be obtained the diagnosis may be made with some confidence. Vaginal discharge may not be at all obvious, and in some cases, doubtless, it is overlooked by the patient; but even the discovery of a discharge containing the gonococcus must be regarded as incomplete evidence, and the most noticeable feature is the lack of signs in the abdomen

to correspond with the patient's constitutional disturbance; there is evidence of peritonitis, but not often of a severe infection. Appendicitis may be simulated, and also subacute gastric perforation, but, if a true history can be obtained, it will usually point to the existence of a chronic or latent vaginitis (and endometritis), with some alteration in the amount of the discharge as the result of recent coitus. Very rarely does peritonitis arise during a first infection with the gonococcus.

Treatment.—The prognosis in these cases of diffuse gonococcal peritonitis is usually good, and it is a little doubtful if they are much benefited by immediate operation. There seems to be comparatively little tendency for a secondary infection from the bowel to ensue, and this may partly be explained by the abundance of the protective fibrin which is thrown out over the serous surfaces; there is also little tendency for these fibrinous sheets to form permanent adhesions. Such cases, if left to nature, probably recover, and merely exhibit the signs of chronic salpingitis which can be dealt with during a quiescent interval. Immediate coeliotomy has, however, owing to the uncertainty of diagnosis, been performed in a number of cases, and the results are very favourable in pure gonococcal infections. When the diagnosis has been made, or confirmed, at the operation, attention should be directed to the Fallopian tubes, and these should be removed, provided that pus can be expressed from the abdominal ostia. The ovaries should be left, and no effort should be made to remove the fibrinous plaques, which may be numerous. Any fluid exudate should be removed by dry sponging, and in most cases the abdominal cavity may be closed without drainage. Further than this the treatment is that of peritonitis as already described.

Puerperal Peritonitis

Etiology.—Fortunately, at the present day, peritonitis following childbirth is not common. It is a particularly

fatal peritoneal disease since the common causative organism is the streptococcus pyogenes. Such an infection may follow ruptures or tears of the genital passages during labour, or these may be caused by the introduction of an instrument to produce criminal abortion; in either case the infection may be limited to the pelvis, but general peritonitis is particularly likely to follow a pure streptococcal infection, against which the peritoneum has very low powers of resistance. The disease may extend directly from the infected genital passages, or by the lymphatics, and there may be staphylococci, or gonococci, as well as streptococci present.

Symptoms.—The onset may be sudden and marked by a rigor. There is always evidence of severe toxæmia with high temperature, and often delirium. The degree of abdominal pain is variable; vomiting is not very marked. As regards the bowels, a septic diarrhœa is usually seen rather than constipation. The lochia are usually offensive and altered in amount. The breasts may stop lactating. Complications of a pyæmic character are common if the patient survives long enough, and pericarditis, empyema, and infective arthritis are met with.

Physical Signs.—These resemble those met with in the severest forms of perforative peritonitis, together with those of recent pregnancy. The breasts should be examined for evidence of pigmentation and lactation, and the linea alba may exhibit pigmentation. In cases where no history of recent pregnancy is obtained, the routine examination of the vagina may reveal changes due to the puerperal state, and also local injury to the genital passages. Rectal examination causes much pain, and pelvic tenderness is a marked feature of these cases. As regards the abdomen, distension is usually considerable; tenderness and rigidity, localised or diffuse, are present, and there is often dulness in the flanks due to free peritoneal fluid.

Diagnosis.—When it is known that the patient has recently been delivered of a child, or abortion has taken place, the diagnosis may be quite clear, but in other cases

no such history may be obtainable, and the physician depends for his diagnosis on the objective phenomena. The signs of peritonitis are usually clear, and the presence of an offensive lochial discharge may suggest the source of infection. A routine examination of the patient's chest, vagina and rectum in most cases reveals evidence of recent pregnancy, even where the history of the case is misleading, and especial caution must be adopted owing to the possibility of the case being primarily one of criminal abortion.

Treatment.—The prognosis in puerperal peritonitis is very grave, largely owing to the fact that most cases are due to streptococcal infection. It should be remembered that this form of peritonitis comes under the heading of "puerperal fever," and is therefore a notifiable disease in this country. Immediate operative interference gives the patient her only chance of recovery, and the abdomen must be opened freely so that the path of infection is fully exposed. Injury to the uterus and genital passages must, if possible, be repaired, but where the uterus is grossly infected, and possibly perforated, hysterectomy may be called for. In any case the operator must aim at preventing re-infection of the peritoneal cavity, he must remove infective fluid, and provide adequate drainage, both abdominal and vaginal. Dudgeon and Sargent state that saline irrigation does good in streptococcal peritonitis, and, if the organism can be identified at the operation by films or cultures, serum or vaccines may be given a trial. In the event of criminal abortion being suspected the medical attendant must not lose sight of his legal responsibilities. If the peritoneal disease is recovered from, complications of a pyæmic nature, such as we have mentioned above, must be treated by prompt surgical measures.

After Treatment.—Large quantities of saline are usually required, owing to the condition of shock and toxæmia present, and, in addition to the general principles of treatment, we believe that the best results are to be obtained by vaccination, if the patient survives for the first

forty-eight hours. The vaccine should, if possible, be autogenous, and the initial dose should be small.

Acute Local Peritonitis

Acute local peritonitis may be suppurative or non-suppurative, and the latter form is very common inasmuch as every case of appendicitis, or salpingitis, in which the infection reaches the serous coat of the organ, becomes one of acute local peritonitis. Acute localised suppurative peritonitis will be fully considered in so far as it depends upon appendicitis, but there are many other causes for localised suppuration in the abdomen, and there are also many situations other than the right iliac fossa where pus is likely to be encysted. We propose now to deal with such localised abscesses from the point of view of their causation and their anatomy.

A bacteriological classification of localised abdominal abscesses is hardly possible, for, whatever the organism, the symptoms are usually those due to an inflammatory swelling in the abdomen, and the physical signs are mainly dependent on the situation of the abscess, and its relation to surrounding organs, and they are usually classified accordingly.

Sub-phrenic Abscess

These abscesses are divided into two classes according to whether they contain gas or not; the gas-containing abscess is usually termed *subphrenic pyopneumothorax*, and the non-gaseous form is sometimes called *sub-phrenic empyema*. It is difficult to form a definite opinion as to the relative frequency of the two conditions, as in many of the published statistics no attempt is made to differentiate between them; out of seventy-three cases secondary to appendicitis Elsberg found that only fifteen per cent. were gaseous, but it is probable that the percentage of gas-containing abscesses would be considerably higher in cases secondary to gastric or duodenal perforations. Clinically,

we believe that there can be no question as to the overwhelming preponderance of the non-gaseous over the gaseous forms; in our own experience we have only once encountered a frank instance of sub-phrenic pyopneumothorax, though we have seen many cases of sub-phrenic empyema.

Etiology.– Sub-phrenic abscesses are almost invariably secondary to some septic focus situated within the abdomen, and the majority of them are consequent on gastric or duodenal perforations, on appendicitis, or on suppuration in or around the liver; illustrative of this are the statistics of Leith, who found that out of 212 cases, 74 were secondary to gastric ulcer, 37 to disease of the liver, and 20 to appendicitis. The affections of the liver which may be complicated by this condition are cholangitis, cholecystitis, pylephlebitis, suppurative hydatid disease and actinomycosis. As regards gastric and duodenal ulcer, subphrenic infection may arise apart from any gross perforation, and it is worth remembering that malignant ulcers, as well as simple ones, are liable to this complication. Less common primary causes are pancreatitis, pericolitis, salpingitis, suppurative lienitis, and retroperitoneal suppuration arising in connection with disease of the kidneys, the spine, the ribs, or the iliac bones. The sub-phrenic space is occasionally infected from an empyema above the diaphragm, but it is noteworthy that the converse route of infection, *i.e.* from peritoneum to pleura, is by far the more common one; in some cases infection is due to exploration by a needle which traverses the sub-phrenic space before reaching the empyema. Trauma, usually by a stab or a bullet wound, is sometimes responsible for sub-phrenic abscess. Finally, when no primary cause for sub-phrenic abscess can be found, it is called *idiopathic*.

Any of these conditions may give rise to either a gaseous or a non-gaseous abscess, but for the production of the former condition either gas-producing organisms, or a perforation of a hollow viscus, must be present; according to

Rolleston, 77 per cent. of cases of sub-phrenic pyopneumothorax are due to gastric, and 19 per cent. to duodenal, perforations.

Pathology.—The abscess may be right- or left-sided, and it may be intra- or extra-peritoneal; in a few cases it is both intra- and extra-peritoneal, but the most common variety is that which lies within the peritoneal cavity, and on the right side of the falciform ligament. Usually the path of infection from the lower to the upper portion of the abdomen is decided by the anatomical conditions which have been described by Box, Eccles, and Russell; thus lesions of the appendix, pylorus, duodenum and bile-ducts tend to give rise to right-sided abscesses, whereas lesions at the cardiac end of the stomach, or of the descending colon, are apt to infect the left sub-phrenic space. At the same time it must be remembered that the normal anatomical conditions may be upset by the formation of adhesions, and that in consequence it is by no means uncommon for appendicitis to be complicated by an abscess above the spleen, or for a left-sided gastric perforation to give rise to a right-sided sub-phrenic abscess. Barnard describes six forms of sub-phrenic abscess, viz.—

Four intra-peritoneal ..	Right and left anterior.
	Right and left posterior.
Two extra-peritoneal ..	Right and left.

The majority of these abscesses lie between the diaphragm and the liver, but the only absolutely constant relation is the diaphragm, which forms the roof in all cases.

Bacteriology.—The bacillus coli is undoubtedly often present, and staphylococci, streptococci, the bacillus pyocyaneus and the bacillus typhosus have all been found.

Symptoms.—There is nothing characteristic about the symptoms of sub-phrenic abscess. The onset may be acute, as is usually the case in sub-phrenic pyopneumothorax due to a gastric perforation, or it may be very insidious, as is the rule in post-appendicular instances. So also the course

of the disease is extremely variable; in some cases an acute onset leads to a fatal termination within a few days, or even hours; in others weeks may elapse before the condition is even suspected, and further weeks before it is cured. There may be an obvious primary focus of infection, such as appendicitis or a gastric perforation; or no such focus is discoverable even after the sub-phrenic abscess has been found. Suppuration beneath the diaphragm is one of the lesions to be looked for in cases of prolonged or recurrent fever complicating appendicitis, gastric or duodenal perforations, or indeed any peritoneal infection, after the primary focus has received appropriate treatment. In "primary" sub-phrenic suppuration the onset of the illness may be marked by rigors and vague pains in the abdomen, chest, or back; fever persists, the pain increases, and vomiting and constipation may be present. There is usually some respiratory distress, and the pulse rate is accelerated in proportion to the degree of fever.

Clinical Signs.—1. *Non-gaseous sub-phrenic abscess.*—Here the signs are often indistinguishable from those of empyema. Inspection may reveal a local bulging at the lower part of the chest, and the spine may be concave towards the side of the lesion. Oedema may be present over the lower ribs. The liver may be displaced downwards by a collection of pus above it; but this fact is of no diagnostic value, as it is impossible to decide in these cases whether one is dealing with a displaced or with an enlarged liver. The thoracic signs are those of a pleural effusion, namely dulness at the base, with diminished or absent breath sounds and vocal fremitus. A dome-shaped area of dulness at the base points to fluid below rather than above the diaphragm, but this is seldom demonstrable, for in many cases a sub-phrenic abscess is accompanied by a superjacent pleural effusion, serous or purulent, and even when this is not present the base of the pleural space is often obliterated by adhesions. In the case of left-sided abscesses displacement of the apex beat upwards and outwards, rather

than inwards, is good evidence that the pus is below, and not above, the diaphragm. Pus below the right dome of the diaphragm produces less outward displacement of the apex beat than does a similar collection of pus above it. The most trustworthy evidence of sub-phrenic suppuration is that afforded by the X-rays, provided that elevation and immobility of the diaphragm can be demonstrated on the affected side; but even the X-rays fail us if the outlines of the diaphragm are obscured by a super-jacent pleural effusion, and, moreover, many of these cases are too ill to be taken to the X-rays apparatus.

Litten's Sign.—It is necessary to refer to this so-called sign of sub-phrenic abscess, though in our experience it is valueless. In certain spare individuals it is sometimes possible to detect, by close inspection, a horizontal "line" of intercostal retraction which moves up and down vertically during respiration in proportion to the amplitude of the diaphragmatic excursions. Litten maintained that in sub-phrenic suppuration this line is on a higher level on the affected side than on the sound side. As a matter of fact there are but a few individuals in whom this "line" is demonstrable. Moreover in sub-phrenic abscess the homolateral dome of the diaphragm is usually motionless, so that no line of retraction would be anticipated.

2. *Gaseous Sub-phrenic Abscess* (*Sub-phrenic Pyopneumothorax*).—Here the diagnosis is much less difficult than that of non-gaseous sub-phrenic abscess. There is usually no difficulty in demonstrating the classical signs of pneumothorax, namely—

(*a*) Increased girth on the affected side, associated with a tympanitic percussion note.
(*b*) Displacement of the apex beat away from the abscess (consequently in left-sided abscesses it is displaced chiefly upwards).
(*c*) Coin sound.
(*d*) Succussion splash.

(*e*) Distant amphoric breath-sounds, accompanied by tinkling râles.

(*f*) Shifting dulness below the tympanitic area.

It is chiefly on the distribution of these physical signs that we must rely when attempting to form a conclusion as to whether the lesion is above or below the diaphragm; extension of the area over which the coin sound is heard below the level of the ribs is suggestive of sub-phrenic pneumothorax, though this phenomenon may be found with that very rare complication of supra-phrenic pneumothorax, inversion of the diaphragm. Extension of the area of coin sound and tympany to the apex of the pleural cavity is proof positive of a supra-phrenic lesion, and extension up to the level of the third rib would make the diagnosis of sub-phrenic abscess improbable, though not out of the question.

Diagnosis.—When, after an operation for appendicitis, or for a perforation, fever persists or recurs, and signs of fluid, or of pneumothorax, develop at the base of one side of the chest, sub-phrenic abscess becomes the most probable diagnosis. Where the signs are those of fluid only, in the absence of definite X-ray evidence, it is usually impossible to diagnose with certainty between sub-phrenic abscess and empyema, though certain signs which we have already mentioned may point towards one condition or the other. In addition we have to exclude consolidation of the lung, pleurisy, and growth, abscess, or hydatid cyst of the liver.

When the signs are those of pneumothorax, the diagnosis is usually simple; for we have only to exclude supra-phrenic pneumothorax, a gigantic cavity in the lung, a dilated stomach, and diaphragmatic hernia. The history alone will probably suffice to exclude, or to indicate, these conditions; and we have previously referred to certain physical signs by which the supra-phrenic may be distinguished from the sub-phrenic pyopneumothorax. Here also the X-rays may be a great help.

We are entirely opposed to exploratory puncture as an aid to the diagnosis of sub-phrenic abscess; if the abscess is so small as to produce equivocal physical signs, it is more than likely to be missed altogether by the exploring needle —moreover, even if pus be encountered we are still, as a rule, in the dark as to whether it is above or below the diaphragm. *Furbringer's sign*, based on the movements of a needle which has pierced the diaphragm, is useless here; for the diaphragm roofing a sub-phrenic abscess does not move. Finally there are to be considered the risks of this procedure, *e.g.* puncture of the stomach, colon, or liver, or perhaps infection of a previously healthy serous sac, pleural or peritoneal. Whenever there is a reasonable presumption of the presence of pus we prefer operation without any preliminary exploration by puncture.

Treatment.—Efficient drainage will effect a cure in most cases, but the patient is sometimes very ill when the operation is undertaken, and the character of the infection varies greatly in virulence, so that there is rather a high mortality if all cases of sub-phrenic abscess be considered.

In those cases where the abscess lies close to the anterior abdominal wall, it may be reached by an incision below the costal margin, but this does not as a rule afford very good drainage, so that a transpleural route is to be preferred. The selection of the rib for resection must be decided according to the estimated size of the abscess cavity, but it should be one of three, namely, the eighth, ninth, or tenth; the last is the one most often selected, and the advantage of a low rib depends on the fact that the pleural cavity tends to be obliterated from below upwards owing to the upward pressure of the abscess. If the pleural cavity is not obliterated by inflammatory adhesions, the parietal pleura must be sutured to the diaphragm, and this is most easily accomplished after incising the diaphragmatic pleura, especial care being taken at the extremities of the incision to prevent leakage; the muscle of the diaphragm may then be incised and the abscess reached with a blunt instrument;

a thirty-six hour plug may with advantage be placed in the lower angle of the wound. Even in cases where there are no adhesions in the pleura it is wise to secure the diaphragm by means of strong catgut sutures, since its descent after the abscess is drained may lead to tearing of this inflammatory tissue (Barnard). A large drainage tube should be inserted equal in length to that of the abscess cavity, and it should be packed round with gauze and sutured to the margins of the wound.

An extra-peritoneal sub-phrenic abscess may be drained by a lumbar incision.

After Treatment.—The patient should be nursed in a semi-recumbent position lying towards the affected side, to favour free drainage; there should be no undue haste in shortening the tube or replacing it by a smaller one. A careful watch must be kept on the temperature chart, and on the state of the chest on the affected side, for ascending infection of the pleura may occur in spite of precautions; further drainage will then be necessary.

Sub-Hepatic Abscess

This variety of localised suppurative peritonitis has no special characters beyond its anatomical situation, and it may be caused by local infection from the duodenum, bile passages, stomach, or colon, or it may be due to ascending infection from appendicitis or pelvic disease. Clinically, it is characterised by swelling in the upper right quadrant of the abdomen below the level of the costal margin. Drainage can usually be carried out through an anterior incision.

Peri-Splenic Abscess

The spleen being one of those organs which is supplied with blood by "end arteries" is particularly liable to infarction. Infarcts of the spleen, however, though they are superficial and give rise to peri-splenitis, do not as a rule, lead to the formation of peri-splenic abscesses; these

usually belong to the class of " residual abscesses " appearing during convalescence from general peritonitis, which has been successfully dealt with. Since the introduction of the Fowler position these abscesses have decreased in frequency.

Such abscesses can usually be drained through a muscle splitting incision in the left loin.

Pelvic Abscess

Suppuration in the pelvis may arise from many causes, the commonest of which are disease of the appendix and the Fallopian tubes, but it must be remembered that infection may spread down from above, and the semi-sitting position favours the accumulation of exudate in the pelvis. This does not necessarily give rise to the formation of an abscess because it is usual to combine the Fowler position with pelvic drainage.

Symptoms.—The special symptoms associated with pelvic suppuration are pain in the lower abdomen, dysuria, or retention of urine, dyschezia, or constipation, and fever. The pain is of variable degree, and a large collection of pus may be present without causing very much discomfort. As regards the bladder, pain, and frequency of micturition are rather commoner than retention, but the frequency is partly accounted for by the difficulty with which the bladder is emptied. The bowels are constipated, and if the rectum is emptied it causes considerable pain and distress to the patient. Fever is not invariably present, and, owing to the relative immunity of the pelvic peritoneum, the constitutional signs of suppuration may be slight.

Physical Signs.—Where the pelvic abscess is at all large the intestinal coils are pushed up against the abdominal wall so that there may be some central distension. Occasionally there is oedema of the abdominal wall. Respiratory abdominal movement is fairly free, and the amount of rigidity present in the lower abdomen is very variable. If the abscess is sufficiently large to rise up out of the pelvis,

a resistant mass is felt in the lower abdomen which may be symmetrical, or may extend towards either iliac fossa. The lack of abdominal rigidity in some cases suggests the presence of a pelvic tumour rather than an abscess. Even when a definite mass is felt, the percussion note over it may be only slightly impaired, for the abscess may be separated from the abdominal wall by coils of intestine. Above the mass the percussion note is usually resonant, and there is rarely any dulness in the flanks.

Rectal Examination.—These abscesses sometimes point through the wall of the rectum, and it is not uncommon for spontaneous cure of the lesion to occur in this manner; but before this takes place they cause considerable bulging of the anterior or lateral rectal walls, and digital examination may reveal a fluctuating swelling. The degree of tenderness on rectal examination varies greatly.

Vaginal Examination.—We are not now considering those abscesses limited to the pelvic organs of the female; in other forms of pelvic suppuration the value of accurate vaginal examination consists in establishing the relationship between the abscess and the pelvic organs, and also in differentiating uterine and ovarian tumours from pelvic abscesses. The exact position of the uterus may be difficult to ascertain, and its mobility is commonly restricted in cases of pelvic suppuration from whatever cause it arises.

It should be remembered that in some cases of pelvic abscess, due even to appendicitis, there may be no sign of abdominal disease, and pelvic examination alone reveals the cause of fever and illness.

Diagnosis.—Before diagnosis is attempted, the state of the bladder must be ascertained, and where there is a hypogastric swelling a catheter should be passed, whether the patient has passed water recently or not. This is at times a difficult proceeding, owing to pressure on the neck of the bladder, but it is absolutely necessary to be sure that the bladder is entered and emptied. In the female, pelvic abscess may at times be confused with both uterine and

ovarian tumours, and we can recall at least one case in which the abdomen presented the appearance of a five months' pregnancy. This patient had also missed several periods, but there were no confirmatory signs of pregnancy in the breasts or vulva. A vaginal examination was not made as the patient was unmarried, but digital examination of the rectum failed to differentiate the uterus from the large cystic swelling, which extended from the bottom of the pelvis nearly to the umbilicus; incision gave exit to at least two pints of rather offensive yellow pus. An ovarian cyst may stimulate a pelvic abscess, and the chief reliance must be placed on the length of history, and on the results of a vaginal examination. It is remarkable, however, that some women will state that a large pelvic tumour has been present only a few days, and thus even a soft or cystic uterine fibroid may be mistaken for a pelvic abscess. Extra-uterine pregnancy is another source of error, especially as it is abdominal pain which causes the patient to seek advice. The existence of amenorrhœa, followed by an irregular vaginal discharge of dark blood, changes in the breasts, and the results of vaginal examination, must be relied upon for accurate diagnosis. Fortunately, in the male the diagnosis is rarely difficult, and the cases in which pelvic abscesses are apt to be overlooked are those where the patient has persistent fever and some discomfort during recovery from infective abdominal disease. If a rectal examination is made from time to time in such cases, any considerable collection of pus in the pelvis will rarely escape observation.

Treatment.—Drainage of pelvic abscesses is best carried out through the anterior abdominal wall, although by this route the abscess is not opened at its most dependent point. If the drainage tube, however, is inserted to the full extent of the abscess cavity, the natural result of intra-abdominal pressure is to force out the exudate, especially when the Fowler position is adopted. Even in cases where the peritoneal cavity has to be traversed before reaching the abscess, the careful insertion of gauze strips

renders this route a safe one, the strips being left in position till firm adhesions are formed, usually about forty-eight hours.

Either rectal or vaginal drainage is permissible in certain cases, but both are open to the objection that it is difficult to be sure that no damage is done to blood-vessels, or to the intestine, and where the rectal route is adopted it is practically impossible to retain a drainage tube in the wound. If pus is not reached by the abdomen after the whole length of the index finger has been passed down from above the pubes, it may be taken as an indication for drainage from below; either the rectal or the vaginal route may be selected, but these are best reserved for cases where there is definite bulging of the rectal or vaginal wall. In the case of the rectum, the anus should be dilated, the bulging rectal mucosa incised, and the rest of the operation should be done with blunt instruments, or with the finger. After the abscess has been emptied, a tube may be passed into the cavity and secured so that it cannot pass up into the peritoneal cavity; it will remain in the abscess for a few hours only; indeed, it is not desirable to leave it, since it might form a track for fæcal extravasation. If the vaginal route is selected, the posterior fornix should be incised, and the rest of the operation performed with blunt instruments; here again, tube drainage is only of temporary value.

Peri-renal Abscess

To merit this name, an abscess in the loin must be extra-peritoneal, but the initial infection may arise within the peritoneal cavity, and there may still be some connection with the interior of the peritoneum. Appendicitis is the commonest intra-peritoneal cause of suppuration in the kidney pouch, but it is not very rare for a patient to come under treatment with fever, pain, and swelling in the right loin, without clear evidence as to the source of infection; the history of the case may suggest appendicitis, but the

possibility of duodenal ulceration must not be lost sight of. The condition should be treated by incision and drainage in the loin, and, in cases where the appendix is at fault, appendicectomy should be performed by the usual route after the abscess cavity has completely healed.

Acute Peri-colitis

Clinically it is very difficult to determine whether pus is present or not in cases of acute, or sub-acute, inflammation originating in the walls of the colon. If an abscess does form, it may be either intra- or extra-peritoneal. Two varieties are recognised according as they arise in connection with the ascending or descending colon, and they are termed peri-colitis dextra and sinistra.

Etiology.—(1) Infection from ulceration of the colonic mucosa, either stercoral, dysenteric, neoplastic, or traumatic from the presence of foreign bodies.

(2) False diverticula of the colon; rarely present except in the iliac and pelvic colon, and caused by deposits of hardened fæces which lead to ulceration and become partially encysted in the wall of the colon.

(3) Penetration of the bowel wall due to foreign bodies, such as pins and needles, which cause infection outside the colon, often arising in suppurative inflammation of an appendix epiploica.

Pathology.—The inflammatory process may originate in the wall of the colon, but it is not limited by it, and spreads into the retro-peritoneal tissue either behind, or at the side of, the bowel. The first change is either a localised, or a spreading inflammation of the wall of the colon. If an abscess is formed, it may burst into the bowel, the bladder, the peritoneal cavity, or externally.

Symptoms.—Abdominal pain, constipation, and fever are present, while vomiting rarely occurs.

Physical Signs.—These are few in number, and consist of local tenderness over some part of the course of the

ascending or descending colon, together with local prominence, and a resistant mass which yields an impaired note on percussion. Abdominal respiration is usually free, and there is no diffuse rigidity or tenderness.

Diagnosis.—The condition has to be distinguished from growth of the colon, hyperplastic tuberculosis, actinomycosis, and appendicitis. In the case of pericolitis dextra, the last mentioned is the most difficult to exclude, and it is possible that disease of the appendix may give rise to spreading inflammation in the extra-peritoneal tissue around the colon. A careful elucidation of the history of the attack should serve to eliminate new growth, but the diagnosis may still be uncertain at the time of operation. The absence of vomiting is a prominent factor in these cases, pointing to absence of peritoneal irritation. The following case is instructive:—

A. E. M. male aet. 20, clerk.

Patient has been perfectly well until the onset of the illness ten days before admission to the hospital. This began with slight pain on the right side of the abdomen; there was no vomiting, the bowels were open, and the appetite was good. On the sixth and seventh days of the illness the bowels did not act, but otherwise they were quite regular, and there was no diarrhœa. The patient complained of headache, but there was neither vomiting nor nausea.

On examination, the patient lay on his back in evident discomfort; the respirations were shallow, pulse 96, temperature 101° F.

Shortly after admission the temperature rose to 103-4° F. The abdomen exhibited slight general distension, and it moved poorly on respiration. On the right side a large mass could be felt in the right lumbar and iliac regions; this was extremely tender, but there was no œdema of the skin over it, and no fluctuation could be detected. There was localised rigidity of the abdominal wall over the swelling, which was taken to be an inflammatory mass due to appendicitis.

A McBurney incision showed that the inflammation had spread along the outer aspect of the ascending colon, so that the peritoneal reflection had been pushed inwards in front of the bowel: the peritoneal cavity was then opened through the right rectus, and a large dark mass, which proved to be the cæcum and ascending colon, was identified; the cæcum could not be displaced, and the appendix

was not seen; the inflammatory mass was composed of loose friable tissue, with no pus; a tube was placed on the outer side of the colon, and the inner incision was closed. There was a subsequent discharge of both pus and fæcal matter, but the fistula was easily closed by a second operation, and the patient made a perfect recovery.

Treatment.—In the early stages expectant treatment by rest in bed, hot fomentations, simple purgatives, and a light diet is suitable, but if there is evidence of pus formation the abscess must be drained. On the right side the possibility of an appendicular origin must be borne in mind, and the desirability of removing the appendix when the pericolitis has subsided will naturally suggest itself.

Abscess of the Lesser Sac

Suppuration limited to the lesser sac of the peritoneum is rare, and, when it is met with, the primary lesion is usually a leaking gastric ulcer, but it may also follow disease of the bile passages, pancreas or liver; more rarely still it may belong to the class of so-called "residual abscesses" occurring during convalescence from general peritonitis due to any cause. Such abscesses are obscure both as to their symptoms and physical signs, and are most often diagnosed as sub-phrenic, or sub-hepatic, abscesses. If the abscess enlarges towards the anterior abdominal wall, it may come forward between the liver and the stomach; it may push the stomach in front of it; or again, it may present between the stomach and the transverse colon. The physical signs differ according to the relation of the anterior part of the abscess to these viscera, and where it lies directly behind the stomach there may be resonance on percussion all over the surface of the abscess. The size of the abscess cavity will depend on its limitations by adhesion within the lesser sac, or by the closure of the foramen of Winslow. In nearly all cases there is upper abdominal pain, with distension, anorexia, and some degree of fever. Hiccough may be a troublesome symptom. The abscess may transmit aortic

pulsation to the abdominal wall, which may be both seen and felt.

Treatment.—In suspected cases of suppuration in the lesser sac, exploration is clearly desirable, and the incision should be planned over the most prominent part of the swelling; the abscess may be drained through a vertical slit in the gastro-hepatic omentum, but if it presents between the stomach and the transverse colon, a drainage tube may be inserted below the stomach;—by the former method, however, the abscess is entered directly, and the tube can also be more easily secured if it is passed above the lesser curve of the stomach. The tube must be kept in for several days, but must not be allowed to become adherent to surrounding structures.

Perigastric Abscess

From the clinical aspect, the most important instance of suppuration around the stomach is the epigastric abscess. Such suppuration is due nearly always to infection through the wall of the stomach; in some 3 to 5 per cent. the primary cause is gastric carcinoma (Fenwick), and the rest are due to minute perforations of simple ulcers. There is a tender swelling present in the epigastrium, and in those cases where treatment is delayed, there is a tendency for the abscess to discharge through the umbilicus. The sour, acrid odour of the pus suggests a gastric origin, and in some instances a gastric fistula may follow either rupture of the abscess or treatment by drainage. These fistulæ, however, usually heal spontaneously, and the only troublesome feature is the tendency to auto-digestion of the abdominal wall at the mouth of the sinus; the dressings should be soaked in a solution of sodium bi-carbonate, or other alkali, to neutralise the acidity of the discharge.

Perigastric abscess may at times resemble a circumscribed phlegmonous gastritis, but the latter does not often cause a visible epigastric swelling, although there may be considerable

tenderness and rigidity in this region. The constitutional signs in the latter disease are usually severe.

Residual Abscess

This generic term is applied to the various localised collections of pus which are discovered after the surgical treatment of diffuse peritonitis has been carried out. They may be found in any situation, and many of those previously described under special names may be residual abscesses. The modern treatment of general peritoneal infection, by confining operation almost solely to the focus of primary infection and its immediate neighbourhood, might appear to favour the formation of residual abscesses, for doubtless many pockets of pus may be left in the abdominal cavity at the close of the operation. However, with adequate pelvic drainage, and the adoption of the Fowler position, clinical experience shows that such abscesses are rather more rare than formerly; but the abdomen must be carefully examined from day to day when the dressing is done, and suspicion should be aroused if there is evidence of localised swelling, resistance, or immobility, at some distance from the wound. The patient usually complains of some pain, but it often does not correspond to the area of tenderness over the residual abscess, and definitely localised tenderness and resistance is in our opinion the most accurate guide to the presence of localised pus during peritoneal convalescence. The temperature and pulse are often not affected. It must be remembered that a certain number of these abscess cavities contain gas, and therefore dulness on percussion may not be present.

Treatment.—In cases where a residual abscess is suspected, exploratory operation is justified, and should not be postponed too long, for if an abscess is forming a large part of its wall will be made up of intestine, matted together by adhesions which in themselves constitute a protection against re-infection of the general peritoneal

cavity; but they may also become a cause of obstruction. It is therefore desirable to wait only until there are signs that some part of the abscess is close beneath the parietal peritoneum, usually evidenced by percussion dulness, and the abscess may then be entered through a muscle splitting incision without traversing the peritoneal cavity.

Complicated Tuberculous Peritonitis

Tuberculosis of the peritoneum, so long as it remains a simple tuberculous infection of the serous membrane, is usually a chronic, or at the worst a subacute, lesion. Acute tuberculous infection of the peritoneum does, however, take place, but it is usually a part of acute miliary disease, and does not necessarily cause abdominal symptoms. The forms of tuberculous peritonitis with which we are concerned are those in which some secondary abdominal catastrophe has ensued, such as acute intestinal obstruction or suppurative peritonitis.

Etiology and Pathology.—Tuberculous peritonitis occurs at all ages, but, if we include tuberculosis of the mesenteric glands, the disease is much commoner in children than in adults. The commonest period in the latter is between twenty and thirty years of age, and females are affected more than males, owing to the occurrence of tuberculous salpingitis. In later adult life there is no doubt that cirrhosis of the liver predisposes to peritoneal tuberculosis. The precise relationship between bovine and human tuberculosis is still *sub judice*, but it seems reasonable to suppose that the ingestion of tubercle bacilli in milk, and other foodstuffs, accounts for at least a large proportion of the cases of intestinal and peritoneal tuberculosis. Tuberculous ulceration of the intestine is common in phthisical patients, and is accounted for by the swallowing of tubercle bacilli in the saliva. Tuberculosis of the peritoneum predisposes to abdominal catastrophes by causing adhesions which bind down the intestinal coils to one another, to the abdominal

wall, to the omentum or to the mesentery. Mesenteric tuberculous adenitis causes similar mischief by producing adhesions between the glands and adjacent coils of intestine, or by breaking down into abscesses producing suppurative peritonitis. Tuberculosis of the intestine may lead to adhesions, to ulceration, with secondary infection of the peritoneum by intestinal organisms, or to gross perforative peritonitis. Of all these lesions obstruction by adhesions between intestine and mesenteric glands is probably the most common.

Clinical Aspect.—Symptoms pointing to the tuberculous origin of the disease may be entirely obscured by the secondary intestinal obstruction or peritonitis, and the complete diagnosis can be made only where a full history is obtainable, or where there is extra-abdominal evidence of tuberculosis. Nevertheless it should be remembered that, if intussusception be excluded, adhesions to mesenteric glands is probably the commonest cause of intestinal obstruction in children, and that any case of tuberculous peritonitis may suddenly develop grave symptoms calling for urgent surgical interference.

The following varieties of tuberculosis of the peritoneum are commonly recognised—

(1) *Acute miliary tuberculosis.*—Here there may be neither symptoms nor physical signs of abdominal disease, and the process is part of a generalised tuberculosis.

(2) *Ascitic form.*—In this condition the patient exhibits failure of general health with loss of weight and abdominal discomfort ; the appetite becomes poor, and constipation is generally troublesome. There may be some irregular fever and a tendency to night sweats. There is at first some tympanites, and gradually fluid collects within the peritoneal cavity, so that persistent enlargement of the abdomen is observed. Dilated venules may be seen on the surface of the abdominal wall. The encysted ascitic form produces cysts which resemble ovarian cysto-adenomata in women, and urachal cysts in young children.

(3) *The suppurative or ulcerative form* may occur at

any age, and is characterised by failing health, irregular fever, discomfort, tenderness, and griping pains in the abdomen, which is tumid and has an elastic feel on palpation. There is often alternating constipation and diarrhœa, and examination of the abdomen reveals multiple tumours composed of enlarged glands, adherent coils of gut, and rolls of omentum. These masses are tender, of irregular size, and more or less fixed; the omentum may become rolled up to form a transverse bar, with resonance above and below it. There is often also evidence of free fluid. Rectal and vaginal examination may show the presence of masses in the pelvis.

(4) *Obliterative form.*—The leading symptoms here are flatulence, constipation, and abdominal pain. The intestines become bound together in masses, which become fixed to the parietal peritoneum, so that the cavity tends to become obliterated.

Apart from tuberculosis of mesenteric glands, it is clear that the third form is the one which is most likely to lead to the complications of obstruction or suppurative peritonitis, and the clinician must be guided in his diagnosis by the history of previous ill-health, by any abnormal signs that have been observed, and by such signs of tuberculosis of the peritoneum as are not masked by the secondary lesions. The co-existence, for example, of visible peristalsis and multiple abdominal tumours is highly suggestive of tuberculous peritonitis with obstruction by adhesions, if carcinoma can be ruled out, and if it is certain that the palpable masses are not fæcal.

Treatment.—Simple tuberculous peritonitis may be treated by open air, tuberculin, or surgical operation, and, as regards the last, the ascitic form undoubtedly yields the best results from operation. In other varieties of tuberculosis of the peritoneum, tuberculin treatment at the present time appears the most successful, but where the patient is suffering from obstruction or suppurative peritonitis, there can be no question as to the need for surgical

intervention. Where obstruction is due to adhesion between mesenteric glands and the bowel wall, enterolysis can usually be effected without difficulty, but the raw area of the intestine may require infolding, and, in order to prevent recurrence, removal of the glands is sometimes practised; however, the first duty of the operator is to relieve the obstruction, and this must be done in accordance with the vitality of the intestine concerned; the tuberculosis may be left for subsequent treatment. The following case of purulent peritonitis secondary to tuberculosis is of interest.

P.S. Female, aged 12.

History. Six weeks failure of health with vague abdominal pain, but neither vomiting nor constipation. Acutely ill for 1 week; vomiting occurred on the third day; bowels not open for 5 days before admission to hospital. Abdominal pain, increasing in severity, and not localised to any particular zone.

State. Abdomen distended only in the lower half, and more prominent on the left than the right side. A visible semi-cystic tumour occupied the umbilical region, but it projected more to the left than the right of the middle line. There was some rigidity over this swelling, and the whole abdomen was slightly tender. Percussion dulness was present in the left iliac fossa and left lumbar region, but the note over the prominent area was resonant. There was no evidence of disease in the right iliac fossa. Rectal examination revealed a large nodular mass, which was clearly the lower limit of the cystic tumour mentioned above. The tongue was dirty. Temperature 103° F., Pulse 124. Facial expression rather anxious.

Operation. On opening the abdomen, a large gas-containing abscess was immediately entered, and at least half a pint of very offensive pus and a good deal of gas made its escape. The parietal peritoneum was greatly thickened, and tubercles were present in large numbers on all the peritoneal surface exposed; the Fallopian tubes were greatly thickened, and the intestines were matted together. A search was made for an intestinal perforation, but as none could be found, it was assumed that the presence of the gas was due to microbic activity, and the cavity was drained with a large tube. The child was nursed in the Fowler position, and had six pints of saline by subcutaneous infusion during the first 24 hours. The bowels acted on the second day, after the administration of magnesium sulphate, but subsequently enemata had to be given on alternate days to obtain a satisfactory result. For the treatment of the

intestinal adhesions intra-muscular injections of fibrolysin were given in six doses of 2·3 c.c., and the bowels then acted naturally. For the treatment of the tuberculosis, bovine tuberculin was used in progressive doses starting with 1/20,000 milligramme one month after the operation. Convalescence was slow, and three months after the operation two tuberculous ulcers appeared on the face; these were scraped, and healed completely in ten days. The abdominal mass could not be felt either by rectal, or abdominal, examination two months after the drainage of the abscess, and at the end of another three months there was only a small sinus present. This subsequently closed, and the child has continuously increased in weight and enjoyed good health up to the present date.

Diseases of the Omentum

Torsion

Torsion of the omentum may occur in a hernial sac, or within the abdominal cavity. Primary abdominal torsion is distinctly rare; Corner and Pinches (Trans. Med. and Chirurg. Soc., Vol. 88, 1905) give details of only six cases. Inside the sac of a hernia torsion of the omentum is not uncommon, and the symptoms it produces are those of some degree of strangulation, associated with the presence of an irreducible hernia; in some cases the origin of the twist may be attributed to the existence of a hernial sac, but the omentum may be withdrawn into the abdominal cavity and yet the symptoms persist. Concerning torsion apart from the presence of a hernial sac, no satisfactory explanation can be given, but it is to be observed that in all the six cases collected by Corner and Pinches, the tumour was in the right half of the abdomen. The symptoms are very variable, and *pain* is the only one which is constantly present. Vomiting and constipation may be observed, but there may be diarrhœa. In some cases the clinical picture has been that of obstruction, with considerable abdominal distension due to reflex paralysis of the intestine. The temperature and pulse rate are usually above normal. There are no physical signs which are at all characteristic

of this lesion, but in cases where the history points to hernial trouble, and an empty sac is associated with the presence of an abdominal tumour on the same side as the hernia, a suspicion of twisted omentum may be aroused. In cases of pure abdominal torsion there is definite local resistance, or even a palpable mass, in the abdomen, but as we have already stated this is situated in nearly all cases on the right side, and therefore the appendix comes under suspicion. In the female such a lesion would probably be mistaken for a small ovarian cyst with twisted pedicle. The following case, which has come under our notice, was not included in the series of Corner and Pinches, but here also the clinical characters suggested the diagnosis of appendicitis.

FIG. 13. Torsion of Omentum (Dr. Hedley's case, B. M. J., 1911).

Primary Torsion of Omentum. J. H. male, aet. 40.

No history of previous attacks of abdominal pain, and no history of hernia at any period of life. Dull pain in outer and lower part of right iliac fossa observed for two days, with gradually increasing severity. No vomiting and no nausea. The pain shifted somewhat from the right iliac fossa towards the umbilicus. The bowels were freely open. Temperature 100 F., pulse 72, respirations 20. There were no other symptoms, and the only definite physical sign was the presence of tenderness in the right iliac fossa, where some resistance was encountered. The abdomen was opened by displacement of the right rectus inwards, and a large portion of the right half of the omentum was found to be congested, owing to torsion and secondary thrombosis.

The twisted omentum had a definite pedicle and exhibited 1½ turns from right to left; it was easily ligatured and ablated. The appendix was found to be normal, and no trace of a hernial sac could be discovered. No cause for the torsion could be found, and the patient made a rapid and uninterrupted recovery.

Treatment.—In the case of the torsion associated with a hernial sac, the natural course of operation will be to explore the hernia first, and the twisted omentum may be drawn down through the sac. In instances of abdominal torsion, coeliotomy by displacement of rectus is indicated, and all that is necessary is simple ligature and excision of the involved omentum, which is often definitely pedunculated.

Epiploitis

Acute inflammation of the omentum may be suppurative, or non-suppurative. It is common as a pathological sequel to appendicitis, and often-times the limitation of inflammation by a barrier of omentum accounts for the escape of the patient from general peritonitis. Occasionally an inflamed appendix may be enclosed within a ball of inflamed omentum, and this useful structure also forms protective adhesions in many other acute abdominal lesions. Epiploitis may also follow operations on the abdomen, or for hernia, and may be due to infection by ligatures.

Symptoms and Physical Signs.—Fever, abdominal pain, and tenderness are usually present. Vomiting may occur, but nausea is more usual, accompanied by constipation and loss of appetite. The tongue is furred, and a tumour is found in the abdomen, which may have the characteristic plaque-like feel of an omental mass lying close beneath the anterior abdominal wall.

Diagnosis.—Most of the cases are met with after hernial operations, and the diagnosis can be deduced from the history; but if met with as a primary disease, epiploitis may closely resemble tuberculous peritonitis, or even abdominal carcinoma.

Treatment.—Unless there are urgent symptoms, or high fever, suggesting the existence of suppuration, it is best to adopt purely medical treatment in the first instance. The patient should be confined to bed, and placed on a light diet, the pain being relieved by hot fomentations. When the acute symptoms have subsided, removal of the omental masses is desirable, and the line of excision must be well on the healthy side of the inflamed tissue. Omental abscesses should be treated by simple drainage, if the abscess is large and the omentum adherent to the parietal peritoneum ; in other cases, where the abscess is small, excision of the diseased area may be carried out with advantage. In every instance where omentum is removed it is important to remember that if inflamed tissue is left behind it is liable to be the cause of obstruction by adhesions.

CHAPTER V

INTESTINAL OBSTRUCTION

A DISTINCTION is often drawn between "acute" and "chronic" intestinal obstruction, and it may be possible both clinically and pathologically to distinguish between these conditions; although we wish, for the most part, to restrict ourselves to acute abdominal disease, it is not desirable to omit consideration of chronic obstruction, inasmuch as both conditions call urgently for surgical interference, and since chronic obstruction, if not relieved, must inevitably become acute. Clinically, *acute obstruction* is manifested by the sudden onset of abdominal pain, vomiting, and constipation, often occurring in an individual, who, before the attack, was thought to be in good health; *chronic obstruction* varies in degree from mere difficulty in obtaining regular action of the bowels, to recurrent attacks of painful constipation, accompanied in some instances by vomiting. Pathologically, the two conditions are more widely separated; the chronic form depends upon the progressive diminution in the size of the lumen of the bowel, whereas acute obstruction is characterised not only by arrest of the fæcal flow, but also by impairment of the blood supply of the intestine. This vascular change may affect only a small or a large portion of the gut, but in either case it is the essential factor in the production of urgent symptoms, and is responsible for the early fatal issue of the case if the condition remains unrelieved. The commonest example of acute intestinal obstruction is afforded by a strangulated external hernia,

with which we shall deal in a subsequent chapter; here the vascular changes are the most prominent feature from the onset of the attack, where interference with the blood supply of only a portion of the bowel wall, as in Richter's hernia, is sufficient to produce the gravest symptoms. Chronic obstruction is most often seen in cases of carcinoma of the colon or rectum, where the growth produces an annular stricture, which impedes the onward progress of the solid, or semi-solid, fæces contained in the large intestine.

Etiology of Obstruction

A careful analysis of 500 cases of obstruction admitted to St. Thomas's Hospital during a period of twenty years reveals the following causes :—

Lesion.	No. of cases.	Percentage.
Intussusception	197	39·4
Carcinoma of cæcum and colon	78	15·6
Adhesions (mainly affecting the small intestine)	61	12·2
Bands (mainly affecting the small intestine)	49	9·8
Carcinoma of rectum	48	9·6
Volvulus	20	4·0
Meckel's Diverticulum (causing obstruction by abnormal adhesions)	14	2·8
Simple Stricture	12	2·4
Gallstone impaction	6	1·2
Strangulation through mesenteric aperture	4	0·8
Internal Hernia	4	0·8
Paralytic obstruction without discoverable cause	4	0·8
Pressure from tumour outside bowel	2	0·4
Carcinoma of small intestine	1	0·2

Only those cases were selected which were operated upon

for obstruction, or in which inte nal obstruction caused death before operation could be performed; the causative lesion was therefore accurately determined either by laparotomy or *post mortem* examination. It will be noted that in this list there is no mention of fæcal impaction, a condition which the older text-books stated to be one of the commonest causes of obstruction. It rarely, however, causes acute symptoms, and it yields to medical treatment in the shape of enemata and aperients, and is in reality only an extreme degree of constipation, not associated with impairment of the vitality of the bowel, and therefore not characterised by severe abdominal pain or repeated vomiting. In so far as these 500 cases are concerned, the only instances of fæcal impaction have been one or two cases where fæcal matter, with foreign bodies, such as plum stones, has been impacted behind organic strictures, usually of carcinomatous origin. Fæcal matter in the large intestine usually becomes arrested in the rectum or pelvic colon, the cæcum, or the transverse colon. If it forms a palpable tumour, this is usually too large to be only a malignant stricture of the bowel in whose course the tumour lies, and a mass of fæcal matter usually retains the doughy feel of hardened fæces which can be indented by the examining finger. If doubt exists as to the presence of organic obstruction, the administration of several large enemata, repeated at short intervals, will usually settle the differential diagnosis between pure fæcal impaction and organic obstruction. In the former case this method of procedure will rarely fail to relieve the symptoms completely, while in the latter only slight relief can be expected, and often the enemata will produce no result at all.

Causes of intestinal obstruction other than those of the above table may occasionally be met with, but in order to keep as far as possible to the clinical aspect of our subject we will first consider the general symptoms and physical signs of obstruction, and then the above types in detail.

Symptoms

Constipation, abdominal pain, and vomiting are the three most prominent symptoms of obstruction, and the sequence of their onset is an indication of the acuteness of the lesion. In those varieties, such as obstruction by bands, or intussusception, where strangulation of the bowel occurs early, pain and vomiting make their appearance often before retention of fæces is observed ; whereas, in cases of stricture of the bowel, constipation is often observed for days or even weeks before the onset of noticeable abdominal pain, and vomiting appears only when the vitality of the bowel wall is becoming impaired by the pressure of retained fæcal matter. Herein, too, lies one of the salient differences between small and large bowel obstruction, for in the former the important factor is strangulation, while in the latter it is diminution of the lumen of the bowel. To put the matter a little differently, the higher the obstruction in the intestinal tract, the more acute the symptoms, because the lesion is more likely to be one which strangulates the bowel ; the lower the obstruction, the more the case resembles simple constipation. The thicker wall of the large intestine affords more protection to its blood-vessels, and for this reason, and because of its limited mobility, strangulation of the colon is rare. The fact that the small bowel is a more delicate nervous structure than the large also accounts partly for the severity of the symptoms in high obstruction.

Constipation may be absolute, neither fæces nor gas being discharged, but it is quite common for the contents of the bowel below the lesion to be evacuated. The occurrence of this is not entirely dependent on the site of the obstruction, for whilst the emptying of the colon is not mechanically interfered with where the case is one of small bowel obstruction, yet strangulation of a portion of the small intestine often inhibits peristalsis of the whole intestinal tract below the lesion, while vigorous and even visible peristalsis may be going on above it. It is always important to ascertain, in

the absence of fæcal discharge, whether gas has escaped from the anus, as this may be some indication of the degree of the obstruction, and it is more likely to occur in small than in large bowel lesions.

Pain is usually most acute in those cases where the obstruction is due to strangulation, such as occurs in association with an adherent Meckel's diverticulum or internal hernia ; in intussusception it is commonly the first symptom observed. This initial pain is probably due to stimulation of the nerves of the mesentery, and is usually associated with shock, which in a few cases may not be recovered from, death taking place from intestinal obstruction and shock before vomiting or constipation have had time to become noticeable symptoms. In the majority of cases, however, the pain is intermittent and colicky in nature, its exacerbations being often coincident with powerful and visible intestinal movement. The site of the pain may be at first localised, but as the case progresses, it becomes more diffuse ; this is an important differential symptom from appendicitis, where pain is at first diffuse and becomes localised later in the right iliac fossa. It is not uncommon, however, for acute abdominal pain, from whatever cause, to be referred to the umbilicus. In obstruction due to stenosis of the bowel wall the pain usually increases slowly, and definite localisation of it may be associated with paroxysmal rigidity of the gut above the stenotic obstruction.

Vomiting is a prominent symptom and quickly follows the onset of pain. To it have been applied the two adjectives "*projectile*" and "*regurgitant*" ; the former because the intestinal contents are usually ejected forcibly, and the act is associated with powerful contraction of the abdominal muscles and diaphragm, while the regurgitant character of the vomiting is evidenced by the fact that the vomit changes progressively from a gastric to a bilious, and then to a fæcal character. Several explanations of this latter phenomenon have been advanced, one of which is reversed peristalsis, which does not commend itself to many authorities; it

certainly is very rarely observed when the abdomen is opened for the relief of obstruction, such peristalsis being nearly always seen to pass in the normal direction. It has also been suggested that as the intestinal contents are forced against the face of the obstruction, an axial or marginal reflux current is produced, and that this will account for the ease with which the intestinal contents reach the stomach. On the other hand, neither of these explanations is necessary, and the true cause probably rests on simple hydrostatic principles. In obstruction, and in many cases of peritonitis, the bowel becomes filled with fluid; during vomiting, the cardia is relaxed, while the pylorus is contracted; when vomiting has ceased, the cardia in its turn is closed; relaxation of the musculature of the stomach tends to produce a potential vacuum, and if at any time the pylorus is relaxed, fluid will of necessity flow from the duodenum into the stomach, and thus a siphonage of the intestinal fluids is initiated. It is probable that distension of the bowel and the pressure of fluid will render even the ileo-cæcal valve incompetent, so that the contents of the colon, rendered fluid by excess of intestinal secretion and the action of imprisoned organisms, may flow back into the ileum. It is not necessary for the intestinal canal to be full of fluid for this reflux stream to be started, since gases under pressure obey the same laws as fluids. In the persistent vomiting of sea-sickness, bile and the contents of the duodenum are drawn back into the stomach, and the reason why the process goes no further is that the gas contained in the small bowel is at low pressure and the amount of fluid contents is small. Vomiting of formed fæces does not occur in obstruction unless there is a fistulous communication between the stomach and the colon, and this is a very rare event, so that by the term fæcal vomiting is meant the ejection of fluid matter having the colour and odour of fæces. "Black vomit" may be seen, though this is more common in general peritonitis than in pure intestinal obstruction; this colour is due to altered blood pigment.

Unrelieved obstruction leads to the transmigration of infective organisms from the bowel to the peritoneum, so that it is difficult to say when the symptoms of obstruction give place to those of peritonitis, but as regards the vomiting, diffuse peritonitis causes functional insufficiency of the muscles concerned in emesis, and therefore the projectile vomiting of obstruction gradually yields to the easy overflow vomiting of peritonitis; the mechanical explanation being the same as that which accounts for the backflow of intestinal fluids in obstruction, since the stomach remains unparalysed. In peritonitis without obstruction, the vomiting rarely becomes fæcal, but it must be remembered that as obstruction leads to peritonitis, so also does peritonitis cause obstruction by adhesions, and pure peritonitis often leads to the accumulation of fluid within the walls of the bowel and thus favours the production of fæcal vomiting. Speaking generally, however, early fæcal vomiting may be regarded as a valuable sign of intestinal obstruction, but it does not serve to distinguish between large and small bowel lesions, for the decomposition of the contents of the small intestine may readily give rise to a fæcal odour due to the action of organisms on proteid substances. That the vomiting is primarily a reflex nervous phenomenon is evidenced by the fact that it occurs in cases of strangulated omental hernia almost as readily as when the sac contains bowel. The effect of this persistent vomiting, associated as it is with accumulation of fluid inside the bowel, is to deprive the tissues of the body of their much-needed fluid and lead to severe constitutional symptoms.

Constitutional Signs of Obstruction.—The face is pallid and shrunken, the expression anxious, the complexion muddy; the eyes become sunken, and when collapse supervenes, the skin is covered with a cold sweat. The *pulse* does not increase much in rate until the later stages of the illness, but it decreases in volume at an early period; as the obstruction is followed by peritoneal infection, the pulse rate rises, so that it becomes both rapid and feeble. This

slow increase of pulse rate possesses some diagnostic value in deciding between peritonitis and obstruction, when the case is seen early. *Respiration* is usually shallower than normal, and to compensate for the loss of depth the rate is a little increased. *Fever* is not common; the axillary temperature is often subnormal, even after the early shock is recovered from. Here again consecutive peritonitis may be suggested by a rise of temperature. The *tongue* is thickly furred, and subsequently becomes brown and dry; the breath is offensive; extreme thirst is usually complained of. The *urine* is scanty and high-coloured, or in some instances there may be suppression; this is most often seen when the lesion is high up in the bowel, and is accounted for by the loss of fluid by constant vomiting and the failure of intestinal absorption. If the obstruction remains unrelieved, all these constitutional signs will become more and more evident until the patient dies, within a week, in coma.

Abdominal Physical Signs.—*Distension* of the abdomen occurs in nearly all cases, except those in which the site of the obstruction is high up in the small intestine; its distribution varies with the position of the obstructive lesion, and will be again referred to in discussing the varieties of obstruction. *Visible peristalsis** is one of the most valuable signs of obstruction; though it is observable in normal patients with very thin abdominal walls, and may occasionally be present in violent attacks of colic, yet its presence points strongly to organic obstruction, and its direction and the pattern which it produces are helpful in localisation of the lesion. It is best seen in cases of small intestine obstruction and it tends to disappear as peritonitis supervenes. *Respiratory excursion* of the abdominal wall is usually retained in pure obstruction until the distension becomes very marked or the patient suffers from consecutive peritonitis. It is shallower than normal, but between the attacks of pain it is usually fairly free. The localised absence of respiratory movement, seen especially in peritonitis

* For description of types of visible peristalsis, see pp. 42–46.

associated with appendicitis, is not seen in obstruction unless there is extreme local distension. ***Rigidity*** of the abdominal wall is a characteristic of peritonitis and not of obstruction, and though the abdominal wall may be tense from the distension of the subjacent bowel, yet palpation is usually readily permitted, and does not cause much pain. *Local tenderness* on firm pressure is however, met with in obstruction, and may from its position in the course of the bowel, suggest a strangulating lesion of the small intestine or a malignant stricture of the colon. A ***palpable tumour*** is sometimes present, but one must remember that local distension of bowel may produce a resistant swelling; the hardening of the bowel associated with a small tumour is a valuable sign, and may be termed ***palpable peristalsis.*** This is most often met with in cases of intussusception and stricture of the large intestine. It may at times be difficult to distinguish between palpable peristalsis and local rigidity of the abdominal wall, and it is often desirable, especially in cases of suspected intussusception in young children, to administer chloroform to eliminate the rigidity of the abdominal muscles. *A **fluid thrill*** is sometimes elicited in cases of obstruction, and it is then due partly to free fluid in the peritoneal cavity, and partly to the fluid in the lumen of the bowel, for it is rare for intestinal obstruction to cause sufficient ascites for this alone to yield the phenomenon. A local fluid thrill, not transmitted from one side of the abdomen to the other, may be met with where the fluid is confined to the bowel. *Splashing* can often be produced by alternate pressure of the hands over distended small intestine. *Dulness on percussion* is often present in the flanks, and, if the position of the patient is altered during percussion, it may be found that the dulness shifts, which is regarded as a sign of free fluid; this, however, may take place when the fluid lies within the bowel, so that it is a sign which must be interpreted with caution, especially as collapsed bowel yields a dull percussion note. Usually, bowel which is distended with a quantity of fluid and a little gas, gives a flat, yet

high-pitched note. If one is in doubt whether the case is one of obstruction or local peritonitis, rolling the patient over to examine for the sign of shifting dulness is hardly desirable, since in the latter case there is some risk of favouring a spread of the infection, and the information obtained is hardly commensurate with the risk to the patient. *Audible peristalsis* is of varying degree; in some cases, where gas is forcing its way through the obstructed coils, one hears loud borborygmi, and a stethoscope is not needed; but auscultation often yields valuable information, as the less audible the peristalsis, the more likely peritonitis is to be present.

Rectal Examination may reveal the presence of a tumour in the bowel wall or palpable through the wall of the rectum. It is especially valuable in cases of intussusception, where bimanual examination by the rectum and abdomen often demonstrates the presence of the causative lesion. *Ballooning of the rectum* is met with in cases of high rectal carcinoma, or malignant stricture of the pelvic colon. It is, however, too inconstant to be of much diagnostic value, and is actually found in many conditions apart from obstruction.

Vaginal Examination.—Here again valuable information may be obtained, more often by the discovery that the pelvic organs are normal than by finding a tumour which is causing obstruction, though this is occasionally felt by vaginal examination.

Examination of Sites of External Hernia.—This must never be neglected, and the patient's clothing must be pulled down low enough to expose the femoral as well as the inguinal regions, for a strangulated femoral hernia often causes visible peristalsis and other phenomena associated with intra-abdominal obstruction.

Diagnosis of Obstruction from other Conditions

This is often fraught with difficulty, and a correct conclusion can best be arrived at by a careful consideration of the previous history of the patient, the order of onset of the

existing symptoms, and the recognisable physical signs. The gums must be examined for the presence of the blue line of plumbism, the knee jerks and pupils must be examined to eliminate intestinal crises, and at the same time it must be remembered that a patient who works in lead, or a tabetic, may have organic obstruction. Examination of rectum, vagina, and the hernial orifices may throw light on the forms of pelvic peritonitis and e[illegible] hernia. Colic in its many forms is not usually accompanied by abdominal distension, and the localisation of t[illegible] ge to the right hypochondrium, the lo[illegible] ugh the epigastric region, or the course of the colo[illegible] ; the successful administration [illegible] purge will often confirm the diagnos[illegible] In adults does sometimes lead to paralytic obstruction and consecutive peritonitis, and where the bowel is inverted the case presents the signs of obstruction, but, as a rule, enteritis produces diarrhœa, and not [illegible] distension. In children the diagnosis between enteritis [illegible] intussusception is usually made by the discovery of an abdominal tumour in the latter disease, in which vomiting is often not a marked feature of the case, though diarrhœa is met with. ***Gastric and duodenal perforations*** are diagnosed on the possible history of preceding dyspepsia, with perhaps hæmatemesis or melæna, the characteristic acute onset, and the gradual loss of liver dulness due to free gas in a non-distended abdomen. ***Peritonitis***, arising from disease of the vermiform appendix or Fallopian tubes, or peritonitis due to such organisms as the pneumococcus, is usually associated with fever ; tenderness and rigidity appear early, and the onset is often signalised by diarrhœa. The presence of marked leucocytosis is in favour of peritonitis. If a case of obstruction is first seen after peritoneal infection has occurred, differential diagnosis may be impossible ; this clinical transition, however, usually takes twenty-four hours.

Acute hæmorrhagic pancreatitis does simulate obstruction very closely, since pain, vomiting, and constipation are

the leading symptoms; the vomiting, however, rarely becomes fæcal, and the pain is limited for some time to the upper half of the abdomen, which is more tender and rigid than in obstruction. *Twisted ovarian pedicle* produces similar but less urgent symptoms; the results of a combined vaginal and abdominal examination may lead to a correct diagnosis.

In none of these diseases, with the possible exception of intestinal colic, is visible peristalsis likely to be met with.

Treatment

In cases such as we are concerned with, treatment must be by operation. When once the diagnosis is made, there should be no delay in preparing for operative relief of the obstruction, although its site may not have been diagnosed. Such preliminary steps should be taken as we have already considered in the chapter on Laparotomy, and the surgeon should have his needles ready threaded for such procedures as resection and anastomosis of bowel, or the formation of an artificial anus. The object of the operation is twofold: to remove the cause of the obstruction and to empty the distended bowel of its retained products; it is likely to fail if the patient goes back to bed with a greatly distended abdomen.

Before the anæsthetic is given, the stomach should be washed out. This is a most important point, and will be appreciated by the patient, the anæsthetist, and the surgeon. The patient will be relieved of much objectionable gastric fluid, there will be much less tendency to vomiting during the course of the operation, and therefore less risk of subsequent aspiration pneumonia. If the condition of the patient warrants it, we prefer a general anæsthetic. We will first discuss the procedure in a case where the cause of obstruction is unknown, and where the condition of the patient is good.

The Search for the Obstruction.—If no satisfactory diagnosis has been made, the best incision is one from four to six inches in length through the right rectus, with the upper

third of its length above the level of the umbilicus. The great merit of this incision is that it gives good access to most of the peritoneal cavity, and brings one directly on to the cæcum and appendix, the state of the former being the criterion between large and small bowel obstruction, and disease of the latter the most common source of error in diagnosis. If, however, the surgeon feels confident that the obstruction is due to growth of the lower colon or rectum, a left rectus incision has the advantage that a satisfactory colostomy may be performed through the incision made for exploration.

As soon as the peritoneal cavity is opened, fluid tinged with blood often escapes, and distended bowel, small intestine or cæcum, presents in the wound; this should be prevented from prolapsing by the gentle insertion of wide gauze plugs, and two fingers of the left hand should be introduced to palpate the pelvis and hernial regions, not forgetting the obturator foramen. If the search is negative, the cæcum should next be examined, and if this is distended we learn at once that the obstruction is in the large bowel; the cæcum is then returned to the abdomen, and the hand is passed down into the pelvis towards its left side to search for the pelvic colon, which, if distended, is easily found through a right rectus incision. Distension of the pelvic colon indicates obstruction in the rectum, or just above it, and further palpation in the pelvis will usually reveal an annular growth of the bowel, or some such obstructing lesion. The diagnosis is made, and treatment consists in performing left iliac colostomy. The original incision may then be closed, and left-sided colostomy performed through a muscle-splitting incision in one stage, the exploratory incision being covered with a sealed collodion dressing before the colon is opened. A rather small Paul's tube should be used, and the actual opening of the bowel must be left till the end of the operation, to avoid contamination of the wounds. The contents of the colon will be quite fluid, and must be seen to escape freely before the patient is sent back to bed.

If the cæcum is dilated while the pelvic colon is collapsed, the lesion lies between these two points, and special attention should be directed to the splenic and hepatic flexures, common sites of ring carcinoma. It is easy to identify the transverse colon by the attachment of the omentum to it, and if this be collapsed, the lesion is almost certainly at the hepatic flexure. When the colon is greatly distended, the localisation of a small annular constriction is often difficult, and much time may be gained by isolating a portion of the bowel, wrapping it round with sterilised gauze pads or cloths and puncturing by means of a trocar or narrow-bladed knife; the bowel may thus be emptied, diagnosis rendered easier, and the patient rid of much toxic fluid. The aperture should be closed with a purse-string suture covered with a couple of Lembert stitches; if the surrounding bowel is carefully protected and the colon washed over with saline, the risk of the procedure is very slight. Having identified the cause of the obstruction, the duty of the surgeon is to relieve it, and it is often not desirable to attempt more than the relief of obstruction. For growth at the splenic flexure, a transverse colostomy may be performed in the upper angle of the right rectus incision, the rest being sealed off with collodion; for carcinoma of the hepatic flexure, a caecostomy in the lower angle of the wound is satisfactory. The operator should, however, ascertain in the case of growth of the large bowel whether there are metastases which prohibit radical operation at a future date, or whether the growth itself is a removable one. If metastatic deposits are present, or the growth is too fixed for removal at a subsequent operation, the formation of an artificial anus well above the growth is the only available course. When the growth is capable of removal, there are several courses open to the surgeon, since immediate resection and intestinal anastomosis are out of the question where acute obstruction is present; these we shall discuss in treating of the special varieties of obstruction.

When the cæcum is not distended, the small intestine must be the seat of the mischief, and as a rule several

distended coils will present in the wound. If the preliminary search with two fingers of the left hand does not reveal the site of the obstruction in the small bowel, these coils may be allowed to escape gradually, being covered with sterilised cloths. Forcible pulling on the coils is most undesirable and may easily lead to rupture of the gut, but, to reach the lowest part of the distended bowel on the proximal side of the obstructive lesion, the coils must be gently drawn out. In cases of high obstruction collapsed bowel is often seen soon after the dilated coils have been exposed, and it may be quicker and easier to run the collapsed gut through one's hands up to the obstruction than to work from above downwards. The most difficult cases are those in which the obstruction is low down in the ileum and due to adhesions in the pelvis ; in these cases the preliminary digital exploration may often reveal the nature of the lesion at an early stage of the operation. In all cases, however, some prolapse of both distended and collapsed bowel is essential in order to be sure that the intestinal passage is restored, which is evidenced by the gradual distension of the previous shrunken coils after the obstruction has been relieved.

The Relief of the Obstruction.—Where it can be done with speed and safety the obstructing lesion should be removed, adhesions must be divided, and bands removed, especially when they are formed by Meckel's diverticulum, the vermiform appendix, or Fallopian tube ; intussusception reduced ; volvulus untwisted ; internal herniæ reduced by traction, and so on. But further than this the condition of the bowel at the site of obstruction must be carefully examined, particularly in cases of strangulation.

Treatment of the Intestine.—In a large number of cases the actual constriction is not tight, and as soon as relief is given the contents of the bowel pass freely on. Here all that is necessary has been done, and the abdomen may be closed with some confidence as to the progress of the case.

A. *When the bowel is viable but the obstruction is severe.*—Here the great danger is that, although the intestinal passage

is restored, yet the bowel may remain in a state of paralysis and the patient may still suffer from toxæmia. The best way to avoid this risk is to evacuate the distended coils and thus give immediate relief to the intestinal musculature from the pressure of imprisoned fluid and gas. To carry out this procedure, all the intestine except the dilated coil just above the seat of obstruction should be returned to the abdomen, and this portion of the bowel should be surrounded with warm sterilised towels to prevent soiling of the peritoneum. It must next be opened by an incision large enough to admit a medium-sized rubber tube which leads to a receiver; the tube should be passed at first only a few inches, and then further, as the flow from the proximal loop of bowel diminishes; in this way a considerable tract of the intestine can be emptied, and it answers better than expression of the bowel contents by "milking" with the fingers, although this plan should be adopted if the condition of the patient is not good enough to justify a procedure that may take some time. When the bowel is satisfactorily emptied, the incision in its walls should be closed with a double row of Lembert sutures and the intestine cleansed with saline. The coil may then be dropped back into the peritoneal cavity and the abdomen closed. If it is thought desirable, the abdominal incision may be partially closed before this evacuation of bowel contents is performed.

B. *When some portion of the bowel is not viable.*—The affected intestine may be at the site of the obstruction or beyond it, according to the nature of the lesion. In such cases, if the lesion be of the small bowel, and the condition of the patient is good, resection and anastomosis is the correct course. A V-shaped portion of the thrombosed mesentery must be excised with the bowel, and it is most important to resect wide of the disease through healthy intestine. Where possible, we are in favour of axial anastomosis, though it is difficult if the proximal end is greatly distended while the distal portion is collapsed, and this condition may render the use of a Murphy's button or Mayo

Robson's bobbin desirable, though simple suture is to be preferred. Special attention must be paid to the mesenteric border of the gut; this should be first secured by a separate stitch which takes up all the coats and the divided mesentery as it passes on to the gut; this stitch may be tied and cut short inside the lumen of the bowel, and the rest of the suturing should be carried on at this portion of the bowel as if the primary fixation stitch had not been applied. Artificial aids to anastomosis do not save much time, and there are grave objections to Murphy's button, since it may exert too much pressure on the bowel wall and produce gangrene beyond the line of suture, or by its weight cause kinking of the loop in which it lies and produce recurrent obstruction, or again, if used in the small intestine, it may not be able to pass the ileo-cæcal valve; on the other hand, these bobbins do enable the surgeon to join distended to collapsed bowel, though the risks attached to this suture are great, as another factor, namely, the infection of the proximal intestine, has to be considered. In some cases it may be wise to close both ends and perform a lateral anastomosis. This introduces a double risk, at the line of anastomosis, and at the closed end of the upper portion of gut, and hence end-to-end union is to be preferred. Whichever method of anastomotic closure is adopted, the upper bowel must be emptied of its contents. We have laid down this course as the best for strangulation of the small intestine because the production of an artificial anus is likely to lead to inanition and severe excoriation and auto-digestion of the skin, both of which will render a second operation for the closure of the intestine dangerous and difficult. If the surgeon, however, knows that he is dealing with the lower end of the ileum, he may trust to the two stage operation, as the state of acute obstruction is most undesirable for anastomosis. The first operation is then concluded by tying a Paul's tube into each end of the bowel after resection through healthy intestine, and the two ends are fixed in the wound. In the case of gangrenous large intestine there can be no doubt that this method of procedure should

always be adopted, and the second stage may be postponed till the patient is quite fit, while in the case of the ileum the second operation must be undertaken, if possible, within ten days, or the patient will be too wasted, and the skin will have become too sore, for the safety of the second operation.

C. *Relief of Obstruction when the Condition of the Patient is bad.*—Under these circumstances the medical attendants must decide whether operation should be performed or not, but unless the patient appears likely to die within a very short time, it is usually worth while running some risk with the chance of saving the patient's life. Gastric lavage often improves the condition and makes operation appear more feasible in severe cases, and the dangers of a general anæsthetic may often be avoided by lumbar or local anæsthesia. In such cases an incision should be made near the mid-line, and a Paul's tube tied into a distended loop of bowel, which should be anchored to the wound; no search should be made for the site of obstruction, as this will prolong the operation and probably increase its risks. This procedure, of course, is only to be recommended where the condition of the patient does not warrant any further steps, and is an operation of only a temporary character. If recovery ensues, the abdomen must be opened, the obstruction treated radically, and the fæcal fistula closed. It does certainly succeed in a few cases where the small intestine is obstructed, but not so severely strangulated as to produce gangrene of the wall of the gut.

After Treatment.—The results of operations for obstruction depend very largely on judicious after-treatment, and it is difficult to lay down definite lines for the treatment, since so much depends on the steps taken at the operation; for example, a case where resection and anastomosis of the bowel has been performed must be managed very differently from one in which obstruction has been relieved by the formation of an artificial anus. Directly after the operation the patient should be clothed in a warm flannel gown, and transferred from the operation table to a bed with warm

blankets and hot water bottles as quickly as possible. The most urgent symptom requiring attention in the first twelve hours is shock, and the essential treatment for this condition lies in the administration of saline. Intravenous infusion may at times be called for before the patient leaves the operating table, and, if so, it should be carried out slowly, so that the abdominal wound and the infusion wound are closed at the same time. It is not desirable to put more than two pints of physiological saline solution (0·9 per cent.) into the veins, as a greater quantity is likely to find its way from the general circulation into the serous sacs and lungs. Adrenalin (1 in 1000 aqueous solution of the chloride) is with advantage added to the salt solution, in the strength of m. 30–60 to the pint of saline. The position of the patient in bed is of the greatest importance, as the surgeon does not know what degree of peritoneal infection may be present. To protect the patient as far as possible, obstruction cases should be treated by posture just as cases of peritonitis are, and the Fowler position should be adopted from the first.

In a few cases of severe shock the return of blood to the heart should be favoured by placing the head low and raising the foot of the bed on wooden blocks, but unless the shock is very severe this position is best avoided, as it embarrasses the diaphragm and tends to cause basal congestion of the lungs; occasionally, however, these risks must be run to save the patient from immediate shock and collapse. Auto-infusion is useful, and consists of the application of firm flannel bandages from the hands and feet up to the trunk, thus returning the blood from the superficial to the deep veins. The continuous administration of saline *per rectum* is indicated in cases where peritoneal infection is present, or where the patient is wasted from loss of fluid from the tissues. It should be commenced before the patient comes round from the anæsthetic, and 10 or more pints may be absorbed in the first twenty-four hours after operation. If the rectal tube is inserted directly the patient is returned to bed, four pints can be slowly run in before consciousness

returns and the patient will not then resent the presence of the metal tube in the rectum. This rectal infusion is not compatible with the early administration of purgatives, but, if the saline is not at first retained, an enema should be given to clear the rectum and pelvic colon. In those cases where saline is not retained by the rectum, continuous subcutaneous infusion may be adopted. Pituitary Extract is a valuable drug, as, in addition to raising the blood-pressure, it stimulates peristalsis; it may be given in 1 c.c. doses of the Burroughs and Wellcome preparation hourly. Strychnine and digitalis may be useful after the loss of blood from the general circulation has been compensated for, and preparations of Ergot, which increase the peripheral resistance, may be used while shock is still present. Morphia, of course, is best avoided, as inhibition of peristalsis is most undesirable; it should only be given in cases of extreme restlessness, and not for the relief of pain. Twenty grains of aspirin in a little saline (2 oz.) will often relieve pain when given by the rectum.

As regards diet and the administration of aperients, much will depend on the precise nature of the operation, and for purposes of description this aspect of the after-treatment may be considered under the following headings:—

A. *Those Cases in which Obstruction has been relieved and the Bowel remains intact.*—Here the treatment is that of an ordinary abdominal operation, except that one is anxious to obtain an early action of the bowels. These are most often instances of small bowel obstruction, and therefore purgatives are indicated rather than enemata. Some surgeons give a dose of calomel (grs. 3–5) directly the patient is able to swallow it, and if this does not act in 6–8 hours, it is followed by a dose of sodium or magnesium sulphate. We prefer, however, to wait at least six hours before giving drugs by the mouth, lest vomiting be excited; at the end of this time two drachms of magnesium sulphate may be given every two hours till the bowels act, or calomel may be given in repeated small doses of gr. ½–1 in a similar fashion.

Repeated small doses of castor oil are best avoided unless one can wait till the third day, as it is very liable to induce vomiting, and it causes needless intestinal discomfort, by acting on the lower rather than on the upper bowel. Flatulence may be relieved by the passage of a rectal tube through the anal sphincters occasionally, the tube being left in position for half an hour at a time. In the presence of troublesome vomiting, enemata are better than aperients, and where there is much abdominal distension an early administration of a soap-and-water enema with an ounce of turpentine will often give great relief, and both flatus and fæces will be evacuated in a favourable case. The vomiting itself must receive attention, and, though it may only be of the post-anæsthetic type, steps should be taken to check it, as it tends to exhaust the patient and throw excessive strain on the abdominal wall; cocaine hydrochloride in doses of gr. $\frac{1}{6}$, or tincture of iodine in drop doses in a little water, repeated half-hourly for three or four doses often succeed, but if these fail, early gastric lavage should be adopted, with plenty of water to which a little sodium bicarbonate has been added. This evacuation of the stomach contents may have to be repeated from time to time, but it usually gives so much relief that it is welcomed rather than resented by the patient.

As regards diet, the object should be to give food which will require little digestion and will be readily absorbed without giving rise to much residuum, or tending to the formation of gas within the bowel. For the first three days the diet should be restricted to fluids. Thirst is often a prominent feature of the early stage of convalescence and there can be no objection to draughts of water up to 5 or 6 ounces at a time, instead of the meagre sips to which the patient is often condemned during the first twelve hours. Even if vomiting is occurring this drinking of water will tend to wash out the stomach; but the amount swallowed at any one time should not be more than a cupful. The sucking of ice does occasionally check the tendency to vomiting,

but if it is persisted in, the mouth gets very dry and the tongue hard, and thirst is not quenched by it. The administration of saline per rectum does much to diminish thirst.

Milk is an excellent fluid food, but where peristalsis is not active it has a tendency to cause flatulence, and the fæcal residue on a milk diet is undesirably bulky. Albumen water, made up with the white of four eggs to a pint of water with the addition of lemon and sugar to taste, is a far more suitable form of fluid diet for the first three days of convalescence, as it is readily absorbed, and does not favour the production of decomposition products and gas in the bowel. An allowance of two pints in the twenty-four hours is sufficient to maintain the patient's strength. Glucose is an excellent and easily assimilated food-stuff, and it is best administered in the form of raisin tea, made by stewing chopped Valencia raisins in twice their bulk of water for two hours, and then filtering. The infusion obtained is a solution of glucose made palatable by the other soluble constituents of the raisin. Barley water may also be used with advantage. These three fluids may well be alternated, and if 4 to 5 ounces are given every two hours the patient will rarely suffer from either hunger or thirst. If it be desired to add milk to the diet, it should be peptonised, and a few ounces may be given in place of other fluids. Plasmon, which contains the proteid elements of milk, may be given after the first day, and somatose and sanatogen can also be added as the case progresses. By the third day the patient should be able to take a little solid food in the form of bread and butter or sponge cake, and as soon as the bowels are found to be acting satisfactorily, perhaps with the aid of a saline aperient or small doses of castor oil, the diet may be steadily increased, the ingestion of abundant fluid being encouraged. Stimulants may be needed in some cases, and, indeed, on the first day, brandy, well diluted with water, is often retained better than any other liquid. If stimulants are used, the best form is either good old brandy or iced champagne, the latter having a beneficial effect in allaying vomiting. Flatulence, in the

later stages of convalescence, may be relieved by the occasional administration of a drachm of Sal Volatile, with a pinch of sodium bicarbonate, in a wineglass of water.

Daily examination of the abdomen must be made to ascertain if there is any evidence of peritonitis, evidenced by imperfect respiratory movement or rigidity of the abdominal wall, or of recurrent obstruction, as shown by distension or visible peristalsis. If no complications arise in the first week, the patient may be allowed to assume any position of comfort that does not throw too much strain on the abdominal wound, and the skin stitches should be removed on the eighth or tenth day; if the stitches go through more of the wall than the skin, it is well to leave them for at least ten days from the date of operation. If the incision is a long one, a large dressing and a firm bandage should be applied even after the wound is healed for another week, and for a period of between two and three weeks, as a rule, the patient should be confined to bed. In the case of old patients it may be well to lift them out of bed on to a couch for a few hours daily after the first fortnight. If there is any sign of weakness in the abdominal scar, the patient should be provided with a belt before he is allowed to get up.

B. *Cases in which the obstruction is relieved by the formation of an artificial anus.*—Here there is little anxiety about obtaining an action of the bowels, and only occasionally will the administration of aperients be necessary. When they are needed, small doses of magnesium sulphate or castor oil will usually suffice. The details of management of the case will vary according as the artificial anus is situated in the small or large bowel. In the former case the risks are those of inanition, and excoriation of the skin; in the latter there may be slight excoriation, but if the patient survives from the shock and is not suffering from consecutive peritonitis at the time of operation, very little special care is needed beyond frequent dressing.

In cases of jejunostomy, the condition of the patient will

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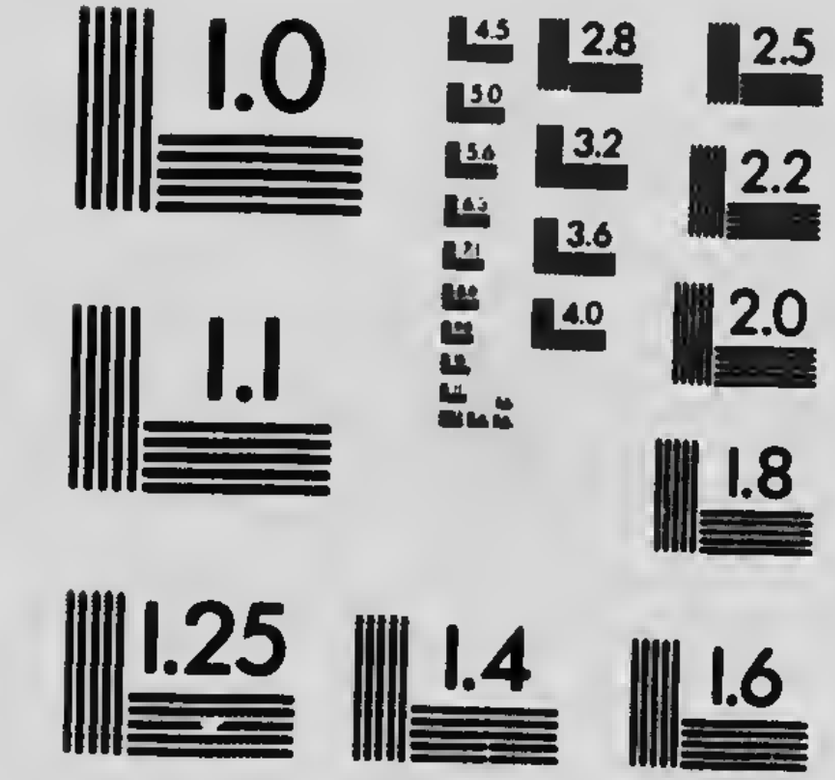

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probably be bad, or this type of operation would not have been performed; stimulants and the administration of fluid by the rectum will probably be needed, while the amount of fluid taken by the mouth should be restricted. As soon as possible, semi-solid food should be given by the mouth in the form of plasmon, somatose, and peptonised beef jelly. The strength of the patient must be maintained, as a second operation has to be faced for the closure of the artificial anus, and to this end mouth feeding may be supplemented by nutrient rectal enemata. Subcutaneous alimentation may at times be desirable, and the best form is a 5 per cent. solution of glucose, of which a pint may be injected slowly beneath the skin twice a day. This solution is isotonic with the blood, is easily absorbed, and can be readily sterilised by boiling. Sterilised olive oil may be used at times, and about two ounces injected subcutaneously every day may be absorbed, and will help to keep up the patient's strength. If a Paul's tube has been tied into the bowel, it will probably become loose about the fourth day, and, as a prophylactic against excoriations of the skin when the tube sloughs out, it should be painted over with "Whitehead's varnish" or "New skin" for an area of some four inches round the wound, and a further zone should be protected by the application of a mixture of zinc ointment and castor oil. As soon as the condition of the patient and of the skin around the artificial anus are sufficiently good, an operation for closure must be performed, and the after treatment then will be such as will be described under the next heading.

When the artificial anus is made in the large intestine, it may be that this is all the surgeon is able to do for his patient, removal of the obstructing lesion, probably a carcinoma of the colon or rectum, being contra-indicated either on account of metastatic deposits or the fixity of the tumour. In most of these cases the diet need only be restricted for the first two or three days, and then there is little special management required beyond care of the skin around the colostomy, and the subsequent provision of a well-fitting

colostomy belt with a cup to fit over the artificial anus. This must be made and fitted before the patient is allowed to get up. In other cases, of course, preparation has to be made, as in the case of small intestine fistulæ, for a second operation for closure.

C. *Where the relief of the condition involves resection and anastomosis of bowel.*—Usually these cases will be instances of small bowel obstruction, as such procedures in the case of the large intestine should be done in two stages, but the precautions needed will be similar after the second operation of the two stage method to those adopted after resection of a small portion of the small intestine. Here the special dangers are peritonitis, which may have been present when the resection was performed, or may result from infection during the operation, or later from leakage at the line of suture, and obstruction at the site of the new intestinal junction. The administration of saline is usually important, and can be readily carried out by the rectum in small bowel anastomosis, and even where the site of junction is quite low down in the large bowel it can be given with safety if it be run in very slowly with a short tube. If it is not tolerated by the rectum, the saline may be given subcutaneously, or into the axilla through a hollow needle which pierces the axillary border of the pectoralis major and passes beneath the deep fascia of the axilla. Diet must be restricted as described under section A, and in the case of small bowel anastomosis the food should be fluid for the whole of the first week. It is true that if an anastomostic junction is sound it is sealed at the end of six to twelve hours from the time of operation, but nevertheless it is well to provide the patient with a diet which is nourishing and easily assimilated, and does not produce much fæcal residuum. In large bowel anastomosis the diet may be a little more generous. As regards purgatives, they should be withheld entirely until the fourth night after the operation, and then a saline aperient is the best, or castor oil may be given in small doses, repeated if necessary. If it is desired to obtain an action of the bowels

at an earlier date, a small turpentine enema may be given, not exceeding one pint in volume where the anastomosis is close to the rectum. Careful daily abdominal examination must be made, and if there are signs of local effusion of peritoneal fluid, drainage may be called for, or in other instances a second operation may be needed for recurrent obstruction. The subcutaneous administration of anti-colon serum in doses of 25 cc., up to three injections in twenty-four hours, appears to be of value in some cases of suspected consecutive peritonitis, the causative organism being usually the *bacillus coli*.

THE COMMONER FORMS OF OBSTRUCTION

I. Intussusception *

Definition.—In this condition, which forms nearly 40 per cent. of the commoner forms of obstruction, one portion of the intestine becomes invaginated into a lower portion, and thus a cylindrical tumour is formed composed of three layers of gut surrounding the central lumen of the bowel, which becomes constricted by the process of invagination.

Etiology.—Irregular peristalsis must be accepted as the causative factor, and from studies of peristalsis produced experimentally by faradic stimulation of the bowel, the drawing up of the outer layer by contraction of its longitudinal muscular bands appears to play a more important part than the descent of an upper into a lower portion of bowel. Sudden, localised, and excessive peristaltic action is therefore the essential cause of intussusception, and it will be conceded that this is more likely to occur in young children, who are especially liable to gastro-intestinal disturbance, than in adults. To obtain accurate information concerning intussusception and its phenomena, we have made

* *Vide* "The Practitioner," November, 1910, "The Clinical Aspect of Intussusception," by J. E. Adams.

a careful analysis of 100 cases treated during a recent period of eight years at St. Thomas's Hospital, and such figures as are quoted are obtained from this investigation.

The length of history together with the results of our cases is given below :—

LENGTH OF HISTORY IN 100 CASES OF INTUSSUSCEPTION.

	Result.	
	Cured.	Died.
Less than one day	17	6
One day and less than two days	21	11
Two days	11	6
Three days	2	11
Four days	4	3
Five days	2	0
Six days	0	1
Seven days	1	1
Eight days	0	1
Fourteen days	0	1
Three months	1	0
Total	59	41

Age.—Exactly 70 per cent. of the cases, including both acute and chronic forms, occurred in children under one year. Eleven cases were in children between one and two years old, thirteen more were less than ten years old, and the ages in the remaining cases were 10, 22, 25, 33, 45, and 60 years respectively. It is therefore pre-eminently a disease of early infancy. Of the seventy cases under twelve months of age, only one was less than three months old, and the commonest age period was between six and nine months. Thirty-one of the children were more than six, and less than nine months of age, and if diet has any bearing on the causation of the disease, it would appear to lie in the transition from a milk diet to a more complex one at the period of weaning and the earliest dentition. We did not find that breast feeding or artificial rearing showed any definite relation to

the incidence of intussusception, and, as the date of weaning among the poorer classes is often postponed till the end of the first year, the influence of diet, if any, must be due to the addition of solids to a hitherto fluid form.

The fact that intussusception is far more often met with in hospital practice than among children of higher social standing is probably to be explained by the ignorance of the poorer mothers and the rash manner in which they augment the diet of their infants.

Sex.—From our investigation we find that males are much more liable to this disease than females, and this difference in sex incidence has been noted by other observers. Sixty-six per cent. of the cases were boys, and it may be that the diet in the case of young male children is pushed with greater rapidity than in the case of girl babies.

Seasonal Incidence.—That intussusception is not more common during the prevalence of "diarrhœa and vomiting" than at other seasons of the year is shown by the fact that sixty-seven of the cases occurred during the first six months, and the remaining forty-three in the second half of the year. The late summer months in our large cities are certainly periods of peristaltic unrest among children of the hospital class, and yet intussusception appears to be least common at that time of year; but the figures at our disposal are, perhaps, too small for any certain deductions to be drawn as to seasonal incidence. Twenty-nine of the cases occurred during January, February, and March.

