CHAPTER XXVII

THE VERMIFORM APPENDIX

HAMILTON BAILEY AND MCNEILL LOVE

SURGICAL ANATOMY

The vermiform appendix is present only in man, certain anthropoid apes, and the wombat.[1] Morphologically, it is the undeveloped distal end of the large cæcum found in many lower animals. It is true that many herbivores are provided with a wide-lumened cæcal diverticulum in which bacteriolytic breakdown of cellulose takes place. However, the walls of this diverticulum lack the heavy deposition of lymphoid tissue (fig. 765) that characterises the *vermiform* appendix (R. J. Last).

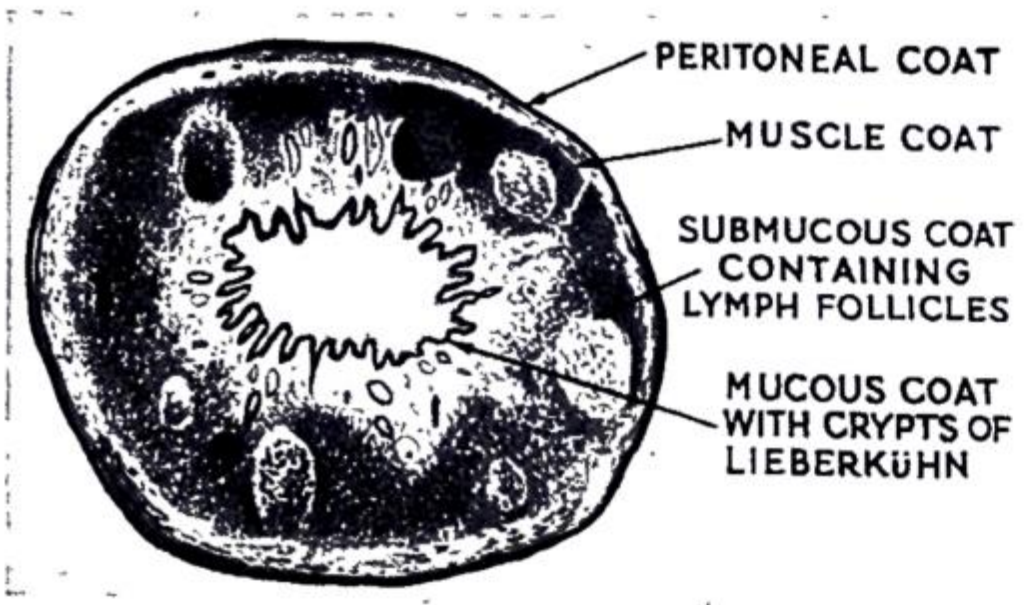

FIG. 765.—Cross-section of a vermiform appendix.

The appendix varies considerably in length and circumference. The average length is between 3 and 4 inches (7·5 to 10 cm.), but variations from ½ inch to 8 inches are not unusual: specimens of over 1 foot (30 cm.) in length have been recorded. In all large series of measurements, the appendix averages ½ cm. longer in the male than in the female. The lumen, which should admit a matchstick, is irregular, being encroached upon by the multiple longitudinal folds of mucous membrane. In infancy the orifice of the appendix is manifestly patent. As growth proceeds, the opening becomes narrow and partially occluded by a valve-like fold of mucous membrane—the valve of Gerlach.

From without inwards, the structure of the appendix is as follows. There is a peritoneal coat which completely invests it, except along the narrow line of attachment of the mesoappendix. The muscular coat resembles that of the small intestine. There is a well-developed submucous coat containing, especially in childhood and youth, a large number of lymphoid follicles. The mucous membrane resembles that of the large intestine, but there are fewer crypts of Lieberkühn.

The **mesoappendix** which springs from the lower surface of the mesentery is subject to great variations. Often it does not extend to the tip of the organ. Sometimes as much as the distal one-third of the appendix is bereft of mesoappendix. Especially in childhood, the mesoappendix is so transparent that the contained blood-vessels can be seen. In many adults it becomes laden with fat, which obscures these vessels.

The **appendicular artery,** a branch of the lower division of the ileo-colic artery, passes behind the terminal ileum to enter the mesoappendix a short distance from the base of the appendix. It then comes to lie in the free border of the mesoappendix; but for a variable distance from the tip, where the mesoappendix is lacking, the artery lies directly on the muscle wall beneath the peritoneal coat.