Preceding Irregularity in Action of the Bowels.—In four cases only was there a history of attacks of diarrhœa and vomiting prior to the occurrence of intussusception, but in twelve instances constipation had been observed by the mother of the child, and six of these latter infants were less than twelve months old. One child aged ten years had had five or six attacks similar to that for which operation was performed and when the intussusception was reduced a "leading" intestinal polyp was discovered. One infant of three months had passed blood for several days shortly

after birth, and another child four months old, had passed blood *per anum* for three weeks before the onset of severe symptoms and the discovery of an abdominal tumour.

Two of the cases included in our series refer to one child, and this is the only case of undoubted recurrent intussusception in the hundred cases; the patient was a boy, five months old, and the first intussusception occurred without diarrhœa, but with pain and vomiting and the presence of an abdominal tumour, and the passage of blood and mucus *per anum*. It was of the ileo-cæcal variety, and was easily reduced by manipulation after opening the abdomen. The convalescence was uninterrupted, but five weeks after leaving the hospital the child was troubled with persistent diarrhœa for several days; when this ceased it was succeeded by a severe attack of abdominal pain with vomiting; an abdominal tumour was present, and blood and mucus were again passed *per anum*. A second operation was performed, and an ileo-colic intussusception was easily reduced; the child made a good recovery. This second operation was performed in 1906, and the child has not been admitted to the hospital since that date. Inasmuch as steps are rarely taken at the operation to do more than reduce the invaginated gut, it appears strange that recurrence is not more common. In this case the second intussusception was not of the same variety as the first. If a large series of recurrent cases could be collected, it would be interesting to note how often the recurrence was of the same type as the primary intussusception.

Anatomical Abnormalities.—Apart from the presence of intestinal polyps, or tumours growing into the lumen of the bowel, no anatomical explanation of intussusception can be found. It is true that the cæcum appears to be extremely mobile in many of the cases, but there is no proof that this condition favours intussusception. It is also remarkable that the jejunum, in the absence of a polyp, appears to be immune from invagination.

Injury.—This has been stated to play some part in the

causation of intussusception, but in only one case in our series was there a history of injury; in that instance a young child fell against a fender five days before admission, and the illness dated from the blow received. An abdominal injury may cause enterospasm and it is possible that this may occasionally favour invagination.

Pathology.—As mentioned above, the diminished lumen of the bowel is surrounded by three layers which are arranged so that mucosa is always in contact with mucosa, and peritoneal coat with peritoneal coat. The outer layer is the sheath, the middle the returning layer, and the innermost the entering layer: the outer coat forms the *intussuscipiens*, while the two inner layers are the *intussusceptum*. There are four common varieties, *ileo-cæcal*, *ileo-colic*, *enteric* and *colic*; the first of these is by far the most common. In an ileo-cæcal intussusception the ileum passes into the ascending colon, preceded by the valve itself, and followed by a variable portion of the cæcum, the essential factor being that the ileo-cæcal valve forms the apex of the intussusceptum; this form may attain a large size and the valve may occasionally present at the anus. In the ileo-colic form the intussusception begins in the ileum, and then passes through the ileo-cæcal valve, while the cæcum stays in position. In both these varieties the initial changes are often followed by invagination of a part, or the whole, of the cæcum into the colon, and the only essential difference between the two forms is that the apex in the first is the ileo-cæcal valve, whereas in the second it is some part of the ileum. An *enteric* intussusception takes place nearly always in the ileum; it may occasionally be double, and more rarely still one intussusception may be invaginated inside another. Intestinal polyps, usually adenomata, are often present in such cases. *Colic* intussusceptions are most common in the descending colon and they are rarely of large size.

This simple nomenclature, however, does not describe precisely what the operator finds in a large number of cases: a more complex state of affairs is often seen to be present.

Sometimes it may be that intussusceptions start at two different points, so that we get a large ileo-cæcal intussusception with a small invagination of the cæcum into the ascending colon, in which case the condition is an *ileo-cæcal* and *cæco-colic* intussusception; or, more often, it may happen that the whole cæcum follows the ileo-cæcal valve, in which case it should be called an *ileo-cæcal* and *cæcal* intussusception. It happens fairly often that there is first a small invagination in the lowest portion of the ileum and then the tumour grows in the manner of the ileo-cæcal variety; this is termed an *enteric-ileo-cæcal* intussusception. An endeavour has been made of recent years to describe the state of affairs revealed at operation or *post mortem* examination with greater accuracy than heretofore, and in the table subjoined the more complicated nomenclature has been reproduced according to the opinion of the operator or the pathologist, though it must be admitted that the operation is often performed with such rapidity that absolutely accurate observation is difficult. An intussusception increases at the expense of the outer layer so that the apex remains unaltered, and as it increases in size the tumour which it forms tends to have a curved outline, due to the traction on the mesentery carried in with the gut. This traction also tends to pull the aperture of the intussusception towards its mesenteric side. Engorgement with blood ensues to a variable degree, and this, coupled with the constriction of the neck of the intussusception, affords the two phenomena which are characteristic of acute obstruction, namely arrest of the fæcal stream and impairment of blood supply. Shock is a prominent feature in the later stages of the disease, and this is due rather to the persistent traction on the mesentery than to the consecutive peritonitis following obstruction.

VARIETIES OF INTUSSUSCEPTION
as observed at operation or *post mortem* examination in 99 out of 100 cases.

1. Ileo-cæcal	35	
2. Ileo-colic	15	
3. Enteric	10	All of ileum (Double with gangrenous inner intussusceptum in one case. Leading polyp present in 3 cases).
4. Colic	10	(Leading sarcomatous polyp in one case).
5. Enteric ileo-cæcal ..	5	(With appendix as part of the intussusceptum in one case).
6. Ileo-cæcal and cæcal	5	
7. Enteric ileo-colic ..	4	(Leading polyp in one case).
8. Cæcal	3	
9. Ileo-colic and cæcal	3	
10. Cæco-colic	2	
11. Ileo-colic and cæco-colic	2	
12. Ileo-cæcal and colic	2	
13. Ileo-colic and colic ..	1	
14. Cæcal and cæco-colic	1	
15. Ileo-colic and ileo-cæcal	1	
16. Variety not stated ..	1	

It has been suggested by Cuthbert Wallace that the terms "ileo-cæcal" and "ileo-colic" should be done away with, and that where intussusceptions involve both small and large gut the term "entero-colic" should be used to describe the variety encountered. If this were done the forms would be reduced to three, namely enteric, colic, and entero-colic. The first two would be "simple" intussusceptions, and the last "compound." Reduced to this method of nomenclature, and including the cæcal with the colic forms, the above series would read thus :—

Entero-colic intussusceptions	73
Colic intussusceptions	16
Enteric intussusceptions	10

It must also be remembered that in rare instances intussusceptions may be multiple.

Mention should perhaps be made of what are termed "agony intussusceptions," which are found at *post mortem* examinations where death has occurred from any cause. They are always easily reduced, and in them the invagination occurs in an anti-peristaltic direction, the intussusceptum being formed from bowel situated normally below the intussuscipiens. They are doubtless due to abnormal contractions of the coats of the intestine during the death agony and do not give rise to symptoms. They may be single or multiple.

Symptoms.—The three leading symptoms are abdominal pain, vomiting, and the passage of blood *per anum.*

Pain.—Definitely absent in only one case out of the hundred. In seven others its presence was not recorded, but it was the most noticeable feature of the disease in ninety-two cases, and was usually evidenced in the case of young infants by a sudden screaming fit with doubling up of the thighs on the abdomen. The one case in which it was absent was that of a child, nine months old, who had an ileo-cæcal intussusception for sixteen hours before admission; this child vomited and passed blood by the anus, and there was an abdominal tumour felt under chloroform in the right hypochondrium; there was some abdominal rigidity, but the child looked healthy and had not cried.

Vomiting.—Present in 90 per cent., absent in six cases. Usually only of gastric contents, but in some cases bilious. Fæcal vomiting was observed in one case, that of a moribund child three months old, with an ileo-colic intussusception of three days' standing. The vomit was stated to contain altered blood in one case, after one day's history, in a child aged six months, with an intussusception of the ileo-cæcal type. Only the second of these two cases was operated upon, but both died, the first of peritonitis, the second of shock. In most instances vomiting occurred shortly after

the sudden onset of abdominal pain, but occasionally vomiting preceded the severe pain in the belly.

Passage of blood per anum.—When this occurs in association with abdominal pain and vomiting in a young child, the possibility of intussusception should always be borne in mind and abdominal examination will usually settle the diagnosis. It is generally considered that the passage of blood and mucus without fæcal matter is a diagnostic sign of this disease. Blood is passed by children as the result of rectal polypi or gastro-enteritis, and a rectal examination should reveal the presence of the former where this is the source of the hæmorrhage. In our cases, blood, usually accompanied by mucus, was passed in 83 per cent.; sometimes, however, the blood was mingled with fæcal matter, and there was no excess of mucus. As a rule the blood is rather dark, and the admixture with mucus gives a resemblance to prune juice. In fifteen cases no blood was passed, but only five of these were children under one year, and its absence in these infants was probably due to the fact that the invaginations were small and not tightly constricted and congested.

In children under twelve months, then, of whom there were seventy in this series, bleeding *per anum* was present in 92 per cent., whereas in cases of intussusception after the age of ten it is unusual, and was present only in one case out of six. This was a female of thirty-three, with an ileo-cæcal intussusception; blood had been passed for three days before operation, at which the invagination was reduced with some difficulty. The presence or absence of this symptom probably depends on the distance the blood has to travel from the lesion to the anus and the relative capacity of this length of the intestinal canal, for the amount of blood extravasated is usually not large. At times the bleeding is so slight that it is barely observed till a rectal examination is made, and the examining finger is found to be stained with blood. In one case, that of a child operated on three or four hours after the onset of symptoms, blood was passed

after the operation although none had been seen before it; this child was only five months old.

Constipation was present during the attack in 33 per cent., in the remainder the bowels continued to act, and this affords proof that these are, as a rule, cases of small bowel obstruction, or that the obstruction to the lumen of the bowel is not complete.

Diarrhœa during the attack was observed in thirteen cases, all young children, and probably due to some enteritis in the neighbourhood of the invagination. This term, of course, applies to the frequent passage of liquid stools and not merely to the recurrent discharge of blood and mucus *per anum*.

Physical Signs.—*General Appearance.*—It is a noteworthy fact that intussusception is an affection of well-nourished and healthy-looking children. In eighty-eight of our cases a note of the general condition was found, and of these, sixty were described as well nourished and healthy looking; nine were well nourished but looked ill, and only nineteen were poorly nourished and weakly. Many of the weakly-looking children were suffering from acute obstruction and peritonitis at the time of their admission, so that it is quite likely that some of these were healthy children before the onset of the illness.

Abdominal distension.—This sign of intestinal obstruction is usually wanting in intussusception.

It was present in only 22 per cent. of our cases and many of these had signs of peritonitis. During operation it is unusual to find much distension of the bowel above the invagination, for the lumen rarely becomes completely closed.

Rigidity of the Abdominal Wall.—Localised rigidity over the tumour is not uncommon, and to abolish this it may be necessary to palpate under chloroform in order to arrive at an accurate diagnosis. Some rigidity was present in thirty-four of our cases, it was absent in fifty-six, and not mentioned in the notes of ten cases. It occurs apart from the

presence of peritoneal infection, but, as these figures show, it is not a common sign of intussusception.

The presence of an Abdominal Tumour.—This is the essential sign of intussusception, and without its presence this condition cannot be diagnosed, but only suspected. It may be necessary to administer chloroform in order to obtain relaxation of the abdominal muscles and abolish crying in a young child, and, in any doubtful case with a history of abdominal pain, vomiting, and the passage of blood *per anum*—especially the last-mentioned symptom—it is the duty of the medical attendant to administer an anæsthetic if ordinary palpation is unsatisfactory.

Nature of the Tumour.—The size of a tumour formed by an intussusception is very variable, but it is generally not large; occasionally, however, it can be distinctly felt in four of the anatomist's nine abdominal regions, as in one of our series of the ileo-cæcal variety. The swelling is cylindrical with a curved outline, due to the pull of the mesentery on the invaginated bowel; its long axis is more or less transverse, and it may be felt in any part of the abdominal cavity. We give a table below which shows the various situations of the tumour in their order of frequency, arranged according to whether palpation was performed with or without the aid of chloroform. Of a hundred cases, sixty-eight possessed a tumour which could be readily felt, nineteen required the relaxation of an anæsthetic to reveal the tumour, while in twelve no tumour was present, but eleven of these did not have chloroform administered for the sake of palpation, as many of them were too ill for any interference. In one only was no tumour discovered after examination under chloroform. The existence or otherwise of a tumour was not mentioned in the notes of one case. The method of palpation adopted is important, and it often requires very firm pressure to feel the tumour between the posterior abdominal wall and the hand; this can best be done by laying the flat hand gently on the abdominal wall and waiting for the relaxation which occurs

at the end of crying, or just before an inspiration; little by little firm pressure will bring the hand deeper into the abdomen, and, if palpation is performed slowly in this fashion, an anæsthetic is often not required.

SITUATION OF ABDOMINAL TUMOUR IN INTUSSUSCEPTION.

	Palpation without chloroform.	With chloroform.
1. Right hypochondrium	14	2
2. Umbilical region	10	4
3. Left iliac fossa	7	0
4. Left lumbar region	5	0
5. Right iliac fossa	5	0
6. Left lumbar region and left iliac fossa	5	1
7. Situation not stated	5	3
8. Epigastrium	2	3
9. Right lumbar region	2	3
10. Left hypochondrium	3	1
11. Left hypochondrium and left lumbar regions	3	0
12. Epigastrium and left hypochondrium	1	1
13. Right lumbar region and right iliac fossa	1	0
14. Right and left iliac fossæ	1	0
15. Hypogastrium	1	0
16. Epigastrium and right hypochondrium	1	0
17. Right hypochondriac and lumbar regions	1	0
18. Epigastrium, left hypochondrium, lumbar region and iliac fossa	1	0
19. Epigastrium and left lumbar region	0	1

ABDOMINAL TUMOUR ABSENT.

Palpation without chloroform .. .. .. 11 cases.
Palpation with chloroform .. .. .. 1 case.
Presence or absence of tumour not stated in one case.

Rectal Examination.—This is a routine procedure in all acute abdominal diseases, and, although the results may be negative, it should never be omitted in cases of suspected intussusception; the following figures show the results obtained in our series.

A. Apex of intussusception felt per rectum in 27 cases. In one of these the apex was visible three inches outside the anus.
B. Apex not palpable, but bimanual examination revealed the presence of a tumour in 5 cases.
C. Rectal examination negative in 58 cases.
D. Results of rectal examination not stated in 10 cases.

Diagnosis.—It is important to remember that not every swelling felt in the abdomen of a young child who is passing blood and mucus *per anum* is an intussusception. The following are the common sources of error:—the lower margin of the liver, Reidl's lobe of the liver, the kidney, enlarged mesenteric glands, and the spleen. An intussusception should form a cylindrical curved tumour with its long axis transverse, and one can as a rule roll it beneath one's fingers, but not displace it far laterally. Reidl's lobe, the spleen, and a kidney, one should be able to get the hand behind and move forwards and laterally in a young child; nevertheless we have known abdominal section performed when the tumours were respectively the lower edge of the liver, Reidl's tongue-shaped projection from the right lobe of the liver, and the right kidney. The left kidney is not likely to be a source of error, as it is seldom low enough in the abdomen. But the commonest source of error is provided by enlarged mesenteric glands, often tuberculous; these are usually present either in the inner part of the right iliac fossa, in the angle between the ileum and cæcum, or lying in the root of the mesentery. Now a tumour in the right iliac fossa is rather unusual in intussusception, in fact the absence of the normal degree of resistance in this situation is usually regarded as a suggestive sign of invagination, since the bowel passes away from this region to the right hypochondrium and further along the course of the colon. Mesenteric glands are often firmly fixed and cannot as a rule be rolled up and down the abdomen, and the long axis of the mass is usually vertical or oblique, not transverse.

However, this is the most pardonable error, and, even where it is suspected that the mass felt is glandular, in a case with hæmorrhage from the anus and abdominal pain of sudden onset, exploratory cœliotomy is justifiable, since it is better to make a mistake in diagnosis than to delay operation on a case of intussusception; in some cases too the glands may with advantage be removed. Thickened omental masses, often due to tuberculous infiltration, may also be a source of error in diagnosis.

Another condition to which attention has recently been drawn is that of Henoch's Purpura with effusion into the bowel wall.* In such cases the symptoms of severe abdominal pain, with vomiting, and the passage of blood and mucus *per rectum* immediately suggest the presence of an intussusception, and, if there is effusion into the wall of the intestine, a tumour may be felt in the abdomen. These effusions usually occur in the neighbourhood of the ileo-cæcal valve, and, where the case is met with before the onset of the characteristic purpuric eruption, it is hard to see how the diagnostic error is to be avoided. An instance of this disease came under our notice some few years ago, in which rectal examination revealed a swelling having all the characters of the apex of a small intussusception, and the diagnosis was only made clear by the advent of multiple purpuric spots, some few hours after the onset of abdominal pain, vomiting, and the passage of blood and mucus *per anum*. This hæmorrhagic effusion begins in the sub-mucous coat, and its presence may favour the production of a true intussusception, and indeed, several instances of intussusception occurring during the course of an attack of Henoch's Purpura are to be found in the literature. Hardening of the tumour beneath the examining hand occurs in intussusception, and is due to spastic contraction of the bowel involved in the lesion; when present, this is a most valuable sign, and it does not occur in Henoch's Purpura. Bimanual examination is a valuable procedure in infants, as although

* See also pages 459-463.

the apex of the intussusceptum may not be encountered by a finger in the rectum, yet the tumour may be felt between the examining finger in the rectum and the hand on the abdominal wall much in the same way as the uterus can be felt bimanually.

Rectal examination will also eliminate such lesions as rectal prolapse and polypi, the latter being easily recognised, whether sessile or pedunculated. Rectal prolapse should never be mistaken for intussusception, for the external tumour can in these cases be seen to start from the anal margin, so that it is impossible for the finger to be passed between the intussusceptum and the anal wall. In our series diagnosis failed on four occasions. One child was thought to be suffering only from diarrhœa and vomiting; in the other three cases apparently the possibility of intussusception was not considered. At the *post mortem* examination three of these cases exhibited small intussusceptions which were easily reduced and there was no peritonitis, while in the fourth case gangrene was present.

Treatment.—Before laying down lines for the treatment of this disease, it is desirable to consider the results in our cases, of which 91 were submitted to operation. Of these, 59 were cured and 32 died, giving an operation mortality of 35·1 per cent.

1. Exploratory cœliotomy.	Recovery 2. Died 0. Spontaneous reduction of intussusception in both cases.
2. Cœliotomy and reduction by water pressure.	Recovery 1. Died 0.
3. Cœliotomy and reduction by manipulation.	Recovery 53. Died 23. In fatal cases :— Death from shock without peritonitis 12. General suppurative peritonitis 2. Perforative peritonitis 1. Local peritonitis 5. No. P.M. 3.

4. Cœliotomy, resection and axial anastomosis. Successful case was in a girl of 22.	Recovery 1. Deaths 3. In fatal cases :— Death from obstruction at seat of anastomosis 1. Death from leakage and general peritonitis 1. Death from shock 1.
5. Cœliotomy, resection, and formation of artificial anus.	Recovery 0. Deaths 4. In fatal cases :— Death from local peritonitis 2. Death from inanition 1. No. P.M. 1.
6. Cœliotomy and artificial anus.	Death from shock, no peritonitis at P.M. 1.
7. Cœliotomy, partial reduction, and artificial anus.	Death from shock, no peritonitis 1
8. Cœliotomy, reduction, and removal of sarcomatous polypi.	Recovery 1. Subsequent resection and anastomosis for recurrent growth with fatal result.
9. Cœlictomy and lateral anastomosis for irreducible chronic intussusception.	Recovery 1. (Female aged 60.)

Natural cure of intussusception may take place in one of two ways; either by spontaneous reduction, or by spontaneous anastomosis after the separation of a gangrenous intussusceptum. That both these phenomena do occur cannot be denied, but the correct treatment is certainly by cœliotomy. Reduction by water pressure used to be in vogue, but the results are uncertain, though the method may be combined with cœliotomy to ascertain if the reduction is effected, or, if necessary, to reduce the last inch or so, which is rarely restored to its right place by water pressure. This method is carried out by means of a rubber tube passed into the rectum, provided with a funnel which should not be raised more than 2 feet above the level of the abdomen when the hips are elevated. Reduction by water pressure, if combined with laparotomy, often saves

a few minutes in the length of the operation, and time is a most important factor in operating on young children. In acute intussusception delay is dangerous, and when once the diagnosis is made it must be remembered that the chance of saving the infant's life depends largely on the rapid preparation for operation and the rapid performance of it. For any case of intussusception the best incision is one which splits the fibres of the right rectus and lies rather close to the umbilicus with one-third of its length above the umbilical plane. As soon as the peritoneum is divided, the coils of small intestine must be prevented from prolapsing, as this is productive of shock; the intussusception should be sought for with two fingers in the peritoneal cavity, and reduced by pressing back the intussusceptum through the sheath for the greater part of its length inside the abdomen; the last portion is best reduced outside the peritoneal cavity, as by this means the state of the bowel can be examined, and the operator can ascertain that reduction is complete.

In all cases of operation for intussusception the cæcal region should come directly into view, for by this means only can one be sure that an entero-colic invagination has been entirely reduced; occasionally also, if the appendix has been drawn into the tumour, its extreme engorgement may make appendicectomy desirable. Another reason for always exposing the ileo-cæcal junction to view is that intussusceptions may be multiple, and it has happened to one of us that while operating on a child of one year old, a five-inch intussusception of the lower part of the colon has been reduced, and a second entero-colic invagination has been discovered owing to the precaution of inspecting the cæcum before closing the abdomen. Such cases are very rare; in this particular instance the leading physical signs were the presence of a tumour in the left iliac fossa, the apex of an intussusceptum felt *per rectum*, and an absence of the normal resistance in the right iliac fossa; the first and second were explained by the invagination of the colon, but the third

sign was only explained when an entero-colic intussusception was discovered beneath the liver in the right half of the epigastrium. The liver had prevented this mass from being palpated before the abdomen was opened.

The reduction of the last portion of intussuscepted bowel often involves considerable pressure on the intussuscipiens, and there is some risk of rupture occurring in this layer; however, in young infants the mortality of any operative procedure beyond cœliotomy and reduction is so high that the risk must be run, though perhaps in a difficult case it might be wiser to make a longitudinal incision in the ensheathing layer through its anti-mesenteric border and endeavour to press back the apex of the intussusceptum by means of a finger within the lumen of the bowel. If this failed, owing to the firmness of adhesions or gangrene of the invaginated bowel, this longitudinal incision could be used for the performance of anastomosis and resection by Maunsell's method, as described in textbooks on Operative Surgery. After cleansing the bowel with saline, the opening in the ensheathing layer must be closed with Lembert sutures.

The method of suture of the abdominal wall deserves some attention, since intussusception babies are especially prone to burst their abdominal wounds. Two strong salmon gut sutures should first be passed through the rectus muscle and sheath as well as the peritoneum, and left untied. The wall may then be sutured in layers in the usual way, and before closing the skin wound the two salmon gut stitches should be tied. If there is much shock and there is need for rapid closure of the wound, these two sutures may be used to close the abdominal cavity and the anterior layer of the rectus sheath, and the skin may be sutured more leisurely. If it is preferred, the reinforcing sutures may be passed through the skin as well as the other layers of the abdominal wall. All skin stitches should be left in till the tenth day, and the wound must be carefully examined when they are removed, to ascertain that the deeper parts of the

wound are soundly healed. Neglect of these strengthening sutures led to the bursting of the wounds in two cases of the series here described.

After the abdomen is opened, acute intussusception may be classified as reducible, irreducible, and gangrenous, and many of these forms may be complicated by the existence of a leading intestinal polyp. In the first class the treatment is obvious, and if a polyp be felt through the wall of the bowel after reduction it should be completely removed. In one of our cases such a polyp was removed by incision into the cavity of the gut, and microscopically it proved to be a sarcoma ; subsequent operation was performed for recurrence with symptoms of obstruction but with no intussusception. Usually these polypi are mucosal adenomata, but the possibility of malignancy must be borne in mind. Fortunately between 80 and 90 per cent. of acute intussusceptions are reducible, but if reduction cannot be effected it will not be certain whether gangrene is present in the innermost layer or not ; the usual course is to resect and anastomose, and, if the condition of the patient is good, this is probably the best procedure ; the mortality in young children is, however, very high, and it has recently been suggested that a simple lateral anastomosis should be performed ; this will relieve the obstruction and afford a chance for the natural cure of the invagination by the separation and passage of the gangrenous intussusceptum along the intestinal tract. The other two possible courses are, either to resect and secure a Paul's tube in each end of the gut fixed in the wound, or to bring out the intussusception and make an artificial anus above it. As will be seen from our figures, the mortality attending these procedures is appalling, and, even if the first operation succeeds, the closure of an artificial anus in a young child is a hazardous proceeding. Where gangrene is present, resection is the only choice, and in cases involving small bowel, immediate anastomosis should be performed. In the case of a pure colic intussusception a two-stage operation may with advantage be employed.

Drainage of the peritoneal cavity is rarely called for in these cases, but if there is much infection, a tube for 24–48 hours down to the neighbourhood of the anastomosis may be desirable.

Operation for Chronic Intussusception.—These patients are usually adults, and will stand extensive operative procedures. If, therefore, the intussusception is irreducible, resection and immediate anastomosis should be performed, though perhaps the two-stage operation will be the wiser course if acute obstruction is in existence at the time of the operation. In cases where a long operation is not likely to be borne well, lateral anastomosis alone may be expected to give complete relief, as in one of our cases, a woman aged sixty. The possibility of a growth, malignant or simple, as the starting-point of a chronic intussusception must be present in the mind of the operator, and this may determine the choice of operation.

Prognosis.—This depends largely on the promptness with which surgical treatment is carried out. In our hundred cases the operation mortality is 35·1 per cent.; the case mortality is 41 per cent. Operation, therefore, offers the best chance of recovery, although it is true that if any procedure beyond cœliotomy and reduction has to be performed the prognosis becomes less favourable. In our series nine cases were not submitted to operation, four because they were not diagnosed correctly, and five others because they were not in a fit condition to stand any operative procedure. The four cases have already been referred to in discussing the diagnosis of intussusception, and the three of them which presented reducible invaginations with no peritonitis at the *post mortem* examination ought to have been successfully dealt with by the surgeon. As regards the other five cases, had the risks of a general anæsthetic not been feared, the risks of the operation might perhaps have been undertaken, in the two of them at least which presented reducible intussusceptions at the *post mortem* examination. In two others the intussusceptum was

gangrenous, and in the fifth case there was general suppurative peritonitis.

The cause of death in twelve of the twenty-three cases which died after the operation of cœliotomy and reduction was shock; at the *post mortem* there was no peritonitis, nor any other lesion to account for the fatal event. Chloroform anæsthesia is often difficult to maintain at the right degree in these young children, and if they are not sufficiently anæsthetised, movement and vomiting are likely to occur, favouring prolapse of bowel through the wound and thus producing shock; if they are too deeply anæsthetised, respiration tends to cease and shock is again induced by the prolongation of the operation. It is possible that lumbar anæsthesia is the ideal for these cases, as it seems to be reliable and safe even in the case of children under one year, and the shock associated with operation done under spinal anæsthesia is reduced to a minimum. The complete muscular relaxation obtained renders the operation of reduction by manipulation very easy; a successful case of resection and anastomosis for gangrenous intussusception in a child aged seven months has recently been recorded by Fairbank and Vickers where the success was attributed mainly to the employment of spinal anæsthesia (*Lancet*, February, 5, 1910, p. 364).

After Treatment.—A method of combating shock in young children has recently been described by Waterhouse (*British Medical Journal*, July 9, 1910), which seems particularly appropriate for intussusception cases. It depends on keeping the child in an atmosphere considerably above room temperature, and this can easily be achieved in the case of small infants by placing over them a cradle to which is attached an electric light bulb, the whole being roofed in by blankets. A temperature of 100–105° F. should be maintained for at least twelve hours after operation. Our own experience of this method is entirely favourable.

If saline administration is necessary in young children, it is most easily given subcutaneously, and several pints may

be thus absorbed in twelve hours. Aperients in these cases are often unnecessary in the early stages of convalescence, but we prefer, where purgatives are required, to use drachm doses of castor oil, repeated if an action of the bowels does not readily result. In the case of children who are being breast fed, facilities should be afforded for the mother to continue to nourish her child after the operation. In cases that do well it is not necessary to keep the child in bed more than a fortnight.

II. Carcinoma of Cæcum and Colon

Out of 500 cases which required operative relief for obstruction, 78 were instances of carcinomatous growth occurring in the cæcum or colon. This number represents 15·6 per cent., and in our description of the condition we shall adhere to the type which is commonly met with, namely, those cases in which chronic obstruction was manifest before the onset of urgent symptoms; at the same time we must admit that in not a few of our hospital series the acute stage was the only one which caused the patient to seek relief.

Etiology and Pathology.—Concerning the etiology of intestinal cancer little is known beyond the fact that the commonest situations of the disease are those where irritation is likely to play a part in the causation. Thus, growths are most often encountered in the cæcum or at the flexures of the colon, all places where some degree of fæcal stasis is common. The growths are columnar- or spheroidal-celled carcinomata, they arise from the glandular epithelium, and they tend to form annular strictures of the bowel, though occasionally they project into the lumen of the gut in the form of malignant polypi. Carcinoma, wherever present, is surrounded by inflammatory changes in the tissue which it invades; hence a carcinoma of bowel may produce diminution of the lumen without attaining a large size, due in part to the proliferation of cancer cells, and in part to the inflammatory

infiltration of both mucosa and muscular layers. The latter must produce a block in the peristaltic activity of the large bowel at quite an early stage, and therefore it is not surprising that constipation apart from actual constriction of the intestinal lumen is an early symptom of the disease. To compensate for this intrinsic obstruction, the musculature of the bowel above the growth hypertrophies, and the degree of constipation is in inverse proportion to the amount of compensatory hypertrophy. In the meantime changes occur in the mucosa, which becomes swollen, and often ulcerates at the site of the growth, while catarrhal changes are often seen on the proximal side of the stricture. Gradually, hypertrophy of the gut fails and dilatation becomes a marked feature of the case; this change is often most noticeable in the cæcum, on which the back pressure of arrested intestinal contents is thrown, and this, together with catarrhal changes in the mucosa, prepares the way for the production of what are usually termed stercoral ulcers: "dilatation ulcer" is perhaps a better term for these lesions, which may occur anywhere in the gut on the proximal side of the obstructing lesion and are probably examples of local pressure and infective gangrene of the bowel wall. When these dilatation ulcers rupture, the case presents the clinical picture of perforative peritonitis and exact diagnosis becomes obscure. In rare cases, ulcerative colitis, even proceeding to perforation, may occur on the proximal side of a cancerous stricture with much dilatation of the colon or cæcum.

As regards the pathological changes which determine the transition from chronic to acute obstruction, several phenomena are observed. Increase of the growth in the form of a polyp may occlude the canal, or stricture may result from super-added catarrh and œdema of the mucosa; occasionally the bowel becomes kinked and twisted at the point of stricture, or surrounding adhesions may determine the transition. In other cases we find true fæcal impaction, usually in the form of plum or cherry stones, or a particle of bone, as the causative lesion. It has been necessary on

pathological and anatomical grounds to consider obstruction due to carcinoma of the colon and the cæcum together, but of course the latter produces small, while the former causes large, bowel obstruction, so that clinically they tend to produce different pictures, and obstruction in cæcal cancer is often due to glandular infiltration in the ileo-cæcal angle.

Such cases, more commonly than colonic carcinoma, come first under the notice of the medical attendant with symptoms of acute obstruction. Volvulus, or intussusception, occurring in the neighbourhood of the growth, may be the cause of the acute condition.

Symptoms.—Two stages are usually observable in the anamnesis of these cases, and they may be termed primary and secondary. The primary symptoms are those of chronic obstruction, in which the patient is usually troubled with some irregularity of the bowels, flatulence, anorexia, slight nausea, and a general feeling of lassitude. In addition to these general signs of ill health there are usually attacks in which abdominal pain is present, often ascribed to indigestion or colic, since they may be provoked by dietary indiscretion or excess. These attacks are associated with constipation and slight vomiting or nausea, with disinclination for food. *In the early stage* aperients relieve the symptoms, and the intervals between the attacks are of variable duration; as the lesion progresses, however, the attacks become more severe and the action of aperients less reliable, while the clear intervals between the attacks become shorter. In cases where the stenosis is low down in the colon, diarrhœa may occur at some periods of the illness, due to catarrhal changes in the bowel excited by fæcal stasis during obstructive attacks. This is a symptom about which inquiry should always be made. Occasionally blood may be passed by the rectum; this may be derived from a growth, when it is commonly intermixed with the fæces, or the blood may come from "symptomatic piles," which form in the rectum when stenosis is present in the lowest part of the colon.

Symptoms of the Second Stage.—An attack worse than any

of those preceding it supervenes at some period of the illness. There is sudden severe abdominal pain, often referred to the umbilicus, which may cause the patient to double up or roll upon the floor. There is usually some collapse, the pulse becomes feeble, the facial expression anxious, and the complexion pale; sweating may also be observed. Vomiting occurs, and is frequent and forcible, the vomited material usually being at first gastric, then bilious, and ultimately fæculent. Constipation is absolute, neither fæces nor flatus being passed.

Physical Signs.—Here we shall describe the condition typical of a case in which the acute symptoms of obstruction have become manifest, since the primary stage presents no characteristic features, save possibly the presence of an abdominal tumour in the course of the colon, and the existence of visible peristalsis.

General Signs.—The complexion is usually muddy, and the patient may be wasted; the eyes are dull and a little sunken; the tongue is foul and thickly furred, the mouth dry, and the breath offensive. Thirst is usually intense. The temperature is often subnormal, but there may be slight fever. The patient is restless and obviously in great pain, this pain being persistent and yet somewhat paroxysmal.

Condition of the Abdomen.—*Distension is* constantly present, but its degree is variable; it is often extreme, and the lower the growth in the colon, the more pronounced the distension is apt to be. When the obstruction is by a growth of the cæcum, the distension is central and may exhibit patterns, which, seen through the abdominal wall, have a "ladder-like" appearance. A growth further on in the colon causes the addition of distension in the right flank, while the left may be comparatively flat; a pelvic cancer tends to cause universal distension, both in the flanks and in the central portion of the belly. As a matter of fact the cæcum is the most distensible part of the large intestine and it often happens that in low growths of the colon a dilated cæcum is a more noticeable feature of the case than

a dilated transverse colon. *Visible peristalsis*, when present, is a valuable sign, and its distribution and point of termination will often point correctly to the site of the lesion; in carcinoma of the cæcum it will cease at the right iliac fossa. *Respiratory excursion* is inversely proportional to the degree of distension of the abdomen.

Rigidity of the abdominal wall does not appear till late, and is then due to consecutive peritonitis; local rigidity may be present over the situation of the growth. *Localised tenderness* is commonly met with in carcinoma, and the abdomen should be carefully and firmly palpated for evidence of local pain or pressure. *A palpable tumour* may be present, but it is often obscured by the distension of the intestinal coils. *Palpable peristalsis*, due to the hardening of the bowel wall during muscular contraction, is associated with a cancerous stricture in many cases, and where palpation is easy this sign will generally be encountered. *Splashing*, due to the imprisoned fluid in the lumen of the bowel, is associated with small, rather than with large, bowel obstruction, and therefore where it is found in carcinomatous lesions, the growth will usually be at the cæcum.

Dulness on percussion, due to the presence of free peritoneal fluid, is to be expected, and often there is shifting dulness due to movable fluid, which tends to gravitate into the most dependant parts of the abdomen.

Audible peristalsis is common in cancerous obstruction of the large bowel.

Rectal examination is usually negative, but a growth of the pelvic colon is occasionally intussuscepted into the rectum and thus rendered palpable, and occasionally a growth high up may be felt through the rectal wall. Ballooning of the rectum is fairly common, but it is not a reliable sign.

Vaginal examination.—At times a growth of the pelvic colon, or even of the cæcum, may be palpable through the appropriate lateral vaginal fornix.

Diagnosis.—The diagnosis depends, as a rule, upon a

history, in a patient past middle age, of increasing constipation, with anorexia and loss of weight, culminating in complete obstruction; on the presence of visible peristalsis; on the discovery of shifting dulness in the flanks; and upon the presence, in some cases, of a tumour in the course of the large intestine. There is at times, however, a complication which renders the diagnosis obscure, and that is perforation of a stercoral or dilatation ulcer; but even when this has occurred and the clinical picture is one of peritonitis rather than of obstruction, a careful elucidation of the history should indicate the nature of the primary lesion. The following case is selected as a fairly typical example of obstruction due to carcinoma of the pelvic colon with perforated dilatation ulcer of the transverse colon.

H. Mc E. Female, aet. 53. Married. Mother died of cancer of the bowel. Patient's health quite good until nine months before admission: during this time there had been steady loss of flesh. No solid fæces passed during this time. Stools often streaked with blood during the last six months. No action of bowels for ten days previous to admission; flatus passed. Frequent black stercoraceous vomiting for two days.

On examination. Uniform distension of the abdomen; tense and tender all over. No visible or palpable peristalsis. No tumour to be felt. Fixed dulness in flanks. Liver dulness partially obliterated in mid-axillary line. Rectal examination negative. Temperature 101. Pulse 120.

Abdominal exploration revealed the presence of free gas in the peritoneal cavity, early general peritonitis, and a growth in the pelvic colon. Cæcostomy was performed by means of a Paul's tube. Death occurred within a few hours.

Post mortem examination. Ring carcinoma present at commencement of pelvic colon, with lumen a quarter of an inch in diameter; obstruction rendered absolute by a large number of cherry stones, which were lodged in the lumen on the proximal side of the growth. Several stercoral ulcers were present in the course of the large bowel, and one of these, situated about the middle of the transverse colon, was perforated. There were no metastases.

In this case a search might well have been made for the site of the perforation, as there was free gas in the peritoneum,

and this might have been selected as the place for insertion of the Paul's tube, but the condition of the patient was very grave and the operative procedure had to be hastily carried out. It is generally recognised that stercoral ulcers do not heal well after suture.

Treatment.—If the site of the growth cannot be diagnosed, a paramedian incision through the right rectus sheath should be made, and the seat of the obstruction searched for. Relief of the distension of the bowel may be required as described in the preceding chapter, and when once the growth is found, the duty of the operator is to relieve the obstruction. To this end three courses are open to him, since any attempt at removal of the growth and immediate anastomosis is out of the question in the presence of acute obstruction and distension :—

(*a*) He may perform colostomy at some distance above the growth, leaving resection and anastomosis for a second operation, and closure of the artificial anus for a third.

(*b*) He may bring the growth and the colon outside the abdomen, and secure a Paul's tube in the gut just above the obstruction, leaving for a second operation resection of the artificial anus and growth, with anastomosis of the bowel.

(*c*) He may resect the growth and tie a Paul's tube in each end, and leave the artificial anus to be dealt with at a subsequent operation.

The most desirable method in any particular case will probably depend largely on the condition of the patient, but, where possible, we prefer the last-mentioned plan, and occasionally we have taken steps to lessen the time required for the second operation by tying in only one Paul's tube, closing the distal end of the colon with three layers of sutures and dropping it back into the abdomen. When an inoperable cancer of the cæcum is the cause of obstruction, a temporary ileostomy, to be closed later by lateral anastomosis, is the best course.

After Treatment.—This must be directed to the treatment of shock, and the care of the skin surrounding the artificial anus.

III. Obstruction due to Adhesions

This form of obstruction represents some 12 per cent. of acute cases. It is due to antecedent peritonitis, either localised or general, and is, therefore, met with after appendicitis and its complications, after operations on the intestine or pelvic organs, after salpingitis, and as a complication of diseased mesenteric glands. Tuberculous or carcinomatous glands often become adherent to bowel, and it not infrequently happens also that gut becomes adherent to new growths in the abdomen, usually of intestinal or ovarian origin. The early history of a suspected case of obstruction due to this cause is therefore of the greatest importance, as there are no special signs or symptoms by which the diagnosis can be made with certainty.

Symptoms.—The obstruction is usually of the small bowel, and therefore pain and early vomiting are marked features of the case. At the onset there is often a good deal of shock. The pain may be general, or localised to the neighbourhood of the adhesions, but in either case it is usually colicky in nature and liable to extreme exacerbations which may prostrate the patient. The degree of constipation is variable.

Physical Signs.—The *facial expression* becomes anxious at a very early stage, and the eyes may be sunken. The *pulse* is rather more rapid than in many forms of obstruction, and is liable to increase in rate during the attacks of acute pain. *Fever* is only present when consecutive peritonitis is superadded to obstruction. The *tongue* is dirty and the mouth very dry. The *urine* is often scanty.

Abdominal Signs.—*Distension* is usually present, but its amount varies greatly, and depends on the situation of the adhesions. In cases where the vomiting is most

pronounced and the pain most severe, the distension is often least, for the obstruction is likely to be high up in the small intestine. *Visible peristalsis* is commonly seen, and its topographical distribution will often suggest the site of the obstruction. *Respiratory excursion* is generally good, in the absence of great distension and consecutive peritonitis. *Local rigidity* is often met with and *local tenderness* is a most important physical sign. A *palpable tumour* is rarely present except in cases of adhesions to an abdominal growth. *Palpable peristalsis* is rare. A *fluid thrill* may be encountered. *Splashing* can often be elicited where coils of small bowel are affected, and this is a sign which should not be neglected. *Dulness on percussion* is common in the flanks, and is due, as a rule, to free peritoneal fluid, the situation of the dulness varying with the position of the patient. *Audible peristalsis* is common.

Rectal examination rarely yields valuable information apart from negative evidence.

Vaginal examination may reveal the presence of a pelvic tumour or an inflammatory mass with which adhesive obstruction may be connected.

Examination of hernial orifices should never be neglected, as the peritoneal aspect of the neck of a hernial sac is a not uncommon site for adhesions, and there may be local tenderness and pain in this region while the hernial sac itself is empty. Operations for hernia are among the causes of the peritoneal adhesions.

Diagnosis.—The leading factors in the diagnosis of this condition are early and repeated vomiting, acute pain, often with localised tenderness, visible peristalsis, and splashing. If these signs are present in the case of a patient whose history points to preceding peritonitis, or liability thereto as the result of operation, the diagnosis should be tolerably certain.

Treatment.—Cœliotomy and enterolysis is the operative treatment needed, and when the adhesions are divided the bowel must be seen to fill out below the site of obstruction, and *all* the collapsed bowel must be seen to recover before

the abdomen is closed. Occasionally the division or removal of adhesions means denudation of a part of the peritoneal investment of the gut, and in this case infolding of the bare area must be effected by means of Lembert sutures applied at right angles to the line of the bowel. Very rarely is any resection necessary on account of loss of vitality of the gut. In a few cases the adhesions are so dense or so numerous that complete enterolysis cannot be performed; here the choice lies between the formation of an artificial anus and lateral anastomosis, and, unless the opening would be placed in the jejunum, the former is always to be preferred as a temporary relief for the acute obstruction. A second operation may then be performed when the patient and the intestinal tract are in better condition to stand it.

After Treatment.—Early activity of the bowel is essential to avoid the re-formation of adhesions, and to this end the early administration of aperients is desirable. Magnesium sulphate in two drachm doses every two hours till the bowels act, or doses of from a quarter to one grain of calomel given similarly, are the best drugs. If vomiting tends to occur after these, it is desirable to give a soap and water enema with an ounce of turpentine in it. Eserin salicylate, gr. 1/50, or Pituitary Extract, 1 c.c., injected into the buttock every hour for two or three doses, promotes peristalsis by its stimulating action on non-striped muscle and may sometimes be used with advantage in these cases. Fibrolysin is a comparatively new synthetical compound which has an undoubted influence on fibrous tissue by increasing its vascularity, and therefore hastening absorption; in the case of peritoneal adhesions it may favour their early absorption and we have occasionally given it with much apparent advantage, but it is difficult to know precisely what is happening to young fibrous tissue within the peritoneal cavity. It is best given by intramuscular injection in doses of 2·3 c.c. (the phials in which it is sold hold this volume) on alternate days for a fortnight.

In addition to these special measures, the general

treatment is similar to that previously described; for the first few days the diet should be fluid, and the patient should be nursed in the Fowler position.

IV. Obstruction by Bands

Clinically this form of obstruction closely resembles that due to adhesions, and indeed pathologically a band may often be only a giant adhesion. The obstruction to the gut is produced either by the ensnaring of a coil or coils beneath an unyielding band, or the band may form a loop through which the bowel passes and from which it cannot return. In other cases the kinking produced by the pull of a well-defined band may be the etiological factor. Bands, then, may be new or old, the result of organisation of inflammatory tissue in the peritoneum, or abnormally adherent structures such as omental cords, appendices epiploicæ, the vermiform appendix, the Fallopian tubes, the broad ligament, Meckel's diverticulum, etc.

We shall make no attempt to differentiate between the symptoms and signs of adhesive and band obstruction, except in the case of Meckel's diverticulum, because this represents the most typical variety of band obstruction.

Treatment.—After the obstruction has been relieved the "band" should be removed and the ensnared bowel must be very carefully examined to ascertain its viability; resection may be called for in a few cases.

V. Obstruction by Carcinoma of Rectum

This forms just under 10 per cent. of the causes of obstruction, where relief for the obstruction is sought before the rectal cancer itself causes the patient to consult a surgeon. It is rare, however, for this event to take place without the preceding existence of symptoms which are often suggestive of rectal stricture.

Etiology and Pathology.—As in the case of carcinoma of the colon, superadded inflammation, fæcal impaction, or intussusception, often determines the onset of acute obstruction, but chronic obstruction is usually present for some time first, and is exemplified especially in rectal carcinoma by what is termed "spurious diarrhœa," due to catarrhal changes above the stricture and the decomposition of arrested fæcal matter. Bleeding from the ulcerated surface of the growth is common, and "symptomatic piles" are often met with. Dilatation ulcers, especially of the cæcum, are frequent in association with rectal cancer.

Symptoms.—These are usually those of chronic obstruction such as we have already described, associated with "spurious" or "morning diarrhœa," and rectal hæmorrhage, often attributed to piles, which are indeed frequently present, followed later by the signs of acute obstruction with pain, repeated vomiting, and absolute constipation. The cause of "morning diarrhœa" is the catarrh set up in the colon behind the stricture leading to the accumulation of a mucopurulent discharge together with semi-fluid fæces during the hours of rest. Owing to the stricture and the diminished power of expulsion, the rectum is not completely emptied by the usual single morning act of defæcation, and this has to be repeated several times before the patient succeeds in emptying the rectum and pelvic colon. The chronic pain of rectal carcinoma is usually referred to the sacral region and lasts long after defæcation.

The second or acute stage of obstruction due to carcinoma of the rectum does not differ from that of colonic obstruction, except that it is of necessity of the large bowel type, so that distension is a marked feature, while vomiting is late in onset.

Physical Signs.—These have been sufficiently considered, and do not differ from those met with in cases of cancer of the lower colon except that rectal examination in a large percentage of the cases immediately reveals the cause of the obstruction.

Diagnosis.—If rectal examination reveals a carcinoma within reach of the finger, this is rendered easy, and it may be desirable to examine under the anæsthetic before opening the abdomen, so that the steps of the operation may be rendered shorter. If no tumour is discoverable the diagnosis between carcinoma of the lower colon and of the rectum may be impossible before operation.

Treatment.—This, in all cases where acute obstruction is present, consists in the formation of an artificial anus in the lower colon, and if the diagnosis is made correctly beforehand, the abdomen should be opened through the left rectus muscle, for the condition of the colon can then be examined and a satisfactory opening established in a favourable situation. The possibility of removal of the growth at a future date must also be decided at the operation.

After Treatment.—If no subsequent removal is to be attempted, irrigation of the lower portion of bowel should be practised by means of a tube and funnel from above after the first week or so, and the patient should receive instruction in this procedure. To secure the benefit of this daily irrigation it is desirable that the colostomy be performed by means of a Paul's tube, and a glass rod through the mesentery to produce a good spur outside the abdomen.

VI. Volvulus

Etiology and Pathology.—In this condition a portion of the gut is so rotated upon its mesenteric axis as to cause fæcal arrest, and later, interference with the circulation of the bowel, producing strangulation and gangrene. It used to be stated that the pelvic colon was the part of the intestine most often involved, but it seems probable from recent statistics that the condition is quite as common in the cæcum. The small intestine may suffer also, and then it is usually the ileum, occasionally together with the lower part of the jejunum, which is affected; it is never seen in

the jejunum alone. It also occurs, especially in small bowel cases, in association with a band obstruction, the ensnared loop becoming rotated on the distal side of the peritoneal band. In the case of the cæcum it is supposed to be due mainly to dilatation of some of its lateral pouches by retained fæcal matter, and subsequent irregular peristalsis; in the pelvic colon it has been attributed to inflammatory changes in the mesentery. However the condition is produced, it rapidly causes stagnation of fæces, with consequent decomposition and the production of a large amount of gas in the affected gut. The blood supply suffers at the crux of the volvulus, and also as the result of pressure on the bowel wall from gaseous distension; patches of gangrene are, therefore, not uncommonly seen in the wall of the bowel, or the whole of the dilated gut may be gangrenous. Obstruction is also caused to the bowel above the crux, and this usually becomes distended.

Symptoms.—*Pain* is severe and absolutely sudden in onset; it is usually diffuse. *Vomiting* occurs rather earlier than in most cases of large bowel obstruction, and in the case of volvulus of the ileum or cæcum it may be incessant; in volvulus of the pelvic colon, however, it appears rather late, and is not so often repeated. *Constipation* is commonly absolute from the onset of the illness, but it depends more on the tightness of the twist in the gut than on its situation in the intestinal canal. In some cases of pelvic colon volvulus slight action of the bowels occurs during the existence of severe abdominal pain and vomiting.

Physical Signs.—*Abdominal distension* is the marked feature of these cases, and it may be extreme. It may be more or less localised, but the situation of the distension is no accurate guide to the site of the volvulus, for either the cæcum or small intestine in this condition may be displaced to almost any part of the abdomen. Very marked distension in the left half of the abdomen is suggestive of sigmoid volvulus. *Visible peristalsis* is rarely seen, and, when it is present, it affords little aid in deciding on the cause of

obstruction, since it may be present anywhere in the abdomen. *Rigidity and tenderness* are of late onset and attributable to local consecutive peritonitis. On palpation the abdomen has a resilient feel and the percussion note is usually tympanitic. *Dulness in the flanks* is rarely to be demonstrated. The *liver dulness* is often obliterated in the right nipple line.

The remaining signs met with in obstruction are usually absent.

Diagnosis.—This is always difficult and can only be made in the presence of great abdominal distension associated with severe abdominal pain of very sudden onset. The following three cases are selected as instances of the three forms of volvulus.

1. *Volvulus of small intestine.* G. D. Male, aet. 28. Painter.

History. Previous health perfect. Sudden acute abdominal pain associated with incessant vomiting for twenty-four hours before admission to hospital. Absolute constipation. Pain continues with paroxysmal attacks.

State:—Facial expression drawn and anxious. Lower half of abdomen distended, immobile and rigid. Slight respiratory movement in upper part. On palpation there was tenderness below the umbilicus, and on percussion this area was tympanitic. Liver dulness normal. Temperature 98° F. Pulse 120.

At operation twenty-four inches of ileum were found to be gangrenous as the result of a volvulus, the crux of which was situated two feet above the ileo-cæcal valve. Resection and axial anastomosis was carried out, and the patient made a perfect recovery.

2. *Volvulus of the cæcum.* F. D. Male, aet. 33. Bricklayer.

History. Previous health good. Three days' history of severe abdominal pain with absolute constipation and incessant vomiting.

State:—Facial expression anxious. Distension considerable anteriorly, and mainly in epigastrium. Visible peristalsis present in left iliac fossa. Slight tenderness on palpation in upper abdomen. Percussion note resonant all over. Liver dulness obliterated in front. Respiratory excursion poor. Rectal examination negative. Temperature 99° F.

Operation:—Cœliotomy through the right rectus. Right iliac fossa unoccupied by cæcum, which was discovered, after delivery of

the intestines, in the left hypochondrium, as large as a dilated stomach. The crux lay just below the hepatic flexure, and the cæcum was rotated through one and a half turns from right to left through a horizontal axis, the cæcum and colon being situated just below the spleen. The ileum was carried across the attachment of the mesentery, so that six feet of it were congested and distended to such a degree as to cause rupture of its peritoneal coat. The cæcum was punctured and emptied and the viscera restored to their normal position. The abdomen was closed, though there was considerable tension on the stitches. Several complications arose—the wound suppurated, a fæcal fistula developed, suppurative parotitis appeared, and a left-sided empyema had to be drained. The patient died 2 or 3 weeks after the operation with general suppurative peritonitis. At the *post mortem* examination the fæcal fistula was found to be due to rupture of the cæcal wall, near the *caput cæci*, and this lesion was doubtless due to dilatation and pressure gangrene.

3. *Volvulus of Sigmoid.* M.D. Female, æt. 71.

History:—Pain and vomiting for seven days, bowels acting very slightly during this period; repeated vomiting.

State:—Abdomen greatly distended and resonant all over. Pain and tenderness chiefly on the left side. A good deal of collapse present. Temperature subnormal.

Operation. Sigmoid distended and twisted. Transverse colon greatly distended. Bowel tapped, volvulus reduced, and gut replaced; abdomen closed in layers.

Death occurred, mainly from shock, in twenty-four hours. P.M. No peritonitis. Healed ulcer present at splenic flexure of the colon; intestinal tract otherwise healthy.

Treatment.—The affected bowel must be emptied of its contents, and, indeed, it is often impossible to untwist the volvulus until this has been done. Some effort should then be made to secure the gut against a recurrence of the twist, and this may be done by suturing the mesentery to the parietes; in the case of the cæcum, plication of its wall to diminish the size of any lateral pouches may be useful, while the difficulty of securing the pelvic colon may be met by suturing the surface of the gut to the abdominal wall and establishing a temporary colostomy. Where the bowel is gangrenous, resection is essential, and the gut should always be carefully examined for patches of threatened gangrene

in order that these areas may be infolded by Lembert sutures.

If recurrence does occur, resection and anastomosis is probably the best course. It must be admitted, however, that at present the mortality of volvulus, even after operation, is at least 50 per cent.

After Treatment.—Shock usually requires attention during the first few hours after operation. Action of the bowels is best obtained by the early administration of enemata.

VII. Strangulation by adherent Meckel's Diverticulum

Etiology and Pathology.—This remnant of the omphalo-mesenteric duct is present in 2 per cent. of bodies, and the proportion of males to females is stated to be six to one. It represented 2·8 per cent. of our series of obstruction cases and of the fourteen patients only two were females. In the majority of bodies the tip of the diverticulum is free, and it would appear to become adherent as the result of inflammation. Diverticulitis has been described as producing symptoms indistinguishable from those of appendicitis, but it has never fallen to our lot to meet with such a case, and in several instances, where the diverticulum has been amputated for producing band obstruction and strangulation, microscopical examination has failed to reveal evidence of past or present inflammation in its wall at the attached area. This abnormal attachment, then, may be due to affection of the peritoneal coat, and, at times, a band of simple fibrous tissue is found passing from the tip of the diverticulum. The fœtal remnant is usually adherent to the mesentery of the ileum, or less commonly to the abdominal wall at or near the umbilicus; it may, however, be adherent to the omentum or to the wall of some portion of the gut. Obstruction is produced by the passage of bowel beneath the loop formed by the diverticulum and the gut from which it springs, and subsequent strangulation of the ensnared

intestine, usually ileum. The gut from which the diverticulum arises has a lumen little larger than that of the process itself, and its position is within thirty inches of the ileo-cæcal valve, so that the pull of an adherent diverticulum may easily lead to kinking of the lower ileum, and thus contribute to the obstruction; in actual practice, however, the lesion is found to be a strangulation of the small bowel above the level of attachment of the diverticulum. In a considerable number of cases there is an unusual degree of puckering at the umbilicus, and when the diverticulum is attached to the abdominal wall there may be a marked retraction of the scar. Obstruction from this cause is usually met with in patients under twenty years of age, but it may be seen much later in life; quite 50 per cent. of the patients are less than twenty years old.

Symptoms.—There is often a history of previous attacks of temporary obstruction. This is probably due to the fact that the diverticulum forms a more yielding type of band than fibrous tissue, and the bowel may escape from beneath it even after being obstructed. *Pain* and *vomiting* appear early, and *shock* is usually a prominent feature of the onset of the lesion. *Constipation* is commonly absolute.

Physical Signs.—At an early period after the onset of the pain the face becomes drawn and haggard; the tongue is thickly furred; the pulse rate is somewhat accelerated. *Distension* is usually central, but it may be limited to any portion of the abdomen. *Visible peristalsis* is commonly present and is often well defined in those cases where the diverticulum is adherent to the abdominal wall. *Respiratory excursion* remains till late after the onset of symptoms. *Local rigidity and tenderness* are common, and are present in the neighbourhood of the right iliac fossa. A *palpable tumour* is absent.

Splashing may be elicited in a few cases. *Dulness on percussion* in the flanks may be present, but as a rule the amount of peritoneal exudate is not large. If present, the dulness in the flank will usually be due to free fluid, and

therefore will shift with change in position of the patient. *Audible peristalsis* is common. Examination of the normal orifices and hernial sites will yield only negative information.

Diagnosis.—The primary attachment of Meckel's diverticulum is to the ileum close to the ileo-cæcal valve, hence tenderness and pain in this region are common. Appendicitis will therefore offer the greatest diagnostic difficulty apart from the varieties of obstruction. A diagnosis of obstruction due to adhesion or a band is as much as can be expected, but if such a diagnosis be made in the case of a male patient under twenty, who has had antecedent similar, but less severe attacks without evidence of peritonitis, the possibility of strangulation by Meckel's diverticulum must be borne in mind. If, in addition to this, there is an abnormal amount of scarring about the umbilicus, with some definite retraction, the diagnosis becomes probable. If the case be not seen till late, the differential diagnosis between this lesion and appendicitis may be very difficult, but speaking generally the usual differential signs between obstruction and peritonitis hold good in this disease.

Treatment.—Immediate paramedian cœliotomy will reveal the site of abnormal attachment of the diverticulum, and also the state of the ensnared bowel. The former must be detached and then amputated, much in the same way as appendicectomy is performed, by means of Kocher's crushing clamp if the lumen is not too large, or by turning down a sleeve of peritoneum to bury the stump. The covering Lembert sutures should be applied at right angles to the length of the bowel so as not to lessen its lumen; usually one layer of burying sutures will suffice. Attention must then be paid to the obstructed gut and any gangrenous patches may have to be infolded; occasionally, resection is needed, since gangrene in these cases is not very rare. Drainage of the abdomen is seldom needed.

After treatment.—No special after treatment is required, save an early aperient, if the gut released was healthy, or a small enema if resection was necessary at the operation.

VIII. Obstruction due to Simple Stricture

This is a somewhat uncommon cause of obstruction, and occurred in only twelve of our five hundred cases, giving a percentage of just over two.

Etiology and Pathology.—Cases of simple stricture of the bowel may be divided into two classes, congenital and acquired.

Congenital Strictures.—These occur usually in the small intestine, and half of them are met with in the jejunum and ileum, and one-third in the duodenum; they are rarely met with in the colon. Varieties of imperforate rectum are, of course, not included in these statistics. Duodenal stenoses are more common above the papilla of Vater than below it, and in the former case the symptoms and physical signs are not distinguishable from those of pyloric obstruction; stenosis in the latter position, however, causes bile and pancreatic ferment to be present in the vomit.

Strictures of the jejunum and ileum may be situated in any part of the gut, and are sometimes multiple. We have already noticed the narrowing of the ileum in cases where Meckel's diverticulum is present, and in some of these cases there is a definite stricture at this point. In the large intestine the ascending colon and the ilio-pelvic flexure are the most common sites of stenosis.

The degrees of congenital stenosis are very variable. There may be complete loss of continuity, the upper and lower segments may be connected by a fibrous cord, or we may find an annular stricture partially or completely occluding the lumen of the gut. In the colon, either a septum, or complete interruption of the canal, are the deformities most often met with. The precise nature of the developmental error which leads to these abnormalities is still uncertain, though in some cases it is associated with over development of sphincteric muscle fibres such as is present in congenital hypertrophic stenosis of the pylorus.

Acquired Stenosis.—Some antecedent intestinal lesion can

often be traced in the anamnesis of these cases. It may be that the patient has had a troublesome hernia, or evidence of tuberculous or typhoid ulceration of the bowel; dysenteric or stercoral ulcers may cicatrise, and thus cause stenosis, or the stricture may follow injury to the abdomen, and will then usually be complicated by the presence of adhesive peritonitis; it may follow the spontaneous cure of intussusception by sloughing of the intussusceptum, or the operation of enterectomy and axial anastomosis. Some of these strictures may be due to gummatous infiltration of the bowel wall. In our series most of the cases followed surgical interference for strangulated hernia, whether by taxis or open operation, and the greater number of the lesions were in the small intestine.

Symptoms.—In the congenital cases, when the stricture is in the small intestine, early regurgitant vomiting is observed, and the child's bowels do not act; the infant may or may not appear to suffer severe abdominal pain. In the case of stricture of the large bowel, distension of the belly and constipation are often observed before much vomiting occurs. As the distension increases the child cries almost continuously.

The symptoms in acquired stenosis are usually divisible into two stages, the first is a condition of constipation associated with colicky discomfort, the second is the stage of acute obstruction; but the first stage is very short, and it may merely be noticed that the bowels do not act for a day or two, and then begins the acute attack with severe abdominal pain, vomiting, and absolute constipation. Such is the sequence of events noted when the obstruction occurs during recovery from an anastomotic operation, though as a rule the interval during which stenosis develops is longer than the convalescent period after such operation.

Physical Signs.—*Distension* and *visible peristalsis* are commonly present, varying as to their nature according to the situation of the stricture. The anxious expression and earthy pallor seen in obstruction are often late in making

their appearance. The tongue is dirty and the pulse weak. *Respiratory excursion* is usually fairly free. *Local rigidity* and *tenderness* are not uncommon. *Palpable peristalsis* may be met with, and *splashing* can often be elicited, especially in small intestine stenosis. *Free fluid* in the peritoneal cavity is, as a rule, small in amount, and therefore dulness on percussion in the flanks is often absent. *Audible peristalsis* may be present.

Examination of rectum and vagina are usually negative, but pressure in the neighbourhood of the hernial orifices may reveal local tenderness and rigidity.

Diagnosis.—When such symptoms and physical signs as we have described are encountered shortly after an operation for strangulated hernia, or an axial anastomosis for a lesion of the bowel, the diagnosis will probably be fairly clear, though it may be difficult to differentiate this condition from obstruction due to post-operative adhesions. In other cases the history of an attack of typhoid fever or the reduction of a strangulated hernia will suggest the nature of the obstructive lesion. In very young infants, congenital stricture of the bowel is to be suspected when there are symptoms of obstruction with no special evidence of dilatation of the stomach or imperforate rectum. Distinction between duodenal stenosis and pyloric obstruction may be impossible; the absence of both an abdominal tumour and rectal hæmorrhage should eliminate the possibility of intussusception. The following two cases of acquired stenosis are instructive:—

1. *Stenosis due to typhoid ulceration.* J. M. Male, aet. 59. No occupation.

History:—Typhoid fever four years before present illness. Well since. On Thursday, April 13th, seized with colicky abdominal pain. Vomited once but not afterwards. Pain persisted and patient felt something hard in his abdomen. Bowels acted once on morning of the 13th, but after this the man passed neither flatus nor fæces. Admitted to hospital on April 15th. Eyes sunken, expression anxious, tongue moist and furred; pulse 88, temperature 100° F. Pain of a paroxysmal character present, associated only with peristalsis, which

was both visible and palpable. The peristalsis was most marked in the umbilical zone. Slightly tender in the right iliac fossa. No sign of free fluid in the abdomen.

Operation :—A little blood-stained fluid was present in the peritoneal cavity ; there was a tight stricture of the ileum a few inches above the ileo-cæcal valve. Lateral ileo-transverse-colostomy was rapidly performed, but the patient lived only twenty hours.

Post mortem. A linear furrow was present on the peritoneal aspect of the bowel at the point of constriction and a circlet of hæmorrhagic petechiae was seen within the lumen but no ulceration. The anastomosis was sound and there was no peritonitis. There was no band present which could have caused compression of the gut at the seat of the stricture.

2. *Stenosis following hernial constriction.* J. S. Male, aet. 48. Woodcutter.

History :—Left strangulated inguinal hernia reduced by taxis under chloroform eighteen years before present illness. Three days' history of vomiting with sudden onset of violent abdominal pain in lower abdomen with absolute constipation. Abdomen distended, peristalsis visible ; local tenderness, and some rigidity in right iliac fossa.

At operation :—Small intestine distended, cæcum collapsed. Two cicatricial strictures present in lower part of ileum two inches apart. Short-circuiting lateral anastomosis of ileum to ileum. Death from general peritonitis.

Treatment.—The appropriate operation must vary with the position of the stenosis. For duodenal stenosis above the bile papilla gastro-jejunostomy is the best procedure ; in the case of the lower duodenal stricture a junction between the dilated duodenum and the jejunum may be made. In young infants these operations are attended with a very high mortality, and even if the stenosis is lower than the duodenum the outlook is not much improved, for enteroplasty is rarely possible, and the acuteness of the obstruction may demand an immediate enterostomy with the subsequent risks attendant upon efforts at closure in young infants. Possibly, as in the case of intussusception, the shock of the operation could be lessened by the adoption of spinal anæsthesia.

In acquired stenosis also the mortality is high, whatever

type of operation is performed. The most suitable is some form of entero-plasty in which the strictured bowel is divided longitudinally for some way beyond the limits of the stenosis on its anti-mesenteric border, the incision being sutured at right angles to the length of the gut by two rows of stitches,

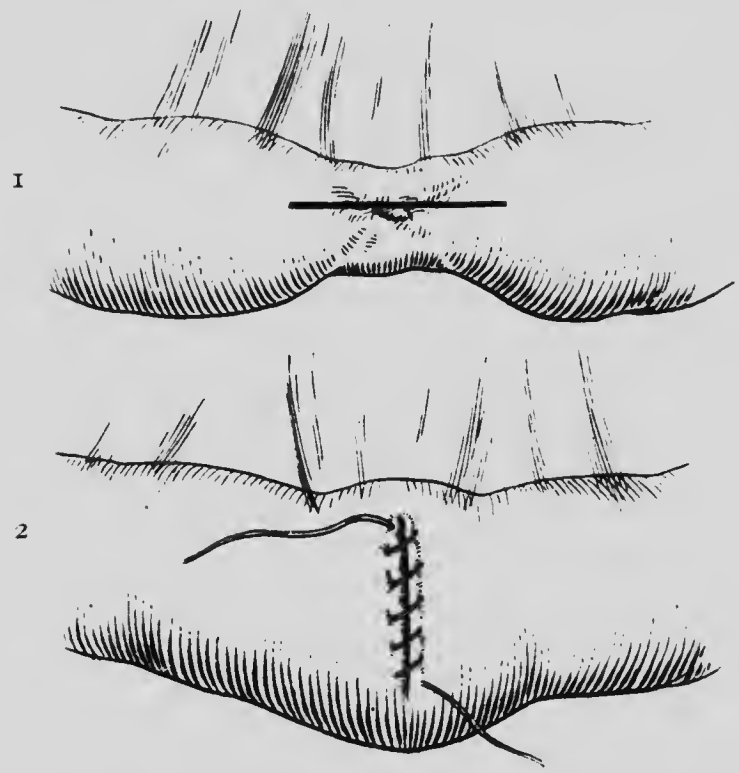

FIG. 14.—Enteroplasty. 1. Longitudinal incision through anti-mesenteric border of stenotic area. 2. This incision sutured transversely.

the first taking up all the coats of the bowel, the second being a continuous Lembert suture. Such an operation, however, can only restore the lumen of the gut if it is at least half that of the normal size before division of the bowel wall. If the stricture is long, this method is hardly suitable, and other conditions which negate the performance of simple

enteroplasty are numerous adhesions and multiple strictures. Where the stricture is single, but too long for enteroplasty, resection and axial anastomosis is the operation of choice; where there are multiple stenoses lateral short circuiting is the only course. We admit that none of these procedures are desirable in the presence of great distension above the stricture, but if the lesion is placed anywhere except in the very lowest portion of the ileum they are probably to be preferred to enterostomy and subsequent operation for the cure of both the artificial anus and the stenosis.

In statistical records enteroplasties show the lowest mortality. In the case of simple stricture of the large intestine, enterectomy and anastomosis in one or two stages, according to the degree of obstruction, is probably the best procedure.

After Treatment.—Enteroplasty should be regarded as an intestinal anastomosis; no food is necessary for six to twelve hours after the operation; the diet should be fluid for three days, and an aperient should not, as a rule, be given before the third night. If an action of the bowels is desired before this, it is best to give a small turpentine enema.

IX. Obstruction due to Impacted Calculi

These calculi are almost invariably gall-stones. Impaction of intestinal calculi may cause obstruction, and the clinical picture produced does not materially differ from that of gall-stone obstruction, but the condition is so rare that it does not call for separate consideration. They occur far more often in men than in women. Swallowed foreign bodies produce the same train of symptoms.

Etiology and Pathology.—Gall-stone obstruction was present in six of our five hundred cases. The obstructing stone may leave the gall-bladder by the duct, or, much more frequently, by ulceration from the gall-bladder or bile passages into the duodenum, the transverse colon, or the stomach.

It is surprising that a calculus which can pass down the common bile duct can also cause intestinal obstruction owing to its failure to pass along the bowel, but its arrest may be partly due to enterospasm and inflammatory changes in the wall of the gut, or the addition of fæcal matter may make the stone impassable. At the site of its impaction there is commonly a considerable amount of congestion of the intestine and there may be ulceration of the mucosa, or perforation may occur. It is very unusual for a gall-stone which ulcerates into the transverse colon to cause obstruction, therefore in general, these cases are instances of small bowel obstruction.

Symptoms.—A history of preceding biliary colic or jaundice is by no means a constant feature of these cases; nor is there always a record of an illness suggestive of an attack of ulcerative cholecystitis. The onset is generally quite sudden, but the symptoms possess some degree of variability owing to the mobility of the obstructing mass. Severe *abdominal pain* of a colicky nature is rapidly followed by *vomiting*, and *constipation*, which becomes absolute. The vomiting is frequently repeated and is forcible, as is usual in cases of high obstruction. Though jaundice is unusual, slight conjunctival icterus has been present in several of our cases.

Physical Signs.—The *facial expression* is often anxious and the features may become pinched. Much distension is uncommon; *visible peristalsis* is often present; *local rigidity* and *tenderness* in the neighbourhood of the umbilicus are not uncommon. Rarely can any definite tumour be palpated—though *palpable peristalsis* may be observed. *Splashing* can rarely be elicited. *Dulness* on *percussion* in the flanks may be present, but the amount of free fluid in the peritoneal cavity is usually not large. *Audible peristalsis* is often present.

Diagnosis.—There are no special features by which the diagnosis of this condition can be made with certainty. Signs of high small bowel obstruction, as shown by urgent

symptoms with little or no distension in a patient, usually a female, who is known to suffer from cholelithiasis should arouse our suspicion, but oftentimes there is no history of biliary colic or jaundice. Most of the patients are past middle life, and small intestine obstruction is relatively rare after forty, so that the diagnosis may be justified in the case of a woman, over forty, who has had no abdominal operation, or difficulty with an external hernia, to account for adhesions in the course of the small intestine. A yellow tinge of the conjunctivæ would go far to strengthen the diagnosis.

The following cases illustrate points in connection with gall-stone obstruction :—

1. J. L. Female, aet. 48.

History :—Severe attack of biliary colic fourteen months before admission ; similar attack also three weeks ago. Had never been jaundiced. Five days' abdominal pain of colicky nature followed by incessant vomiting and absolute constipation.

State :—Expression a little anxious ; abdomen very little distended ; some diffuse tenderness. Conjunctivæ icteric.

Operation :—Cœliotomy through right rectus. Hard mass found in lower part of ileum which completely occluded the lumen of the bowel. The mass was not attached to other structures, but could not be pushed forwards or backwards along the gut, which was deeply congested over the calculus. A longitudinal anti-mesenteric incision was made, and after delivery of the stone this was closed with a double row of Lembert sutures. Abdomen sutured in layers.

After history :—The obstruction continued with frequent vomiting and no action of the bowels, in spite of administration of magnesium sulphate and enemata.

Second operation :—Four days after the removal of the stone the abdomen was re-opened, and the cause of obstruction was found to be a kink in the bowel formed by adhesions at the site of the previous enterotomy. Ileostomy with a Paul's tube was performed a short distance above the obstruction, but the patient died twenty-four hours later.

At the *post mortem* examination :—The artificial anus was situated midway between the duodenum and cæcum ; there was no leakage ; the intestine above it was still greatly distended. The gall-bladder was contracted and thickened ; there was a fistulous communication

¼-inch in diameter between its fundus and the first part of the duodenum. Bile duct patent. No peritonitis. Viscera healthy.

2. J. S. Female, aet. 72.

History :—Patient had serious stoppage of the bowels thirty years ago. No history of jaundice. Abdominal pain of sudden onset, with vomiting and constipation, for three days before admission to hospital.

State :—No jaundice. Very slight distension in upper abdomen with visible peristalsis about level of umbilicus. Persistent bilious vomiting.

Operation :—Median cœliotomy; distended small intestine presented. Gall-stone the size of a walnut found impacted in ileum four feet from ileo-cæcal valve. Stone pushed back gently along the bowel and removed through longitudinal incision on anti-mesenteric border of gut. Opening closed with Lembert sutures. Abdomen sutured in layers. Death from shock on following day. P.M. No peritonitis. No leakage. Gall-bladder small and thickened; contained bile but no stones. Duodenum healthy; no fistula. Calculus must have passed down common duct. Interstitial nephritis, cardiac hypertrophy.

Treatment.—Although the operative treatment of this condition is so simple, the mortality is very high. The patients are often old, and the cases may not reach the surgeon till late, for in patients who are known to be subject to cholelithiasis the attack may at first be regarded as biliary colic, and in those who have not previously exhibited signs of gall-stones the obstruction is commonly high up in the small bowel, and in the absence of distension the gravity of the case may be overlooked. In some instances it is possible to manipulate the stone further on along the lumen of the intestine, and in the lowest part of the ileum the best course is to push it through the valve into the cæcum, leaving the patient to evacuate it by the rectum. In other cases, however, the stone can be pushed back, but not forward; this should then be done, and the coil of bowel containing it should be brought outside the abdomen with a clamp applied at its base. The loop having been shut off from the peritoneal cavity with long gauze plugs, a longitudinal incision, large enough to allow the stone to be

extracted, is made in the anti-mesenteric aspect of the gut. The opening should be closed with Lembert sutures, the intestine cleansed with saline, the clamp removed, and the loop dropped back into the abdomen. If there is much distension above the site of impaction of the calculus, the bowel should be emptied before the enterotomy incision is closed. It is important to examine the bowel very carefully, since there may be some kinking or stricture, due to adhesions, which caused arrest of the stone, and before closing the abdomen these points must be attended to. In the first of the cases given in detail above, it is possible that the kinking of the bowel which determined the fatal issue was present before the impaction of the calculus, as there was no relief of the obstructive symptoms from the first operation ; on the other hand the stone itself may have produced a kink in the bowel, and thus have been the cause of the adhesions.

These calculi, after removal, will often be observed to be facetted, affording evidence of the existence of other stones, and the surgeon should satisfy himself that there are not others in the lumen of the bowel, though it is not desirable to disturb adhesions in the neighbourhood of the gall-bladder and duodenum, lest leakage and peritonitis ensue.

If the bowel over the stone is gangrenous, enterotomy must be performed, with or without anastomosis, according to the condition of the patient.

After Treatment.—If the intestinal canal has been left intact early saline aperients should be used.

X. Strangulation through Mesenteric Apertures

Under this heading may be considered also strangulation through abnormal apertures in the omentum and the broad ligament. They are exceedingly rare causes of obstruction, and a description of them will probably be best served by giving details of two cases from the reports of St. Thomas's

Hospital. The apertures may be congenital or acquired; some of the latter may be the result of abdominal injury. The commonest situation for the opening in the true mesentery is close to the ileo-colic junction.

1. C. B. Male, aet. 68.

History:—Previous health good. Constipation present for three months. Five days before admission the patient took an aperient; he speedily began to suffer acute abdominal pain; vomiting occurred shortly afterwards, and the bowels did not act. The vomiting continued and the constipation became absolute.

On admission, the man was suffering from exhaustion and had an anxious expression. His tongue was dirty and pulse feeble; temperature 97° F. Abdomen distended centrally, slight visible peristalsis, percussion note tympanitic, no dulness in the flanks.

At operation:—Distended coils of small intestine were tapped and a quantity of gas and faecal fluid escaped. The obstruction was due to the passage of a coil of ileum, two feet above the ileo-cæcal valve, through a hole near the root of the mesentery at its lowest part. Reduction was easily performed and the aperture was closed. The patient made a good recovery.

2. Male, aet. 10.

Aperture in transverse meso-colon associated with tuberculous peritonitis.

History:—Scarlet fever at age of 5. Bowels always regular, no similar attacks of abdominal pain before the present one. In perfect health four days before admission. Three days ago the boy was seized with violent abdominal pain just after his bowels had acted. There was no vomiting directly after the onset of the pain, but subsequent attempts at taking food caused vomiting within an hour of ingestion. The vomit was bilious and green in colour. Absolute constipation, with the exception of a small stool brought away by an enema on the day before admission. The pain was of a persistent and gnawing character, with occasional severe paroxysms in epigastric and right hypochondriac regions. Abdomen tender to touch from the onset of the illness. No distension observed by the boy's mother.

State:—Face flushed and expression slightly anxious. Slight abdominal distension. No visible peristalsis. Respiratory excursion fairly good. Marked tenderness on palpation in epigastrium. Slight rigidity all over abdomen. No mass to be felt. Dulness on percussion in flanks and hypogastrium, shifting with alteration in patient's position. Liver dulness present. The vomiting continued but the

vomit consisted mainly of curdled milk; an enema yielded a small and constipated result.

Exploratory coeliotomy was performed two days after admission; the intestine and omentum were found to be studded with small tubercles; the symptoms were thought to be due simply to tuberculous peritonitis, and the abdomen was closed after lavage with saline had been carried out. The vomiting recurred, and the boy complained of great thirst and became very restless; the vomit became brown and almost fæculent, whilst the abdomen became distended. There was no visible peristalsis, and the percussion note all over the abdomen was resonant. The patient's condition became serious so rapidly that no operative interference except enterotomy and emptying the distended bowel could be performed, and death occurred shortly afterwards.

P.M. Coils of small intestine were united by recent adhesions; twelve inches of the ileum were found to be strangulated through an aperture in the transverse meso-colon, two inches from the mesenteric border of the bowel. The rent was evidently recent, as the edges were thin and approximated readily as soon as the ileum was drawn out. The ensnared bowel was deeply congested but not gangrenous. The ileum was studded with small tubercles along its whole length; the jejunum and duodenum were healthy. The strangulated bowel was four feet from the ileo-cæcal valve. Peyer's patches, only one of which was ulcerated, showed tubercles. The large gut was normal. Mesenteric glands large, and many calcareous. The liver also exhibited tubercles on its anterior surface. Other viscera healthy.

In this case the fact that fæcal vomiting occurred only after the first operation suggests that the opening in the transverse meso-colon may have been produced at this operation, perhaps during the process of lavage of the abdominal cavity. It is unfortunate that the precise state of affairs was not ascertained at the second operation, since reduction of the strangulated bowel was quite easy after death. As in the case of strangulated external hernia, it is noticeable that there is no direct relationship between the severity of the symptoms and the degree of strangulation.

If the entangled loop cannot be readily withdrawn, the mesenteric aperture should be enlarged by means of a radial incision in the direction of the blood-vessels.

XI. Internal Hernia

Etiology and Pathology.—As a cause of obstruction, hernia into a retro-peritoneal pouch is as rare as strangulation through a mesenteric or omental aperture. Four such cases occurred at St. Thomas's Hospital during a period of twenty years, including one diaphragmatic hernia. Those occurring in the upper part of the abdomen may be instances of hernia through the diaphragm, into the lesser sac of peritoneum, or into one of the pouches related to the termination of the duodenum and the root of the mesentery. The lower series are those in which the cæcal fossæ, the intersigmoid fossa, or Douglas's pouch are the sites of hernia. Many of these potential hernial orifices are constant features of the peritoneal sac, but their liability to assume pathological importance appears to be small, and no satisfactory explanation can be given of their doing so; it may, however, be assumed with reason that in such cases the pouches are abnormally developed, and it may be that the peritoneum as it passes from the bowel to the posterior abdominal wall also pursues an unusual course in many of the patients. The contents of the sac are usually small intestine, but the degree of obstruction produced is very variable.

A. Diaphragmatic Hernia

This is an example of internal hernia, but not of hernia into a peritoneal pouch. It is excessively rare, and usually the result of injury, though gaps in the diaphragm may be congenital defects or the result of inflammation.

Symptoms.—These are due to interference with both the thoracic and abdominal viscera. Dyspnœa is nearly always present and is due either to pressure on the lung of the affected side, usually the left, or, where the hernia is small, to interference with the excursion of the diaphragm. If the hernial orifice be large, the extruded abdominal viscera may cause displacement of the heart, and we have then a further

source of dyspnœa. The amount of pain and vomiting depends largely on the particular viscera which have passed above the diaphragm, but almost every one of the abdominal organs, even including the pancreas, has been found in a diaphragmatic hernia. Emaciation and constipation are the rule.

Physical Signs.—The most characteristic physical sign is the presence of a tympanitic area at the lower part of the chest, over which no breath sounds are audible; it is possible that the gurgling sound associated with movements of the stomach or intestines may be heard in this abnormal situation. If the stomach lies above the level of the diaphragm, its position would be demonstrable by X-ray examination. There is frequently displacement of the apex beat, and the coin sound may be obtained over the hernia.

As our series includes an instance of diaphragmatic hernia, it may be worth while to describe it in detail.

O. G. Male, aet. 30. A Spaniard.

History :—Patient had fought five duels without any injury to his own person; a sixth meeting had been arranged, but his antagonist sent a hireling to represent him, who stabbed the redoubted duellist in the left hypochondrium with a poignard. This incident occurred some six years before the present illness, and its immediate effects were slight. Three years before coming to this country, the patient had an attack of vomiting with severe pain in the region of the wound, and collapse, from which he completely recovered in a few days. One week before admission to hospital he sailed from a Spanish port for London. During the voyage he suffered from violent sea-sickness; there was absolute constipation for six days, and when he came to St. Thomas's he was much collapsed, and vomiting was still urgent and frequent.

State on admission :—Eyes sunken, cheeks hollow, body emaciated; pulse very feeble, constant emesis of thin fluid. Abdomen retracted and boat shaped; several scars observable in left hypochondrium. Respiratory excursion poor. Epigastrium resonant; note elsewhere over the abdomen impaired. Rectal examination negative.

Operation.—The abdomen was opened below the left costal margin, and a quantity of collapsed gut was encountered. It was then discovered that the stomach and transverse colon had passed through an oval rent in the left cupola of the diaphragm two-and-a-half inches

in length. The stomach was withdrawn into the peritoneal cavity, but the transverse colon could only be partially replaced; closure of the opening in the diaphragm was therefore not attempted.

Three days later the patient again became restless, and began vomiting repeatedly, complaining of severe upper abdominal pain. His temperature sank to 96·6° and he died in a few hours.

P.M.—The left side of the chest contained a large loop of the transverse colon together with the omentum. It was not strangulated, but recent peritonitis rendered the withdrawal into the abdomen impossible. The left pleural cavity did not communicate with that of the peritoneum, but the left lung was pushed up and collapsed. There was slight pleurisy on both sides. There was no sac to cover the herniated bowel, and the rent in the diaphragm was situated in the muscular portion of the left cupola.

Diaphragmatic hernia, then, affords us an example of intestinal obstruction of variable degree associated with a retracted abdomen and respiratory distress, the latter being unusual in abdominal lesions where distension is absent. A diagnosis in the absence of a history of injury would be very difficult.

A diaphragmatic hernia may also result from the passage of a solid viscus such as the liver or spleen through an abnormal aperture in the diaphragm.

B. Hernia into the Lesser Sac of the Peritoneum

A portion of the intestinal canal may reach this space either through the normal communication between the greater and lesser peritoneal sacs—the foramen of Winslow—or through some abnormal aperture in the peritoneal folds which form the boundaries of the sac. The normal foramen of Winslow is only large enough to admit two fingers, and it is probable that in those cases where the lesion has occurred—and their number is exceedingly small—some abnormality in its size and relations has predisposed to the passage through it of intestinal coils. Non-descent of the cæcum to the right iliac fossa may be a predisposing cause, and it may also be associated with an unduly large foramen. The neck of the

sac is formed by the boundaries of Winslow's foramen, and the contents consist usually of small intestine, but both large and small bowel have been incarcerated here, or colon alone may be involved.

Symptoms and Physical Signs.—Acute abdominal pain with repeated vomiting and more or less absolute constipation are usually present, and such characteristics as will aid the diagnosis are, first, that the pain is intense and epigastric in situation; secondly, that there is a prominence or tumour in the epigastrium, slightly resonant on deep, but dull on light, percussion.

The rest of the abdomen may be retracted; visible peristalsis is absent; hiccough, which might be expected from pressure indirectly on the diaphragm, is not usual; there may be slight dulness in the flanks, due to free fluid.

Diagnosis.—As far as we are aware no surgeon claims to have diagnosed the condition before operation, but it seems possible that the diagnosis . ;ht be made in the case of acute obstruction with well marked and localised epigastric pain and prominence.

Treatment.—An incision through the right rectus would be the most suitable. The neck of the sac, which will be close beneath the abdominal incision, must first be examined, and an attempt may be made to reduce the contents by gentle traction. Failure in this procedure may be due to adhesions within the lesser sac, or to some degree of volvulus of the contained bowel. Enterotomy must be performed to lessen the distension of the gut so that reduction may be aided. This can best be carried out through a vertical slit in the gastro-hepatic or gastro-colic omentum, and when the gut is emptied and any twist undone, it should be easy to reduce it once more through the foramen of Winslow from the lesser into the greater peritoneal sac; the incision in the wall of the sac may then be closed. Any attempt at enlargement of the neck of the sac is almost impracticable, since the only part readily accessible contains the portal vein, the common bile duct, and the hepatic

artery ; for the same reason, when once the gut is reduced, no attempt should be made to close the opening of the foramen, since the satisfactory application of sutures would wound one of these structures or the inferior vena cava.

The results obtained in two of the recorded cases are of interest. Treves, in the *Lancet* of October 13th, 1888, describes a case where he made the diagnosis at the operation with some difficulty, owing to the presence of greatly distended coils of intestine around the neck of the sac. He failed to reduce more than two or three feet of the contents, and does not state that he performed enterotomy for the relief of the distension, and he certainly did not expose the incarcerated bowel through the gastro-hepatic omentum. The patient died six hours after operation. At the necropsy reduction could not be effected till the three important structures in the right free border of the gastro-hepatic omentum had been divided. A more fortunate result was described by Arthur Neve in the *Lancet*, of May 28th, 1892. The diagnosis in this case was easily made, but reduction by traction was ineffectual, and the abdomen was closed without relieving the condition. On the second night large enema was given, and shortly after this spontaneou reduction occurred and the patient made a good recovery.

In neither of these cases does the surgeon appear to have relieved the distension of either the free or the imprisoned bowel, and the failure to reduce the sac contents may thus be accounted for, since in the second case an enema succeeded where the surgeon had failed.

Hernia into the lesser Sac through an abnormal aperture.—Such abnormal apertures are usually acquired and not congenital, and the gut may reach the lesser sac through the lesser omentum, the gastro-colic omentum, or the transverse meso-colon. Probably the last-mentioned route is the commonest and the hernia is a possible sequel to posterior gastro-jejunostomy. It should not happen if the aperture made in the posterior layer of the transverse meso-colon is accurately fixed at the close of the anastomosis, but if it

should occur, persistent vomiting of a more urgent and fæcal type than is met with in "vicious circle" vomiting would result, and probably absolute constipation would be present with severe abdominal pain. Examination of the site of anastomosis should immediately reveal the nature of the lesion, and there should be no difficulty in reducing the jejunum after enlarging the vertical opening in the meso-colon. The aperture should then be carefully closed with sutures and anchored to the line of the anastomosis.

FIG. 15.—Hernia into left duodenal fossa (specimen 1279, St. Thomas's Hospital Museum). "A preparation showing a hernia of the jejunum about the size of an orange into the fossa duodeno-jejunalis. The colon has been raised in order to expose the small intestine, which has been filled with plaster of Paris."