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[1] Wombat—a nocturnal, burrowing Australian marsupial.

Raymond Jack Last, Contemporary. Professor of Applied Anatomy, Royal College of Surgeons of England.
Joseph von Gerlach, 1820–1896. Professor of Anatomy and Physiology, Erlangen.
Johann Nathanael Lieberkühn, 1711–1756. Anatomist, Berlin. He demonstrated his anatomical preparations in London, and was awarded the F.R.S.

An accessory appendicular artery (fig. 766), when present, requires independent ligation during appendicectomy.

The appendicular vein is a radicle of the ileo-colic vein, which drains into the portal system.

Lymphatic Vessels.—Four, six, or more lymphatic channels traverse the meso-appendix to empty into the ileo-cæcal lymph nodes.

McBurney's point lies at the junction of the lateral third with the medial two-thirds of a line joining the anterior superior iliac spine and the umbilicus (fig. 767).

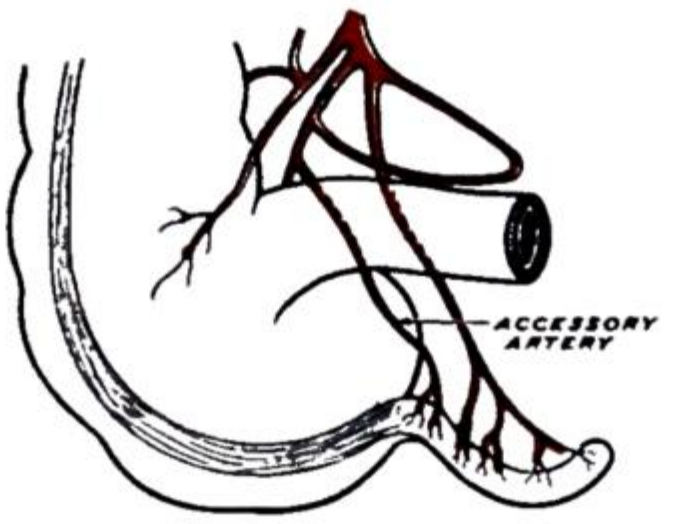

FIG. 766.—In nearly 50 per cent. of cases there is an accessory appendicular artery, a branch of the posterior cæcal. (*After T. Seshachalam.*)

FIG. 767.—McBurney's point, the surface marking of the base of the appendix.

McBurney's point is the classical site of greatest tenderness in appendicitis, and also a most useful point to have in mind when a grid-iron incision to expose the appendix[1] is about to be made.

Inconstancy of Position.—The vermiform appendix is the only organ in the body which has no normal position. The relative frequency of the more usual positions occupied by the organ is depicted in fig. 768. In addition, the appendix must necessarily share in abnormalities in position of the cæcum. The most frequent of these is failure of the cæcum to descend, which results in the base of the appendix

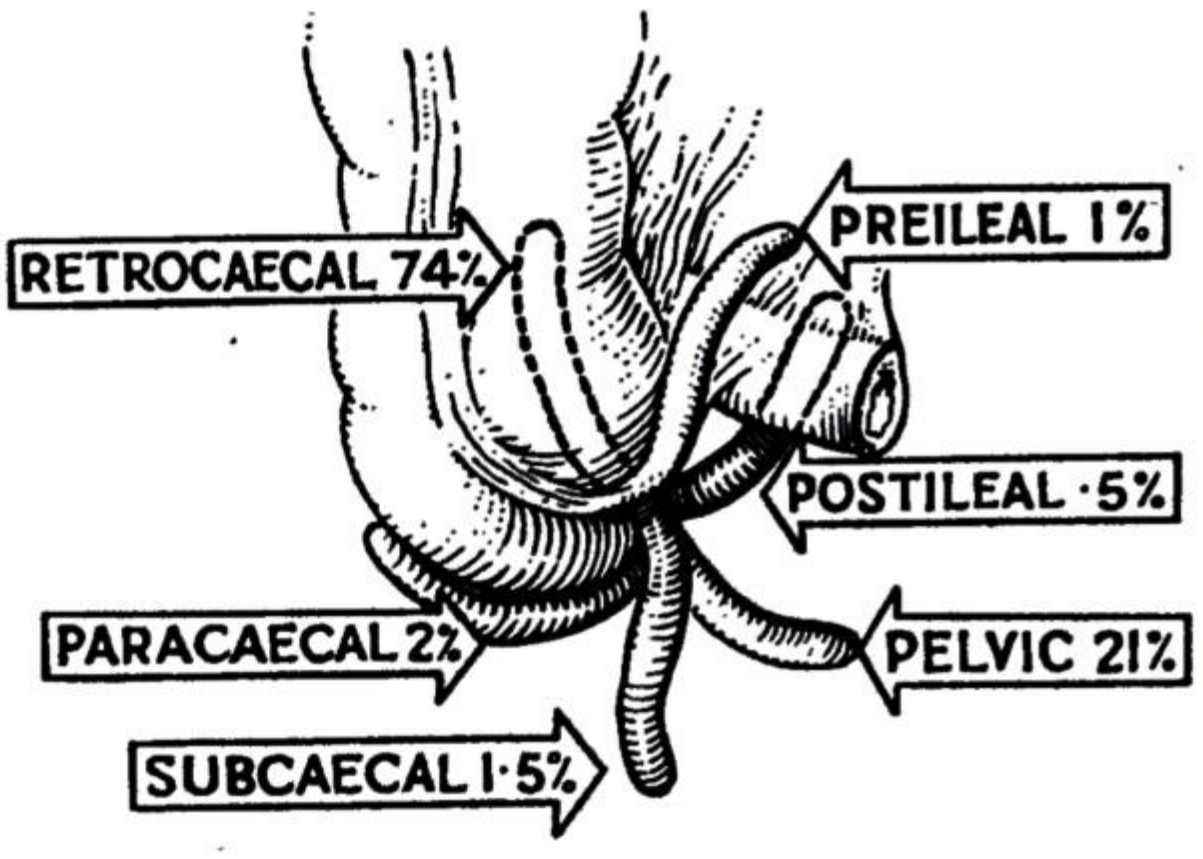

FIG. 768.—The various positions of the appendix.

FIG. 769.—A well-developed terminal ileal fat-pad (X) in an obese subject. (*After Howard A. Kelly.*)

being situated in the right hypochondrium. Very occasionally the cæcum and appendix are situated in the left iliac fossa. This is due either to abnormal rotation of the gut during embryonic life or to transposition of viscera.

Locating the Appendix.—Even when the cæcum is in full view it is not always an easy matter to find the appendix. If the terminal ileal fat-pad (fig. 769) is retracted to the left, the inferior ileo-cæcal recess is displayed, and often therein

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[1] Appendicectomy is the most frequently performed operation; 8·4 per cent. of recruits for the Royal Air Force in 1941 bore the scar of an appendicectomy.

Charles McBurney 1845–1913. Surgeon, Roosevelt Hospital, New York.

lies the base of the appendix. In difficult cases, if one of the tæniae coli is traced downwards, it must lead to the base of the appendix. If the organ is still not visible and it is certain that it has not been removed, it will probably be found buried in the posterior cæcal wall, and will be discovered by palpation and dissection.

CONGENITAL ABNORMALITIES

Agenesis.—Once in 100,000 persons the vermiform appendix is absent; sixty such cases have been described in the literature. It is not denied that a number of these are congenital, but doubtless a few of them can be explained by sloughing of an appendix that had intussuscepted previously (Intussusception of the Appendix, see p. 610).

Duplication.—A few cases of double appendix have been reported; in some instances one of the twin appendices has been found acutely inflamed and the other uninvolved.

Left-sided Appendix.—*Situs inversus viscerum*, a congenital abnormality where there is complete transposition of thoracic and abdominal viscera, occurs once in 35,000 individuals, and is more common in males. In such cases, of course, the vermiform appendix is situated on the left (fig. 770), as it is also in some cases of non-rotation of the mid-gut. What is important to know is that despite the position of the appendix on the left, the pain and tenderness of acute left-sided appendicitis are situated on the right. The explanation of the paradoxical phenomenon is unknown. Through lack of this knowledge, in spite of the fact that the apex beat was situated on the right, the operation for removal of an acutely inflamed left-sided appendix has, in almost every instance, been unduly prolonged and complicated because a right-sided incision was made. At least 100 cases of left-sided acute appendicitis have been reported.