C. Hernia into the Duodenal pouches

These may for clinical purposes be divided into right and left duodenal hernia, the latter being much more common than the former. In *left duodenal hernia*, the neck lies to the right of the sac, just to the left of the body of the third lumbar vertebra. The anterior margin of the neck of the sac is occupied by the inferior mesenteric vein. The symptoms are pain, vomiting, and constipation of varying degree; the physical signs, in so far as they are characteristic, are represented by a globular swelling in the neighbourhood of the umbilicus extending towards the left lumbar region; this has the feeling of a cyst, and is usually slightly mobile. It may yield a low-pitched tympanitic note on percussion. Hæmorrhoids and the passage of blood *per anum* may be

noticed, and are explained by pressure on the inferior mesenteric vein which runs in the neck of the sac.

Treatment.—Cœliotomy, for preference through the left rectus sheath with displacement of the muscle outwards, should readily disclose the nature of the lesion. Reduction is often easy ; but if it is not readily carried out, the neck of the sac may be cautiously nicked, care being taken not to injure the inferior mesenteric vein or the left colic artery. Failing reduction by this method, the sac wall should be split vertically, as described above in dealing with hernia into the lesser sac, and the gut emptied ; reduction through the neck of the sac can then be effected. A few sutures may be carefully applied to close the neck of the sac.

Right Duodenal Hernia.—The symptoms and physical signs of this lesion closely resemble those of left duodenal hernia, but the neck of the sac lies to the left of the hernia, and in its anterior boundary runs the superior mesenteric artery. The globular swelling produced by the hernia then occupies the umbilical and right lumbar regions. The same treatment is applicable as to the left-sided variety, care being taken not to damage the artery in the anterior fold of the neck of the sac.

D. Lower Series of Internal Hernia

The diagnosis of these lesions can hardly be made before operation, and the signs are merely those of obstruction with pain mainly below the umbilical plane. They can be approached through a sub-umbilical right rectus incision. Those into cæcal fossæ form the majority of this lower series ; intersigmoid hernia is very rare, and hernia into Douglas's pouch is rarer still. Our series included a case of peri-cæcal hernia and we give the following brief outline :—

J. C. Male, aet. 52.

History :—An attack of the same nature as the present illness occurred twenty years ago, when all the symptoms were relieved by

the application of hot fomentations to the abdomen. The present illness started five days before admission to the hospital, with generalised abdominal pain, repeated vomiting and constipation; the symptoms increased every day in severity.

State on admission:—The abdomen was distended and especially prominent near the middle line below the umbilicus, in the neighbourhood of which there was visible peristalsis. Pulse 100, temperature 98° F., tongue thickly furred. Rectal examination negative.

Operation:—The abdomen was opened by a median sub-umbilical incision; the small intestine was enormously distended for the most part, but there were loops of collapsed bowel in the pelvis. A loop of ileum four feet from the ileo-cæcal valve was discovered to be incarcerated in a pouch internal to the cæcum. This loop was easily withdrawn and the collapsed bowel below rapidly filled with gas. The abdomen was closed. A saline aperient was given on the third day with good effect and the patient made a rapid recovery.

This appears to have been an instance of hernia into the ileo-colic fossa, and apparently no attempt was made to obliterate the sac, though this should not be difficult. The ileo-appendicular fossa can easily be obliterated by removal of the appendix.

Post Operative Treatment of Internal Hernia.—If the reduction is effected by the operation, the intestinal canal is usually left intact, and the most important point therefore is to secure early activity of the bowels by the administration of calomel or saline aperients. If the sac has not been obliterated, nor the neck closed, it is desirable to place the patient in such a position that the tendency of the bowel will be to fall away from the neighbourhood of the orifice of the hernia.

XII. Paralytic Obstruction

Although in our series of obstruction cases paralysis of the gut, without mechanical obstruction, is recorded in only four instances, the condition is certainly more common than these figures suggest, for it is met with as a secondary phenomenon in a variety of lesions, *e.g.* in peritonitis, after simple hernia operations, and various procedures within the

peritoneal cavity; owing to this, the secondary paralysis of the gut has not been recorded separately, or else the case has been entered in the Hospital statistics as one dying from peritonitis, overlooking the fact that in some instances the peritonitis has been brought about by the paralytic condition of the bowel.

Etiology and Pathology.—The neuro-muscular mechanism of the intestine is controlled mainly by the sympathetic nervous system, and the peripheral distribution of these nerves is represented by the plexuses of Auerbach and Meissner, situated respectively beneath the mucosa and between the muscular coats of the bowel. The receiving stations of these nerves lie in the solar and mesenteric ganglia, which are connected with the lumbar nerves by the rami communicantes, and with the lower thoracic nerves by the descending splanchnic nerves. The pneumogastric nerves also contribute fibres to these ganglia, and the action of vagal and splanchnic fibres is antagonistic, for whereas experimental stimulation of the vagus produces peristalsis, the splanchnic nerves contain inhibitory fibres. Paralysis of the musculature of the bowel may therefore result from effects produced upon the bowel wall and its contained nerve plexuses, from changes in the abdominal ganglia, from cutting off the vagal accelerator impulses, or from stimulation of the splanchnic inhibitory fibres. Clinically, the condition is met with in cases where the peritoneal coat of the bowel is acutely inflamed, in torsion and strangulation of abdominal viscera other than the bowel itself, in lesions of the spinal cord or some of its peripheral nerves, or of the abdominal ganglia. The paralysis due to peritonitis is presumably the result of direct poisoning of the cells of the intestinal plexuses by the bacterial toxins; torsion of omentum, or of the pedicle of an ovarian cyst, may cause paralytic obstruction as a reflex nervous phenomenon; lesions of the ganglia due to injury, or the pressure of a tumour, cause direct paralysis; lesions of the spinal cord or some other part of the central nervous system may produce

paralysis in so far as they cut off the vagal accelerator fibres or irritate and stimulate the splanchnic inhibitory nerves.

However the primary disturbance of the muscle tone of the bowel is originated, the effect it produces on the gut and its contents is the same. Stagnation of the fæces occurs, and stagnation in the presence of putrefactive organisms, which normally inhabit the bowel, leads to decomposition and the production of gas. Cessation of digestion and assimilation also takes place, and the food stuffs which principally contribute to the offensive fluids and gas, which fill the bowel, are proteids and carbohydrates. Bacterial decomposition of proteids occurring in any part of the intestine gives rise to fæcal-odoured fluid, while carbohydrates in their decomposition give rise to the generation of marsh gas and carbon dioxide. The bowels become waterlogged, and the patient is robbed of the nutrient fluids which should be present in his tissues. Over-distension of the bowel by imprisoned gas also hampers the contractility of the muscular coats, and that this extreme distension plays an important part in the production of paralytic obstruction was amply proved in a case recorded by one of us in the "Annals of Surgery," for January, 1910. The initial cause of the paralysis in this instance was apparently irritation and stimulation of the right great splanchnic nerve, for the patient's abdomen became distended and tense three days after the fracture of the seventh, eighth, and ninth ribs on the right side. His condition was too grave to allow of the safe administration of an anæsthetic, therefore puncture of a distended coil, close to the umbilicus, was performed with a hollow needle, since aperients and enemata had failed to produce any movement of the bowels, which had not acted since the accident. Only gas and a few drops of fæcal matter were ejected, but the patient experienced great relief. Two doses of eserin salicylate gr. 1 50 were injected into the buttock, and within the next sixteen hours the bowels acted twice. At the end of this time, however, the

abdomen became as distended as before, and under local infiltration anæsthesia a winged rubber catheter was tied into a much distended coil of gut near the site of the previous puncture. Practically nothing but gas escaped, and no eserin was administered, but within twenty hours there had been three satisfactory actions of the bowels, and from that time peristalsis was re-established and the patient made an excellent recovery. The small fæcal fistula closed at the end of a few weeks.

We arrive therefore at the paradoxical conclusion that paralysis causes distension, and distension produces paralysis. But the effects go further than the muscular layers of the intestine. The serous coat in a state of quiescence offers little resistance to the attacks of the increasing myriads of organisms within the lumen of the bowel; if the paralysis is not relieved, consecutive peritonitis ensues just as it does in the case of organic obstruction, so again we must admit that peritonitis may cause paralysis, and paralysis causes peritonitis. The peritoneum possesses almost unlimited power of absorption, and thus death most often occurs from toxæmia due to peritoneal intoxication. Thus it happens that cases may be recorded as fatal from peritonitis of unknown origin, where the initial state was one of paralysis of the bowel and the secondary peritonitis was due to the transmigration of organisms from the mucous to the serous coat of the intestine, so infecting the largest serous sac in the body. Such a case will be described below.

As regards the bacteriology of these infections, the staphylococci are usually first in the field, and they may be associated with streptococci, the colon bacillus, or any of the organisms which normally lie within the lumen of the bowel. As regards cultural results, the staphylococcus albus, though present, is not infrequently outgrown by the more virulent and hardy organisms, mainly bacilli.

Symptoms.—*Pain, vomiting, and constipation* are all present, but, as a rule, the first is slight, and due mainly to the stretching of the abdominal wall. It usually amounts

to little more than discomfort, and, as compared with obstruction due to bands or adhesions, such a case might almost be regarded as *painless obstruction*. In this connection we may note that loss of pain in cases of peritonitis, or of strangulated hernia, indicates paralysis of bowel, and is therefore of bad prognostic significance. The absence of pain is a misfortune for the patient, as it may cause the surgeon to delay before he decides upon operation.

Vomiting is late in onset and rarely occurs before the third day of constipation has been reached. In spite of the fact that vomiting occurs late, a fæculent character of the vomit is met with early. The explanation is simple; vomiting does not usually occur till much decomposition has taken place within the bowel, so that a quantity of fluid has accumulated, and the stomach, which resists paralysis almost to the last, has emptied its contents into the small intestine. In some cases therefore the first vomit may have a distinctly fæcal odour. The consideration of the mechanism of fæcal vomiting in obstruction has already received attention (*see* p. 150), and it has been pointed out that the essential factors are a non-paralysed stomach, and a water-logged intestine, conditions which are pre-eminently found in paralytic obstruction. Paralysis of the stomach is a very rare event, and even in the condition known as acute dilatation of the stomach, vomiting occurs in the earlier stages of the lesion, although the musculature of the organ may have to contend against a high intra-gastric pressure; the explanation probably lies in the fact of the great muscular power of the stomach wall. The stress of paralytic obstruction undoubtedly tells most severely on the weaker walled small intestine, but even the thick walled large bowel may sometimes suffer.

Constipation is present from the onset of paralysis, and is continuous and absolute. The administration of aperients serves only to increase the amount of fluid lying stagnant in the intestinal canal; enemata are often retained, proving that even the strong muscles of the colon are unable to

respond to the powerful stimulus of fluid distension. If the enemata do produce the evacuation of fæces, it is usually only from the lowest part of the large intestine, for the rectum resists paralysis for a longer period than the colon. As a rule neither fæces nor flatus can be evacuated either by natural or artificial means.

Hiccough is commonly met with, and its presence is dependent on the dilatation of the bowel and the pressure produced on the inferior surface of the diaphragm, reflex spasm of which is held to be the explanation of the phenomenon of hiccough.

Physical Signs.—The general signs of obstruction are usually exhibited at a fairly early period of the illness; a Hippocratic facies makes its appearance, the respirations are shallow, the tongue is dirty and the breath offensive; the temperature is usually not raised, and the pulse is weak rather than rapid, though it commonly reaches 100 per minute.

Distension of the abdomen is invariably present; it is the earliest sign to appear, and is the predominant feature throughout the case.

Visible and audible peristalsis are both absent. *Rigidity* is not as a rule observed, and then only in the later stages, when consecutive peritonitis has made its appearance. *Local tenderness* is very unusual, and the patient will commonly allow deep palpation without complaining. *Splashing* is rarely elicited. The *percussion note* over the abdomen is usually tympanitic, the liver dulness is often encroached upon, but there may be some dulness in the flanks, due either to free fluid, or to fluid within the lumen of the more dependant coils of intestine; the hypogastrium may also yield a dull note, but the central part of the abdomen is almost invariably tympanitic, and situated here are coils of ileum firmly blown up against the anterior abdominal wall. *A fluid thrill* is met with in some cases of paralytic obstruction though it is rarely transmitted from one side to the other of the abdominal cavity. *No peristalsis*

can be heard on auscultation. Examination of rectum, vagina and hernial sites is negative.

Diagnosis.—The diagnosis of paralytic obstruction may be difficult, but the symptoms of obstruction associated with a more or less painless distension of the abdomen are highly suggestive. When paralysis of the intestine occurs in the course of peritonitis from any cause, the pre-existing pain usually disappears and it is quite common for the patient to state that he feels better, whereas the cessation of pain is really a sign of the gravest mischief. Any obstructive signs appearing after manipulative or operative treatment of a hernia or any portion of the intestinal canal should be regarded with suspicion, and the following case, which was unfortunately not operated upon till after peritonitis had supervened, is most instructive.

G. H. Male, aet. 38. Porter.

Admitted with four weeks' history of hæmorrhage from the rectum. He occasionally passed as much as half a pint of bright red blood at a time. On examination a few hæmorrhoids were present.

Operation :—The piles were removed after Whitehead's method. The folds of the rectal mucous membrane were found to be somewhat redundant, but there was no further lesion in the rectum to account for the hæmorrhage.

The usual custom of giving an ounce of castor oil followed by an olive oil enema on the fourth night after operation was followed in this case, but the bowels did not act. The patient complained of no pain, but the abdomen was observed to be slightly distended. Enemata were given, but they produced no action of the bowels. On the fifth day the facial expression of the man was anxious although he still complained of no definite abdominal pain, and palpation of the abdomen was allowed without causing discomfort. On this day the man vomited for the first time, and the vomit was fæculent both in colour and odour. He presented a Hippocratic facies, his tongue was thickly coated and his breath offensive. Pulse rate 96. The abdomen was greatly distended and the liver dulness was diminished. There was no visible or audible peristalsis, nor was there any definite rigidity of the abdominal wall on palpation. There was no sign of free fluid in the flanks.

Abdominal exploration revealed recent peritonitis with a few patches of lymph, but no les. of the bowel wall. The small gut was

uniformly distended, but no cause for the peritonitis could be discovered. The peritoneum was cleansed and the abdomen closed, but the patient survived for two hours only.

Post Mortem Examination.—The peritoneal cavity contained a little free fluid. The duodenum, two-thirds of the jejunum, and the ileum were much congested, and the peritoneal coat was covered with lymph. The mucosa was swollen, but it showed no ulceration. The large bowel contained a quantity of fæces, but its walls were healthy. The stomach and all the abdominal viscera were normal. The heart was hypertrophied ; lungs healthy ; all the other organs were normal. At the site of operation the wound was healthy ; there was no evidence that infection had spread *viâ* the rectum to the peritoneal cavity.

The apparent explanation of this case is that the rectal operation acted as a powerful stimulus to the afferent nerves and the inhibitory abdominal centres of the small intestine, just as rectal operations often cause a temporary nervous paralysis of the bladder without any injury to the nerves or the nerve centre of the bladder. This patient did not suffer from nervous retention of urine, but he died from retention of fæces with its disastrous consequences.

Paralytic obstruction is well known to occur after the apparently successful treatment of strangulated hernia by taxis. A case of this kind is included in our series.

A. B. Male, aet. 21.

Strangulated inguinal hernia reduced by taxis six days before admission to the hospital. A purgative was taken two days after the reduction of the hernia, as the bowels had not acted. Pain and vomiting followed the taking of the medicine, and the vomiting persisted until admission. The abdomen was then seen to be distended and immobile. There was some dulness on percussion in the flanks. The abdomen was opened and the portion of the small gut which had been within the hernial sac was at once exposed ; it was dark in colour and flabby ; the bowel above was distended with fluid fæces ; the bowel below was completely collapsed. A Paul's tube was tied into the distended gut, but the patient died a few hours later.

P.M.—The point of strangulation had been just above the ileo-cæcal valve. There was very little peritonitis. The Paul's tube had been secured in the gut thirty inches above the cæcum. There was no obstruction to the lumen of the intestine.

In this instance, persistent paralysis of the small intestine, due to the stimulus of local strangulation within the sac, had caused the bowel to remain in the condition obtaining before the relief of strangulation, distended above and collapsed below the hernia. The upper segment of the bowel had become more distended by reason of purgatives and putrefaction; the lower segment remained collapsed, since it was empty from the time of strangulation.

Treatment.—The treatment of paralysis of the intestines undoubtedly presents many difficulties. When it occurs in the course of peritonitis the outlook is grave, and in other conditions the prognosis depends largely on the early recognition of the true state of affairs and the prompt relief of the over-distended bowel. Aperients are rarely successful in restoring the flow of the fæcal stream, and it is often their failure to produce evacuation of the bowel which gives rise to the suspicion of the presence of paralytic obstruction. Enemata on the other hand, by stimulating the musculature of the intestine, may suffice in the slighter degrees of this condition, for peristalsis of the small intestine may be set up as a sequence to their stimulating influence on the large bowel, which is thus rendered empty. Turpentine in a soap-and-water enema is the most efficient. Where the causative lesion is one of pressure on the cord or its nerves, complete relief can only be expected if the primary disease is effectually dealt with, but in other cases, where the initial lesion is uncertain, much may be done by relief of the distension of the bowel. To this end a temporary opening must be made in the distended coils, as mere enterotomy with evacuation of fæces and suture of the incision is rarely successful in the cure of the condition, although it often affords temporary relief. In the case which we have quoted as a sequel to fracture of the ribs, relief for one day resulted from puncture of the distended gut through the abdominal wall. This was performed with some hesitation, and, though it was attended with no undesirable results, we do not consider that it should be adopted as a common procedure, partly

because its effect is likely to be only temporary, and also because of the risks of infection of the peritoneal cavity and the abdominal wall. The condition of these patients is often such that the administration of a general anæsthetic is undesirable, but such a small operation as ileostomy can be satisfactorily performed under local infiltration anæsthesia if the incision be made in the middle line close to the umbilicus. Where there is much distension of the small intestine, coils of ileum are usually blown up firmly against the anterior abdominal wall in the region of the umbilicus, and a small median incision just above the navel is not likely to lead to the subsequent formation of a ventral hernia. The main object is to set free the imprisoned gas from within the lumen of the bowel, in order to lower the intra-intestinal pressure and favour the propulsion of the fluid fæces from the small to the large gut. If a certain amount of fæcal matter can be safely evacuated, so much the better, but it is not desirable to produce an artificial anus. We have found that a large winged rubber catheter (No. 12), which can easily be tied into a distended loop under local anæsthesia, will often give the necessary relief, and it has the advantage of leading only to the formation of a fæcal fistula which nature will close in a few weeks. By this means the patient escapes the risk associated with a high artificial anus as regards inanition, and further operation for the restoration of the intestinal canal. We do not suggest that this procedure will succeed in every case of paralytic obstruction, but if one such opening fails there can be little objection to a second made into a different loop in the bowel. The precise situation of the opening in the small intestine is, of course, not determined by this limited operation. In cases where the distension of the gut contributes largely to the causation of the paralysis, the operation may be expected to give good results, but where peritonitis is the primary lesion, the outlook is less hopeful, though we believe that patients' lives have many times been saved where dependence on aperients and enemata would have meant trusting to a false hope. Performed under

local anæsthesia it affords the best chance for the relief of the condition from whatever cause it arises, and the operation itself is almost devoid of risk owing to the fact that the bowel is blown up against the parietal peritoneum, and the opening causes first escape of gas and not fæcal matter, so that if a purse-string suture be placed in position and the bowel incised within its circle, the catheter can be slipped into position and the suture tightened before any fæcal matter is extruded; the slackened bowel wall can then readily be secured to the parietal peritoneum with a few stitches. If the catheter becomes blocked with fæces, syphonage with water can easily be used to clear the tube.

After Treatment.—Enemata will probably be of value afterwards to aid the fæcal flow, and in some cases eserin salicylate, in doses of 1/50 gr. injected into the buttock at four hourly intervals for five or six doses, may be of great service, since eserin does undoubtedly favour peristalsis by its direct stimulation of the muscular coat of the intestine.

XIII. Obstruction due to Pressure of a Tumour on the Bowel

This is a very unusual cause of obstruction, although, when one considers the enormous size that abdominal tumours may reach, it appears strange that the bowel can find room to carry on its function within the abdomen. However, if the peritoneal cavity can accommodate the pregnant uterus at full term with little more than a tendency to constipation, it is clear that a tumour which does not arise in close connection with the bowel may assume very large proportions without producing obstruction.

Etiology and Pathology.—The situation of the tumour is of the greatest importance; an impacted uterine fibroid may easily compress a portion of bowel against the bony wall of the pelvis, or a growth originating in the retroperitoneal tissue, or between the layers of the mesentery, may at an early date produce pressure obstruction. It is far more

common, however, to meet with obstruction due to adhesion between the intestine and a tumour than to encounter true instances of obstruction due to pressure. The tumours which are most likely to cause obstruction by pressure are ovarian cysts burrowing in the broad ligament and meso-sigmoid, fibroids, and mesenteric cysts.

Symptoms.—These do not differ from those met with in cases of stenosis due to other causes, and the sequence of events may be constipation, leading up to severe abdominal pain, with urgent vomiting and complete obstruction, or the acute symptoms may be the earliest evidence of illness.

Physical Signs.—The presence of a definite resistant abdominal or pelvic tumour in a patient suffering from obstruction, evidenced by distension, visible peristalsis, local tenderness, and perhaps some rigidity, are the signs usually present. The local tenderness and rigidity are likely to be present in the neighbourhood of the tumour, as the vitality of the bowel is likely to suffer here, and some degree of local peritonitis will probably result.

Diagnosis.—A differentiation between obstruction due to adhesion between a growth and the bowel wall, and true pressure obstruction is not likely to be possible, and unless the growth is impacted in the pelvis, or is thought to be retroperitoneal, the former diagnosis is more likely to be correct. The following case illustrates the difficulty of diagnosis.

E. W. B. Male, aet. 13½.

History.—A perfectly healthy boy until 10 days before admission to hospital. During this period he had suffered from acute abdominal pain and vomiting, associated with almost complete obstruction. The vomit was fæculent on the tenth day of the illness. Enemata yielded no result.

State on Examination.—Expression anxious, eyes sunken. Pulse 120. Temperature 99. Abdomen uniformly distended and resistant on palpation over the right half. Visible peristalsis present, forming a ladder-shaped pattern. Resonant all over, except low down over the pubes. Liver dulness normal in extent. No fluid in flanks. No tenderness. *Per rectum* a smooth elastic mass could be felt through

the anterior wall. The bladder was emptied by catheter but the tumour remained unaltered in character.

Operation.—Cœliotomy revealed a sub-peritoneal cyst, of the size of a large orange, growing in the mesentery of the small intestine. The intestine opposite the growth was severely compressed, but not gangrenous. There were several small cysts close to the larger one. Removal of the cyst without cutting off the blood supply to the gut was impracticable, therefore both cyst and compressed gut were excised. The bowel was united by lateral anastomosis. The boy lived only two days.

P.M.—Acute general peritonitis. The upper portion of small intestine was 16 feet long and was distended, the lower portion measured 22 inches and remained in a state of collapse. No other tumour was present in the abdomen. The nature of the cyst remained doubtful even after microscopical investigation.

In such a case as this, it is quite likely that paralysis of the bowel may have been present, as is suggested by the state of the gut found at the *post mortem* examination, due to interference with the innervation of the intestine by the growth between the layers of the mesentery.

Treatment.—Removal of the tumour is essential to cure, but if this cannot be performed, it may be best to relieve the obstruction by the formation of an artificial anus, with subsequent anastomosis and closure, or, if the obstruction is not acute, by immediate lateral anastomosis. The condition of the compressed bowel must be carefully examined, since resection may be called for.

XIV. Obstruction due to Carcinoma of the small Intestine

Out of five hundred cases of acute obstruction, only one was due to primary carcinomatous stricture of the small intestine, so that this condition must be regarded as rare.

Etiology and Pathology.—A primary cancerous growth of the small intestine, usually the ileum, is much less common than that of any part of the large bowel. It produces obstruction by diminishing the lumen of the gut, by becoming adherent to other abdominal contents, by inducing kinks or volvulus, or by becoming intussuscepted.

Symptoms.—There may be a history of diarrhœa preceding the acute onset of obstruction, but in many cases the actual condition of obstruction is the first evidence of serious illness. *Pain*, *vomiting*, and *constipation* are then present and are usually pronounced in degree.

Physical Signs.—There are no distinctive signs which point to such a stricture of the small intestine, but the distension is apt to be central, and visible peristalsis may reveal the ladder-shaped patterns met with in small bowel obstruction. The percussion note is commonly tympanitic in the middle of the abdomen, but there may be dulness in the flanks, due to the presence of free fluid. The detection of a mobile tumour on palpation of the abdomen is the most suggestive sign, but its presence may often be obscured by the existing distension.

Diagnosis.—Small bowel obstruction is rare in patients over forty years of age, and carcinoma of the small intestine is not likely to be met with in subjects younger than this. In the absence of the probability of post-peritonitic or post-operative adhesions, or evidence of cholelithiasis, as shown by conjunctival jaundice, such a diagnosis may at times be made if the case is clearly one of small bowel obstruction, and the presence of a tumour would go far to confirm this. There is, however, one source of error which must be remembered. Malignant disease of the colon or rectum may give rise to adhesions between the growth and some adjacent part of the small intestine, and the latter event may precipitate the onset of obstruction. In such cases careful inquiry will usually elicit a history of constipation of some months' duration, and possibly the passage of blood *per rectum* will have been noted, whilst the evidence of physical signs is all in favour of a small intestine lesion, and the symptoms may be more urgent than are met with in large bowel obstruction except in the later stages with extreme abdominal distension. In several instances of this double lesion we have succeeded in making a correct diagnosis by noting the disagreement between the history and the physical signs.

Treatment.—The obstruction must be relieved. The growth is often removable, but there may be more than one carcinomatous stricture, and secondary deposits in the liver and peritoneum must be looked for. If the growth is in the jejunum we prefer the risks of resection and immediate anastomosis to the formation of a temporary artificial anus with subsequent removal of the growth and closure of the gut, since the risks of inanition and infection of the wound are probably greater than those of immediate anastomosis. In the case of the ileum, if the growth be reasonably near its termination, it is far better to be content to make an artificial anus for the relief of obstruction and leave the further treatment for a second operation. We prefer to excise the growth and tie a Paul's tube in each end of the divided bowel at the first operation, leaving closure of the gut for the second, rather than merely opening the bowel above the growth, for the sooner a cancer is removed the better for the patient. The risks of the two methods are probably equal, but the restoration of the intestinal tract is more easily completed by one further operation if the growth be excised when the obstruction is relieved. If the tumour is not suitable for excision, or if metastases are present, we have the choice of artificial anus or lateral anastomosis. While admitting that a condition of acute obstruction is most unsuitable for the performance of any anastomosis, we would still prefer a lateral short-circuiting operation for a jejunal growth, but not for one in the lower ileum. The mortality from peritonitis in anastomosis performed for acute obstruction is due to the infectivity of the contents of the upper segment of bowel, and to minimise this the gut should be emptied as far as possible before the junction is effected. Infection often occurs when there is no evidence of leakage at the anastomotic junction, and is probably due to infection *viâ* the sutures and the holes they produce in the bowel wall. In the case of inoperable carcinomatous stricture of the ileum, artificial anus is probably the best immediate treatment. Further procedures may

then be possible for the closure of this by anastomosis with the colon, but it is rather unlikely that the patient will survive long, or get well enough to stand a second lengthy abdominal operation.

The after-treatment of these cases requires no further description than has been already outlined in speaking of artificial anus in the small intestine.

CHAPTER VI

THE STOMACH AND DUODENUM

Of the medley of diseases and symptoms usually classified as **The Gastric Neuroses** we need consider two only, viz. Gastralgia and Gastro-succorrhœa.

During the last few years there has been an increasing scepticism as to the reality of most, if not all, of the gastric neuroses, and attempts have been made to explain these various symptom-complexes (of the existence of which, as such, there can be no possible doubt) on an organic basis. We are inclined to think that the pendulum has swung a little too far in this direction. While fully prepared to admit that the majority of those patients who were formerly diagnosed as " Hyperacidity " should now be recognised as suffering from Duodenal Ulcer, we are still convinced of the existence of certain well-defined groups of gastric symptoms which may occur without any demonstrable lesion of the stomach or duodenum ; of these, the two conditions we are about to consider, viz. Gastralgia and Gastro-succorrhœa, are examples. Both of these conditions are found almost exclusively in hysterical or neurotic subjects and are independent of organic disease.

Gastralgia

This neurosis is more common in females than in males, and is frequently associated with the menopause ; in some

women typical gastralgic attacks may occur with every menstrual period. It is characterised by periodic attacks of diffuse epigastric pain, which is frequently spasmodic and is not definitely related to meals. The onset of the pain is usually abrupt, but there may be warnings of malaise and nausea; it may be so intense as to cause great collapse and to necessitate the administration of morphia and stimulants. Vomiting is rarely present. There may be hysterical manifestations, such as the globus hystericus. The attack of acute pain lasts from fifteen to thirty minutes, and may be repeated several times during the day; it seldom occurs during the night.

Diagnosis.—The most important points are evidence of a neurotic constitution, a history of previous attacks of a similar nature, the paroxysmal and spasmodic character of the pain, the absence of any sharp localisation (as in ulcer or biliary colic), the fact that the pain is relieved by pressure, and the absence of vomiting. The conditions most likely to be confused with gastralgia are Ulcer, Biliary Colic, and early Gastric Perforation.

Gastro-succorrhœa Continua Periodica, or **Intermittent Hypersecretion.**—This is an uncommon condition, usually associated with profound neurasthenia and more common in males than in females. The onset is usually in the early morning, and is frequently heralded by intense headache and malaise; then follow paroxysmal epigastric pains of rapidly increasing severity, flatulence, and, finally, vomiting. The vomited matter consists first of food; but, after this has been ejected, pure gastric juice may be brought up.

Diagnosis.—In those cases where the pain is so intense, and the vomiting so incessant, as to produce great collapse, a gastric perforation, a small bowel obstruction, or acute pancreatitis might be suspected. Evidence of neurosis, a history of previous attacks of a similar nature, and the characteristic vomit should make the diagnosis clear. This condition is sometimes associated with Tabes.

We have next to consider certain organic lesions which it will be convenient to classify as follows :—

Acute Catarrhal Gastritis.
Suppurative Gastritis.
Phlegmonous Gastritis
Membranous or Diphtheritic Gastritis.
Corrosive Gastritis.
Peptic Ulcer (Gastric or Duodenal).
Gastrectasis.

Acute Catarrhal Gastritis

Acute Catarrhal Gastritis may be due to gastric irritants excreted into the stomach by its own mucous membrane ; it has been proved that antimony salts, when injected intravenously, produce vomiting in part, at any rate, by direct action on the gastric mucosa ; and the intra-gastric secretion of cobra venom, and of the toxalbumins of cholera, has also been demonstrated. It is probable that the initial gastric catarrh of many of the specific fevers may be brought about in this manner. But in many cases catarrhal gastritis is due to irritants introduced *viâ* the mouth and œsophagus. Of these irritants the most important is alcohol ; other common causes are excess of indigestible or decomposing food, and certain irritant poisons, of which the most important is arsenic. In some cases emotional states, such as grief, fright, or anger, are held to be responsible for the attack ; in such instances the catarrh is probably secondary to stagnation of the gastric contents, the primary effect of the abnormal nervous condition being to induce pyloric spasm. The same explanation may hold good for those cases where exposure to cold seems to have brought on an attack.

Morbid Anatomy.—The mucuos membrane is reddened, swollen, and covered with sticky mucus ; there may be small hæmorrhagic patches, and the submucosa may be a little œdematous. Microscopically, there is proliferation,

degeneration, and desquamation of the gastric epithelium, with leucocytic infiltration of the intertubular tissue.

Symptoms.—Usually within a few hours after the causative agent has begun to act there is intense nausea with malaise, headache and epigastric discomfort. There may be a little fever, but a high temperature or a rigor should arouse suspicions as to the specific fevers. Later on the discomfort may give place to genuine pain, and vomiting usually takes place; there may also be diarrhœa. If the vomiting is incessant there may be considerable prostration, and it is in such cases that the condition may simulate one of the more serious intra-abdominal diseases. Thus we have seen intense abdominal pain, associated with incessant vomiting and collapse, at the onset of a case of "Toxic Scarlet Fever"; in this case gastric perforation was very closely simulated, and laparotomy was seriously considered. It is not often, however, that there is any difficulty in diagnosis; a history of some dietetic indiscretion can be obtained in many cases; the abdominal wall is usually soft and its movements free; and the symptoms are promptly relieved after vomiting sets in.

Treatment.—Vomiting should be encouraged by the administration of large quantities of tepid water; gastric lavage is usually indicated in alcoholic cases. When vomiting has ceased, calomel should be given in repeated small doses. Only water should be allowed for twelve hours, and only milk and water for the succeeding twenty-four hours.

Suppurative Gastritis or **Abscess of the Stomach Wall.**—This condition is usually classified with Phlegmonous Gastritis, but there is no doubt that the two conditions are quite distinct, the former lesion being circumscribed, the latter diffuse. The two conditions are analogous to the "Abscess" and "Cellulitis" respectively of the subcutaneous tissues.

Etiology.—Most cases of suppurative gastritis are secondary to septicæmic conditions such as puerperal fever, infective endocarditis, etc.; some cases are secondary to

gastric ulceration, or to operations on the stomach; and a few cases are "primary."

Morbid Anatomy.—The Abscess occupies a circumscribed position in the submucosa; it may be as small as a bean or as large as a cocoa-nut; there may be more than one abscess, but even when multiple abscesses are present each separate abscess is definitely circumscribed. The abscess may rupture into the stomach, into the peritoneal or pleural cavity, or

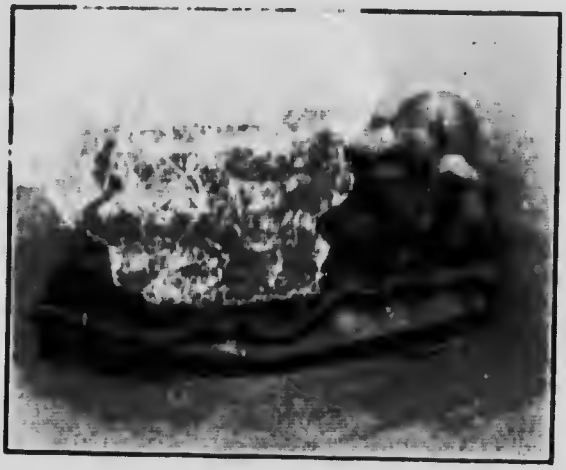

FIG. 10.—Phlegmonous Gastritis (Adams, *Lancet*, 1910). Naked-eye appearance, showing extreme infiltration of submucosa and less marked thickening of the mucous coat.

through the anterior abdominal wall. The peritoneum may be infected even without a microscopic breach of its surface.

The **Diagnosis** must always be problematical; the presence of a palpable epigastric tumour and possibly of purulent vomit, might be suggestive. The clinical picture so closely resembles the more common condition of Perigastric Abscess that this latter disease is usually diagnosed.

Treatment.—The presence of a palpable tumour with evidence of suppuration would call for immediate surgical treatment, by incision and drainage.

Phlegmonous Gastritis

Here again the conditions may be either *primary* ("idiopathic"), or *secondary* to such conditions as septicæmia, gastric ulcerations, operations on, or injuries to, the stomach. But, unlike the circumscribed form, the great majority of cases are primary. A typical case of acute primary phlegmonous gastritis, complicated by pneumococcal peritonitis, has been described by one of us,* and to this paper the reader is referred for a complete account of this uncommon and interesting disease.

Etiology.—*Sex:* Males are affected more often than females in the ratio of five to one. *Age:* The majority

FIG. 17.—Phlegmonous Gastritis. Two inch objective. The infiltration of the submucous coat is very obvious. (Adams, *Lancet*, 1910.)

of cases have been between twenty and thirty, but cases have been reported as young as eleven and as old as seventy. *Diet:* A history of alcoholic excess is present in about 25 per cent. of all cases; in many cases, too, a history of other dietetic errors can be obtained.

Pathology.—The essential lesion is a diffuse inflammatory infiltration of the submucosa, due to bacterial invasion, and apparently strictly comparable to subcutaneous cellulitis; so close, in fact, is the analogy that phlegmonous gastritis has been called "erysipelas of the stomach." In this connection it is interesting to note that D. W. S. Baird has described a case of phlegmonous gastritis

* J.E.A. *Lancet*, Jan. 29th, 1910.

complicating erysipelas with consequent streptococcal septicæmia.* Probably in most cases the infecting organism belongs to the streptococcus class; in our case the the pneumococcus was isolated.

Morbid Anatomy.—The submucosa is much thickened, especially in the pyloric half of the stomach; the stomach wall may be eight or nine times its normal thickness. The

FIG. 18.—Phlegmonous Gastritis. One-sixth inch objective. Section through submucosa showing fibrinous reticulum with entangled leucocytes and diplococci. (Adams, *Lancet*, 1910.)

mucosa is sometimes swollen and hyperæmic, or even hæmorrhagic, but in many cases it is almost normal. In most cases there are but slight changes in the muscular and serous coats. Microscopical examination of the submucosa shows a dense fibrinous network, in the meshes of which are packed innumerable leucocytes and frequently also abundant micro-organisms, usually streptococci.

Symptoms.—Epigastric pain, vomiting and restlessness, often accompanied by delirium and some degree of collapse,

* Amer. Jour. of Med. Sc., Nov. 1911.

are the most noticeable symptoms; symptoms due to secondary peritonitis supervene rapidly and increase the diagnostic difficulties. The onset is usually acute and is sometimes marked by a rigor. Vomiting is almost invariably present; it is not purulent (as it may be in the circumscribed suppurative gastritis). A past history of alcoholism would be a point worth considering.

A few observers claim to have diagnosed the condition, but it is evident that in most cases the diagnosis cannot be more than conjectural.

Prognosis.—There is no authentic instance of recovery from primary phlegmonous gastritis. The average duration of the disease is six days.

Treatment.—Probably incisions down to the submucousa, after free exposure of the stomach wall and packing off the peritoneal cavity with gauze, would offer the best chance of recovery.

Membranous or Diphtheritic Gastritis

This is a rare condition, more common in children than in adults, and probably always secondary. Most cases occur in marasmic or cachectic subjects, and there is usually membrane in the mouth or throat, as well as in the stomach. Only a small proportion of the cases are due to the Klebs-Loeffler bacillus. The exudate may be thin and friable, or it may form a definite coherent membrane; it usually covers a small portion only of the gastric mucosa, but occasionally the whole surface is involved.

Diagnosis.—In most cases there are no gastric symptoms at all, or any present are masked by the gravity of the primary disease. The diagnosis is only possible when large shreds of membrane are found in the vomit; occasionally a cast of the whole stomach may be ejected, as in a case recorded by John Thomson.*

* Arch. Pediat. N. Y., April, 1895.

Corrosive Gastritis

This condition is due to the ingestion of such substances as concentrated acids or alkalies, corrosive sublimate, etc. The changes produced may be confined to the mucous membrane, or all the layers of the stomach wall may be involved; alkalies are said to penetrate more deeply than acids. The changes may be diffuse, but more often they are localised, both cardiac and pyloric portions being affected, with perhaps an intervening area which has escaped. The stomach wall may be completely dissolved, giving rise to large perforations, the margins of which are composed of ragged necrotic tissue. If recovery ensues after extensive damage to the stomach, it is associated with great scarring, and extreme deformities of the stomach may be produced; almost invariably there are two strictures, one at the cardiac end of the stomach, the other at the pyloric end, or midway between the cardia and the pylorus (in which case the characteristic "hour-glass" stomach is produced).

Symptoms.—The history of ingestion of poison, the possible presence of excoriation of the mouth or fauces, the intense substernal or epigastric pain, with vomiting, dysphagia and collapse, usually make the diagnosis obvious. There is often diarrhœa, and sometimes tenesmus. The urine is scanty and may contain blood and albumen. The patient may die of shock within a few hours, of peritonitis at a later stage, or of inanition consequent on stenosis in the final stage.

Treatment.—Gastric lavage is, usually, not permissible. The appropriate chemical antidote should be administered by the mouth, and, if necessary, morphia and strychnine should be given hypodermically. Even in those cases where gastric perforation can be diagnosed with certainty—and such cases are by no means common—surgery is, as a rule, not indicated. The patient is seldom in a condition

to undergo laparotomy, and in any case, the prospects of a successful closure of the perforation are slender.

Gastric and Duodenal Ulcer

The Peptic Ulcer is, as its name implies, intimately connected with the presence of gastric juice. Thus, it may be found (i) in the stomach, (ii) in the duodenum above the biliary papilla, (iii) after gastro-jejunostomy, in the part of the anastomotic loop nearest to the stomach, and (iv), very rarely, in the last few inches of the œsophagus, usually in patients who have suffered from prolonged and incessant vomiting.

As to the **Pathology** and **Etiology** of the condition, but little need be said here, though it is necessary to refer briefly to one or two points. A useful distinction has been drawn between the acute and the chronic ulcer. The acute ulcer is usually circular, sometimes oval, in outline, its edge is always clean, giving it a characteristic "punched out" appearance, and its wall, from edge to floor, is often funnel-shaped and "terraced." The diameter of an acute ulcer is commonly that of a threepenny piece; it is seldom larger than that of a sixpence. Finally, acute ulcers are frequently multiple. In strong pathological contrast stands the chronic ulcer, with its very irregular outlines, its indurated and rounded edge, its frequently extensive area, and its solitary habit. Out of 112 cases at the London Hospital, the acute ulcers were multiple in 54 per cent., and the chronic in 13 per cent. Moreover the chronic ulcer has a predilection for the pyloric end, the lesser curvature, and the posterior wall of the stomach. In 109 cases of chronic ulcer investigated by Fenwick, no less than 75 per cent. were in the vicinity of the pylorus. The acute ulcer, on the other hand, has no such affinity for any particular area of the gastric wall. Clinically, however, the differentiation between acute and chronic ulcers is by no means so easy. We can sometimes suspect that we are dealing with an acute

ulcer, and we can often be certain of our diagnosis of chronic ulcer, but there are numerous cases where one can express no positive opinion either way. Nor is this a matter of vast importance. After all, the chronic ulcer is merely an acute ulcer which has not healed, but which has undergone secondary inflammatory changes leading to induration and cicatrisation; perhaps the free mobility of the pyloric end of the stomach accounts for the liability of this portion to chronic ulceration, for the acute ulcer has less chance of healing here than elsewhere. The majority of duodenal ulcers are of the chronic type; in 95 per cent. the ulcer is within one and a half inches from the pylorus, the favourite site being half an inch from the pylorus, on the anterior wall half-way between its upper and lower borders.

Hæmorrhagic Erosions.—There is another type of lesion of the gastric mucosa which takes the form of minute, multiple abrasions of the mucous membrane, usually in the fundus of the stomach. These abrasions are circular, 2 to 4 mm. in diameter, and may be quite superficial, or they may extend down to the submucosa. Whether they have any importance as being potential gastric ulcers, as has been maintained by some writers, is more than doubtful; for they are found chiefly in cachectic conditions, in septicæmia, in chronic heart or lung disease, in cirrhosis of the liver, and in new-born infants. At the same time it is likely that they account for a certain number of cases of profuse hæmatemesis in chlorotic young women; and not improbably those cases described by Hale-White as gastrostaxis, where hæmatemesis occurs without any demonstrable lesion of the gastric mucosa, are instances of undiscovered minute erosions.

Sex Incidence.—Gastric ulcer in the post-mortem room is more common in the female than in the male in the proportion of roughly two to one. Clinically, the proportion of females to males is three, or 3·5, to one. The probable explanation of this discrepancy between clinical and *post-mortem* statistics is that in the female, with her more

sedentary life and less hurried and irregular meals, an acute ulcer has a better chance of healing than in the male. Some confirmation of this theory is afforded by *post-mortem* statistics provided by the Fenwicks; of thirty acute ulcers, 3 occurred in males and 27 in females, whereas of 59 chronic ulcers, 43 were found in males and 16 in females.

Duodenal ulcer is more common in men than in women; during the last ten years at St. Thomas's Hospital a diagnosis of duodenal ulcer was verified either at operation or autopsy in 47 cases, of which no less than 41 were males.

Age.—Gastric ulcer may occur at any age, but it is most common between the ages of 20 and 40. In females 75 per cent. are said to have definite symptoms before the age of 30, whereas in 70 per cent. of males the onset is after 30 (Fenwick); these statistics were compiled from clinical evidence, however, and it is probable that a number of the 75 per cent. of the females under 30 were suffering from chlorotic gastralgia, between which condition and gastric ulcer diagnosis is often impossible.

Duodenal ulcer may also be found at any age; the majority of cases seek advice between the ages of 25 and 45. Of 47 cases of proved duodenal ulcer at St. Thomas's Hospital 39 (*i.e.* 83 per cent.) were aged more than 30, and 26 (*i.e.* 55 per cent.) were between 30 and 50.

Duodenal Ulcer in Burns.—Duodenal ulcers occur occasionally as a complication of burns or scalds; most authorities state that these ulcers are found in about 6 per cent. of all fatal cases, but there were only two instances in the last 65 autopsies on cases of burns and scalds at St. Thomas's Hospital (*i.e.* 3 per cent.). This complication is of importance in that it may cause death by perforation or hæmorrhage. It affects young subjects chiefly, and is probably associated with sepsis. *Post mortem*, hæmorrhages and erosions are found throughout the intestinal tract, but ulcers only above the biliary papilla. Usually the presence of an ulcer cannot be diagnosed till hæmorrhage

or perforation occurs. There seems to be no reason why the latter complication should not be treated surgically, provided that the case is operable.

Symptomology of Gastric and Duodenal Ulcer

Before passing on to a detailed consideration of those acute complications of the peptic ulcer, to wit Perforation and Hæmorrhage, with which we are at present concerned, it is necessary to refer briefly to the main points on which a diagnosis of uncomplicated ulcer may be made. Such complications as stenosis, perigastric adhesions, etc., and the treatment of uncomplicated gastric ulcer, do not come within the scope of this book.

In the first place it may be stated that, in the absence of complications, a duodenal ulcer produces as a rule a more characteristic clinical picture than does a gastric ulcer; also that in either case the diagnosis must be based on the history rather than on the physical signs. In the case of the **Duodenal Ulcer** the history is commonly somewhat as follows: the patient, usually a male, and often aged more than thirty, complains of periodic attacks of pain, or discomfort, which comes on some two hours or more after meals, and is relieved by taking food. The onset of the disease is nearly always insidious, and the patient will say that he has been subject to attacks of indigestion for many years, the earlier attacks being, as a rule, so mild as to be disregarded. At first, he may say, the discomfort was felt only after the heaviest meal of the day; but later on every meal may be followed, in the course of an hour or two, by pain. The patient is often awakened at night by "hunger pain," and in consequence he is wont to make a practice of having some milk or biscuits at his bedside, knowing by experience that these will bring him relief. Usually the periodicity of the symptoms is well marked, and between the attacks the patient enjoys perfect health. The attacks seem to be more prone to occur in winter than in

summer. During an attack there is often flatulence or pyrosis, but vomiting is not very common. The pain is situated low down in the epigastrium, often just above and to the right of the umbilicus. The appetite is usually unimpaired, even during the progress of an attack. Physical examination is, as a rule, negative; there may be a little deep tenderness over the painful area, and possibly some rigidity of the upper segment of the right rectus muscle; but any physical signs which may be present are trivial in comparison with such a history as the above, which would be pathognomonic of duodenal ulcer. The occurrence of melæna with such an attack would afford an almost superfluous confirmation of the diagnosis. The bulk of all cases of duodenal ulcer give such a history, but one must admit that there is a definite but small percentage of cases where (*a*) the ulcer may be latent till its presence is betrayed by perforation or by hæmorrhage, or (*b*) pain may be an inconspicuous feature, the prominent symptom being hæmorrhage, or, it may be, pyrosis.

Differential Diagnosis.—The only conditions likely to be confused with duodenal ulcer are gall stones and appendicitis; important differentiating points in favour of ulcer would be the absence of fever during an attack, the definite relation of the pain to meals, and its relief by the ingestion of food. There is usually no difficulty in discriminating between duodenal and renal pain. We need hardly say that the diagnosis of duodenal ulcer should not be made till the knee jerks and pupils have been examined. The distinguishing points in the differential diagnosis from Gastric Ulcer will be found further on.

Gastric Ulcer.—Here the pain is not nearly so constant in its time-relation to meals; as a rule it comes on within a few minutes after meals, but it may occur at any time during the first hour of digestion, and it is certain that in some cases the pain may occasionally, *but not constantly*, come on several hours after a meal. As to the site of the pain, it is usually felt high up in the epigastrium, and it may

be substernal; in addition, there is almost invariably pain referred to the back, either in the spine between the sixth and eighth dorsal vertebræ or near the angle of the left scapula, a symptom to which we are disposed to attach some importance. Considerable stress has been laid on the occurrence of sharply defined areas of hyperæsthesia in the epigastrium; Dr. James Mackenzie has brought forward evidence of the relationship between the approximate situation of an ulcer and the site of its corresponding area of hyperæsthesia. (Vide Chapter II.) These sharply defined areas of hyperæsthesia undoubtedly occur in some cases, but we believe that their frequency and importance have been much exaggerated. In our opinion it is the exception to find any hyperæsthetic area. Moreover we agree with Sir B. Dawson, that even when present, such areas are not pathognomonic of ulcer, and that they are not uncommon in the gastric neuroses.

The pain of gastric ulcer is not relieved by taking food, but it is usually relieved, temporarily at least, by the administration of sodium bicarbonate. Associated with the pain there is often epigastric tenderness and rigidity. Vomiting is rarely absent; the occurrence of hæmatemesis or of coffee-grounds vomiting, with pain as described above, is almost conclusive. Melæna may occur with or without hæmatemesis. It is important to remember that the first symptom of an acute ulcer may be hæmorrhage or perforation. It is evident that in the case of gastric ulcer, a diagnosis apart from hæmorrhage is often conjectural; as we have said, a duodenal ulcer may be diagnosed with confidence even in the absence of hæmorrhage. The presence of occult blood in the stools, as revealed by the Benzidin test, may afford useful confirmatory evidence of the presence of a gastric or duodenal ulcer.

Differential Diagnosis.—(i) From *Duodenal Ulcer.* Pain occurring constantly within one hour of meals is almost certainly gastric in origin; gastric ulcer has no definite seasonal periodicity; vomiting is common in gastric

ulcer ; dorsal pain is not found in duodenal ulcer. Hæmatemesis in marked excess of melæna points towards Gastric Ulcer, whereas the converse is suggestive of Duodenal Ulcer.

(ii) The pain of *Gastralgia* (including the gastralgia of *Chlorotic dyspepsia*) is not so sharply localised, and is more capricious in its relation to the time, quality and quantity of meals.

(iii) *Biliary Colic* may very closely simulate Gastric or Duodenal Ulcer. Jaundice, rigors or sweats, attacks of severe paroxysmal pain, not very definitely related to meals, and not relieved by repeated vomiting, these would be points in favour of biliary colic.

(iv) *Cirrhosis of the Liver* may give rise to chronic dyspepsia with occasional hæmatemesis ; but there is rarely much pain after meals, and the patient's facies, the presence of dilated veins on the abdominal wall and, perhaps, a history of alcoholism, should make the diagnosis clear.

(v) *Carcinoma of the Stomach.*—The differential diagnosis between simple and malignant ulcer is often very difficult. Rapid emaciation, severe anæmia not due to hæmatemesis or melæna, absence of hydrochloric acid from the gastric contents, and the presence of a palpable tumour, are the chief points in favour of carcinoma.

Perforation of Peptic Ulcer

We shall consider together perforation of gastric, duodenal and jejunal ulcers, as there is no essential difference between the clinical results of these different types of perforation.

Past History.—In the great majority of cases there is a definite past history of dyspeptic symptoms, and it is chiefly on this history that we have to rely in forming an opinion as to the site of the perforation, though there are certain symptoms and signs after perforation which may assist us in this connection ; to these we shall refer later. In many cases there is a definite exacerbation of the

pre-existing symptoms of ulcer, which may be so severe as to obscure the exact time of onset of perforation. In quite a small proportion of cases, probably less than 10 per cent., no previous history of indigestion can be obtained. Sometimes an ulcer may perforate as a result of a sudden strain, *e.g.* lifting a heavy weight, or as the result of a blow on the abdomen. In hospital patients perforation not infrequently follows a heavy meal, in which case mechanical distension of the stomach may be a factor in bringing about the perforation.

The symptoms of the actual perforation may be (i) acute, (ii) sub-acute, or (iii) chronic.

(i) **Acute Perforation**. Here a large area of peritoneum is suddenly irritated by gastric or intestinal contents which have escaped through an opening which may be the size of a three-penny bit or even larger.

First Stage (6 to 8 hours).—The symptoms and physical signs which result are characteristic and generally unmistakable. There is a sudden onset of excruciating abdominal pain situated at first, as a rule, in the upper half of the abdomen, but very rapidly becoming generalised. This sudden and often dramatic onset of abdominal agony is one of the most striking features of the picture and should always arouse suspicions of perforation. As we have said, the pre-perforative exacerbation of symptoms of ulcer may occasionally obscure the onset of perforation; but very rarely indeed do they altogether mask it; almost invariably the patient can describe the exact moment when he was attacked by anguish compared with which his previous symptoms were trivial. Though the pain becomes generalised almost immediately, the sufferer is usually able to indicate, more or less accurately, the site of localised pain at the moment of perforation; this information is of no little value in localising the ulcer, which is commonly subjacent to the spot thus indicated.

At a later stage, as the fluid in the peritoneal cavity gravitates towards the pelvis, the pain tends to be most

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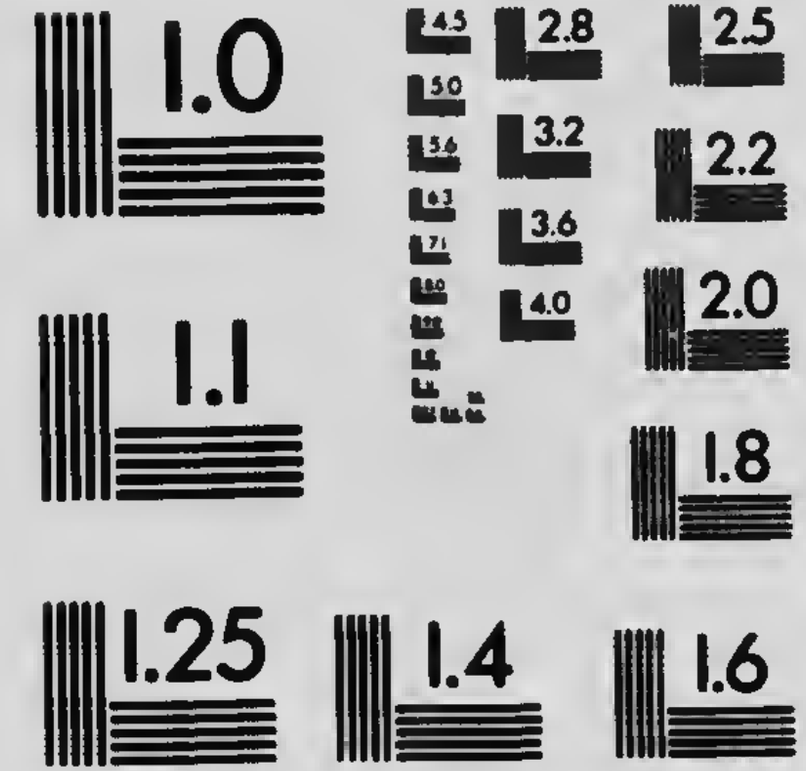

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intense below the level of the umbilicus. Sometimes this localisation of pain and rigidity to the lower abdomen is so marked that attention is never directed to the epigastrium, and the case is diagnosed with confidence as appendicitis, or, it may be, as ruptured ectopic gestation.

We have already laid stress on the customary severity of the pain, and we would still further emphasise this feature. The patient is afraid to move, to speak, even to breathe; the slightest touch is a torment for him; moreover, the pain is continuous and not definitely paroxysmal. The pain of intestinal obstruction, or of biliary colic, may be very intense during the bouts of violent peristalsis; but in the intervals between them the patient is comparatively placid, a most important differential point.

Initial vomiting is inconstant, being present in less than 30 per cent. of all cases. There may be retching or a little vomiting in the stage of shock immediately following perforation, but there is usually no more till general peritonitis has set in. Shortly after the onset, the characteristic phenomena of shock are generally observed, a subnormal temperature and cold moist skin, a rapid and feeble pulse, and an anxious facial expression; the "Facies Hippocratica" is *not* seen till general peritonitis is well marked, though many text-books describe it as being present in the earlier stages. The tongue may be dry, but it is fairly clean. Respirations are shallow, rapid (up to 40 per minute), and jerky; frequently there is an expiratory "grunt."

The characteristic features of the abdomen are its unyielding rigidity and its immobility; in no other condition are these phenomena so striking. There may be slight abdominal fulness, but in the early stages it is much more common to find a flat, or even a retracted, wall. There is extreme and wide-spread tenderness to the most gentle palpation, and in most cases it is possible to detect a spot where palpation reveals an even more exquisite tenderness than elsewhere, suggesting the site of the perforation.

If a large amount of fluid has been poured out into the

peritoneal cavity, *e.g.* if perforation has taken place shortly after a heavy meal, it may be possible to detect some dulness in the flanks, but in most cases percussion of the flanks reveals nothing abnormal till some hours after perforation. Owing to the extreme muscular rigidity, a fluid thrill can seldom be elicited. Reduction or obliteration of the liver dulness can usually be demonstrated.

The symptoms and physical signs recounted above are those which are met with during the first six to eight hours subsequent to perforation, and on these a definite diagnosis can, and should, be made in most cases. To recapitulate them, a sudden onset of intense and diffuse abdominal pain, occurring in a subject with a previous history of indigestion, associated with a motionless and rigid abdominal wall, with shallow and painful respiration, with a normal or sub-normal temperature, and with, perhaps, some acceleration of the pulse-rate and reduction of liver dulness, these data are sufficient to justify a confident diagnosis, and in their presence it is unjustifiable to postpone laparotomy till confirmation has been afforded by the phenomena of the second stage—that of peritonitis.

Second Stage.—The symptoms of shock are replaced by those of peritonitis. The temperature rises; the pulse may improve in tension and volume, but it becomes more rapid; usually it is between 100 and 120, but as peritonitis advances it may be 140 or uncountable. The tongue becomes foul, and vomiting sets in, the vomit being brown, black, or fæculent in the final stages. Micturition is painful, and there is usually constipation. The abdominal retraction gives place to a progressive distension; the wall, though universally resistant, has not that unyielding rigidity which is so characteristic of the first stage. Signs of ascites become obvious, and in most cases there is complete obliteration of the liver dulness. The peritonitis is frequently most intense in the right half of the abdomen, so that the physical signs may now be indistinguishable from those of appendicular peritonitis.

It is important to remember that it is by no means uncommon to hear a coarse friction rub in one or other axilla (most frequently on the right side) in cases of perforative peritonitis; we have several times found friction within twelve hours of a perforation, but we believe it to be exceedingly rare within five hours. With this rub may be associated signs of massive pulmonary collapse at one or both bases (again, most commonly on the right side); such cases may simulate lobar Pneumonia (*vide* Chapter XVI.).

(ii) **Sub-acute Perforation.**—If the contamination of the peritoneum by gastric or intestinal contents be effected slowly, the onset of perforation symptoms is correspondingly less brusque, and the diagnosis may become exceedingly difficult. This slow leakage through an ulcer may be due to (1) a minute or pin-hole perforation; or (2) partial closure of a larger perforation by lymph, or by an omental tag, or by old adhesions around the ulcer; or (3) the fact that the viscus happens to be more or less empty at the moment of the perforation (hence the sub-acute perforations are more common with duodenal than with gastric ulcers). The symptoms of a sub-acute differ from those of an acute perforation in that the onset is not nearly so abrupt and the initial symptoms are less severe. The preliminary stage of shock described above may be entirely absent, and the physical signs are less diffuse; consequently diagnosis is often impossible till peritonitis becomes evident, and as this peritonitis is commonly localised to the right half of the abdomen, these cases are frequently mistaken for appendicitis.

(iii) **Chronic Perforation** differs from a sub-acute perforation in that the peritoneal infection is localised from first to last by old or recent adhesions. Recovery may take place without the occurrence of suppuration, but more frequently a perigastric, or peri-duodenal, abscess results. Such abscesses may be the origin of sub-phrenic, or of perinephric, suppuration; if undiagnosed they may "track" considerable distances, pointing in the pelvis perhaps, or

even in the neck; they may rupture into the general peritoneal cavity, or into the pleura or pericardium, or into some other portion of the alimentary canal (most commonly the colon), in which case a *gastro-colic fistula* results. A gastro-colic fistula would be recognised by the constant occurrence of diarrhœa immediately after all meals, and by the presence of undigested food in the stools.

Differential Diagnosis

(*a*) *Between gastric and duodenal perforations.*—The past history (*vide* page 257) yields the most useful information, provided that the patient is able to give a complete account of his previous symptoms. The site of pain at the moment of perforation, and an area of maximal abdominal tenderness subsequent to perforation, sometimes indicate the position of the ulcer quite accurately, so that in many cases one can predict that the perforation will be found at the cardiac, or at the pyloric, end of the stomach. In the absence of a definite account of past dyspeptic symptoms, and if the stage of peritonitis has set in, differential diagnosis is impossible. Duodenal ulcer is more likely in males over 30, gastric ulcer in females under 30; peritonitis which is most intense on the right side of the abdomen suggests duodenal ulcer.

(*b*) *From Appendicitis.*—As a rule the onset is not so abrupt, but sometimes gangrenous appendicitis may set in with symptoms indistinguishable from those of perforation. A past history of attacks of abdominal pain, usually right-sided, lasting only two or three days and perhaps associated with fever, would point to appendicitis. A case of "appendix dyspepsia" culminating in a gangrenous appendicitis of acute onset would almost certainly be diagnosed as a perforation. In gangrenous appendicitis there is, in all but the most toxic cases, some degree of pyrexia from the first, whereas pyrexia is usually delayed in perforation. Sharply localised tenderness about

McBurney's point is a sign of some value, though it may be found in perforative peritonitis. Obliteration of liver dulness with a flat abdomen is seldom, if ever, observed in appendicitis.

(*c*) *From Acute Obstruction.*—Difficulty may arise (i) early, in cases of high obstruction, or (ii) late, in low obstruction. (i) High obstruction ; here the onset of severe, diffuse, abdominal pain may be very acute ; but the pain is definitely paroxysmal, and is usually associated with some degree of visible peristalsis and with early abdominal distension. Repeated vomiting, rapidly becoming fæculent, is a prominent symptom ; in the early stages there is no abdominal tenderness or rigidity between the attacks of griping. (ii) In the consecutive peritonitis of low obstruction there may be great distension with diffuse tenderness and rigidity, obliteration of liver dulness, signs of ascites, and cessation of peristalsis. Such cases are often mistaken for perforation, and, on the physical signs, the only certain diagnosis is general peritonitis of undetermined cause.

(*d*) *From Acute Pancreatitis.*—Many cases of this condition are diagnosed as perforation. The initial collapse is even more striking ; vomiting is conspicuous, and there is sometimes slight cyanosis of the skin ; the symptoms tend to be confined to the upper abdomen longer in pancreatitis than in perforation. The presence of glycosuria, or of a palpable pancreas, would be strong confirmatory evidence ; but unfortunately these are found only in a small proportion of cases.

(*e*) *From Mesenteric Embolism or Thrombosis.*—Here there is usually some obvious exciting cause for the abdominal disaster, *e.g.* mitral stenosis, infective endocarditis, cirrhosis of the liver, or thrombosis elsewhere ; hæmatemesis and melæna are common, as also is ascites.

(*f* and *g*) *From Pneumonia and Pericarditis* (*vide* Chapter XVI.).

(*h*) *From Ruptured Ectopic Pregnancy.*—Here the acute onset, with early prostration, occurring in a young woman

who may have been suffering from the vomiting of pregnancy, may lead to errors. A history of menstrual irregularity, the early appearance of pallor, restlessness, and a soft and very rapid pulse, are important signs.

(*i*) *From Lead Colic.*—There may be excruciating pain with collapse, and extreme abdominal rigidity and retraction. But the pain is paroxysmal and accompanied by peristaltic sounds, and the abdomen loses some of its tenderness and rigidity between the paroxysms. It is of course a fatal blunder to diagnose lead colic merely on the strength of a "lead line" in the gums; painters are not exempt from ulcers.

(*j*) *Gastralgia.*—The gastralgic attacks of chlorotic young women may simulate perforation. Dr. Beddard has reported four such cases (*Practitioner*, March, 1912); on two of these patients laparotomy had been performed twice, and on a third once! There is no true reflex rigidity and little, if any, constitutional disturbance.

(*k*) *Perforative Cholecystitis* may very closely simulate Gastric or Duodenal perforations. A past history pointing to gall stones, the presence of jaundice, and an intact liver dulness, would be points in favour of cholecystitis.

(*l*) Other conditions which have been mistaken for perforation are—*Acute Gastrectasis* (page 275), *Dysmenorrhœa* (page 434), *Gastric Crises* (page 559), and *Corrosive poisoning* (page 253).

Treatment.—Laparotomy should be performed at the earliest possible moment; it is a worse mistake to postpone operation till general peritonitis has set in than it is to open a normal abdomen. If the patient is seen very soon after the onset, and shock is very great, or if the shock of a journey to a hospital or nursing home has been added to that of the original condition, it may be wise to wait for an hour or so in the hope of an improvement; meantime a hypodermic injection of morphia should be given (provided that the diagnosis is certain), the patient should be surrounded by hot-water bottles, and the extremities lightly bandaged

with cotton wool. In any case operation should not be postponed for more than two or three hours; if there is then still much shock the operation should be performed under spinal anæsthesia.

As to the site of the incision, if clinical evidence points to a pyloric or duodenal perforation, one should go through the right rectus; if to a cardiac perforation, through the left rectus. When there is no definte evidence as to the site of perforation, a paramedian right rectus incision, extending from the ensiform cartilage to the umbilicus, is the best. When the peritoneum is opened the diagnosis will often be confirmed by the audible or visible escape of gas; a fæcal odour would at once suggest an error in diagnosis and direct attention to the appendix. If the peritoneal cavity is flooded with exudate and gastric contents, some of this fluid should be absorbed by dry gauze pads; but at this stage no attempt should be made at a peritoneal toilet —only so much fluid is removed as will facilitate the finding of the perforation which is the surgeon's objective. The vicinity of the stomach is kept as dry as possible by packing it off with abdominal pads, the incision is widely retracted, and the anterior surface of the stomach is examined; if the site of perforation is not at once evident, gentle manipulation of the stomach may reveal a perforation through which gas and fluid are bubbling. If examination of the pyloric region of the stomach is fruitless, the first part of the duodenum should be investigated; finally, attention is directed towards the cardiac end, with the help of a head-light if necessary. If no perforation can be found on the anterior wall, the lesser sac must be explored; to do this satisfactorily it is necessary to turn up the stomach, colon and great omentum, and make a vertical opening in the posterior layer of the transverse meso-colon. Fortunately this is seldom necessary, as the bulk of perforations which give rise to diffuse peritonitis are on the anterior wall; perforations within the lesser sac usually give rise to a localised perigastric or sub-phrenic abscess (*vide* Chapter IV.).

Closure of the Perforation.—We maintain that the perforation should be closed as soon as it is found, the cleansing of the peritoneum being attended to subsequently. The simplest method of closure is to invaginate the perforation and bury it with interrupted sero-muscular sutures. If there is much induration around the ulcer, excision is the best treatment, unless the induration is so extensive that excision is impracticable: when this is the case the perforation may be closed by turning up a flap of omentum and suturing this over the opening.

We are not in favour of immediate gastro-enterostomy as a routine, a step which is advocated by some surgeons. This procedure adds considerably to the length and risks of an operation which is already sufficiently formidable. At the same time we believe that immediate gastro-enterostomy is often justifiable, for instance in the case of a perforation close to the pylorus, or in the duodenum, with but little contamination of the peritoneum; but the anastomosis should not be performed till after closure of the perforation and cleansing of the peritoneum, and then only if the general condition of the patient is good.

Multiple perforations are present occasionally, hence one should make it a rule to scrutinise the whole of the anterior wall of the stomach even if a perforation has already been seen and closed.

Cleansing the Peritoneum.—When there is but little exudate, it can be removed by means of gauze plugs introduced through the original incision: the immediate vicinity of the perforation is dealt with first, and then plugs are introduced gently in directions radiating from it, with particular attention to the renal pouches and care not to disturb uncontaminated areas of peritoneum. When the exudate is abundant, and undigested gastric contents are present, irrigation is the best method; a small supra-pubic incision is rapidly made over a finger introduced through the original incision, and a large drainage tube is passed down to the pelvic floor; the nozzle of the irrigating

apparatus is introduced into the upper incision, and the peritoneal cavity is flushed out with large quantities of normal saline solution at a temperature of 105° F., until the fluid which escapes from both upper and lower incisions comes back clear, the irrigating nozzle being moved from place to place throughout the injection. Particular attention should be paid to the spaces between stomach and liver, the two renal pouches and the pelvis. If an irrigation apparatus is not available, the edges of the upper incision are held up and apart, and hot saline solution is poured in from a jug; large quantities (10 to 16 pints) are necessary. After the irrigation is completed, no attempt should be made to mop up the excess of fluid; such fluid as does not escape from the incisions when the retractors are removed is quickly absorbed, to the benefit of the patient.

Drainage.—If general peritonitis has set in, or if there has been any gross contamination of the peritoneum by gastric contents, a cigarette drain, passed down to the pelvic floor, may be left in the supra-pubic incision; the upper incision is closed, and the patient is at once placed in the Fowler position, and kept in this position for several days. If there are any doubts as to the efficiency with which the perforation has been closed, a similar drain may be passed down to this region through the upper incision, but in most cases no drainage at all is necessary, and both incisions can be closed when the peritoneum has been cleansed.

After Treatment.—The Fowler position must be maintained strictly for several days, even if all goes well. Continuous saline irrigation per rectum should be started immediately after the operation and continued for at least twenty-four hours. On the second day equal quantities of milk and water (in half ounce doses of each) may be given by the mouth every hour; on the third day the food by the mouth may be gradually increased, and mince and fish may be allowed at the end of a week. For at least six weeks after the operation, the patient should be kept at rest and on a light diet.

Prognosis.—The operation mortality in ten years at St. Thomas's Hospital was 39 per cent. (92 cases), for Gastric, and 53 per cent. (41 cases) for Duodenal perforations. The higher mortality for Duodenal perforations is probably due to the greater difficulty of early diagnosis, so that early operation is not common; sub-acute perforations are more frequent in duodenal ulcer, and peritonitis is so often restricted to the right side that many cases are at first regarded as appendicitis and operation is postponed. There has been a steady improvement in the results of operations for perforated Gastric Ulcer; thus in 1900 and 1901, four cases died and none recovered; in 1905, four cases died and eight recovered; in 1911 two cases died and eleven recovered. There is no analogous improvement in the statistics of duodenal operations; in 1911 seven cases died and seven recovered.

Jejunal Ulcer

It is convenient here to refer to this troublesome and often dangerous sequel to gastro-enterostomy. An admirable account of the condition is given by Sir B. G. A. Moynihan in the Universal Medical Record, January, 1912, to which we are indebted. There are now over 100 cases on record. The ulcer is usually very close to, or exactly on, the anastomotic line (46 out of 58 cases). In 52 out of 77 cases the anterior operation had been performed. As to the interval between gastro-enterostomy and the appearance of symptoms of jejunal ulcer, it was within one year in 27, and between one and three years in 20, out of 66 cases. Many of these jejunal ulcers perforate, some with acute, others with sub-acute symptoms. Moynihan refers to an interesting case described by Dr. Norman Porritt, where two perforations occurred, one in a jejunal and one in an acute gastric ulcer, six days after an operation of gastro-enterostomy for pyloric stenosis. A remarkable case of recurrent perforations has been published by Mr. Battle (*Lancet*, 1906, and St. Thomas's Hospital Reports); a

woman aged 35 had a perforated gastric ulcer sutured in March, 1903; anterior gastro-jejunostomy was performed in April, 1904; a perforated jejunal ulcer was sutured in May, 1905, and finally another perforated jejunal ulcer was excised and sutured in March, 1906!

Hæmorrhage from Peptic Ulcers

We believe that the prognosis of gastric or duodenal hæmorrhage is more serious than is usually taught; in one standard text-book, for instance, we find the statement, "death rarely results directly from the hæmorrhage"; death from hæmorrhage occurred in no less than 17 cases at St. Thomas's Hospital during the years 1909 and 1910. The all-important factor in the prognosis, and therefore in the treatment, of this condition is the age of the patient; it is true that "death rarely results from the hæmorrhage" in the case of young people, but over the age of 30 this is a dangerous and often fatal complication. Thus the average age of the last 32 fatal cases of hæmorrhage at St. Thomas's Hospital was 41·8; of these 32 cases, only three were aged less than 30, 18 were aged more than 40, and nine more than 50. The explanation of these striking figures is surely to be found in (1) the condition of the arteries and (2) the chronicity of the ulcer; in elderly people the eroded vessel is more likely to be sclerotic and embedded in the indurated tissue of a chronic ulcer, both factors tending to keep the lumen of the eroded vessel patent.

Treatment.—In all cases of severe hæmatemesis, morphia should be administered hypodermically at once, and the patient should be kept well under its influence until there is definite evidence that the hæmorrhage has ceased. No food should be given by the mouth; half to three-quarters of a pint of normal saline solution should be administered per rectum every four hours and, if necessary, thirst may be further relieved by rinsing out the mouth from time to time with cold water through a Higginson's syringe. The

abdomen should be protected from the weight of the bed-clothes by means of a cradle; an ice-bag suspended from this cradle so as to be light contact with the epigastrium probably assists in arresting peristalsis in this part of the abdomen. We prefer to administer no food by the mouth until at least 48 hours after the hæmorrhage has apparently ceased, when equal parts of milk and water may be administered half-hourly in half-ounce doses; this amount of fluid by the mouth may be doubled on the fourth day, the rectal saline injections being continued as before; on the fifth day jelly, blanc-mange, and bread and milk may be allowed, and on the sixth day pounded fish and mince. On the least sign of any recurrence of the hæmorrhage, food by the mouth should be stopped and, when it is begun again, it should be increased with greater caution. We are convinced that it is a mistake to "push" mouth-feeding more rapidly than we have indicated; we have repeatedly seen recurrence of hæmorrhage in cases treated by the Lenharz method, where raw eggs, milk and sugar are given in rapidly increasing quantities, starting immediately after a hæmatemesis. If at any time there is evidence of acidosis—*e.g.* acetonuria, or an odour of acetone in the breath, a 5 per cent. solution of glucose should be substituted for the saline given per rectum. Unnecessary stimulation, *e.g.* by digitalin, brandy, or intravenous saline infusions, should be avoided, as it only tends to aggravate the hæmorrhage. "Hæmostatics," such as adrenalin or ferric perchloride, given by the mouth are useless.

Surgical Treatment need rarely be considered in the case of patients aged less than 30; as has been pointed out, most of these patients recover under such medical treatment as is outlined above. In the case of elderly people, however, the question of operation should be seriously considered, and it is one of the most difficult problems with which a medical man is ever confronted; he has to strike the mean between operating too early (and consequently perhaps unnecessarily) and operating too late,

so that an operation which might otherwise have been successful kills the patient by shock. Unfortunately it is impossible to lay down any hard and fast rules to assist him in this quandary; we can only suggest that in any case medical treatment on the lines previously indicated should be tried for at least 24 hours; if after this period there is no evidence that the hæmorrhage has ceased, operation should be advised. Recurring hæmorrhages, whether by the mouth or by the bowel, accompanied by a gradual but steady deterioration in the patient's general condition, are also an indication for surgery. The older the patient and the thicker his arteries, the sooner should surgical treatment be considered.

Operation.—Before operation the patient's extremities should be warmly wrapped up, and throughout it there should be as little exposure of the trunk as is possible; the temperature of the room should be kept at about 75° F. The abdomen should be opened as rapidly as possible by a paramedian incision through the right rectus sheath, preferably under spinal or venous anæsthesia. The exterior of the stomach and duodenum should first be examined by inspection and palpation for the opacity or induration at the base of an ulcer; if this be found, the ulcer should be excised, or, if the patient's condition is desperate, infolded. If the ulcer is in the duodenum, and the patient's condition is sufficiently good, gastro-enterostomy should also be performed. If the external examination is negative, the interior of the stomach should be investigated through a free incision, three or four inches in length, in its anterior wall; the edges of this incision are held up by forceps and the gastric contents are rapidly removed with the help of gauze plugs. Through this opening the whole of the gastric mucosa can be examined; if necessary, the posterior wall can be everted through the opening by means of the hand introduced into the lesser sac through an opening in the gastro-colic omentum. If an ulcer is found on the anterior wall it should be excised.

If, as is often the case, the ulcer be on the posterior wall adherent to the pancreas, it may be possible to tie the bleeding point; in any case the tissues in its vicinity should be under-run deeply with stout catgut. When the ulcer is close to the greater curve and the circumjacent induration is so great that excision or infolding is not possible, the hæmorrhage may be arrested by ligature of the coronary or gastro-epiploic artery.

If no ulcer can be seen in the stomach, a finger should be introduced through the pylorus in order to investigate the condition of this region.

In some cases, after the bleeding point has been dealt with, gastro-enterostomy may be performed if the patient's condition warrants it, but we maintain that treatment of the bleeding point is the real object of the operation. Gastro-enterostomy, *per se*, is often lauded as a cure for hæmatemesis; it is of course sound treatment for duodenal hæmorrhage, though even here we believe that local treatment should be attempted also where possible. But gastro-enterostomy performed with the object of stopping gastric hæmorrhage, we believe to be a perfectly futile operation. It is true that hæmorrhage has been known to cease after this operation alone, we have seen this ourselves more than once; but we believe that this result can be explained as an effect of the shock attending the operation, which lowers the blood pressure and therefore favours clotting in the eroded vessel; but surely this is a very clumsy and dangerous way of bringing about hæmostasis.

Dilatation of the Stomach (Gastrectasis)

Acute Dilatation of the stomach is probably much more common than the number of published cases would indicate. It is an extremely serious condition if not recognised early and treated promptly and energetically; unfortunately in many cases the diagnosis is made in the *post mortem* room.

For instance, out of one series of 60 cases only 13 were diagnosed during life.

Etiology.—It occurs in all sorts of conditions; chief among them are (i) Debilitating conditions, such as severe anæmias, cachexias, toxæmias, heart disease, rickets. (ii) Febrile conditions, such as pneumonia, typhoid fever, miliary tuberculosis. (iii) Trauma, injuries to the head or spine; blows on the abdomen. (iv) Previous disease of the stomach, such as chronic dilatation, or ulcer (simple or malignant). (v) Surgical operations either on the abdomen or even on the extremities. (vi) Diseases of the nervous system, such as apoplexy or myelitis. (vii) Gross over-feeding or over-drinking.

Pathology.—The dilatation is usually enormous, so that when the abdominal wall is incised nothing but stomach is visible; yet when the contents are removed during life there may be a rapid return to a more or less normal size. In many of the recorded cases, the dilatation involved also the first half of the duodenum, and in a few instances the jejunum was similarly affected to a greater or less extent; but in some cases the stomach alone was dilated. As for the mechanism of this sudden gastric enlargement, the theory of pyloric spasm is untenable, seeing that (i) in many cases the duodenum is similarly dilated, and (ii) the vomit frequently contains bile. Constriction of that part of the duodenum which lies upon the bodies of the vertebræ, either by traction of the root of the mesentery, or by the weight of the superjacent stomach itself, may play a part in maintaining or increasing a dilatation once this has been initiated; duodenal constriction at this site has been demonstrated on numerous occasions.* It seems extremely improbable, however, that duodenal obstruction can play any but a secondary part; it is certainly not invariably present for, as has been already stated, the dilatation may involve the jejunum; moreover some cases of acute dilatation are associated with profuse diarrhœa. The primary

* *Vide*, Box and Wallace, *Lancet*, July, 1911, p. 214.

factor must surely be a sudden gastric paralysis and atony (exactly comparable to the condition of acute paralytic ileus described in Chapter V.), accompanied by a copious "paralytic" secretion from the mucosa.

Symptoms.—The onset is usually acute, and is characterised by epigastric pain and collapse; vomiting is inconstant and, when present, occurs only in the early stages. There is often anuria and constipation; but in exceptional cases copious diarrhœa may occur.

Physical Signs.—There is progressive abdominal distension from above downwards; as the stomach contains gas as well as fluid, the note over it is usually resonant or tympanitic when the patient is recumbent. A pronounced succussion splash can always be obtained, and on this, and on the result of passing an œsophageal tube, the diagnosis depends.

Differential Diagnosis.—Either peritonitis or intestinal obstruction may be diagnosed. We mistook the condition for peritonitis in one case; a man aged 36 had a thoracoplasty performed with the object of closing a pneumothorax, and during the course of the operation numerous sutures were passed through the diaphragm; the day after the operation he vomited and his epigastrium became painful, tender and rigid; death took place on the fourth day, the diagnosis being peritonitis secondary to infection through the diaphragm. At the autopsy only a prodigious stomach was found.

Treatment.—As soon as the condition is recognised, the foot of the bed should be elevated and an œsophageal tube passed; if the pelvis is not raised, syphonage is likely to be ineffectual. After the gastric contents have been evacuated, lavage should be performed, only small quantities of water being introduced at a time. The patient should then be instructed to lie on the right side or on his face, the foot of the bed being kept well elevated; the genupectoral position advocated by many writers is usually inadmissible on account of the patient's collapsed condition. A careful

watch must be kept on the condition of the stomach subsequently, as it is likely to dilate again with great rapidity; if this occurs, syphonage must be repeated as often as necessary. Eserine salicylate, four doses of gr. 1-40th at half-hourly intervals, or Pituitary Extract—three doses of 1 c.c. hourly—should be administered hypodermically, and all food by the mouth should be stopped. Surgical treatment, *e.g.* by gastro-enterostomy, has been advised for this condition, but we are entirely opposed to anything of the sort.

The Prognosis is always serious even when early and efficient treatment is adopted.

CHAPTER VII

THE LARGE AND SMALL INTESTINE

We consider elsewhere the following intestinal lesions :— in Chapter V., simple stricture (including Congenital Stenosis or Occlusion), Meckel's Diverticulum, Carcinoma, Volvulus Strangulations, Stercoral Ulceration and Paralytic Ulcers ; in Chapter XIII., Thrombosis, Embolism, Henoch's Purpura and Angio-neurotic Œdema ; and in Chapter VI. ; Jejunal Ulcer. With those intestinal diseases which do not give rise to " acute abdominal symptoms," we are not at present concerned, but there remain certain conditions which it will be convenient to group together in this chapter.

Intestinal Diverticula

When all the intestinal coats are involved in a diverticulum, it is classified as " congenital " or " true," and of this class Meckel's Diverticulum (of which a description is given in Chapter V.), is an important example ; when the diverticulum is formed by a hernia-like protrusion of the mucosa through the muscular coats, it is classified as " acquired " or " false." Diverticula may be found anywhere between the pylorus and the anus, but the pelvic colon is the favourite site. It seems probable that these intestinal pouches give rise to no abnormal symptoms unless they have undergone secondary changes ; these secondary changes are classified by Hartwell & Cecil (American Journal of Medical Sciences, 1910) as follows :—

(1) Acute diverticulitis, with or without peritonitis.
(2) Perforation.

(3) Sub-acute or chronic diverticulitis, without marked changes.

(4) Chronic diverticulitis with great induration of diverticulum, intestinal wall and mesentery.

(5) Carcinoma.

(6) Post-inflammatory adhesions, leading perhaps to intestinal obstruction.

Diagnosis.—The condition is seldom recognised, though it might be suspected in the case of an elderly subject with a history of repeated sub-acute attacks of pain in the left lower quadrant of the abdomen, of chronic constipation, with occasional attacks of diarrhœa, no blood being passed in the stools, without any marked cachexia or loss of weight, and with definite thickening of the lower bowel. Many cases are diagnosed as carcinoma, and the true nature of the disease is revealed only by a microscopic examination of the resected bowel. Perforation of a diverticulum may give rise to a local or to diffuse peritonitis; perforation into the bladder is also common, a vesico-colic fistula resulting.

Treatment.—Laparotomy is necessary if symptoms of peritonitis or of obstruction are present. It is sometimes possible to close a perforation by invagination and suture, but where much induration is present around the bowel, resection of the affected segment is advisable; should peritonitis be present, this resection must be postponed and a primary colostomy performed.

Acute Enteritis and Colitis

We believe that no useful purpose is served by multiplying the nomenclature of inflammatory infections of the intestinal tract, *e.g.* by describing as separate diseases such conditions as duodenitis, jejunitis, or sigmoiditis. Even the distinction between enteritis and colitis is not always, clinically, an easy one to make; though in certain cases the brunt of the disease may fall on the colon, and in others on the small bowel, yet it is probable that, as a rule, the whole of the

intestine suffers to a varying degree, and, it may be added, in not a few cases the stomach is also involved, the condition being then a gastro-entero-colitis.

Ætiology.—In most cases abnormal bacterial activity within the intestine is the disturbing factor; this may be due either to the ingestion of virulent bacteria, or to a diminished resistance on the part of the individual. The occasional occurrence of a chemical enteritis cannot be denied, but it is certainly rare as contrasted with the bacterial variety; even in the gastro-enteritis due to irritant poisons, bacterial action comes into play as soon as the mucosa has been damaged, and there is a growing tendency to regard all instances of so-called "ptomaine poisoning" as due to bacterial infection rather than to the irritant action of products of putrefaction.

The diarrhœas of infants are usually due to infected milk; in the case of adults, tinned meats are often at fault, and it must be remembered that a sample of meat may be virulently infected with, say, B. Gärtner, and yet exhibit no sign of putrefaction. The normal degree of immunity to intestinal bacteria may be lowered by such conditions as a chill, a specific fever, passive venous congestion of the bowel, peritonitis, renal disease, or any cachectic state.

The **Bacteriology** of entero-colitis is complicated by the fact that in any given case an immense variety of bacteria may be cultivated from the stools, so that it is difficult to be certain which one is responsible for the catarrh; the serum agglutination reaction is sometimes of assistance here. The disease may be due to the introduction of new and virulent varieties of bacteria into the intestines (as in the case of food-poisoning) or to some process whereby the normal intestinal flora become pathogenic, as in the diarrhœa following a chill. Shortly, the organisms usually responsible belong to that vast family of bacilli which ranges from the Colon bacillus to the Typhoid bacillus and includes such intermediates as B. Gärtner, B. Paratyphosus, B. Shiga-Kruse, B. Flexner-Strong; less commonly are found

B. enteritidis sporogenes, B. pyocyaneus, Staphylococcus aureus and Streptococci.

Morbid Anatomy.—Macroscopically there may be little evident change; there may be intense injection of the musoca, or even multiple erosions, but in other cases slight follicular swelling and redness may be the only abnormality. Occasionally a croupous enteritis is seen, represented by patches of superficial necrosis of the mucosa, leading to the formation of a membrane; this is usually found in secondary or terminal entero-colitis. As a rule the intestinal mucosæ of infants who have died of epidemic enteritis are almost normal in appearance. There may be profuse hæmorrhage from the bowel without any gross breach of the mucous membrane. In the acute colitis of adults examination by the sigmoidoscope or proctoscope often reveals a vividly injected and velvety mucous membrane, which bleeds on the slightest touch.

Clinical Course.—(i) **In Adults,** the onset is usually abrupt and associated with vomiting as well as with colicky abdominal pain and diarrhœa; there is often a little pyrexia, which rarely exceeds 101° F. When the jejunum is chiefly affected there may be little or no diarrhœa; the lower down in the intestine the affection, the more severe is the diarrhœa, and the more intense the pain on defæcation and tenesmus afterwards; moreover the griping pains are located in the umbilical region in small bowel disease, below this level in large bowel disease. The tongue is usually moist and furred, and if the large intestine is affected there may be definite colonic tenderness, but otherwise physical examination is negative. The stools are watery and very offensive; they frequently contain numerous flakes of mucous and sometimes also blood. In the course of two or three days, in an uncomplicated case, the acute symptoms gradually subside, but a chronic painless diarrhœa may persist subsequently for some days; in other cases the diarrhœa gives place to an obstinate constipation.

The Diagnosis is usually easy; tuberculous or malignant

disease must be excluded ; in the presence of symptoms of a very acute colitis, such as incessant purging with much pain and tenesmus, and with the passage of bloody stools, ulcerative colitis may be suspected.

Treatment.—The patient must be kept in bed till all acute symptoms have gone ; no food should be allowed by the mouth for twelve to twenty-four hours, but he should be encouraged to drink lemonade or barley-water. An aperient should be administered at once ; half an ounce of castor oil with seven minims of laudanum is the best, but if there is much vomiting, calomel in quarter-grain doses half-hourly to four doses may be substituted. Pain may be treated by hot fomentations to the abdomen, and collapse by half-ounce doses of brandy at frequent intervals, or, if necessary, by saline solution subcutaneously. Once the aperient has had time to act, but not before, efforts may be made to stop the diarrhœa by giving an ounce of Mist. Cretæ with 10 minims of laudanum, or 30 grains of Pulv. Cretæ Aromaticus cum Opio every two hours ; another effective remedy is the starch and opium enema (Laudanum 20 minims, Mucilage of Starch 2 ounces). After the first twelve hours cautious feeding may be tried, first with cold milk and soda, later with tepid arrowroot to which a glass of port has been added.