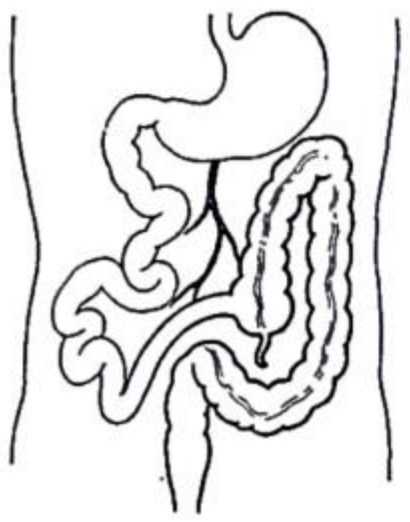

FIG. 770.—Left-sided caecum and appendix due to incomplete intestinal rotation. (*After Findlay and Humphreys.*)

ACUTE APPENDICITIS

During recent years the mortality from acute appendicitis has been falling. Earlier diagnosis and appendicectomy while the inflammation is still confined to the appendix, the cognisance of the general public that it is dangerous to take or give to a child a purgative in the presence of undiagnosed abdominal pain, more discrimination in performing immediate appendicectomy in late cases, a greater appreciation of the importance of accurate fluid and electrolytic balance, better anæsthesia, and the control of infection by antibiotics have all played a part in bringing about this improvement. Nevertheless, hospital statistics [1] show that in cases where the inflammation is no longer limited to the appendix, the fatality rate is 5 per cent. in males and 6 per cent. in females, while when men of sixty-five years of age and over, stricken with acute appendicitis, are considered alone, one in four succumb.

All are agreed that early diagnosis with prompt appendicectomy is the goal. Countering this, is that, for one reason or another, numbers of patients fail to seek medical advice until a late hour. In such cases there must be no rule of thumb, and when to operate and when not to operate becomes a matter of refined judgment, helped considerably by the hour at which the aid of the surgeon is sought. Although belittled by some, the dividing line of forty-

[1] Statistics from the Social Medical Research Unit of the Medical Research Council, The London Hospital, 1957.

eight hours from the onset between what constitutes the clarion call for immediate operation and the restrained, but even more responsible and exacting, course of instituting the Ochsner-Sherren (delayed) treatment, is upheld by the following reliable statistics:

MORTALITY ACCORDING TO THE DAY OF OPERATION

	No. of Cases	*Death-rate*
1st day	1,507	1·3 per cent.
2nd day	912	3·6 „ „
3rd day	663	8·9 „ „
4th day	356	12·9 „ „
5th day	442	11·6 „ „
6th day	346	8·4 „ „

After the 6th day the mortality declined gradually.

(*Frank L. Meleney's statistics.*)

ÆTIOLOGY

Until the close of the nineteenth century appendicitis remained unrecognised. Unquestionably, before this time it was a comparatively rare disease, but there can be no doubt that it existed even in remote times, for an acutely inflamed, perforated appendix was found preserved in the mummy of a young royal princess of Egypt (A. M. Spencer).

The riddle of appendicitis—its actual cause and its meteoric rise from an insignificant disease to the most common serious intra-abdominal inflammatory affection of Western civilised races—has been a matter for much divergent speculation. So far no satisfactory explanation has been forthcoming. The following ætiological factors are important, but for the most part they must be looked upon as purely contributory.

Race and Diet.—Appendicitis is particularly common in the highly civilised European, American, and Australasian countries, while it is rare in Asiatics, Africans, and Polynesians. Rendle Short showed that if individuals from the latter races migrate to the countries where appendicitis is common, they soon acquire the local susceptibility to the disease. Even apes in captivity appear to acquire the human liability to appendicitis. These significant facts satisfy many that the rise of appendicitis amongst the highly civilised is due to an unbridled departure from a simple diet rich in cellulose. But this cannot be the whole explanation, for acute appendicitis occurs in lifelong vegetarians and even in babes at the breast.

Social Status.—In England, acute appendicitis is more common among the upper and middle classes than in those belonging to the so-called working class. Thus the mortality from acute appendicitis is about 20 per cent. higher in men of social classes I and II (professional and managerial workers) than it is in social class V (unskilled labourers) (Registrar-General, 1954).

Familial Susceptibility.—That there is sometimes a familial tendency to the disease cannot be disputed. This generally accepted fact can be accounted for by an hereditary abnormality in position of the organ, which predisposes to infection. Thus the whole family may have a long retrocæcal appendix (fig. 771) with a comparatively poor blood supply, and many of its members fall victims to appendicitis in one form or another.

Obstruction of the Lumen of the Appendix.—When an acutely inflamed appendix has been removed, in a large percentage of cases, some form of obstruction

FIG. 771.—Long retrocæcal appendix. This type tends to be familial.

Frank Lamont Meleney, Contemporary. Professor Emeritus of Clinical Surgery, Columbia University, New York.
Arthur Morgan Spencer, Contemporary. Medical Superintendent, Powick Mental Hospital, nr. Worcester.
Arthur Rendle Short, 1880–1953. Professor of Surgery, University of Bristol.

FIG. 772.—Fæcoliths. X-ray of an appendix after removal.

to its lumen can be demonstrated. The obstructing agent is usually a fæcolith or a stricture; exceptionally, a foreign body or a round worm or threadworms are found.

Fæcoliths (fig. 772) vary in size and have a laminated structure. They are composed of inspissated fæcal material, calcium and magnesium phosphates and carbonates, bacteria and epithelial débris; rarely, a foreign body is incorporated in the mass. The presence of a fæcolith or fæcoliths postulates some form of appendicular stasis. The fæcal stream is fluid when it passes from the ileum into the cæcum, and any that enters the appendix must go through a process of dehydration in order to become solid (S. G. Shattock).

Worms, and other Foreign Bodies.—That worms (fig. 773) and other intestinal parasites can, and do, injure the appendicular mucous membrane and occasionally block its lumen, must be allowed. The same will be admitted for a foreign body. Nevertheless, in the majority of instances it is evident that parasites and foreign bodies can sojourn in the appendix without causing appendicitis.

FIG. 773.—An appendix filled with oxyuria vermicularis.

The Abuse of Purgatives.—It is abundantly clear that the ingestion of purgatives, particularly castor oil, by patients with 'stomach ache,' and the violent peristaltic action which results, favours, and often determines, perforation of an inflamed appendix. 'Purgation means perforation' is a wise adage.

Epidemic Form.—From time to time acute appendicitis occurs as an epidemic. In this instance the infection is streptococcal, and the portal of entry almost certainly the naso-pharynx.

BACTERIOLOGY

There is no one organism mainly responsible for appendicitis. Cultures from inflamed appendices usually reveal that the infection is mixed and there is hardly a pyogenic organism which has not been isolated from such specimens. The most common organisms present are a mixture of *Esch. coli* (found in 85 per cent. of cases), enterococci (30 per cent.), non-hæmolytic streptococci, anaërobic[1] streptococci, together with *Cl. welchii* (30 per cent.) and bacterioides (see p. 482). Sometimes there is synergistic action among these organisms that renders each species more parhogenic than it would be in pure culture. In most instances the infecting organisms are normal inhabitants of the lumen of the appendix, although in the case of streptococci they may be blood-borne from streptococcal infection of the naso-pharynx.

PATHOLOGY

The menace of acute appendicitis lies in the frequency with which the peritoneal cavity is infected from this focus. Peritoneal infection takes place:

1. By perforation.
2. By transmigration of bacteria through the appendicular wall.

Attention has been directed, on the one hand, to the value of the greater omentum in attempting to limit the extent of the peritoneal invasion, and on the other to violent peristalsis from ingested purgatives in producing a widespread infection. Obviously, if the inflamed appendix lies dangling

[1] The foul odour of exudates connected with appendicitis with perforation are caused by anaërobic streptococci or certain anaërobic bacilli, and not by *Esch. coli*, as is so commonly believed.

Samuel George Shattock, 1852–1924. Professor of Pathology, London; Royal College of Surgeons of England.
William H. Welch, 1850–1934. Pathologist, Johns Hopkins University, Baltimore, U.S.A.

amidst coils of small intestine (fig. 774), the threat of peritonitis is increased; should early perforation occur, diffusing peritonitis is inevitable.