(ii) **In Children.**—There is no essential difference between the conditions usually described separately under such headings as " Dyspeptic Diarrhœa," " Acute Infectious Enteritis," and " Epidemic," " Choleraic," or " Summer Diarrhœa " ; they are simply different grades of one and the same condition, namely, infective gastro-entero-colitis. As to predisposing conditions, any cause which lowers the child's resistance to infection predisposes it to this disease ; common examples are rickets or teething, and there is no doubt that a sudden change of temperature, in either direction, may be responsible for an attack. The infection is nearly always due to tainted milk, the disease being rarely seen, at any rate in a serious form, in sucklings. Insanitary

houses, hot and dusty weather, and a prevalence of flies, all tend towards the contamination of milk, and thus towards epidemics of entero-colitis. Most cases occur within the first two years of life.

The Symptoms may vary from a slight attack of diarrhœa with little constitutional disturbance, to an illness which may end fatally within twelve hours. As a rule the onset is sudden, with abdominal pain, vomiting, diarrhœa and fever; but sometimes the onset is insidious, and a mild attack of diarrhœa gradually merges into a more grave condition. Both vomiting and diarrhœa are frequent or even incessant, and in consequence of the rapid loss of fluid, the tissues shrink with amazing rapidity, so that within twenty-four hours a previously plump baby may resemble the victim of a famine; the skin feels dry and inelastic, the abdomen becomes flat or even carinated, and the fontanelles are depressed, whilst the face acquires a curiously senile aspect. There is often high pyrexia, sometimes amounting to 108° F. or more, shortly before death; but a sub-normal temperature is not uncommon; the pulse is soft and rapid. Convulsions are often seen at the onset, and they may be repeated later on; in fatal cases the child sinks into a coma which, taken in conjunction with the wasting and the carinated abdomen, may suggest meningitis. The stools are generally green, slimy, and offensive, but they may be watery and even resemble the stools of cholera; often blood may be passed in considerable amounts. Little or no urine is passed.

As a rule the child's fate is decided one way or the other within three or four days; some cases die of toxæmia within twenty-four hours, others of toxæmia or exhaustion at the end of three or four days, and yet others drag on for a week or more, succumbing perhaps eventually to a terminal broncho-pneumonia.

Diagnosis.—The only difficulty is when an acute onset is attended by much pain and the passage of blood per rectum; here a careful bimanual examination must be

made under an anæsthetic in order to exclude intussusception.

Treatment.—The mildest attack of diarrhœa occurring in a young child should be treated seriously by rest in bed, dieting and protection from chill. If acute symptoms arise, the stomach should be washed out and a purge administered —calomel and Dover's powder may be given in doses of ¼-grain of each every three hours to a one year old infant. The food should be restricted to albumen water. The colon should be irrigated with tepid saline solution, introduced slowly through a soft rubber catheter passed high up; this may be done once or twice a day.

The loss of fluid from the tissues must be made good by solution run slowly into the axillæ; either normal saline solution, or a 5 per cent. solution of dextrose, may be used; recently good results have been obtained by the use of hypertonic saline solution (2 drachms to the pint). Hyperpyrexia must be reduced by sponging, and, conversely, the sub-normal temperature of collapse is to be combated by warmth, supplied for choice by means of an electrically heated cradle. Camphor is the best cardiac stimulant (2 minims of a 10 per cent. solution in olive oil hypodermically every two hours). Should the acute symptoms subside, but the diarrhœa persist, an astringent mixture, *e.g.* Dilute Nitric Acid 1 minim, Tincture of Catechu 5 minims, Glycerine 5 minims, Decoction of Logwood to 1 drachm, t.d.s., may be given.

Phlegmonous Enteritis

Phlegmonous enteritis is a very rare condition of which MacCallum in 1906 ("Bulletin, Johns Hopkins Hospital, 1906," xvii., 254) was able to collect from the literature only seven examples; of these, in five the upper part of the small bowel or the duodenum was involved, in one the colon and in one the whole digestive tract. More recently, Taylor and Laking (*Lancet*, July, 1911) have published a case of

phlegmonous duodenitis secondary to the impaction of a fish-bone. The condition appears to be strictly comparable to Phlegmonous Gastritis (described in Chapter VI.), a purulent infiltration of the submucous tissue being the characteristic feature. Most cases have been diagnosed as intestinal obstruction, as in the following instance :—

J. T. Male, æt. 68, a wheelwright.

Past History of dyspepsia of several months' duration. *Present History :* A week ago, sudden onset of epigastric pain lasting a few hours ; three days ago, onset of severe epigastric pain, vomited once and passed three very offensive motions, one of which contained a little blood ; had passed neither flatus nor fæces since. *State :* "Peritonitic" facies ; foul tongue ; pulse 124, temperature 99 ; abdomen distended, motionless and tender ; suggestion of visible small intestine peristalsis near umbilicus. *On laparotomy*, most of intestinal coils black and apparently gangrenous. *Post Mortem*, first four feet of jejunum dilated and œdematous, but of good colour ; rest of small bowel plum-coloured, thickened and friable. Large bowel swollen and œdematous, but only at the left pelvic brim was it discoloured. Mucosa necrotic in some places, deeply engorged in others. The only thromboses discovered were a recent clot at termination of superior mesenteric artery and some soft clots in tributary venules of portal vein. No sign of corrosive poisoning.

Ulcerative Colitis

There is good reason for the opinion which is held by many that ulcerative colitis differs in no essential respect from the bacillary dysentery of the tropics ; as Dr. Hawkins has pointed out, the analogy in respect of both the symptoms and morbid anatomy of the two diseases is very striking. The chief objection to the classification of ulcerative colitis as a sporadic variety of tropical dysentery is a bacteriological one ; the specific bacillus is seldom recoverable from the stools, nor is a positive serum reaction often obtained. Yet in a few undoubted cases both these dysenteric criteria have been satisfied, and it seems probable that, as suggested by Dr. Hawkins, more positive results would be obtained were cases examined in the earliest stages of the disease. In the

later stages in which patients usually come under observation rectal scrapings yield only B. Coli, and the serum reaction is negative.

Morbid Anatomy.—The ulceration is usually strictly localised to the colon; sometimes there are only a few scattered ulcers, but more commonly the colonic mucosa is ulcerated from end to end, and the islets of mucous membrane left between the confluent ulcers give it a characteristically polypoid appearance. There is frequently a little peritoneal inflammation around the base of some of the ulcers, or the thinned wall may be so stretched as to give rise to localised pouching of the wall. Perforation may occur, and when this happens it is frequently multiple; probably the peritonitis set up by a single perforation so weakens the bases of other ulcers that secondary perforations are favoured. Peritonitis may result from peritoneal infection through the inflamed base of an ulcer quite apart from any gross perforation. In many cases chronic interstitial nephritis is present, and occasionally death results from portal pyæmia with multiple liver abscesses.

Most cases are aged between twenty and forty, and the two sexes are equally liable to the disease. The insane appear to be specially susceptible, and ulcerative colitis is endemic in many asylums.

Symptoms.—There is an abrupt onset with severe colicky abdominal pain, diarrhœa, and often vomiting. The diarrhœa is frequent, from five to twenty stools being passed in the twenty-four hours; pain on defæcation, with straining and tenesmus, is usually a prominent symptom. The stools are fluid, dark in colour, and offensive, and they often contain considerable quantities of blood and mucous; occasionally sloughs from ulcers may be recognised. There is usually pyrexia of a hectic type, and the evening temperture may be as high as 104° F. The abdomen is distended and there is extreme colonic tenderness; the ulcers may often be seen through the sigmoidoscope (which must of course be introduced with great caution). The urine may contain a

trace of albumin. The patient wastes rapidly, the complexion becomes sallow and the face drawn and anxious. The tongue is often red, dry, and glazed. After a period lasting from a few days to many weeks, these acute symptoms may subside, or death may take place from exhaustion, portal pyæmia, or peritonitis. Even if the attack ends favourably, a relapse is almost inevitable, though the patient may be perfectly free from symptoms, intestinal, or otherwise, during the stage of intermission, which may last for a few weeks or for so long as a year or even more ; this feature of a series of attacks of acute symptoms such as are described above, separated by more or less prolonged and complete remissions, is very characteristic of the disease.

Prognosis.—The mortality is undoubtedly very high, but at the same time it is certain that complete and permanent recovery may take place. The disease cannot be regarded as cured until the patient has been free from symptoms for several years.

Diagnosis.—An attack of acute catarrhal colitis can be distinguished from the ulcerative variety only by the after-progress of the case. Other diseases to be considered are carcinoma, intussusception, typhoid fever, uræmia, and tuberculous enteritis.

Treatment.—The patient must be kept in bed on a milk diet. If the dysentery bacillus can be recovered from the stools, or if the serum reaction against this organism be positive, anti-dysenteric serum should be administered (3 daily doses of 25 c.c.). Calomel gr. $\frac{1}{4}$ and opium gr. $\frac{1}{2}$ may be given twice a day in the form of a pill, and the colon should be irrigated daily with tepid solutions introduced slowly through a rectal tube ; the solutions commonly used are creolin (a drachm to the pint) silver nitrate (20 grains to the pint), or normal saline solution, half to three-quarters of a pint being administered at a time. Severe pain must be treated with opium or morphia, due precautions being taken against the patient acquiring the habit. Chronic cases which prove obdurate to treatment on these lines may

sometimes be cured by the performance of cæcostomy ; it is essential that the intestinal contents be diverted from the colon, and we have little faith in the mere irrigation of the colon through an appendicostomy, though this operation may be tried before the more serious one. The artificial anus must, unfortunately, be a permanent one in most cases ; short-circuiting is seldom justifiable, as the rectum is usually involved as well as the pelvic colon. The surgical treatment of perforation is not likely to be successful, perforations being frequently multiple and the whole bowel wall extensively diseased ; we know of no case where it has been attempted.

Tuberculous Enteritis

In most cases tuberculous enteritis is due to the swallowing of tuberculous sputum, and it is found in more than half of all fatal cases of phthisis ; in a few cases, perhaps, the intestine is invaded from the peritoneum or from adherent tuberculous mesenteric glands. Tuberculous ulcers may be found in any part of the small or large intestine ; they are most common in the last foot of the small intestine, are not infrequently found in the rectum, and are very rare in the duodenum. An ulcer is formed by the confluence of tubercles which appear in Peyer's patches or solitary follicles ; extension of the ulcer is along the lymphatics which run transversely round the lumen of the gut, and hence the long axis of the ulcer is usually transversely disposed. A tuberculous ulcer can be recognised macroscopically by its characteristic irregular and infiltrated margin, by its thickened and opaque base with minute but visible tubercles on the peritoneal aspect, and by its transverse disposition. The base of a tuberculous ulcer is often adherent to an adjacent coil of gut. Occasionally one meets with very marked localised tuberculous thickening and induration of the whole bowel wall, with or without ulceration of the mucosa ; this condition may produce a palpable tumour. It has been

described as *Hyperplastic Tuberculosis of the ileo-cæcal region;* but, though most common in the vicinity of the ileo-cæcal valve, the process may involve only isolated portions of either small or large intestine.

Symptoms.—Very gross destruction of the intestinal mucosa may occur without the production of any symptoms at all; we recollect one patient with advanced phthisis and tuberculous laryngitis and pharyngitis, who died without exhibiting any diarrhœa or other abdominal symptoms; yet at the autopsy there was extreme ulceration of the small intestine and perforative peritonitis. Even chronic diarrhœa in a phthisical subject is not positive evidence of tuberculous enteritis, since it may be due to amyloid disease; blood in the stools would point to tuberculous rather than to amyloid disease, but in our experience this is an unusual symptom. The demonstration of tubercle bacilli in the stools would afford definite evidence of tuberculosis. *Perforation* occasionally takes place, and usually gives rise to a localised peritonitis, the spread of infection being limited by previously formed adhesions; in some cases a localised abscess is present without any visible intestinal perforation, and here we must assume infection through the diseased bowel-wall. Intestinal obstruction may result from the cicatrisation of a healed ulcer or from peritoneal bands or adhesions (*vide* Chapter V). Hyperplastic tuberculosis of the ileo-cæcal region is usually mistaken for carcinoma of the cæcum, but cases have been diagnosed as appendicitis.

Treatment.—Diarrhœa, if present, may be checked by a diet of milk, eggs, and farinaceous preparations, and by the administration of astringents or opium; if the stools are very offensive, as is usually the case, intestinal antiseptics should be given, and of these we have found Fraudin's naphtholated charcoal (one teaspoonful thrice daily) the most useful. At the same time treatment must be carried out on the lines usual for tuberculous disease elsewhere. Perforation, when recognised, must be dealt with surgically, and such treatment is frequently successful; in some cases,

however, the drainage of an abscess is followed by the appearance of a fæcal fistula, in which event death from inanition may ensue. Hyperplastic tuberculosis is best treated by the resection of the affected bowel.

Syphilitic Ulceration

Syphilitic Ulceration of the intestine is extremely uncommon. Intestinal ulceration may occur in syphilitic subjects, and may lead to perforative peritonitis or to obstruction; but in not a few of such cases the syphilitic nature of these ulcers is very questionable, especially when we consider the liability of syphilitic subjects to tuberculosis.

Uræmic Ulceration

Uræmic Ulceration of the bowel is quite a common condition. Perhaps Nephritic Ulceration would be a better term, for the uræmic manifestations are often inconspicuous or absent. The ulcers may affect either small or large bowel, and they may be either single or multiple; in fact, appearances indistinguishable from Ulcerative Colitis may be found in Bright's Disease. They usually complicate chronic interstitial nephritis, and may be found in young subjects.

Symptoms.—Uræmic symptoms may be evidenced only by some slight dyspnœa or headache; diarrhœa is common, and there is often frequent vomiting in addition. There may be free hæmorrhage from the bowel. Peritonitis may occur with or without intestinal perforation.

Diagnosis.—The condition is frequently unrecognised, especially when renal symptoms are lacking. The presence of albumen and casts in the urine, with arteriosclerosis, high blood pressure, and probably renal retinitis, would point towards the correct interpretation of the symptoms.

Treatment should be directed on the lines usual for nephritis. No attempt should be made to check the

diarrhœa or hæmorrhage, unless the latter is very profuse. The treatment of consequent peritonitis would probably be hopeless.

Intestinal Neuroses

Four types may be recognised, namely, Nervous Diarrhœa, Mucous Colic, Enterospasm, and Enteralgia. An admirable account of the last two conditions has been given by Dr. Hawkins (*British Medical Journal*, January, 1906), to whom we acknowledge our indebtedness.

Enteralgia may be defined as intestinal neuralgia, and is perhaps comparable to the classical example of paroxysmal neuralgia, namely, tic douloureux. It can be diagnosed only after the possibility of any organic disease has been excluded, and, strictly speaking, it could be with certainty distinguished from enterospasm only after the inspection of the gut through a laparotomy incision. As a typical case, we quote Dr. Hawkins's example —

> Male, æt. 35 ; history of attacks of severe abdominal pain during the last sixteen years ; pain is paroxysmal, referred to the umbilicus, and is not related to meals ; no other symptoms ; three or four such attacks a year, each lasting from two to seven days ; no evidence of organic disease ; weighs 13 stone.

Enterospasm.—In the paper quoted above, Dr. Hawkins refers to two cases where the symptoms pointed to intestinal obstruction and to peritonitis respectively, but where laparotomy disclosed no abnormality beyond sharply localised spasticity of segments of the gut. After a review of thirty-five cases, he considers that enterospasm affects males and females equally ; that the subjects of this condition are usually neurasthenic or emotional ; that the pain may be represented either by sharp attacks of colic or by chronic abdominal aches ; that the pain is commonly localised either to the right or to the left iliac fossa ; and that in consequence either appendicitis or carcinoma of the sigmoid colon may be suggested.

Mucous colic (or Mucous Colitis).—This is a secreto-motor neurosis of the colon. It is a disease chiefly of nervous women, but men are not exempt. The subjects of mucous colic are often sufferers also from chronic dyspepsia and constipation, and it is interesting to note that some of them are also the victims of asthma, another secreto-motor neurosis. The attacks of mucous colic, which rarely begin before the age of twenty, are characterised by paroxysms of severe abdominal pain, associated, as a rule, with constipation, but occasionally with diarrhœa. When the bowels act during or shortly after an attack, the motions consist almost entirely of mucus tubes, which are, in fact, intestinal casts. It is noteworthy that in some instances blood may be passed as well as mucous, so that ulcerative colitis may be imitated. Physical examination of the abdomen is negative, apart from colonic tenderness, and possibly palpable colonic spasms. These attacks may last for months and produce an ill-health verging on cachexia; but in other cases the attacks are of short duration, and between them the patient has excellent health.

Diagnosis.—Not every constipated woman who occasionally passes a little mucus has mucous colic; before the diagnosis can be made, considerable quantities of mucus must be passed in tubular form with paroxysmal abdominal pain. It is essential to exclude organic disease, especially carcinoma of the colon or rectum. We have seen an attack which apparently began in the appendix, the picture of a mild catarrhal appendicitis being closely imitated for a few hours; later on the tenderness spread along the line of the colon and eventually the true diagnosis became manifest. No doubt such cases will suffer appendicectomy more frequently now that early operation for appendicitis is advocated.

Treatment must be directed against the neurasthenic state which is probably present. It is essential that the action of the bowels be regulated, castor oil and senna pods being the most useful agents. Daily colonic irrigation is

often successful. Intractable cases should be treated surgically; either a cæcostomy or an appendicostomy may be performed, and no attempt should be made to close this opening for at least a year.

Before leaving the consideration of these intestinal neuroses, we would again insist on the extreme importance of the exclusion of organic disease before arriving at a definite diagnosis of one of these conditions; especially does this hold good in the case of enteralgia or enterospasm, diagnoses which should never be lightly made.

Intestinal Colic

Intestinal Colic is really a symptom rather than a disease; it is a name given to the griping pain which is produced by violent and irregular peristalsis. Strictly speaking, then, the pains of intestinal obstruction, of enteritis, of colitis, are varieties of colic, and these we have already considered; it remains only to deal with two common varieties of colic, namely, that due to lead poisoning, and that due to indigestible or irritating food. The only difference between lead and food colic is that the former is always associated with obstinate constipation, whereas diarrhœa occurs sooner or later in the latter condition; in other respects the symptoms are the same. There is very severe griping abdominal pain, associated with rigidity and retraction of the abdominal wall, and not infrequently with sweating and collapse. The pain is nearly always relieved by pressure.

The **Diagnosis** of these cases often gives rise to considerable difficulty and not a little anxiety, for a mistake may cost the patient his life. The presence of a "lead line" in the gums is often helpful, though, of course, it does not stamp the case as being one of lead colic any more than does the absence of a lead line negative such a possibility. In respect of the collapse, the excruciating pain, the extreme abdominal rigidity and retraction, the similarity to the

picture of a gastric or duodenal perforation may be very striking ; on the other hand the pain is paroxysmal, between the paroxysms the abdominal wall is everywhere soft, and the liver dulness is not reduced.

Again, the constipation, and the obviously peristaltic nature of the pain, may suggest acute intestinal obstruction ; but visible peristalsis is rarely if ever seen, and there is usually no vomiting. In either case, where doubt exists it may be removed by the administration of an aperient.

Treatment.—Pain is relieved by hot fomentations ; if intense, and if the diagnosis is certain, morphia must be given hypodermically. Half an ounce of castor oil should be given with seven minims of laudanum, and repeated in half an hour if necessary.

Idiopathic Dilatation of the Colon

This is essentially a chronic disease, but must be mentioned here because it occasionally gives rise to acute symptoms. It is probably a consequence of a congenital neuro-muscular defect of the colon, and the subjects of the condition are as a rule obstinately constipated from birth, though attacks of diarrhœa may occur. In most cases the patients are young children, but in a second group no serious trouble arises till old age is reached. The whole colon may be involved in the dilatation, but more commonly the condition is confined to the vicinity of the pelvic portion. The colon may attain a gigantic size, and the resulting abdominal distension may be so extreme as to embarrass respiration. The outlines of the dilated colonic loop may be visible, and peristaltic prominences are sometimes seen.

Treatment.—Palliative treatment by frequent passage of a rectal tube may be successful for a time ; this must be done with great care, as the wall of the distended gut is very thin and may be perforated by the tube, an accident which we have seen on one occasion. Early surgical treatment should certainly be advocated ; the dilated loop

should be short-circuited by anastomosis, and either fixed or excised in order to prevent a subsequent volvulus.

Perforation of Typhoid Ulcers

This accident is met with in from two to three per cent. of all cases of typhoid fever; as a rule it is a complication of the more severe forms of the disease, particularly those characterised by meteorism and hæmorrhage, but even the mildest cases must be regarded as being liable to it. Perforation may occur at any stage of the disease—even in the first week, or, on the other hand, during convalescence; but the danger of perforation is greatest during the height of the disease, and half the cases are seen during the third and fourth weeks. The perforation is commonly found in the ileum, close to the ileo-cæcal valve, but it may be in the colon; the size varies from a minute pin-point aperture to a large oval defect of the intestinal wall: or there may be an oval cribriform area. Multiple perforations are not uncommon. Perforation is usually heralded by a sudden attack of severe abdominal pain, situated as a rule near the right iliac fossa; with this pain there is often vomiting and collapse, and micturition is sometimes frequent and painful. On examination, the facial expression is anxious, there is tenderness and rigidity over the painful area, and the abdomen is more distended than before; in a few instances only is there a widespread abdominal retraction, with rigidity and immobility, such as characterises so many gastric or duodenal perforations. On percussion, the liver dulness is usually diminished or obliterated, and there may be dulness in the flanks.

At the time of perforation there is nearly always a sudden fall of temperature, but it tends to rise again quickly, and generally to a higher level than before. The pulse and respirations are accelerated from the first. If the condition be not recognised early, there is progressive increase in the abdominal distension, in the area of tenderness and rigidity,

and in the pulse-rate; the face gradually acquires the Hippocratic appearance, and vomiting and hiccough become incessant.

Diagnosis.—If the patient's life is to be saved, an early recognition of the condition is essential; the operation mortality within 24 hours is 55 per cent.; after this time it is 87 per cent. A sudden attack of severe abdominal pain, arising in the course of typhoid fever, and associated with a sharp fall of temperature and acceleration of the pulse-rate and with local abdominal tenderness and rigidity, is almost certain evidence of perforation; confirmation may be obtained by the demonstration of a progressive increase in the tender and rigid area, or perhaps by a progressive obliteration of the liver dulness. Pain and a fall of temperature may also mark the onset of profuse typhoid hæmorrhage; but the pain is seldom severe, a sudden feeling of faintness being the more common sensation; moreover, there is no local tenderness or rigidity, and the diagnosis is usually made manifest by the rapid appearance of pallor, with a soft and running pulse, and of blood passed per rectum.

In toxic and comatose patients there is no complaint of pain, and tenderness cannot be demonstrated, so that the diagnosis is usually impossible.

Sub-acute perforations, where there is but little initial peritoneal contamination through a minute aperture, may give rise to considerable difficulty at first, and the diagnosis depends on the progressive increase in the severity of the symptoms and the extent of the signs. Peritonitis may complicate typhoid fever apart from any gross perforations; the signs and symptoms are those of a sub-acute perforation. A leucocyte count may be of value occasionally, especially if a progressive increase of leucocytes can be demonstrated; but it must not be forgotten that a progressive leucocytosis may be associated with hæmorrhage.

Treatment.—Operation should be performed as soon as the condition is diagnosed, provided that the patient's condition warrants surgical treatment; if a general anæsthetic

is contra-indicated, spinal or local anæsthesia may be employed. The abdomen should be opened through a low right rectus incision, and the vicinity of the ileo-cæcal valve should be investigated first; if no perforation be found here, the colon must be examined. The perforation, when found, is closed by Lembert sutures, and the possibility of multiple perforations must not be forgotten. Fæcal extravasation should be absorbed by gauze plugs, and the abdomen closed as rapidly as possible. Drainage is usually unnecessary.

(The diagnosis between the gastro-intestinal type of typhoid fever and acute abdominal conditions is considered in Chapter XVI.)

CHAPTER VIII

APPENDICITIS

Of all the contents of the peritoneal cavity, the vermiform appendix is the most prone to lead to acute abdominal disease, and although it is well-nigh impossible to submit new thoughts or new observations on appendicitis, yet such a common lesion must perforce occupy considerable space in a work of the present character. This degenerate remnant of the intestinal tract has been credited by some authors with a physiological function, but as to what that function is there is wide difference of opinion ; others boldly pronounce that it is useless, and from the standpoint of clinical medicine it appears to be not only useless, but harmful, owing to its peculiar susceptibility to disease, and the grave consequences that may result therefrom.

A satisfactory classification of the forms and varieties of appendicitis presents a difficult problem to the clinician, but there is a rudimentary division into mild and severe attacks. The former includes appendicular colic and catarrhal appendicitis, the latter interstitial appendicitis and appendicitis with peritonitis. It is with the severe attacks that we are mainly concerned, but we would here point out that in no disease is there more often a wide discrepancy between physical signs and pathological conditions than in appendicitis. We must also recognise the existence of chronic appendicitis producing changes in the appendix without a recognisable acute attack, but such cases are foreign to our present consideration.

The term " appendicular colic " is used by most writers

to designate painful peristaltic efforts on the part of the vermiform appendix to dislodge a foreign body, a fæcal concretion, or a pellet of mucus, from its own lumen into that of the cæcum. This will obviously be difficult if the anatomical position of the appendix be such that its opening into the cæcum is very obliquely placed, or if the lumen of the appendix itself be lessened by a stricture or external adhesions. The cæcal aperture leading into the appendix is more or less guarded by a crescentic fold of mucous membrane, the valve of Gerlach, which may to some extent prevent the entrance of fæcal matter; but this valve is often poorly developed, and fæces are not uncommonly present within the lumen of the appendix. Obstruction to the return of fæcal matter back to the cæcum is not unlikely to result in catarrhal inflammation of the mucosa, and hence we find that some authors regard catarrh of the mucous membrane as the characteristic pathological state corresponding to the clinical phenomena of appendicular colic. Again, when the appendicular peristalsis is directed towards the expulsion of a pellet of mucus, this excess of mucus itself may be the result of catarrh. Whatever the pathology of appendicular colic may be, it is clear that if inflammation is present, it must be limited to the mucous membrane and submucous tissue, and clinically this may be manifested by abdominal pain, localised early to the right iliac fossa, a slight rise of temperature and pulse rate, a little nausea or possibly actual vomiting, together with constipation. As regards physical signs, deep tenderness in the appendix region with rigidity of very slight degree may be present, and the tongue may be furred. Subsidence of the attack usually occurs within thirty-six hours of the onset, and is often coincident with the natural or medicinal evacuation of the bowels. "Catarrhal appendicitis" is probably a wiser term to apply to such attacks, though, if they are afebrile and of very short duration, appendicular colic does to some extent afford a descriptive name. An attack with any graver symptoms than these is almost

certainly due to more advanced pathological changes, and to such the term "acute appendicitis" should be applied. This implies inflammation beyond the limits of the submucosa, affecting in particular the serous coat. But inflammation of the peritoneum covering the appendix means inflammation of a portion of a large serous sac, and therefore any attack of acute appendicitis is equivalent to an attack of peritonitis, the limitation of which is most uncertain. However, at some stage of all varieties of acute appendicular disease the changes involve no more than the coats of the appendix itself, and we may fairly recognise *acute appendicitis* as a pathological and a clinical entity. When the inflammatory changes have gone further afield, the condition may be called *appendicular peritonitis*, the forms of which we shall discuss later.

Acute Appendicitis

Etiology and Pathology.—It is generally recognised that the initial lesion in inflammation of the appendix affects the mucous coat. Organisms are constantly present on the surface of its healthy mucous membrane, and bacilli of the colon group and other organisms can be readily demonstrated by the microscope in sections through the healthy appendix. In the normal state, the mucous cells offer an impassable barrier to these organisms, and they are seen no deeper than the free surface of the mucosa, but when once the mucous membrane is injured, the organisms have free access to the non-resistant muscular coat and pass on towards the peritoneal covering of the appendix. The transference of inflammatory changes from the mucosa to the peritoneal investment is facilitated by the presence of *hiatus musculares*, or gaps in the muscular coat, to which Lockwood has drawn attention, through which the mucosa projects till it lies very close to the serous coat. These *hiatus* probably go far to explain the rarity of appendicitis without peritonitis. Increased virulence of the organisms

within the lumen of the appendix without damage to the mucosa does not suffice to produce an attack of appendicitis any more than the presence of virulent organisms on the intact skin is likely to cause cellulitis. The defect in the mucous membrane is probably due either to local injury, or to thrombosis and impairment of the blood supply to a portion of this coat. The appendix has been christened "the abdominal tonsil," and if the cæcum be regarded as a second mouth, the analogy is good, for as the mouth is a collector of organisms from all external sources so is the cæcum from all the small intestine. To regard the cæcum as a second stomach, as some authorities have done, is quite erroneous from the bacteriological point of view, for the cæcum provides an alkaline haven for rest and multiplication of bacteria, whereas the stomach repels the immigrant organisms by its acid secretion. The etiology of this disease may therefore be considered under the two usual headings of "general" and "local."

General Causes.—*Age.*—The commonest period of life affected is that between the tenth and the thirtieth year, but the disease is met with occasionally in children under five, and in old people of sixty or seventy.

Sex.—Males are affected far more than females, the common proportion being about two and a half to one. A suggested explanation is that in the female the appendix derives an additional blood supply through the vessels of the appendiculo-ovarian ligament, thus rendering the female appendix less liable to obliteration of its vessels.

Season.—Apparently rather more cases are met with in the summer months than during the winter.

Diet.—The presence of hard foreign bodies, such as minute particles of iron or stone, in food-stuffs has been held responsible for the increasing incidence of appendicitis.

Digestive disturbances.—Chronic constipation does probably favour inflammation of the appendix, since intestinal stasis aids the formation of fæcal concretions, and the multiplication of bacteria with · the cæcum.

Local Causes.—It has already been pointed out that the primary lesion affects the mucous coat, and in most cases this is traumatic in origin, and either the mucosa is scratched or subjected to pressure, or else the appendicular vessels are blocked by pressure or thrombosis. The microbic invasion follows some injury to the mucosa, direct or indirect. External injury to the abdomen is held accountable for the onset of the disease by the patient in some eight per cent. of cases, and it is not improbable that blows over the right iliac fossa may determine thrombosis of appendicular vessels or lead to kinking of the organ, and possibly to the formation of adhesions around it.

We have already spoken of the anatomical position which the appendix may occupy, and the most important factor is the facility which exists for the return of fæcal matter from the appendix to the cæcum. The imperfect valve of Gerlach may, instead of protecting the appendix from the reception of fæces, obstruct their return, and any condition of stricture or tortuosity, which hampers the exit from the appendix, favours inflammatory changes in it, for distension will impair its blood supply and favour the activity of its contained organisms.

Fæcal concretions.—From their shape, their lamination, and the deformities in the lumen of the appendix which they cause, it appears certain that fæcal concretions are formed within the walls of the appendix. They result from inspissation of fæcal matter with the addition of mucus and epithelial *débris*, and they contain micro-organisms. They do not necessarily cause inflammatory changes, but they are a menace as long as they are present; increase in their size often determines the onset of ulcerative and perforative appendicitis. It is indeed rare to operate on a case of acute perforative appendicitis without finding a concretion inside the appendix, or lying in the peritoneal cavity. Such cases often exhibit two or more areas of gangrenous ulceration, and quite commonly a concretion is found for each ulcer. In composition, these concretions

are usually made up of fæcal matter with the phosphates and carbonates of lime and magnesium; occasionally a foreign body, such as a piece of wood or metal, may be found as a nucleus. The pathological history of such cases is that a portion of fæcal matter enters the appendix, and, as the result of intestinal stasis, or obstruction to its exit into the cæcum, it fails to move on, and becomes dry and hard; salts, epithelial cells, mucus, and organisms are added to it, with or without more fæcal matter, until it becomes larger than the normal appendix can accommodate; pressure-ulceration of the mucous coat ensues, and to this is superadded microbic invasion of the necrotic wall with resulting interstitial inflammation in some cases, or perforation with peritonitis in others.

It is true that at operation one may find that there is no evidence that the concretion was tightly embraced by the appendix, but possibly the inflammatory exudate is capable of absorbing some of the salts of which the concretion is composed, thus causing it to shrink in size. As one would expect, such a state of affairs as this is most commonly seen when a concretion becomes arrested on the distal side of a stricture, and there one often finds a bed of necrotic mucous membrane corresponding to the size and shape of the concretion. At times there is gangrene of the whole appendix below a concretion, suggesting that the enterolith has, by its presence, cut off the whole of the blood supply beyond its own situation.

Foreign bodies.—Pins, needles, pieces of bone and wood, and the seeds of fruit, have often been found in the appendix, and at times their presence is certainly responsible for the inflammatory attack. Intestinal parasites may also be found, but do not as a rule give rise to acute infective appendicitis.

Bacteriology of Appendicitis.—The most important organism in connection with appendicitis is the colon bacillus. Other organisms also play an important part, including the varieties of *staphylococcus*, the *streptococcus*

pyogenes, *pneumococcus*, *bacillus pyocyaneus* and others which are included in the flora of the intestinal lumen. The important researches of Dudgeon and Sargent have thrown considerable light on the relative importance of these various organisms. By cultivations from the peritoneum at a distance from the diseased appendix, as well as from its surface, they have shown that the *staphylococcus albus* may be the first organism invading the peritoneum, and that its presence favours phagocytosis, and therefore confers benefit on the patient; it is not infrequently present in company with the colon bacillus Further, by inoculations into the peritoneal cavity of guinea-pigs, they found that a preliminary injection of a culture of *staphylococcus albus* prevented the lethal effect of inoculation with *bacillus coli*; guinea-pigs treated with the latter injection alone succumbed in twenty-four hours. The presence of the *staphylococcus albus* has no influence over the prognosis in cases of further infection by the *bacillus pyocyaneus* or *streptococcus pyogenes*. Where a perforative appendicitis was examined, the colon bacillus was most often cultivated, either alone or together with other organisms. Streptococcal infections are apt to be unlimited by inflammatory adhesions, and their presence, either alone, or together with the colon bacillus, makes the prognosis exceedingly grave. The *staphylococcus aureus* is also a deadly organism. Appendix abscesses of some standing appear to resemble closely the interior of the intestine in their bacteriology, and many varieties of organisms and spirilla can be seen in cover-slip preparations; cultures usually yield growths of the colon bacillus, some variety of staphylococcus, a streptococcus, bacillus pyocyaneus, pneumococcus, or rarely, the bacillus ærogenes capsulatus. These results are obtained by anærobic as well as ærobic cultivation. The offensive odour of appendix abscesses is usually due, not to the colon bacillus, but to the bacillus proteus, or some anærobic organisms. The bacillus pyocyaneus does not cause a blue colouration of the pus in these abscesses.

Symptoms.—*Abdominal pain, vomiting,* and *fever,* are the three leading symptoms of acute appendicitis, and they are usually manifested in the order mentioned. Though there are wide variations in these symptoms, yet during the common age period of the disease, from ten to thirty, the onset is usually characteristic. In old people and in young children the symptoms and signs of all peritoneal lesions are apt to be contradictory.

Pain.—This is very rarely absent, its onset is sudden, and it is the first warning that the patient is out of health. The initial pain is commonly referred to the mid-abdominal zone, since the afferent nerves of the appendix are connected by the sympathetic ganglia with the lower dorsal segments which receive cutaneous impulses from the lower abdominal wall. The pain, after a varying period, becomes localised to the right iliac fossa, and in most cases is so situated when the patient comes under treatment. It is variously described as "aching," "griping" or "cutting" in character, and in accordance perhaps with the anatomical "lie" of the appendix it may be further referred to the right loin, the pelvis, or even the ischio-rectal region. Pain on micturition, and frequency of the act, is often met with in cases where the appendix lies close to the bladder in the pelvis. Cutaneous hyperalgesia in the right iliac fossa is sometimes observed by the patient, but of this we shall speak in considering the physical signs.

Vomiting.—At the onset of the attack, and within a few hours of the occurrence of pain, nausea is the almost universal rule. In a large proportion of cases this is followed by vomiting. The contents of the stomach, sometimes with bile, are ejected. Vomiting is not usually very severe, but it may be repeated in bad cases. In some instances nausea is present without vomiting, but they are often both present, and, since vomiting may be regarded as a reflex symptom due to peritoneal irritation, the degree of emesis is some guide to the amount of peritoneal involvement.

Fever.—In cases where the temperature is taken from

the onset of pain, some degree of fever is almost certain to be observed. The temperature often rises suddenly to 103° F. or 104° F. at the onset of the illness, but its course afterwards is very variable, and the temperature is the poorest possible guide either to the presence of pus or to the amount of peritoneal inflammation. In most cases the fever is of a remittent type.

Constipation is more common in appendicitis than diarrhœa, but the latter is not rare in those cases of ulcerative and perforative appendicitis which have a particularly sudden onset. Diarrhœa, though present at the onset of the illness, is usually succeeded by constipation, and in many cases there is no initial diarrhœa. Constipation is due doubtless to reflex nervous inhibition caused by peritoneal irritation and pain in the first stages; later, it is due to local paresis of inflamed bowel, and in the worst cases there may be a general paralytic condition of the intestine. Initial diarrhœa, when present, is probably to be explained by a general toxic state of the intestinal contents, which is one of the factors in the production of the attack of appendicitis; the diarrhœa therefore immediately precedes the inflammatory change in the appendix, and is usually significant of a severe attack.

Physical Signs, General.—In some cases the patient lies with right leg flexed at the hip to relax the abdominal muscles on this side. The face often betrays some anxiety, or it may be merely flushed with fever. *The tongue* is always more or less coated, but remains moist unless the disease passes beyond the limits at present under consideration. The *pulse* is little altered in tension or volume, but is quickened in proportion to the degree of fever. The *respiration* is apt to be a little quickened and shallow.

Local Signs.—*Distension* of the lower abdomen is present in most cases, though in the absence of spreading appendicular peritonitis it is not very marked. Occasionally it is not more than a local fulness of the cæcum, visible only when the abdomen is viewed from the level of the

abdominal wall. An apparent *tumour* may be observed, made up of dilated cæcum beneath hardened and contracted rectus muscle. A real tumour, which is both visible and palpable, is never present if the disease is limited to the walls of the appendix. *Visible peristalsis* is sometimes seen in acute appendicitis and is occasionally of the small intestine type.

Rigidity is always present in some part of the right iliac fossa in the acute stage of the disease; it is commonly limited to the lower half of the right rectus, and at times a comparison with the left rectus is needed to convince the observer of the existence of the muscular contraction and rigidity. On the other hand there may be diffuse rigidity involving a large part of the abdominal wall, or it may be present only in the right flank. The rigidity frequently obscures the presence of an abdominal mass, which may be palpable only under an anæsthetic.

Tenderness is another sign which may always be relied upon; the area of tenderness varies from a point the size of a finger tip, to the whole lower segment of the abdomen. The tenderness does undoubtedly correspond in a very large proportion of the cases to the well-known point of McBurney at the junction of the outer and middle thirds of a line drawn from the anterior superior iliac spine to the umbilicus. This point does not correspond precisely to the anatomical situation of the cæcal orifice of the appendix, but as a clinical point it is of the greatest value. Tenderness may, like rigidity, be mainly present in the right flank, in which case the appendix probably passes up on the outer side of the ascending colon. Similarly in pelvic appendicitis the tender area may best be reached by digital examination through the right wall of the rectum, or, in females, through the right lateral vaginal fornix.

Cutaneous hyperæsthesia is often present in first attacks of appendicitis in the right iliac fossa, and if well marked, is said to be characteristic of a distended, non-perforated, appendix. We have not been able to satisfy ourselves of

the possibility of forecasting the state of the appendix according to the degree of cutaneous hyperæsthesia. The distribution of this hyperæsthesia is in the eleventh dorsal segment.

Tumour.—Provided that the rigidity of the abdominal wall is not too pronounced, a tumour may be felt in acute appendicitis. The tumour encountered when the disease has proceeded no further than the serous coat, feels undoubtedly like the appendix itself, but, as it is often palpated through the *caput caeci*, it feels larger and more oval, lying usually parallel to, and just above, the outer portion of Poupart's ligament. In such cases as these, a palpable tumour is by no means common, for the abdominal rigidity usually permits of the discovery only of a resistant area, with no definite outlines, in the right iliac fossa. Examples of an easily palpable tumour in this region are usually due to inflammation which has spread beyond the limits of the appendix, involving particularly the wall of the cæcum and neighbouring omentum, and an abscess may be present.

Dulness on percussion is not commonly met with unless the disease has spread beyond the appendix itself, though occasionally there is enough fluid exudate to cause a little impairment of resonance over the resistant area described above. In a few cases the amount of fluid is sufficient to yield a dull note in the right loin; the left flank is resonant.

Auscultation usually reveals some audible peristalsis, proving that the noiseless stage of peritonitis has not been reached.

Rectal examination is often negative, but there may be right-sided tenderness high up in the rectum even when the appendix does not occupy a low position in the pelvis; in the latter case definite tenderness is usually complained of on pressure through the right rectal wall.

Vaginal examination.—Pressure through the top of the right fornix may elicit tenderness. The fornix is rarely depressed in acute appendicitis.

Blood examination.—A leucocytosis above 12,000 is commonly present, and the differential count shows a marked preponderance of polymorpho-nuclear neutrophiles. A rising leucocyte count indicates a spread of the inflammation from the appendix to the peritoneum, and the probable formation of pus.

Diagnosis.—Since this involves the differentiation between appendicitis proper and the various forms of appendicular peritonitis, and also consideration of the means whereby we may seek to distinguish between appendicitis and a multitude of acute abdominal diseases, together with some lesions of the respiratory and nervous systems, it will serve our purpose best to consider the clinical pictures presented by appendicular peritonitis, before discussing this most difficult problem in abdominal diagnosis.

Appendicular Peritonitis

Varieties.—The forms of peritonitis due to acute appendicitis can be classified, rather by their clinical than by their pathological differences, into three principal types, viz.: (*a*) Appendicitis with localised abscess; (*b*) Appendicitis with local peritonitis, imperfectly shut off from the rest of the peritoneal cavity; (*c*) Appendicitis with diffuse or general peritonitis. The first two are both examples of local peritonitis, and the second may be a stage of the disease antecedent to either the first or third form of peritonitis, but these three forms do represent the stages at which complicated cases of appendicitis are met with at the bedside, and for purposes of treatment and prognosis this classification will usually suffice. Unfortunately those who have opportunities of watching the course of appendicitis cases have seen both forms of local peritonitis lead to a generalised infection, and it is probable that some cases in which the primary infection involves the peritoneum without localisation, may ultimately be correctly regarded, from the clinical standpoint, as appendicitis with local

abscess. The whole question is one of the balance of power between infection and resistance.

If the peritoneum is able to set up defensive adhesions which wall off the appendicular region, a local abscess will probably result, but if there is a sudden rupture of the appendix, with an outpouring of infective organisms, general peritonitis must be expected, though the infection will naturally be of longer standing in the right iliac fossa than over the rest of the peritoneal cavity. The character of the exudate affords some guide to the length of the infection and its virulence, for in long-standing cases we find thick creamy pus, but in the worst and most rapid forms of peritonitis the exudate is commonly only turbid. There may be two types of fluid exudate in different regions of the abdomen, pus in the neighbourhood of the appendix, and serous or turbid fluid further away from the primary source of infection. A serous exudate may be met with in the left iliac fossa, while the right contains an encapsuled abscess; in such cases the course of events may have been a mild general peritoneal infection with a more severe local one, and the abscess is the site of the most active invasion and the most strenuous resistance. On the other hand, there are cases which appear to be absolutely localised from the first, up to the formation of a definite abscess, and then leakage occurs leading to general peritonitis; such leakages may at times be actually discovered by operation, and although the peritoneum has had time in such cases to acquire some degree of immunity, the prognosis is always particularly grave, showing that when once the local resistance is overpowered the general peritoneum is often helpless. We have already referred to the researches of Dudgeon and Sargent, which suggest that the *staphylococcus albus* may play an important part in the limitation of peritonitis by the increase of phagocytes and the formation of protective fibrinous adhesions; but they found that this organism was not of value in protecting against the *streptococcus pyogenes;* moreover, in streptococcal infection, where the

outlook is always grave, adhesions are rare. From these facts we learn that the state of the peritoneum is dependent largely on the nature of the organism which passes from appendix to peritoneal cavity, and this the clinician is unable to foretell. We must acknowledge that difficulties will continue to arise, but the large majority of the cases belong to one of these three types of peritonitis.

The term " peri-typhlitis " has recently been abandoned, but it has much to recommend it, as it actually supplies a name to a condition of inflammation which has passed the limits of the appendix whilst it is still limited to the region of the cæcum. It may be conceded, then, that " appendicular peri-typhlitis " would be the best term for our second variety of peritonitis, and the three varieties might appropriately be called " appendicular abscess," " appendicular peri-typhlitis," and " appendicular peritonitis."

Appendicular Abscess

It has been laid down as a general law in surgery that acute inflammation which lasts for four or five days without evidence of subsidence invariably terminates in suppuration, but in severe appendicitis cases pus may often be searched for on the fourth or fifth day and not be discovered. The explanation lies probably in the fact that the peritoneum itself is capable of absorbing pus, sometimes leaving no trace of its presence, and at others leaving adhesions only. It is therefore difficult to be sure when an acute attack of appendicitis, which has not subsided after the first few days, has culminated in the formation of a localised abscess. Furthermore, in the case of intra-peritoneal inflammation, there may be evidence of defervescence and yet the formation of pus may be in progress.

Symptoms.—The only evidence of pus formation these afford is that the initial symptoms of pain, vomiting, and fever are apt to be more severe in abscess cases, and that in the progress of the case the fever tends to persist, while

constipation is nearly always a noticeable feature. The persistence of pain, and of fever, are certainly good evidence of the presence of pus, and, if the temperature falls after the initial rise at the onset of the illness, and then rises again steadily and progressively for several days, an abscess is almost certain to be present. In the absence of this sequence of events, the temperature chart must not be taken as a very reliable guide. Vomiting may occasionally be absent, but even so there is usually some nausea.

Physical Signs, General.—In the period of the disease prior to the formation of a local abscess the general signs do not materially differ from those seen in acute appendicitis capable of resolution, but the fact of their persistence suggests that the case is going on to abscess formation. The tongue remains moist, but does not clean readily, the pulse often remains rather rapid, and the facial aspect may be persistently anxious. When once the abscess is securely shut off, these signs usually lessen, and the comfort of the patient increases until the abscess assumes large proportions.

Local Signs.—The local evidence of appendicular abscess depends largely on the anatomical situation and direction of the appendix, for the organ usually forms part of the wall of the abscess cavity, and therefore a pelvic appendix usually gives rise to a pelvic abscess, and a retro-cæcal appendix to a retro-cæcal abscess, but the situation of the abscess is not an infallible guide to the position occupied by the appendix, for the infection may travel away from the appendix, disease of which is recognised as one of the commonest causes of sub-phrenic abscess; of these special abscesses we have written in the chapter on peritonitis.

Flexion of the right leg may be a persistent phenomenon, especially in young children. *Respiratory movement* is usually absent in the right iliac fossa, some degree of *distension* of the lower abdomen may be seen, and a *visible tumour* is often observed. If visible peristalsis is present, it suggests that protective adhesions on the inner side of the abscess are causing some obstruction to the small

bowel. *Rigidity* is present in the early stages, and may be persistent, but it is usually limited to the right half of the abdomen at first, and diminishes until it is limited to the neighbourhood of the tumour produced by the abscess. *Tenderness* is present at an early stage, and persists throughout, although it lessens in degree as the inflammation becomes more localised. *Cutaneous hyperæsthesia* we have not found to be constantly present over abscesses. *A tumour* is always present, and can usually be felt in the right iliac fossa above the outer half of Poupart's ligament. At times, however, the tenderness and palpable tumour lie on the outer side of the ascending colon, and the inflammatory mass may be present in the loin as a perinephric abscess, or it may be felt deep in the abdomen behind the cæcum. The *tumour* may be in the pelvis, and not palpable by examination of the abdomen alone; in such cases the disease has received the separate name of "pelvic appendicitis," as the abdominal signs are almost negative, even as regards tenderness and rigidity, and until a rectal examination reveals the existence of a tense, rather soft swelling in the pelvis, the disease remains obscure; in the female such cases may be indistinguishable from salpingitis with abscess.

Dulness on percussion over the tumour is by no means always present, since gut commonly lies over the collection of pus, between it and the abdominal wall. The whole surface of the swelling, however, must be carefully percussed, for if a dull note is detected, it may be taken as an indication that there the pus is close beneath the anterior abdominal wall, though enlarged and inflamed omentum may of course yield a dull note. *Fluctuation* is rarely to be felt with certainty; the proximity of bowel renders it an unreliable sign, and it should certainly never be waited for.

Rectal and *vaginal examination* are of the greatest importance, and may reveal the existence of an unsuspected abscess or the extent of an abdominal abscess; a fluctuating mass can often be detected in the recto-vesical pouch, and bimanual examination, either by rectum or vagina, may

often yield valuable information; it must, however, be performed gently, as there is a risk of causing rupture of the abscess.

Blood examination.—The leucocytes commonly number 20,000 or more in the presence of an appendicular abscess, and if daily blood-counts be made for several days in a doubtful case, a steady increase of leucocytosis with a high percentage of polymorpho-nuclear neutrophiles strongly favours the diagnosis of abscess.

Appendicular Peri-typhlitis

This name appears to us singularly appropriate if it be applied only to those cases of appendicitis where the peritoneal infection has not spread beyond the region of the cæcum, though it may not be limited to this zone by complete protective adhesions. Either the patient's resistance has kept the infection from spreading further, or else the case comes under observation before the organisms have had time to reach the more distant parts of the general peritoneal cavity.

Etiology and Pathology.—This does not materially differ from the forms of the disease which we have already considered. The appendix is often perforated, but not necessarily so; concretions may be found in the appendix, or lying outside it, in perforative attacks. The extension of the inflammatory infection is usually in one of these directions, either there is an acute ex dative inflammation of the right iliac fossa involving the appendix, the cæcum, and the lower end of the ileum, or the right half of the pelvis may be involved, or again, the infection may have travelled to the right kidney pouch. The position of the appendix, and that assumed by the patient after the spread of inflammation from appendix to peritoneum, probably account for the direction taken by the infecting organisms.

Symptoms.—Cases belonging to the variety of appendicitis now under consideration exhibit one of two modes

of onset; either the onset of the illness is severe, and acute from the very first, or else a recurrence of symptoms of a more alarming character is noted after a period of quiescence succeeding the initial attack. In the first type pain, vomiting, and some degree of collapse, are the common initial symptoms, and it is in such cases as these that diarrhœa is often present; a marked rise of temperature, and a corresponding increase in pulse rate, are a little late in making their appearance. In the second type, the case may at first appear to be one of catarrhal appendicitis, or of acute appendicitis in which resolution is likely to occur, but after a few days of decline of fever and of subsidence of vomiting and pain, there is a recurrence of vomiting, possibly a rigor, with return of pain, more severe than before; the facial aspect rapidly becomes anxious, and the tongue, which was becoming clean, is noticeably dry and becomes coated again. Here again the change from convalescence to acute infection may be signalised by diarrhœa, and no doubt some of these spreading infections are actually induced by the injudicious administration of purgatives in cases where the degree of infection is doubtful. This initial diarrhœa, associated with an acute attack of appendicitis with peri-typhlitis, we have found to be present in about twenty per cent. of cases, and among this number the mortality was high. It probably indicates a highly toxic state of the intestinal contents.

Physical Signs, General.—The temperature is usually above normal and often over 100° F., but it is not a reliable sign of peritoneal infection, and in some of the worst cases it is sub-normal. The respirations are quickened and shallow. The patient usually prefers to lie on his back, and the knees may be drawn up to relax the abdominal muscles. Hiccough may be present. The face is drawn and anxious, and dark hollows are usually to be seen beneath the eyes, which have themselves often lost their normal lustre. The tongue has some moist fur upon its dorsum, but it is commonly dry and rather hard at the tip or margins; the breath is offensive.

Local Signs.—*Abdominal respiratory movement* is present only in the upper half; the lower abdomen is commonly distended, and this may be more marked on the right than the left side. *Visible peristalsis* may occasionally be met with. *Rigidity* is always present in the right iliac fossa, and it affects mainly the lower half of the right rectus, but may be present over the whole of the lower abdomen and in the right lumbar region; comparison of the two lumbar regions is often a useful guide in determining the extent of infection; in cases of this present type there is usually only slight rigidity of the upper abdomen, and it is very rarely present in the left loin. *Tenderness* corresponds more or less closely to the area of rigidity, and while it is often most noticeable near McBurney's point, this is not by any means a constant situation for the most tender spot. *Cutaneous hyperæsthesia* may be present in the right iliac fossa, but it is not a sign of great value.

A *tumour* is often not felt owing to the diffusion of muscular rigidity; in these cases one feels a deep resistance, whereas in other cases there may be a fairly well-defined mass to be felt on abdominal palpation. *Dulness* on percussion may be present over some of the resistant area, but as a rule the dull note is limited in extent, and is more often due to inflamed and thickened omentum in the area of infection than to free inflammatory exudate. The percussion note in the flanks should always be examined, and it will often be dull in the right loin, since a collection of fluid in the right renal pouch is frequently present in appendicular peri-typhlitis. In infective cases, the patient should not be rolled over to ascertain whether the dulness shifts with alteration in the patient's position, owing to the risk of favouring extension of the infection to a healthy region of the peritoneum. Dulness in the left flank is rather unusual in these cases.

Auscultation commonly reveals that peristalsis is going on in the left half of the abdomen, but the intestinal movements on the right side may be inaudible.

Rectal and vaginal examination often reveal the presence of an inflammatory swelling on the right side of the pelvis.

A Leucocytosis is usually present.

Appendicular Peritonitis

This term, which suggests no limitation to the infection, we use to include the forms of peritonitis, due to disease of the appendix, to which the adjectives "diffuse" or "general" are usually applied. The infection may be due to the sudden perforation of an inflamed appendix, or to the spread of infection from what was previously a local peritonitis, either a leaking or ruptured abscess, or to extension from a local peri-typhlitis. In any case, when once the general peritoneal cavity is invaded, the outlook is most grave, and the symptoms and physical signs are characteristic of the severest illness. It may here be stated, however, that the physical signs of peritonitis in the old and in the very young, are equivocal, and the typical signs of peritonitis are best seen in patients, who, before the attack, were healthy and strong.

Symptoms.—*Abdominal pain* is constantly present until paralysis of the intestine supervenes, as it usually does in fatal cases, some forty-eight hours before death. Absence of pain is of grave prognostic importance. The pain is usually diffused all over the abdomen, but is often felt most acutely in the right iliac fossa, and the patient often states that it began in this region. It is more or less constant, and often of a burning character. It is not associated with powerful peristaltic efforts, as in obstruction cases.

Vomiting is early and continuous, at first of gastric contents, later bile stained, succeeded in the worst cases by fæculent vomiting. The characteristic vomiting of general peritonitis is easy ejection of rather copious offensive dark brown fluid; the act of vomiting is not usually painful. Diffuse peritonitis without vomiting may be met with, but it is rare.

Fever.—At some stage of diffuse peritoneal infection, the temperature is usually raised, but as a sign of infection it is absolutely unreliable, and the thermometer may record almost any temperature.

Constipation is nearly always present, and in the later stages is due to a mechanical and infective paralysis of the bowel musculature. *Hiccough* may be present. *Tenderness* all over the abdomen is common.

Physical Signs, General.—The patient lies on his back, often with the knees drawn up to relax the abdominal wall and to keep the bedclothes off the abdomen. *The facial expression* is anxious and drawn, the skin is dusky, and there are often dark hollows beneath the eyes, which themselves are dull. *The tongue* is dry and brown, often cracked, and protruded with difficulty; the breath is offensive and the mouth is dry. The *respirations* are rapid and shallow. The *pulse* is rapid, usually 120 or more per minute, and its tension and volume are diminished.

Local Signs.—General *distension* of the abdomen is almost invariably present when peritonitis attacks previously healthy patients, but it is important to realise that both in the aged and in young children, general peritonitis may be present with a flat or even retracted abdominal wall. The distension is usually more pronounced below the umbilicus than above it. *Abdominal respiratory movement* is often entirely absent, but it may be seen above the umbilicus. *Visible peristalsis* is rarely present, and its existence in general peritoneal infections means that organisation of exudate has taken place, causing adhesive obstruction to the small intestine.

Rigidity is felt all over the abdomen and in both flanks, the rectus muscles being held firm so that accurate palpation is difficult; as a rule, the rigidity is most intense in the right iliac fossa, and this suggests the primary cause of the peritonitis. There is often well-marked deep resistance in the right iliac fossa, but the muscular rigidity commonly prevents satisfactory palpation of the inflammatory mass, which may

be revealed only after the patient is anæsthetised. *Tenderness* is usually diffuse, but more noticeable in the right iliac fossa than elsewhere. *Cutaneous hyperæsthesia* has not as a rule any definite distribution when general peritonitis is present. A *tumour*, localised and defined, is not commonly present in these cases, though in peritonitis due to the leakage of an appendicular abscess the mass of the abscess may still be readily palpable.

Dulness on percussion is usually present in the right iliac fossa and in both flanks, the dulness being due to the presence of free fluid in the dependant parts of the abdomen.

Auscultation usually reveals abnormal peristaltic quiescence. *Rectal* and *vaginal examination* may show the presence of inflammatory swellings on the right side of the pelvis. Douglas's pouch is often felt to be full of fluid.

Diagnosis

1. Diagnosis of the Character of an Attack of Appendicitis.—We have already dwelt at some length on the nature of appendicular colic and simple catarrhal appendicitis, and we shall now consider the conditions which will aid in the differentiation between the four clinical varieties of the disease in its acute stage which we have described. This is a problem of the greatest importance, though often of the greatest difficulty, since the correct treatment of appendicitis depends upon a true appreciation of the precise pathological state of the patient and his peritoneal cavity.

Acute disease limited to the appendix is usually recognised by the short history of the illness, and the accurately localised physical signs. As regards the length of history, it is true that if the appendix perforates very early in the attack, the form with local peritonitis, or even general peritonitis, is likely to be met with, but if the history is less than four days in duration, and the abdominal rigidity and tenderness are strictly localised to a small area, the infection has probably not extended far beyond the serous coat of

the appendix itself. On the other hand, diffuse tenderness may be present even in these cases, but true rigidity on firm but gentle palpation is usually quite localised to the right iliac fossa.

The presence of an abscess due to appendicitis is diagnosable by the length of history, and by the presence of a tumour which is known to be increasing in size, associated usually with persistent fever. If the question has to be decided when the patient is first seen, the length of history is a most valuable guide, especially if it is clear that the local symptoms of pain and tenderness are not subsiding. Even in the case of a large accumulation of pus, vomiting does not often persist, but fever is very constant. There is no need to wait until there is visible œdema or redness of the skin, for this is an indication of infection of the abdominal wall, and is to be avoided. Fluctuation through the abdominal wall is not usually reliable, but a visible tumour, which in part yields a dull note on percussion, is valuable evidence of the presence of an abscess, and also of its having reached the parietal peritoneum. A fluctuating swelling may be felt in the pelvis by rectal or vaginal examination. In some cases appendicular abscesses contain gas, and percussion dulness may be obscured. In those instances of abscess, due to appendicitis, but not situated in the right iliac fossa, the history usually makes it clear that the onset of the illness was associated with right iliac pain. Occasionally the abscess is situated beneath the left rectus muscle, and in these cases examination of the rectum or vagina reveals inflammatory thickening passing from the right to the left side, pointing to disease of an appendix lying across the pelvic brim. There is another type of appendicitis which should be considered in this connection, although from the clinical aspect it might almost be regarded as "sub-acute appendicitis," and that is a variety in which a tumour, even a large tumour, is found in the right iliac fossa, and slowly undergoes resolution. Such urgent symptoms as are met with at the onset of attacks of this form of the

disease subside rapidly, and it is only the presence of a tumour which gives the physician in charge any cause for anxiety. The tumour is undoubtedly due to infiltration of the wall of the cæcum and neighbouring bowel and of the omentum, the whole process being non-suppurative. Such cases are seen at the end of five or six days' illness, and they can be differentiated from cases of appendicular abscess only after expectant treatment for a few days; they may be regarded as instances of "peri-appendicular tumour." The size of the tumour usually begins to diminish at the end of a week's illness, and, as a rough clinical guide, we may consider that if this subsidence does not begin to occur at the end of eight to ten days the case will go on to suppuration.

In both local and general peritonitis of appendicular origin, the symptoms are usually severe at the onset, and the condition of the patient is at a glance seen to be grave. The pulse is rapid, the facial expression anxious, and the respirations are rapid and thoracic. Considerable rigidity of the abdominal muscles is present, and one of the best differential signs between local and general peritonitis is that in the former rigidity is present in the right loin but not in the left, whereas in general peritonitis there is universal rigidity. A more or less defined mass is more often felt in local peritonitis. The percussion note is commonly dull in both flanks in general peritonitis, but in peri-typhlitis the dulness is limited to the right flank. In cases with general peritoneal infection vomiting is often prolonged, and hiccough is not rare.

A few words must be said with regard to the signs of peritonitis in the old and the very young. At the two limits of life these signs are often equivocal; the abdomen of a young child or of an old patient may sometimes be full of pus, but yet remain somewhat retracted and only slightly rigid; in the old, the pulse rate is often not much increased, and probably this is accounted for by the fact that the heart has undergone fibrotic changes before the attack of

appendicitis. In young children we have also noted an absence of vomiting in as high a proportion as ten per cent. of acute appendicitis cases of all types.

Differential Diagnosis

The diagnosis of acute abdominal diseases, though difficult, is somewhat simplified by the recollection that nearly fifty per cent. of the urgent cases are found on exploration to be due to appendicular disease. This fact, however, should not cause either the physician or the surgeon to be less vigilant in his examination of the patient, or less anxious to diagnose the condition before operation. An obscure case must be approached with a full knowledge of the possible catastrophes that may occur within the walls of the abdomen, as well as of other lesions that are accompanied by acute abdominal pain. A brief review of some of these conditions is all that is possible in these pages. The first consideration is the sex of the patient, for in females disease of the right uterine appendages often resembles appendicitis.

Diseases of internal female genitalia. Acute Salpingitis. This disease may occur in precisely the same forms as appendicitis, and it is often impossible to distinguish certainly between the peritonitis of salpingitis, and that due to appendicitis; this is especially true where there is a right-sided abscess, for an appendicular abscess may occupy the right half of the pelvis, and a tubal abscess may occupy the lower part of the right iliac fossa. The existence of a purulent vaginal discharge, of pelvic pain, of a recent pregnancy, and of scalding pain on micturition are points in favour of salpingitis. As a rule, too, the patient with tubal peritonitis does not appear to be so ill as one with appendicular peritonitis, and, though lower abdominal rigidity is commonly present, the pain and constitutional disturbance are less severe than in appendicitis. Vaginal or rectal examination often makes the diagnosis clear, since

salpingitis is a bilateral disease and often there is clear evidence of inflammation on both sides of the uterus, though a large mass may be felt only on the right side.

Dysmenorrhœa and *ovarian neuralgia.*—Acute pain in the right iliac fossa, associated with some rigidity, considerable tenderness, and even fever and slight vomiting, may occur at the beginning of menstruation, and may persist throughout the period. The patients are usually neurotic young women, and the resemblance to appendicitis may be very striking, but a careful physical examination, and the observation of the coincidence of the attack with menstruation, will often decide the diagnosis. The tongue usually remains clean, and the function of the bowels is not much disturbed.

Tubal pregnancy.—If an ovum becomes deposited in the right Fallopian tube, it is liable to cause disturbance of the patient, and both pelvic and right iliac pain by reason of its unfavourable position for growth and development. Attacks of pain with slight vomiting, and even lower abdominal rigidity, may be observed, and these become acute if tubal abortion or tubal rupture occurs. The diagnosis from appendicitis is to be made by a careful inquiry into the menstrual history of the patient, with especial attention to the passage of decidual blood, and by vaginal examination, which often reveals a mass in Douglas's pouch with acute tenderness on pressure through the lateral vaginal fornix. In cases of tubal rupture, the case is usually clearly one of intra-peritoneal hæmorrhage rather than of intra-peritoneal bacterial infection.

Torsion of ovarian cyst or fibroid.—The pedicle of an ovarian cyst or of a sub-peritoneal fibroid is liable to become twisted, and may cause acute pain in the right iliac fossa, vomiting, constipation, and some abdominal rigidity. Here again reliance must be placed on the menstrual history, the age of the patient, and the results of vaginal and rectal examination. When the cyst or fibroid has become abdominal rather than pelvic, the case is often difficult, but

the onset of the attack is not so definitely associated with right iliac pain as one may rightly expect in appendicitis.

Abdominal Lesions Common to both Sexes.—Any of those conditions which lead to diffuse peritonitis may be confounded with appendicular peritonitis, and, having regard to the frequency of appendicitis, the diagnosis often becomes a question rather of pathological odds than of clinical certainty, since the history of the progress of symptoms is all that one has to rely upon in many cases, and the accuracy of the anamnesis varies directly with the intelligence of the patient, and his or her condition at the time of examination.

Gastro-intestinal affections.—Acute catarrhal gastritis may present similarities to an attack of appendicitis, but as a rule the relation to some error in diet is clear, and the pain is more localised to the upper abdomen ; tenderness in the epigastrium is the most prominent physical sign, and fever and leucocytosis are rarely present.

Acute enteritis due to food poisoning, or such mineral poisons as mercury and arsenic, are generally accompanied by profuse diarrhœa and extreme prostration, and are distinguished from appendicitis by the absence of localised tenderness and rigidity, and usually of distension. The pain is more obviously colicky in character.

Lead Colic, by reason of the constipation which is associated with it, does more closely simulate appendicitis, but the indications of local inflammation are wanting, and a careful inquiry into the occupation and physical state of the patient, as regards the blue line on the gums and other manifestations of plumbism, should make the diagnosis fairly certain.

Mucous Colic.—When this affects the first part of the large bowel, it may cause doubt as to the nature of the attack ; if constipation be present, the diagnosis may be very difficult, since right-sided rigidity, tenderness and pain may all be present ; as a rule, however, the onset of the attack is less sudden, and the initial symptoms

are less severe, than in the case of appendicular inflammation.

In *ulcerative colitis* one depends on the presence of blood in the stools for a correct diagnosis.

Typhoid Fever.—Typhoid ulceration commonly occurs in the lower part of the ileum, but it may also be found in the cæcum and ascending colon, and also in the appendix itself, so that typhoidal appendicitis is a pathological entity. Abdominal rigidity, tenderness and distension are all seen in typhoid fever, but the definite onset of the disease commonly follows a period of malaise and increasing fever; in typical cases there are seen, after the sixth day, the rose pink spots, and there is a leucopenia. Doubtful cases may be decided by the Widal reaction, though this is rarely positive until the illness has lasted at least a week.

Acute Intestinal Obstruction.—Cases due to adhesions, or bands, or to internal hernia, may have an onset like that of acute appendicitis. The urgency of the vomiting, the paroxysmal pain, and the early distension with visible peristalsis, without evidence of localised inflammation, will generally serve to distinguish these cases from appendicitis.

Perforated Gastric and Duodenal Ulcer.—If these cases are at all characteristic in their history, or physical signs, they do not offer great diagnostic difficulty. When a consecutive peritonitis has appeared, however, the physical signs become more obscure. The former are usually seen in young anæmic women, who have suffered for months or years from pain very shortly after the ingestion of food; many of them have had attacks of vomiting, and hæmatemesis is common; hyperæsthesia and deep tenderness are both most intense in the upper abdomen.

Duodenal Ulcer is commoner in men between thirty and forty who have suffered from hunger pain, relieved by the ingestion of food, nausea and vomiting, associated in some cases with melæna. The onset of perforation is accompanied by more severe prostration than is usual in acute appendicitis; abdominal rigidity is very marked from the first,

and the most acute tenderness is usually limited to the upper segment of the abdomen; vomiting is rarely repeated after the onset of perforation until peritonitis ensues. The amount of free fluid in the abdomen is far greater than is found in cases of appendicular peritonitis. If the abdomen is not distended, the diminution or absence of liver dulness is highly suggestive of perforation of the stomach or duodenum.

Tuberculous Peritonitis.—In several ways may this disease give rise to error in diagnosis; a tuberculous inflammatory mass in the right iliac fossa may lead to the diagnosis of appendicular abscess; tuberculous ulceration and tuberculous adhesions may lead to obstruction with right iliac pain, and general suppurative infection may follow tuberculous peritonitis. A careful inquiry into the history of the case will often show the presence of alternating diarrhœa and constipation, with febrile attacks of pain, and progressive loss of weight, whilst abdominal examination usually reveals more than the one inflammatory mass in the right iliac fossa.

Pneumococcal Peritonitis.—In the case of children this differential diagnosis may be very difficult, and it is generally recognised that there is a type of pneumococcal peritonitis which has a sudden onset closely resembling that of appendicitis. A history of any recent illness due to the pneumococcus is most important, and such infections include not only inflammation of the lung and pleura, but also abscesses and otitis media. The relationship of pneumococcal peritonitis to disease of the Fallopian tubes must not be forgotten, and an examination of any vaginal discharge may throw light on the diagnosis. It is generally recognised that this form of peritonitis is twice as common in girls as in boys.

Acute Pancreatitis.—The sudden onset of the disease, the distribution of the pain, its extraordinary severity, and the rapid prostration of the patient, together with other pancreatic symptoms, of which we shall speak later, should enable this disease to be distinguished from appendicitis.

Diseases of the Gall-Bladder and Bile Passages.—*Biliary colic* may closely resemble appendicitis in the pain and rigidity which it causes. As a rule, however, the abdominal pain of biliary colic is placed higher up than appendicular pain, and is felt also in the right shoulder at the back. The local tenderness is just below the right costal margin.

Cholecystitis.—The pain of this condition is sometimes referred to the lower quadrant of the abdomen, especially in those cases where the gall-bladder is very large, or is low by reason of visceroptosis. Even when there is inflammation around the gall-bladder, the swelling often has a pyriform shape, and is mainly above the umbilical plane.

Lesions of the Kidney.—*Renal colic*, or ureteral colic, with pain referred to the external genitalia and the inner side of the thigh, together with hæmaturia and disturbances of micturition, should not give rise to doubt; but in those cases where a stone is fixed low down in the ureter, the symptoms, and localisation of tenderness, may suggest appendicitis, but hardly the acute form of the disease. Skiagraphy will usually make the diagnosis clear.

Pyelitis, due to stone, or to a primary bacterial infection of the urinary tract, may give rise to acute attacks of pain, with slight vomiting, fever, and abdominal rigidity. Extreme tenderness over one or both kidneys, especially on bimanual examination, and a careful examination of the urine should serve to eliminate appendicitis.

Movable kidney, in the acute attacks known as Dietl's crises, may cause a little doubt, but the resemblance to acute appendicitis is very slight. In most acute renal affections there is an absence of fever, unless pyelitis be present. An examination of the urine should never be omitted in cases of abdominal pain.

Extra-abdominal Diseases which may resemble Appendicitis. *Pneumonia.*—The sudden onset of this disease may be attended with severe abdominal pain, and, when the right

lower lobe is affected, the distribution of the pain to the right iliac fossa is not uncommon. There may also be tenderness and some abdominal rigidity in these cases. A routine examination of the chest in all these acute abdominal attacks will usually exclude this source of error, even though the signs of pneumonia discoverable do not amount to more than suppressed breath sounds or a slight pleural friction.*

Malaria.—Abdominal symptoms are not very rare in malarial attacks. If, then, a malarial subject has a rigor, with fever and acute abdominal pain, and with localised tenderness and rigidity over the right half of the abdomen, the resemblance to appendicitis may be very marked. The history of the case, and the discovery of splenic enlargement, should arouse suspicion, and the diagnosis may be confirmed by an examination of the blood.

Tabes.—Gastric crises may lead to erroneous diagnosis if the chief seat of the pain be in the right iliac fossa and a brief examination of the nervous system be omitted. An investigation of the pupils and knee-jerks will usually prevent this mistake.

Hysteria.—In neurotic men as well as women the symptoms and signs of appendicitis may easily be counterfeited, but such conditions are hardly likely to be mistaken for the graver forms of appendicitis, especially if the general aspect of the patient is considered. In such patients the patellar reflexes are usually markedly increased, while the palate reflex is commonly absent.

Tuberculous and suppurative Arthritis of Hip, and Caries of Spine.—Occasionally the flexion of the leg at the right hip-joint, with local tenderness and swelling, may appear to be due to a lesion above Poupart's ligament, but careful inquiry into the history will prove absence of true abdominal symptoms. Caries of spine may cause right iliac pain, and a psoas abscess may resemble one due to appendicitis. In both these diseases the patients are usually young children, and the history is not always quite clear, but any repeated

* See also pages 555–557.

vomiting is rare, and the temperature is usually not much above normal. Rigidity on firm abdominal pressure is usually absent, while superficial tenderness may be present.

Treatment.—The method of classification of the forms of appendicitis which we have discussed in detail is particularly suited to a consideration of the appropriate treatment of the disease. It has now become generally recognised that appendicitis in most of its varieties is a surgical disease, and at most hospitals cases of appendicitis are admitted to the surgical wards as soon as the diagnosis is made, so that the surgeon may operate at the time which he deems best for each individual case. A correct appreciation of the exact pathological condition is more likely to be acquired by one who is accustomed to seeing and feeling the interior of the peritoneal cavity than by a physician who only palpates the abdomen. The latter may give an excellent opinion as to the desirability of operative or expectant treatment, but the operator himself should be the best judge as to whether a given mass in the right iliac fossa is a collection of pus, or merely thickened omentum and infiltrated bowel, and a correct estimate in this direction often determines the scope of the operation. It is indeed the nature of the operation performed in these acute abdominal lesions which often seals the fate of the patient, and the best results can only be obtained by those who have full knowledge of the safety of any given procedure. If appendicitis could be placed on the same basis as regards treatment as a strangulated hernia, the mortality of the disease would be enormously decreased, but this is hardly to be expected, since the diagnosis cannot be such a simple matter. There will always be obscure cases of appendicitis, and the lay mind requires much education before it can appreciate the absolute need for operative interference for a lesion that is not visible to the eye. If every case of appendicitis were operated upon as soon as the diagnosis had been made, the present mortality of the disease would still be decreased, but in a number of cases, no doubt, the

appendix would be removed for catarrh of its mucous membrane, and it might be said that the operation was not a necessary one. But in view of the slight risks of an operation for this condition, and the fact that one attack of catarrhal appendicitis predisposes to future disease, who shall deny that the patient may not only have been saved from a fatal attack, but also have escaped the annoyance of recurrent disease? These arguments carry more weight in view of our present knowledge that the mortality after operation for acute appendicitis, where the peritoneum exhibits nothing more than reactionary serous effusion, is not appreciably higher than that after operation in the quiescent stage; in both cases this mortality is under one per cent. in the practice of most surgeons.

In all cases of appendicitis, in whatever stage the disease is first met with, we believe that the best results are obtained by attention to the following procedure.

1. As soon as the diagnosis is made, whether immediate operation is decided upon or not, the patient should be placed in bed in the Fowler position, with the pelvis as low as possible. This position should be rigidly maintained from the time of diagnosis until convalescence is well established, whether operation has been performed or not. The patient, even if a young child, as a rule prefers this position to any other, and since its more common use, such complications as sub-phrenic abscess, perisplenic abscess, pneumonia, and many other conditions, have been much less frequent. It favours gravitation of any infective material to the bottom of the pelvis, where it is least likely to do harm, it favours abdominal drainage, and it enables the patient to perform the acts of micturition and defæcation with the least possible disturbance. The position of the patient's back should be as vertical as possible, and pillows must be piled up behind him until comfort is attained; sometimes six are required. In order to prevent the patient "slipping down" the bed, a hard bolster must be secured beneath the flexor aspect of the patient's thighs, and when

this is carefully adjusted there is no tendency to sliding down the bed even if the patient is very stout. There is no need for the patient's position to be materially altered by the nurse, for the washing process can easily be carried out, and both micturition and defæcation can easily be arranged for by a temporary alteration in the position of the lowest pillows. It is sometimes difficult to make an accurate abdominal examination in this position, but even here the advantage to the patient should outweigh the convenience of the medical attendant, although occasionally it may be necessary to let the patient down for a minute or two to make an accurate examination.

2. *Treatment of pain.*—The most reliable drug for the relief of abdominal pain is morphia, but unfortunately it is a leucocytic poison, and it is upon the activity of the leucocytes that the patient's life probably depends. In addition to being a foe to the patient, morphia increases the difficulties of the clinician, for by its soothing effect it obscures all the reflex signs from which the pathological state of the peritoneum can be inferred; the patient states that he is comfortable, he looks less anxious, the abdomen may be soft and moving with respiration, and yet the peritoneal infection may be steadily advancing. Morphia also inhibits intestinal peristalsis. If a patient be seen after morphia has been used to any extent, the true state of affairs may be suspected if the pupils are contracted, the tongue abnormally dry, and the abdomen markedly distended, while the patient states that he feels better than he did before the injection, or the administration of the opium by the mouth. As we have said in a preceding chapter, *morphia has no place in the treatment of peritonitis.* Abdominal pain can usually be relieved by the application of heat, and hot fomentations frequently changed will often suffice, or dry heat may be used in the form of wool heated before the fire and firmly bandaged on, or by the use of a hot water bottle, or, better still, an "electric poultice." Aspirin in twenty grs. doses in two ounces of saline given

by the rectum, is often useful for the relief of pain, but the chief reliance must be placed on hot applications, though care must be taken not to blister the skin.

3. *Diet.*—We have already stated what we consider to be the essentials of a diet for these acute abdominal cases, and, as a rule, alternations of barley water, raisin tea, and albumen water form the best diet for the early stages, either before operation or after. Alcohol is not often needed, but if there is any indication for it we would recommend either diluted brandy or a dry iced champagne. The latter is sometimes useful in checking vomiting either after operation or before it.

4. *The question of aperients.*—In cases of mild or catarrhal appendicitis it often happens that the condition improves greatly after the bowels have acted; the judicious use of aperients therefore plays an important part in the treatment of appendicitis. If early operation is decided upon, all purgatives should be withheld till the operation has been performed, but if a policy of delay is adopted, the greatest judgment is required as to the desirability of aperients. In catarrhal appendicitis regular purgation with small doses of castor oil (two to four drachms) is usually a sound line of treatment. Some clinicians prefer enemata, but there is no doubt that the effect of an enema varies greatly according to its volume and the energy of the nurse who administers it, and in many cases it causes repeated and painful peristalsis even of the small intestine; this may disturb protective adhesions, and all that is desired is the least degree of peristalsis that will propel the contents of the intestine and empty the lower bowel.

The greatest difficulty arises in connection with those cases where a localised inflammatory mass is present, especially when there is doubt as to whether pus is present or not, or again where the diagnosis of abscess has been made, but operation has been postponed; in these cases we believe it is wisest to give neither aperients nor enemata, as both are liable to cause such peristalsis as will weaken

adhesions and favour the leakage of pus to uninfected areas of peritoneum. We have unfortunately seen several disasters in such cases. So long as it is felt that pus may be present, the bowels should not be stimulated, even if it means that no action occurs for several days, but as soon as the inflammatory mass shows a tendency to subside, and the fears of an abscess are allayed, aperients in small doses are advantageous and will hasten convalescence. In peri-typhlitis and diffuse peritonitis the value of purgatives is undeniable, but the need for immediate operation is greater, and we shall therefore consider their use after dealing with operations in appendicitis.

Operative Treatment

1. **Acute Appendicitis.**—Cases of this type are usually seen by the practitioner early, because the condition of the patient at the onset of the illness often gives rise to considerable anxiety. It frequently rests with him, therefore, to decide whether treatment by immediate operation shall be carried out, or whether the surgeon shall be summoned only after the acute symptoms have subsided. The arguments urged in favour of the latter course are, firstly, that immediate operation is not necessary, and secondly, that the operation in the quiescent stage or "interval operation" is safer than the operation in the acute stage. With regard to the first point, we submit that it is rarely possible to foretell within the first twenty-four hours what pathological course the disease will pursue, and in answer to the second, that practical surgical experience has shown that appendicectomy in the acute stage has not an appreciably higher mortality than the interval operation, if performed within twenty-four hours of the onset of the attack. It follows therefore that, if possible, the operation should be performed within twenty-four hours of the onset of symptoms, for then the risks of peri-typhlitis will be avoided, and the difficulty of the operation will be slight, owing to

the absence of inflammatory adhesions. Even supposing that a case which would have subsided without operation is selected for surgical interference, the patient escapes a double period of convalescence, and much time is saved and anxiety avoided. A consideration of further importance is that this line of action prevents the patient adopting a course of procrastination, for there are some, who, if seen in a first attack from which recovery ensues, will foolishly wait for a second before realising the need for operation.

Operation in the first two days of the illness.—It may usually be assumed that there will be few adhesions around the appendix, but it is well to be prepared for difficulties, and a rectus sheath incision affords the best access to the appendix. The length of the incision depends on the amount of fat in the abdominal wall, and the anterior layer of the rectus sheath is opened over the outer half of the muscle, which is itself displaced inwards. The posterior layer and peritoneum are best incised vertically, since easy access to the appendix is required. An endeavour should be made to preserve the nerves which enter the deep aspect of the muscle, and the deep epigastric artery and its *venæ comites* should be pushed out of the way if possible. On opening the peritoneal cavity, clear, or slightly turbid, fluid may escape, and this should at once be absorbed by gauze plugs. This fluid is usually reactionary rather than infective, but nevertheless the general peritoneum should be shut off from the seat of operation by the insertion of wide gauze plugs, one on either side, and one at the lower angle of the wound. The cæcum can usually be pulled up into the wound, and the appendix exposed. If the base is not infiltrated, amputation may be effected by means of a crushing clamp, but, if the walls of the appendix close to the cæcum are much infected, amputation by the " coat sleeve " method is to be preferred. In either case the stump should be buried by one or two sero-muscular purse-string sutures through the wall of the cæcum. If no gross perforation of the appendix has occurred, the peritoneum is dried with gauze plugs, and

the wound closed in layers without drainage, silk or catgut sutures being used according to the custom of the surgeon. When the peritoneal fluid is purulent and offensive, it is often wise to drain the wound according to the method which we shall describe in dealing with peri-typhlitis, but the bolder course of closure without drainage is often possible in cases of acute appendicitis where early operation is performed. As a guiding rule it may be laid down that where the surgeon is in doubt it is better to drain the wound than to close it, for one seldom regrets leaving a vent for peritoneal exudate, and many wounds are opened some two days after the primary operation—in some cases too late to save the patient. After the appendix has been amputated and the peritoneum dry sponged, there may be nothing to drain, but where a rough and unhealthy looking cavity is left, we prefer to drain the wound, although the tube may have to be retained for only a day or two. When a rectus sheath incision is employed for approaching the appendix, the risks of subsequent ventral hernia are not great, owing to the obliquity of the wound and the tendency of the displaced muscle to resume its normal position.

Operation after the first two days.—In these cases treatment by immediate appendicectomy is not so attractive, and the reason is that the infection has commonly spread beyond the limits of the appendix itself and produced a peri-typhlitis. However the time limit is by no means an arbitrary guide to the extent of the inflammation, and, if on clinical grounds the case appears to come under the category of acute appendicitis, the wisest course lies in immediate operation, as in the cases with shorter history; but clinically and operatively these cases should usually be classed as appendicular peri-typhlitis, for both adhesions and exudate are present.

Appendicular Abscess.—Before operating upon an appendicular abscess, the surgeon should endeavour to discover whether the pus lies at any point directly beneath the parietal peritoneum, or whether he is likely to enter the

peritoneum before reaching the abscess cavity. Careful light percussion over the inflammatory mass is the best means of ascertaining this, and if a dull area, even of very small extent, can be discovered, this should be chosen as the site of the incision. If no dull spot can be detected, it is not as a rule necessary to wait until the abscess reaches the surface, but the mode of operative procedure should be slightly altered.

A. *When the abscess has reached the parietal peritoneum.*—If the dull area lies outside the lateral vertical plane, a "spanning" or muscle-splitting incision should be adopted. The skin, fascia, and external oblique should be divided in a direction corresponding to that of the external oblique fibres; the internal oblique and transversalis should be split with a blunt instrument in a horizontal direction nearly at right-angles to the primary incision, and separated with deep retractors. The floor of the wound should now be inspected carefully, and if there is evidence of inflammatory infiltration of the transversalis fascia and parietal peritoneum, so that these cannot be picked up with forceps, it may be inferred that the pus lies directly beneath, and the abscess may be opened, preferably by a blunt instrument. If the floor of the wound appears to be free from infiltration, the edges of the wound should be well retracted, and a suitable spot sought for.

If the dull area lies near the outer border of the rectus muscle, a rectus sheath incision should be used, while for an abscess close to the middle line a paramedian incision is suitable. Incision directly through the rectus muscle is to be avoided if possible. Obliquity of the route through the layers of the abdominal wall does not interfere with satisfactory tube drainage, and is the best precautionary measure against subsequent hernia. Direct access through muscles, if the tube has to be retained for more than a week, usually leaves a scar in which the parietal peritoneum is adherent to the skin.

When once the abscess is opened, notice should be taken

of the character of the escaping pus, and this should be absorbed with gauze plugs; sweet odoured pus usually signifies a non-perforative appendicitis, but the pus of most appendix abscesses is extremely offensive. The cavity should then be very gently explored with the finger, and at any point where the wall appears weak a gauze plug should be inserted to prevent leakage into the general peritoneal cavity, such plugs being left in position for forty-eight hours. The pus should be gently mopped out with gauze, and a large drainage tube inserted, with a gauze plug wrapped round the portion within the abdominal wall to prevent infiltration of the muscular layers. The tube should just reach the bottom of the abscess and rest lightly on its floor. The wound may next be closed loosely around the tube by means of a few catgut stitches. The tube is best secured to the skin by a salmon gut suture. Appendicectomy in cases of localised abscess of this type is certainly better postponed until the abscess is healed, and the procedure which we recommend will be mentioned below.

B. *When the abscess can be reached only across the general peritoneal cavity.*—Here the site of incision must be in accordance with the most prominent part of the swelling. As soon as the peritoneum is opened, the normal intestine must be gently displaced and protected from infection by the insertion of wide gauze plugs around the wound. The finger is then pushed on in the space left between these plugs, and the inflamed area sought for: adhesions are gently broken down until the finger enters the abscess cavity: the pus is rapidly absorbed by gauze plugs, or sponges, and the cavity dried. If the appendix can be readily felt and brought up near the surface without much disturbance of the walls of the cavity, there is not much added risk in performing immediate appendicectomy, and the patient will be saved from a second operation, which is itself often difficult and dangerous. We do not hold that this course should be adopted in every case, but the peritoneum around the abscess cavity is probably protected to some extent

by an exudate containing many active leucocytes; moreover, the fact of localisation of the abscess indicates a considerable degree of local resistance, and the colon bacillus often loses much of its virulence in a localised abscess, so that the risks of spreading the infection by soiling the neighbouring peritoneum with pus from a localised abscess are small. The results of evacuation of the abscess and removal of the focus of infection in these cases at one operation, as a matter of experience, compares very favourably with the results of drainage and appendicectomy in two stages, and where the procedure appears easy we believe it is also safe, but each case must be judged according to the state of affairs found at the operation, and to adopt any routine procedure in these cases is unwise. In any case, whether immediate appendicectomy is carried out or not, the protecting plugs should be replaced by fresh ones at the end of the operation after all visible pus has been wiped away, and a large drainage tube should be secured in the wound. These plugs will usually have fulfilled their function of causing peritoneal adhesions in two or three days, and may then be removed; the tube must be kept in position, but gradually shortened as the healing of the abscess cavity tends to push it out of the wound. It is rarely required for more than ten days.

Retro-cæcal and peri-renal abscesses are best approached from the loin by a spanning incision and treated by incision and drainage only.

Pelvic abscesses can usually be reached from the abdomen, though the peritoneal cavity may have to be traversed before the abscess is entered; occasionally, however, the abscess is found to point into the lumen of the rectum in the male, or into the vagina in the female. In the latter case there is very little difficulty in drainage through the posterior vaginal fornix, and in the former some surgeons advocate drainage through the wall of the rectum. We have several times adopted this rectal route for pelvic abscesses which could not be reached from the abdomen,

and have found it fairly satisfactory, but it is not devoid of risk and it is difficult to maintain satisfactory drainage, since a tube will not stay in position for more than two days, and its presence tends to the formation of a track along which fæces may pass into the peri-rectal tissues.

Removal of appendix after drainage of appendicular abscess.—The need for appendicectomy after the cure of an abscess is still questioned by some surgeons, but we believe it to be the correct course in every case, since at the lowest computation something like 39 per cent. of patients, who have had abscesses drained, suffer from local recurrent abscesses or attacks of appendicitis, and any of these may prove fatal. It is true that the operation may be among the most difficult in abdominal surgery, but, if care and good judgment are exercised, the mortality is no higher than that of the ordinary interval operation after non-suppurative attacks. The interval which is allowed to elapse between the healing of the abscess and the second operation varies in the practice of different surgeons; we prefer to wait at least three weeks, during which time the patient is able to gain in general health and take a little exercise before undergoing another operation, but it is most important that the patient should be regarded as an invalid until the appendix has been removed, and all vigorous exercise should be forbidden; the diet should be light, and care be taken in the regulation of the bowels. The choice of incision will vary with the primary wound; if a spanning incision was adopted in the right iliac fossa, and the scar shows sign of weakness, it is best to excise the scar tissue, remove the appendix, and perform a cure for ventral hernia by suturing the muscular layers so that their margins overlap, and each muscle affords a double layer of tissue to cover the wound. If the original spanning scar is sound, we prefer to remove the appendix through a rectus sheath incision, and if this was the original route we go through the original scar. The object is to have sufficient room for the second operation, which may be difficult, and at the same time to

strengthen the old scar if it shows signs of weakness. Drainage of these wounds is sometimes necessary for a day or two owing to the almost certain infection of the ragged cavity remaining after the appendix has been removed, in cases where adhesions are still abundant.