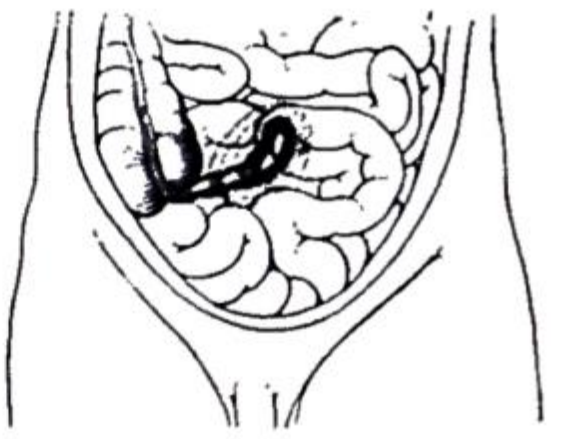

FIG. 774. — When an inflamed appendix lies amidst coils of small intestine the risk of peritonitis is high.

It is of great importance to recognise two types of acute appendicitis.

(*a*) **Non-obstructive Acute Appendicitis.**—The inflammation usually commences in the mucous membrane; less often in the lymph follicles. Like any inflammatory process, it terminates in one of the following ways: (1) Resolution; (2) Ulceration; (3) Suppuration; (4) Fibrosis; (5) Gangrene. Non-obstructive acute appendicitis is less serious than the obstructive variety in that the mucopurulent products of inflammation have an opportunity of escaping along the lumen into the cæcum. Nevertheless, all grades of inflammation occur. One or more of the lymph follicles which early in the course of the inflammation become swollen may break down and suppurate or, what is more common, suppuration occurring in the bottom of one of the crypts of Lieberkühn leads to a minute perforation of the mucous lining. In either event, once infection reaches the loose submucous tissues the inflammation progresses rapidly. The organ becomes turgid, bright red, and hæmorrhages occur into the mucous membrane. Swelling of the organ is restricted by its inelastic peritoneal coat, but expansion can occur into the leaves of the mesoappendix. Towards the tip of the organ the mesoappendix is sometimes lacking; then the intramural vascular supply of the distal part of the appendix is liable to become strangulated or the appendicular artery becomes thrombosed by extension of the infection to it. In these ways gangrene sets in. At other times the infection passes through one or more of the hiatuses where the blood-vessels pierce the muscularis, to reach the subperitoneal plane. Here it spreads under tension, and a purulent blister is liable to form (fig. 775) and perforation results. As a rule, in non-obstructive appendicitis the inflammation progresses sufficiently slowly for protective adhesions to form, and the resulting peritonitis is localised. In many instances the infection never progresses beyond the mucous lining, nevertheless, although the attack passes off, it is unlikely that a *status quo ante* is ever regained. Because the tip suffers most, fibrosis usually occurs therein. More rarely fibrosis following ulceration supervenes in the proximal end and the stricture thus formed predisposes to future acute appendicular obstruction.

FIG. 775. — Acute appendicitis. Perforation imminent.

(*b*) **Acute Appendicular Obstruction.**—About one-third of cases of acute appendicitis belong to this group. The obstruction can be by obturation (fæcolith, foreign body, or parasites); intramural (almost invariably an inflammatory, but exceptionally a carcinomatous, stricture); extramural

(adhesions and kinking). Of these, much the most common is a fæcolith. On occasions the appendix becomes strangulated in an inguinal or femoral hernia.

Possibly in some cases œdema of Gerlach's valve or spasm of the circular musculature at the base of the appendix is sufficient to obstruct the lumen, but such obstruction cannot be proved. A kink is unlikely to cause complete obstruction.

When the lumen of an inflamed appendix is obstructed, the products of inflammation become pent up (fig. 776), and except in the rare event of the obstruction being overcome, the inflammation proceeds more rapidly and more certainly to gangrene or perforation than is the case when the lumen is unobstructed. Close examination of gangrenous appendices directly after their removal shows conclusively that they usually belong to the obstructive group (Sir David Wilkie). Often within twelve to eighteen hours the appendix distal to the obstruction becomes lifeless and green (fig. 777). When perforation occurs it does so suddenly, most often at the site of an impacted fæcolith, and before protective adhesions have had time to form. The escaping purulent and gaseous contents being under high pressure, early widespread peritonitis is liable to ensue, especially if the appendix is free-lying.

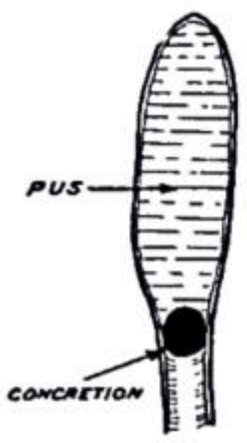

FIG. 776.—Acute obstructive appendicitis.

FIG. 777.—Acute obstructive appendicitis with gangrene. There is a large fæcal concretion impacted in the proximal end of the lumen of the organ.

CLINICAL FEATURES

Age Incidence.—Rare before the age of two, acute appendicitis becomes increasingly common during childhood and adolescence. The maximum incidence is between the ages of twenty and thirty; thereafter there is a gradual decline, but no age is exempt.

The patient often gives a history of similar slight attacks. The attack can commence at any time, but frequently it does so in the early hours of the morning, awakening the patient from sleep. Recent constipation is usual.

Non-obstructive Acute Appendicitis.—Typically, the first symptom is generalised abdominal pain, gradually becoming localised near the umbilicus or in the epigastrium. In severe cases this is followed in three or four hours by vomiting. The vomiting is reflex, and often as soon as the stomach is empty it ceases. In subacute cases, and also in acute cases commencing several hours after the last meal, there is no vomiting, but almost invariably nausea and anorexia are present. During the first six hours rarely is there any alteration in the temperature or pulse-rate; after that time

Sir David Wilkie, 1882–1938. Professor of Surgery, University of Edinburgh.
Reginald Fitz, 1843–1913, Physician, Massachusetts General Hospital, Boston, U.S.A., did much in first framing the clinical features of acute appendicitis.

slight pyrexia[1] (99° to 100° F. (37·2° to 37·7° C.)), with a corresponding increase in the pulse-rate to 80 or 90, is usual. In severe cases, as time passes the temperature rises to about 101° F. (38·3° C.) but seldom more, and the pulse-rate becomes correspondingly elevated. Only occasionally is the classical sequence of abdominal pain followed by nausea or vomiting reversed. After a lapse of about twenty-four hours the pain becomes localised in the right iliac fossa.

In cases of under twelve hours' duration usually tenderness and some rigidity are present in the right iliac fossa. In spite of many exceptions, McBurney's point is the most usual site of maximum tenderness. Later, in progressive cases the rigidity increases. When the inflammation has implicated the walls of the appendix sufficiently to stretch its peritoneal coat, hyperæsthesia will be found in Sherren's triangle (fig. 778). When present, this is a most valuable sign. Rovsing's sign is sometimes helpful in strengthening the diagnosis; even pressure is exerted over the contents of the left iliac fossa; this displaces coils of small intestine to the right. If pressure in the left iliac fossa causes pain in the right iliac fossa, the case is probably one of acute appendicitis.

FIG. 778.—Sherren's triangle, formed by the umbilicus, the highest point of the iliac crest, and the right pubic spine.

Leucocytosis.—In 90 per cent. of cases the white count is greater than 10,000 per cu. mm.

Acute Appendicular Obstruction.—The onset is abrupt and the leading symptom is colic—severe generalised abdominal pain which comes and goes, and from the commencement of the attack is referred to the umbilicus. Usually the temperature is normal and the pulse-rate in between the attacks is not necessarily accelerated. Vomiting occurs early and as a rule is repeated two or three times. After a few hours the pain passes to the right iliac fossa, but its spasmodic nature is maintained. The physical signs resemble those of non-obstructive acute appendicitis with the exception that when the appendix is free-lying the rigidity is more pronounced and comes on earlier. The presence of hyperæsthesia is of the utmost diagnostic value. Unlike non-obstructive appendicitis, it is present during the very early hours of the attack and remains until (1) the obstruction has been overcome; (2) perforation occurs; or (3) gangrene supervenes.

Immediately after an obstructed appendix has perforated the violent abdominal pain disappears. The patient often says that he feels better. Rigidity may be almost, if not entirely, absent, but soon the pulse-rate begins to rise steadily and other signs of diffusing peritonitis are not long delayed.

Every effort is made not only to diagnose acute appendicitis irrefutably, but also to diagnose the position of the appendix—whether it is retrocæcal, in the right iliac fossa, or pelvic. The special symptoms and signs likely to

[1] In 20 per cent. of cases the temperature is 98·6° F. (37 °C.), or less.