Treatment of Non-suppurative Appendicular Tumour.—Occasionally the surgeon explores a case of appendicitis, expecting to open an abscess, and after due exploration, he finds no pus, but only inflammatory thickening of bowel and omentum. Such cases are best treated by means of a drainage tube leading from the mass to the surface. Exudate commonly escapes after the second day, and the tumour subsides. The tube may be left out early in accordance with the nature of the discharge, and about three weeks after the tumour has gone, the operation of appendicectomy may be safely performed.

Operation for Local Appendicular Peritonitis (Perityphlitis).—As soon as the diagnosis is made, operative interference is usually a necessity, and the essentials here are rapid removal of the offending appendix, and avoidance of further infection of the peritoneal cavity. The patient should always be placed on the table with the pelvis low, and protective plugs should be used after the peritoneum is opened, to shut off the seat of operation from healthy intestine. The incision should pass either through the sheath of the rectus or through the muscle itself; if the general condition of the patient is not good, the latter route is better, as it is the quickest way into the peritoneal cavity, and the success of the operation depends largely upon the rapidity of its execution, since the patients are not in a fit state to stand prolonged anæsthesia. The appendix should be sought for between the protecting gauze plugs by gently dislodging the cæcum, and all inflammatory fluid and pus should be rapidly absorbed. It is often difficult to bring the cæcum up into the wound, and thus the appendix stump is buried with difficulty; this should undoubtedly be attempted even when the cæcum is very fixed, but if it

is found to be impossible without running the risk of breaking down protective adhesions, it is better to tie a ligature firmly around the base of the appendix, after securing its mesenteric vessels, than to prolong the operation and run the risk of spreading the infection. We prefer to crush, ligature, and bury the stump of the appendix, but, if this cannot be carried out quickly and without much difficulty, the crushing may be dispensed with, and even the burying is not absolutely necessary. Very rarely is simple ligature followed by a fæcal fistula which can be attributed to leakage through the appendix stump. In some cases also it is difficult to make sutures hold in the wall of the cæcum. As a suture material silk is preferable to catgut, since the latter is absorbed very rapidly within the peritoneal cavity. After the appendix has been removed, the peritoneum at the seat of operation should be carefully dried with gauze, and a large drainage tube should be placed in position; the protective plugs may now be withdrawn, and it is usually the wisest plan to insert a fresh one on the inner side of the wound, to be left in position for the succeeding forty-eight hours. With regard to drainage, more than one tube is rarely needed but care must be taken that it is directed down to the floor of the pelvis; we prefer to have also one lateral opening in the tube opposite the infected operation area which corresponds roughly to the level of the pelvic brim; a narrow gauze plug within the tube favours drainage by capillary attraction, and thus we have a modification of the "cigarette drain." If the patient is kept rigidly in the Fowler position, loin drainage, or even drainage directed from the appendix stump, is never needed, since the infective fluid passes to the bottom of the pelvis, and intra-abdominal pressure causes it to escape through the one pelvic tube. The wick should be changed whenever the dressing is done; as a rule once in the twenty-four hours is sufficient, and the protective plug may be removed altogether at the end of two clear days. The tube must be gently rotated at each dressing, to prevent its becoming adherent to bowel, and

it may as a rule be gradually withdrawn and shortened daily after the fourth day.

Operation for General Appendicular Peritonitis.—Immediate operation in these cases offers the only chance for the patient, and since this has become clearly recognised the mortality has fallen considerably. In the days before operative treatment was considered essential, a few cases that were clinically [illegible] peritonitis may have recovered, but now the mortality among the most unpromising cases is not higher than 70 per cent. This is perhaps no great achievement, but to save [illegible] apparently hopeless cases is something. Even though the still alarming mortality should stir us to intervene in appendicitis before widespread infection is present. To close the whole peritoneum is beyond the power of the surgeon, but he can put the patient on the road to recovery by the rapid removal of the focus of infection and the provision of adequate drainage. Since speed in operating is one of the essentials for success, the incision should pass through the right rectus muscle. If the peritoneal cavity is full of infective purulent fluid, protective plugs are useless, and therefore the cæcum should be found without delay, and the appendix removed in the quickest way possible, consistent with prevention against leakage from its stump. All the fluid encountered should be absorbed by gauze plugs and the seat of operation rendered as clean as possible. Washing with saline is undesirable, since it is as likely to cause diffusion of infective material into the peritoneal cavity as to wash it out of the wound. Secondary incisions on the left side of the abdomen are not usually of much advantage, since the whole peritoneum cannot be reached through either one or two incisions, and in general peritonitis the place of the surgeon is merely to aid the patient's resistance, for he cannot hope to remove all the invading organisms. Drainage is provided for in the way we have already described, and a second tube is rarely needed, though some surgeons make a practice of placing a second tube down to the *caput cæci;* plugs outside

the tube may sometimes be used with advantage. Sutures of silk or catgut may be used for the peritoneum, catgut for the rectus sheath, and salmon-gut for the skin. We prefer catgut for all the deep sutures, for thus the possibility of stitch sinuses is reduced to a minimum, and if strong catgut be used it will hold till the wound is sealed in its separate layers. The wound should not be closed too tightly around the drainage tubes.

Post Operative Treatment

We have already insisted on the value of the Fowler position in dealing with peritoneal inflammation both before and after operation. In addition to this treatment by posture, we must urge the value of saline administration. The leading feature of intestinal toxæmia, particularly when due to the toxins of the colon bacillus, is loss of body fluids. Fluid often accumulates within the intestinal lumen, but the connective tissues rapidly lose their fluid, and the sunken appearance of the face in peritoneal poisoning is abundant clinical evidence of this fact. To compensate for this loss, saline should be given in large quantities. It is best given *per rectum* by means of some such apparatus as is represented on page 78. This apparatus should be in readiness before the patient is returned to bed from the operating table, and by its use it is often possible to get four or five pints absorbed before the effect of the anæsthetic has worn off. The fluid should flow in very slowly, and the reservoir should be only some six inches above the level of the buttocks. By this means it is possible to get ten to fifteen pints of saline absorbed in the first twenty-four hours after operation, and we believe that many lives have been saved by this simple procedure. It used to be stated that the saline washed out the toxic material from the peritoneum, and that the amount of discharge was therefore abundant, but we have not found this to be the case, nor is the urinary excretion noticeably increased in amount; it is therefore

safe to assume that the saline is used to make up the body fluids of the patient, and indeed this is obvious in many cases, for after a few hours the sunken and dried skin of the patient often fills out and becomes normal in appearance. If the saline is not readily absorbed by the rectum, an enema should be given to ensure emptiness of the lower bowel. No purgatives are to be given while the saline administration is continued. If saline proctoclysis, as administration *per rectum* is called, is not satisfactory, dermatoclysis, or subcutaneous saline infusion, may be substituted, and in this way a large volume of salt solution can be absorbed. This can be initiated during the operation if thought desirable, as it often is in the case of young children. A more rapid method of securing saline absorption is by sub-fascial infusion, carried out by piercing the purified skin and the axillary border of the pectoralis major with a hollow needle attached to a reservoir, or large syringe, so as to pass beneath the axillary fascia. In an adult, a pint of fluid can be thus introduced and will be gradually absorbed. For shock during operation, or shortly after it, the most rapid method of saline absorption, namely, intravenous infusion, must be used.

In our opinion most cases of local appendicular peritonitis, and all of general peritonitis, are best treated by the continuous administration of saline during the first twenty-four hours after operation, whilst cases of acute appendicitis and appendicular abscess which exhibit a peritonitic facies are also benefited by it.

The questions of diet and the relief of pain have already been discussed, but something remains to be said on the matter of aperients. There is no doubt that intestinal toxæmia is best avoided by early and free purgation, but we consider that in severe infections the absorption of saline is of more vital importance than activity of the bowels. If saline administration is held to be desirable, it is therefore necessary to wait until a satisfactory quantity has been absorbed before purgatives are given. This may mean

waiting twenty-four hours from the time of operation, but we have never seen harm result from this delay, though if both saline absorption and immediate purgation were considered necessary, the fluid might be injected beneath the skin. An enema is sometimes called for if the proctoclysis is not satisfactory, but even this tends to cause repeated peristalsis, which is unfavourable for the absorption of salt solution. If there is any question as to the security of the appendix stump, small enemata should be used rather than purgatives, since the latter are more prone to cause leakage of fæcal matter either from the stump of the appendix or from infiltrated and devitalised bowel in its neighbourhood.

As to the choice of purgatives and the time at which they should be given, there is much difference of opinion. If there is need for saline, the aperients can quite well be withheld until sufficient saline has been absorbed, and in those cases where the patient is not suffering from loss of tissue fluids there is usually little anxiety about the action of the bowels. Cases of localised abscess, and of acute appendicitis, can be quite safely treated in the same manner as ordinary abdominal diseases after operation, and an aperient should be given on the second or third night, according to the custom of the surgeon. For such patients castor oil in half-ounce doses, repeated in six hours if necessary, acts satisfactorily. In cases of spreading or general peritonitis, purgatives should be given as soon as proctoclysis has been discontinued, and here we prefer doses of magnesium sulphate, two drachms every two hours, or from a half to one grain of calomel every hour, until the bowels act. If these aperients cause vomiting, recourse must be had to turpentine enemata. Eserine salicylate has recently been used as a hypodermic purgative, and by reason of its stimulating effect on non-striped muscle it does undoubtedly aid peristalsis. It is best given in aqueous solution in doses of gr. 1/40–1/100 injected into the buttock intramuscularly. We have found it distinctly valuable, but not absolutely reliable, and, as a matter of fact, it appears

to act best when given in small doses at the same time as a saline aperient, for by this means both the muscle and the mucous glands of the intestine are stimulated. The injection may be repeated at four hourly intervals for five or six doses. We have never seen eserine produce diarrhœa or bleeding from the rectum. Pituitary extract may also be used to stimulate intestinal activity (1 c.c. hourly for 3 doses).

If vomiting is taking place, purgatives by the mouth are to be avoided, and an enema, followed by eserine, is especially appropriate. It is certainly true that if the bowels be freely opened in cases of peritonitis, the patient's chance of recovery is greatly improved, since poisoning from the decomposing intestinal contents is avoided; but at the same time the existing peritoneal infection remains to be dealt with by the bacterial resistance of the patient. If the bowels act normally after the operation, without the aid of drugs, it is evidence of the re-establishment of peristalsis, and may be considered a very good omen as regards prognosis. Failure of both aperients and enemata point to paralysis of the bowel, and the prognosis is correspondingly grave. There are, however, some cases in which a toxic diarrhœa develops, and in these also the prognosis is bad.

Value of Serum and Vaccines.—Of recent years an anti-colon bacillus serum has been prepared and has been used in a large number of cases of appendicular peritonitis. Where there is a perforation of the appendix, the main infection is probably due to the colon bacillus, but it must be remembered that the most virulent and fatal infection is streptococcal, or due to the streptococcus pyogenes and the colon bacillus together. Under these circumstances it would appear a rational course to administer anti-colon serum in all cases where there is a perforative lesion of the appendix, and also an anti-streptococcic serum in those cases where stained films of the exudate show the presence of these cocci. Such has been our practice during the last few years as regards the perforative attacks of appendicitis

where the condition of the patients at the time of operation was obviously grave. The worst cases, with local or general peritonitis, have received a dose of 25 c.c. of anti-colon serum (Burroughs Wellcome and Co.), into the pectoral muscle at the close of the operation, and two further intramuscular injections of the same volume during the succeeding twenty-four hours. These bad cases have also been treated by proctoclysis beginning directly after the operation in most instances. In a few cases, where there was evidence of a coccal infection, the corresponding anti-serum has also been given. Although this method of treatment has been adopted by us in between thirty and forty cases, we hesitate to draw any definite conclusions as to the value of serum treatment in peritonitis for two reasons; firstly, because only the worst cases, where the infection was widespread and severe, were selected for this treatment, and secondly, because the majority of them had saline proctoclysis concurrently, so that two factors were at work in resisting the peritoneal infection. Under this treatment we have seen unexpected recoveries in cases of general peritonitis with black vomiting, which is usually regarded as a fatal prognostic sign, but, on the other hand, the general mortality has not been lowered, and from personal observation we would say that large quantities of saline by the rectum have had a more beneficial effect than treatment by sera. Vaccines, however, do appear to be of value in peritonitis when the acute stage of the illness has subsided. The operation itself must produce a certain amount of auto-inoculation, and, if the patient survives the first four or five days, his ultimate chance of recovery can, we believe, be increased by the judicious administration of the appropriate vaccine; but this method is not likely to reduce the mortality very greatly, since the majority of deaths from appendicular peritonitis occur within three days of the operation. Nevertheless we have seen several instances of the beneficial effect of a colon vaccine on patients who made very little progress before the inoculation. In one of our cases with diffuse peritonitis

and peristent black vomiting the operation was followed up by serum treatment, but vomiting, pain, and extreme restlessness, continued for a fortnight until a vaccine was given, and from this time onward convalescence was rapid.

Complications of Appendicitis

There is probably no abdominal disease which is so commonly followed by secondary lesions as appendicitis. These complications occur both before and after operation, and while they are not often attributable to the operation, much may be done to prevent their occurrence by early surgical intervention. Complications after operation during the first forty-eight hours are rare, but they are common after the incision and drainage of abscesses, and after operations undertaken in the later stages of perforative attacks. As we have stated, the best way to avoid complications is to remove the appendix whilst the disease is still limited to the organ itself, and the second line of defence consists in the early and persistent adoption of the Fowler position.

A careful daily examination of the patient and his temperature chart must be made in order that the surgeon may be aware of all the symptoms and physical signs exhibited, and he must be prepared to perform any further operation as soon as the diagnosis is clear. Persistent fever may indicate inadequate drainage of the wound, or the formation of a fresh abscess in some portion of the peritoneal cavity ; it is usually then associated with localised abdominal pain. If the abdomen appears healthy but the temperature remains high, the chest must be examined for signs of inflammatory infection of the lungs or pleuræ, and the possibility of a sub-phrenic abscess must be borne in mind. Colicky attacks of abdominal pain are suggestive of commencing obstruction from adhesions, and, if associated with difficulty in securing an action of the bowels, a careful inspection for visible peristalsis should be made, so that enterolysis may be performed before actual obstruction with vomiting and toxæmia has made its appearance.

A very interesting account of complications arising during convalescence after operations on the appendix has been published by Wallace and Sargent in the St. Thomas's Hospital report for 1904. They analysed the post-operative course of 1075 cases of appendicitis, including interval operations as well as the treatment of localised abscesses and of diffuse peritoneal infections. We have not space for more than a brief consideration of these complications.

Spreading infection of the abdominal wall.—This is not as common as one might expect, but at times one sees sloughing of the rectus muscle in cases with virulent infection, or a cellulitis of the abdominal wall may be met with. The latter calls for treatment by multiple free incisions, while the risks of the former must be met by strapping together the margins of the abdominal wound and tight bandaging, and by the subsequent repair of the almost inevitable ventral hernia when the wound has healed.

Secondary intra-peritoneal abscesses.—These have been considered in detail in the chapter on Peritonitis, but we may here call attention to the fact that these abscesses have become much less common since the Fowler position with pelvic drainage has been more generally adopted. Their position is to some extent dependent on the original situation of the appendix, and according to their relative frequency they are pelvic, left iliac, right lumbar, subphrenic, sub-hepatic, and perisplenic. Supra-phrenic suppuration may also occur in conjunction with abscesses below the diaphragm or independently, such suppuration being due to ascending infection involving the lung or the pleura. Pyæmic abscesses may of course be produced in any part of the body, but, excepting in the lungs, they are distinctly rare outside the portal system.

Pyæmia.—This is usually of the portal system, leading to suppurative pylephlebitis and multiple abscesses of the liver. General pyæmia was only met with in one case of the thousand investigated by Wallace and Sargent, unless

ulcerative endocarditis be included in this category. This disease accounted for three deaths, and occurred in one case with a localised abscess, and in two with diffuse peritonitis. Death from true septicæmia occurred in one case complicating appendicular abscess.

Intestinal obstruction.—This is most commonly due to bands or adhesions, less commonly to definite volvulus. It almost always affects the small intestine and in post-operative cases usually follows the drainage and incision of a localised abscess. The protective adhesions, which have saved the patient from death by peritonitis, may in their turn obstruct and kink the involved coils of bowel, and therefore the common site of obstruction is internal to the site of the abscess. The diagnosis should be made before repeated vomiting occurs, by the observance of visible peristalsis, and possibly of splashing on palpation of the obstructed coils. Relief is usually a simple matter and if the abscess wound is fairly clean, access to the adhesions may be gained through the site of the first operation ; but if the obstruction occurs early a separate rectus incision is better. This complication rarely arises before the end of a week after the drainage of an abscess, but it may be met with much later. The prognosis is usually good.

Volvulus also occurs after operation for appendicular infections, usually of a diffuse character. Here the diagnosis is not so easy, and operative interference is likely to be delayed ; for this reason, in the recorded cases, the results have not been favourable. Here, again, it is a small intestine lesion.

Large bowel obstruction is rare, though it may be met with as the result of pressure from inflammatory masses in the pelvis. A temporary colostomy may sometimes be required.

Persistent Sinus.—This is most often met with after the drainage of an abscess, and depends upon the existence of exposed mucous membrane at the bottom of the wound, or on the presence of a concretion. Removal of a concretion

has several times caused such sinuses to heal, but in other cases appendicectomy must be performed before sound healing is obtained. Stitch sinuses rarely discharge for more than a few weeks, and are more superficial than those due to exposed mucous membrane or a concretion.

Fæcal fistula.—This also most commonly follows the incision and drainage of a localised abscess, though it may follow appendicectomy in urgent cases where the stump is, often unavoidably, ineffectually dealt with. In abscess cases the lumen of the appendix may be in direct communication with the abscess cavity, and incision of the abscess then may readily give rise to a fæcal fistula, or the lesion may be due to a subsequent inflammatory infiltration causing gangrene of adjacent bowel. Other causative factors may be the disturbance of protective adhesions, or actual damage to the softened bowel wall, during the course of the operation. The ileum close to the ileo-cæcal valve is the most common seat of the fistula, and the time of its appearance after the drainage of abscesses is usually three to five days from the date of operation. A fæcal fistula, however, may develop two or three weeks after operation where prolonged drainage has been needed. Caution is undoubtedly necessary where a tube is required in the wound for any length of time; in any case it should be rotated whenever the dressing is changed, so as to prevent the formation of firm adhesions between the bowel and the rubber, and in some cases this tendency may be avoided by pouring a few drops of boiled olive oil down the tube. Multiple lateral openings in the tubes are not advisable, since they favour the production of adhesions. The actual presence of fæcal matter in the discharge is an indication for the removal of the tube, and this should be replaced with very light gauze packing to favour granulation, but not to act as a dam. Fortunately the majority of these fistulæ close spontaneously, so that operative interference should not be thought of for many weeks, unless the patient is going down hill from inanition. Frequent dressings and

great care of the skin are necessary both for the safety and the comfort of the patient. The most troublesome fæcal fistulæ are those which follow appendicectomy after the drainage of an abscess where numerous adhesions may have to be broken down and a ragged infected cavity is left at the operation. Such fistulæ may call for operative treatment, and if so, the surgeon must be prepared for an extensive operation, for it is essential to expose the affected loop of bowel thoroughly, and if infolding of the wall reduces the lumen of the gut too much, resection and anastomosis must be carried out. When the fistula communicates with the cæcum, simple suture with layers of Lembert sutures is often sufficient.

Fistulous communications between the abscess cavity and the bladder, vagina, or ***rectum.***—The former produces cystitis, but usually no special treatment is required and the condition clears up rapidly. Discharge of pus by the vagina or the rectum usually helps to drain the abscess rapidly, and the fistula remains patent for only a short period.

Ureteritis and Sloughing of the Right Ureter.—Hæmaturia of a temporary character has often been recorded, and is probably accounted for by ureteritis at the brim of the pelvis, where the appendix and right ureter have very little tissue intervening between them. It is not usually serious, and so far as we are aware does not lead to ureteral stricture. Sloughing of the right ureter is fortunately very rare, but when it occurs a very troublesome urinary fistula may result, requiring treatment by a plastic operation, or even by nephrectomy.

Secondary hæmorrhage.—Considering the proximity of the deep epigastric vessels to the infected abdominal wound, it is remarkable that this should be such a rare complication. It is rarely seen before the end of the first week after the operation—usually the drainage of an abscess—and is almost always arterial. It is best avoided by double ligature and division of the artery and its accompanying veins at the primary operation if they lie beneath the incision or

even close to it. Treatment consists in ligature of the bleeding point, if the friable tissue will stand this; if not, artery forceps must be used and left in position for forty-eight hours.

Thoracic complications.—These may arise either early or late during convalescence from operation on any variety of appendicular disease.

Pulmonary Thrombosis and Embolism.—The most rapidly fatal of all complications is that in which a clot is formed at the base of the pulmonary trunk in the right ventricle, and is then dislodged so as to block the bifurcation of the pulmonary artery. Fortunately this disaster has no special tendency to follow operations on the vermiform appendix. Pulmonary embolism, due to the transference of clot from the site of operation, is characterised in the first instance by pain and cough with blood-stained expectoration. In severe cases of appendicitis it is apt to lead to abscess of lung or empyema.

Bronchitis and Pneumonia.—A large number of fatal cases of appendicitis exhibit diffuse bronchitis, and some degree is not uncommon in cases of recovery. Many of these infections are doubtless attributable in greater or less degree to the anæsthetic, and they may be best avoided by rapidity of operating and careful protection of the patient from exposure; the Fowler position, too, favours free action of the lungs and renders hypostatic pneumonia less likely to arise.

Massive Pulmonary Collapse (*vide* Chapter XVI.) is probably a more frequent complication than is generally realised.

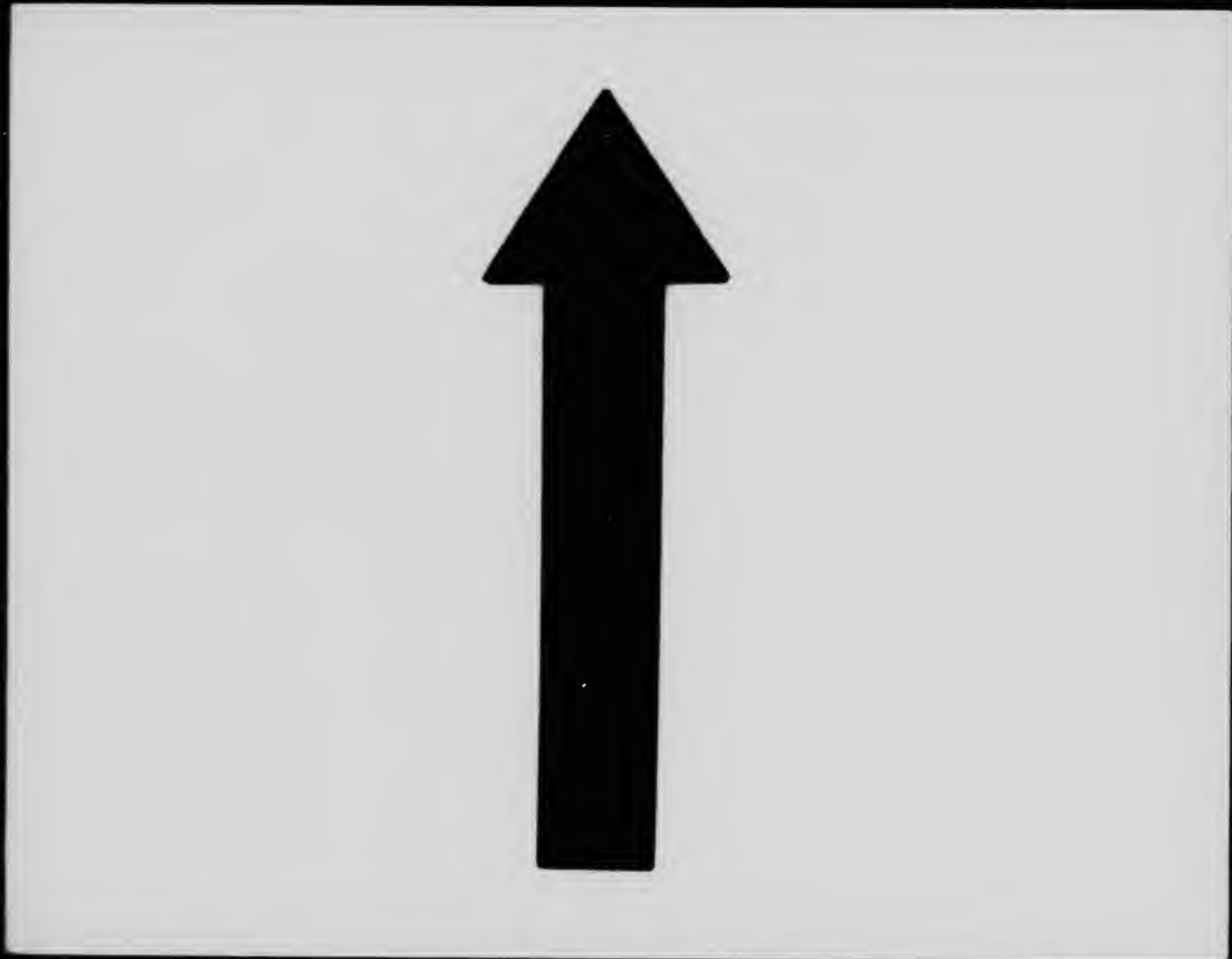
Pleurisy and *empyema* are more often due to direct extension of inflammation from below the diaphragm; the latter is sometimes very insidious in its onset, and, in the presence of persistent fever, if examination of the abdomen affords no satisfactory explanation, the presence of pus either below the diaphragm, or in the pleura, is to be suspected. It may sometimes be possible to call in the aid

of the X-rays in the determination of the mobility of the diaphragm and the level of its cupolæ in relation to the ribs, but oftentimes the physical signs are the only available evidence. In cases of doubt, exploratory operation is justifiable when the balance of evidence points to the existence of pus below the diaphragm, for these infections are often due to the colon bacillus, and unless early operation is performed the mortality is very high.

Femoral thrombosis, more common in the left than the right leg, is occasionally seen in these cases. It may be due to extension from radicles of the deep epigastric veins, or to prolonged rest in the recumbent position, but if the former explanation be correct it should be more common on the right than the left side.

Psoas contraction.—This is a rare sequel of appendicitis, but in one case of gangrenous disease within our experience, the appendix lay partially buried in the right psoas. Removal was successfully effected and the patient made a good recovery; two months later he was again under treatment with a flexed right hip and a lumbar abscess; the abscess was drained, but the flexion persisted, and was due to an infiltration of the psoas muscle, leading subsequently to multiple abscesses and death from pyæmia. Efforts to straighten the leg under an anæsthetic probably tended in this case to favour the production of abscesses, and the more gradual method of weight extension is the better course of treatment, although it is difficult to apply sufficiently forcible extension to overcome such a strong muscle.

Parotitis.—This may occur at any period during convalescence and is associated with the withholding of oral feeding in patients with dry and dirty mouths. Suppuration is common but not invariable, and the cultures from the abscess usually yield the staphylococcus aureus. It is almost certainly caused by infection along Stenson's duct, and subsides rapidly after incision has been made, even although pus may not be discovered.



MICROCOPY RESOLUTION TEST CHART

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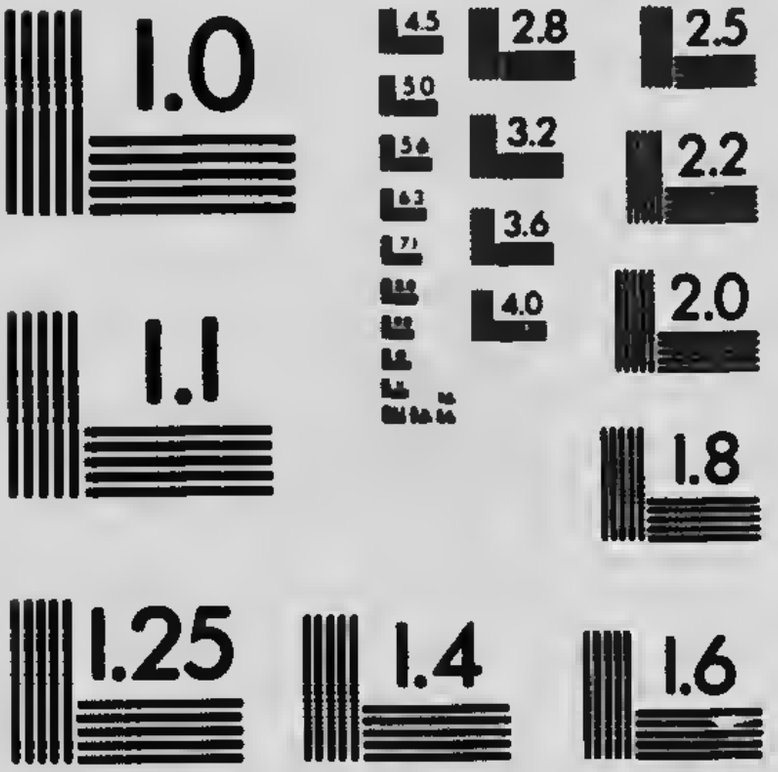

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Suppurating ovarian cyst.—It is possible for infective appendicitis to cause this secondary complication in a woman with an ovarian cyst, but it is rare; more often a tubo-ovarian abscess is associated with appendicitis, and in some cases, when dense adhesions surround the area of inflammation, it is difficult to tell whether the attack was primarily tubal or appendicular.

Ventral hernia.—It is no disgrace to the surgeon for a hernia to develop in cases where prolonged drainage has been needed, but much may be done to guard against it by the spanning, or displacement, of muscles rather than division of their fibres wherever the abdominal incision is made.

Tuberculous and Actinomycotic Appendicitis

The former is one of the recognised forms of chronic appendicitis, while the latter commonly shows itself first as an appendicular abscess.

Tuberculous ulceration of the appendix may, of course, lead to perforative peritonitis, and the nature of the primary lesion may then only be suspected by the discovery of tubercles on the peritoneum. A localised abscess around a tuberculous appendix is rare. In the presence of these extensions of infection the diagnosis of tuberculous appendicitis rests mainly on a microscopical investigation.

Actinomycotic invasion of the appendix and the wall of the cæcum gives rise to a large inflammatory mass which tends to cause a brawny induration of the abdominal wall, subsequently breaking down and producing sinuses through which pus, with characteristic canary yellow granules, may be seen to discharge. The symptoms are usually sub-acute, and, if incision is made before sinuses develop, a ragged abscess cavity with enormously thick walls may be entered. Such a condition should arouse suspicions of actinomycosis, and microscopic diagnosis must be resorted to. Death usually occurs from actinomycotic invasion of the liver and pyæmia.

CHAPTER IX

THE LIVER AND BILE PASSAGES

THE most prominent etiological factor in rendering these diseases "acute" is the presence of cholelithiasis; for, whilst the presence of gall-stones alone may be regarded as an indication for surgical interference, the complications to which they give rise frequently demand immediate operation if the life of the patient is to be saved. We have already seen what a serious form of intestinal obstruction may result from the escape of a calculus from the gall-bladder into the bowel by ulceration, and we shall now consider the lesions of the bile passages and liver which may be caused by stones still within these ducts, but whose presence has led to serious bacterial infection from the adjacent intestine.

It will be necessary in the first place to consider briefly the clinical and pathological aspects of simple cholelithiasis as an introduction to the grave complications which we must include in this chapter.

Cholelithiasis

Etiology and Pathology.—Gall-stones may be formed both in the gall-bladder and the hepatic ducts, but the former is by far the commoner site of origin. According to the accepted theories of the day, calculus formation is dependent upon catarrh of the mucous lining of these passages; mere stagnation of bile does not lead to the production of the varieties of calculus commonly met with,

although it may cause deposition of biliary pigment. Biliary catarrh causes excessive secretion of the mucous glands, and one of the results of this is the deposit of cholesterin, a substance which is present in large quantities in nearly all biliary calculi. Another result of catarrh of the bile passages is the production of calcium in combination with bilirubin, so that one meets with calculi composed of bilirubin-calcium, of this substance with the addition of cholesterin, and of pure cholesterin. The first are formed in the intra-hepatic ducts, the last in the gall-bladder, and the mixed form may result when the catarrh involves both gall-bladder and ducts. Those composed almost entirely of cholesterin are the most common. Inflammation which causes destruction rather than proliferation of the mucous membrane does not lead to the formation of gall-stones, and therefore suppurative cholecystitis is not one of the causes of cholelithiasis.

Causation of Catarrh of the Gall-Bladder.—There are undoubtedly many factors which predispose to this state, but the essential one is bacterial infection, and the source of this lies in the adjacent bowel. Typhoid and colon bacilli have frequently been found in the interior of gall-stones, and experimental cholecystitis produced by inoculation with these organisms has led to calculus formation. Similar results have been obtained by the use of attenuated cultures of staphylococci and streptococci. The obvious path of infection for these bacteria is by ascension along the common bile duct, and another way in which they may reach the bile passages from the intestine is by the portal blood stream and excretion into the ducts.

Among predisposing causes must be included those conditions which favour stagnation of bile, such as constipation, a sedentary life, obesity, pregnancy, tight lacing, and, possibly, nephroptosis. It is noticeable that cholelithiasis is a rare disease amongst outdoor labourers.

Foreign bodies in the gall-bladder certainly give rise to the formation of calculi, but it may be that the addition

of bacteria accounts for this result, since experiments by Mignot go to show that aseptic foreign bodies may be introduced into the gall-bladder without causing cholelithiasis. If non-absorbable sutures are passed through the whole thickness of the wall of this viscus it is well known that stones will form around them. Round worms, pins, and portions of hydatid cysts have all been found as the nuclei of gall-stones. The influence of pregnancy is important, and Naunyn found that 90 per cent. of women suffering from cholelithiasis had borne children. Probably the explanation lies in the constipation which pregnancy often induces.

Age.—Most of the patients are over forty years of age, and old age is held to predispose to the formation of gall-stones, owing to the failure of the musculature of the bladder and ducts.

Sex.—Females are more affected than males. The mathematical proportion, according to some authors, is as five to one, but others state that it is only four to three.

Clinical Aspect of Cholelithiasis.—Kehr states that only about 5 per cent. of persons with calculi in their gall-bladders exhibit symptoms; Moynihan that 100 per cent. do. The truth lies hidden between these two remarkable statements. The latter author makes much of so-called "gall-stone dyspepsia," but, whilst not denying its existence, we submit that it hardly possesses distinctive clinical features of its own, and oftentimes such symptoms as are met with are due rather to peri-cholecystic adhesions than to the mere presence of gall-stones. The more important acute manifestations with which we are acquainted are biliary colic, biliary obstruction, and biliary infection. Intestinal obstruction, due to gall-stones, has already been considered.

1. Biliary Colic

This name is given to attacks of severe abdominal pain attributable to spasm set up by the passage of calculi along

the cystic or common bile ducts, though it is admitted that inflammation and spasm without calculi may produce the same symptoms. There are many reasons for thinking that biliary colic depends on inflammatory changes, and Kehr's view is that it is the inflammatory exudate of cholecystitis which drives the stone, formed in the gall-bladder, into the ducts. We have already shown that catarrh is essential for the formation of biliary calculi, so that inflammation of the gall-bladder may be at one time responsible for their production,and at another for their expulsion, with the phenomena of biliary colic. The existence of tenderness and enlargement of the gall-bladder, together with fever, which are all associated with biliary colic, lend colour to this view. When a calculus is impacted in the bile duct, it sets up painful spasm of the ducts and gall-bladder. Acute cholecystitis may be due to microbic infection from the intestine or blood stream, and there is no question but that the presence of gall-stones, either in the bladder or the ducts, does favour such infection.

Symptoms.—The onset may be absolutely sudden, and the attack often comes on during the night; it may, on the other hand, be preceded by shivering, a feeling of nausea, or actual vomiting. The *pain* of biliary colic is often excruciating, but in some cases it consists only of mild attacks of griping; it is located in the first instance in the right hypochondrium or the epigastrium, and passes through towards the back on the right side of the lower dorsal vertebræ; but it may radiate much further than this, and even extend to the arms and legs. The patient often throws himself upon the floor, doubles his thighs upon the abdomen, and writhes in agony. The first is nearly always more severe than subsequent attacks, and this paroxysm of pain is followed by a dull aching. The severe attack lasts usually for about five or six hours, rarely only for a few minutes. There is no definite relationship between the size of the calculi and the severity of the attack. Sudden relief, and even entire disappearance of all pain, occurs when the stone reaches the duodenum or

drops back into the gall-bladder. *Fever* is present in over 50 per cent. of the cases. It may be a nervous phenomenon, or again, it may be accounted for by the presence of cholecystitis. *Vomiting* is rarely absent; at first the vomit is purely gastric, but later, it is stained with bile, unless the stone has occluded the common duct. A calculus has been vomited. Anorexia and constipation are usually present.

Physical Signs.—The patient suffers, at any rate in severe attacks, from a certain degree of shock and prostration. The skin, during the paroxysm, is hot and bathed with perspiration. *Jaundice* is present in more than half the cases, and even where it is not observable in the skin there is usually conjunctival icterus. Its occurrence after biliary colic is due to a calculus in the common bile duct or to inflammation and spasm spreading to the ducts from the gall-bladder, and thus it may occur when the stone is in the gall-bladder or the cystic duct. It may not be out of place to consider here the true significance of jaundice. It is due to the presence of bile pigment in the blood, and is manifested by yellow staining of the skin, conjunctivæ, mucous membranes, blood serum, and, as a rule, of the urine by bile pigment. The manufacture of this pigment from hæmoglobin is essentially the work of living liver cells, and in a jaundiced state the bile pigment circulates in the blood instead of reaching the intestine. It is now recognised that all types of jaundice are due to obstruction to the flow of bile, the only difference being that in some cases the block is intra-hepatic, and in others it is extra-hepatic; the latter is, of course, the commoner variety of clinical jaundice.

The pulse during biliary colic is small and feeble, but of normal, or of but slightly increased, rate. Enlargement of the liver is of variable degree, but enlargement and tenderness of the gall-bladder is more constant. The abdominal wall during the paroxysm is rigid and retracted, afterwards it becomes soft and relaxed except in the region of the gall-bladder. The blood may show slight increase of leucocytes; suppurative cholecystitis causes a considerable leucocytosis.

Albuminuria is not infrequent; bile pigment is present before there is any obvious manifestation of jaundice. The fæces passed in cases of common duct obstruction are noticeable for their clay colour and dry appearance.

Diagnosis.—This is made upon the following points: (1) The severe character of the pain in the right hypochondrium and the back. (2) The tenderness below the tip of the right ninth costal cartilage and the gall-bladder area, with local rigidity. (3) The presence of vomiting. (4) Jaundice. (5) The existence of gall-stones in the stools. The last-mentioned is, of course, the only true objective sign of cholelithiasis, but, unfortunately, the diagnosis has often to be made before any such discovery, or even investigation, is possible, for sifting the stools through a hair sieve may be necessary to demonstrate their presence. Biliary colic is rare in young people.

Cholecystitis without calculus causes pain of a less excruciating character, but apart from this it cannot be distinguished from biliary colic. *Renal colic* is associated with pain having a different distribution, passing from back to front, and not from front to back; *ureteral colic* has such a typical distribution of pain that the diagnosis is rarely difficult, and both these conditions are associated with blood, pus, and albumen in the urine, but not with bile. Blood and albumen, however, may be present in the urine during an attack of biliary colic. *A floating kidney* may be responsible for biliary colic and jaundice from traction on the peritoneum and pressure on the duodenum. *Gastric ulcer* does not cause sudden attacks of paroxysmal pain with sweating, fever, and collapse, and gastric pain is definitely related to the ingestion of food. *Duodenal ulcer* causes pain some time after meals, and may produce melæna. *Appendicitis* is rarely a source of difficulty in diagnosis, unless cholecystitis and disease of the appendix, which may cause it, co-exist. When the appendix is placed close beneath the liver some doubt may arise, but severe appendicitis causes a much more toxic condition of the patient

than is seen in simple cholelithiasis. *Mucous colitis* causes severe, and even paroxysmal pain, but the presence of mucus in the stools settles the diagnosis. *Acute pancreatitis* is associated with constant pain, more or less localised to the epigastrium, and it causes more profound collapse than is seen in biliary colic. *Lead colic* must be differentiated by the blue line on the gums, by the anæmia, and the absence of localised tenderness and rigidity over the gall bladder area. *Hepatic crises* in tabetic subjects may resemble biliary colic, but they are usually afebrile, and can be diagnosed by examination of the nervous system. Angina pectoris, spinal disease, and lumbago must also be mentioned as conditions which may resemble colic due to gall-stones.

Prognosis.—Death from biliary colic has occurred, but it is very rare. Rupture of the gall-bladder and perforative peritonitis is described, and Courvoisier collected forty-one cases, but we do not know whether cholecystitis was not present in some of these. Facetted calculi in the stools probably indicate that other stones are present in the gall-bladder, and, therefore, recurrent colic must be expected. A solitary round calculus may mean that all is over and the patient may escape further attacks.

Treatment.—The acute pain of biliary colic yields to nothing but morphia or its congeners, or the inhalation of chloroform, and where the diagnosis is certain there is no reason to withhold these drugs. Antipyrin and sodium salicylate are also of value when the acute pain has passed off. Copious draughts of hot water, and hot baths, tend to allay spasm affecting the bile ducts; very cold drinks may in some cases do good, and, if there is much collapse, iced champagne is recommended. Local treatment by means of hot fomentations affords considerable relief when the colic is subsiding.

With regard to surgical treatment, it is generally held that biliary colic itself is not an indication for operation, unless it be frequently repeated, but such complications as

acute cholecystitis, or rupture of the gall-bladder, demand surgical interference without delay. The treatment most suitable for cholelithiasis is cholecystostomy during a quiescent period; Mayo advises removal of the mucous membrane of the gall-bladder. Some surgeons prefer cholecystectomy, but we hold that the gall-bladder should certainly not be removed unless it is *known* that the ducts are all free from calculi.

2. Biliary Obstruction

(*a*) **Calculi present in the Gall-bladder.**—This leads, as a rule, to chronic cholecystitis, often of the atrophic variety; sacculation and fibrosis of the gall-bladder are met with, and calculi may be practically embedded in the wall of the viscus. This condition is held to predispose to cancer. Acute inflammation may be set up at any time, mainly due to ascending infection from the duodenum, and cholecystitis, either suppurative, ulcerative, or phlegmonous may thus be caused.

(*b*) **Calculus in the Cystic Duct.**—The stone, or stones, usually lodge close to the neck of the gall-bladder, leading to spasm of the duct and biliary colic. Retention of the secretion of the gall-bladder occurs, leading to hydrops, and cholecystitis may result. In addition to this, catarrh of the common duct is favoured, and thus the patient may exhibit jaundice, though this is uncommon. A dilated gall-bladder has been the cause of many mistakes in abdominal diagnosis, and even an appendix abscess may be simulated. Cholangitis and cysto-choledochitis are other likely complications.

(*c*) **Calculus in the Common Duct.**—If the passage of a gall-stone along the common duct is obstructed, we have already seen that biliary colic and jaundice result. The commonest place for the calculus to lodge is in the neighbourhood of the bile papilla. This leads to communo-choledochitis, and chronic jaundice of intermittent degree, to biliary cirrhosis, and oftentimes to lesions of the pancreas,

a complication to be dealt with in Chapter X. These pancreatic sequelæ are especially liable to arise if the calculus be lodged in the ampulla of Vater.

3. Biliary Infection

(1) **Affecting the Gall-bladder.**—Acute cholecystitis may be serous, sero-fibrinous, suppurative, ulcerative, phlegmonous, gangrenous or perforative. The inflammation may affect the outer coat and give rise to peri-cholecystitis, and local, or even general, peritonitis. Ulceration may occur through the wall of the gall-bladder into the substance of the liver, producing a localised abscess of liver, or diffuse suppuration, and also fistulous communication with hollow organs may ensue.

(2) **Affecting the Cystic Duct.**—This leads to inflammation, possibly to ulceration, and leakage of bile and infective material.

(3) **Affecting the Common Duct.**—This gives rise to a condition which has been particularly studied by Charcot and Osler, who have termed it "intermittent hepatic fever." A calculus may act like a ball-valve, especially if it lies in a dilated ampulla of Vater; transient intermittent jaundice is commonly present, though there may be none. Obstructive biliary cirrhosis ensues with dilatation of the intra-hepatic ducts and peri-cholangitis. The gall-bladder is often thickened and shrunken; it may contain no calculi, but small ones are present in some cases. There is infective catarrh of the common duct, and the head of the pancreas tends to be enlarged from chronic interstitial pancreatitis. Stenosis of the common duct, and suppurative pylephlebitis are liable to follow.

Clinical aspect.—The patient suffers from ague-like attacks of pain, fever, rigors, and variable increase in the jaundice. Dyspepsia and gastric pain are often troublesome, and vomiting occurs in recurrent attacks. A leucocytosis is seen during the attacks.

Diagnosis.—The condition bears a considerable resemblance to malaria, but there is no reaction to quinine and the malarial parasite is not found in the blood. Suppurative cholangitis presents a similar picture, but the state of the patient is much more grave. In hepatic abscess there is little or no jaundice; the liver is enlarged, and a leucocytosis, if present, is constant. The question of malignant disease will occasionally be raised, but this does not cause such periodical attacks as are seen in intermittent hepatic fever.

Treatment.—Since there is considerable danger of suppuration in and around the ducts, it is clear that medical treatment should yield to surgical unless rapid improvement results. The medicinal measures available consist of Spa treatment, with local hot fomentations, saline aperients, copious draughts of water, and possibly the administration of such drugs as sodium salicylate and bile salts. Surgical treatment means rather a severe operation, for it is necessary to remove the obstructing calculus, and to drain, or perhaps remove, the gall-bladder. The best route for removal of the calculus, if it lies in the ampulla, may be by approaching it through the wall of the duodenum. One of the most important objects of surgical intervention is to ward off pancreatic complications.

Biliary Fistula

External fistula.—It should be mentioned that suppuration in the gall-bladder may give rise to peri-cholecystitis, which causes it to become adherent to the anterior abdominal wall. Discharge of pus and bile may then be found in the right hypochondrium, or more often, at the umbilicus. A calculus may thus be discharged on to the surface of the abdominal wall.

Acute Cholecystitis

Many of the following conditions are dependent on the presence of gall-stones for their occurrence, but most of

them may be met with apart from this lesion. We have already enumerated the varieties of acute cholecystitis which may be recognised pathologically, but which the clinician can hardly be expected to differentiate from one another.

Etiology and Pathology.—The predisposing causes are: calculi, foreign bodies, such as worms or parasitic ova, and stagnation of bile. The exciting causes are: bacterial invasion of the gall-bladder, traumatism, and possibly toxins conveyed by the blood stream. The path of infection may be by the portal vein, the hepatic artery, the common bile duct, or perhaps through the wall of adjacent bowel. Hæmic infections are represented by those attacks which follow influenza, or pneumonia, and occur in the course of septico-pyæmia. Alimentary infections, which occur *viâ* the portal vein or the common duct, are attributable to typhoid fever, cholera, gastro-enteritis, ulcerative colitis, and appendicitis. It is well known that typhoidal cholecystitis may occur during the course of the fever and be overlooked; typhoid bacilli which reach the gall-bladder in this way may lie dormant for even ten or fifteen years The bacillus coli, streptococci, staphylococci, and pneumococci are also found. Cholecystitis, due to bacterial toxins, has been produced experimentally by Claude (*Bull. Soc. Anat.*, Paris, 1896, p. 502); but there is no clinical proof of its existence in man. Injury may certainly play a part in the actual onset of acute cholecystitis by lowering the resistance to infection. Calculus cholecystitis appears to be fairly often associated with trauma.

Varieties of Acute Cholecystitis

I. Acute Catarrh

This is a non-suppurative inflammation leading to a serous or sero-fibrinous exudation into the gall-bladder, causing erosion, or superficial ulceration of the mucous membrane.

Morbid Anatomy.—The gall-bladder is distended with exudate. Its walls are thickened and tense. The mucosa is congested, and it may show erosion with a deposit of sticky bile on its surface. The muscular coat may be infiltrated and softened. The cystic duct is often obstructed from swelling of the mucous membrane. Gall-stones may be present, or there may be a little inspissated bile. The fluid may be clear, or slightly turbid, and bile-stained. The lymphatic glands close to the ducts are enlarged. Microscopically, the mucous membrane shows round-celled infiltration and catarrhal desquamation, with some serous infiltration and degeneration of the muscular layers. The serous coat may be a little œdematous but is otherwise not affected.

Symptoms and Physical Signs:—The onset is fairly sudden. Local tenderness and pain in the right hypochondrium are usual, but the pain in some cases is located in the right iliac fossa, and hence it may give rise to a diagnosis of appendicitis. The pain is less severe than that of biliary colic, but it is often paroxysmal in nature. The most tender spot is usually situated about two inches above and to the right of the umbilicus. The gall-bladder may be felt as a tense pyriform tumour, but more often it is obscured by the rigidity of the upper segment of the right rectus muscle. On percussion, the note in this region may be dull, but even when the gall-bladder is enlarged there may be bowel between it and the abdominal wall. Vomiting occurs with some degree of frequency. The liver is not enlarged unless there be co-existent cholangitis. Jaundice may or may not be present. There is usually some rise of temperature.

Diagnosis.—If a tumour is present in the right hypochondrium, it has to be distinguished from fæces in the colon, hydronephrosis, floating kidney, renal tumour, or carcinoma of bowel. In most cases, however, the abdominal rigidity is too great to allow the gall-bladder to be felt as a definite tumour, and the diagnosis has to be made from the severer

forms of cholecystitis, from biliary colic, and from appendicitis. As regards the first, the question is merely one of the degree and severity of the symptoms; the second is differentiated by the excruciating character of the pain, and the paucity of physical signs. Appendicitis may present considerable difficulty, and it must be remembered that the appendix is a focus from which infection of the gall-bladder may be derived, and the two diseases may co-exist. A low gall-bladder and a high appendix may produce similar symptoms, and physical signs which are almost identical.

Treatment.—Mild cases of cholecystitis can be successfully treated by medical measures, and with rest in bed, a light but nourishing diet, aperients, and the local application of hot fomentations, subsidence of the symptoms may be expected. In cases which are due to the presence of gall-stones, however, recurrence is not unlikely, and attacks which are not attributable to gall-stones may be the starting point of cholelithiasis. Indications for operation are very severe pain, evidence of local peritonitis, and high temperature. If calculi are present they must be removed, and both the ducts and the gall-bladder should be carefully explored, and adequate drainage provided for. Where surgical treatment is not applied, chronic changes are liable to occur, including the production of hydrops, empyema, chronic atrophy, and peri-cholecystitis.

II. Membranous Cholecystitis

This condition is commonly associated with the presence of calculi within the gall-bladder. To establish the diagnosis, casts of the viscus must be found, with or without gall-stones, in the fæces.

III. Suppurative Cholecystitis

Etiology and Pathology.—The presence of calculi is by no means essential, but the commonest predisposing cause

is a stone impacted in the cystic duct. The bacterial infection may be hæmic or alimentary. The condition may, of course, be secondary to cholangitis. The gall-bladder is usually enlarged; it contains pus, which is rarely offensive in odour, and which may be bile-stained. The mucous lining is largely replaced by granulation tissue, and the muscular coat is soft and friable. The peritoneal covering is thickened and dark red in colour, with adherent lymph on its surface. Calculi may be present, adhering to the wall of the viscus, or lying bathed in pus.

Symptoms.—*Pain* is constant, but liable to exacerbations. It is present in the right hypochondriac or umbilical regions, though it may simulate that of appendicitis, and be felt in the right iliac fossa. The temperature is raised, and it may reach 103° or 104° F., being associated with rigors. Anorexia, vomiting, and headache are prominent symptoms. The bowels are constipated. The pulse rate is increased, varying from 100 to 130.

Physical Signs.—Jaundice is not a constant feature, and is fairly often wanting. Tenderness and rigidity in the right hypochondrium are constant, and the rigidity usually prevents palpation of the enlarged gall-bladder. Under anæsthesia, however, a mass corresponding in outline to the gall-bladder may be felt. Dulness in the right flank is sometimes present, but generally the abdomen is distended, and a tympanitic note is common, except in the right hypochondrium. The respiratory excursion of the upper abdomen is restricted. Hyperæsthesia may be found just above and to the right of the umbilicus. A leucocytosis of from 12,000 to 30,000 is common.

Diagnosis.—Suppurative cholecystitis tends to cause local, or even diffuse, peritonitis, and on this complication the difficulty of accurate diagnosis rests. Where the disease is limited to the gall-bladder it has to be differentiated from duodenal ulcer, appendicitis, and possibly sub-phrenic abscess. A history of antecedent biliary colic, or recurrent attacks of jaundice, will be of the greatest value. The

diagnosis from biliary colic rests on the physical signs rather than the symptoms. If local peri-cholecystitis is present, suppuration may occur outside the gall-bladder, and such an abscess may extend in almost any direction. General peritonitis may result from this lesion, and, apart from jaundice, it has no special characteristics suggestive of a biliary origin. Co-existent suppurative cholangitis, or pylephlebitis, are very serious complications.

Treatment.—Surgical interference is indicated as soon as the presence of pus in the gall-bladder is suspected, and the only point which calls for discussion is whether cholecystostomy or cholecystectomy should be performed. We shall consider this matter below in reviewing the general procedure of operations on the gall-bladder.

IV. Phlegmonous Cholecystitis

In this condition all the coats are swollen, friable, and infiltrated with serum or sero-pus. Gall-stones are often present, and the lesion may originate in an ulcer formed by the pressure of calculi. The clinical signs are similar to those described above, but the condition of the patient is more grave.

V. Gangrenous Cholecystitis

Such gangrene may be partial or complete ; in the latter case the cystic duct is occluded, and there is severe infection of the gall-bladder. Clinically it is impossible to differentiate between gangrenous and phlegmonous cholecystitis.

Operative Procedures for Disease of the Gall-bladder

The common operations performed on the gall-bladder are ideal cholecystotomy, cholecystostomy, cholecystectomy, and cholecystenterostomy; but it is clear that the conditions described above certainly demand drainage, so that

the question of cholecystostomy or cholecystectomy will be the one to be decided when operation has revealed the precise nature of the pathological lesion. Speaking generally, it may be said that disease of the serous coat of the gall-bladder wall is an indication for partial or complete cholecystectomy, but the presence of stones, and even pus in the interior, is successfully treated by adequate drainage. In all cases of gall-bladder disease it is important that the condition of the bile ducts should be ascertained by palpation, and, if possible, by inspection.

1. **The Incision.**—Urgent operations such as we are considering require that all possible precautions should be taken against shock, and a special danger associated with operations on jaundiced patients is that of hæmorrhage, so that every bleeding vessel must be secured with great care, and it is recommended that calcium salts, either the chloride or lactate, should be given up to a total of 120 grains in eight doses before the operation. In emergency cases we have given this drug immediately after the operation *per rectum* with satisfactory results, using double doses. The precise value of this treatment is now under experimental investigation.

The gall-bladder is best exposed by a muscle-splitting incision through the upper part of the right rectus, beginning just below the costal margin at the tip of the eighth cartilage. Enlargement of the wound may be obtained by prolonging the incision through the skin and the rectus sheath, if necessary, parallel to the costal margin from both the upper and lower limits of the vertical wound. This will enable the rectus muscle to be split for a considerable distance and give good access to both gall-bladder and ducts.

2. **Examination of the Gall-bladder and Ducts.**—If there are no adhesions between the gall-bladder and the anterior abdominal wall, the liver should be pulled upwards beneath the ribs, and held up in this position. The state of the gall-bladder may then be investigated by inspection and palpation, and before any active steps are taken the

cystic and common bile ducts must be examined. The presence or absence of calculi in all these situations must be ascertained. Inflammatory adhesions, or the presence of infective peri-cholecystitis, may contra-indicate these investigations.

3. **Treatment of the Gall-bladder.**—The necessary treatment is usually clear from the external appearance of the gall-bladder, and, if there is evidence of disease of its outer coats, partial or complete cholecystectomy will probably be indicated. Adhesions around the gall-bladder should be broken down, provided that this step does not cause risk of peritoneal infection. It may sometimes be necessary to open the gall-bladder before it is decided whether drainage or removal is desirable, but in all these cases it is important to ascertain the condition of the ducts before the bladder is opened.

(*a*) *Cholecystostomy.*—For removal of calculi and the treatment of inflammation of the mucous coat, this operation is all that is needed. Before the gall-bladder is opened—and this may be done by a trocar and cannula, or by a scalpel—it is important that gauze plugs should be introduced to pack off the general peritoneal cavity. After the bladder has been emptied of calculi, or inflammatory fluid, a probe or narrow gall-stone scoop should be introduced to ascertain the state of the cystic duct, lest any stone should be impacted at the neck of the gall-bladder, but it is not desirable to attempt to probe the common duct from an infected gall-bladder. The operation is completed by securing a rubber tube into the gall-bladder with a purse-string suture, anchoring the viscus to the parietal peritoneum and posterior sheath of the rectus by means of catgut stitches which pick up the serous and muscular coats about half an inch from the orifice in the gall-bladder. By this means closure of the wound is favoured when the drainage tube is removed. It may also be necessary to drain by a tube, or gauze plugs, the area below the gall-bladder.

The after-treatment of these wounds demands some care.

Gauze plugs should not be removed until the fourth day after operation, and any tube which is draining the gall-bladder is best left *in situ* until it becomes quite loose. The fistula which is left usually closes spontaneously, although the process of repair may take a month or two. If it does not heal naturally, steps must be taken to close the biliary fistula by operation.

(*b*) *Cholecystectomy.*—Partial cholecystectomy may be indicated for the treatment of localised areas of disease of the gall-bladder wall, but for extensive disease it is necessary to remove the whole of the organ, and to establish free drainage of the wound. Drainage of the cystic or hepatic ducts may be called for. If it is clear, on exploring the upper abdomen, that cholecystectomy is necessary, any existing adhesions to adjacent intestine must be separated, and then the gall-bladder freed from the under surface of the liver. It is usually better to begin at the fundus and proceed towards the cystic duct. Where it is healthy the peritoneum on the surface of the gall-bladder is raised as a flap to minimise the raw surface resulting from cholecystectomy, but in phlegmonous disease this will not be possible, and some risk must then be run in order to get away the whole of the infected gall-bladder. At times it is better to begin the removal of the bladder at its neck, and it is always desirable to clamp the cystic duct at an early stage of the operation, to prevent calculi being pushed into it during the necessary manipulations. The stump of the duct should be clamped and closed with a silk ligature or suture, but, in any case, one must be prepared for leakage from the duct, and therefore a large drainage tube should be secured down to the wound in the bile passages.

(*c*) *Cysto-choledochotomy.*—This operation is called for in addition to cholecystostomy or cholecystectomy in those cases where it is not possible to dislodge a calculus from the cystic duct into the gall-bladder and remove it with forceps or a scoop, and it should be done even in the presence of disease of the gall-bladder in order to prevent extravasation

of infective bile. The incision should be made directly over the stone, and close to the liver, in order to get satisfactory healing. The wound must be closed with sero-muscular sutures of fine catgut, and tube drainage established down to the lesion in the duct. If the operation presents great difficulties, it may be wiser to be content with drainage of the gall-bladder in the hope that the cystic duct calculus may be discharged into the dressings; or the stone may be removed at a subsequent operation.

(*d*) *Communo-choledochotomy.*—This may be very difficult, and to make it easier it is desirable to place a cushion beneath the patient's lumbar spine, and to pull up the anterior edge of the liver in order to rotate it through a transverse axis. A calculus may be impacted in the first, second, or third parts of the duct, and its situation may be ascertained by a finger passed into the foramen of Winslow. If it lies in the first part, it may be removed by direct incision over the calculus as it rests upon the finger in the foramen. If the stone is impacted in the second part, an attempt may be made to push it back into the first part; if this fails, an incision must be made as low down as possible in the first part of the duct, and then the stone may be removed by forceps passed along the dilated duct. Provision must be made for the escape of a quantity of bile when the common duct is incised, and the peritoneal cavity must be efficiently shut off by gauze pads. The duct should be sounded by a flexible probe both in an upward and downward direction before the wound in its wall is sutured. Closure should be secured by fine catgut sutures and ample drainage must be allowed for. Care must be taken to prevent the pressure of a drainage tube on the wall of the duct, and for this reason the best form of drain is of the cigarette type. The drainage tube should not be withdrawn until it is clear that bile is passing satisfactorily along the duct. For a gall-stone impacted in the third part of the common bile duct there are two methods of operating which have proved successful: one is to open the anterior

wall of the duodenum over the situation of the calculus, and then remove it by incising the mucous membrane of the posterior wall of the bowel, and the other is to incise the peritoneum on the outer side of the duodenum, displace the intestine, and reach the duct as it enters the posterior aspect of the duodenum. For stones lodged in the ampulla of Vater the former is probably the better method, but it must be carried out with great care, and the intestine should be emptied and clamped before it is opened. After the calculus has been removed, the duct should be probed to see if other stones are present; the incisions in the mucous membrane and duct are left unsutured, whilst that in the anterior wall of the duodenum is closed in the usual way by Lembert sutures.

In those cases where it is felt that the patient would not stand this operation, or where choledochotomy is impossible owing to adhesions, one must be content with drainage of the gall-bladder, to be followed, later, by removal of the lower calculus. For irremovable impacted calculus in the common duct, cholecyst-enterostomy is the correct treatment.

Diseases of the Bile-ducts

Acute Catarrhal Cholangitis

Definition.—This is the pathological name for the condition commonly referred to as simple catarrhal jaundice. It is due to a local inflammatory swelling of the mucous membrane at the termination of the common duct, producing biliary obstruction, and diverting the bile into the general circulation. It is usually painless, and lasts for a period of three to four weeks. It has to be distinguished from contagious jaundice or Weil's disease, which is due to generalised toxæmia or hæmic infection.

Causation.—The primary lesion is gastro-duodenal catarrh, and this may be attributable to alcohol, dietary

indiscretion, or chill. Fever may be present at the commencement of the illness owing to the gastro-enteritis, but it is very rare afterwards. It is possible that in many cases catarrhal jaundice is caused by an extension of duodenal catarrh not up the bile duct, but along the pancreatic duct; consecutive catarrhal pancreatitis causes swelling of the head of the pancreas, and this in its turn causes biliary obstruction.

Clinical Signs.—These are too well known to require any detailed description, and the diagnosis is generally straightforward; but there are times when the jaundice persists longer than the common period, and doubts may thus arise. To this question we shall refer again in dealing with acute yellow atrophy and the jaundice of phosphorus poisoning. Deep green or "black" jaundice excludes simple catarrhal cholangitis, and frequent recurrent attacks suggest intermittent hepatic fever due to a calculus in the ampulla of Vater.

Treatment.—Rest in bed, a light diet, and the administration of cholagogue aperients, suffice in most cases. Large quantities of warm water containing small doses of sodium bicarbonate may be taken with advantage. The duodenitis may be treated by means of such drugs as bismuth and salol, and convalescence may be hastened by spa treatment at Carlsbad, Harrogate, or Llandrindod Wells.

Suppurative Cholangitis

Etiology.—This is a serious condition associated with biliary obstruction and biliary stagnation, with super-added infection by suppurative organisms. Cholelithiasis is undoubtedly a predisposing cause, and the complication is especially prone to supervene on intermittent hepatic fever, but it may be met with in patients who have never shown signs of cholelithiasis. Rupture of an hydatid cyst into a duct also favours this infection, which may also be associated with a growth at the biliary papilla, whereby duodenal catarrh and ascending infection of the common duct are

favoured. It may be a sequel of influenza, pneumonia, typhoid, and cholera, or it may be a part of a general systemic pyæmia.

Pathology.—The mucosa of the ducts is swollen and eroded, or even ulcerated. The outer walls are thickened and inflamed, and there may be extension to the peritoneum, the liver tissue, or the radicles of the portal vein. An empyema of the gall-bladder may also be present. The ducts may become enormously distended with purulent exudate. Abscesses scattered throughout the liver are not uncommon, but there may be one large single abscess. The pus is stained with bile. Suppurative pancreatitis is by no means a rare complication. General or local suppurative peritonitis may be present. Microscopically, the large portal areas are dilated, and both portal veins and bile ducts may be involved in the suppurative process ; there is extensive necrosis of the hepatic tissue, as well as diffuse small-celled infiltration.

Symptoms and Physical Signs.—A period of anorexia and malaise usually precedes the acute onset of this infection, which is marked by collapse, followed by rigors and high fever. There is pain in the upper abdomen, of a dull aching character, with occasional exacerbations, but cases are described in which pain was absent. Jaundice, by no means constantly present, is due to blockage of the finer bile ducts in the liver substance. Septic diarrhœa may be observed.

The aspect of the patient is grave. The tongue is coated and dry ; the pulse rapid and of poor volume ; some mental confusion is common, and coma is present in fatal cases. The liver is tender, increased in size, and smooth to the touch ; it usually exhibits progressive enlargement. The spleen is also enlarged in a high percentage of cases.

Diagnosis.—In a patient, whose past history points to cholelithiasis, suffering from fever of an intermittent type with severe constitutional disturbance, this lesion may well be suspected, but the differential diagnosis has to be made from tropical liver abscess, from suppurative pylephlebitis,

and also from rapidly growing malignant tumour. In tropical abscess there is commonly a history of antecedent dysentery, and the physical signs of this condition are usually characteristic. Pylephlebitis causes less jaundice but more splenic enlargement than suppurative cholangitis, but the two conditions are often co-existent. A very rapidly growing tumour, with fever and jaundice, and general enlargement of the liver may be a source of difficulty in diagnosis, and sometimes there is actual pus in the ducts in these cases. A history of past attacks of biliary colic, or the passage of gall-stones, does certainly favour a diagnosis of suppurative cholangitis, but it must be remembered that this is a rare disease.

Prognosis.—This is always grave, and much depends upon the possibility of obtaining free drainage of the ducts.

Treatment.—Cholecystostomy is clearly indicated, and, as a rule, the ducts as well as the gall-bladder should be opened and drained. Any abscess present in the liver substance must also be incised freely.

Abscess of the Liver

Single or Tropical Abscess

The close association between dysentery and tropical liver abscess is well known, but it must be remembered that there are two definite forms of dysentery—the amœbic and bacillary—and it is the former which gives rise to the single abscess of liver. The bacillary form may be the cause of multiple liver abscesses. These two varieties of dysentery possess well-defined clinical differences, and so also do the two classes of suppuration in the liver.

There are other causes of single hepatic abscess, such as injury, suppuration in an hydatid cyst, pyæmia, and rarely, typhoid fever and appendicitis. A penetrating wound due to a stab or a bullet may lead to a localised single abscess, and a blow which ruptures the liver without tearing its capsule may be followed by local suppuration.

Etiology of Tropical Abscess.—The geographical incidence of this disease varies very greatly; it is more common in the East than in the West Indies; Europeans are more liable to it than natives; and males are more often affected than females. Isolated cases of large solitary abscess are met with in patients who have never been out of England. Alcoholism is often regarded as a predisposing factor. This disease rarely attacks young children or those of advanced age.

Pathology.—The right lobe is affected in from 60 to 80 per cent. of the cases, and the abscess is most often deeply placed towards the posterior and upper border of the liver. In shape it is round, and the abscess cavity rarely contains less than half-a-pint of pus; the record is something like nineteen pints.

The liver shows recent inflammation, together with fibrin adherent over the abscess, which, as it enlarges upwards, causes the liver to adhere to the diaphragm, the pleura, and ultimately to the lung. Infection of the pleura is not uncommon, and the resulting pleurisy may be dry, serous, or purulent. The abscess cavity, which has ragged, fibrinous, and blood-stained walls, is surrounded by necrosing hepatic tissue infiltrated with polymorpho-nuclear leucocytes. An abscess of long standing is lined by comparatively smooth granulation tissue, and has a fibrous capsule, which may send out processes into the surrounding substance of the liver. Small amœbic abscesses have a shreddy, spongy wall, and contain a glairy fluid. Amœbæ are present in the tissue around the abscess cavity, which shows necrosis rather than acute inflammatory changes. The absence of dense leucocytic infiltration is somewhat characteristic. Large amœbic abscesses resemble chronic abscesses due to any cause. The pus in these amœbic cases is viscid yet translucent, and it hardly resembles ordinary pus. In other forms the pus is creamy, yellow, or brownish-red, most frequently the last.

Microscopy.—Amœbic abscesses contain within their

walls amœbæ, necrotic liver cells, and red blood corpuscles. Leucocytes are very few in number. Organisms, such as staphylococci and streptococci, may be present.

Bacteriology.—From this point of view tropical abscesses may be divided into two classes, viz.: those which do, and those which do not contain amœbæ. Cultures from those which do contain the amœba are often sterile, but this parasite may be grown outside the body. Abscesses which do not contain the amœba yield cultures of organisms derived from the alimentary tract. Whether the amœba alone is capable of causing suppuration is not yet certain, for it is quite possible that it may produce this change by carrying suppurative organisms into the liver substance from the intestine. Amœbæ are found chiefly in the wall of the abscess and not amongst its contents. In addition to staphylococci and streptococci, the pneumococcus, the bacillus coli, and bacillus pyocyaneus have been cultivated.

Symptoms.—The onset is gradual, with malaise, debility and shivering. Nocturnal sweats may be pronounced. The fever is usually remittent, and resembles that of malaria. Pyrexia may be absent. Rigors are common in the course of the disease. Pain over the liver, with a sense of fulness in the right hypochondrium, is usually present, and the pain is dull and constant in character, with occasional sharp stabbing pleural pain in addition. It may be referred to the right scapular region. Vomiting is very inconstant; it is said to occur most often when the abscess is situated in the left lobe. The appetite is bad, and flatulence may be troublesome. Either constipation or diarrhœa may be present. Some depression and mental irritability are not uncommon, and there may be insomnia. Delirium and convulsions occur before death. In some cases there is a hacking spasmodic cough, and the abscess may communicate with the lung and bronchus; the expectoration may then closely resemble anchovy sauce in appearance.

Physical Signs.—The face has a sallow or muddy complexion; the eyes are sunken, and the expression

anxious. The patient adopts the dorsal *decubitus*, except with a large right-sided abscess, when he lies on the affected side. Jaundice is present in slight degree in from 10 to 20 per cent. of cases, but deep jaundice is rare; the conjunctivæ, however, are frequently yellowish and bloodshot. The pulse is of low tension and somewhat increased in rate.

Local Signs.—Rigidity of the rectus below the costal margin is found on palpation, and percussion over the lower costal arches may cause pain. There is some distension in the upper abdomen, and it may be general. Definite bulging of the right hypochondrium, with a visible rounded projection, may be seen, and this may be observed to move with respiration. Mensuration may reveal enlargement of the right side of the chest. Redness and œdema of the skin may be seen. Fluctuation is rare. The area of liver dulness on percussion is usually increased both in an upward and downward direction, and skiagraphy may show elevation or immobility of one or other cupola of the diaphragm. In most cases the upper level of liver dulness begins to rise in the anterior axillary line, reaching its maximum near the angle of the scapula; this dome-shaped dulness at the right base is very suggestive of liver abscess. The spleen is rarely enlarged. Œdema of the feet may be seen in the later stages of the disease. The urine is high coloured, loaded with urates, and albuminuria is common.

Diagnosis.—Pain in the upper abdomen, with progressive enlargement of the liver and fever, in a patient who is known to have resided in the tropics and to have suffered from dysentery, points strongly to a diagnosis of tropical abscess. Fluctuation or œdema over the right hypochondrium makes the diagnosis simple, but these are rarely present. A leucocytosis may be suggestive, though it is by no means constant. The differential diagnosis may be very difficult and we can only give a mere outline of the possibilities which have to be borne in mind.

1. *Suppurating hydatid cyst.*—Here the complement fixation reaction may be required to settle the diagnosis, since leucocytosis may be found in both diseases; the hydatid eosinophilia may be observed.

2. *Sub-phrenic abscess.*—A previous history pointing to gastric ulcer, duodenal ulcer or appendicitis is of great value. If an air-containing abscess be present, succussion may be obtained, and the " bell sound " on percussion.

3. *Suppurative pylephlebitis and multiple abscesses of liver.*—Here one must depend on the local signs, and a previous history of an acute infective abdominal condition rather than a dysentery of tropical origin.

4. *Intermittent hepatic fever.*—This condition can be established only where there is a clear history of cholelithiasis. There is jaundice of varying intensity.

5. *Pancreatic cyst.*—In nearly all cases this is preceded by abdominal injury, and it is not associated with fever.

6. *Malaria.*—A leukopenia, rather than a leucocytosis, is present in malaria. It must be remembered that acute hepatitis without abscess may occur in malaria. Blood examination for parasites is important.

7. *Neoplasm.*—If the rate of growth is very rapid, and the enlargement of the liver general, an abscess may undoubtedly be simulated.

8. *Lymphadenoma.*—There will usually be other signs of this disease as well as those affecting the liver.

9. *Syphilitic gummata of liver.*—These are usually multiple, and can be felt to be so on palpation of the enlarged organ.

10. *Cirrhosis of the liver with ascites.*—Marked excess of peritoneal fluid in tropical abscess is rare, and it is only late stages in cirrhosis which may resemble the disease under consideration.

11. *Right-sided pleural effusion.*—This is diagnosed by the lateral displacement of the heart to the left, the position of the diaphragm, and the absence of downward enlargement of the liver.

Prognosis.—Recurrence is not uncommon, even after apparently successful treatment, especially if the patient resides afterwards in a tropical climate.

Treatment.—In considering the question of diagnosis we have made no mention of exploration with a trocar and cannula because we consider such a course unsafe and undesirable, but if it is regarded as a step in the operative treatment of tropical abscess, there is no great objection to it, and many authorities advocate this method of localising, and even draining, the abscess. For this purpose a wide bored needle of some 3½ inches in length, capable of being fitted on to a glass syringe or aspirator, should be employed. If the situation of the abscess is unknown, the usual site for puncture is in the eighth space in the anterior axillary line, an inch and a half above the right costal margin, and the needle should be directed inwards, backwards, and slightly upwards, since the common position for the abscess is in the upper and back part of the right lobe. Several punctures may be made in the liver if the first is not successful, and it is said that such "hepatic phlebotomy" is not harmful. Castellani and Chalmers advise that small abscesses should be treated differently from large ones, the latter calling for more extensive operation.

1. *Aspiration.*—This is regarded as the best method of dealing with small abscesses. When once the pus has been found by the exploring needle, the abscess is emptied and the cavity irrigated at frequent intervals with bi-hydrochloride of quinine (3 grains to the ounce), by means of Rogers's sheathed aspiration cannula. Major Leonard Rogers (*Lancet*, October, 1912) advises the injection of one grain of emetine hydrochloride, dissolved in an ounce of water, after aspiration; if the cavity is a very large one, the aspiration and injection may have to be repeated. He says there is good reason to hope that the open treatment will in future be only exceptionally required.

2. *Open operation.*—This is essential if the abscess is

large, if the pus is not sterile, and if there is extension to the pleura, lungs, or peritoneum. Two routes are available, thoracic and abdominal.

(*a*) *Thoracic route.*—Guided by the cannula, part of the rib below it should be excised; the pleural cavity having been entered, the diaphragm should be partially divided and sutured to the edges of the pleural wound; the abscess may then be opened, irrigated thoroughly with the quinine solution, and then partially sewn up with a drainage tube secured to the edges of the wound. The tube should be of only moderate size so as to minimise the risk of conveying infection from the exterior.

(*b*) *Abdominal route.*—All that is necessary is incision and drainage through the site of the swelling of the abdominal wall, in one stage if the liver is adherent to the parietes, or in two if the liver is free, after packing gauze between the liver and the edges of the wound to promote the formation of protective adhesions.

After Treatment.—Frequent irrigation with quinine lotion is advocated by most authorities; there must be adequate drainage, and there should be no undue haste in shortening or removing the tube. A course of ipecacuanha or, better, of emetine, is recommended as a prophylactic against recurrence, especially in the case of those who have to return to a tropical climate.

Multiple Liver Abscess

This disease may arise in one of the following four ways, viz.:—

1. It may be part of a general pyæmia.

2. It may arise from portal pyæmia, due to dysentery, appendicitis, ulcerative colitis, etc.

3. It may be a later stage of suppurative cholangitis, and the extension of the inflammation is sometimes accounted for by the presence of parasites in the hepatic ducts.

4. It may spread from a large single abscess.

As a part of general pyæmia it is very rare, and most frequently it is due to suppurative pylephlebitis. Its relation to dysentery is that it is rare in the amœbic form, but less so in the bacillary variety of the disease. Small hepatic abscesses in amœbic dysentery are said to be caused by additional coccal infection. Appendicitis is certainly the commonest cause of these multiple liver abscesses, and it appears that a small abscess under tension is most likely to give rise to this complication. Gastric ulceration is rarely followed by multiple abscesses in the liver.

Prognosis and Treatment.—The outlook is very grave, but drainage of abscesses is certainly indicated, and they may usually be approached by the abdominal route. Such cases as we have met with, complicating appendicitis, have all terminated fatally.

Acute Yellow Atrophy

Definition.—An acute degeneration of the liver with diminution in size, accompanied by jaundice, fever, and nervous symptoms, and usually terminating fatally.

Etiology.—The commonest age period is the third decade. Females are affected twice as often as males. The influence of pregnancy is especially important, and an undoubted relationship exists between acute yellow atrophy and puerperal eclampsia. The time for its occurrence is between the fourth and seventh months of pregnancy. Alcoholic excess is a potent factor in the causation of the disease, and, in a less certain degree, chloroform narcosis, mental disturbance, and secondary syphilis may at times play their part.

Acute yellow atrophy may supervene in the course of cirrhosis, catarrhal jaundice, gall-stone obstruction, or chronic venous engorgement.

Pathology.—The liver may lose a half, or even two-thirds, of its normal weight, and it is said that the shrinkage usually begins in the left lobe. The capsule is wrinkled

and loose; it can often be pulled off quite easily, revealing small sub-capsular hæmorrhages. Section shows that the organ is of bright yellow colour with the outlines of the lobules obscured. There may be areas of compensatory hyperplasia, exhibiting adenomatous nodules. The gall-bladder commonly contains thick mucus and bile, but the large ducts often contain mucus only. The amount of fat which can be extracted is perhaps five per cent. above normal. Leucin and tyrosin are present in large quantities in the liver cells, the kidneys, and the blood of the veins.

Microscopical changes.—Hæmorrhagic degeneration, with proliferative cholangitis, followed by necrosis, is the usual picture presented by sections. Sometimes there is evidence of regeneration, as shown by the adenomata mentioned above, and new bile ducts may be formed. Micro-organisms of many types have been found, but there is no established causal relationship with any specific organism. Other solid organs show cloudy swelling, and in the intestine there is evidence of catarrh.

Clinical Aspect.—This disease in its characteristic form presents two quite definite stages. In the first there is gastro-intestinal disturbance with some malaise for a few days or even weeks, followed by jaundice. In the second stage the patient sinks into a "typhoid state," the jaundice increases in intensity, and nervous symptoms are manifested. This stage lasts for three days to a week. It must also be remembered that there are cases with little or no jaundice. The first stage may present the characters of an attack of simple catarrhal jaundice, but there are usually more severe constitutional disturbances, and malaise, vomiting, constipation, and muscular pains are features which call for attention.

The second stage of the illness is marked by intense headache, restlessness, and delirium. Muscular twitchings and transient paralyses may be observed, and coma supervenes before the fatal issue. Vomiting is repeated, and the vomit may contain altered blood. Hæmorrhagic rashes

occur. The fever is of variable degree. Abortion usually occurs in the case of pregnant women. With regard to the physical signs, especial attention should be directed to the area of liver dulness; a temporary enlargement may be found in an early period of the illness, and this is succeeded by progressive diminution until the dulness completely, or almost completely, disappears. There are no characteristic blood changes, but a slight leucocytosis is usually present.

The *urine* is high-coloured from the presence of bile pigment; the percentage of urea is diminished, and its place is taken by leucin and tyrosin, probably derived from the disintegration of hepatic cells. This change must not be regarded as pathognomonic of acute yellow atrophy.

Diagnosis.—This may be impossible until the second stage of the disease is reached. In the first place acute yellow atrophy has to be distinguished from phosphorus poisoning, a condition which we shall consider in a separate paragraph. Clinically, there are many points of resemblance between the two diseases, but there is usually an interval between the action of phosphorus as an irritant poison and its destructive effect on the liver. In Weil's disease there is high fever, and enlargement of both liver and spleen; pains and cramps are present in the calves; there is neither leucin nor tyrosin in the urine.

Prognosis and Treatment.—The outlook is very gloomy, since the mortality in fully recognised cases is very nearly a hundred per cent. Treatment can only be directed to maintaining the strength of the patient, and endeavouring to dilute the toxins by saline infusions.

The Jaundice of Phosphorus Poisoning

Incidence.—Since the introduction of red or amorphous phosphorus in place of the yellow variety in most commercial processes, the incidence of phosphorus poisoning, both acute and chronic, has greatly diminished. Poisoning, however, is occasionally met with as the result of sucking

matches by children, or from the medicinal use of phosphorus.

Pathology.—The appearance of the liver may bear a close resemblance to that seen in acute yellow atrophy, although it is usually enlarged. It is friable and pale, exhibiting sub-capsular hæmorrhages, cloudy swelling, and the deposition of bile-pigment granules within the cells. Fatty changes are found in the other solid viscera, and the spleen is enlarged.

Clinical Signs.—The first symptoms point to irritant poisoning; there is vomiting, severe gastric pain, and, possibly, collapse. The vomit is luminous in the dark, and it may contain blood. There is thirst, gastric and hepatic tenderness, but no enlargement of the liver. Some temporary improvement in the patient's condition commonly follows, and then, from two to six weeks after the onset of the illness, more severe symptoms make their appearance. Jaundice supervenes, and gradually increases in severity; there is recurrent vomiting of dark fluid, marked prostration, and the patient sinks into coma, and dies in five or six days. Hæmorrhages into the skin, as well as from the mucous membranes, are not uncommon. The liver is enlarged and tender, and the jaundice is attributed to inflammation of the smaller bile ducts. The urine is diminished in quantity; it may contain albumen, blood, and casts. Leucin and tyrosin *may* be present, the former more often than the latter.

Diagnosis.—We have already referred to the clinical resemblance existing between acute yellow atrophy and jaundice due to phosphorus poisoning, and the diagnosis of the latter usually depends on the history of the case rather than the physical signs. In the early stages, if the source of the trouble is unknown, a diagnosis of irritant poisoning is all that can be expected, unless luminosity of the vomit is observed; in the later stages the resemblance to acute yellow atrophy is very marked, but there are the following differences to be observed. In acute yellow atrophy the

diminution of the liver dulness is constant, whereas phosphorus causes some enlargement, at any rate at first. Acute yellow atrophy is characterised by rapid disintegration of liver cells with but slight increase in the amount of fat; the liver of phosphorus poisoning contains 30 per cent. of fat; the liver of acute yellow atrophy contains only 5 per cent. It is possible that time may play a part in these relative proportions between fatty disintegration and degeneration. Similar changes in the liver in the direction of rapid fatty degeneration have been described in cases of delayed chloroform poisoning.

Prognosis and Treatment.—Phosphorus poisoning to this degree is usually fatal. In the early stages gastric lavage is indicated, followed by draughts of mucilaginous drinks, and oxidised oil of turpentine, which should be given in 40 minim doses every 15 minutes for three or four doses, and then thrice daily. Oils and fats must not be administered, because they render phosphorus soluble. In the jaundiced state sodium bicarbonate by subcutaneous infusion has been recommended.

CHAPTER X

THE PANCREAS

THIS chapter will be devoted to a consideration of those inflammatory lesions of the pancreas, which, by reason of the anatomical situation of the gland and their comparative rarity, are liable to be mistaken for other acute abdominal diseases. Pancreatic cysts, chronic pancreatitis, and cancer, especially of the head of the pancreas, are now well-recognised clinical entities, but the varieties of acute inflammation affecting this important structure are far more difficult of recognition.

Inflammatory lesions of the pancreas may be catarrhal or parenchymatous, the former being an affection of the ducts, the latter involving the secreting and connective tissue of the gland. Of these two types, that affecting the parenchyma is the more serious, since it may arise as an extension from the ducts, or by infection of the blood supply of the organ. The following is a simple classification of acute pancreatitis.

1. Catarrhal inflammations.
   - (*a*) Simple non-suppurative catarrh.
   - (*b*) Suppurative catarrh.
2. Parenchymatous inflammations.
   - (*a*) Hæmorrhagic pancreatitis, in which the acute inflammation may precede the hæmorrhage, or the hæmorrhage may be the initial lesion.
   - (*b*) Suppurative pancreatitis, with diffuse purulent infiltration.
   - (*c*) Gangrenous pancreatitis.

Sub-acute parenchymatous pancreatitis occurs in the form of a localised abscess. The symptoms and physical signs in such cases more closely resemble those of chronic than acute pancreatic disease, and in the only case which we have operated upon, the patient had complained of recurrent severe attacks of abdominal pain together with varying jaundice for several weeks. There was fever, anorexia, and loss of weight; the stools were pale but not fatty, and the Cammidge "C reaction" was positive. Exploratory operation revealed a swelling of the head of the pancreas, with no evidence of either biliary or pancreatic calculi; the tumour felt too soft to be either the usual scirrhous carcinoma or chronic pancreatitis; incision into it gave exit to a little non-offensive pus, and revealed an abscess cavity three-quarters of an inch in diameter. The abscess was drained and the patient made a complete recovery. Cultivations from the pus showed the presence of the staphylococcus albus in pure culture.

Histology and Physiology of the Pancreas.—Some knowledge of the results of recent research on the character and physiological functions of this gland is essential to the complete understanding of its pathological lesions, and a brief outline of the views of modern observers may now be considered. The pancreas is a compound acinous gland, composed of alveoli of tubular shape surrounding ducts, which are of varying size. The alveoli around the smallest ducts are grouped together to form primary lobules, and as these ducts pass into larger ones, and the number of alveoli increases, secondary lobules are formed; these again are massed together around the ducts which open into the main duct of the gland, and form the so-called tertiary lobules, the smallest sub-divisions of the gland which can be recognised by the naked eye. A single layer of cells lines the alveoli, and each cell is of cylindrical shape with a tapering extremity placed towards the lumen of the alveolus, or commencement of the primary ducts.

The nuclei of these cells are centrally placed, and there

is often a spherical para-nucleus, a small protoplasmic mass which stains more deeply than cytoplasm. The ducts are lined by a single layer of columnar cells which exhibit very faint longitudinal striation, and the larger ducts have a double coat of connective and elastic tissue forming the basement membrane of these cells. Between the alveoli, or acini, there are islands of small spherical or polygonal cells to which attention was first drawn by Langerhans in 1869. These are commonly termed the islands of Langerhans, and in man they are scattered throughout the glandular substance of the pancreas; they possess a centrally placed round or oval nucleus, and are richly supplied with a capillary network of blood vessels and also with an abundant plexus of nerve fibres. The blood vessels of these islands are probably derived from sinuses which are connected with the inter-acinar capillaries.

The capsule of the pancreas is composed of a fine layer of connective tissue which sends processes in between the lobules of the gland forming an inter-lobular framework which supports the vessels and nerves to the primary and secondary lobules.

Physiological functions of the pancreas.—The chemical composition of the pancreas, as determined by Oêdtmann, consists of 74·53 per cent. of water, 24·57 per cent. of organic matter, and 0·95 per cent. of inorganic material. The chief constituent of the cells bears a close chemical resemblance to trypsin, and this substance, after hydrolysis with dilute acids, yields a reducing body belonging to the pentose class, so that Neuberg has estimated that nearly 2½ per cent. of the dry weight of the pancreas is a pentose, while other organs in the body do not contain more than a half per cent. of this substance.

Pancreatic ferments.—These are four, or possibly five, in number, viz.: (1) Amylopsin, which converts starch and glycogen into dextrin and maltose; (2) trypsinogen, which after being activated by the entero-kinase of the succus entericus, converts proteids into peptones, albumoses, and

amino-acids; (3) steapsin, which splits up neutral fats into fatty acids and glycerine; (4) a milk-curdling ferment, which in the presence of calcium salts convert caseinogen into casein; (5) a doubtful ferment, called lactase, which is reputed to be capable of splitting milk sugar into galactose and dextrose. Of these ferments the most important is steapsin, and the conversion of neutral fats into fatty acids and glycerine is peculiarly the function of the pancreas. Other body fluids emulsify fats, and the gastric juice may have a slight fat-splitting power, but there is certainly no such ferment in the succus entericus. Like the other pancreatic ferments, steapsin acts most rapidly in a neutral or weakly alkaline medium, and the presence of bile in the intestine favours its activity very greatly.

According to the generally accepted views, the fatty acids resulting from the ferment action of steapsin combine with the sodium, potassium, calcium, and magnesium in the intestinal fluids, forming soluble alkaline soaps, which are absorbed by the cells of the intestinal villi together with the glycerine moiety. Within these cells they are again built up into neutral fats. The assistance of bile in these processes is probably due to the fact that both lecithin and bile salts increase the solubility of alkaline soaps, and cause free fatty acids, which are insoluble in water, to become soluble.

Pathological phenomena in connection with diseases of the pancreas afford abundant evidence of the activity of this constituent of pancreatic juice in the production of fat necrosis.

Fat necrosis.—The fat of the abdominal viscera, particularly in the neighbourhood of the pancreas and in the great omentum, is sometimes found to exhibit dull white, or yellowish-white, opaque areas of very variable size. These patches of fat necrosis are visible to the naked eye by reason of the contrast between the opaque white necrotic areas and the clear yellow, glistening, normal fat, and their hardness renders them easily palpable in the midst of healthy fatty

tissue. They bear a superficial resemblance to the minute tumours of miliary tuberculosis seen on peritoneal surfaces,

FIG. 19.—Fat necrosis.

but they do not, as a rule, project like miliary tubercles, and their dull white colour serves to render them distinctive. Confusion between neoplastic deposits in the omentum and

fat necrosis is hardly likely to arise. That fat necrosis found during life is pathognomonic of some lesion of the pancreas appears certain, for not only may it be found in all varieties of pancreatic disease, but numerous experiments have been carried out which show that if the pancreatic secretion be diverted from its normal course it is capable of producing widespread fat necrosis. The most convincing observation is that of Opie, who transplanted the cut end of the pancreatic duct to a position within the subcutaneous fat of the abdominal wall. The animal lived for twenty-seven days, and at the end of this time areas of fat necrosis were present in the subcutaneous tissue of the abdomen and thorax, but the condition was most noticeable around the cut end of the duct. Experimental injuries to the pancreas which damage its thin capsule, and may readily lead to escape of pancreatic juice, are followed by local fat necrosis, and the dependence of this condition on lesions of the pancreas is so clear that in the following case, although no lesion of the organ was actually demonstrated at the operation, it may be assumed that the stress of the injury fell upon the pancreas, causing bruising, or even rupture, of some of its lobules.

F. C., Male, aged 7 years.—On the day of admission to hospital the child was knocked down by a cart, and two wheels passed over his abdomen. On examination some two hours later his pulse rate was 104°; respirations 24, and he was suffering from a considerable degree of shock. There were contusions of the abdominal wall, and on palpation there was diffuse rigidity and tenderness. No dulness in the flanks; liver dulness normal. Normal urine was drawn off by catheter. No evidence of injury to bones. There was no vomiting after the boy came into hospital. The next day there was still universal abdominal tenderness, and the facial aspect was anxious; the pulse rate was 114.

Two days after the accident, as the general condition of the patient showed no improvement, the abdomen was explored. There was no free gas or fluid present, but areas of fat necrosis were found scattered throughout the great omentum and the transverse mesocolon, most noticeably to the left of the stomach. The pancreas felt normal, and the other viscera were quite healthy. The abdomen was closed, and the patient made a rather slow recovery, putting on

three pounds in weight in the month following the operation, and leaving the hospital at the end of five weeks.

The only digestive disturbance was evidenced by slight constipation; there was at no time either azotorrhœa nor liporrhœa. Cammidge's pancreatic reaction " A " was positive; " B " was negative.

The appearance of fat necrosis in the great omentum as seen by naked eye is shown in Fig. 19. Microscopically, these dull white areas exhibit the needle-like crystals of fatty acid combined with calcium both within and outside the necrotic fat cells, surrounded by a zone of acute inflammation; bacteriologically, they are usually sterile.

In many pathological states of the pancreas there is evidence that pancreatic digestion is in abeyance, and it is mainly by such evidence as this that it is possible to arrive at a diagnosis.

Concerning the part played by the islands of Langerhans, many theories have been put forward, but the one which appears to be supported by both experimental and pathological evidence is that these peculiar cells provide an internal secretion which exercises a control over normal carbohydrate metabolism. In a large number of cases where death has occurred from diabetes, the only discoverable lesion has been a hyaline degeneration, or a sclerosis, of these cell islets, and, further than this, it is most unusual to meet with a case of chronic interstitial pancreatitis involving the islands of Langerhans in which diabetes has not been present during life, and in a case of pancreatitis described by S. G. Scott, in which only these islands remained, there was no sugar in the urine.

Diagnosis of Pancreatic Disease

In the present state of our knowledge we are dependent upon a general consideration of the history of the patient, as much as upon the symptoms of the recent illness and its physical signs, for the diagnosis of pancreatic lesions; thus

it may be quite easy to recognise the onset of chronic pancreatitis, or carcinoma of the pancreas, in a patient who is known to be subject to cholelithiasis, but the diagnosis of acute pancreatic disease, and the differentiation of the recognised pathological varieties of pancreatitis, is still a matter of great difficulty. The explanation of this lies in the fact that pancreatic symptoms require careful clinical, and often chemical, investigation, for their correct interpretation. These symptoms may be classified under three headings as follows: (1) Digestive disturbances; (2) abnormal metabolism; (3) those discoverable by chemical tests.

(1) **Digestive Symptoms.**—(*a*) *Loss of appetite, pain,* and *discomfort after meals,* are all common in patients suffering from pancreatic disease, and, even in acute attacks, a history of previous indigestion will suggest an upper abdominal lesion.

(*b*) *Vomiting.*—The vomiting in acute pancreatitis, especially the hæmorrhagic form, is severe and prolonged, and may often be suggestive of intestinal obstruction. The vomit is usually bile-stained and is ejected with some force. It is possible for suppurative pancreatitis to cause the vomiting of pus; in the latest stages of acute pancreatitis "black vomit" may be seen.

(*c*) *The fæces.*—The condition of the fæces is one of the most important considerations in the diagnosis of pancreatic disease. Unfortunately constipation is common in acute attacks, so that the characteristic state of the fæces, which may be termed "pancreatic stools," is not often seen before operative treatment is undertaken. These characters must, however, be borne in mind, since the patient may have noticed something abnormal before the onset of the more severe symptoms. In general character "pancreatic stools" are bulky, greasy, and pale; they are passed frequently, and the patient often considers that he is suffering from diarrhœa, whereas the frequency of defæcation is due to the quantity of partially digested material that accumulates within the intestine, and is not associated with excess of

mucus and fluid as seen in true diarrhœa. The pale colour of these stools has been the subject of much discussion; it used to be held to be due to the absence of bile, caused by blockage of the common duct, but there seems to be no doubt that this is not the correct explanation, for in cases of chronic pancreatitis, or of carcinoma of the head of the pancreas, the fæces still remain pale even after cholecyst-enterostomy has been performed, whereby the whole of the bile has been conducted into the small intestine and the patient's jaundice has been completely relieved. Further than this, Claude Bernard, experimenting with de-pancreatised dogs in 1856, discovered that bile alone caused the fæces to be of bright yellow colour. It is well known that if a healthy person be dieted with an excess of fat the stools passed become paler than normal. The explanation of the pallor and greasiness of these stools, then, lies in the excess of fat contained in them, and their increased bulk is explained by the quantity of undigested residue which they contain; their softness is also due to the presence of fat. Since in pancreatitis the principal, almost the only, ferment for splitting fats is interfered with, it is not surprising that a considerable quantity of undigested fat is passed in the fæces, and to this condition the term "liporrhœa" or "steatorrhœa" is commonly applied. This term should be reserved for those cases where fat in the stools is recognisable by ordinary inspection; "chemical steatorrhœa" may occur in a variety of abnormal states. Analysis of these stools shows that neutral fats are present in excess of fatty acids. When steatorrhœa is present, before the pancreas can be held to blame, it must be ascertained that there is no abnormal amount of fat taken with the food, and also one must be confident that the intestine is in a healthy condition for the absorption of fat; confirmation of the diagnosis may sometimes be obtained by noting the amelioration which ensues if some preparation of fresh pancreas be taken by the patient after meals.

Failure of fat digestion is not the only physiological defect

noticed in pancreatic diseases. When proteid substances, such as muscle fibres, are found in large quantities in the fæces, the patient is said to be suffering from "*azotorrhœa*," and while this condition is not so characteristic as steatorrhœa, yet it is of some importance. Microscopical examination of the fæces is usually needed to establish the presence of azotorrhœa.

(2) **Abnormal Metabolism in Pancreatic Disease.**—(*a*) *Glycosuria.*—We have already paid some attention to the relationship existing between diabetes and pancreatic disease, and we have seen that the co-existence of these lesions usually points to very extensive loss of pancreatic substance, so that the long resisting islands of Langerhans are destroyed. Glycosuria, therefore, since it appears late in pancreatic lesions, is of little value in diagnosis of acute pancreatitis, though occasionally the fact of finding a reducing substance in the urine of a patient suffering from acute abdominal symptoms may suggest that the pancreas is at fault; but one is seldom in possession of sufficient knowledge of the patient's previous history to be certain that the glycosuria is a recent symptom.

(*b*) *Cammidge's reaction in the urine.*—This reaction, which was introduced by P. J. Cammidge in 1904, and has undergone certain modifications since that date, is undoubtedly of value in the confirmation of a diagnosis of lesions of the pancreas. Unfortunately it takes some considerable time to perform, and is not yet possible outside a chemical laboratory. The improved method or "C reaction," now recommended by Cammidge, is held by this authority to prove in nearly all pancreatic diseases the presence in the urine of a substance, which, on hydrolysis, gives the reaction of a pentose; for details of the investigation we must refer the reader to Cammidge's publications. We have already noticed that whereas the pancreas on analysis yields 2½ per cent. as pentose, the proportion in any other solid organ of the body is very little above 0·5 per cent.; it is suggested, therefore, that the reaction appears to be obtained most

constantly in inflammatory disease of the pancreas, whereas in cancer, according to Cammidge's recent publications, the reaction is positive in only some twenty-five per cent. of cases. Other observers, following the same chemical routine, have not obtained quite the same results; but it may be stated that a positive " C " reaction points strongly to a pancreatic lesion. The urine of presumably healthy people almost invariably yields a negative result, and those suffering from non-pancreatic diseases only occasionally give a positive reaction, and this very rarely in cholelithiasis unassociated with pancreatitis. This latter fact tends to show the value of the reaction to the clinician, and it is to be hoped that it may be so simplified as to be more quickly and more generally made use of. Both sugar and albumen must be removed from the urine before the Cammidge reaction is undertaken.

(*c*) *The presence of lipase in the urine.*—It has been suggested by Opie that a fat-splitting ferment might be excreted in the urine in cases where acute disease sets free the pancreatic juice, and such might be expected in those cases where laparotomy reveals fat necrosis. Opie has stated that he found evidence of the presence of such a ferment in one fatal case of acute hæmorrhagic pancreatitis, but his method is open to some objection, since he took no precautions against the action of micro-organisms, and there seems to be a possibility that normal and albuminous urines possess some power of splitting fats. If further research should prove the practical value of the test it might be a valuable addition to the means of diagnosis in suspected pancreatic disease. Hewlett, in the Boston Journal of Medical Research, vol. ii., 1904, published his results in cases of experimental pancreatic disease in dogs. Acute hæmorrhagic pancreatitis was produced by injecting hydrochloric acid, or bile, into the main pancreatic duct, and in each of these experiments Hewlett found large amounts of lipase in the urine after operation, as shown by the power which the urine possessed of splitting up ethyl butyrate into butyric

acid and alcohol. If all due precautions are taken to avoid error by control tests, this power of urine to split up ethyl butyrate would appear to point strongly to a severe pancreatic lesion.

(*d*) *Fat necrosis.*—When the abdomen has been opened and fat necrosis of the omentum is revealed, the diagnosis of a pancreatic lesion may be regarded as certain, and the necrosis is usually due to an acute attack of hæmorrhagic, gangrenous, or suppurative inflammation ; in acute hæmorrhagic pancreatitis there is also almost invariably a quantity of blood-stained fluid free in the peritoneal cavity. Extensive fat necrosis undoubtedly points to a very grave prognosis, but we have seen recovery in two or three cases in which the omentum was studded with masses of crystalline fatty salts.

(3) **Symptoms discoverable by Artificial Tests.**—*Sahli's test.*—If iodoform be taken by the mouth, iodine should appear in the saliva and urine in from four to eight hours. In order to test the value of pancreatic digestion, Sahli administers iodoform in gelatine capsules, which are hardened with formalin so as to resist gastric digestion. Formalin, however, is capable of rendering gelatin indigestible by trypsin as well as pepsin, and herein lies the difficulty of the test, for the capsule containing the iodoform must be so hardened that it resists gastric, but not pancreatic, digestion. The value of the test, therefore, is negative rather than positive, and if, after such a hardened iodoform capsule has been taken by the mouth, the iodine reaction appears promptly in urine and saliva it probably excludes serious pancreatic disease.

Catarrhal Pancreatitis

(*a*) **Non-suppurative.**—On account of the anatomical position of the pancreas the diagnosis of this condition is difficult, and, indeed, most authorities regard it as a rare disease. As a precursor, however, of chronic interstitial pancreatitis it is probably not so very uncommon.

Etiology and Pathology.—The close association between pancreatic disease and cholelithiasis must here be considered; it is only since operative interference has become more general in the treatment of gall-stones that the interrelationship of disease of the bile ducts and the pancreas has been investigated, and more completely understood. It is also quite reasonable to assume that catarrhal pancreatitis may be a complication, or, perhaps, the cause, of catarrhal jaundice, which is named from its most pronounced physical sign rather than upon a definite pathological basis. Obstruction to the bile ducts by calculus, or other cause, is well known to favour infection of both the larger and smaller hepatic ducts, and in the same way obstruction to the outflow of pancreatic secretion may lead to infection of the ducts of this gland; hence among the predisposing causes of pancreatic catarrh must be included gall-stone obstruction, duodenal catarrh, carcinoma, or other obstructing diseases of the papilla of Vater, and also anatomical variations in the pancreatic ducts which favour obstruction from external pressure. Other predisposing causes are specific fevers, such as mumps, typhoid fever, and influenza, and injuries.

It must be assumed that the infection is usually conveyed along the ducts from the duodenum, just in the same way as catarrhal cholangitis is considered to be secondary to duodenitis, and it is easy to understand how gall-stone obstruction favours the infection of both the bile and the pancreatic secretion. In some instances the infective agent may be carried by the blood stream, and this is the probable path of infection in the metastatic pancreatitis met with in the course of mumps.

Post mortem and microscopical evidence of the appearance of simple catarrhal pancreatitis is rare, because the disease is not a fatal one, but a few cases have been examined, and the changes found are those of catarrhal and desquamative inflammation of the ducts, with general congestion of the blood vessels and round-celled infiltration, the latter process

extending into the connective tissue and exhibiting the earliest stage of chronic interstitial pancreatitis. Macroscopically the gland is swollen and darkened in colour, containing an abnormal amount of blood, which renders the gland harder than normal.

Symptoms.—These point essentially to a lesion of the upper abdomen. The onset is often sudden, and associated with rather alarming collapse. *Anorexia* and *repeated vomiting* are pronounced features of the case; the vomiting is preceded by *severe epigastric pain*, which may be of a stabbing character, passing through the abdomen to the left shoulder. This may serve as a point of distinction from the pain of biliary colic, which is often referred to the right shoulder, and both of these differ from renal colic in passing from front to back, and not from behind forwards. The vomit is at first gastric, but afterwards it becomes stained with bile, and may ultimately be dark brown in colour. *Fever* is usually present in some degree, but the temperature is not often raised above 102° F. The *pulse* and *respiration* are both quickened. *Constipation* is the rule. *Restlessness* is seen in severe cases. *Jaundice*, evidenced by icteric conjunctivæ, is not uncommon, but bile pigment is absent from the urine.

Physical Signs.—The *respiratory movement* is usually very limited in the upper abdomen. *Swelling*, *tenderness*, and *rigidity* in the epigastrium are the most noticeable features. A *tumour* may sometimes be felt, and it will be found in the right hypochondriac and epigastric regions; it does not descend with inspiration, and its boundaries are ill-defined, though it has a horizontal long axis, and the mass commonly appears to be four or five inches in length. It is always extremely tender, and attempts to palpate such a pancreas must be made with a well-warmed hand placed flat upon the abdomen, with gradually increasing pressure; transmitted non-expansile pulsation of the abdominal aorta can usually be felt as the hand passes from right to left. The rigidity of the abdominal wall, and occasionally distension of

the stomach, may prevent successful palpation. Unless gall-stones are present the gall-bladder is not enlarged. The point of maximum tenderness is situated just above and to the right of the umbilicus. The right rectus is often more rigid than the left. The patient's general appearance is that of an acute abdominal illness ; the complexion becomes dull and the expression anxious ; wasting may be observed soon after the onset of symptoms.

Diagnosis.—In a patient who is known to be subject to gall-stones, or who has had a recent illness such as influenza, typhoid, or mumps, the onset of symptoms similar to the above should suggest the existence of pancreatitis. It has been observed in its simplest form during the course of mumps, and the few fatal cases that have been described go to prove that the onset of acute abdominal pain, situated in the epigastrium, with vomiting and collapse, during the course of this specific disease, points to metastatic inflammation of the pancreas, which may be regarded as the abdominal salivary gland. Such a complication is not very uncommon, and in some recorded outbreaks of epidemic mumps symptoms of pancreatitis have been observed in between 1 and 2 per cent. of the cases. The onset may be at almost any period of the attack of parotitis from the first to the twentieth day, and sudden and severe epigastric pain is commonly the first symptom, followed very shortly by vomiting; nausea, and tenderness in the epigastrium persist for several days, together with constipation, and the attack passes off, as a rule, within a week. The patient may be very collapsed at the onset of the attack, and mental depression often persists for some time afterwards ; many of the cases are followed by orchitis.

Although the diagnosis may not be quite clear on clinical grounds alone, there may be confirmatory evidence in the existence of some of the pancreatic symptoms to which we have already paid attention. To this end both urine and fæces should be carefully examined. Cammidge's reaction in the urine, if positive, affords strong evidence of pancreatitis,

and Sahli's test may be tried. It is not very likely that a lipase would be found in the urine, for catarrhal pancreatitis does not usually give rise to fat necrosis. Steatorrhœa and azotorrhœa may be present, and an acid reaction in fresh fæces may be regarded as in favour of a diagnosis of pancreatic disease.

Treatment.—Instances of catarrhal pancreatitis occurring during the course of mumps have rarely been fatal, and the condition is amenable to medical treatment in the early stages. Calomel should be administered freely, aided, if necessary, by a saline aperient, in order to clear the upper part of the small intestine, and favour drainage of the bile and pancreatic ducts by the normal channel. The diet should be fluid or semi-solid, and pancreatised before ingestion, as in Benger's foods. If the symptoms do not begin to subside after five or six days, there is evidence that the pancreas is grossly diseased, and abdominal exploration should be carried out, for not only is it necessary to endeavour to drain the pancreatic ducts for the existing lesion, but as a preventive against chronic interstitial pancreatitis drainage of both biliary and pancreatic ducts should be established. It is in such obstinate cases as these that the origin of the pancreatitis is likely to be due to cholelithiasis, although there may be no evidence of obstruction of the common duct. The following case illustrates the value of surgical interference in an early stage of infection of the pancreatic ducts.

M. A., Female, æt. 51. Married. Suffered from jaundice three years before admission; well since; no definite history of biliary colic. Sudden onset, on August 10th, 1908, of severe stabbing pain in the right hypochondrium, lasting without intermission until the patient entered the hospital. The pain was so severe that the patient fainted at the commencement of the illness. She retched frequently and violently, but the vomiting was not profuse. On examination, the patient's expression was anxious; there was no jaundice present, the tongue was dry and covered with brown fur; temperature 101° F., pulse 133, weak and thready. The abdomen was slightly distended, but there was moderately good respiratory movement. The right

rectus was rigid in its upper half, and this area of the abdomen was very tender, even on light palpation. There was no tenderness in either iliac fossa, and the percussion note was resonant all over the abdomen. No tumour could be felt. Abdominal exploration was performed without delay through the upper part of the right rectus muscle. The peritoneum contained a little fluid, which was just tinged with blood; the gall-bladder was shrunken and surrounded by old adhesions; a stone, the size of a hazel nut, was removed from it; the ducts appeared to be normal, and free from calculi; very little bile escaped after the stone was removed; there was no fat necrosis, but the pancreas was felt to be a little enlarged and distinctly hard. Cholecystostomy was performed and the lower part of the wound was also drained. There was a good deal of purulent discharge from the wound although none had been found at operation, but the biliary fistula closed rapidly, and the patient's condition was very good six weeks after the operation. She was seen again in January, 1909, and appeared to be in excellent health. Cammidge's "C reaction" was positive a week after operation, and also one month later.

It appears to us that in this case the operation was performed just at the onset of a diffuse pancreatitis, the earliest sign of which was the blood-stained peritoneal exudate, and that the good result was due to early drainage of the gall-bladder, which, though it showed no sign of recent inflammation, was probably the starting-point of pancreatic infection.

Drainage of the gall-bladder may be effected either by cholecystostomy or by cholecyst-enterostomy; in the former case the bladder is secured by sutures to the parietal peritoneum and the posterior rectus sheath, and the biliary fistula is a temporary one; in the latter operation the gall-bladder is anastomosed to the duodenum, and thus permanent drainage is effected. As regards recent pancreatitis, due to gall-stones, cholecystostomy appears to yield very good results, and it would seem wisest to reserve cholecyst-enterostomy for the treatment of chronic pancreatitis. It is sometimes difficult to bring the duodenum and a shrunken gall-bladder into close apposition for anastomosis; in this event the opening may be made into a high part of the

jejunum. The colon has been selected for this purpose, but it is undoubtedly bad practice, for the risks of infection from the large gut are too great, and the small intestine is deprived of bile; a large number of the cases have died from suppurative cholangitis, and even fæcal matter has been found in the substance of the liver itself at the necropsy. If cases of catarrhal pancreatitis come to operation, and no gall-stones are found, and the ducts appear to be free, there is little indication for cholecystostomy, and several such cases have apparently been benefited merely by the palpation of the gland during the course of exploration. On the other hand, by drainage of the gall-bladder and bile-ducts, exit is given to bile, which is likely to be infected, and therefore capable of causing further disease of an already infected pancreas. A complete examination of the gall-bladder and bile-ducts, and of the pancreas, must be made before one is satisfied that simple cholecystostomy is the best treatment; any stones in the ducts must be searched for, the part being exposed in the manner we shall consider under the heading of parenchymatous pancreatitis.

Suppurative Catarrh of the Pancreas

This disease is both more rare and more serious than simple pancreatic catarrh, just in the same way that suppurative cholangitis is a far more serious malady than catarrhal jaundice. As a matter of fact, suppuration in the ducts of the pancreas rarely occurs apart from suppurative cholangitis, and the two diseases are usually dependent on the presence of gall-stones in the bile passages and secondary infection from the bowel. There may also be calculi present in the ducts of the pancreas. The symptoms and physical signs of such suppuration in the pancreas can hardly be distinguished from those of suppurative cholangitis though some of the "pancreatic symptoms" may be present; there may be sugar in the urine or a positive "Cammidge

reaction" may be obtained. The disease is usually fatal from septicæmia or portal pyæmia, but if operation is performed on such a case it is the duty of the surgeon to remove any calculi that may be present, searching especially in the neighbourhood of the ampulla of Vater, and to effect thorough external drainage by means of tubes and gauze tampons.

Acute Parenchymatous Pancreatitis

Under this heading we include acute hæmorrhagic, diffuse suppurative, and gangrenous pancreatitis.

Etiology and Pathology.—All forms of pancreatitis are rare in patients under forty. Males are affected more often than females, and alcoholism is a predisposing cause. Experimental research has thrown a good deal of light on the question of causation of this very fatal disease. Injection of bile, bile salts, hydrochloric acid, and other substances into the main pancreatic duct produce the same pathological phenomena as are observed on the operating table, namely: blood-stained effusion into the peritoneal cavity, diffuse fat necrosis, most marked in the region of the pancreas, and infiltration of the gland with blood, causing widespread necrosis. In the human subject the causative lesion is without doubt, in most cases, a bacterial infection of the main pancreatic ducts, and occasionally it may be shown that bile has been directed int the duct of Wirsung instead of passing into the duodenum, the obstruction being due to an impacted biliary calculus in the ampulla of Vater. The bile in such cases is rarely sterile, and cultural examinations have shown the presence of the colon bacillus in the bile, the pancreas, and the peritoneal exudate.

In a large number of cases, however, though biliary calculi are present, there is no evidence of obstruction to the passage of bile into the duodenum, and in a certain proportion of cases, dying from acute parenchymatous pancreatitis,

no evidence of past or present cholelithiasis has been discoverable at the *post mortem* examination. Most authorities agree that the pancreatic infection is primarily one of the ducts, and probably an antecedent duodenitis is responsible for the onset of the more alarming symptoms. In a few cases, perhaps, a local blood or lymphatic infection may be responsible.

The exact pathological lesion produced in the gland, whether suppurative, hæmorrhagic, or gangrenous, probably depends upon the same type of infection, though the hæmorrhagic form has given rise to some difference of opinion. Some authorities hold that the inflammation precedes the hæmorrhagic infiltration of the gland, and that this is due to the action of liberated pancreatic secretion acting upon the wall of the blood vessels; others consider that hæmorrhage takes place into the substance of the gland either as the result of traumatism or of disease of the blood vessels, and that secondary infection of this effusion accounts for the further changes that are met with. In support of the latter view there seems no doubt that some instances of this disease follow severe abdominal injury, which may have led to partial rupture of the gland. On the other hand, hæmorrhagic effusion is met with in acute inflammation in other situations, so that probably both views are correct.

Gangrenous pancreatitis may represent a late stage of the hæmorrhagic form, where the effused blood has compressed the blood vessels, or it may originate in an infective thrombosis of the main blood vessels. In either case the gland becomes dry, black, and friable, and may be detached from its bed on the posterior abdominal wall. Suppurative pancreatitis is probably the result of a less virulent infective agent, or is evidence of greater resistance on the part of the patient than obtains in either the hæmorrhagic or gangrenous form. All forms of acute parenchymatous pancreatitis tend to cause peritonitis by reason of proximity, and, if death does not occur in the early stages, it is usually due to

a widespread peritoneal infection, yielding cultures of the colon bacillus.

There are very few abdominal diseases in which the symptoms progress with such rapidity as in acute pancreatitis, and in untreated cases a fatal termination nearly always ensues within four or five days of the onset of the illness. Unfortunately, the diagnosis from other lesions is often obscure, for while we may arrive at the conclusion that the patient is suffering from acute abdominal disease calling for surgical interference, the diagnostic investigations of urine and fæces required to confirm a clinical suspicion, in their present form, take so much longer than the surgical method of opening the abdomen to see, that it is usually in the interests of the patient to fall into the hands of the surgeon rather than into those of the clinical pathologist. There are no differential signs by which we may separate the three forms of acute parenchymatous pancreatitis. The symptoms and signs are essentially those of acute disease in the upper abdomen.

Sudden epigastric pain is nearly always the first symptom, and the severity of the pain is emphasised by the fact that in a large percentage of cases the patient faints at the onset of the attack. Occasionally, the pain is localised to the right hypochondrium; if it appears to pass through the body, it is felt posteriorly beneath the left scapula. In some cases the patient may writhe in agony, and some accompanying collapse and sweating is nearly always observed. The pain is often paroxysmal, with a tendency to increase with each succeeding attack, and it becomes rapidly diffused over the abdomen, but it is rarely felt much below the level of the iliac crest. *Vomiting*, or at least *retching*, may be regarded as an invariable second symptom; it follows the attack of pain after a very short interval, and the vomit rapidly becomes bilious in character. It is frequently repeated, but the amount ejected is rarely large, and it is only in the later stages of the disease, when peritoneal infection has occurred, that the vomit ceases to be bilious

in character. Black vomit is rare in acute pancreatitis. *Constipation* is almost constant in these cases, but the obstruction is not absolute, and flatus is passed. *Fever* is often absent at the beginning of the disease, owing to the collapsed state of the patient; when this is recovered from, there is some rise of temperature, pointing to an acute infective lesion, but the temperature is rarely above 102° F. *Hiccough* is occasionally a troublesome symptom.

Physical Signs—General.—The patient is often sweating profusely, if seen at the onset of the attack, and exhibits great distress; the complexion early assumes a dusky or cyanotic appearance, and the eyes become sunken. The *hands* may be cold and clammy. The *tongue* is dry and may be covered with a thin brown fur. The *pulse* is rapid, usually over 120 per minute, and of poor volume. *Respirations* are quickened and shallower than normal.

Local Signs.—The patient commonly adopts the dorsal *decubitus*, but he may be very restless, especially during the paroxysmal attacks of pain accompanied by vomiting. *Respiratory excursion* of the abdomen is greatly limited, and movement may be restricted to a small area of the abdominal wall below the umbilicus. Some degree of *distension* is almost invariable, but in the early hours of the attack it is limited to the upper half of the abdomen. No localised tumour or peristalsis is visible. *Rigidity* in the upper half of the abdomen is well marked, and is best realised by gentle pressure applied by the flat hand over the upper and lower segments of the rectus muscles alternately. *Superficial tenderness* is commonly present from the umbilical plane to the costal margin, and is usually most intense above and to the right of the umbilicus. Absence of tenderness or rigidity is often noticeable in the iliac fossæ and the flanks. *Localised cutaneous hyperæsthesia* cannot, as a rule, be demonstrated. Tenderness on deep pressure may be general all over the abdomen.

The presence of a tumour.—The external tenderness and rigidity of the upper abdominal wall, as a rule,

prevents the palpation of any tumour, and, even under the full muscular relaxation induced by an anæsthetic, it is rare to feel any definite mass. Ill-defined resistance, however, is frequently met with in the epigastric region, and, with the aid of an anæsthetic, it may be possible to feel a mass placed transversely across the abdomen about the level of the transpyloric plane and rather to the right of the median line. Such a mass usually extends for four to five inches across the abdomen, and appears to be some two inches in breadth. The absence of a tumour in any other situation is important, and such a mass as we have referred to is too diffuse to be the normal pancreas, which may, perhaps, be felt in the case of thin patients. The pulsation of the aorta is transmitted by the mass, and inspiratory descent is rarely present.

Percussion often yields a dull note in the flanks, which may be shown to shift with alteration in the position of the patient, and is due to the presence of free peritoneal fluid. There may at times be some dulness also above the pubes, and this points to a profuse intra-peritoneal effusion; the central part of the abdomen, including the epigastric area, is resonant. The liver dulness commonly fails to reach the costal margin in the right nipple line, although it begins at the normal level; this is explained by the epigastric distension.

Rectal and *vaginal* examinations are, as a rule, negative. *A leucocytosis* is usually present.

Diagnosis.—The diagnosis of acute parenchymatous pancreatitis remains one of the hardest problems in connection with acute abdominal cases. The facts that the lesion is comparatively rare, and also that diagnosis is usually so easy after the abdomen has been opened, both tend to blunt our powers of pre-operative diagnosis. Statistics show that the disease is now more often encountered than formerly, and as the clinician has more opportunities, so doubtless his power of correct observation will increase. The surgeon is rather apt to rely for diagnosis upon the discovery of fat necrosis.

In such cases as we have seen, the diagnosis has usually lain between acute pancreatitis, high intestinal obstruction, and perforated gastric or duodenal ulcer. In patients who have been known to suffer from gall-stones, the possibility of acute infective cholecystitis has, however, been before one's mind, and, as in all acute abdominal cases, the appendix has also been under some suspicion. All these, except appendicitis, may be termed acute upper abdominal diseases, but the appendix must always be thought of in upper as well as lower abdominal lesions, for it may lie close beneath the liver, or low down in the pelvis. Let us first consider those cases in which the past history offers no suggestion of cholelithiasis. In the abruptness of its onset, and the initial fainting and collapse which is so common, acute pancreatitis most closely resembles acute gastric or duodenal perforation. In these latter cases there is frequently a definite history of dyspepsia, and sometimes of hæmatemesis or melæna; acute pancreatitis tends to occur in patients who have always considered themselves thoroughly healthy, or have at most been troubled with slight indigestion; it is certainly more common in men than in women, and, according to some authorities, many of the subjects are somewhat addicted to the abuse of alcohol, which may suffice to explain their dyspeptic symptoms. In men, perforations of the duodenum are considerably more common than those of the stomach; hence the diagnosis will often rest between perforated duodenal ulcer and acute parenchymatous pancreatitis. In the former vomiting may occur at the time of perforation, and the patient is often markedly collapsed; but the vomiting is apt to cease after the onset of perforation until peritonitis ensues, whereas in acute hæmorrhagic pancreatitis frequent vomiting and retching is a noticeable feature from the beginning of the attack. We regard the progressive obliteration of liver dulness in the right nipple line as a most valuable sign of perforation, provided the abdomen is not distended; unfortunately, in acute pancreatic lesions the upper abdomen nearly always

exhibits some distension, so that this physical sign is not of much value in this differential diagnosis. The previous history of the patient and the nature of the vomiting are the most essential points in this connection.

In high intestinal obstruction, there may be some collapse at the onset ; vomiting occurs early, and is usually repeated ; a careful watch for visible peristalsis must be kept and the past history may suggest previous peritoneal inflammation. Such obstruction is rare in patients over forty, and acute pancreatitis is not often met with before this age. The pain of obstruction is of a more colicky nature, and the vomit rapidly becomes dark in colour. Flatus can generally be passed in pancreatic lesions even if the bowels do not act, whereas, in obstruction, even high up in the small intestine, there is more often absolute constipation. The localised tenderness of pancreatitis tends to be constant in its position, namely, just above and to the right of the umbilicus. In patients whose previous history does not suggest the existence of gall-stones, an attack of acute infective cholecystitis is diagnosed by the presence of right sub-costal pain, localised tenderness and resistance, and often a tumour just below the right costal margin, with increase in extent of liver dulness, associated with a more or less sudden onset of vomiting, and nearly always with jaundice. Slight jaundice may be present in pancreatic cases not associated with gall-stones. The onset of acute parenchymatous pancreatitis is to be suspected in patients who are known to suffer from cholelithiasis, if, with rapid loss of weight, and without the onset of jaundice, they are found to be suffering from excruciating upper abdominal pain, with frequent vomiting and retching, and extreme collapse ; if there is no evidence of enlargement of the gall-bladder, and no palpable tumour, but rigidity in the upper abdomen, a dry tongue, and a rapid weak pulse are present. The temperature is usually lower than in acute cholecystitis.

As regards acute appendicitis, it is only in those cases where the appendix occupies the "fœtal position" that

confusion is likely to arise. The onset of appendicitis is rarely so acute as that of pancreatitis, and the extreme severity of the epigastric pain in the latter disease, together with its early limitation, will usually suffice to distinguish between these maladies. In acute parenchymatous pancreatitis, tenderness in the right iliac fossa is rarely present, although there may be percussion dulness in the flanks.

In all suspected cases, if there be time and opportunity for investigation, a positive "Cammidge" reaction in the urine would go far to strengthen the diagnosis, but where this is not possible exploratory cœliotomy is certainly in the best interests of the patient.

Treatment.—The treatment of acute parenchymatous pancreatitis is essentially surgical, and any suspected case should be as rapidly as possible submitted to laparotomy. The very severe pain and collapse will require some attention; the early administration of saline by the rectum will lessen the collapse, and, provided the diagnosis has been made, a small dose of morphia with strychnine may be given with advantage. In these cases it is not desirable to delay the operation until the patient has recovered from all symptoms of collapse, but as soon as the condition warrants the strain of operation, laparotomy should be undertaken. This is important in contra-distinction to the course which we recommend in perforated gastric ulcer, and the difference is explained by the fact that the infectivity of gastric perforation appears to be considerably less than that of acute pancreatitis with the diffusion of the more active pancreatic secretion.

The object of the operation is three-fold, namely, to relieve the tension of the infiltrated pancreas, to afford drainage of the lesser sac of peritoneum, and to drain the infected bile passages. The most suitable incision is one which passes through the right rectus, not far from the middle line, above the level of the umbilicus, but, in cases where the diagnosis is still in doubt, a lower rectus incision, with its centre opposite the umbilicus, should be employed, for it

can easily be enlarged upwards to provide access to the pancreas and the bile passages. On opening the peritoneum, odourless blood-stained fluid will almost certainly escape; this is characteristic either of a late stage of obstruction, or of acute parenchymatous pancreatitis. Examination of a portion of the great omentum will usually settle the diagnosis, and if areas of fat necrosis are discovered, attention may be immediately directed to the upper abdomen. It is well to have a sand bag or inflatable pillow at hand, which can be slipped in beneath the patient's upper lumbar spine to render the pancreas more prominent. A sufficiently free incision must be made to obtain access to the bile-ducts in their entire length, as well as the pancreas, and palpation below the stomach through the transverse meso-colon will usually reveal an enlarged and rather hardened pancreas; it may be noticed that the amount of blood-stained fluid in this region is more abundant than elsewhere; fat necrosis may also be well marked. The gall-bladder and bile-ducts should next be examined, a proceeding which is greatly facilitated by the presence of the sand bag pushing the liver and bile-ducts forwards; if the lower margin of the liver be lifted so as to rotate the organ through its transverse axis, nearly the whole of the bile-passages can be brought clearly into view, so that the only portion of the common duct not seen is that which is embraced by the head of the pancreas. Careful palpation of the gall-bladder and duct should be carried out to ascertain the presence of any stones, and if the condition of the patient will warrant some prolongation of the operation, these should be removed. Special attention must be paid to the termination of the common duct at the ampulla of Vater, for a stone lodged here undoubtedly favours acute pancreatitis by contamination of the pancreatic ducts with infected bile. If gall-stones are found to be present, but the condition of the patient is not good, the operator should be content with drainage of the gall-bladder, and removal of the stones should be postponed for a future occasion. In any case, whether the gall-bladder or the ducts have been

opened, a rubber tube should be sewn in the opening to ensure thorough drainage of bile, and that portion of the wound should be packed off with strips of gauze. It is not uncommon in these cases to find a good many adhesions around the gall-bladder, and these must be gently broken down to ensure free drainage. Attention must now be turned to the pancreas itself, and the ideal incision is one through the left costo-vertebral angle, which affords retro-peritoneal access to the gland. Unfortunately this procedure prolongs the operation, since the first incision must be closed and the patient rolled over on to the abdomen, and also it gives access only to the tail of the gland; so that in most cases a trans-peritoneal route, even with its risks of infection, is to be preferred. The stomach must be lifted up and a vertical slit made through the gastrocolic omentum; the lesser sac will thus be entered, and the pancreas, covered by a single layer of peritoneum, is then exposed; the gland may then be carefully incised in a horizontal direction, and one or more cigarette drains introduced, passing from the abdominal wound through the lesser omentum, and packed round with gauze to prevent the spread of infection from the incised gland, and to check bleeding. The peritoneal cavity should next be dried with gauze strips, through the lowest part of the incision, since the fluid present in these cases is sometimes infected with the colon bacillus; but if this cannot be satisfactorily carried out, it is wisest to make a stab-wound low down in the abdominal wall and pass a tube through it to drain the pelvis. The main wound should now be closed, after anchoring the gall-bladder to the peritoneum and posterior rectus sheath at its upper angle; any tube leading from the ducts should be brought out just below this, and lower still a wide gauze plug should be placed in case leakage of bile occurs; the tubes and packing for pancreatic drainage must be brought out below this, and the lowest part of the peritoneum can be closed with catgut sutures. It is important to leave a wide enough gap in the peritoneum for efficient drainage of both bile-ducts and

pancreas ; the fibres of the rectus muscle may be left to fall together, and the anterior layer of the rectus sheath closed securely with strong catgut around the emerging plugs and tubes ; the skin should be stitched with salmon gut. A voluminous dressing should be applied firmly by the aid of a many-tailed bandage, room being left for a connecting tube to drain off the bile into a bottle to be placed beneath the patient's bed. If the case does well, the plugs and tubes should not be disturbed for fully four days, and then the gauze plugs may be gradually withdrawn, so that they are completely removed at the end of a week after operation. Drainage tubes may be left to be extruded by the healing of the wound, and gradually shortened from the surface, that in the gall-bladder being retained in position for at least ten days. A rather large wound in the abdominal wall is thus left to heal, but it is most important for the patient to provide free exit both for bile and infective fluid or pus from the pancreas ; the risk of a ventral hernia is slight, since the incision is mainly supra-umbilical.

We have no experience of drainage of the pancreas through the left costo-vertebral angle, but, if the severity of the operation would not be greatly increased, it would appear to be a favourable position for drainage. We have, however, seen recovery in one case of acute hæmorrhagic pancreatitis where nothing further was done than dry sponging of the peritoneum and drainage of the general cavity by means of a rubber tube placed in the lower angle of an incision through the right rectus ; in this case palpation of the bile passage did not reveal the presence of any calculi, and the condition of the patient made it necessary for the operation to be rapidly completed ; recovery ensued, but we do not consider that the best plan of treatment was adopted ; the drainage tube should at least have been passed down to the region of the inflamed pancreas.

After Treatment.—This must first of all be directed to counteract shock, and rectal saline will be of great value. These patients are not able to utilise fully the ordinary

food-stuffs, and, therefore, recourse may be had to alcohol, and pancreatised Benger's food, or beef jelly. Fluids and semi-solids should be given for the first ten days, and for at least three weeks all articles of diet should be pancreatised. Aperients or enemata should be given early, as in other cases of incipient peritonitis, and calomel or magnesium sulphate are probably the most suitable drugs. The treatment of the wound has been already discussed. The patient should, of course, be nursed in the Fowler position.

As regards the course of the illness after operation, it must not be assumed, as is justifiable in most acute abdominal diseases, that a patient, who seems well at the end of four or five days, will make a good recovery, for even though vomiting ceases, the bowels act satisfactorily, and the pain subsides, yet there may be a quantity of offensive discharge from the wound indicating progressive gangrene of the pancreas. In such a case operated upon by one of us, the pain was completely relieved, and neither vomiting nor constipation was present, but both the temperature and pulse-rate remained above normal; the patient's appetite was variable, though he took pancreatised food in fair quantity, but there was gradual loss of weight and cardiac power, while the mental condition was apathetic. Death occurred from progressive toxic asthenia seventeen days after operation. In this case drainage was effected without incising the gland, and cholecystostomy was performed, although no gall-stones could be found. The gall-bladder tube discharged bile for some days, and then the entire discharge was of dark thick fluid, having a very offensive odour, and causing some digestion of the margins of the wound. At the *post-mortem* examination the head of the pancreas was disorganised, and detached from its bed, while the tail was still firmly attached, although it showed advanced necrosis. The gall-bladder contained offensive brown fluid, but there were no stones, either here, or in the ducts. There was no peritonitis, but abundant fat necrosis, some of the areas in the great omentum measuring half an inch in diameter.

The lungs exhibited a septic broncho-pneumonia, such as is often met with in fatal abdominal cases. It would probably have been wiser to incise the pancreas in this case, and it might have been done as a second operation, together with an attempt to drain through the left costo-vertebral space. It is interesting to note that in this case Cammidge's "C reaction," carried out six days after operation, was negative, though the diagnosis was never in question. In positive cases it is certainly present for a considerable period after apparently complete recovery has ensued, as it was present in one of our cases six weeks after operation.

CHAPTER XI

THE SPLEEN AND KIDNEYS

The Spleen

Of all the contents of the peritoneal cavity the spleen is certainly the least liable to be at fault in what are sometimes called abdominal catastrophes, if we exclude cases of injury. We must, however, give some consideration to pathological processes to which this organ is liable, and which may give rise to urgent abdominal symptoms. Such lesions are usually due to hæmic infections, or to anomalies of the anatomy of the spleen.

The relationship of the spleen to bacterial infections, such as infective endocarditis, septico-pyæmia and specific fevers, is an unknown quantity. It is well known that this organ affords a resting-place for micro-organisms in many infections, but whether this is to the advantage of the patient or not is uncertain, and the results of experimental splenectomy have as yet failed to afford definite information on the question. The soft and diffluent spleen of infective diseases is frequently seen in the *post mortem* room, but during life there are rarely any manifestations of such a pathological change in this organ.

1. Rupture of the Spleen

Traumatic rupture is described in the chapter on Abdominal Injuries; pathological rupture is said to occur in malaria and typhoid fever, and it may also result from the giving way of a superficial abscess or infarct. It is

excessively rare unless the patient receives some injury, although this may be little more than a tap on the abdomen in the case of a malarial spleen. The symptoms are those of intra-peritoneal hæmorrhage, but rarely indeed does the condition of the patient warrant surgical interference.

2. Wandering Spleen (Torsion of the Pedicle)

It is well known that the spleen may occupy almost any position in the abdomen, and we have already noted the importance of diagnosing the spleen, normally or abnormally placed, from an intussusception. Abnormal mobility of the spleen implies a long pedicle, this predisposes to torsion, and twisting of the pedicle may give rise to a train of symptoms similar to those caused by torsion of the pedicle of an ovarian cyst, or of the omentum; these symptoms may bear a close resemblance to those of appendicitis or intestinal obstruction.

Etiology and Pathology.—A wandering spleen is most often seen in women who have borne children, and it may be a part of a general visceroptopsis. In addition to abnormal length of the pedicle and the lieno-renal ligament, there must be deficiency in those folds which normally anchor the spleen in the left hypochondrium, namely, the phrenico-colic fold and the gastro-splenic omentum. The condition is attributed to gradual enlargement of the organ, or to injury which damages these peritoneal folds. Torsion leads to thrombosis of the vessels of the spleen and even to necrosis; if recovery ensues, local peritonitis and inflammation of the capsule will probably lead to fixation of the organ. Such adhesion may give rise to intestinal obstruction.

Clinical Signs.—Abdominal pain, local or diffuse, with vomiting and some degree of collapse, are the leading symptoms, and the diagnosis can only be made when it is ascertained that the normal area of splenic dulness is absent, and when a tumour with a characteristic "splenic

notch" is found in an abnormal situation. It will be seen, therefore, that diagnosis before operation is unlikely; a wandering spleen may be mistaken for a tumour of the ovary, a uterine fibroid, an ectopic pregnancy, a movable kidney, or even a fæcal mass.

Treatment.—The symptoms and the presence of an abdominal tumour are likely to lead at least to an exploratory operation, and then the question of splenopexy or splenectomy will arise. The latter is the safer course, owing to the damage sustained by the splenic substance, and since excision of the spleen has been found to do no harm. Splenopexy is appropriate only for wandering spleen in the absence of torsion of its pedicle.

3. Inflammation of the Splenic Capsule

This is often called perisplenitis, and it may be part of a local or general peritonitis. It is also sometimes associated with pleurisy or pneumonia, and local thickenings of the capsule of the spleen may be attributable to infarction. Perisplenic abscess we have already referred to as one of the complications of appendicitis; but it is remarkable what slight changes occur in the spleen pulp, and even in its capsule, as the result of suppuration around, but not due to infection of, the spleen itself. Perisplenitis is characterised by a stitch-like pain in the left hypochondrium, together with a coarse friction rub, and usually some enlargement of the organ.

Treatment, in the absence of infection of the surrounding peritoneum, is symptomatic, and thickenings of the splenic capsule are not calculated to be harmful, though adhesions to the diaphragm, the stomach, colon, or abdominal wall may result.

4. Infarction and Abscess of the Spleen

This may be either simple or infective, and, in either case, it is most often due to embolism of some portion or

branch of the splenic artery. The branches of the splenic artery are end-arteries, and therefore anastomosis only occurs through the capillaries. Thrombosis of a large trunk of the splenic vein is also capable of leading to infarction.

Simple Infarction.—An artery may be blocked by a fragment of clot, or of vegetations derived from the heart, or by a calcareous fragment dislodged from an atheromatous plaque in the aorta. Thrombosis in the branches of the splenic artery (usually in leukæmia), or thrombosis of the splenic vein, may also give rise to infarction.

Anæmic necrosis follows, producing what is known as a white infarct. Hæmorrhage, derived probably from vessels of the capsule, may ensue, and the affected area becomes a red infarct. Such an infarct is conical in shape, with its base at the capsule and its apex towards the hilum, and its position is often indicated by slight projection of its base. Inflammation of the peritoneal covering of the infarct results, and ultimately, fibrous tissue is laid down, and the site of previous infarction is marked by a puckered and depressed cicatrix.

Infective Infarction.—This is usually due to an infected embolus from ulcerative endocarditis or other infective lesion, and the changes of acute inflammation, and suppuration may follow, ending in a local abscess.

Abscess of the Spleen.—The diffluent spleen of infective fevers rarely becomes purulent, but there may be single or multiple infective infarcts in which suppuration occurs. Fusion of these may take place and thus the spleen may be infiltrated with pus. In general pyæmia such abscesses are not uncommon, they also occur in portal pyæmia, and are described in typhoid fever. A syphilitic gumma, a suppurating hydatid cyst, and actinomycosis may also induce similar changes. Suppuration of the spleen may follow sub-capsular injury, just as it does in the case of the liver.

Clinical Signs.—Infarction of the spleen may produce no clinical symptoms, if the lesion is small. Simple infarcts

cause left-sided pain of rather sudden onset; the pain resembles a " stitch " and lasts for a day or two; there may be a local friction rub, tenderness over the spleen, with some increase in the area of splenic dulness both upwards and downwards; in pyæmic cases the onset of splenic infection may be heralded by a rigor. Great enlargement of the spleen is sometimes attributable to multiple infective infarcts. There is danger of extension of the infection to the peritoneum, stomach or intestine, pleura or lung.

Treatment.—Simple infarction of the spleen does not call for active treatment except for the relief of pain and of the condition of the heart. Infective infarction, if it leads to abscess formation, may demand local drainage, and the spleen is best reached through a muscle-splitting incision in the left hypochondrium. The peritoneum must be packed off securely unless the spleen is adherent to the parietal peritoneum, and care must be taken to stop all hæmorrhage, since peri-splenic adhesions are very vascular.

The Kidneys

Although the kidney is a retro-peritoneal organ, it is capable, under certain conditions, of causing symptoms which closely resemble those of peritoneal disease, and these we shall briefly consider, since the differential diagnosis is of the highest importance.

1. Dietl's Crises in Movable Kidney

As long ago as 1864 Dietl described severe attacks of abdominal pain in connection with movable kidney, attributable to torsion of the renal pedicle. The stress of this torsion affects mainly the renal vessels and not the ureter, and the symptoms are said to be due to congestion of the kidney rather than to accumulation of urine in the pelvis of the organ. They must be distinguished from the neurasthenic symptoms which are so common in patients

with displaced kidneys, as well as from the abdominal pain met with in intermittent hydronephrosis. The chief symptom is pain, usually lumbar, sometimes epigastric, more often on the right than on the left side of the abdomen (since the right kidney is more frequently mobile than the left); the pain is severe and colicky in nature; vomiting, either gastric or bilious, occurs early and may be repeated. The abdomen is distended, the bowels do not act, and at the onset of the attack there is a good deal of prostration and sweating. The temperature may be raised.

The abdominal symptoms may be strongly suggestive of appendicitis, but the abdomen is tender rather than rigid; there is absence of deep tenderness over the cæcal region; the kidney is enlarged and extremely tender; there is diminished urinary excretion, and the symptoms are greatly relieved if the kidney can be restored to its proper place by manipulation, or if the patient is put to bed with the head low and the pelvis raised. Slight jaundice may be present in these attacks, and then cholecystitis or biliary colic may be simulated; the diagnosis may not be clear until the relief of symptoms is effected by manipulation or posture. The urine passed after the attacks is usually blood-stained.

Treatment of the attacks has already been indicated; prevention against recurrence can only be secured by the application of a suitable belt or kidney truss, or, if these fail, by nephropexy.

2. Renal Colic

Both renal and ureteral colic are recognised as clinical entities, and they afford the most characteristic symptoms of a renal calculus. If the stone is lodged in the pelvis of the kidney, and, by reason of its size or its contour, it does not travel down the ureter, renal colic, with pain more or less limited to the region of the kidney, results; but if the calculus passes some distance down the ureter, the distribution

of pain is more widespread and it is felt in the groin and inner side of the thigh, and may be associated in the male with retraction of the testicle. Vomiting and sweating are usual accompaniments, but fever is rare unless there is infection of the renal pelvis. Considered from the point of view of abdominal disease, it is well known that during the intervals between the attacks of colic nausea, vomiting and dyspepsia may be caused by a renal calculus, and when the attacks are in progress spasm and rigidity of the abdominal muscles is not uncommon; but the sudden onset, perhaps after exertion, the absence of fever, the normal pulse rate, and the distribution of the pain, serve in most cases to distinguish renal colic from a peritoneal lesion. Hæmaturia is an almost constant sign unless the ureter is blocked, though the blood may be only microscopic in amount, but it must be remembered that the passage of clots, or other solid matter, down the ureter may give rise to renal colic. Albumen and pus are also present in the urine in many cases, and a history of frequent micturition, and of irritability of the bladder, is important. Radiography at the present day affords the most valuable evidence of calculus, and it may almost be said that, with a good picture, a negative skiagram eliminates the diagnosis of calculus, although the relative denisity of stones varies within very wide limits. A positive opinion cannot be expressed unless the photograph shows clearly the outlines of the last rib, the psoas muscle, and the crest of the ilium. With increasing accuracy it is possible also to demonstrate the outline of the kidney itself.

Treatment.—This should be directed to the relief of pain and the relaxation of the ureteral spasm. There is no doubt that morphia is the most valuable drug for this purpose, and the inhalation of either chloroform or ether is also most beneficial; the best results are perhaps obtained by the use of only a moderate dose of morphia combined with inhalations of ether when the spasm is most severe. The local application of heat is most desirable, and the

best plan is to place the patient in a bath of water as hot as can be borne. Drinking large quantities of hot water should also be encouraged.

Apart from the attacks of renal colic, nephrolithiasis must be treated either by palliative or operative means, but a discussion of these is outside the scope of the present work.

3. Acute Infections of the Urinary Tract

Ascending, or hæmic, infections of the urinary tract may be due to a variety of organisms, but attention has of recent years been especially directed to infection by the *bacillus coli*, and this type of urinary infection is certainly the most likely to cause symptoms suggestive of intra-peritoneal disease. Coccal infections are common in patients suffering from renal calculus or pyonephrosis, but sudden invasion of the urinary tract by the colon bacillus may occur in patients whose previous health has given no cause for anxiety. For this reason we shall consider here in detail that form of colon bacillus infection which is associated with urgent abdominal symptoms, for other infections by staphylococci, streptococci, bacillus proteus, or the pneumococcus can usually be recognised as affections of the urinary passages from the first.

Mode of Infection.—1. *Ascending Infection.*—This occurs in females, and is easily explained by the shortness of the female urethra and its proximity to the anus; the organisms pass along the urethra to the bladder, and further still to the ureters and the kidney. The stress of inflammation may be most marked in any part of the urinary passage, and it is generally held that pyelitis may be produced in this way without evidence of cystitis; the ascending currents in mucous channels, which are themselves unaffected, described by Bond, may explain the method of invasion. Dudgeon, who has studied these infections very minutely, regards this mode of invasion of the kidneys as the most frequent.

2. *Haemic Infection.*—Infection by the blood stream may be due to the excretion of organisms from the blood into the renal tubules, but it is probable that a healthy kidney can resist such invasion, for typhoid bacilli excreted during enteric fever do not set up any marked changes in the renal tissue. The source of infection in such cases is held to be an ulcerative lesion of the mucous lining of the bowel.

3. *Lymphatic Infection.*—This is a possible mode of infection, whereby bacilli escape from the intestine into the peri-colic lymphatics, and then pass to the urinary passages. This probably does explain the transformation of hydronephrotic kidneys into pyonephroses in some cases, but it must not be regarded as a common mode of invasion by the *bacillus coli.*

Etiology.—Women are more often affected than men, and pregnancy plays an important part in this liability to infection. It may occur at any age and is quite common in young children. Sudden chills and previous illnesses are both held responsible in some cases. If the infection reaches the kidney, the right is more often affected than the left, and this may perhaps be explained by the tendency to abnormal mobility of the right kidney.

Pathology.—The morbid changes may affect any part of the urinary tract, though the most typical lesion is a pyelitis, and all grades of inflammation from catarrh to suppuration may be met with. It must be remembered that although the symptoms may appear to implicate one kidney only, yet these bacillary infections tend to be bilateral, and one kidney is often affected after the other.

Symptoms and Physical Signs.—The clinical features of this disease are most variable, and Rolleston (*Practitioner*, April, 1910), speaks of three types, namely—

1. With local symptoms. Pain in the kidney; tenderness on palpation; the urine may contain blood as well as pus and bacilli; there may be painful and frequent micturition.

2. With constitutional symptoms. This form is especially seen in children, and suggests infective endocarditis, influenza, or typhoid.

3. With acute abdominal symptoms.

It is the last variety to which we wish to draw particular attention. This group of cases is characterised by diffuse abdominal pain, nausea, vomiting, and constipation. The onset is sudden with a high temperature, even reaching 105° F., and there may be rigors. There is headache and sometimes marked mental depression. The pulse rate may be very rapid. A leucocytosis is present. The abdomen is tumid and tender, especially in the flanks, and not infrequently there is some local rigidity of one or other rectus; if the right rectus muscle is implicated, the case may closely resemble acute appendicitis; tenderness and rigidity in the hypogastrium is also not uncommon. The renal region on one or both sides is extremely tender, and bi-manual palpation may be impossible.

The condition of the urine is most important. Its reaction is nearly always acid; it is often turbid, containing pus, epithelial cells, and bacilli, but its variable appearance is such that we may quote from a paper by Dudgeon and Ross (*Annals of Surgery*, March, 1910), who describe five types of urine in these infections:—

A. Urine quite clear, but on cultivation the bacillus coli is detected.

B. Turbidity of varying degrees. Bacilluria.

C. Similar to type B, but with varying degrees of inflammation as shown by a deposit of leucocytes.

D. Pyuria and bacilluria.

E. Pyuria, and on cultivation the bacillus coli is present.

They also state that the urine may be alkaline.

Diagnosis.—Until the urine is examined the diagnosis of many of these cases is in doubt, and it may be necessary to requisition the aid of a bacteriologist before it can be established with certainty. The presence of pus in acid urine, fever, and tender enlargement of one or both kidneys

are the leading features of the disease. It should, however, be remembered that the reaction of the urine *may* be alkaline. When abdominal symptoms predominate, it is clear that, unless a routine examination of the urine is made, an erroneous diagnosis may easily be arrived at, and it is not at all improbable that in some cases where a healthy appendix has been removed for acute abdominal symptoms a thorough examination of the urine would have prevented this unnecessary operation.

Prognosis and Treatment.—With regard to life, the outlook is good, and fatal cases are very rare even in children. As to the duration of the disease, there is great variability, and it must be admitted that many cases of acute infection by the bacillus coli become chronic and may remain so for months; even after apparently complete cure recurrent attacks are liable to occur in spite of every precaution.

Some authorities suggest that drugs should be given with a view to altering the reaction of the urine, and that if it is acid, potassium citrate or sodium bicarbonate should be used to make it alkaline, whilst alkaline urine should be acidified by the administration of acid sodium phosphate and urotropine. Whether this view is correct or not we are not prepared to state, but like other organisms the colon bacillus prefers an alkaline medium to grow in, whilst it has a special faculty for acidifying culture media. An acid reaction in the urine is certainly a preventive against infection by other organisms. Urotropine, which is of such value in the treatment of typhoid bacilluria, does not have the same beneficial, and almost specific, action in the case of colon bacillus infections, but good results may be obtained by the combined use of urotropine and sodium acid phosphate. Very excellent results have also followed the use of anti-bacillus coli serum; in acute cases Dudgeon advises the administration of a polyvalent serum in doses of 25 c.c. spread over a period of 72 hours, giving some three or four doses in all. The same author advises a vaccine rather than serum in the case of old people, and in these infections

in pregnant women, since serum is at times followed by severe constitutional symptoms. In sub-acute cases, and in chronic bacilluria following an acute attack, vaccine treatment is indicated, and as in other diseases the best results are only to be obtained by the use of a vaccine prepared from the patient's own micro-organism. Dudgeon is in favour of doses of from 30,000,000 to 100,000,000 bacilli every five days.

Surgical treatment in colon bacilluria is contra-indicated, since the disease is frequently bilateral, but the possibility of a calculus being present must not be lost sight of, and then, of course, nephrolithotomy should be performed. Infections of the urinary tract due to other organisms are amenable to treatment by antiseptics such as urotropine, helmitol, B-naphthol, sodium salicylate, salol, and boric acid, but in all cases care must be taken to eliminate the presence of a calculus or similar lesion, and for this purpose skiagraphy may be needed.

CHAPTER XII

THE FEMALE GENITALIA

We have in this chapter to deal with certain conditions which, though strictly pertaining to the gynæcologist, may at times imitate more or less closely various medical or surgical diseases.

Dysmenorrhœa

All women suffer from a certain amount of discomfort during the menstrual periods, and the severity of this discomfort varies inversely with the psychical stability of the individual; when menstruation is associated with pain which is so severe as to incapacitate the woman from carrying on her ordinary work, or amusements, the condition is known as dysmenorrhœa.

There are three distinct varieties of Dysmenorrhœa, namely Spasmodic, Membranous and Acquired Dysmenorrhœa, and it is usually easy to decide to which category any particular case belongs.

(1) **Spasmodic Dysmenorrhœa,** or **Uterine Colic.**—Here the pain is simply due to irregular and powerful uterine contractions. The primary condition may be uterine atony, so that there are no efficient contractions till the uterine cavity has become filled with clot; or the irregular contractions may be due to congenital flexions, or to stenosis or spasm of the os internum.

Diagnosis.—The pain is felt on the first day of the period and is paroxysmal; it usually ceases when the menstrual flow is established, though the discharge may be scanty; it is accompanied by sickness and collapse. On pelvic

examination, the uterus is freely mobile ; it may be unduly flexed but nothing else abnormal will be found.

(2) **Membranous Dysmenorrhœa.**—According to Blair Bell ("Principles of Gynæcology," Longman, 1910), there are two factors concerned in this condition, firstly an abnormally dense endometrium and, secondly, a rapid extravasation of blood beneath this thickened membrane, which is consequently stripped off the uterine wall as a whole, or in large flakes. In some cases definite casts of the uterine cavity may be passed, but the presence of flakes of membrane in the discharge is sufficient evidence on which to base a diagnosis, provided always that the passage of membrane is a constant phenomenon of menstruation, and that this membrane has not the microscopical characteristics of membranes associated with abortion or ruptured ectopic pregnancy. This type of dysmenorrhœa may appear for the first time after marriage : it is usually associated with sterility, and frequently with menorrhagia.

Diagnosis.—The pain may be very violent and colicky ; it is strictly menstrual, beginning abruptly with the onset of menstruation and ending with the passage of the membrane or shreds of membrane, a microscopical examination of which must be made in order to confirm the diagnosis.

(3) **Acquired Dysmenorrhœa** may be due to a variety of pathological conditions in the pelvis, such as displacements of the uterus, or growths or inflammations affecting it or its surroundings.

The *Diagnosis* depends on the recognition of some such abnormality. There is often both pre- and post- menstrual pain in addition to that felt during the period ; the pain is not definitely colicky, but is rather of a continuous, congestive character.

Differential Diagnosis of Dysmenorrhœa from other Conditions

As has been already stated, the pain of dysmenorrhœa may be so severe as to cause collapse and vomiting, and

there may be some degree of pyrexia and acceleration of the pulse rate, so that it is evident that various peritoneal lesions may be simulated. In some women attacks of gastralgia (*vide* Chapter VI.), may be associated with the menstrual periods, and, if severe, a gastric perforation may be suspected. Constipation is the rule before and during menstruation, so that when the pain is definitely colicky, and is associated with vomiting, intestinal obstruction may be imitated. Finally, in not a few cases where the pain is of a congestive type and pyrexia is present, an erroneous diagnosis of appendicitis or of pelvic peritonitis is made.

Naturally, the most important points in favour of a diagnosis of dysmenorrhœa would be a past history of excessive menstrual pain, the coincidence of the onset of symptoms with the date of an expected period, and the presence of a sanguineous vaginal discharge. But these points would not be of much assistance where the onset of one of the more grave abdominal lesions happened to coincide with a menstrual period; moreover, as has been previously pointed out, such a lesion, when occurring near the date of menstruation, may either postpone or accelerate the appearance of the menstrual flow. Hence it is that, before diagnosing uncomplicated dysmenorrhœa, we have to rely also on the absence of any such physical signs as definitely localised tenderness or rigidity, defective respiratory movement, abnormal percussion dulness, diminution of the liver dulness, or visible peristalsis. Even so, the diagnosis between pelvic appendicitis occurring near the time of menstruation and dysmenorrhœa is often impossible.

Treatment during the attack of Dysmenorrhœa.

Aspirin gr. x with Phenacetin gr. x every four hours will often give considerable relief, especially if combined with a warm hip-bath and hot drinks. Dr. Eardley Holland tells us that he has found Phenazone (Antipyrine) the

most successful drug; this should be given in 10 grain doses every two hours for six hours before the onset of the period (most women can anticipate it by this length of time): subsequently 10 grains should be taken every four hours. Some writers recommend amyl nitrite or nitroglycerine. Opium and alcohol should be strictly forbidden.

The **Treatment between the Attacks** depends on the type of case. *Spasmodic dysmenorrhœa* should first be treated by tonics such as strychnine and arsenic, and attention to general hygiene; the dysmenorrhœa of chlorotic girls often can be cured by a course of iron and exercise, especially if aperients are freely taken before each period. If these measures fail, dilatation of the cervix may be tried. Dysmenorrhœa of this type usually ceases after marriage, especially if the woman becomes pregnant.

The treatment of *membranous dysmenorrhœa* is usually unsatisfactory, curetting is sometimes successful, especially if followed by the application of iodized phenol. The treatment of *acquired dysmenorrhœa* is eminently satisfactory if the underlying pathological condition, *e.g.* a submucous fibromyoma, a uterine displacement, or an inflamed tube, can be satisfactorily dealt with; dysmenorrhœa due to old pelvic inflammation is less amenable: here we have to rely on such measures as frequent hot douches, vaginal applications of ichthyol, and the habitual use of saline aperients.

Ectopic Pregnancy

Etiology and Pathology.—In normal circumstances the ovum, wherever it may be fertilised, becomes implanted within the uterine cavity, and there undergoes its subsequent development; if implantation takes place elsewhere, the condition is called Ectopic Pregnancy. Ectopic Pregnancy may be Ovarian or Tubal, and Tubal Pregnancies may be further classified according as to whether the ovum is implanted in the ampulla (the most common site), in the isthmus, or in the intramural portion of the tube. Cornual

FIG. 20.—Tubal pregnancy (St. Thomas's Hospital Museum, 2482). "A uterus with its appendages. The distal extremity of the right Fallopian tube is dilated into an oval sac in consequence of gestation having occurred within it. The fœtus is ½" in length, and lies attached by an umbilical cord within an extremely delicate amnion and villous chorion. The uterine mucous membrane is thickened into a decidua."

Pregnancy, where implantation takes place in a rudimentary horn of the uterus, is analogous to Tubal Pregnancy, except that termination of this form is always by rupture and never by abortion. The victim of an ectopic pregnancy may be a recently married woman, or she may be already the mother of a large family; occasionally she may be unmarried, a point worth bearing in mind. The condition may arise at any age during the child-bearing epoch, most frequently between the ages of 25 to 35, and often after a prolonged period of sterility. There is no satisfactory explanation for the adoption by the fertilised ovum of an abnormal site of implantation; past attacks of salpingitis have been held responsible, but Bland Sutton maintains that the healthy Fallopian tube is more likely to become gravid than one which has been inflamed.

Course of Ectopic Pregnancy.—During the first month or six weeks the gravid tube becomes swollen to accommodate the growing ovum; at the same time its walls become thin at the site of the implantation, whilst the abdominal ostium may or may not become occluded. Sooner or later, in the majority of cases before the third month, the contents of the tube escape, either through the abdominal ostium ("Tubal Abortion"), or through a rent in the tube "Tubal Rupture"), the former phenomenon being favoured by a patent abdominal ostium and by an ampullary site of implantation. Before either of these accidents occurs the ovum may die and become separated by hæmorrhage from its attachment to the tube, thus forming what is known as a "Tubal Mole"; this resembles a firm blood-clot, 1 cm. to 8 cm. in diameter, but on section a small smooth-walled cavity containing the remains of the embryo may be found in its interior, and microscopical examination of the clot will always reveal the presence of chorionic villi. At the time of implantation of the ovum in the tube there is no local decidual reaction, but a decidua is formed within the uterine cavity; this membrane becomes separated from the endometrium by hæmorrhage at the time

of either tubal abortion or tubal rupture, both of which conditions are consequently associated with an external discharge of blood per vaginam. Both conditions are also associated with internal hæmorrhage from the tube; if the abortion be incomplete, or if the rupture be extra-peritoneal (*i.e.* between the layers of the broad ligament), this hæmorrhage may be slow or trivial; but more commonly abortion is "complete," or rupture intra-peritoneal, in which case the mother may bleed to death in a few hours. As has been said, the pregnancy is usually brought to an end before the third month; rupture usually takes place between the sixth and tenth weeks; it may be as early as the fifteenth day, or as late as the sixth month. In some cases tubal rupture has apparently been precipitated by a fall, a sudden strain, or even by coitus.

Diagnosis.—Too much importance must not be attached to the absence of signs of pregnancy, though their presence is often helpful. The breast signs in particular are very variable in ectopic gestation. The diagnosis is very occasionally made before rupture or abortion; pelvic pain, often unilateral, coming on shortly after a "missed" period, and the discovery of an enlarged Fallopian tube, with no evidence of an infective explanation for it, would justify such a diagnosis. The symptoms of tubal rupture or abortion are identical—a sudden attack of pelvic pain, often described as a feeling of "something giving way," accompanied by the signs of hæmorrhage, viz., a sub-normal temperature, increasing pallor, dyspnœa passing on to air hunger, restlessness, and a progressive acceleration, and diminution in volume, of the pulse; vomiting and sweating are also common at the onset. On examination, the breasts may or may not be suggestive of pregnancy; the abdomen is usually "full," and it may even be tensely distended by blood. Respiratory movements are restricted below the umbilicus, and there may be percussion dulness above the pubes and in the flanks. Tenderness and rigidity are found early over the hypogastrium, and may extend later over

the whole abdomen; they may be most pronounced on the side of the lesion, which the patient may also be able to indicate by a history of unilateral pains prior to the rupture. Vaginal examination will reveal a firm swelling in Douglas's pouch, and uterine hæmorrhage if this has not been noticed previously. If added to these signs and symptoms we have a past history of one or more missed periods and, possibly, of recent pelvic pain, the diagnosis is certain. If the hæmorrhage be less severe, as in incomplete tubal abortion or in extra-peritoneal rupture, the symptoms are correspondingly less acute after the onset, and the diagnosis is more difficult; it may not be possible till, perhaps, subsequent infection of the effused blood necessitates operation. Blood effused into the broad ligament may often be recognised per rectum as a firm swelling in front of the finger which pushes the uterus over to the opposite side.

Differential Diagnosis.—When the signs of internal hæmorrhage are manifest, there is seldom any difficulty; but when the hæmorrhage is trivial or slow, other acute abdominal conditions may be imitated. Mistakes are most likely to be made in the differential diagnosis from *gastric perforation*, the onset of which is characterised by very similar symptoms; the results of a vaginal examination, and of repeated investigations of the liver dulness, will settle the question in most cases. Pyrexia is common, and there is usually no hæmorrhage per vaginam, associated with *strangulated ovarian cysts*, *ruptured pyosalpinx* or *pelvic appendicitis*.

Treatment.—As soon as the condition has been recognised, operation should be advised, and if internal hæmorrhage is evidently severe, morphia should be administered at once. Shock may also be combated by hot water bottles, by bandaging the extremities, and elevating the foot of the bed; but saline infusion should be postponed till the bleeding tube has been secured, after which it may be administered throughout the rest of the operation.

If possible the operation should be performed at the

patient's home. After anæsthetisation the patient should be put in the Trendelenburg position, the abdomen opened through a low paramedian rectus incision, and the bleeding tube found and clamped as rapidly as possible; the remaining steps of the operation, namely, removal of the tube and effused blood, and suture of the two layers of the broad ligament, may be proceeded with at once: but if the condition of the patient is desperate, it may be wise to cover the wound with abdominal pads soaked with hot saline and to infuse with saline and adrenalin before attempting anything further. Should the rent in the tube involve the uterus, it must be closed by suture, and in exceptional cases even hysterectomy has been performed for this condition. The after treatment is directed against shock; the foot of the bed is elevated and the patient is surrounded with hot water bottles; saline may be administered per rectum or intravenously, and 1 cc. pituitary extract (20 per cent.) may be given hourly to three doses.

Complications of Ovarian Cysts

The diagnosis of any of these complications is simplified if the woman is known to be the subject of an ovarian cyst, or even if there is a previous history of an abdominal tumour the nature of which has not been diagnosed. When the symptoms due to complications are the first indications that anything is amiss, greater difficulty may arise; in this connection we would point out that the only constant symptom of an uncomplicated ovarian cyst is a progressive abdominal enlargement; in a majority of cases menstruation is unaffected.

Torsion of the Pedicle.—A slight twist to the extent of half a turn is found in the pedicles of most cysts, and produces no symptoms; if the axial rotation continues, however, the vitality of the cyst is impaired in proportion to the rapidity of such rotation. When rotation is rapid and the twist tight, both arteries and veins are obliterated,

and gangrene of the cyst ensues ; a less acute torsion will compress the veins only, when the effect is hæmorrhage into the cyst. In either case, the cyst swells and becomes infected, immediately, if the torsion be acute, eventually, if it be chronic. If this infected cyst be not ablated, there ensues a peritonitis which is at first local, and later, probably, general. Torsion may be the result of a fall, or of a sudden strain ; but it may take place during sleep. Dermoids seem to be more liable to torsion than any other variety of ovarian cyst.

Symptoms.—Acute torsion causes a sudden attack of abdominal pain with vomiting, sweating and collapse ; later on there may be recovery from the collapse, and signs of peritonitis, at first local, subsequently diffuse, ensue. Sub-acute torsion causes less urgent symptoms and there is usually no initial vomiting and collapse, the symptoms being rather those of peritonitis, local or diffuse. In either case examination of the abdomen or pelvis reveals a definite cystic tumour, which is extremely tender, and should this tumour have been palpated before the onset of torsion, it will now be found to have increased in size. If this tumour is known to have been present before, diagnosis is easy, though it is impossible to distinguish between a sub-acute torsion and simple inflammation of an ovarian cyst. When the patient is seen for the first time, the condition may be mistaken for other abdominal lesions ; if the cyst is in the right iliac fossa it may simulate an appendix abscess very closely, though an appendix abscess is seldom so sharply defined as is an ovarian cyst. When the cyst is pelvic, its freedom from the uterus would distinguish it from other conditions which give rise to pelvic peritonitis.

We have met with one instance of torsion of previously normal uterine adnexa ; the patient was a child aged eleven, admitted to hospital six days after a sudden onset of violent and colicky pain in the lower abdomen : there was a history of somewhat similar symptoms three or four months before. The child looked extremely ill, there was extreme tenderness

and rigidity over the hypogastrium, and a tender mass was felt in Douglas's pouch, slightly to the left of the middle line. Operation revealed blood-stained fluid in the pelvis; the left Fallopian tube and broad ligament had undergone several tight twists in the clock-wise direction close to their uterine attachment; the ovary was four inches long, an inch thick, and an inch and a half wide, but microscopical

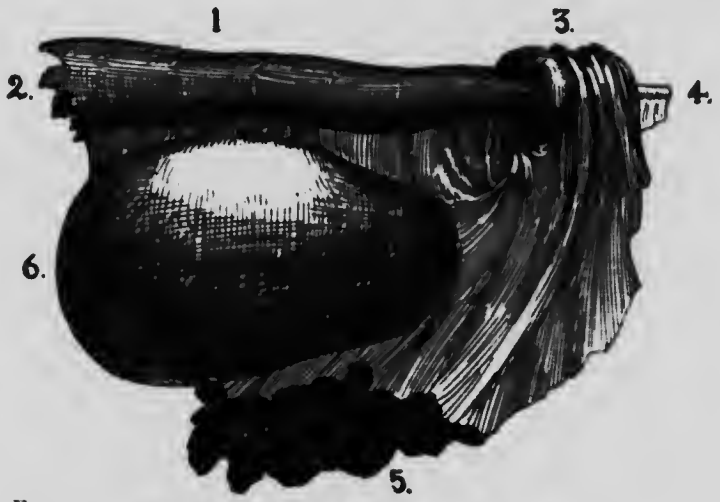

FIG. 21.—Torsion of Broad ligament and Fallopian tube in a child aged 11. (Cassidy and Norbury, *Lancet*, 1911.)
1. Strangulated Fallopian tube.
2. Its fimbriated extremity. 3. Site of Torsion.
4. Uterine end of Fallopian tube (normal).
5. Base of broad ligament infiltrated with blood clot.
6. Strangulated ovary.

examination showed only extreme vascular engorgement. A full account of this case may be found in *The Lancet* (January, 1911, Cassidy and Norbury).

Treatment.—The cyst should be excised at once; even when the symptoms are sub-acute, delay in operation is dangerous. The abdomen is opened through a sub-umbilical paramedian incision, and the cyst delivered through the wound, any adhesions being carefully separated by the fingers if possible; if necessary adherent omentum may be

tied off and divided in sections close to the cyst. The pedicle is clamped, transfixed by a ligature, tied in two halves and divided; the stump should be sutured to the back of the broad ligament beneath the Fallopian tube, in order to prevent subsequent adhesions to its raw surface. Drainage is usually unnecessary and the abdomen may be closed at once.

Suppuration

An ovarian cyst may become infected as a result of torsion or by reason of adhesions to another inflamed viscus, *e.g.* the appendix or Fallopian tube; or infection may occur during pregnancy or the puerperium. The diagnosis is based on increasing pain and tenderness over the tumour, with pyrexia; eventually peritonitis, local or diffuse, may follow. The signs and symptoms closely resemble those of sub-acute torsion, and the treatment is identical.

Rupture

Rupture of an ovarian cyst may be spontaneous or traumatic; if the rent be small and associated only with a gradual leakage, no acute symptoms are produced, but a sudden discharge of the contents of the cyst into the peritoneal cavity may give rise to pain, and, if hæmorrhage also occurs, to shock. If the contents of the cyst are infected, peritonitis will ensue. The condition is recognised by the disappearance of the previously ascertained cystic tumour, with the simultaneous appearance of signs of ascites.

Treatment.—If acute symptoms are produced, ovariotomy should be performed, and the cystic contents absorbed by gauze pads.

Salpingitis

Infection may reach the Fallopian tubes either from below, *viâ* the uterus, or from above, *viâ* the peritoneal

cavity; examples of the latter condition are seen frequently in diffuse peritonitis, of either septic or tuberculous nature, and occasionally in localised appendicular peritonitis, where the infection may spread from appendix to tube by direct continuity. Infection from below is the more common and the more important variety, and with it we are now chiefly concerned. Yet a third route of infection is possible, namely, that by the blood; probably this path is responsible for most cases of "primary" tuberculous salpingitis. As to infections *vid* the uterus, we may recognise two chief varieties, viz. Gonorrhœal, and Puerperal Salpingitis.

Etiology and Pathology.—*Gonorrhœal Salpingitis.*—The first part of the genital tract to be affected is usually the cervix uteri, gonorrhœal vaginitis being almost confined to children; thence infection may spread to the uterus, producing an endometritis, or even a metritis, for the gonococci may actually invade the muscular wall, especially when infection occurs during the puerperium. The uterine infection may exist for weeks or months before the tubes are involved. The earliest change produced in the latter is a catarrhal inflammation of the mucous membrane, the folds of which become swollen and adherent to each other; obviously therefore the uterine ostium, which in health will admit only a fine bristle, must be occluded at an early stage. Next, a gradual infiltration of the wall of the tube takes place, and the tube itself becomes tortuous and irregularly thickened, giving it a characteristic nodular feel. Sooner or later the abdominal ostium becomes sealed, in most cases, but before this process is completed there is usually more or less infection of the pelvic peritoneum; in fact the signs and symptoms of salpingitis are really for the most part those of pelvic peritonitis, though in rare instances diffuse gonococcal peritonitis may ensue (*vide* Chapter IV.). The pathological changes may be arrested at this stage; sometimes this arrest is permanent, but more commonly the gonococci, after lying dormant for a while, regain their ascendency over the tissues, and their activity is evidenced

by another attack of pelvic peritonitis. There may be a series of these exacerbations of the symptoms, and with each the damage becomes a little more extensive—more dense pelvic adhesions around tubes, ovaries and uterus, greater destruction of the tubal epithelium, more marked infiltration of the tubal wall. When once the abdominal ostium has been sealed up, the tube tends to become distended into a cyst by exudation into its own lumen ; if this exudate be purulent, the cyst is called a *pyosalpinx*, if serous, a *hydrosalpinx*. These cysts, whether hydro- or pyo-salpinges, are nearly always bilateral ; they are retort-shaped, the neck of the retort being represented by the isthmus of the tube and the body by its ampulla, and they are often prolapsed into Douglas's pouch and adherent to adjacent structures.

The gonococci usually become extinct after a while, but secondary infection of the tube, *e.g.* by B. Coli, can, and often does, occur.

Puerperal Salpingitis differs from the Gonococcal variety only in being a more acute condition ; the spread of infection from uterus to tubes is much more rapid, and infection of the pelvic peritoneum is inevitable and immediate once the tubes are involved. If the infection is localised to the pelvis, a pelvic abscess is formed, but unfortunately in not a few cases diffuse puerperal peritonitis ensues ; both these conditions are treated in Chapter IV.

Tuberculous Salpingitis closely resembles gonococcal salpingitis both pathologically and symptomologically ; it is the commonest variety of tubal disease in virgins, and it often results in pyo-salpinges.

Diagnosis of Salpingitis.—The characteristic history of Gonococcal salpingitis is one of continuous pelvic pain associated with dysmenorrhœa, dyspareunia, and, perhaps, dysuria ; in addition there is general deterioration of health, which may amount to chronic invalidism or even cachexia. Throughout the course of this illness there may be a series of attacks of pelvic peritonitis, each characterised by an exacerbation of the previously existing symptoms. There

may or may not be a previous history of gonorrhœal infection or of leucorrhœa.

On examination per vaginam, the uterus is fixed and the thickened or tortuous and distended tubes may be felt on each side of it, or perhaps prolapsed and adherent behind it. During an acute attack there may be rigidity and tenderness over the lower part of the abdomen, and a variable degree of pyrexia. The differential diagnosis from relapsing or sub-acute appendicitis may be difficult, especially when the appendix occupies a pelvic position; the most important point is that salpingitis is almost invariably bilateral, so that purely right-sided symptoms and signs are strongly in favour of appendicitis.

There is seldom any difficulty in recognising Puerperal salpingitis and peritonitis (*vide* Chapter IV.). Tuberculous salpingitis is also a bilateral affection; the diagnosis rests on the absence of any evidence of a puerperal or gonococcal infection, with perhaps a strong family history of tuberculosis, or with signs of tuberculosis elsewhere.

Treatment.—While any acute symptoms are present, rest in bed is imperative. Many cases of gonococcal salpingitis recover without surgical interference; but if there is definite evidence of the presence of pus, either within or without the tubes, or if the condition has become chronic and after prolonged expectant treatment there is no sign of definite inprovement, operation should be advised, and the diseased tubes ablated, the uterus and ovaries being left if possible.

From the operative point of view salpingitis resembles appendicitis, except that for all stages and varieties of the disease the mortality is much lower. A similar classification of the disease and its sequels may therefore be adopted as a guide to surgical interference, though the clinical differentiation may be very difficult, and it is generally held that early operation in acute salpingitis is not called for in the same way as it is in acute appendicitis. Pelvic peritonitis due to tubal disease calls for incision and drainage

if there is a local abscess, and the subsequent removal of the tubes if the symptoms persist. It does sometimes happen that such an abscess in a female patient is drained without the diagnosis between appendicitis and salpingitis being clear; exploration when the abscess has healed is usually desirable in such cases, and the primary seat of disease should be removed. Pelvic peritonitis of tubal origin, without a localised abscess, requires operative treatment if the symptoms are severe and do not subside within a short time after the commencement of medical treatment by rest in bed, warm vaginal douches, and hot fomentations to the abdomen. Diffuse peritonitis due to salpingitis demands immediate operation with removal of the primary foci of the disease. These operations should be performed by the abdominal route, and great care must be taken to leave as little raw surface as possible. Drainage is less necessary than in the case of appendicular infections, and the vagina may sometimes be utilised for this purpose.

After an acute attack of salpingitis the desirability of removal of the tubes during a quiescent interval must be decided according to the severity of the inflammation and the probability of recurrence.

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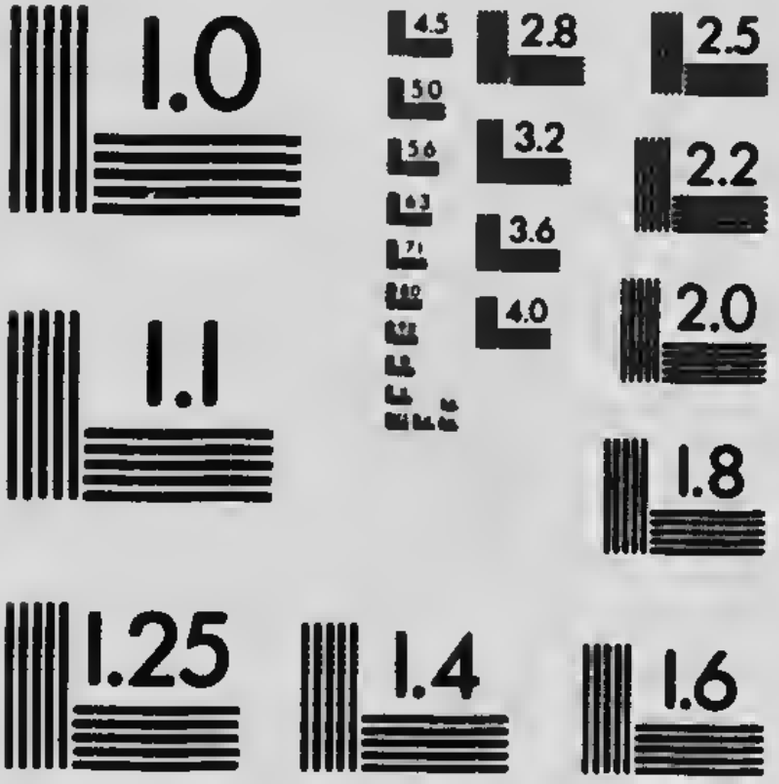

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CHAPTER XIII

VASCULAR ABDOMINAL DISEASES

THESE diseases, which are by no means common, may be classified anatomically as lesions of arteries, veins, or capillaries. The two former are liable to embolism and thrombosis, while the last in a pathological state may give rise to the intra-mural effusions met with in Henoch's Purpura.

It must be remembered that the veins of the alimentary canal belong almost entirely to the portal circulation; therefore we shall consider mesenteric venous thrombosis under the heading of pylephlebitis.

Embolism and Thrombosis of the Mesenteric Arteries

This condition is rare, but it is nevertheless important, and only by a careful study of its clinical phenomena can we hope for accurate diagnosis and successful treatment, at the present time recovery is exceedingly rare, for the reason that early operation is not sufficiently often undertaken. A study of some 120 cases was published by Jackson, Porter and Quintz in 1907, and we are greatly indebted to the writers of this paper.

Etiology and Pathology.—Embolism of these vessels is due to the impaction of clot or fibrin, derived from the heart or some portion of the arterial system, at about the level of the first lumbar vertebra. Atheroma and endocarditis are the commonest antecedent diseases,

and the former may be present in the aorta or in the main mesenteric trunks; in these cases thrombosis succeeds embolism.

Thrombosis may occur in these vessels either as the result of degenerative or infective changes in the inner coat of the arterial walls; it may also be due to injury, and syphilitic endarteritis has been held responsible in some cases.

Sex.—This disease is nearly twice as common in men as compared with women.

Age.—The commonest age period of the recorded cases is from 30 to 60.

Results of Arterial Obstruction.—These depend on several factors, of which the most important are the situation of the arterial block, the suddenness with which it occurs, and the bacteriological state of the intestine whose blood supply fails. In the first place all observers have found that the superior mesenteric is far more often affected than the inferior mesenteric artery, but this statement may be due, as suggested by Corner, to the fact that the figures are derived mostly from a study of fatal cases, and, since the superior mesenteric supplies some twenty-five feet of small bowel and half the large intestine, the probability of these cases reaching the *post mortem* room is very great.

The arterial occlusion may occur near the origin of the mesenteric trunk, or in some one or more of its sub-divisions, and, owing to the manner in which the branches increase as the bowel is approached, it is evident that the nearer the block to the origin of the vessel, the greater the area of bowel affected. Experimental ligation of the main superior mesenteric artery in dogs has been uniformly fatal, while ligation of a mesenteric branch of a lower arcade may be followed by a successful anastomotic circulation and recovery; one knows also from experience of the operation of circular enterorrhaphy that the blood supply may be cut off from fully an inch of the bowel without

running any serious risk of failure. The inosculation of vessels both in the intestinal border of the mesentery and in the wall of the bowel itself is free, and the ultimate result of thrombosis depends on the length of bowel whose vitality is threatened, and on the amount of compensatory circulation required. Obviously, then, the results are likely to be more severe in the case of the superior than in the case of the inferior mesenteric artery.

Time has always played a part in the effects produced by arterial block; if gradual occlusion of a mesenteric vessel occurs, the local blood-vessels have more opportunity of multiplication in order to effect a collateral circulation. Thrombosis apart from embolism is, however, rare, and therefore instances of recovery after blockage of a main trunk are correspondingly few in number. That recovery may ensue even after the most extensive thrombosis of the main mesenteric trunks was shown many years ago by the case recorded by Professor Chiene of Edinburgh. In this case the body of a female subject in the dissecting room was found to have an aneurysm of the abdominal aorta, together with extensive atheroma. The inferior mesenteric artery arose from the lower part of the sac, and both it and the cœliac axis and superior mesenteric arteries had been converted into fibrous cords at their origins; the compensatory circulation was maintained as follows:—the stomach, liver, spleen, pancreas and duodenum were supplied by the left lower intercostals and from the left renal and capsular arteries, which anastomosed with the left lumbar arteries; the remainder of the intestine, except the cæcum and ascending colon, which were supplied by the last dorsal artery on the right side, received its blood supply from the internal iliacs through a large plexus surrounding the rectum.

Hæmorrhagic infarcation nearly always ensues in the wall of the affected bowel and its mesentery. One might perhaps expect to find anæmic necrosis in the bowel when the block is arterial, but in nearly all cases, due partly, no

doubt, to the inflammatory infiltration set up by organisms, the bowel wall becomes thickened, its mucuos membrane loosened, and hæmorrhages often occur into the lumen of the gut.

In most cases a line of demarcation is observed, and sometimes the affected bowel becomes distended with gas ; perforative peritonitis may ensue. We have already stated that the initial thrombosis may be due to infection of the vessel walls, and, in any case, when the blood supply is cut off from a segment of the bowel, the organisms, which normally lie on the surface of the mucous membrane, tend to penetrate the wall of the bowel and produce perforating ulcers. The primary thrombosis may be due to some infected ulcer of the bowel, but more often still do we find ulceration secondary to thrombosis.

Hæmorrhagic infiltration of the mesentery is common, and it may give rise to a definite hæmatoma ; the mesenteric glands may be infiltrated with blood. Adynamic paralysis of the affected intestine occurs at an early stage.

Symptoms.—In most cases these are acute, and the onset is associated with sudden abdominal pain, nausea, and vomiting. Two clinical types are met with, one in which colicky pain and hæmorrhagic diarrhœa are prominent symptoms, and another in which abdominal distension and obstruction are the leading features. It is only in the former type that the symptoms are directly suggestive of the precise lesion, and it is probable that such cases are more often due to disease of the inferior than the superior mesenteric artery. At the beginning of the illness there is often a sudden fall in temperature, and the patient may exhibit a good deal of collapse. The vomit is at first gastric, but it may be bloody later on. The pain is usually of a cramp-like nature, or the patient may complain of recurrent attacks of colicky pain. *Hæmorrhagic diarrhœa*, if present, is a most suggestive symptom, and the blood is commonly passed in large quantities, and may be little altered as to colour and consistence.

In the second type of the disease to which we have referred, the abdomen is distended, tender and painful; vomiting is frequent, and the bowels are obstinately confined; the patient rapidly acquires an abdominal facies, and other signs and symptoms such as we have described in connection with paralytic obstruction with consecutive peritonitis may be present.

There are cases, more often due to venous than to arterial mesenteric thrombosis, in which the symptoms are more remittent in character, and the onset is more gradual.

Physical Signs.—There are no physical signs which can be regarded as characteristic of this disease. In the obstructive form abdominal distension may be local, but is more often general; respiratory movement is restricted; there is rarely any abdominal tumour to be felt; peristalsis is in abeyance; there may be dulness in both flanks and even above the pubes. In the type in which hæmorrhagic diarrhœa is present, the abdomen is not distended in the early stages, and there may be a mass felt, due to hæmorrhagic infiltration of some portion of the mesentery. In the later stages of both types the clinical picture is one of consecutive peritonitis with marked toxæmia.

Diagnosis.—It is an axiom of clinical medicine that to establish a diagnosis of embolism there must be discovered a source from which the embolus may have been detached; hence a diagnosis of mesenteric thrombosis due to embolism requires the discovery of gross cardiac or arterial disease. Thrombosis alone may occur in patients with sound circulatory systems, but in such cases the initial symptoms are not so sudden in onset as in thrombosis following the lodgment of an embolus. The previous occurrence in the same patient of an embolic or arteriothrombotic lesion, such as gangrene of a limb, may suggest the nature of the abdominal lesion. Repeated intestinal hæmorrhages, and the possible discovery of a mesenteric hæmatoma, with colicky abdominal pain, would go far to confirm the diagnosis. Oftentimes, however, the patient is not seen until some degree

of secondary peritonitis has developed, and thus the diagnosis is obscured.

Prognosis.—The case described by Professor Chiene, to which we have already referred, shows that recovery may ensue even after a very extensive mesenteric block, but with very few exceptions it must be regarded as an almost uniformly fatal disease. Even where operation has been performed, the number of recorded recoveries is excessively small.

Treatment.—Early surgical intervention is the only treatment, but there are obvious limitations, for removal of all the bowel whose blood supply is threatened might involve resection of more than the whole of the small intestine. Surgery, then, is more likely to succeed in the rarer cases of inferior mesenteric thrombosis, where only a portion of the large bowel is affected. Exploratory cœliotomy is certainly justifiable, for without it diagnosis must be somewhat uncertain, and it is possible that the affected area of gut may be within the limits of successful resection.

Portal Thrombosis or Pylephlebitis

By this term is meant coagulation in, and blockage of, the portal vein itself, or of any of the radicles which go to form it, and it occurs in two forms, namely, *simple* and *suppurative*. Since the former may exist without causing symptoms and is usually part of a chronic disease, we propose under this heading to deal only with the suppurative form, to which the comprehensive term *portal pyæmia* is applied.

Simple Thrombosis of the mesenteric veins, if it occurs suddenly in the main trunks, may give rise to practically the same pathological changes as have been described under arterial thrombosis, but the venous obstruction is much less common than the arterial, and inflammation in the larger veins is most frequently suppurative.

Etiology and Pathology.—Suppurative pylephlebitis

may begin in any situation in the mesenteric area, in the main portal trunk, or in the portal radicles within the substance of the liver. Usually the origin is in one of the lesser tributaries of the area drained by one of the mesenteric veins, most often the superior, and the source of infection is some ulcerative or infective process in the bowel wall. Suppurative or gangrenous appendicitis is by far the commonest cause of portal pyæmia, and it is liable to occur especially in those cases in which surgical intervention is postponed and pus allowed to accumulate under considerable tension. Infective thrombosis is commoner in men than in women, possibly because appendicitis is commoner in the former, and in our experience it occurs more often in children than in adults. Other causes are simple or malignant ulcer of the stomach or intestine, including fissure and ulceration of the rectum, thrombosed internal piles, and suppurative pancreatitis. Typhoid fever and dysentery must especially be mentioned, and on rare occasions the disease has followed operation upon the intestinal tract.

Suppuration in the main portal vein may extend locally from peri-cholecystitis, or from a perigastric or sub-hepatic abscess, and within the substance of the liver there may be an extension from a suppurative cholangitis, or any abscess of the liver. The causative organisms may be any of those commonly met with in intestinal lesions, including those of bacillary and amœbic dysentery.

Pathological Anatomy.—The lesion may be discovered when the lesser mesenteric radicles are swollen with more or less purulent clot, and their walls are soft and friable; or the main portal trunk may be so distended, and it may contain almost pure pus. In the third locale of infection, where the suppurative phlebitis affects the terminal distribution of the portal vein, the substance of the liver may resemble a sponge filled with purulent fluid; this condition may affect almost the whole liver, but is more often seen in the right lobe than the left; in rarer cases there may be present one or two large abscesses. The

pus formed in these cases is commonly offensive in odour, and the causative organisms may be the colon bacillus, the typhoid bacillus, the common pyogenic organisms, or the anærobes of the intestinal tract.

Symptoms.—Only in those cases where there is a definite interval between the onset of the primary disease and that of suppurative pylephlebitis can we appreciate the symptoms belonging to the portal pyæmia, and no better examples can be afforded than those met with in connection with appendicitis. The onset is usually gradual, and it may occur in a case where the post-operative prognosis appears good, or, on the other hand, where the condition of the patient has always caused anxiety. In two cases which have recently come under our notice the patients were both boys, one aged ten, and the other four. In one case, a localised abscess had been merely drained, and in the other a gangrenous and perforated appendix had been removed and the peritoneal cavity drained. In both cases there was a gradual rise of temperature with a general toxic appearance of the child, but in the abscess case the symptoms were manifested first on the third day after operation, whereas in the second case convalescence had been uninterrupted for a fortnight.

Rigors are nearly always manifested, and these may be regarded as the first symptom suggesting the serious condition present; there may be vomiting and either diarrhœa or constipation, and some amount of abdominal pain. Jaundice is present in only a small proportion of cases. As the disease progresses the patient passes into a typhoidal state, with low, muttering, delirium, and death occurs in coma.

Physical Signs.—Abdominal distension is usually present, but this may not be general; tenderness is found some distance away from the primary lesion, and in those cases where the infection has reached the liver, the most characteristic feature is an enlarged and tender liver beneath a rigid and distended upper abdominal wall. The liver

edge may be three or four inches below the costal margin. The spleen is said to be enlarged in about a quarter of the cases. There may be distended veins visible on the surface of the abdominal wall. In some cases there may be signs of free fluid in the peritoneal cavity.

Diagnosis.—In such cases as arise in connection with appendicitis, the state of affairs becomes clear when an enlarged and tender liver is found in a patient whose temperature chart has shown a gradual septic tendency; the occurrence of rigors in such cases must always arouse a suspicion of pylephlebitis. In other cases the diagnosis may be extremely difficult, and one has to consider other causes of suppuration in and around the liver, and of septico-pyæmia, portal or systemic; it may be desirable to investigate the action of the patient's serum on the typhoid bacillus.

Prognosis.—Suppurative pylephlebitis must be regarded as an invariably fatal disease when the portal trunk or its hepatic terminals are affected, but it is quite probable that minute infective thrombi may form in the peripheral mesenteric veins, and become disintegrated or absorbed without causing further trouble. Unexplained rigors certainly occur in cases of severe appendicitis, and it is not improbable that they are sometimes associated with the presence of small septic foci in the portal system.

Treatment.—It is clear that here prevention is better than cure, and in the case of appendicitis such a dangerous complication as portal pyæmia is best avoided by the prompt surgical treatment which we have already advocated. If pus is not allowed to accumulate in the peritoneal cavity under tension, and if ulcerative processes in the gastro-intestinal tract are treated early, the formation of infective thrombi becomes less probable. In the early stages, when the complication may be suspected, large doses of citric acid or sodium citrate should be given, since citration does delay the coagulation of the blood, and thus favours the struggle of the serum against the invasion of organisms. When once portal pyæmia has developed the treatment is

that of liver abscess, but since the abscesses in the liver are usually multiple, the outlook is not hopeful and we have not seen any case of recovery.

Intra-mural Effusion of the Bowel

Effusion into the wall of the intestine may be hæmorrhagic or serous; in the former case the disease is often termed Henoch's Purpura; in the latter, the lesion may be due to intestinal angio-neurotic œdema. We are aware that some authorities do not agree with this classification, but since the pathogeny of the two conditions is probably quite different, and since in the cases which have been recorded as Henoch's Purpura discolouration and swelling of the bowel wall has been the salient visible lesion, it seems justifiable to consider the two lesions under separate headings, though our knowledge of Henoch's Purpura is far greater than that of angio-neurotic œdema, especially as it attacks the intestinal tract.

Henoch's Purpura

Definition.—A hæmorrhagic diathesis characterised by attacks of acute abdominal pain, together with vomiting and the passage of blood and mucus *per anum*. Joint pains and swellings may also be present.

A hæmorrhagic diathesis is easy of recognition if there are external signs, such as bleeding from the gums, or purpuric spots in the skin, but we shall endeavour to give an accurate account of this form as it affects the intestine, for all authorities are agreed that it may be present without external hæmorrhage and without any purpuric eruption. Purpuric spots, when they appear, bear a close resemblance to what is called the "port wine nævus"; they vary greatly in size and, if very small, are called petechiæ, or, if large, ecchymoses. In colour they are at first reddish purple, but later they fade and produce a dull brown stain

in the skin. Their surface is not appreciably raised above the level of the surrounding skin, and they do not fade on pressure. The lower extremities are more often the seat of these spots than any other part of the body, and they are frequently most numerous in the vicinity of joints.

For much of the following description we are indebted to the excellent paper on this subject by G. A. Sutherland, published in the *Lancet* of June 26, 1909.

Etiology and Pathology.—Here we must admit that our knowledge is sorely deficient, since we do not certainly know whether the inherent defect lies with the blood or the blood-vessels. Increased permeability of the vessel walls has been described, and, as a rule, the coagulability of the blood is diminished, but which of these factors is predominant has yet to be discovered. Lessened coagulability of the blood may be due to several causes, but in the case of hæmophilia, a condition allied to the several forms of purpura, it is held to be due to deficiency in pro-thrombin in the blood of sufferers from this disease.

In Henoch's Purpura there may or may not be a skin eruption such as we have described, the mucous membranes may bleed, and hæmaturia may be met with, but the essential lesion is exhibited by the coats of the intestine. Most commonly in the neighbourhood of the ileo-cæcal valve, more often in the small than in the large bowel, there is effusion of blood into the mucous, sub-mucous, muscular, or sub-serous layer, causing localised swelling and discolouration of the bowel; ulceration of the mucosa may be found, but it is usually not extensive. As regards the age incidence of the disease, it occurs much more commonly in children than in adults. It is not often seen during the first year of life.

Symptoms.—The leading symptoms are vomiting, pain, and the passage of blood and mucus *per anum*. The vomiting may precede the abdominal pain, but it is perhaps more often second in point of time; the vomit may contain blood. Pain is always present and is often very severe,

but some recorded cases have been characterised by mild recurrent attacks of pain. In other instances the child assumes the position of opisthotonos owing to the paroxysmal nature of the attack. The pain is regarded as being due to increased peristalsis in the intestine above the lesion, and it is intermittent and spasmodic ; complete relaxation occurs between the attacks.

The passage of blood and mucus from the anus is not a constant factor, and its presence probably depends on the situation of the blood effusion in the bowel wall, and also on the relation between the amount of blood which actually reaches the lumen of the intestinal canal and the capacity of the latter : hence it is most often seen in the younger patients. In most cases very little fæcal matter is passed, but, rarely, there may be diarrhœa.

Hæmaturia and bleeding from the gums may be present. In the later stages of the disease, where no amelioration occurs, the symptoms become those of acute intestinal obstruction, with frequent vomiting and abdominal distension, and later still secondary peritonitis and death from peritoneal toxæmia ensue.

Physical Signs.—These are by no means constant. The child usually lies on its back ; the abdomen is retracted and its respiratory movements are impaired during the attacks of abdominal pain, when the facial expression often becomes anxious, and in severe cases there are often dark rings to be observed beneath the eyes. The tongue is fairly clean, and the pulse rate is somewhat increased, but the temperature is not usually raised above 101° F. There may be some oozing of blood from the oral mucous membrane, especially that covering the alveolar processes, and the gums may be swollen. The whole surface of the body must be searched for purpuric spots. In a few cases there are tender swellings around joints, or there may be arthritic pains and tenderness without swelling. Abdominal tenderness is usually present, and since 75 per cent. of the intestinal effusions are in the region of the ileo-cæcal valve, the tenderness

on pressure is most marked in the right iliac fossa. The presence of a definite tumour is rare, but it has several times been observed. There may be slight visible peristalsis, but there is usually no sign of free fluid in the abdomen.

Diagnosis.—It will be seen from the above description that, as far as the abdominal symptoms go, the disease closely resembles intussusception, and indeed we must admit that certain examples of it may be indistinguishable. If there are purpuric spots, or visible evidence of mucosal hæmorrhage, the diagnosis becomes simple, and if there is a history of several recurrent attacks, intussusception is unlikely; but a difficulty arises, as we have pointed out in speaking of intussusception, forasmuch as a local intramural effusion may be the starting-point of intestinal invagination. How often this occurs nobody can say, but several cases have recently been recorded which have undoubtedly been Henoch's purpura with intussusception. We have shown by statistics that a tumour is almost constantly to be felt in intussusception, and we are forced to regard its presence, and the existence of purpuric spots, as the criteria in this differential diagnosis, but at the same time we must remember that a tumour may occasionally be present in Henoch's purpura, and a purpuric eruption may certainly be absent.

The urine should always be examined for the presence of blood. The disease must of course be distinguished from gastro-enteritis and other conditions causing the passage of blood *per anum* which we have considered under the differential diagnosis of intussusception.

Treatment.—Exploratory operation is certainly undesirable, since in these patients there is always a risk of hæmorrhage from the wound; but if a tumour is felt and there is no evidence of external purpura, the procedure is pardonable, and cases have been operated upon without ill effects. Moreover, the possibility of intussusception and Henoch's purpura co-existing must be borne in mind. A number of cases of supposed intussusception are operated upon and

no invagination is found; it is usual to regard them as instances of spontaneous reduction, and no doubt this explanation is often correct. There is, however, the possibility that some of these cases are examples of Henoch's purpura, and that the hæmorrhagic area found in the bowel wall is due to primary effusion, and not to partial strangulation and congestion. If there is a distinct dimple in the bowel, that may be taken as direct evidence of previous invagination, but in the presence of effusion only the second interpretation must be conceded as a possibility, and occasionally proof is afforded by the appearance, after operation, of a purpuric eruption.

When the diagnosis of Henoch's purpura is clear, the treatment is mainly symptomatic; intestinal colic must be relieved by laudanum, and the diet should consist of milk in small quantities. Calcium chloride may be given by the mouth, and in severe cases normal horse serum, or, if it can be obtained, normal human serum, should be given *per rectum.*

Intestinal Angio-neurotic Œdema

This is regarded by many authorities as a distinct clinical entity, but in the absence of external manifestations of such œdema, either before or during the onset of the abdominal symptoms, it is clear that the diagnosis must be uncertain. External angio-neurotic œdema, and such œdema affecting the larynx, is well known, and if in such patients there are attacks of griping and paroxysmal abdominal pain, with vomiting and a tendency to partial or complete constipation, the pathological explanation of a serous effusion into the wall of the bowel may be accepted. Such attacks may be supposed to affect the bowel, and not the subcutaneous tissues or the larynx, and the diagnosis might then be strengthened by the sudden cessation of the symptoms without any medical interference. The term "colic" may include a number of these cases, but in the

present state of our knowledge we cannot say how often it does so.

Treatment.—If the diagnosis can be made, those drugs which are especially useful in common forms of angio-neurotic œdema should be tried. Calcium in the form of lactate or chloride, is the drug most favoured.

CHAPTER XIV

THE COMPLICATIONS OF EXTERNAL HERNIA*

In Chapter V. we have already dealt with the rarer condition of internal hernia, and the present chapter is added because the symptoms of complicated external hernia are essentially abdominal, and because it is not uncommon for a patient with urgent abdominal symptoms to be suffering from hernia, and the first step in the diagnosis is to decide whether this lesion plays any part in the production of such symptoms. Generally speaking, the co-existence of acute abdominal symptoms and an irreducible hernia quite rightly direct one's suspicions to the rupture, and, as regards operative technique, the first essential is exploration of the hernia. Greater difficulties arise in the case of hernia which have been tampered with before the patient reaches the surgeon's hands, as we shall see in dealing with the complications dependent upon taxis.

It has hitherto been the custom to describe three serious complications of external hernia, namely, inflammation, incarceration or obstruction, and strangulation; it is extremely doubtful, however, whether any useful clinical purpose is served by this pathological accuracy, and it is clear that when a hernia becomes irreducible and painful, and when the patient suffers from vomiting and obstruction of the bowels, steps must be taken to restore their function. Th two factors which determine the need for operation on

* For much help in the preparation of this chapter we are indebted to the "Urgent Surgery" of Félix Lejars.

a hernia are sudden irreducibility and vomiting. In patients with chronic irreducible ruptures the onset of vomiting points to a serious alteration in the hernial contents, and in those whose hernia has always been reducible, sudden irreducibility must arouse the suspicion of strangulation, and if vomiting occurs, a diagnosis of strangulation is justified. Fæcal vomiting is a complication which ought never to be seen, for it points to unrelieved obstruction lasting long enough to cause accumulation of a large quantity of fluid matter above damaged intestine. With regard to the action of the bowels, we can hardly afford to wait after the onset of such symptoms to see if the bowels will act, and because there is a visible cause of obstruction it is clearly wrong to place reliance on medical treatment. The pulse rate is usually increased, there is often some initial shock associated with a normal or sub-normal temperature, and the tongue is furred; but these auxiliary symptoms are variable and unreliable.

The pathological changes associated with strangulation are well known, but those which occur in the intestine above that contained in the sac are of equal importance. The damming of the fæcal stream results in the outpouring of mucus, the liquefaction of fæcal matter, the generation of gas, and the multiplication of pathogenic organisms; the bowel becomes distended, the mucosa eroded, and thrombosis takes place in the sub-mucous coat; this leads to œdema of the bowel wall, paresis of its musculature, and transudation of organisms from the interior to the external aspect of the intestine. Patchy exudative peritonitis is not uncommon, and areas of gangrene may be present in the bowel above the constriction. These changes are similar to those which occur in the imprisoned bowel, except that they do not begin with thrombosis, and it is important to remember that the condition of the intestine within the sac is a poor criterion of the state of the bowel above.

Diagnosis.—The diagnosis of strangulated hernia is made on a consideration of the history, and the presence

of a swelling in one or other of the known hernial orifices, the special characters of which will be considered under their appropriate headings. The commonest source of error in the case of inguinal hernia is some abnormality of the testicle; orchitis from any cause may at times simulate a strangulated hernia if the swelling involves the vas and spermatic cord, and this is even more likely to be a source of difficulty if the testis is imperfectly descended; torsion of an undescended testis has often given rise to the diagnosis of strangulated hernia. The translucency of a hydrocele can usually be relied upon to differentiate it from a hernia, but it must be remembered that in young children a hernia distended with gas may be translucent, and, on the other hand, a chronic hydrocele may exhibit very imperfect translucency. A patient may have both hydrocele and strangulated hernia on the same side of the scrotum, and we can remember an instance in which a young man of twenty presented what appeared to be a translucent strangulated hernia. In his case a small coil of gut descended for the first time to the bottom of a complete congenital sac and he was seen some six hours later. Vomiting had occurred once, and there was discomfort rather than pain in the scrotum. Operation revealed a tunica vaginalis distended with clear serous fluid, and behind this an empty loop of strangulated small intestine. Here, as in many cases, operation was demanded by the history of a sudden scrotal swelling, of a painful character, accompanied by vomiting.

Mistakes in the case of suspected femoral hernia are most frequently due to enlarged and inflamed inguinal glands, but the anatomical situation of a femoral hernia, its pedunculation, and its lateral mobility, will usually serve to differentiate it.

In all cases the *symptoms* of strangulated hernia rather than the *physical signs* determine the need for operation, and in cases of doubt it is better to explore than to wait until the diagnosis is a clinical certainty.

Treatment of Strangulated Hernia.—There is but one correct method of treatment for strangulated hernia,

and that is by means of herniotomy; but if sudden irreducibility and vomiting be regarded as the leading clinical features of strangulation, there may be occasional uncertainty as to the diagnosis. If a hernia suddenly descends, or if a hernia which was previously reducible suddenly becomes irreducible, and the patient is seen before vomiting has occurred, treatment by taxis will meet the immediate needs of the case; such an accident, however, may afford a suitable opportunity for urging the need for radical cure on a patient previously averse to operation, for there can be no question that the radical cure of hernia is essentially a life-saving operation, and fortunately such strangulation is becoming less common. If simple taxis succeeds, the patient should be kept at rest, so that the rupture does not descend, until such time as the operation can be performed. If reduction is not effected, a hot bath, which relaxes the peri-saccular tissues, should be given, and often an irreducible will become a reducible hernia. Such cases are common in young children. Where vomiting has occurred before the patient is seen by a medical man, it is clear that certain changes have taken place which render replacement of the contents of the sac, except after visual inspection, highly undesirable. In old-standing irreducible herniæ, vomiting is usually the first indication of mischief; in recent irreducible hernia, there is frequently an interval between the descent of the rupture and the occurrence of vomiting, during which pain and tension of the swelling increase. Vomiting, then, contra-indicates taxis. It must, however, be admitted that the exigencies of practice may sometimes compel one to employ taxis, even where one would prefer immediate herniotomy, but we need only consider the principles of this procedure. The first step is to empty the bowel of its contents, and this, in the case of inguinal hernia, is aided by drawing down the tissues around the neck of the sac with one hand, while the other is used to compress the whole sac by the application of lateral pressure, and not by pressure on the lowest part of the sac; the return of the intestinal contents to the

abdomen is signalised by a gurgling noise, and if this is heard it is probable that a further gentle but sustained effort will bring about the reduction of the hernial mass, for when the bowel is empty reduction is easy. Irreducible omentum is more difficult to deal with, and if taxis is not successful in a very short time no forcible attempt should be made, and one must acknowledge that taxis has failed. If taxis has apparently succeeded, the finger must be passed through the hernial ring, to make sure that the contents of the sac have returned to the abdomen. If intestine has been reduced, and omentum remains in the sac, it may be permissible to wait until herniotomy can be conveniently performed, *but only if no vomiting has occurred.* We shall have occasion to refer again to taxis with regard to the disasters which it may cause, and the ultimate failure which may follow apparently successful reduction.

Operation for Simple Strangulated Inguinal Hernia

Anæsthesia.—General anæsthesia is contra-indicated only in old and feeble patients, and the choice will depend largely on the custom of the surgeon and anæsthetist; gas and oxygen, ether, and chloroform, are all suitable, and their safety appears to correspond to this order, but spinal and local infiltration analgesia will also satisfy the requirements of the operation, so that in any case where general narcosis seems undesirable there should be no hesitation in using regional anæsthesia. In our experience of local infiltration anæsthesia there are certain steps of the operation which are apt to cause pain, and sometimes a little shock, but this we have prevented by the use of chloroform given only to the stage of mental confusion. These painful proceedings are—(1) Incision of the sac, and the nearer the neck this is opened the more pain is produced; (2) Stretching or dividing the constricting tissues at the neck of the sac; (3) Pulling down omentum or intestine, and thus stretching the branches of the abdominal ganglia.

Steps of the Operation.—No further preparation of the operation area is necessary than shaving, and painting with iodine solution just before the incision is to be made, the iodine being applied for at least ten inches around the proposed site of incision.

1. *Exposure of the Sac.*—In the case of a scrotal hernia, the incision should begin about an inch above the centre of Poupart's ligament, and extend well down to the lower half of the scrotum. The successive layers of skin, subcutaneous fat, and fascial planes, must be carefully divided along the whole length of the wound, bleeding points being secured as the vessels are divided. When it is thought that the scrotal portion of the sac is being approached, the tissues should be held up by means of two pairs of dissecting forceps, and divided layer by layer. If the sac is easily recognised, it may be fully exposed up to its neck, before being opened, by dividing the aponeurosis of the external oblique, but if there is any doubt, it is simpler to deepen the scrotal portion of the incision until the sac is opened; if this is done by division only of tissue which can be picked up by forceps, there is very little risk of going too deep, and the escape of sanguineous fluid is usually the sign of an opened sac.

2. *Exposure of the Sac contents.*—Even if no fluid escapes when the sac is opened, there is usually very little difficulty in recognising the congested purple intestine, or fatty, strangulated omentum. The edges of the sac should now be secured by pressure forceps, and, if it has not already been done, the sac must be exposed up to the level of the internal abdominal ring. The sac contents should be wrapped in gauze moistened with hot saline, and the sac wall divided with scissors towards the neck and also down to its fundus.

3. *Relief of the Constriction.*—The index finger can now be passed up to the seat of the constriction between the sac wall and the contents, and, as a rule, the gentle pressure of the finger is sufficient to free the contents, and enable the bowel or omentum to be brought down so that a full

inspection may be made of the tissues on the proximal side of the constriction. Care must be taken not to incise the sac wall beyond the level of the internal abdominal ring, since this renders the radical cure more difficult, but if digital stretching does not succeed, the constriction must be relieved by cautious division of the sac wall by passing a knife or the blade of a pair of scissors along the finger pulp.

In congenital sacs there are often several bands of constriction, and the test of efficient relief in all cases is determined by the freedom with which the sac contents can be drawn down into view.

4. *Treatment of the contents of the Sac.*—The sac contents must be cleansed with hot saline; strangulated omentum is best removed after careful multiple ligature of its pedicle; strangulated intestine should be returned after its viability is proved. The effect of hot (115° F.) saline on strangulated bowel is remarkable, and in spite of its congested and swollen appearance, intestine may be returned to the abdomen provided that: (1) Pulsation can be felt in its mesentery; (2) Its peritoneal polish is still present; (3) Its resiliency is retained. If vermicular contractions are observed in the bowel wall after douching with saline its viability is assured. Special attention must be paid to the points of strangulation, for here a groove in the bowel is usually seen. If recovery quickly takes place, this groove disappears, but even if the groove remains the bowel may be safely returned, provided that it is of good polish and resiliency at these two points. The treatment of doubtful and gangrenous intestine will be dealt with later. The reduction of strangulated bowel after it has recovered a healthy appearance is usually quite easy, and sometimes it tends to slip back into the abdomen before the inspection is completed; this must be carefully guarded against by wrapping gauze around the affected loop. As regards omentum, the use of an interlocking suture to secure the stump after removal of the strangulated portion is to be recommended, as there is some risk of a simple suture

slipping off during reduction of the omentum. It is well to push a gauze wick into the abdomen before the sac is dealt with, in order to ascertain that there is no blood extravasation.

5. *Treatment of the Sac and Canal.*—This step in the operation will vary according to the custom of the surgeon, but if the condition of the patient is not good it may be advisable to postpone the radical cure until a later date. Whatever plan of operation is preferred, the object is to obliterate the sac at the level of the internal abdominal ring, and the simple method of transfixion, ligature, and ablation, as in Bassini's operation, has much to recommend it. In the case of a congenital hernia, where the sac extends to the bottom of the testicle, it must be divided into proximal and distal portions a short way above the globus major of the epididymis; the upper part should be treated by ligature and removal, while the lower half is left unclosed to guard against accumulation of fluid and the formation of a hydrocele. The subsequent closure of the canal must be carried out in the manner with which the surgeon is most familiar.

After Treatment.—In the majority of cases this calls for no special care, for as soon as the constriction is relieved the patient is restored to health. Morphia is rarely necessary after the operation, and should be withheld, since peristaltic rest is to be avoided. The bowels often act spontaneously, and there should be no haste in giving an aperient; if no motion has been passed by the second night after operation, a small dose of castor oil may be administered. The patient should be kept at rest for the same length of time as in the case of ordinary radical cure, and a minimum period of twelve days seems to be desirable. There is no need to insist on absolute recumbency, and the patient should be encouraged to sit up in bed from the sixth day, and if progress is satisfactory he may be moved from bed to a couch at the end of ten days. This is certainly desirable at an earlier date in the case of patients past middle age.

The Complications of Strangulated Inguinal Hernia

Following the admirable classification of Léjars we shall consider under this heading: (1) Adhesions in hernial sacs; (2) Abnormalities of the sac; (3) Unusual contents of the hernial sac; (4) Complications due to taxis. Gangrenous hernia will be dealt with separately. Most of the complications are discoverable only during the course of the operation, and their existence affords an additional argument in favour of early herniotomy.

1. Adhesions within the Sac. (*a*) *Adherent Omentum.*—The sac must be opened with care; if the adhesions are recent they may be separated by the finger, which should be swept around the interior of the sac; if the adhesions cannot be thus easily broken down, they must be divided between ligatures, or by dissection at the expense of the sac wall rather than by cutting omentum. This separation must be carried out until the omentum can be freely pulled down, and especial attention must be paid to the neck of the sac; the finger should be passed round the abdominal aspect of the neck to make sure that the omentum is released. The process of freeing the omentum may be facilitated by the removal of portions as they are liberated, but, if possible, it should all be freed before ligature and ablation is proceeded with.

(*b*) *Adherent Intestine.*—Great care must be exercised to avoid injury to the congested and therefore friable bowel wall. Adhesions between the intestine and the sac wall must be freed at the expense of the sac rather than the gut; tags of fibrin must not be left hanging from the intestine, but should be ligatured and cut short, and any raw patches on the wall of the bowel should be covered in by invagination with Lembert sutures. Inter-intestinal adhesions must be dealt with in the same cautious fashion, and in all cases hæmostasis must be secured before reduction is commenced. If the intestinal wall is torn during these manœuvres, the extravasated fluid should be immediately sponged away,

and the wound sutured after careful cleansing with hot saline; even after such an accident the bowel may be returned, provided that the suturing is satisfactory, and only rarely will drainage through the neck of the sac be indicated.

In large, old-standing herniæ the complete separation of adhesions may be well-nigh impossible, but at all costs the bands causing obstruction and strangulation must be divided. Occasionally this may mean division of the neck of the sac, and of some other bands without securing reduction of the hernial mass, and it may be necessary to be content with this partial operation, though the result must be somewhat doubtful. If recovery ensues, a further operation may be done to effect reduction of the hernia, but in all such cases the good effects of operation must be seconded by the judicious use of a suitable truss before the patient is allowed to resume the erect position.

(*c*) *Hernia en Glissade.*—These, so-called, sliding herniæ of the cæcum and ilio-pelvic colon may well be considered here, for they form a particularly troublesome variety of adherent hernia. Owing to the incomplete peritoneal investment of these portions of the large intestine, it is possible for the cæcum on the right, or the colon on the left, side to slip down into the inguinal canal, carrying the peritoneum as it passes from the intestine to the parietes; in some cases the bowel may turn forwards so that it is exposed before the sac is opened, and therefore great care is necessary in operating on these herniæ, which are nearly always of large size. The gut may be recognised by its thick, fleshy, and reddened wall, and, if it is encountered before the sac, the latter must be searched for and opened up fully. It will then be found that the sac cannot be emptied of intestine in the usual way, owing to the broad attachment of the cæcum or colon to the posterior wall of the sac, and in this band runs the vascular supply of the intestine, and therefore its division is not permissible. The scope of the operation consists in freeing the sac from surrounding structures, such as the spermatic cord, diminishing its size by careful suture,

and reducing both the remains of the sac and the intestine; then the inguinal canal must be closed as far as possible: but such an operation hardly merits the term "radical cure," and therefore the patient should be ordered to wear a truss after the wound has firmly healed.

2. **Abnormalities of the Sac.** (*a*) *Encysted or Infantile Hernia.*—This abnormality requires little comment, since it is well known, and, in the presence of strangulation, the tunica vaginalis, which lies in front of the hernial sac, is usually distended with fluid; it sometimes happens that the hernial sac invaginates itself into the cavity of the tunica, but in any case three layers of peritoneal tissue have to be divided before the sac contents are exposed, and between any two there may be a collection of fluid; the hernial sac, however, is almost sure to contain blood-stained fluid, and thus it can be distinguished by its dark colour before it is opened.

(*b*) *Diverticula of the Sac.*—When a diverticulum is present, its connection with the sac may be in any situation, but is most often near the neck. In some cases the sac may be definitely bilocular; it is then most important to locate accurately the seat of strangulation, and any diverticulum of the sac must be thoroughly exposed and freed if a satisfactory radical cure is to be effected.

(*c*) *Interstitial Hernia.*—This form of rupture is nearly always associated with imperfect descent of the testicle, and if symptoms of strangulation appear in a cryptorchid, the possibility of an interstitial hernia should be borne in mind; occasionally, however, such abnormal sacs develop after complete descent of the testicle has occurred. There are several varieties of such herniæ, named according as they possess different relationships to the layers of the abdominal wall; in most cases there are two processes of the sac, an *intra-inguinal*, and an *intra-abdominal* portion; the former is of very varying size, and depends on the degree of descent of the testicle; the latter is the essential feature of this abnormal form of hernia, and the three chief anatomical varieties are as follows:—(1) The sac lies between the

transversalis fascia and the peritoneum (*intra-parietal* or *pro-peritoneal hernia*), between the inguinal canal and the iliac fascia, or between the horizontal ramus of the pubis and the bladder. Such abnormal extensions of the sac can only be discovered during operation. (2) The sac lies between the external and internal oblique muscles; it then forms a more or less horizontal swelling above the level of Poupart's ligament, covered by the expanded tendinous portion of the external oblique; this is called an *inter-parietal hernia*. (3) The sac has passed through the external abdominal ring, and lies on the surface of the lower part of the external oblique; this is called an *extra-parietal hernia*, and it may closely simulate a femoral rupture. If these abnormal sacs are met with during the course of herniotomy for strangulation, it is necessary to divide the structures of the abdominal wall until they are fully exposed, so that the neck of the intra-abdominal sac may be incised, and the whole sac removed; the peritoneum and the muscular layers must then be sutured in turn, and the abdominal wall may be strengthened considerably by the use of overlapping sutures.

(*d*) *Retrograde Strangulation.*—In hernia of this type the strangulation occurs at the neck of the sac, but the affected omentum or intestine lies, not within the sac, but inside the abdomen (*vide* Fig. 22). Such a state of affairs is rare, but it calls for consideration owing to its gravity and the ease with which it may be overlooked, unless the surgeon constantly makes a practice of inspecting the intestine or omentum adjacent to that within the sac. Occasionally the sac contains nothing but offensive fluid, and such a state of affairs renders complete exploration on the abdominal side of the neck essential.

3. Unusual Contents of the Sac. (1) *Hernia of the Bladder.*—Those who have had experience of the radical cure of hernia are fully aware of the significance of a thick, soft mass of tissue, which is sometimes encountered on the inner side of the sac, and a similar mass may be found in the presence of strangulation, giving the impression of a second

sac. Such a protrusion may be invaginated into the inner wall of the sac, or it may be merely adherent to its inner side; it may be congested and red from strangulation, but gangrene rarely occurs, and its presence is not of serious import, provided that its wall is not incised. The essential steps are to identify the structure, if necessary by exploration of the bladder with a sound, and secondly, to separate the sac very carefully from the bladder wall, observing the

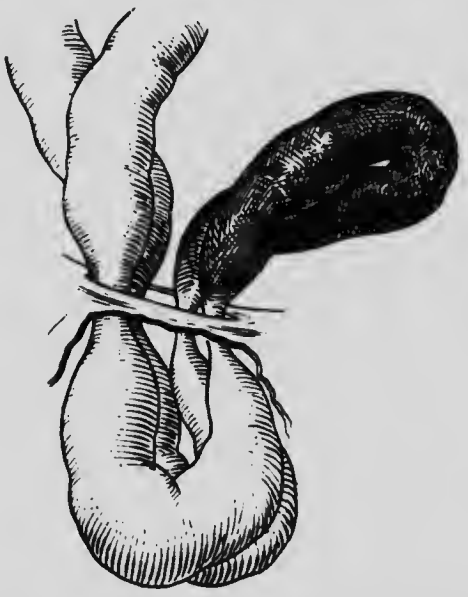

FIG. 22.—Retrograde Strangulation (after Léjars).

general rule that the neck of a hernial sac should not be ligatured until it is clear that it consists only of one serous layer. If, by any mischance, the bladder is wounded during operation, the opening should be closed immediately with a double row of sero-muscular catgut sutures. Where the injury is recognised at once and treated in this fashion, leakage of urine rarely occurs, and the hernia wound may be closed without drainage.

(2) *The Vermiform Appendix in Hernial Sacs.*—Like any

other portion of the intestine, the vermiform appendix may be included in the sac of a strangulated hernia, occasionally alone, but more often together with other intestine or omentum. If it is found in a state of congestion, there is no doubt that appendicectomy should be carried out, for the operation will be lengthened only by a few minutes, and the patient will be rid of an obvious source of danger.

Another direction in which the appendix may complicate hernia is in the occurrence of appendicitis within a hernial sac. Clinically, the condition may be suspected when there are indications of a febrile illness, pain in the sac and the lower abdomen, vomiting, and constipation, or possibly diarrhœa, together with diffuse tenderness in the hernial region and its neighbourhood.

Several different conditions may be revealed by herniotomy—

(*a*) The sac may contain only inflammatory fluid, and the appendix may lie close to the abdominal aspect of the neck.

(*b*) The diseased appendix may be alone in the sac.

(*c*) The sac may contain both appendix and omentum.

(*d*) The hernia may be large and irreducible, with the inflamed appendix in its midst.

It is clear that the ideal course in all these cases is to perform appendicectomy *via* the sac, allowing for drainage of the infected zone through the neck of the sac, but in some cases it may not be possible to draw down the *caput cæci* sufficiently, and the operation must then be performed through an abdominal incision, using the herniotomy wound for drainage if such is deemed necessary. Infected omentum must be ligatured as high as possible and excised. In the last-mentioned pathological picture the treatment may be very difficult, and it may occasionally be desirable to leave the sac contents unreduced after treating the appendicular lesion, the treatment of the hernia being left for a future occasion.

(3) *Hernia of the Uterine Appendages.*—The ovary and Fallopian tube may be found in the sac of a hernia, either

alone, or together with intestine or omentum. When strangulation occurs, the symptoms closely resemble those of other strangulated herniæ, though the intestinal signs may not be very evident ; redness and œdema of the coverings of the sac tend to appear early. The need for operation is usually quite clear, but the correct line of treatment can be determined only after the sac has been opened. If the organs are merely congested, and the sac contains only clear or sanguineous fluid, recovery will commence as soon as the constriction is relieved, and reduction with subsequent radical cure can be carried out ; if, however, early or late gangrene is present, as it often is, the organs must be sacrificed, and drainage through the neck of the sac established if necessary. A Fallopian tube within a hernial sac may be the seat of salpingitis, and here again removal will almost certainly be indicated.

(4) *Richter's Hernia.*—This form of hern. is more fully described as a *partial strangulated enterocele,* and it is most often seen in femoral sacs. Owing to the fact that only a part of the lumen of the gut is strangulated, the symptoms are apt to be less pronounced than where the whole diameter is implicated, but this renders the condition all the more grave, since the small swelling present in the hernial region may be overlooked, and thus operative treatment may be delayed. As regards treatment, if the portion of the intestine recovers its tone and colour after the relief of the constriction, reduction and radical cure may be performed ; but in considering gangrenous hernia we shall be obliged to refer again to Richter's hernia, owing to the frequency with which localised gangrene is present.

(5) *Littre's Hernia.* This name has been given to a strangulated hernia when the sac contains Meckel's diverticulum ; it is exceedingly rare, and clinically it resembles Richter's variety in that there is incomplete obstruction of the intestine. Treatment obviously calls for amputation of the diverticulum, and careful inspection of the bowel to which it is attached.

4. Complications due to Taxis.—Taxis was at one time the routine method of dealing with strangulation, but now fortunately it is rarely employed, and many of the evils due to such a risky procedure have become very unusual; but it must be remembered that taxis is still sometimes performed by the patient, and therefore we must be aware of the results which may follow it. In all those cases where taxis fails, the symptoms of strangulation persist, or the patient even becomes worse, and shows signs of collapse and peritoneal infection. It must be admitted that most of these accidents are due to persistent and forcible efforts at reduction.

(*a*) *Reduction en masse.*—In this case both sac and hernial contents are reduced into the extra-peritoneal tissue without relief of the strangulation; the hernia then becomes pro-peritoneal, and it may be possible to detect a tense rounded swelling through the abdominal wall. If such an accident has occurred, it is clear that only a complete opening up of the hernial region will enable the surgeon to deal adequately with the sac and its contents, and it is fortunate if operation is undertaken before gangrene becomes imminent.

(*b*) *Hernia en bissac.*—In the case of a bilocular hernial sac it is possible to reduce the contents of the lower compartment into the upper, whilst the constriction at the neck still remains; if the upper sac lies at a deeper level it may appear that reduction has been effected and yet the symptoms of strangulation persist.

(*c*) *Rupture of the Sac, and reduction into the extra-peritoneal tissues* (*vide* Fig. 23).—If the neck still remains intact strangulation may persist, and the contents may be pushed through a rupture of the sac wall into the extra-peritoneal tissue. The diagnosis of this condition is hardly possible before operation.

(*d*) *Tearing away of the Sac at its Neck* (*vide* Fig. 24).—Here a circumferential rent is produced as the result of considerable force, and, whilst the constriction remains unrelieved, the hernial contents may be pushed into the extra-peritoneal tissue.

(*e*) ***Persistent obstruction after successful reduction.***—Taxis may succeed in returning the contents of the hernial sac into the peritoneal cavity, but, owing to adhesions between the coils of intestine, or to omental bands or apertures, obstruction may persist; this condition may be

FIG. 23.—Rupture of sac, and reduction into extra-peritoneal tissues (after Léjars).

FIG. 24.—Rupture of neck of sac (after Léjars).

due to injury caused during taxis, for if both omentum and bowel lie within the sac the former may be torn and the intestine pushed through the opening; a condition of intra-abdominal strangulation may thus be produced, and

the clinical picture becomes one of intestinal obstruction with consecutive peritonitis.

(*f*) *Rupture of the intestine.*—It would appear that considerable violence is needed to cause actual rupture of the gut within the sac, but within our own experience such an accident has followed taxis performed by the patient himself. In this case, the man, who had often reduced his inguinal hernia before, found it painful and irreducible; he used a good deal of force and reduced it "with a bang like the bursting of a paper bag." At operation the sac was found to contain only a little offensive fluid; on opening the abdomen a small rupture of the ileum was found, with early peritonitis; the ileum was sutured, and the man made a good recovery. In this case there was no fæcal extravasation, and thus the successful issue was favoured.

(*g*) *Peritonitis without rupture of the gut.*—Reduction of invisible intestine may sometimes mean the return to the peritoneal cavity of intestine with blood supply damaged beyond recovery; in this case not only are the signs of strangulation not relieved, owing to paralysis of the intestine, but infection of the peritoneum rapidly ensues through the damaged bowel wall. Occasionally a condition of paralysis of the gut remains after reduction, and this leads in the first place to obstruction since peristalsis is inhibited, and later on, to peritonitis. The increasing distension of the abdomen, and inability to pass fæces or flatus, are the characteristic features of the onset of this complication. Pain is less than the pain of hernia, and it may be almost negligible.

Treatment.—It is clear that the exact state of affairs in these cases cannot be diagnosed with any degree of accuracy, but the need for early exploration, where untoward symptoms are present after apparently successful taxis, is abundantly clear, and, as a general rule, the best method of procedure is to explore first the hernial region, and then the wound may be enlarged so as to gain access to the peritoneal cavity if necessary. In some instances it may be wiser to operate through two wounds, but the duty of the surgeon is to relieve

the immediate condition even at the risk of weakening the abdominal wall.

Strangulated Femoral Hernia

Strangulation in the femoral canal has always been treated on sounder surgical principles than in the case of inguinal or umbilical hernia, and rarely indeed is any attempt at taxis made in these cases. One reason for this is the knowledge that the strangulating agent is usually outside the sac, composed of unyielding fibrous tissue, in the shape of Gimbernat's ligament. The clinical picture is well known, but occasionally an inflamed lymphatic gland is mistaken for a strangulated femoral hernia, and at other times there may be a doubt as to whether a given hernial swelling is inguinal or femoral in nature. It is characteristic of a femoral hernia escaping through the saphenous opening, that it tends to pass forwards, upwards, and outwards in the direction of the anterior superior iliac spine, but the neck of the rupture is always below Poupart's ligament, outside the pubic spine, and internal to the femoral vessels. Another feature possessed by an irreducible femoral hernia is its lateral mobility, so that if the body of the swelling be grasped, it can be readily moved from side to side; this will serve to distinguish it from an inguinal hernia and from enlarged glands in the groin. However, it is more in the interests of the patient to explore in all doubtful cases than to postpone operation with a view to certain diagnosis.

Steps of the Operation. 1. *Exposure of the sac.*—The only preliminary to the skin incision that is needed, is shaving and painting with iodine. Either an oblique, vertical, or curved incision may be used, according to the preference of the surgeon; the advantage of the oblique or curved incision is said to be that it gives readier access to the neck of the sac and the femoral ring, and facilitates the radical cure stage of the operation. In any case the wound should extend well above Poupart's ligament, so that the region of

strangulation is thoroughly exposed, and the first step in the operation should be to free the sac in its whole extent before opening it. A femoral sac usually has a quantity of fat adherent to its outer wall, but the other coverings may be very thin, so that care must be taken in deepening the wound, and the appearance presented may be that of a tense blood cyst. It is desirable to detach all the structures from the surface of the sac before incising it, so that the neck may be fully exposed and its relationship to Poupart's and Gimbernat's ligaments determined.

2. *Relief of strangulation.*—The sac should now be opened by the cautious division of the successive layers of tissue held up by forceps. Blood-stained fluid usually escapes as soon as the peritoneal layer is divided, but one must be prepared to come directly upon bowel or omentum. The edges of the sac should be secured by pressure forceps, and it should be laid open from the fundus nearly up to the neck, so that the contents can be fully examined. These should next be bathed with warm saline and gently pulled open, for it is not always necessary to divide or stretch the tissues which have obstructed the return of the hernia. In some cases gentle traction will enable the constriction to be examined, and by careful manipulation, reduction may be effected; but in no case must any attempt at reduction be made until inspection has proved the viability of the sac contents. If omentum is present, the strangulated portion should be ligatured and excised, and this can usually be done before steps are taken to increase the circumference of the crural ring. This enlargement may often be effected without the use of scissors or knife, for it is possible to pass the index finger gently between bowel and the sac wall, and thus to dilate the femoral ring sufficiently to enable the strangulated tissue to be brought down for inspection, and to be easily reduced. By this method the fibrous ring outside the neck of the sac can be stretched considerably, but it should not be employed if the bowel is gangrenous, since injury to the gut might occur at the level of the neck of the

sac. If incision is necessary, it is the structures on the inner side of the crural ring which are usually divided, but the old-fashioned method of nicking Gimbernat's ligament with a hernia knife is open to drawbacks, and whatever is divided should be plainly seen. Personally, we have found that the simplest and quickest method of dealing with the strangulation is by partially dividing Poupart's ligament over the anterior aspect of the sac, and, since the steps of the radical cure require the bringing down of Poupart's ligament for suture to the pectineal fascia, we can see no disadvantage in this method of operating, although most text-books condemn the division of this ligament. Complete division is needed only where a hernio-laparotomy becomes necessary for resection and anastomosis, and we have never regretted partial section of this structure, and do not remember to have seen any local weakness, or recurrence of the hernia, as a result. The ease with which one blade of a pair of blunt-pointed scissors can be passed between the neck of the sac and Poupart's ligament makes this method the quickest and safest for the relief of strangulation. The risk of damage to an abnormal obturator artery alone is enough to make the attack on Gimbernat's ligament undesirable, for if it is wounded it gives rise to troublesome bleeding, and delays the operation considerably.

3. *Reduction and radical cure.*—If any omentum present has been dealt with in the usual way, and the intestine has been reduced, it remains only to deal with the sac and to close the femoral ring. The former is treated by ligature at the neck and removal; the latter may be closed in a variety of ways, but so far as our experience goes there is little evidence that anything more is necessary than the union of Poupart's ligament to the fascia covering the pectineus muscle. A silk purse-string suture passed successively through Gimbernat's ligament, the pectineal fascia, the inner aspect of the sheath of the femoral vessels, and Poupart's ligament effects this very well, and additional security may be obtained by passing two sutures through

Poupart's ligament and the pectineal fascia over the purse-string. Recurrence after this form of radical cure is very rare, and, with reference to the integrity of Poupart's ligament, it matters little provided that any incision through it is carefully sutured by this method of closing the femoral ring, whereby the ligament is brought down about half an inch below its normal level.

After treatment.—The same lines should be followed as in the case of strangulated inguinal hernia.

Strangulated Umbilical Hernia

Two factors have combined to make the prognosis in strangulation of umbilical more grave than obtains in the case of either inguinal or femoral hernia. One is that palliative treatment has too often been relied upon in the past, and the other is that efficient radical cure of such a rupture is undoubtedly more difficult than that of the other varieties. Strangulation in these herniæ is more likely to be complicated by long-standing adhesions and chronic irreducibility. At St. Thomas's Hospital in the year 1899 nearly twice as many strangulated as non-strangulated umbilical herniæ were operated upon ; in 1909 the proportion of strangulated to reducible and irreducible was 3 to 25. Such a change in statistics indicates a diminution in the occurrence of strangulation in this disease.

Umbilical Herniotomy.—As in the case of other hernia operations, a general anæsthetic is to be preferred, but local infiltration will suffice where the condition of the patient does not warrant inhalation anæsthesia.

1. *The incision.*—Whether the swelling is strictly umbilical or par-umbilical matters little, and we prefer an operation following the plan of W. J. Mayo, the essential features of which are that the suture line should be horizontal, and that the planes of the abdominal wall should be overlapped. A transverse skin incision is the best, and it is often desirable to make an elliptical wound so as to excise

the redundant skin and fat over the sac. Care must be taken in dividing the skin that the sac is not opened unintentionally, for both sac wall and subcutaneous tissue may be considerably stretched and thinned in the centre. No attempt should be made to isolate the sac before opening it, but the sac wall and its coverings should be removed *en masse* from the most prominent part of the hernia. Adherent omentum is a source of much difficulty in these cases, and the simplest course is to remove portions of it together with the sac wall.

2. *Relief of the constriction.*—It must be remembered that in the case of umbilical hernia, strangulation within the sac is almost as common as strangulation outside the neck, so that it is desirable first to free the contents, and then, with knife or scissors, to enlarge the umbilical ring. The neck of the sac is often firmly adherent to the fascial plane, so that whatever is divided should be freely exposed to view.

3. *Reduction of hernial contents.*—When the omentum has been cut short, adhesions divided, and the hernial ring enlarged, the intestine should be withdrawn for inspection, bathed with hot saline, and returned to the abdomen; but before doing this it is important to pass the finger inside the abdomen to make sure that the abdominal aspect of the hernial orifice is free from adherent bowel or omentum. In some recurrent cases adhesions in this situation are so firm that division of them would dangerously prolong the operation, and one may feel obliged to leave them, but, if a satisfactory radical cure is to be carried out, it must be possible to pull up the peritoneum forming the neck of the sac and suture it without tension.

4. *Radical cure.*—The peritoneum must be freed from the aponeurotic margins of the hernial ring, and freed sufficiently to enable it to be sutured horizontally, without tension, after the redundant part of the sac is cut away. The aponeurotic layer should then be converted into an upper and a lower flap by horizontal cuts from the lateral extremities of the opening. The lower flap must next be

secured to the deep aspect of the upper by mattress sutures as shown in Fig. 25, and then the lower margin of the upper

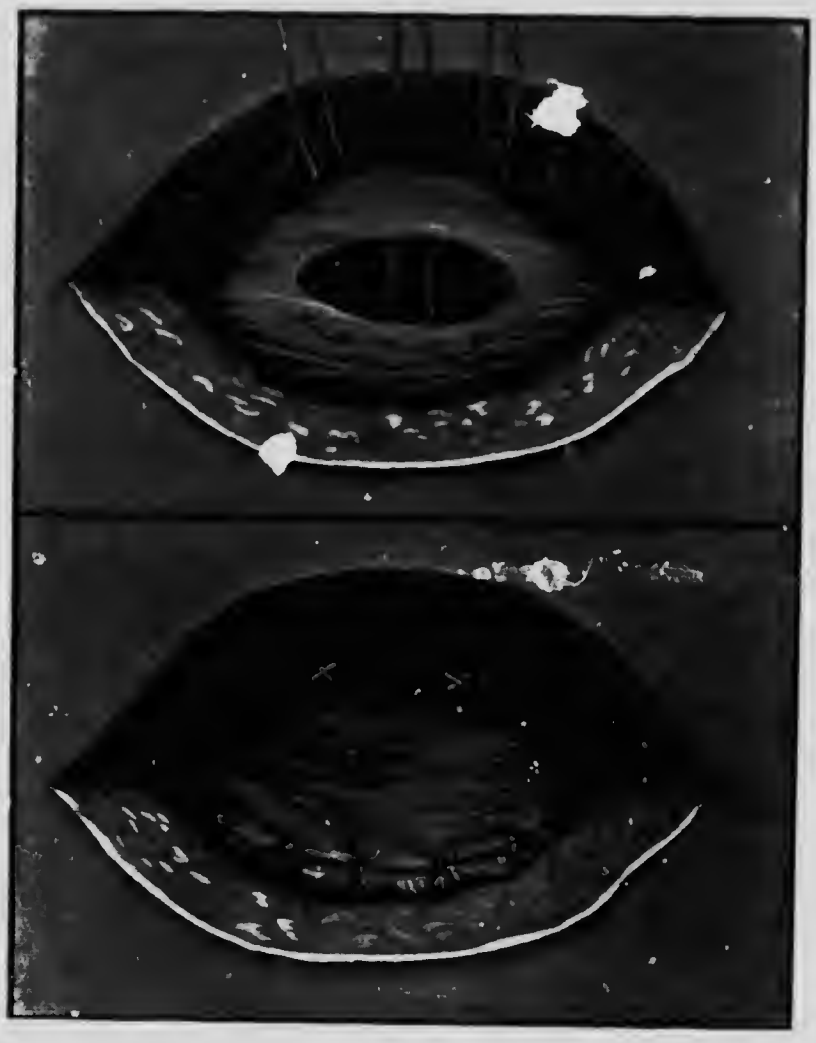

FIG. 25.—Radical cure of umbilical hernia (Mayo).

flap may be stitched to the surface of the lower aponeurosis. The skin should be closed with a Kocher's glass drainage

tube left between the stitches for twenty-four hours, to drain off serum from the space remaining beneath the skin.

It must be admitted that occasionally the reduction of a strangulated umbilical hernia is extremely difficult, owing to the presence of numerous firm intra-saccular adhesions, and if the patient is old and feeble, or bronchitic, as is frequently the case, it may not be desirable to spend more time than is required to relieve the strangulation and remove adherent omentum. Treatment of the sac and abdominal wall may then be left for another operation. If the patient is kept at rest in bed between the two operations a perfectly good result may be obtained by this proceeding.

Ventral Hernia

This does not differ greatly from umbilical hernia in its clinical aspect; it usually occurs at the site of a previous abdominal incision or injury to the abdominal wall, and as a result of this the sac may be very thin, or even absent, over some part of the hernial protrusion, so that omentum or intestine is directly adherent to the overlying skin. The incision, therefore, must be deepened with great care, but the steps for the cure of the hernia are essentially similar to those used in umbilical herniotomy, and the margins of the orifice should be separated in their several planes and united by overlapping suture.

The Rarer Forms of Hernia

Obturator Hernia.—This variety of strangulated hernia is particularly grave owing to the deep situation of the swelling, and by reason of the difficulties of the operation. If the hernial swelling is large, lying in the upper part of the adductor region, on the inner side of the femoral vessels, it may be recognised before operation, but the diagnosis is rarely made until the abdomen has been opened for symptoms of intestinal obstruction. It is easy to understand that a

small obturator hernia may be overlooked, and the only characteristic sign, in addition to obstruction, and the existence of a hernial swelling of variable size, is that caused by pressure on the obturator nerve; *pain radiating down the inner side of the thigh towards the back of the knee* may suggest the correct diagnosis in a doubtful case, and it is said to be rarely absent. In the female, vaginal examination may reveal a tender band or swelling at the internal orifice of the obturator foramen. Absence of hernial swellings in the inguinal and femoral rings aids the diagnosis of obturator hernia, but such a rupture may be mistaken for a femoral hernia of the pectineal type. It is rarely met with until after middle age.

As regards treatment, since the diagnosis is rarely made until the abdomen is opened for the relief of obstruction, the operation should be conducted through the laparotomy wound with great care to avoid soiling of the peritoneum, and the Trendelenburg position will probably be found of great value. A finger passed down to the obturator foramen will usually dislodge the ensnared loop of bowel, and this may be aided, if necessary, by external pressure, but the intestine should be surrounded with gauze pads to prevent infection of the peritoneum, and, in case rupture occurs, it is wiser to clamp the two limbs of the affected loop of gut, which is nearly always jejunum or ileum. With these precautions, even resection and anastomosis may be successfully carried out in this disease. Some attempt at a radical cure should be made, and probably the most efficient method is by invagination of the sac into the peritoneal cavity with ligature and excision of its fundus. Such a proceeding requires an incision through the pectineus muscle in addition to the abdominal wound, and a case described by Corner and Huggins (Trans. Roy. Soc. Med., Feb. 1909), in which this method was adopted, has yielded an excellent result.

Sciatic Hernia.—This rare hernia occurs in three varieties; it may emerge through the great sacro-sciatic notch, and appear either above or below the pyriformis

muscle, or again it may pass out through the lesser sacro-sciatic notch (subspinous sciatic hernia). Its interest is mainly pathological, for it causes no appreciable swelling of the buttock, and Wassilieff, in the Revue de Chirurgie, 1891, page 199, thus describes a case:—"The left gluteal region presented a normal appearance; there was no redness, no œdema, no swelling evident either on inspection or palpation. Pressure with the finger-tip caused pain only over a very limited area of the size of a shilling. This area was situated 3½ inches from the middle line in the upper part of the buttock, over a line extending from the posterior superior iliac spine to the posterior part of the great trochanter." The patient exhibited definite symptoms of intestinal obstruction, which followed the onset of the gluteal pain, and this had come on suddenly after muscular effort; the usual hernial orifices were free.

Léjars says that the principal features of such cases are the symptoms of intestinal obstruction, associated with the presence of localised pain in the upper part of the buttock, at the junction of the upper and middle thirds of the ilio-trochanteric line, or, in the case of the subspinous variety, at the junction of the lower and middle thirds of this line.

Treatment.—If the diagnosis is made during cœliotomy for symptoms of obstruction, it may be possible to disengage the bowel in the way which we have already considered in dealing with obturator hernia, but sciatic herniotomy is a recognised, though rather difficult, operation, owing to the proximity of the gluteal artery, which usually passes over the upper aspect of the neck of the sac. The primary incision should be similar to that used for ligature of the gluteal artery, directed downwards and forwards from the posterior superior iliac spine to the great trochanter; the fibres of the gluteus maximus must be split, and the sac should be exposed and opened. The neck may be capable of enlargement by digital pressure, but if an incision must be made, it should be in a downward and outward direction after the gluteal vessels have been located. If anything

beyond reduction is needed, the abdomen must be opened, and several successful cases have been recorded where treatment has been carried out by the abdominal route alone. Possibly the same type of radical cure as in obturator hernia, by invagination, ligature, and excision of the sac, might be practised in sciatic cases.

Lumbar Hernia.—A lumbar hernia usually protrudes through the triangle of Petit, which is bounded below by the crest of the ilium, in front by the posterior border of the external oblique, and behind by the anterior border of the latissimus dorsi; its floor is formed by the internal oblique and the lumbar fascia. Other lumbar herniæ, however, are described, including one situated just below the tip of the twelfth rib, and another due to a protrusion through the external oblique, or the latissimus dorsi, close to their attachment to the iliac crest. These herniæ may be strangulated, and such an accident is said to be far from uncommon, though we have no personal experience of this complication. Operative treatment on the lines already laid down presents no difficulties in such cases, and closure of the opening can be secured by overlapping suture of the margins of the aperture.

Hernia through the Pelvic Floor.—These are very uncommon; they originate in a descent of the peritoneum forming Douglas's pouch, and may be perineal, labial, vaginal, or rectal. The first, in the male, appears on one or other side of the middle line between the anus and the scrotum, or else close to the lower border of the gluteus maximus, behind and beside the anus. In the female, such a hernia is termed pudendal, and occupies the posterior portion of the labium majus; its pedicle may be felt on vaginal examination. A vaginal hernia may push in front of it a part, or even the whole, of the posterior vaginal wall, and in the former variety strangulation is particularly liable to occur. A rectal hernia pushes the anterior wall of the rectum before it, and it may protrude through the anus, having the appearance of a prolapse or rectal polyp.

The diagnosis of these conditions depends on a careful and accurate vaginal and rectal examination, and the treatment in the event of strangulation requires full exposure of the sac, and its removal after the reduction of its contents, as far as this is practicable.

Gangrenous Hernia

The occurrence of gangrene within a hernial sac, whatever the anatomical nature of the hernia, indicates a grave prognosis, and this is often due to the fact that the patient has been poisoned by fæcal absorption before the surgeon has a chance of doing what is necessary for the local condition; in fact he is often hampered in his efforts because the correct treatment means prolonging the operation, and he hesitates to do what the local condition demands, fearing that the patient cannot stand it. On the whole we believe that the boldest course yields the best results, and, where the condition of the patient is bad, it is the anæsthetic and not the operation, which is fraught with danger. The introduction of spinal and local analgesia has done much to facilitate operation even in the worst cases, so that, whilst recognising the futility of elaborate operations on moribund patients, we would urge that no cases of strangulated hernia should be allowed to die without some effort at relief.

Clinical Signs of Gangrene.—These may be briefly considered, although it is important to remember that unsuspected gangrene may be found affecting a portion of the sac contents when the condition of the patient is quite good, and yet, on the other hand, a patient may suffer so severely from the effects of intestinal obstruction that gangrene may be suspected when the bowel is merely congested. The leading characteristics of oncoming gangrene are diminution of pain, and loss of tension in the sac; there may be a fall of temperature, and the pulse usually becomes rapid and feeble; sweating is often seen, the face becomes pinched and

anxious; vomiting may cease, but abdominal distension tends to occur, and hiccough may be troublesome. Constipation is absolute, and neither fæces nor flatus are passed. If the condition remains unrelieved, the patient dies a comparatively painless death from intestinal and peritoneal toxæmia.

Treatment.—This may be approximately considered under the following heads:—(1) Suspected gangrene. (2) Gangrenous patches. (3) Diffuse gangrene. (4) Gangrene with perforation within the sac. The last mentioned represents the spontaneous relief of gangrene, and may lead to secondary perforation of the sac, and the production of a fæcal fistula or an artificial anus, and we can remember having seen a case of umbilical hernia where several inches of the bowel had separated as a slough, together with the front of the sac and abdominal wall, leaving two free ends of small intestine. Such a process usually leads to peritoneal infection, either because the bowel resists separation until obstructive peritonitis develops, or else from backward extension from the sac to the peritoneal cavity.

1. *Suspected gangrene*.—Gangrene of intestine is generally easy of recognition, but there may be many intermediate grades, which can only be characterised as suspicious. If the bowel has completely lost its polish and resiliency, and is grayish-black in colour, with no pulsation of the mesenteric vessels to be felt, it is clear that gangrene is present; but if there is only some loss of polish and resiliency, and if feeble pulsation can still be felt in the mesentery, it is possible that relief of the strangulation will enable recovery to ensue, though there are many cases where it is hardly justifiable to take the risk of returning such damaged intestine to the peritoneal cavity. The question can often be decided when the constriction is relieved, the bowel pulled down, and bathed with hot saline; if there is no obvious improvement within a few minutes, it is probable that the vascular damage has proceeded too far to allow return to a healthy state, and such intestine, loaded as it is with infective organisms,

cannot with safety be reduced and the operation concluded with a radical cure. Several courses are open to the surgeon. Small areas of doubtful intestine may be invaginated with Lembert sutures so that the suture line is at right angles to the long axis of the gut, but if most of the bowel is thus affected the question of resection arises. If there is much doubt it is probably better to err on the side of removal rather than to leave anything to chance, but if resection is judged to be unnecessary there are two plans which have often been successful; these are:—(*a*) the constriction being relieved, and the bowel inspected, it is returned just within the neck of the sac and anchored so that if recovery does not ensue adhesions will form, and leakage will follow the path of least resistance through the neck of the sac. The only difficulty is to ensure the fixity of the suspected intestine at the abdominal orifice of the sac; this may best be done by passing a piece of narrow rubber tubing through the mesentery half-an-inch away from the bowel, and securing its free ends around a wide gauze plug with which the external wound is packed. If all goes well the tube can be slipped out at the end of four or five days and the second stage of the operation completed by a radical cure. It is important that this tube should not be drawn tight, or obstruction, due to kinking of the bowel, may be caused. If actual gangrene occurs, the resulting fæcal fistula must be operated upon before the skin is destroyed by digestive action, or the patient's vitality lowered. (*b*) The constriction may be relieved, and the doubtful intestine pulled down and fixed in the wound by a loop of rubber tubing, gauze packing, or a few sutures. If recovery takes place these restraints should be removed, and as the vitality of the gut returns there will be a tendency for it to withdraw spontaneously into the abdomen. If this has not occurred at the end of a week, the recent adhesions may be broken down, the bowel reduced, and a radical cure undertaken. If the worst happens, the gangrenous bowel will perforate outside the abdomen, and such a fæcal fistula is fairly easy to deal

with after a few days, when the toxicity of the intestinal contents has diminished.

Of these two methods, the first appeals to us as being the sounder for merely suspicious intestine, seeing that if it is necessary to withdraw the bowel from the sac probably primary resection and anastomosis is the operation of choice.

2. **Gangrenous Patches.**—(1) *Partial invagination.*—One or two small areas of gangrene in otherwise healthy bowel may very well be treated by infolding the intestinal wall and securing it with a row of Lembert sutures; this may be done in one place for a patch equal to half the diameter of the intestine, and for multiple smaller areas, but care must be taken that the intestinal lumen is not seriously encroached upon, and to this end the suture line should always be at right angles to the long axis of the gut.

(2) *Partial enterectomy.*—Where a large number of gangrenous patches are present, resection of the whole loop of affected intestine is called for, but in the case of an area involving not more than half the diameter, excision of the gangrenous patch may be practised with good results. If possible, a lozenge-shaped piece of bowel should be excised, with the usual precautions to prevent extravasation of fæces, for the wound can then be closed transversely. Such a partial enterectomy has often been performed with success in cases of Richter's hernia, where gangrene is particularly common owing to the time which may elapse before the nature of the case is determined.

3. **Diffuse Gangrene.**—So far we have discussed degrees of gangrene which can be dealt with rapidly, so that even where the patient's condition is grave, there need be little hesitation as to the correct course of operative treatment. Where there is extensive necrosis of bowel, the case is somewhat different, for resection and anastomosis, which is universally recognised as the most desirable course, means prolonging the operation by about twenty minutes at least, and such a prolongation of anæsthesia may seriously affect the prognosis. As we have stated above, the use of spinal

and local analgesia in these cases has enabled the surgeon to adopt a bolder course, and even infiltration anæsthesia has in our experience been sufficient for extensive hernial operations. Certain manipulations are apt to be painful and productive of shock, but chloroform, administered to the stage of mental confusion, may be used with advantage to bridge over these difficulties. If resection and anastomosis is done under local anæsthesia, it is desirable to give a little chloroform owing to the pain caused by the necessary treatment of the mesentery, although the suture of the intestine is practically painless.

Having decided from the absence of polish, from the flaccidity, the colour, and the absence of pulsation in its mesentery, that the coil of intestine within the sac is gangrenous, the surgeon must decide, after consultation with the anæsthetist, whether the patient will stand a further prolongation of the operation, but both should remember that some risk may be legitimately run, since statistics show a lower mortality after primary resection than after palliative treatment such as the formation of an artificial anus. Let us suppose that the condition of the patient is favourable; then the essentials are that the wound must be large enough to allow considerably more than the gangrenous loop to be pulled outside the abdomen; all the necrotic bowel, mesentery, and omentum must be removed; the anastomosis must be performed with healthy gut and sound mesentery; reduction after anastomosis must be possible without any strain. The first and last steps call for ample room at the neck of the sac.

1. *Enlargement of the wound.*—In the case of umbilical and inguinal herniæ it is not usually difficult to get enough room for the easy withdrawal and replacement of the necessary length of intestine, but in femoral hernia the case is rather different; we have no objection to partial division of Poupart's ligament, and in the female sufficient room can be secured by this step; in the male, however, the spermatic cord lies in danger, and if it is not sufficient to divide the

structures up to the level of the cord, the abdomen must be opened and the intestinal resection performed through an abdominal wound; the objection to this course is the risk of soiling the peritoneum whilst dragging the affected bowel from the hernial to the abdominal wound. In the rarer forms of hernia, laparotomy is usually called for in the presence of gangrene.

2. *Resection of gangrenous tissue.*—Omentum within the sac, though not always gangrenous, is always infected, and therefore ligature and excision through healthy tissue must be carried out. With regard to the intestine, it will usually be noticed that on the proximal side of the first constriction it is distended and injected, whilst beyond the hernial loop the bowel is somewhat collapsed, but its walls seem fairly healthy. It is important that enough should be resected, and much more must be removed on the proximal than on the distal side of the gangrene, for it is well known that the infectivity of intestinal contents increases as the result of obstruction, and the condition of the gut improves as one gets further above the seat of gangrene. Hofmeister has found that in his resections he has removed on an average 6½ times the length of the actual gangrene, and this means that for four inches of gangrenous bowel over two feet should be resected, the greater part being removed on the proximal side of the herniated loop. This seems rather excessive, but it has been common in the past for failure to be due to resection too close to the gangrenous zone, and the portion of bowel excised should, if a mathematical rule can be adopted, *be at least four times the length of the actual gangrene.* At any rate the line of division must be made through healthy-looking bowel, and the mesenteric vessels must bleed freely as they are cut across. A wedge-shaped portion of the mesentery should be excised corresponding to the length of intestine removed, and if the vessels are cut before being ligatured one gets a guarantee of the vascularity of the tissue. The best procedure is to divide the mesentery with a scalpel after light clamps have been

applied, cutting from the bowel towards the root of the mesentery; the intestine should next be severed with scissors between the clamps. The method of cutting through the intestine is of some importance; since end-to-end anastomosis is usually preferred, it is desirable that the intestinal lumina should be as nearly equal as possible, and in order to increase that of the distal limb it may be divided so that it is shorter at its anti-mesenteric border than at its attached margin; by this means also a better blood supply is insured; the proximal bowel should be divided more nearly at right angles to the long axis of the intestine.

3. *Axial anastomosis.*—Before union of the divided ends of the bowel is begun, the upper segment should be emptied as far as possible of its toxic contents, and this will probably favour contraction of its muscular coat, so that the disparity in dimensions of the two portions of gut is reduced. Most authorities are now in favour of axial anastomosis by simple suture, and there is no doubt that it is usually efficient, and it can be done in a short time with an ordinary round-bodied needle, and either silk or linen thread. The only risks are that the blood supply at the suture line may be deficient, or that infolding may take place and lead to subsequent stricture; the former can be guarded against by careful division of the bowel in the way we have advocated, and by careful suture of the mesenteric border before the rest is united; the latter by taking up only enough of the intestinal wall to ensure accurate apposition of its serous coats. End-to-end union is not suitable where the two portions of the intestine are of considerably different calibre, nor for the junction of small to large bowel. Lateral anastomosis should only be employed where axial is contra-indicated, for it means three lines of suture, and therefore takes longer to perform, and affords more possible avenues for peritoneal infection; its merit is the absence of tendency to post-operative stricture, but this is very rare after axial anastomosis, and there are other drawbacks associated with lateral junction which outweigh this one advantage. One is

sometimes tempted to perform a lateral anastomosis between the afferent and efferent limbs of bowel and then resect the gangrenous area, but we are convinced that this is not good practice, and the correct steps of the operation are ***resection***, ***emptying of the bowel***, and ***anastomosis***. The first suture in circular enterorrhaphy should be applied to the mesenteric border of the intestine, and the use of Lee's stitch has done much to increase the safety of this method of junction. This

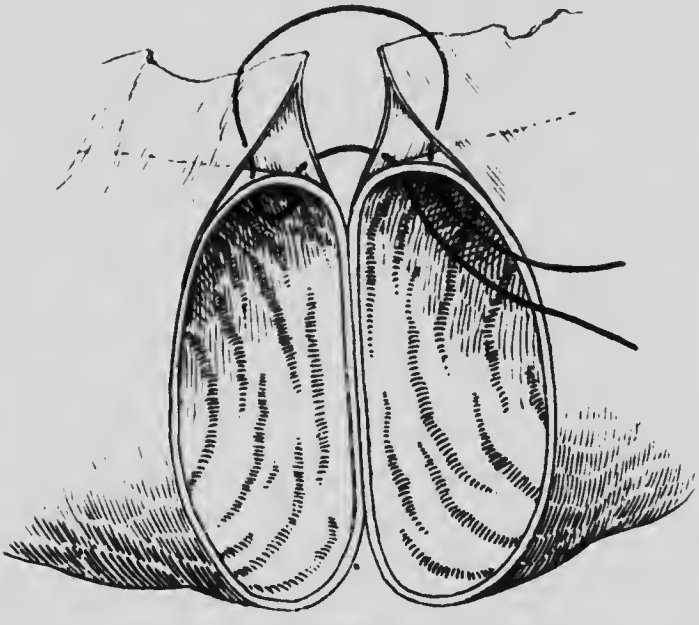

FIG. 26.—Axial anastomosis; Lee's stitch.

suture begins in the lumen of one portion of the intestine, and is a mattress suture tied inside the bowel, obliterating both mesenteric angles. It should be tied and cut short, and then the deep continuous stitch, taking up all the coats in order to secure hæmostasis, may be proceeded with as if Lee's stitch had not been inserted. This encircling suture should be interrupted once or twice in its course around the intestine. The union is completed by a sero-muscular suture, and the

mesenteric gap should next be closed by continuous or interrupted stitches picking up only the edges of the opening, for fear of strangulating any of its blood vessels. Inequality of the two ends of the bowel has been already spoken of, and, if the oblique division of the distal limb is not sufficient to meet the difficulty, a small longitudinal incision may be made through its anti-mesenteric border.

Lateral Anastomosis.—Lateral union is the normal method of uniting small to large intestine, and after colectomy, except perhaps in the transverse and iliac colon, but small bowel is so much more common than large in gangrenous herniæ that this method of union is less often called for than that which we have considered above. The procedure in lateral anastomosis is so well known that no detailed description is required; we should, however, like to lay emphasis on the need for careful closure of the blind ends, particularly that of the proximal limb of bowel. The intestine must be emptied before the ends are closed, and this closure may be effected either by a crushing clamp or ligature, by a purse-string suture, or more accurately by a continuous stitch which is started within the lumen of the bowel; in any case, this first layer must be covered in by a continuous sero-muscular suture which secures broad serous apposition. When the free ends are thus securely closed, the clamps should be applied and the lateral anastomosis performed with a double layer of sutures so that the blind ends of the gut are as short as possible, and the sutured orifice allows ample room for the fæcal stream. This is best effected by excision of the redundant mucous membrane.

Lateral Implantation.—Where ileo-colostomy has to be performed, there is no doubt that anastomotic union between the end of the ileum and the lateral aspect of the colon is very satisfactory, and it has the advantage over lateral anastomosis that there is only one blind end of intestine. It is more difficult of execution than lateral union, and the tendency to contraction of the opening must be guarded against by removal of mucous membrane from the large

bowel and enlargement of the orifice of the portion to be implanted by a longitudinal incision in its anti-mesenteric border.

Mechanical aids to Enterectomy.—Some mention must be made of such devices as Murphy's button, and Mayo Robson's bobbin; the former being made of metal, the latter of decalcified bone. It is still customary for surgeons to be supplied with these appliances, but they are rarely used; although the button may save a little time in uniting two portions of intestine, there are objections to it which have prevented its becoming really popular in this country: it may easily cause more pressure necrosis of the bowel than is desired, and, on the other hand, it may not be passed along readily, and remain fixed at the suture line, or fail to travel through the ileo-cæcal valve, and thus become a source of obstruction. With the bone bobbin it is claimed that one line of sutures is sufficient, but most operators are not satisfied with a single layer, and therefore the time-saving value of this device is open to question. Of these, and similar appliances, it may be said that they make intestinal anastomosis a little easier of performance, but the prevailing tendency of modern surgery is to rely rather on simple suture both for safety and economy of time.

After treatment.—On account of the many possible causes of failure in resection for gangrenous hernia, the outlook is necessarily grave for many days, and, in our experience, many patients appear to be doing well for the first week, and then, with the gradual onset of peritoneal symptoms, they become exhausted and die. In other cases the pulse may remain rather rapid and feeble for some days, the tongue may be coated, and the temperature raised: there may even be some nausea, and yet the patient may struggle through. Not infrequently the operation is followed by over activity of the bowels, and there may be somewhat offensive diarrhœa. The diet must be fluid for the first three days at least, and the treatment in general should be such as we have described for cases of obstruction or

pages 162–170, with the exception that aperients should be withheld until the third or fourth night, for there is no doubt that they throw undue strain on anastomotic unions of the intestine, and, in the absence of vomiting or signs of peritonitis, there should be no haste in stimulating the bowels. There is a tendency to abeyance of peristalsis after such operations as these, and one of the grave sequels to be feared is paralytic obstruction; this usually causes anxiety about the third or fourth day, when distension of the abdomen makes its appearance; vomiting may re-appear, and, though the patient complains of very little pain, there is gradually increasing discomfort from the abdominal distension, stretching of the abdominal wall, and embarrassment of the diaphragm. If aperients do not succeed, a turpentine enema may be tried, with due regard to the situation of the anastomosis, and, if there is still no action of the bowels, one must adopt the course of establishing an opening in the small intestine which is certain to be distended above the lesion. We have already discussed the *rationale* of this procedure in considering paralytic obstruction (pages 229–239), and we believe that as a temporary life-saving measure it should be practised more often than has been the custom hitherto.

Secondary intestinal obstruction of the organic variety may occur, being due to stenosis at the line of junction, kinking and adhesions, volvulus, or band obstruction. In such cases, there is a recurrence of abdominal pain, with vomiting and absolute constipation, together with local distension. Visible peristalsis and splashing in the distended coils may be found. In the presence of such signs abdominal section must be performed and the cause of the obstruction dealt with in a radical manner.

Peritoneal infection may occur at very varying periods after the primary operation. It may be present, as the result of obstruction, when resection and anastomosis is performed; it may be caused by soiling of the peritoneum during the course of the operation; infection may occur

through the stitch holes of the junction, causing diffuse peritonitis at once, or producing first a local and then a general peritonitis; but perhaps the commonest course of events is for a loop of intestine, supposedly healthy, to become gangrenous after its return to the abdomen, and thus lead to diffuse peritonitis. In all these cases the outlook is very grave, and death usually occurs within a short time of the infection. If such a complication is suspected shortly after the operation, free drainage of the peritoneal cavity, and possibly drainage of the intestine, offers the best chance of recovery. Anti-colon serum should be administered in these cases, as the infection is almost certain to be due to the *bacillus coli*. Continuous rectal saline is also of considerable value. The formation of a localised abscess around the anastomosis is less serious, and exit should be given to the pus as soon as the diagnosis is made. Although the peritoneum may have to be traversed to reach the abscess, careful gauze packing will render the operation fairly safe, and even if a fæcal fistula follows, it is likely to be only temporary.

In a few cases the anastomosis fails to unite and fæces appear in the wound, there being no evidence of peritoneal infection. In such an event it is important to ascertain at an early date whether all or only part of the fæcal stream is being thus diverted, and this may be judged by the amount of fæcal discharge and by the result of enemata. When once the bowel below the fæcal fistula has been thoroughly washed out, the result of enemata administered on alternate days may be taken as evidence as to the passage of fæces past the fæcal fistula, and if, from the positive results obtained by enemata, the opening is proved to be a fistula, and not an artificial anus, one is justified in postponing further operation, to see if spontaneous closure is likely to ensue. If all the fæces pass through the wound, or if the fæcal fistula shows no tendency to heal, a somewhat extensive operation must be undertaken to complete the cure. As a general rule the whole of the involved bowel must be freed.

and a second resection and anastomosis carried out; lesser measures than this are likely to fail owing to the spur, which is commonly present, preventing the direct continuation of the intestinal lumen.

Treatment of Gangrene, where the Patient's Condition is Bad.—In some cases it may be felt by both the operator and the anæsthetist that, although gangrenous intestine is found, any prolongation of the operation would inevitably prove fatal; in general practice also it may happen that the surgeon has neither the necessary assistance nor equipment for anastomosis. Under these circumstances one has to adopt the quickest measure which will afford relief from obstruction and toxæmia. There is no doubt that it is undesirable to leave a gangrenous loop of bowel from which toxic absorption may continue, and hence the first point to decide is whether time may be permitted for resection of the gangrenous loop and the fixation of Paul's tubes into the free ends; there is no doubt that this is the next best course to resection and anastomosis, and the longer the loop of gangrenous intestine, the more need there is for resection; the objection to the procedure is that the formation of an artificial anus in the small intestine is liable to lead to inanition, and excoriation of the skin, and the second operation required to restore the continuity of the bowel may be both difficult and dangerous. The second possible course is the establishment of an artificial anus, after relieving the constriction and without excising the gangrenous bowel. This takes a little less time than resection and the fixation of two Paul's tubes, but it is inferior from the point of view of preventing toxæmia, and should therefore be used only where there is but a short loop of gangrenous bowel. We have adopted this method with success, but it means several operations before the patient can be discharged with the hernia cured.

If it is felt that the state of the patient will not permit any of these procedures, the only course is to relieve the constriction, pull down the affected bowel, securing it with

a piece of rubber tubing through its mesentery in the way we have mentioned in dealing with suspicious intestine, and trust to the natural separation of the dead intestine, for the formation of an artificial anus. One great objection to this plan is that the wound inevitable becomes infected, and a spreading cellulitis may be produced which precludes further operation for a considerable time ; it is, however, in some instances possible to afford temporary relief in this way, and then to resect the gangrenous bowel, without an anæsthetic, one or two days later, before natural separation has occurred.

Gangrene with perforation.—If, when the sac is opened, the surgeon is confronted with fæcal extravasation and purulent infection, he is placed in a dilemma. Even if the condition of the patient is good, to cleanse the sac, divide the constriction, and pull down the bowel sufficiently for resection and anastomosis, is to run a grave risk of failure from peritoneal infection, and yet, if it can be done without causing too much shock we believe it is the best plan, for the peritoneum is capable of a great deal of resistance if adequate drainage is afforded in the presence of severe infection. But it must be admitted that this course is rarely justifiable, owing to the grave condition of the patient.

In the case of very small areas of perforative gangrene, cleansing of the area and closure by invagination with Lembert's sutures may be possible, but in most cases the presence of fæcal extravasation in the sac limits the scope of operation to the temporary relief of an artificial anus. The question of the relief of the constriction is a difficult one ; if it is left undisturbed there is less likelihood of infection travelling from the sac to the peritoneal cavity, but, on the other hand, we do not know what is the state of the intestine on the proximal side of the stricture, nor at this point itself, and consecutive peritonitis may be present, or rupture may take place at the seat of constriction. To divide the constriction at the neck of the sac is to run the risk of soiling the peritoneum on the proximal side of the sac, and

the method which is commonly recommended is to enlarge the opening in the bowel sufficiently to ensure free exit of its contents and to tie in a Paul's tube, leaving the wound wide open. In spite of all its risks we believe that some steps should be taken to relieve the constriction and pull down the bowel; the neck of the sac may then be secured to non-gangrenous intestine by means of a few catgut sutures, but we must admit that the mortality of all these proceedings is exceedingly high. Fortunately the number of patients left unrelieved until matters are so desperate is on the decrease, owing to the appreciation by both medical and lay minds of the seriousness of hernial strangulation.

CHAPTER XV

ABDOMINAL INJURIES

THE injuries to the abdomen which we propose to discuss are simple contusions of, and deeper injuries to, the abdominal viscera without a penetrating wound of the abdominal wall. In the case of perforating wounds, the correct line of treatment is usually obvious, and in civil practice, at any rate, if there is reason to suppose that the peritoneal cavity has been entered, complete exploration is indicated, except in some cases of small bullet wounds. Abdominal injuries with visceral complication may simulate acute abdominal disease, and it is possible that some of these lesions may actually be initiated by injury. We must again insist on the importance of an accurate history of the earliest period of the illness, and in the case of blows received on the abdomen, inferential diagnosis is sometimes justifiable from a precise knowledge of the accident.

Contusions of the Abdomen

It may be said that our knowledge of the pathology of abdominal contusions is deficient, for these cases recover and are rarely operated upon. What degree of damage the peritoneum and the abdominal viscera can withstand we do not know, but we apply the term *contusion* to those cases where there is neither perforation of a hollow viscus, nor extensive rupture of a solid one. Bruising and partial rupture of these organs does occur, and at times exploratory operation, in a doubtful case, reveals slight blood extravasations and damage to the peritoneal coat of the viscera.

Evidence of old injuries, which nature has healed, is also sometimes met with during *post mortem* examinations. When considering a case of abdominal injury, it is essential to arrive at a conclusion as early as possible as to whether visceral complication is likely to be present, but it must be admitted that a decision is often impossible until the patient has been under observation for some hours. The following points are of importance :—

The nature of the accident.—The most frequent types of accident are those where the patient has been run over, or caught between buffers, or other projecting objects ; or he may have fallen flat on the abdomen, or have been kicked by a horse. If a vehicle has passed over the abdomen, its character and probable weight should be ascertained, and in all these cases the position of the patient's spine is of importance, for the majority of intestinal ruptures are caused by the grinding of the intestine against the spinal column or some portion of the pelvic bones. The area of the abdomen submitted to injury is sometimes indicated by the bruised track of the wheels on the abdominal wall, but in many cases it is uncertain. The time relation between the accident and the patient's last meal should be ascertained, and if possible, also, the time of the last act of micturition, for thus the state of the stomach and bladder may be inferred—organs which can hardly be ruptured unless they are distended. Of all these facts concerning the accident, the most important is the actual nature of the object by which the abdomen has been struck, and it has been laid down by many authorities that in the case of a kick from a horse, abdominal exploration is indicated without positive evidence of visceral damage, since the chances of escape from deep-seated mischief are very small.

Symptomatology in Abdominal Injury

It is impossible to separate abdominal contusion from visceral injury by any hard and fast clinical signs, for when

the patient is seen shortly after the accident it may not be possible to say whether any viscus is damaged or not, and the diagnosis of mere contusion rests on the rapid abatement of the initial symptoms, and the absence of the graver general condition associated with severe trauma.

Shock is present to some extent in all cases, but its degree must not be taken as a true criterion of the extent of injury sustained, since it depends largely on the nervous disposition of the patient, and generally speaking, is more pronounced in women and children than in men. The face is pallid, the expression anxious, respirations jerky and rapid, the pulse feeble, and the body may be covered with a cold sweat; this is associated with diffuse abdominal pain, and the condition may therefore be appropriately termed *abdominal shock*.

Vomiting nearly always occurs at the time of the accident, and is either due to sudden abnormal pressure on the upper part of the gastro-intestinal tract, or is a reflex manifestation from injury to the solar plexus. If the stomach is empty at the time of the accident, vomiting may not occur. The vomit is usually only gastric, and the presence of blood in it is rare, but hæmatemesis sometimes follows bruising of the gastric mucosa without injury to the other coats. Pronounced hæmatemesis, however, is of grave significance, and should arouse suspicion of rupture of the stomach or duodenum. Repeated vomiting indicates serious injury, and suggests the onset of peritoneal infection.

The Pulse is feeble directly after the accident, and from its behaviour after the treatment of the initial shock much information may be gained. It may be regarded as one of the most accurate guides to diagnosis between contusion and visceral injury, for in the former it always improves, and usually within one hour of putting the patient to bed. In any abdominal injury, the pulse during shock may be either rapid or slow, but it is invariably of low tension; in simple contusion it rapidly approaches the normal in rate and volume; in intra-peritoneal hæmorrhage it remains of low

tension and becomes rapid; in most other serious injuries it improves as to tension but increases in rate.

Intermediate Treatment and its Results.—On this the diagnosis often depends, and in all cases the immediate need is to counteract existing shock; abdominal examination can be made satisfactorily only after the patient has been put to bed, and if there is a rapid recovery as regards the facial aspect and pulse, it is probable that no serious lesion is present; if also normal urine and flatus are passed, and there is no increase in abdominal pain or distension, the diagnosis of abdominal contusion is justified, and the prognosis is good. Repeated inspection of the patient is necessary in doubtful cases, and these examinations should be made at short intervals, even every half-hour, for by this means a diagnosis may be arrived at before peritonitis supervenes, and if the patient is to be saved by operation, this is essential.

The patient must be put into a well-warmed bed with as little disturbance as possible; the head should be rather low, and the limbs enveloped in cotton wool; saline for subcutaneous infusion should be at hand, but neither morphia nor strychnine should be given, but rather adrenalin, or pituitary extract. Warmth, however, is the best restorative. Nothing must be given by the mouth, and, if there is a question of injury to the urinary tract, a catheter should be passed. Except in cases of severe intra-peritoneal hæmorrhage, where the diagnosis can often be made at once, and in cases of such injury as a kick from a horse, the next few hours must be spent in observation, and we may now consider what are the indications for operation, remembering that it is better to err on the side of unnecessary exploration than allow the favourable time for surgical interference to slip by.

General Signs. *The Pulse.*—Persistent feebleness and rapidity, well over 100 per minute, with only temporary improvement after administration of saline, points to grave injury; if the pulse *never* slows down, hæmorrhage is likely to be present. A secondary fall in rate, after the patient is

put to bed, with a subsequent steady rise, is characteristic of rupture of a hollow viscus. *Persistent low temperature*, and cold extremities, afford a further indication of a serious visceral lesion. A rising temperature is suggestive of peritonitis. *Restlessness*, present from the first, points to hæmorrhage, but when of later onset, to peritoneal infection. An *anxious facial expression* and *respiratory embarrassment* are both grave signs. *Persistent vomiting* also points to visceral damage.

Abdominal Physical Signs. *Distension.*—Careful observation may reveal local or general distension, and this may be due to the escape of gas from the intestine into the peritoneal cavity, or to progressive inflation of intestinal coils. Here an accurate mental picture of the patient from the time when he first comes under observation is essential, for a conclusion ought to be reached before general distension is present. *Respiratory excursion* of the abdominal wall is often in abeyance directly after the accident ; its restoration to normal indicates the absence of visceral damage ; its partial return, and subsequent impairment, suggests not only the presence of a visceral lesion, but also its situation.

Rigidity.—Next to a rising pulse rate, protective rigidity with localised tenderness is one of the most certain signs of intra-abdominal mischief ; the only drawback to this sign is that bruising of the muscles may give rise to tension and local tenderness, but the difference is easily appreciated by a comparison of the reaction to superficial and deep palpation, for a bruised abdominal wall is affected by very light palpation but will yield to firm pressure, whereas the rigidity of which we now speak begins when the hand touches the skin and becomes more accentuated as the pressure is increased. Palpation in some cases of abdominal injury reveals *surgical emphysema*, the presence of which is diagnostic of retro-peritoneal rupture of the duodenum or colon ; it is to be felt in the flanks.

Percussion is of the greatest importance in these cases, and any departure from the normal is to be noted at the first

examination. Any dull area detected should be marked off on the abdominal wall with a blue pencil, and a similar note should be made of abnormal resonance. In the case of blood or urinary extravasation, there may be dulness in the loins and above the pubes, and where the spleen is ruptured it is said that dulness is nearly always present in the left flank; even when due to free blood, this dulness may or may not shift with alteration in the position of the patient. It must be remembered that percussion dulness is present also over collapsed bowel, that in the presence of peritoneal exudate the existence of dulness as a sign of serious mischief is of less value than a demonstrable increase in its area, and that localised dulness may be present at one examination and absent at the next. A boy aged 12 was admitted to Hospital, directly after the wheel of a cart had passed over his left lower ribs and flank; he suffered from a good deal of shock, though his pulse was not above 90. When examined in bed, about half an hour after the accident, there was well-defined percussion dulness in the left flank from the outer border of the erector spinæ as far forwards as the nipple line. This area was marked out with a blue pencil. An hour later the limit of the dulness had receded one inch, and within three hours of the accident this area possessed the normal resonance, and it was quite clear that the boy had suffered no serious injury. He was perfectly well in two days. The only reasonable explanation is that the abdominal contusion caused entero-spasm of the subjacent gut, which passed off as the result of the treatment of shock. The presence of abnormal dulness as a positive sign of visceral injury must therefore be constant or increasing in extent.

Abnormal Resonance is another important sign, and may be due to distended intestine, or to gas set free into the peritoneal cavity; occasionally local tympany is met with over the site of intestinal rupture, but it is in relation to the area of liver dulness that this sign is of the greatest importance; absence of liver dulness must only be considered

of positive value where the abdomen is not distended, and we would urge that as a sign of ruptured intestine it is not absence, but progressive diminution, of liver dulness which should be regarded as of value. It is possible that too much attention has been paid to this phenomenon as a means of diagnosing ruptured intestine, but if the case is seen from the first, and the liver dulness can be demonstrated to be diminishing, in the absence of abdominal distension, it must be admitted as a point of diagnostic importance. Not too much time, however, should be spent in waiting for this sign.

Auscultatory percussion may in cases of intestinal rupture yield a localised bell or coin sound, suggestive of free gas in the peritoneal cavity.

To summarise, the duty of the surgeon in cases of abdominal injury seen shortly after the accident, is to decide whether visceral injury is present or not, and if it is, some of these signs which we have enumerated are sure to become manifest during the first few hours, and usually one or two of them, such as a rising pulse rate, or increasing rigidity of the abdominal wall, will become well established. In doubtful cases it is quite justifiable to pin one's faith to the pulse, and to decide that if its rate reaches, say 120, in pure abdominal injury after shock has been treated, the abdomen should be explored. To decide between hæmorrhage and perforation may be difficult, but persistent shock, pallor, rapid and weak pulse, and marked restlessness, are the characteristics of the former, whilst a rising pulse and progressive abdominal rigidity, with anxious facial expression, point to perforation.

The following case illustrates the border-land between abdominal contusion and intestinal rupture extremely well :—

W.E., Male, aet. 26, coal porter.

About half an hour before admission to hospital the man, who was of strong build and sober temperament, had been run over by a cart laden with two tons of coal. Two wheels had passed over the

abdomen from left to right. Vomiting occurred once, within a few minutes of the accident. On examination, there was considerable bruising in the right iliac region, extending towards the buttock, but no evidence of fracture. The pulse rate was 100, the temperature 99° F. The patient was obviously suffering a good deal, but he lay fairly quiet in bed. The abdomen was very little distended, and it exhibited moderate respiratory excursion. There was some rigidity of the abdominal muscles, and ill-defined tenderness in the lower abdomen. Liver dulness present from 6th to 7th ribs in the nipple line. There was no abnormal dulness or hyper-resonance detected. No vomiting after admission.

Repeated observations were made during the next few hours, and the important changes were as follows :—the pulse rate dropped from 100 to 88, the abdominal pain increased, and the man's facial expression became more anxious ; the other signs remained as they were at the first examination. In spite of the fall in pulse rate, it was decided to explore the abdomen on account of the increasing pain, and the anxiety of the patient's expression, and this was done seven hours after the accident. Another factor which carried some weight was the nature of the vehicle by which he had been run over ; for it seemed incredible that a heavy cart laden with two tons of coal could pass with two wheels over the abdomen without doing some serious mischief. All that operation revealed was a vertical rent in the peritoneal coat of the cæcum, an inch and a half in length, placed on its anterior aspect, leaving the muscle exposed but unhurt, and two small areas of blood extravasation into the mesenteries of the lower ileum and the iliac colon. The serous coat of the cæcum was sutured, and the abdomen closed ; there was some pain after operation, but the man progressed quite well, and was discharged 18 days after admission.

Coeliotomy in Abdominal Injuries

When once the diagnosis of visceral injury has been made, preparation must be made for operation at the earliest period, when the condition of the patient warrants what may be a long and difficult operation. All safeguards must be taken to prevent recurrence of shock, and much depends on the skilful management of anæsthesia in these cases. Unfortunately the scope of the operation is rarely known beforehand, so that spinal anæsthesia alone is not altogether

suitable, for anæsthesia is required up to the level of the xiphi-sternum for an indefinite period; but it may sometimes be employed with advantage, and may be combined with general anæsthesia in some instances. Ether, preceded by morphia and scopolamine, is undoubtedly a better preventive against shock than chloroform. Continuous subcutaneous saline infusion from the beginning to the end of the operation is better than intra-venous infusion begun when the patient exhibits shock, and this, together with the maintenance of a constant, and rather high, temperature, constitutes the most important step in rendering these operations safe and successful.

Skin disinfection.—The iodine method is most suitable; it saves time, and reduces the period of exposure of the patient; the iodine may be applied just before the incision is made, and must cover the entire surface of the abdomen from sternum to pubes.

Incision.—The peritoneal cavity should be entered by the quickest route through one or other rectus muscle, and unless there is some indication for placing the incision high up in the abdomen, a sub-umbilical opening through the right rectus, not far from the middle line, is probably the best. After the rectus muscle has been split, the operator should pause a moment, and he may observe extreme tension of the transversalis fascia and peritoneum beneath his incision—this suggests free gas, but it may be due to intestinal distension; he may notice discolouration or emphysema of the extra-peritoneal tissue—this suggests retro-peritoneal rupture of gut, or, if the fascia is bile-stained, rupture of the duodenum; or again, he may observe just before opening the peritoneum, that it possesses a dark purple colour, due to intra-peritoneal effusion of blood. If this last condition is present, he should be sure that all possible safeguards are being taken against shock, for with the opening of the peritoneal cavity there is often a rush of blood, and a displacement of clot, leading to additional hæmorrhage. It must be remembered that the lesions may

be multiple, and there may be both rupture of a solid organ causing hæmorrhage, and perforation of a hollow one leading to intestinal extravasation; however, it is a clinical fact that, of cases coming to the operation table, few exhibit these multiple lesions. Such injuries are apt to be rapidly fatal.

We shall now consider the clinical aspect of the commoner injuries sustained by the contents of the abdominal cavity.

Intra-peritoneal Hæmorrhage

Effused blood must be rapidly removed by absorbent sponges, a careful watch being kept for any source of fresh hæmorrhage. The seat of injury must next be discovered, and the following possibilities should be borne in mind:—

(1) Rupture of the liver or spleen.
(2) Rupture of the outer coat of the stomach or intestine.
(3) Laceration of the great omentum.
(4) Laceration of the mesentery, gastro-hepatic omentum, meso-colon, or other peritoneal fold with the vessels it bears.
(5) Rupture of retro-peritoneal organs, such as the kidney or pancreas.
(6) Rupture of large retro-peritoneal vessels, splenic, renal, iliac, etc. Those of the abdominal aorta and vena cava are usually fatal within a few minutes.
(7) More than one of these lesions may be present.

If there is no clear indication as to the source of the hæmorrhage, the liver and spleen should be first examined with the whole hand passed into the abdomen; if these prove to be intact, the omentum should be drawn down and examined, and then the intestinal coils, finishing with the retro-peritoneal structures mentioned above. As a rule, provided a large incision is made, the. is some visible sign of trauma, which leads to the discovery of the source of hæmorrhage.

1. Rupture of the Liver

Etiology and Pathology.—The absence of elastic tissue in the liver undoubtedly predisposes it to rupture when it is severely crushed, as in run-over or buffer accidents: it is, however, protected to some extent by the lower costal arches, although a fractured rib may tear the surface of the liver. The liver may also be torn from its normal attachments by a fall from a height. Rupture without laceration of the liver capsule sometimes occurs, and it is said to lead to cyst or abscess formation, but in most cases the capsule is torn and intra-peritoneal hæmorrhage results; death may occur from loss of blood within a short period, and this may be due to rupture of very large vessels close to, or within, the liver, the portal vein and inferior vena cava being especially in danger. Where an immediately fatal result does not occur, there is progressive effusion of blood, the presence of which favours peritonitis, and in cases we have met with, the infecting organism has been the *bacillus coli*, arriving perhaps through the portal circulation. Some bile extravasation may take place, but evidence of this is rarely observed before the third or fourth day, when the patient may be slightly jaundiced, and bile pigment may be present in the urine. Rupture of the liver occurs much more frequently in the right than the left lobe, and the fissures may be single or multiple, superficial or deep, or a portion may even be separated and lie free in the abdominal cavity.

Clinical Characters.—The nature of the accident will usually point to injury of the right hypochondrium. Primary shock is rarely absent, and only partial recovery is the rule, as in other cases of severe internal hæmorrhage. Persistent pallor, restlessness, thirst, rapid and feeble pulse, and a cold skin, will usually suggest hæmorrhage, and a consideration of the nature and position of the injury, together with local tenderness and rigidity in the right hypochondrium, will bring the liver under suspicion. Intra-peritoneal hæmorrhage may cause diffuse tenderness, but if the case is seen

shortly after the accident, local rigidity in the right hypochondrium may be well defined. In such cases of ruptured liver as we have seen, these signs of tenderness and rigidity have been progressive, and, in one case, not operated upon until two days after the accident, the patient, a boy of 14 or 15, refused to allow the abdomen to be palpated. Cases not seen till the third or fourth day may exhibit some jaundice, and bile may be present in the urine, due to reabsorption from the peritoneum; this is said to occur in about one-fifth of the cases, and by this time peritoneal infection is usually beginning, and may lead to repeated vomiting, a symptom which is not seen early in rupture of the liver.

Treatment.—In many cases of ruptured liver it is not possible to locate the injury accurately, but if a diagnosis of intra-peritoneal hæmorrhage is made, exploratory operation is certainly called for, and where the liver is suspected, the incision should be made in the upper part of the abdomen, and the operator should have at hand a pillow or sandbag, which can be placed behind the lower dorsal vertebræ to push the liver forwards. The right lobe is injured five times as often as the left; therefore, unless there is some contra-indication, a right rectus incision will be the most suitable, and if extra room be required it may be continued upwards parallel to the costal margin. Division of the muscle fibres is very rarely necessary. Extravasated blood must be rapidly but gently removed, and a search made for the seat of injury.

(*a*) *Laceration of the anterior border.*—A wound in this situation may extend from the free border of the liver on to the upper convex surface, or to the inferior aspect, or it may be seen on both these surfaces. If large vessels are found bleeding they may be ligatured directly, or with the aid of an aneurysm needle, but usually there is free oozing from the torn surface, and the best way of controlling this is by accurate coaptation of the surfaces. If it is felt that the condition of the patient warrants it, suture of the rent

should be undertaken, but it is difficult if the liver is diseased or fatty, and almost impossible if the organ has been severely crushed. The best type of suture is the mattress rectangular stitch, threaded with a needle at each end, and starting one inch from the margin of the wound. If the rupture involves only one surface of the liver, the suture should be passed deeply so that it runs below the bottom of the fissure, and if both inferior and superior surfaces are torn, the sutures

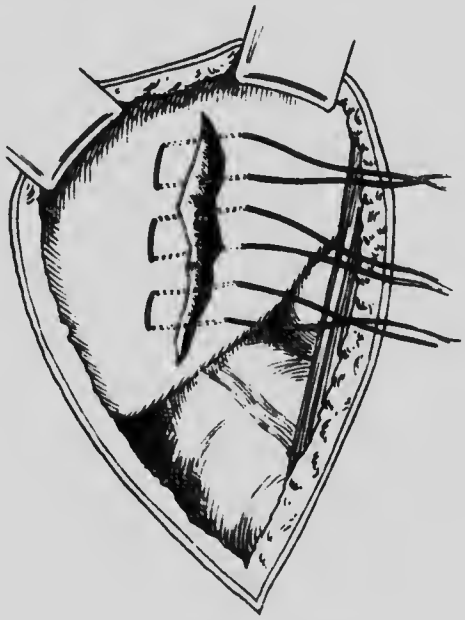

FIG. 27.—Suture of ruptured liver.

should pass through nearly one-half of the thickness of the liver near its free border. The most suitable material is strong catgut, and if the sutures are passed deeply enough, they may be tied quite lightly so as not to strangulate the hepatic tissue. The number of stitches necessary to coapt the whole length of the edges of the wound should be passed before any are tied, and the central ones should be secured last. Superficial sutures through the capsule are not

desirable, since they tend to tear out and to cause oozing. If two surfaces are implicated in the rupture, sutures must be applied to both of them. If hæmostasis is secured, the abdomen may be closed without drainage, but, if there is any doubt, gauze tampons should be left in the wound, and not removed till the fourth day.

(*b*) *Laceration of the convex surface.*—It may be difficult to expose the rent, but the assistant can usually hold down the liver with a hand passed between it and the diaphragm, thus rotating it forwards. Here again suture is to be preferred, but if the stitches cannot be readily applied, firm and rapid packing with gauze may suffice, and this holds in the case of all lacerations of the liver where great speed is necessary, or where the tissue is very friable. So far as we are aware, the successful cases recorded in this country have been almost equally divided between treatment by suture and treatment by packing.

(*c*) *Laceration of the inferior surface.*—Here the application of sutures is very difficult, and packing must necessarily be resorted to. The portal vein and vessels in the transverse fissure must be examined, and, since ligature is inadmissible, the only hope of success lies in vessel suture.

In exposing ruptures of the liver, removal of some of the lower costal cartilages may sometimes be called for, and in all cases a rapid search must be made for other injuries, especially that of the right kidney, for if the right lobe of the liver is ruptured, the proximity of the right kidney unquestionably renders it liable to be damaged at the same time.

After Treatment.—No special details are required here, except that if the lesion is treated by firm gauze packing, it is important that this should not be disturbed before the fourth day, and then its removal should be gradually carried out. If there is a tendency to oozing, the administration of calcium lactate in doses of grs. 30 for six doses may be of value by increasing the coagulability of the blood. Apart from any faulty technique, rupture of the liver may sometimes be followed by abscess formation, and this may be

signified by a rise of temperature during convalescence; suppuration may occur in the liver, the sub-phrenic space, or, more rarely, in the pleural cavity. Slight fever is common during the first few days of convalescence from intra-peritoneal hæmorrhage, and some confirmatory signs should be present before a second operation is undertaken.

2. Rupture of the Spleen

There are no pathognomonic signs of rupture of the normal spleen, and the diagnosis can only be made by the discovery of intra-peritoneal hæmorrhage, and an accurate knowledge of the accident. A large proportion of the recorded cases have been in patients under twenty years of age, and this may be accounted for by the elasticity of the costal arches during youth. In contrast with rupture of the liver, signs of hæmorrhage appear early, those of peritoneal irritation later; therefore a rapid pulse is rarely absent, while diffuse abdominal rigidity is not a marked feature of the case; *local tenderness and rigidity* in the left hypochondrium is often present from the first. When such cases are operated upon several days after the rupture, there is usually little evidence of peritonitis, and we have no knowledge of the bacteriological findings where it has been present. Traumatic fissures of the spleen may be single or multiple, and occasionally the organ is more or less detached from its pedicle.

Pathological rupture of the spleen occurs in malaria, and the enlarged spleen of leukæmia, with its friability and perisplenic adhesions, is also liable to be torn by very slight violence; these cases are usually fatal in a very short time.

It is said that blood from a ruptured spleen tends to coagulate rapidly, and therefore an area of fixed dulness in the left flank is given as a physical sign of splenic rupture. Whether this is the correct explanation or not, we have certainly met with this sign, and when dulness has been present

in both flanks, it has been of greater extent on the left side, and rolling the patient on to his right loin has failed to displace the left-sided dulness.

Treatment.—This should proceed on the same lines as that for rupture of the liver, except that suture is rarely practicable, owing to the friability of splenic tissue. A long left rectus incision will enable the spleen to be reached, but in adults more room may be required, and it can be obtained either by dividing the muscle at right-angles to the primary incision, or by prolonging the upper part of the wound obliquely along the ninth rib; the lower costal cartilages can then be removed, and by powerful traction very easy access to the spleen can be obtained. The vertical part of this incision is best planned close to the outer border of the left rectus.

As soon as the diagnosis has been confirmed, the left hand should be passed towards the pedicle, and its vessels controlled by the fingers. The rupture may then be examined, and if the rent does not extend deeply into the spleen pulp, control of the pedicle may be given over to the assistant whilst the surgeon proceeds to close the wound with mattress sutures. This, however, will rarely be possible, and, as a rule, the correct and quickest procedure is splenectomy. The pedicle is clamped, and the vessels are secured by double ligature, singly, and *en masse*, with strong silk. When hæmostasis has been ensured, the abdomen may be closed without drainage. One reason why rupture of the spleen should be treated by splenectomy is that the lacerations are apt to be multiple, and they may be on opposite surfaces of the organ, and another is that the spleen is too mobile for firm gauze packing to be relied upon; occasionally, however, this is all that can be done, but the outlook is poor, and nearly all the recorded successful cases have been treated by splenectomy.

After Treatment.—This consists mainly in the treatment of shock, and the administration of saline to compensate for loss of blood. It has been stated that the spleen is a

hæmopoietic gland, and that splenectomy, in the absence of a spleniculus, is followed by tender enlargement of the ribs and long bones, as well as of the lymphatic glands, but this we have not observed; nor does the blood exhibit any definite changes other than those accounted for by the severe hæmorrhage—polychromatophilic degeneration is present, and nucleated red cells are seen, but the main feature is the low percentage of hæmoglobin, and this takes a considerable time to return to the normal level. It must be remembered that in these cases we do not know the condition of the blood before the accident.

3. Rupture of Outer Coat of some portion of the Gastro-Intestinal Tract

This is an extremely rare cause of extensive hæmorrhage into the peritoneal cavity, and the diagnosis is impossible. If such a condition is found when the abdomen is opened for hæmorrhage, the correct line of treatment is clear, namely, ligature of any bleeding points, and careful suture of the intestinal wall.

4. Laceration of the Great Omentum

The great omentum may be torn, or bruised, in any portion, and the nearer the seat of injury lies to the greater curvature of the stomach, the more profuse the hæmorrhage, since the large gastro-epiploic vessels may be implicated. The blood may escape into the general peritoneal cavity, or it may spread between the layers of the omentum.

Treatment.—If the omentum is separated close to the lower border of the stomach, all bleeding vessels should be secured and the rent in the omentum carefully sutured. Where the injury lies at a distance from the gastric attachment, damaged omentum may be removed after ligatures have been applied on the proximal side of the injury.

5. Laceration of the Mesentery

Varieties.—The mesentery involved may be that of the small intestine, the stomach, or the colon. The injuries may take the form of intra-mesenteric hæmatoma, or fissure, and the latter may be parallel to the intestine, at right angles to it, or irregular. Mesenteric hæmatomata, by exerting pressure on undamaged blood vessels, may impair, or even cut off, the blood supply from portions of the intestine, leading to gangrene. In the same way a fissure parallel to the gut may cause gangrene, and the nearer the bowel the rent lies, the more likely it is to lead to this complication, and it may be taken as a rule that the anastomosis in the wall of the gut is only able to supply the deficiency for from one to two inches of intestine, so that a mesenteric rupture of large size is very serious, apart from the immediate danger from hæmorrhage. A vertical fissure does not cause much damage to the blood supply of the intestine, although it may give rise to considerable effusion of blood. An irregular tear of the mesentery is dangerous mainly in proportion to that part of it which is parallel to the intestine.

Treatment.—Mesenteric hæmatomata should be treated by incision to give exit to the blood, followed by local ligature of any bleeding vessels and closure of the incision.

Vertical rupture should be treated by ligation of all bleeding points, and suture of the cleft by interrupted or continuous stitches.

Horizontal mesenteric rupture, or rupture parallel to the gut, requires more careful consideration. If the tear is small, and does not involve large vessels, simple suture may be sufficient, care being taken to pass the stitches through avascular areas of the mesentery. If the rupture is of considerable length, or large vessels are implicated, the question of immediate resection of the involved gut must be considered, and if more than two inches of intestine lies denuded of its mesentery, primary resection with axial anastomosis is

the best course. In doubtful cases the rent should be sutured after ligature of the divided vessels, and the loop of intestine which is liable to necrosis should be secured close to the parietal peritoneum by gauze plugs. A secondary resection and anastomosis will be indicated if there is any offensive odour or discharge from the wound.

6. Rupture of the Kidney

Although the kidney is a retro-peritoneal organ, when it is ruptured the resulting hæmorrhage may be both intra- and extra-peritoneal; the peritoneum may also contain urine as a result of this injury. Intra-peritoneal rupture is not very common, but in severe injuries to the kidney, exploratory coeliotomy may be required to settle the question.

Etiology and Pathology.—Contusion of the kidney without rupture of its capsule is a common lesion, and may be diagnosed from the nature of the accident, from the presence of blood in the urine, and from the absence of severe constitutional disturbance. Such "traumatic hæmaturia" rarely lasts for more than three or four days. Ruptures of the organ vary considerably in degree, but those which give rise to intra-peritoneal hæmorrhage are—

(*a*) Rupture of the cortex.

(*b*) Rupture of the cortex and pelvis.

(*c*) Complete disruption of the kidney.

The first of these is not likely to lead to more than a peri-renal hæmatoma, but the second is the serious form encountered in operative practice, while the third is more often seen in cases of multiple injury, where death ensues rapidly. These renal injuries are more common on the right than the left side; males are affected more frequently than females, and it is said that the commonest age period for the accident is between twenty and forty.

Symptoms.—A certain degree of shock is nearly always present; vomiting commonly occurs shortly after the

accident, and may be repeated, though this is unusual. Pain may be present in the affected loin, or may be felt all over the abdomen. The essential symptom is hæmaturia, and the amount of hæmorrhage is a fair guide to the extent of renal damage. Frequency of micturition is the rule, but occasionally there is retention due to coagulation of blood in the bladder, or, more rarely still, there is suppression, due to simultaneous injury to both kidneys, or to injury of one and reflex inhibition of the other.

Physical Signs.—In those cases where the peritoneum over the injured kidney is ruptured, the signs are those of profuse abdominal hæmorrhage; there is persistent shock, pallor, sweating, thirst, restlessness, and rapid pulse, with increasing abdominal pain and widespread tenderness. Frequent vomiting may be present, and distension of the abdomen occurs. There is acute tenderness in the affected loin, but no localised peri-renal tumour; on the other hand, there is an increasing area of dulness on the side of the lesion, and there may be evidence of free fluid in the abdomen. These signs, associated with hæmaturia, point clearly to intra-peritoneal rupture of the kidney.

In extra-peritoneal rupture, the extravasated blood collects around the organ, and may cause a visible swelling in the loin, dull on percussion, and of increasing size. Diffuse abdominal pain and distension are absent; repeated vomiting is rare, but the general condition may be just as grave as in the case of intra-peritoneal rupture, though the shock is less profound.

Diagnosis.—Injury to the kidney is not difficult to recognise, since in almost all cases of any severity there is blood in the urine. It is important to know that the urine was healthy before the accident, for very slight trauma may lead to hæmaturia in patients suffering from nephrolithiasis, and some information as to previous health should be obtained. Contusion is differentiated from rupture much in the same way as abdominal contusion is distinguished from serious visceral injury, by rapid recovery from the

shock of the accident, by the absence of any definite mass in the loin, which may be both tender and rigid; by freedom from tenderness and pain over the rest of the abdomen, and by the absence of *profuse hæmaturia*. In doubtful cases, careful watching for some hours will usually make the condition clear, for in simple contusion the patient's condition improves rapidly, the pulse remains good and the temperature steady, whilst the amount of blood in the urine tends to diminish as the result of treatment by absolute rest in bed.

Extra-peritoneal rupture is characterised by profuse hæmaturia and the rapid development of a swelling in the loin; the temperature often exhibits a gradual rise, and the pulse rate remains above normal. The retro-peritoneal hæmatoma varies greatly in size, but it is rare for the condition to demand immediate operation for hæmorrhage.

Intra-peritoneal rupture affords an example of severe abdominal hæmorrhage *plus* peritoneal irritation, and therefore the condition from the first is grave, and the diagnosis is made by the discovery of the co-existence of intra-peritoneal effusion with hæmaturia, which may, or may not, be profuse. There may be a peri-renal hæmatoma in addition to these signs.

Treatment.—Simple contusion of the kidney yields readily to treatment by absolute rest in bed, a fluid diet, and the local application of cold, and light pressure to the affected side. There may be blood in the urine for several days, but, as a rule, this is of normal colour by the third or fourth day. It is important that the patient should not be allowed to get up directly the urine is clear, for recurrent hæmaturia may be caused in this way, due probably to the separation of minute thrombi from the small renal vessels. If the bleeding persists without evidence of a more serious lesion of the kidney, calcium salts may be given with advantage.

Extra-peritoneal rupture.—Where the evidence is in

favour of extra-peritoneal rupture, there has been a tendency to wait too long before undertaking an exploratory operation, but there can be little doubt that while natural means can heal a cortical rupture quite securely, yet surgical interference is likely to be of great value, and its risks are very slight. It is undesirable to wait until the patient is exhausted from loss of blood and the pain caused by the passage of clots.

The incision.—The patient should be placed on his sound side with a pillow beneath the unaffected loin. A free incision is essential, and either the usual lumbar incision may be used, or the lumbo-ilio-inguinal, extending nearly as far forwards as the anterior superior iliac spine. The muscular planes are often infiltrated with blood, and when the wound is deepened, a dark-coloured, tense, fluid perinephric mass is encountered. Before this is incised, the surgeon must be fully prepared to deal with excessive hæmorrhage, and sometimes this may with advantage be guarded against by getting his assistant to compress the aorta through the abdominal wall. If there is profuse bleeding when this peri-renal swelling is opened, the left hand should be passed into the wound to secure the renal pedicle. Digital compression may now be employed by the fingers of the left hand, while the cavity is cleared of clots and fluid blood. The condition of the kidney must next be ascertained, and every effort must be made to save the organ, since the functional value of the opposite kidney is rarely known in these cases; it is difficult to examine the kidney without removing the hand from the pedicle, and without delivering it into the wound, but as regards the former, it must be remembered that the application of the ordinary strong clamps to the vessels compels the surgeon to perform nephrectomy, and should therefore be avoided; delivery of the kidney must be accomplished rather by the assistant's pressure through the abdominal wall than by traction on the organ itself. As a matter of fact, after the hæmatoma is evacuated, the hæmorrhage is often reduced

to oozing from multiple small vessels and may be checked by pressure on the kidney itself.

Renal hæmostasis.—To secure this two methods are available, namely, suture and packing. Of these, undoubtedly suture with absorbable catgut is to be preferred, but it may be impracticable owing to the difficulty in delivering the kidney, or the friability of the renal tissue.

In *cortical rupture* the wound should be closed by means of deep mattress sutures, all the stitches being passed before any are tied. Occasionally a piece of the cortex is torn away from the rest of the kidney, when the loose portion should be removed, and hæmorrhage from the remainder checked by mattress stitches, passing through the whole thickness of the organ. If suture is impossible, recourse must be had to firm gauze packing, and in any case the wound should be drained with a tube and a gauze plug, removable after the fourth day.

In *cortico-pelvic rupture* it may be possible to retain the kidney if suture of both cortex and pelvis can be effected, but even where this has been done, secondary nephrectomy may be necessary for the cure of a persistent urinary fistula. In most cases of this kind the kidney is ruptured horizontally, and nephrectomy has to be performed at once.

Complete disruption of the kidney.—Where this has occurred, nephrectomy after careful clamping of the pedicle is the only course. A sub-capsular excision should be carried out, care being taken to remove all the secreting tissue. The vessels and ureter should then be ligatured separately and *en masse*, and the wound drained with a gauze plug and a small rubber tube for 48 hours.

Intra-peritoneal rupture.—When a diagnosis of intra-peritoneal rupture has been made, the operation must be undertaken with the least possible delay, even in the presence of shock, since active hæmorrhage is probably going on. Exploration must be made by an abdominal incision placed close to the edge of the rectus; the incision must be large enough to allow the hand to be passed across the abdomen

to palpate the uninjured kidney. The steps of the operation consist of cleansing the peritoneum, checking fresh hæmorrhage, and dealing with the kidney. Nephrectomy will usually be called for, and it is not easy to perform renal suture through an anterior incision. The kidney will naturally be approached through the rent in the parietal peritoneum, but it must be remembered that as this is on the inner side of the colon there is danger to the blood supply of the gut, and the enlargement of the wound should be in the line of the vessels. The [illegible] on the outer aspect of the colon, after the peritoneum has been cleared of blood and probably [illegible] steps of the operation may be rendered practically extra-peritoneal by packing away the intestine towards the middle line. This route gives easy approach to the renal pedicle, and after the vessels are secured, nephrectomy can be carried out. An attempt should then be made to repair the peritoneal tear with catgut sutures after a stab wound has been made in the loin to drain the renal fossa. It may be possible to close the anterior wound completely, but it is most important that lumbar drainage should be provided.

After Treatment.—If the kidney wound has been treated by plugging with gauze, its removal should be cautiously and gradually begun on the fourth day. The drainage tube must be kept in position a little longer in case leakage of urine occurs, and a careful examination of the wound must be made for signs of extravasation. The daily quantity of urine passed, and the presence or absence of blood, must be ascertained, and a cystoscopic examination may be desirable during convalescence, to determine the functional value of the two kidneys. In some cases a persistent urinary sinus calls for further exploratory operation, and it may even be necessary to perform a secondary nephrectomy, but ample time should be given for natural cure of the fistula. Where nephrectomy has been necessary in the first instance, drainage of the wound is required only for two or three days.

7. Rupture of the Pancreas

Rupture of the pancreas must be reckoned among the rarest causes of abdominal hæmorrhage. It seldom occurs apart from other serious injuries owing to the anatomical situation of the organ, and the diagnosis cannot be made with certainty apart from exploratory operation. We have referred elsewhere to fat necrosis as a sequel of pancreatic rupture, but pancreatic hæmorrhage may call for operative interference long before fat necrosis occurs. Where there are signs of hæmorrhage after abdominal injury, and the pain, rigidity, and distension are mainly confined to the upper abdomen, the possibility of injury to the pancreas should be borne in mind, for in some described cases there has been a large hæmatoma of the lesser sac, forming a deep-seated rounded swelling of increasing size.

Treatment.—After the abdomen has been opened, it may be discovered that there is a large swelling behind the stomach, or there may be leakage of blood through the transverse meso-colon, or from the foramen of Winslow. If there is a suspicion of pancreatic injury, the organ may be reached through a vertical slit in the gastro-hepatic omentum with the stomach pulled down and the liver rotated upwards. Rupture of the body of the organ should be treated by careful suture and tamponage with gauze. Rupture of the tail of the pancreas should be treated by removal of the separated portion. A careful examination of the ducts of Wirsung and the splenic vessels must be made in all these cases, and every endeavour must be made to preserve their continuity. Drainage of the wound is essential, for even where accurate suture of the pancreas is possible there is a great tendency for the suture to cause some local necrosis; the most satisfactory route for drainage is through the gastro-colic omentum, below the greater curvature of the stomach; if the end of the gauze plugging is brought out in this manner, the opening in the gastro-hepatic omentum may be sutured.

After Treatment.—Pancreatic fistula not infrequently follows these operations, but it usually closes in a few weeks, and all that is necessary is the use of frequent dressings soaked in dilute hydrochloric acid to prevent the digestive action of the pancreatic fluid.

8. Rupture of Vessels of the Posterior Abdominal Wall

If very large vessels are ruptured, death commonly ensues within a very short time, though a recent case has been recorded where death did not occur until eight hours after laceration of the inferior vena cava. The splenic, renal, and mesenteric vessels are among those which have been successfully dealt with for traumatic rupture. In such cases there is hæmorrhage behind the peritoneum, as well as within the cavity, and only by the most careful sponging away of clot can the seat of hæmorrhage be determined. In the present day it is recognised that suture is the ideal treatment for rupture of blood vessels, and this applies particularly to those large abdominal vessels, for if their blood stream is cut off there is grave risk of gangrene of the intestine, and death from peritonitis. If suture is impossible, and, owing to the friable state of the vessel wall or the extent of the laceration, it will often be so, reliance must be placed on firm gauze packing, or the application of pressure forceps. Plugging is to be preferred if hæmostasis can be secured in this way, for it does the least possible damage to the vessel wall, and in the case of venous injury it is likely to succeed; for arterial rupture, gauze packing is not satisfactory, for though the bleeding may be stopped, aneurysmal dilatation is likely to follow, owing to local weakness of the vessel wall. Ligature is more reliable in these cases, but where total occlusion of the artery is required resection of the viscus which it supplies may be necessary, either in the first instance or at a subsequent operation. In some cases, owing to the need for rapidity, the rupture must be secured with pressure forceps left *in situ* for three or four days.

11. Rupture of Hollow Viscera

This condition is dependent on the complete rupture of a hollow viscus, and we have already considered the general symptomatology of such an accident. It must be remembered, however, that such a rupture may occur without any clinical evidence of free gas in the peritoneal cavity, and we must also consider under this heading retro-peritoneal rupture of such portions of the intestine as are not completely invested by peritoneum.

Rupture of the Stomach

Etiology and Pathology.—Rupture of a healthy stomach has been caused by violent contraction of the abdominal muscles as well as by the blows or crushings which are the usual causes of intestinal rupture, but any hollow viscus may be opened by a force which either causes bursting, tearing from attachments, or crushing of the organ, and in the case of the stomach, a state of distension, or the presence of ulceration, or adhesions, favours the first and second of these modes of perforation respectively. Crushing to the degree of rupture of the stomach rarely occurs alone, and usually neighbouring organs, such as the liver, or spleen, are also involved in the injury. Tearing of the stomach from its attachments certainly occurs in cases of gastric ulcer with pathological and protective adhesions, where the perforation sometimes dates from a fall or blow on the abdomen.

Ruptures of the normal stomach are usually longitudinal, and they tend to occur in the neighbourhood of the lesser curvature, nearer the pylorus rather than the cardia.

Symptoms and Physical Signs.—These belong to three groups: (*a*) Those due to shock; (*b*) Those due to perforation; (*c*) Those due to injury to the stomach. The first two groups of symptoms have already received our attention, but as regards the third, *pain* is intense, and more or less

localised to the upper abdomen; *vomiting* is rarely absent, but is apt to be less frequent than in intestinal rupture, probably owing to the escape of gastric contents into the peritoneal cavity; *the vomit may contain fresh blood: rigidity* appears very early, and *hyperæsthesia* of the abdominal wall is often present above the umbilicus; *distension* comes on rapidly, and the liver dulness is usually obliterated; a tympanitic percussion note, and the coin sound, may be heard over the upper abdomen; there may be evidence of free fluid in the peritoneal cavity.

Diagnosis.—Of all the clinical phenomena enumerated, the only one which points definitely to gastric injury is the vomiting of blood, but it must be remembered that this occurs also in injuries affecting only the mucosa of the stomach, and in rupture of the duodenum, so that any intestinal perforation with contusion of the stomach may present the appearance of complete rupture of the stomach wall. As a rule, though rupture of a hollow viscus can be diagnosed, the localisation of the lesion to the stomach is rarely possible before the abdomen is opened. There may also be multiple gastro-intestinal ruptures. Obliteration of the liver dulness directly after the accident may suggest rupture of the stomach.

Treatment.—The most suitable incision is placed just to the left of the middle line above the umbilicus, but an intra-umbilical incision will also be necessary to remove any extravasated gastric contents, and to cleanse the peritoneal cavity. This opening may be made through the right rectus, and by means of these two incisions the peritoneum can be thoroughly irrigated with saline, which is a better method of cleansing the peritoneum than dry sponging where there may be portions of undigested food free in the cavity.

The gastric rupture should be closed by a double row of Lembert sutures after any bleeding vessels have been separately ligatured. If satisfactory closure is obtained, and the peritoneum is thoroughly cleansed, there is no need

for drainage, but if the gastric wound is difficult to close, an omental graft may be used to reinforce the suture line, and a cigarette drain left in the wound; if there is doubt as to the freedom of the peritoneum from infective material, it is well to drain the lower incision.

After Treatment.—The lines to be adopted here are the same as those which the surgeon is accustomed to observe after gastro-enterostomy. We prefer to rely solely on rectal saline during the first twelve hours, and then to begin feeding with measured quantities of milk and water, not more than one ounce at a time, every hour, for the second twelve hours; after this the amount of fluid may be increased so that three pints are taken in the twenty-four hours by the third day; semi-solids can be added by degrees, and the patient takes solid food at the end of eight days. An aperient is given on the fourth night, or an enema earlier than this if there is any discomfort due to flatulence. The maintenance of the Fowler position is important, and a careful examination of the abdomen must be made from time to time for evidence of peritoneal infection, which may, in cases of extravasation of gastric contents, occur a considerable time after the closure of the rupture.

Rupture of the Duodenum.

Since the duodenum is not completely invested by peritoneum, rupture of this portion of the small intestine may be either intra- or extra-peritoneal, and if the injury be extensive, extravasation may occur both into and behind the peritoneal cavity. Both the jejunum and ileum are more liable to rupture than the duodenum, and this is doubtless accounted for by the small space occupied by this portion of the gut, for its relative immobility predisposes it to injury. Rupture of the duodenum is usually due to its being crushed against the bodies of the lumbar vertebræ, but tearing from its attachments may sometimes result in rupture, and this type of accident may lead to complete

severance of the bowel, a condition met with close to the pylorus or at the deudeno-jejunal junction more often than in the rest of the duodenum. Partial rupture is usually at right-angles to the length of the bowel, and involves the anterior wall twice as often as the posterior.

Diagnosis. *Intra-peritoneal rupture.*—The clinical aspect of this condition closely resembles that of rupture of the stomach, but the vomiting is apt to be more frequent; the vomit may contain blood, and it is usually bile-stained, though bile may be absent if the rupture is extensive and lies above the bile-papilla. We have seen repeated hiccough in connection with rupture of the duodenum, but the main symptoms due to perforation do not differ from those seen in gastric and other intestinal ruptures. Rigidity of the upper segment of the right rectus is present from the first, and the tenderness is often quite localised; dulness in the right flank may be found early, and the diagnosis, if blood is absent from the vomit, rests mainly on a knowledge of the seat of the accident, signs of perforation rather than hæmorrhage, and localising signs in the right upper abdomen. If blood is present in the vomit, the lesion must be gastric or duodenal, and the decision will rest largely on the evidence of subjacent damage afforded by the left or the right rectus respectively.

Extra-peritoneal rupture.—It is usually stated that in this event the symptoms are more equivocal than in intra-peritoneal rupture, and in many cases this is no doubt true; but, on the other hand, retro-peritoneal rupture is capable of causing severe shock, persistent vomiting, rigidity of the right rectus, abdominal distension, and even some dulness in the right flank, so that there is no great clinical difference between the two conditions. If, however, there is evidence of blood extravasation and surgical emphysema in the posterior part of the right loin, the diagnosis is rendered probable, though it may be the colon which is ruptured. Escape of duodenal contents leads to local suppuration in the right loin, or in some cases to infiltration of the abdominal

wall; within a short time of the accident bile may find its way forward in the plane of the transversalis fascia, and this may lead to diffuse tenderness of the abdominal wall. Rupture of the posterior wall of the duodenum may give rise to very slight symptoms, causing only local suppuration or a right-sided sub-phrenic abscess; drainage of this abscess may be followed by a fistula, and the persistent discharge of bile may afford the first clue to the cause of the suppuration.

Treatment.—The operative treatment of duodenal rupture presents many difficulties, owing to the fact that the necessary repair of the injury may mean a lengthy operation, and the patient suffers considerably from shock. However, delay means further risk of peritoneal infection, and therefore an attempt must at once be made to restore the lumen of the canal. It must be admitted that very few successes have been recorded in cases of extensive rupture. In all cases the exploratory incision should be made through the upper part of the right rectus muscle, but before the peritoneum is reached, bile may be observed in the transversalis fascia; if this is present it points to retro-peritoneal rupture, but nevertheless, the abdomen should be opened to ascertain the extent of the damage sustained. Intra-peritoneal rupture should be treated, like all intestinal perforations, by closure with a double row of Lembert sutures, but care must be taken lest stenosis of the bowel be produced; if the duodenum is completely torn across, circumferential suture may be impossible owing to the fixity of the gut, and then the relation of the rupture to the opening of the common bile-duct should be ascertained; if it lies above the bile-papilla, closure of the duodenum and gastro-enterostomy is the correct line of treatment; if it is situated below the bile-papilla, this must be supplemented by cholecystenterostomy to prevent regurgitation of bile into the stomach. If complete transverse rupture occurs, as it occasionally does at the duodeno-jejunal junction, Roux's gastro-enterostomy "*en* Y" would appear to be the most

suitable operation. Rarely will the condition of the patient allow such extensive operations, and one may have to be content with shutting off the injured intestine from the general peritoneal cavity with gauze packing, allowing for adequate drainage, and leaving the restoration of the gastro-intestinal canal for a second operation.

Retro-peritoneal rupture is even less amenable to simple suture of the rent in the duodenum, and, as a first step, drainage through the right loin should be established after the peritoneal cavity has been explored; at a second operation the pylorus may be closed and gastro-enterostomy performed.

In all cases of rupture of the duodenum, the condition of the bile-papilla, and its relation to the seat of injury, must be considered. Stenosis of the orifice may be a sequel leading to biliary obstruction, and for this cholecyst-enterostomy may be required.

Rupture of the Jejunum and Ileum

Rupture of the jejunum is more common than that of the ileum, and this is probably due to the simple fact that the jejunum is considerably longer than the ileum, and therefore offers a larger surface for injury. The bowel may be completely torn across, or the rupture may be merely the size of a pinhole. As in the case of other portions of the intestine, contusions and tears are far more common than bursting. The immediate symptoms, and the ultimate result of the accident, depend greatly on the state of the bowel at the time, and if the bowel contains gas only, the outlook is more favourable than if it is loaded with fluid; if, on the other hand, it is empty, the prognosis is even better. It is said that fæcal extravasation occurs in about 70 per cent. of the cases, and its absence must be attributed to an empty state of the bowel, and the paralysis which so often follows injury. Fortunately, multiple ruptures are rare.

Diagnosis.—Some degree of shock is almost always

present, and it is probably proportional to the size of the rupture, for it is greatest where fæcal extravasation occurs rapidly. In the absence of extravasation the shock may be very slight, and we have known patients walk some considerable distance after an accident causing rupture of the intestine. It is possible that since severe crushing of the gut precedes rupture, there may be, in some instances, an appreciable interval between the accident and the perforation of the bowel wall, and hence the delay of shock and unbearable pain. In a few hours the diagnosis of perforation is fairly certain, from the tense rigidity of the abdominal wall, the rising pulse rate, with increasing anxiety of facial expression, and restlessness; these signs may be confirmed by the discovery of abnormal dulness in the flanks and abnormal tympany in some other part of the abdomen. The distinction from rupture of some other portion of the alimentary canal may not be possible, but in the first place, small intestine is more liable to traumatic rupture than other portions, and secondly, it may be possible to locate the rupture by finding the region of maximum tenderness and rigidity; percussion at this spot may reveal local tympany due to escaped gas, or impaired resonance due to extravasated fæces or early peritonitis. If such an area can be discovered near the centre of the abdomen, and below the umbilicus, the lesion may with some confidence be placed in the jejunum or ileum. Further evidence of rupture in this situation is afforded by the absence of frequent vomiting, the absence of blood in the vomit, which may be seen in rupture of the stomach or duodenum, and the absence of cyanosis, which is met with in rupture of the large intestine with fæcal extravasation. The higher the rupture in the abdomen, the greater the fixity of the diaphragm, and therefore in cases of ruptured ileum there is more respiratory movement exhibited than in those where the jejunum is implicated.

Treatment. The incision should be made over the supposed site of rupture, usually through one or other rectus. As we have already stated, operative interference

is justifiable even when the diagnosis is still in question, for the essential element of success lies in repairing the intestine before the onset of peritonitis. Small perforations should be closed by transverse suturing, after the edges of the wound have been trimmed, if there is much laceration; a double row of interrupted or continuous Lembert sutures should be employed, provided this does not cause too much infolding of the bowel wall and thus predispose to stricture. If the intestine is completely torn across, or greatly lacerated, resection and circular enterorrhaphy must be performed, and the same procedure should be followed if there are multiple ruptures close to one another. As in all cases of end-to-end anastomosis, care must be taken not to denude the bowel of its mesentery, and the mesenteric portions of the gut should be secured before the rest is sutured.

In doubtful cases, where contusion of the bowel is so severe that rupture is imminent, resection should be carried out, but in less severe injuries, and those of small area, the damaged gut may be infolded with sero-muscular sutures.

When suture has been satisfactorily performed, and the peritoneum can be cleansed by sponging, or by saline irrigation in the case of diffuse extravasation, the abdomen may be closed without drainage, but if there is doubt as to the security of the line of union, a gauze plug should be passed down to the site of anastomosis for two or three days; if peritoneal infection is present at the time of operation, the case should be treated on the lines we have indicated by drainage and the Fowler position. Where the condition of the patient is desperate, the surgeon may have to be content with the establishment of an artificial anus at the seat of rupture, leaving this to be closed at a later date.

After Treatment.—In uncomplicated cases this follows the usual lines of intestinal anastomosis, and we may safely wait until the third night for the administration of an aperient. Where peritonitis is known to be present, the early use of magnesium sulphate or calomel may be indicated. Rectal saline is also of the greatest value, and may often be

relied upon to maintain the patient's strength during the first 36 hours.

Rupture of the Large Intestine

Since the rectum is now held to begin at the third piece of the sacrum, rupture of this part of the large bowel can usually be diagnosed without difficulty by consideration of the nature of the accident and the results of digital examination. Such accidents commonly accompany fracture of the pelvis, or are due to perforating wounds of the perineal region; blood is discharged from the anus, and the pain and discomfort is pelvic: if undiagnosed, the condition may lead to pelvic peritonitis or pelvic cellulitis.

Abdominal rupture of the large intestine includes that of the cæcum and colon, and these are less commonly affected than either the small intestine or the duodenum. The colon resembles the duodenum in not possessing a complete peritoneal investment, so that rupture of this portion of the alimentary canal may be either extra- or intra-peritoneal, or both varieties of rent may be present. Extra-peritoneal rupture is, however, extremely rare, and may easily escape diagnosis until the incision of the abscess to which it gives rise is followed by a fæcal fistula; if surgical emphysema is discovered shortly after an abdominal injury, the diagnosis may be made.

Intra-peritoneal rupture of the colon possesses special dangers owing to the infective character of the fæcal matter which it contains, and the great difficulty of cleansing the peritoneum if extravasation has taken place. Fortunately, the thickness of the intestinal walls, and the slow rate of peristalsis, afford protection both against rupture and extravasation.

Diagnosis.—Rupture of the colon cannot be diagnosed with any degree of certainty unless it be an extra-peritoneal rupture on the left side causing surgical emphysema, for the same condition on the right side may be due to a rent in the

duodenum; intra-peritoneal rupture, with extravasation of fæces, is, according to our experience, suggested if cyanosis be added to the other signs of rupture, and further evidence may be adduced by the localisation of the maximum tenderness and rigidity to some part of the abdominal wall over the course of the cæcum or colon. Both gas and fæces may escape through the rent, and the former is a constant factor in rupture of the cæcum.

Treatment.—This must proceed on the lines we have already laid down for rupture of the small intestine, with especial care to avoid stricture by infolding too much of the damaged gut. Extra-peritoneal rupture should be treated by exploratory cœliotomy, to make certain that the peritoneal aspect of the intestine has escaped injury, followed by retro-peritoneal drainage down to the seat of rupture. A second trans-peritoneal operation may be undertaken at a later date, when the condition of the patient warrants it, for the closure of the rupture, and this usually calls for resection and anastomosis.

Lesions causing Biliary Extravasation

This form of extravasation may be due to rupture of the liver, the duodenum, or the bile ducts. The two former have been considered, and the last is a very rare accident occurring by itself; it may, however, be met with in any accident where the right hypochondrium is the region damaged. The gall-bladder is the part most often ruptured, and after this the cystic, and then the hepatic, duct; rupture of the common duct alone is the least common form of injury to the biliary passages. Healthy gall-bladders and ducts are not very likely to be torn by a blow on the abdomen without external wound, but pathological changes may be present without any noticeable symptoms, and such changes may render rupture more liable to occur. Of these lesions, the most dangerous is an impacted calculus in the cystic duct leading to hydrops of the gall-bladder. Sterile bile, if poured

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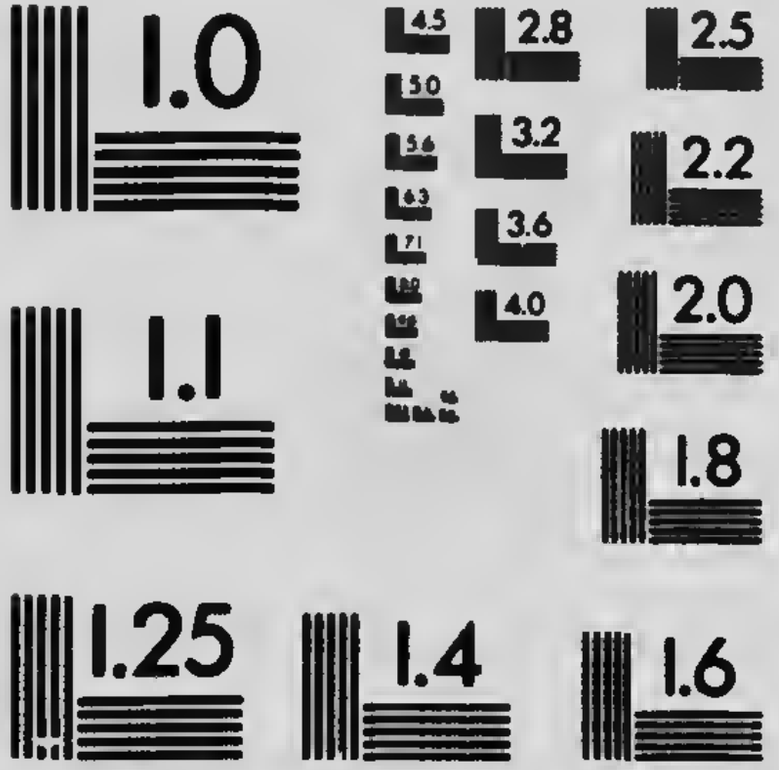

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out into the peritoneal cavity gives rise to a plastic peritonitis, and experimentally, ruptures of the ducts have been produced in animals without fatal results. In the human subject, however, such accidents are very fatal, and we do not know how often the bile is sterile, for any obstruction to the free passage of bile tends to cause ascending infection from the duodenum; a plastic peritonitis also may be followed by suppuration, due to the transmigration of organisms from the adjacent intestine. In most fatal cases death is due to the form of peritonitis in which the *bacillus coli* is the predominant organism, but it may also be due to cholæmia from absorption of bile from the peritoneum.

Diagnosis.—In addition to shock, there is pain in the right hypochondrium, together with local rigidity and tenderness, vomiting, and restlessness. The pain may go through towards the right shoulder. Diagnosis directly after the accident is well-nigh impossible, and the exact nature of the injury may be discovered only by exploration. On the third or fourth day, jaundice is present in about half the cases, and bile is then usually present in the urine. Absence of bile from the stools points to rupture of the common duct rather than that of the gall-bladder.

Treatment.—In cases of doubt, early exploration is essential. Small ruptures of the gall-bladder should be closed by a double row of sutures, none of which enter the cavity of the organ. Extensive rupture of the bladder may indicate cholecystectomy. Small rents in the ducts should be treated by suture, care being taken not to infold too much of the duct wall. Complete rupture of the cystic duct calls for ligature of the stump and removal of the gall-bladder. In complete rupture of the hepatic or common ducts, an attempt should be made to unite the edges by sutures, but this may be very difficult, and then reliance must be placed on gauze packing. Where the common duct is torn across, cholecyst-enterostomy may be utilised.

In all cases of rupture of the bile ducts, catgut is the most

suitable material for ligatures and sutures, and drainage of the wound should always be allowed for, together with careful gauze packing to prevent extravasation of bile into the general peritoneal cavity.

Lesions causing Escape of Urine.

We have already considered one of the important causes of this condition, and the other, which is equally serious, is rupture of the urinary bladder. Intra-peritoneal rupture of the bladder is more serious than extra-peritoneal rupture, for the latter gives rise only to urinary infiltration and cellulitis in the pelvis, while the former, if not recognised early and treated by operation, is certain to be fatal from peritonitis.

Etiology and Pathology of Rupture of the Bladder.—This accident is much more common in men than in women, and nearly 90 per cent. of the patients are males, and mostly adults. It is often a complication of fracture of the pelvis, but we propose to consider it apart from this condition, since it occurs as a purely abdominal injury in many instances. The predisposing condition which is essential to rupture due to abdominal injury is distension ; the flaccid empty bladder may be torn or displaced by fractured bones, but it is only the full bladder which is liable to rupture from a blow on the abdomen. Such blows are usually the result of falls from a height on to the abdomen, or the impact of a hard body on the hypogastrium. Many of the recorded cases have occurred in patients suffering from intoxication, and the explanation is that, while alcoholic excess tends to cause fulness of the bladder, micturition is neglected, and if a forward fall occurs the over-distended bladder is ill-protected owing to the relaxed state of the muscles. Rupture of the bladder may also follow artificial distension, and pathological rupture is met with. Rents due to injury are usually linear, and the intra-peritoneal lesion occurs most

frequently near the summit of the viscus. Extra-peritoneal rupture involves the anterior, or less commonly, the posterior surface. Both peritoneal and non-peritoneal surfaces may be torn at the same time.

Symptoms and Physical Signs.—Shock may be very severe after this injury, but in our experience it has been slight. The pulse rate is increased, and its volume diminished. The temperature is not materially altered. The most characteristic symptom is acute pain in the lower abdomen, associated with an urgent desire to micturate. Such efforts result in the passage of a few drops of blood only, or of blood-stained urine. In a very few cases urine may be passed by the patient, but, as a rule, the condition is one of painful retention following injury. Nausea and vomiting may also be present. Distension of the lower abdomen gradually appears, and in unrelieved cases signs of peritonitis rapidly supervene.

Although the patient is suffering from inability to micturate, the absence of a palpable bladder is characteristic; there may be distension, and there is nearly always acute tenderness and rigidity in the hypogastric region, with percussion dulness above the pubes and extending towards the flanks. This dulness may be made to shift with alteration in the position of the patient. The result of passing a catheter is usually to draw off a very little blood-stained urine, and, especially if a metal catheter is used, the point may be felt to pass beyond the limits of the bladder, so that in some cases it becomes palpable directly beneath the abdominal wall; this further excursion of the catheter may give exit to a large quantity of fluid—urine which has accumulated in the peritoneal cavity; this quantity is sometimes greater than could possibly be retained within the undistended bladder, so that the diagnosis becomes clear. Another point, emphasised by Battle in his oration before the Medical Society of London in 1910, is that after a catheter has been so passed and fluid withdrawn, percussion shows that the area of shifting dulness has considerably

decreased—proving that the fluid must have been withdrawn from the abdominal cavity.

Diagnosis.—In most cases of rupture of the bladder there is little doubt as to the correct diagnosis, but it may not be clear whether the lesion is intra- or extra-peritoneal. Injury to the kidney can usually be eliminated by careful consideration of the accident and by the site of the pain, tenderness, and swelling; frequent desire to pass water is present as in rupture of the bladder, and there may be inability to do so for a few hours, but the power of micturition is soon restored, and the amount passed or drawn off by catheter is considerable, and it is freely mixed with blood. Evidence that the catheter leaves the bladder and draws off additional urine is entirely lacking.

Rupture of the urethra causes blood to escape from the meatus apart from micturition, there is local ecchymosis, and inability to micturate. As a rule a catheter cannot be passed into the bladder, and at a later stage there is evidence of urinary extravasation. Rupture of the urethra close to the neck of the bladder does closely simulate extra-peritoneal laceration of the bladder itself, and exploratory operation may be needed to decide between these two lesions, but some reliance may be placed on the sensation obtained when a metal catheter is passed by an experienced hand, since it is almost possible to know by sense of touch whether the point enters the bladder or not.

Unfortunately the cystoscope can rarely be utilised satisfactorily owing to the collapsed state of the bladder. It has been recommended that a measured quantity of sterilised salt solution should be injected after the catheter has been passed into the bladder, and that evidence of rupture may be obtained by noting the discrepancy between the amount injected and the amount which escapes through the catheter. This is not an absolutely reliable test, and there is some objection to increasing the amount of fluid which may have passed from the bladder into the peritoneal cavity.

Treatment.—This injury still has a high mortality, but it has been steadily reduced by operative interference, so that it now stands at about 20 per cent. The object of the operation is to remove the extravasated urine and to close the wound in the bladder wall, guarding against the risks of subsequent leakage. It can hardly be known beforehand whether the rupture involves the peritoneal coat or not, and since this makes the condition so much more serious, the first step in the operation should be to *open the peritoneal cavity;* this may best be done through a paramedian sub-umbilical incision of sufficient length to allow for the infiltration which may be expected in the pre-vesical space. The extent of the rupture can then be ascertained.

Intra-peritoneal rupture.—Urine and extravasated blood must be allowed to escape, and to facilitate this the head end of the table should be raised and the pelvis cleansed with gauze pads. The table should then be reversed so that the pelvis is raised; the intestines are displaced towards the diaphragm, and covered with gauze moistened with saline; any remaining fluid should next be mopped up, and closure of the bladder may then be undertaken. The collapsed bladder tends to retract behind the pubes, so that it must be raised by means of fixation-stitches passed through its serous and muscular coats beyond the limits of the rupture, which may be a vertical or oblique fissure, or, more rarely, a circular rent. Two layers of sutures, preferably of catgut, are necessary; the first should be sero-muscular, and the superficial one either a continuous or interrupted Lembert suture. If the margins of the wound are not lacerated, and the closure of the bladder is satisfactorily performed, there is no reason why the peritoneal cavity should not be closed, though it may be desirable to leave a small tube in the lowest part of the incision for a day or two. Micturition should be provided for by catheterisation at regular six-hourly intervals, or by tying a catheter into the bladder for three or four days.

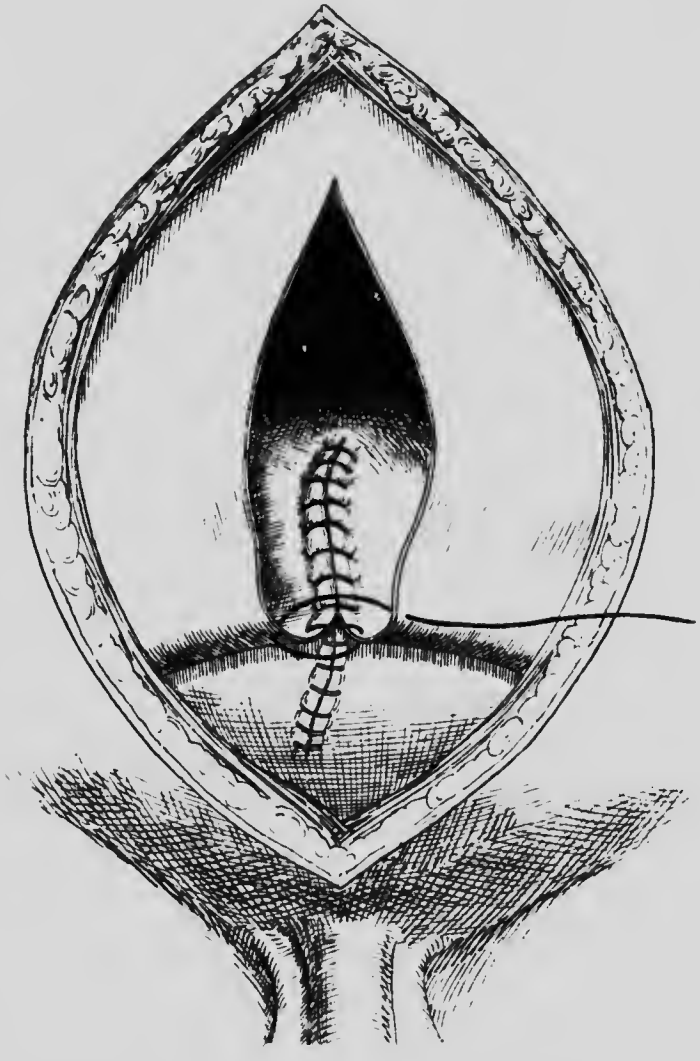

FIG. 28.—Suture of intra- and extra-peritoneal rupture of the bladder.

Intra- and Extra-peritoneal rupture.—In such cases the incision must be large enough to expose the rent fully, and an endeavour should be made to shut off the peritoneal from

the extra-peritoneal part of the lesion; this is best effected by closing the whole wound with the first sero-muscular layer of sutures and continuing the second layer of continuous Lembert sutures from the bladder on to the parietal peritoneum; the second line of stitches of the extra-peritoneal portion can then be carried out with a separate suture. The peritoneum may be completely closed, but the pre-vesical space must be drained, and the bladder secured against distension by regular catheterisation or the tying in of a catheter. If there is too much laceration to allow of this ideal treatment, the peritoneal cavity must be packed off with gauze and the wound treated like a supra-pubic cystostomy.

Extra-peritoneal rupture.—This will probably be accurately diagnosed only after the peritoneum has been opened to explore the extent of the damage, and the parietal peritoneum must be carefully sutured before any attempt is made to treat the rent in the bladder. If it is practicable, the same method of suture should be adopted as for intra-peritoneal rupture, but the only situation in which this is at all easy is on the anterior surface of the organ. The difficulty of this closure is often increased by the infiltration of the pre-vesical space with blood and urine, and if it cannot be carried out completely, partial closure with a large drainage tube passed down to the base of the bladder offers the best chance of recovery. In other situations, where the rent cannot be satisfactorily reached, multiple incisions must be made to prevent urinary infiltration, and the bladder must be drained by the most certain route, namely, by supra-pubic cystostomy. In the case of rupture close to the neck of the bladder, these incisions will have to be made in the perineum.

After Treatment.—The patient should be nursed in a semi-sitting position to prevent ascending urinary extravasation, and the dressings must be carefully examined for evidence of leakage in the case of suture of the bladder, and frequently changed. If regular catheterisation is relied

upon to keep the bladder in a flaccid condition, it must be continued for about four days, and the same length of time must elapse before a catheter which is tied in is withdrawn. If signs of peritonitis develop after the bladder has been sutured, the only chance for the patient lies in re-opening the abdomen and establishing free drainage.

CHAPTER XVI

DISEASES WHICH MAY SIMULATE ACUTE ABDOMINAL LESIONS

THE differential diagnosis between the various acute abdominal lesions which we have considered in the preceding chapters is often exceedingly difficult, so that the most experienced and careful clinician is bound to make frequent mistakes; but when the volvulus which he has diagnosed turns out, at operation, to be a strangulated ovarian cyst, it is only his reputation which suffers—the patient is none the worse. The essential point is to recognise at once when laparotomy is necessary, and when delay is safe. It may happen that a mistake in this differential diagnosis entails a second incision, as for example when a gastric perforation has been mistaken for appendicitis; but even this is a minor error, once the abdomen has been opened.

On the other hand the differential diagnoses which we are about to consider—briefly, those conditions which should be treated medically, and conditions which should be treated surgically—are of vital importance. Laparotomy on the first day of Lobar Pneumonia is a distressing, and, it may be, a fatal blunder; but an even more hideous mistake is the treatment of peritonitis by expectorants and poultices. Yet both these offences against diagnostic accuracy are committed from time to time. We believe that the majority of these mistakes are attributable to some degree of carelessness in history-taking or examination; but we readily admit that there are instances where, after the most searching investigation, it is impossible to be certain whether one is

dealing with a medical or a surgical condition—to decide, for instance, between a gastric crisis or a gastric perforation in a tabetic ; or even to decide between pneumonia and appendicitis. Three rules we believe to be of fundamental importance in this connection ; firstly, never take any diagnosis for granted, however obvious it may appear at first sight ; secondly, never omit an examination of the chest, knee-jerks and pupils ; and thirdly, if after a complete investigation of the case, there is any real doubt as to whether to open the abdomen or not, explore.

(1) Specific Fevers

(*a*) **Scarlet Fever** is seldom mistaken for peritonitis, but we remember one case in which the onset was attended by such severe abdominal pain and incessant vomiting that high obstruction or acute pancreatitis was suspected. The presence of sore throat, high temperature, tachycardia, and lumbar pains should arouse suspicions of scarlet fever.

(*b*) **Enteric Fever.**—There is a well-recognised "gastro-intestinal type" of onset of enteric fever ; it is abrupt, associated with rigors, severe abdominal pain, vomiting, and diarrhœa ; these cases are occasionally mistaken for some acute intra-abdominal lesion, particularly appendicitis (the pain and tenderness being most marked in the right iliac fossa). Points in favour of enteric fever would be a pulse slow in proportion to the temperature, severe headache, cough, mental torpor, and slight abdominal distension without any reflex rigidity ; there would probably be a leucopœnia rather than a leucocytosis. A positive bile blood culture or a positive Widal reaction would confirm the diagnosis.

We have seen one instance of the opposite mistake ; a young man, having been treated by his doctor for a week as "abdominal influenza," was sent to a fever hospital diagnosed as enteric fever ; he was transferred at once to St. Thomas's Hospital and arrived there moribund from

general peritonitis of appendicular origin; his facies was quite suggestive of enteric fever, but in other respects the diagnosis of general peritonitis was only too obvious.

(*c*) **Influenza**.—The abdominal type of influenza, with its prostration, colicky pains, diarrhœa, and vomiting may suggest peritonitis; but as a rule the diagnosis is clear. A slow pulse and high fever, combined with orbital headache, pains in the back and limbs, great prostration, and possibly some respiratory catarrh, indicates influenza. It is worth pointing out that appendicitis may, in some instances, be a complication of influenza; during a small outbreak of genuine influenza in 1905 we met with 7 cases of appendicitis in which the onset of abdominal pain was preceded for several days by influenzal symptoms.

(*d*) **Diphtheria**.—Once only have we seen diphtheria mistaken for an acute abdominal condition; a young woman was admitted to hospital in a collapsed condition, with a history of one day's abdominal pain and vomiting. She made no complaint of sore throat, and her abdominal symptoms were so severe that laparotomy was performed on the assumption that there was a gastric perforation. Nothing abnormal was found at operation, but on the following day her fauces were found to be covered with membrane from which the Klebs-Lœffler bacillus was cultured. During convalescence she had a very profuse hæmatemesis, so that it is possible that we were in fact dealing with an acute abdominal condition, namely, that most uncommon disease true diphtheritic gastritis.

(*e*) **Mumps**.—We have seen one instance of metastatic pancreatitis complicating mumps; a young man had a brisk attack of mumps complicated by orchitis; while the orchitis was subsiding the temperature rose again to 101°, and at the same time there was severe epigastric pain and vomiting. The pancreas was palpable and tender, and Cammidge's pancreatic reaction was positive. These symptoms subsided in 48 hours, and, in view of the previous history, there was no difficulty in explaining them. It is

conceivable that pancreatitis complicating an undiagnosed case of mumps might give rise to considerable difficulty.

(*f*) **Cholera.**—A sporadic case of cholera might be mistaken for an acute abdominal lesion—especially if, as is sometimes the case, the collapse and abdominal pain were out of all proportion to the diarrhœa.

(2) Intra-Thoracic Diseases

(*a*) **Pneumonia.**—That pneumonia can mimic to the minutest detail acute abdominal lesions is recognised by all experienced clinicians. Some mistakes are due to carelessness; but in others the mimicry is so perfect that laparotomy is inevitable. Here, for instance, is a case in point—

A little girl, aged 6, was admitted to hospital at 3 p.m.; at 8 a.m. on the same morning she had vomited several times and complained of severe pain in the right side of the abdomen. On admission she looked ill; the face was a little flushed, but not remarkably so. The alae nasi were slightly active; there was no herpes. The tongue was very foul and dry; the temperature was 100·6, pulse 120, respirations 36. There was no cough and no respiratory grunt. The abdominal wall was slightly retracted and universally rigid and tender, the tenderness being most exquisite in the vicinity of McBurney's point. No mass could be felt *per rectum*, and it was impossible to say whether there was any localised internal rectal tenderness, as the child screamed incessantly throughout the examination. In view of the rapidity of the respirations the chest was examined with unusual care, but nothing amiss could be detected. At 5 p.m. the abdomen was explored through a low right rectus incision, but nothing abnormal was discovered; the appendix was perfectly healthy. The child died two days after the operation; the highest temperature recorded was 102°, and until a few hours before death the respirations were always less than 40. Repeated examinations of the chest revealed no abnormal physical signs. *Post mortem*, the solitary abnormality was a small central patch of pneumonic consolidation in the right lower lobe.

It is with children that difficulty most often arises, pneumonia simulating appendicitis or *vice versa*. In the peritonitis of childhood there is almost invariably a definite

increase in the respiration rate, and the alae nasi are frequently very active; on the other hand the pneumonic child may have but little cough, and never produces any sputum.

In the case of an adult, pneumonia is most frequently confounded with either appendicitis, or with gastric or duodenal perforation; the sudden onset of abdominal pain, often accompanied by vomiting, and associated with a rigid, tender and almost motionless abdomen, makes the resemblance very close—particularly when one remembers that a friction rub is not uncommon in peritonitis.

Differential Diagnosis.—Too much reliance must not be placed on the past history; there is nothing to hinder the subject of previous attacks of appendicitis or indigestion from having pneumonia. A genuine rigor at the onset is common in pneumonia, rare in appendicitis, and almost unheard of in perforations. The lateral decubitus is the rule in pneumonia; the dorsal decubitus with flexed thighs in peritonitis. A flushed face, herpes, and active alae nasi are all characteristic of pneumonia, but any or all may be seen in peritonitis. Seldom is the burning dry skin which is so characteristic of pneumonia found in peritonitis.

Definite signs of pulmonary consolidation are, of course, strong evidence of pneumonia; but we must remember that massive pulmonary collapse may occur in peritonitis. Moreover, peritonitis may cause a definite friction rub; this rub, when present, is almost invariably heard low down in the axilla, or over the lower part of the front of the chest; a rub heard over the base behind is better evidence of pneumonia.

A respiration-rate above 40 is quite exceptional in peritonitis, and one above 30 should always arouse suspicions of pneumonia. We are not disposed to attach any great importance to the pulse-respiration ratio, though, of course, a great reduction of this—*i.e.* an increase of respiration-rate altogether out of proportion to that of the pulse—is always suggestive of pneumonia.

The temperature is usually more than 101° in pneumonia; after perforations it is as a rule sub-normal during the stage of shock, and in even the subsequent stage of peritonitis it rarely exceeds 101°, at any rate during the first 48 hours. The temperature is a less useful guide in deciding between pneumonia and appendicitis. It must be remembered that pneumonia in the aged, or in drunkards, may be afebrile throughout.

As to the abdomen, we must emphasise the fact that pneumonia may cause as rigid, tender, and motionless an abdomen as any peritoneal lesion; at the same time a rigidity which is clearly voluntary rather than reflex, is in favour of pneumonia rather than peritonitis. Internal tenderness *per rectum* would suggest peritonitis, and if definite evidence can be obtained of the presence of either free fluid or free gas in the peritoneal cavity, laparotomy is called for.

One word more; peritonitis is a recognised, if a rare complication of pneumonia (0·3 per cent. out of 7868 cases). As a rule it is a late complication and the diagnosis is easy. It may occur early in general pneumococcal infections; we remember an instance in the case of a little girl aged 6, on whom laparotomy was performed on the first day of a supposed appendicular peritonitis; however, the appendix was normal and the peritoneum but slightly injected, with a small excess of peritoneal exudate. The next day signs of pneumonia were obvious; on the third day pericarditis, and on the fourth day meningitis, developed. *P.M.* there was also general peritonitis of pneumococcal origin.

Acute dilatation of the Stomach (*vide* Chapter IV.) has been recorded as a complication of pneumonia: hence this condition must be excluded before peritonitis is diagnosed. Professor Fussell (American Journal of Medical Science, December, 1911) has published five cases of his own, together with six other cases collected from the literature; of the 11 cases 6 were fatal; the dilatation occurred before the crisis in 8, after it in 3; there was collapse in 5.

diarrhœa in 2, and vomiting in 8 cases. Most of the patients were delirious.

(*b*) **Pleurisy,** and (*c*) **Pneumothorax.**—The physical signs of these conditions are so obvious that mistakes are likely to be made only when an examination of the chest is neglected. The remarks made previously about friction rubs in peritonitis hold good here also.

(*d*) **Massive Pulmonary Collapse.**—Dr. Pasteur has given an interesting account of this condition in his Bradshaw lectures (1908). Operations, particularly those in the vicinity of the diaphragm, are sometimes followed by diaphragmatic arrest with consequent collapse of large areas of one or both lower lobes. The symptoms produced are often acute, and usually dyspnœa is one of them. In the past the common diagnosis for this condition has been "post-anæsthetic pneumonia"; almost certainly a large number of those unfortunates who are unsuccessfully explored several days after a laparotomy for a non-existent sub-phrenic abscess belong to this category.

(*e*) **Pericarditis.**—Dr. Essex Wynter (Proc. Roy. Soc. Medicine, Feb., 1911) has drawn attention to the fact that occasionally pericarditis may simulate peritonitis, and has recorded several interesting cases bearing on this point. We have seen one such instance—

A young woman, aged 20, was suddenly seized with acute epigastric pain and vomiting of such severity that her doctor diagnosed ruptured gastric ulcer, administered morphia, and sent her up to hospital for operation. On admission, matters were complicated by the patient's being under the influence of morphia; laparotomy was seriously considered, but eventually it was decided to await developments. On the day after admission the resemblance to peritonitis was still very close, and pericarditis was not yet suspected. Eventually signs of a pericardial effusion became obvious. Her symptoms yielded to salicylates, and during convalescence she developed a fine crop of rheumatic nodules.

In these cases of pericarditis, as Dr. Wynter has pointed out, there is diaphragmatic arrest, which accounts for the

abdominal immobility; the pain is of course a "referred" pain. Possibly it is only those cases in which the diaphragmatic region of the pericardium is attacked which give rise to abdominal symptoms and signs.

(*f*) **Cardiac Disease.**—Acute dilatation of the heart is often associated with epigastric pain and tenderness, and with vomiting, but the urgent dypsnœa, with cyanosis and tachycardia, and an increase in the area of cardiac dulness, usually point clearly to the correct diagnosis. More difficult are certain cases of chronic cardiac failure which are characterised by the predominance of abdominal symptoms; in one instance, for example, the patient, a robust young man, complained chiefly of abdominal pain and vomiting: his only cardiac symptoms were rapidity and irregularity of the pulse, and he was able to play lawn-tennis without any great distress; yet his abdominal pain proved to be due to a nutmeg liver, the edge of which was at first obscured by rigidity of the superadjacent muscles, so that it simulated a perigastric, or periduodenal, abscess.

Infarction of either the spleen or the kidney may give rise to abdominal symptoms, and we can recall several instances where such patients were sent up to hospital with a view to operation. A routine examination of the chest, and a realisation of the fact that infarction may occur in the very mildest grades of cardiac failure, would safeguard one from making this mistake.

(3) Diseases of the Nervous System

(*a*) **Tabes.**—Laparotomy is not infrequently performed on the subjects of gastric crises, the condition being mistaken as a rule for either a perforation or intestinal obstruction. We have seen one tabetic who bore the scars of two separate laparotomies. The mistake should not be made if its possibility is always borne in mind. Gastric crises, like the other sensory phenomena of tabes, may occur many years before the appearance of ataxy. An investigation of the

pupils and knee-jerks, and an inquiry for a history of lightening pains, girdle sensation, diplopia, or difficulty with micturition, will usually settle the question. But the diagnosis of tabes does not necessarily exclude the possibility of peritonitis in addition. The two conditions were combined in the following case—one of the most difficult we can remember—

C. U., labourer, aged 40. History of indigestion ten years ago but absolutely none since. Denies syphilis. Three years ago was laid up for six weeks and had "a lump as big as a hen's egg" in the right side of the abdomen. On July 24th he got up at 4 a.m. in perfect health; while walking about at 6 a.m., sudden onset of very intense abdominal pain, at first in the right hypochondrium, later, generalised. Vomited three times. Bowels open before onset; not since. Brought up to hospital at 9 a.m. Was evidently in great distress; abdomen retracted, rigid and universally tender. Flanks resonant, liver dulness normal. Pulse 94, temperature 98°, respiration 32, tongue clean. Pupils unequal and almost inactive to light. Knee-jerks absent. On further inquiry into the past history, no trouble with micturition, no eye symptoms and no ataxy; but he owned up to "screwing pains" in the legs during the past year. As there was such strong evidence of tabes, it was decided to watch him. At 3 p.m. pulse 96, temperature 99°; said he had no pain; abdomen not quite so rigid, but still very tender. At 9 p.m. pulse 100, temperature 102°; said he had "no pain to speak of"; abdominal tenderness now confined to right iliac fossa. Liver dulness normal. At 10 p.m. laparotomy; pin-point perforation of duodenum with very scanty exudate in vicinity. Recovered. This, then, was an example of a duodenal perforation in a tabetic.

Another perplexing case was that of a one-legged and one-eyed mariner who was sent up to hospital with the diagnosis of perforated duodenal ulcer. His solitary pupil was myotic, inactive to light and active to accommodation, and no knee-jerk could be elicited from his one leg; for obvious reasons Romberg's sign could not be investigated, nor could one compare the sizes of the pupils. He gave a characteristic history of lightning pains so that, since there was no evidence of peritonitis, one was able to diagnose a gastric crisis with some confidence.

(*b*) **Posterior Nerve-root Lesions.**—Any lesion which causes posterior root irritation of the nerves supplying the

anterior abdominal wall will cause it to become painful, tender and rigid; the common causes are spinal syphilis, spinal caries, and spinal tumour. We have seen a mistake made once only, in the case of a young man who was sent up to hospital diagnosed as appendicitis, but who was in reality suffering from spinal syphilis.

(*c*) **Herpes.**—It is well known that pain and hyperæsthesia may precede the appearance of herpetic vesicles; moreover the condition is frequently febrile, and there may be initial vomiting. We recollect one very puzzling case: a young woman vomited and complained of excruciating pain over the right iliac fossa. Hot fomentations were applied and she was sent up to hospital on the second day, diagnosed as appendicitis. Her temperature was 101°, and there was intense hyperæsthesia with rigidity over the right lower quadrant of the abdomen. There was a large vesicular patch over the right iliac fossa, at first thought to be due to the fomentations; fortunately an examination of the back revealed typical herpetic vesicles there, and saved the situation.

(*d*) **Intra-Cranial Diseases.**—Intra-cranial tumour, abscess, or meningitis, may be associated with incessant vomiting; given a semi-comatose patient and no possibility of obtaining a history, abdominal disease might be suspected. We have never known the mistake made. In tuberculous meningitis the combination of incessant vomiting, obstinate constipation, and a rigid abdomen in a child who screams wherever he is touched, may suggest acute obstruction. Here again the possibility of co-existing conditions must be considered: on one occasion we saw a case of tuberculous peritonitis develop meningeal symptoms, to which were added later on those of perforative peritonitis; all three lesions were found *post mortem*.

(*e*) **Functional Vomiting.**—When functional vomiting has been allowed to go on for some time the patient may become desperately ill; if she comes under observation in this condition and complains of abdominal pain, a mistake

might be made. The correct diagnosis would be arrived at on the history, on the general demeanour of the patient, on the absence of reflex rigidity and of visible peristalsis, and on the effects of medical treatment.

(4) Various Other Diseases

(*a*) **Addison's Disease** is, as a rule, a chronic condition, but it is often marked by acute exacerbations, when vomiting may become incessant. Occasionally it may run an acute course from the first, and the patient may die in a few weeks with perhaps little or no pigmentation. We have seen one such case, which we were very strongly tempted to explore.

A girl, aged 16, was admitted to hospital with a history of three or four days' repeated vomiting, with constipation and abdominal pain. She was not wasted. She looked very ill, appeared to be in great pain, and vomited continuously. The abdomen was distended and tender everywhere, but it was quite soft. There was a little brown pigmentation low down in each axilla, but none elsewhere. She died two or three days after admission. *P.M.* Both supra-renals were caseous; no other lesion was found.

(*b*) **Pernicious Vomiting of Pregnancy.**—It is necessary only to remind the reader of this condition, which is easily detected. Nevertheless, we have known such patients sent up to hospital, diagnosed as intestinal obstruction.

(*c*) **Cyclic Vomiting of Children.**—Here again the diagnosis is simple if a careful history be taken; but the combination of repeated vomiting with a very toxic appearance and, occasionally, a tender abdomen, may be misleading; we remember one case where a mistake was made.

(*d*) **Uræmic Vomiting.**—Incessant vomiting, intense headache, and in most cases diarrhœa, are the chief symptoms of the gastro-intestinal type of uræmia. In exceptional cases vomiting is the only symptom, and this might arouse suspicions of peritonitis or obstruction. In a majority of cases, however, close investigation will reveal symptoms suggesting uræmia—such symptoms as headache, torpor,

diarrhœa (with perhaps bloody stools), muscular cramps, or twitchings; and the diagnosis can be clinched by an examination of the urine, and perhaps of the fundi.

(*e*) **Acute Glaucoma** should be borne in mind as a cause of uncontrollable vomiting. The previous history, the intense orbital pain, and an examination of the eye, would decide the diagnosis.

(*f*) **Leukæmia.**—We remember one instance in which a leukæmic spleen was mistaken for an inflammatory mass.

A man was sent up to hospital with a week's history of abdominal pain and fever. On examination, there was a temperature of 102°F., left femoral thrombosis, and an indefinite tender mass in the left loin. This lump was considered by several competent observers to be an inflammatory mass, but a white count, instead of revealing the expected polymorphonuclear leucocytosis, showed a typical leukæmia.

(*g*) **Acute Osteomyelitis of the Lumbar Vertebræ** may give rise to symptoms and signs suggestive of peritonitis; an interesting case in point, where the lesion was successfully diagnosed and treated, has been recorded by Fraser and McPherson (*Lancet*, December 2nd, 1911, p. 1543), to which paper the reader is referred for the bibliography of the condition.

It may occur at any age, though the majority of the subjects are under the age of 20. There may be a history of some slight spinal injury, and sometimes a septic focus, such as a furuncle, may be present elsewhere. The onset is sudden, with high fever and frequently rigors; pain is the predominant feature, and it may be excruciating; it is most intense in the spine, but there is usually abdominal pain in addition. This abdominal pain may be associated with abdominal distension, tenderness, and rigidity, and with diarrhœa and vomiting, so that the existence of peritonitis may be suspected. The intense spinal tenderness to palpation or movement usually indicates the correct diagnosis, which may be confirmed by the early appearance of meningeal symptoms, or of evidence of pressure on the cord,

e.g. segmental root pains and hyperæsthesia with spastic paralysis below the affected level.

(*h*) **Diabetes.**—That diabetic coma may be ushered in by attacks of severe abdominal pain is well known, and there are numerous cases on record where this condition simulated either appendicitis, a gastric or duodenal perforation, or intestinal obstruction. A mistake might easily be made were the routine examination of the urine neglected.

(*i*) **Henoch's Purpura.**—(*Vide* Chap. XIII.).

(*j*) **Angio-neurotic Œdema.**—(*Vide* Chap. XIII.).

(*k*) **Various Forms of Intestinal Colic.**—(*Vide* Chap. VII.).

(*l*) **Infections of the Urinary Tract.**—(*Vide* Chap. XI.).

(*m*) **Dysmennorrhœa.**—(*Vide* Chap. XII.).

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