James Sherren, 1872–1946. Surgeon, The London Hospital.
Thorkild Rovsing, 1862–1927. Professor of Surgery, University of Copenhagen.

be encountered when the appendix occupies one of its more secluded positions are :

Retrocæcal.—Rigidity is often absent, and even on deep pressure tenderness may be lacking, the reason being that the cæcum, distended with gas, prevents the pressure exerted by the hand from reaching the inflamed structure. However, deep tenderness is often present in the loin, and rigidity of the quadratus lumborum may be in evidence. Psoas spasm, due to the inflamed appendix being in contact with that muscle, may be sufficient to cause flexion of the hip joint ; to extend the joint causes abdominal pain. Hyperextension of the hip joint may induce abdominal pain in degrees of psoas spasm insufficient to cause flexion of the hip. Occasionally an inflamed retrocæcal appendix lies in contact with the ureter, in which event there may be slight hæmaturia and on microscopical examination of the urine, even a few pus cells as well.

Pelvic.—When the appendix lies entirely within the pelvis usually there is complete absence of abdominal rigidity, and often tenderness over McBurney's point is lacking as well. In some instances deep tenderness can be made out just above and to the right of the symphysis pubes. In either event a rectal examination reveals tenderness in the recto-vesical pouch or the pouch of Douglas, especially in the right side of the pouch concerned. Psoas spasm may also be present when the appendix is in this position; alternatively, spasm of the obturator internus is sometimes demonstrable when the hip is flexed and internally rotated. If an inflamed appendix is in contact with the obturator internus, this manœuvre will cause pain in the hypogastrium (Sir Zachary Cope). An inflamed appendix in contact with the bladder causes increased frequency of micturition. Very occasionally early diarrhœa results from an inflamed appendix being in contact with the rectum.

Post-ileal.—The inflamed appendix lies against the mesentery, and if it is not removed early it may give rise to pylephlebitis (see p. 400). As coils of small intestine lie between the inflamed structure and the abdominal wall rigidity and deep tenderness are liable to be slight or absent. Oft-repeated vomiting is much in evidence.

Maldescended.—The tenderness is in the subhepatic region. Hyperæsthesia, however, when present, occupies the usual area.

ACUTE APPENDICITIS IN INFANTS, DURING PREGNANCY, AND IN THE ELDERLY

Acute Appendicitis in Infants.—In infants under thirty-six months of age the incidence of perforation is over 80 per cent. (I. Fields), and the mortality is still considerably higher than that of the general mortality; indeed, when acute appendicitis occurs during the first year of life, only 50 per cent. of the patients reach their first birthday. One of the reasons for the rapid onset of diffuse peritonitis is that the greater omentum, being comparatively short and undeveloped, is unable to give much assistance in localising the infection. Even more important is the difficulty in arriving at an early diagnosis, and particularly in differentiating the condition from enteritis. What should be

James Douglas, 1675–1742. Physician to Queen Caroline, wife of King George II.
Sir Zachary Cope, Contemporary. Consulting Surgeon, St. Mary's Hospital, London.
Irving A. Fields, Contemporary. Assistant Professor of Surgery, Los Angeles, California.

known more widely is that acute appendicitis can complicate enteritis: in these cases *pseudomonas æruginosa* is the predominating organism. The error to avoid is to fail to entertain the possibility of appendicitis in the presence of acute respiratory infection, gastro-enteritis or one of the exanthemata.

Acute Appendicitis in Pregnancy.—Pregnancy with its shift of the vermiform appendix to the central or upper abdomen favours peritonitis: the nearer to term the greater the danger, even in cases of appendicitis without perforation. During the third trimester acute appendicitis carries a maternal mortality of 20 per cent.—ten times greater than in the first trimester (R. B. Parker). As pregnancy advances the pain becomes higher and more lateral. When it is of paramount importance to exclude pyelonephritis, excretory urography and microscopical examination of specimens of urine, obtained from the right ureter by cystoscopy and catheterisation, will help to settle this important question. In doubtful cases it is best to perform early appendicectomy. The pregnant patient with acute perforated appendicitis aborts or goes into premature labour in 50 per cent. of cases, while in acute non-perforated appendicitis abortion occurs in 30 per cent.

Acute Appendicitis in the Aged.—Gangrene and perforation occur much more frequently in elderly patients (fig. 779) than in controls, because, on account of arteriosclerosis, vascular occlusion of the appendicular artery occurs more readily. Elderly patients with lax abdominal walls not infrequently harbour a gangrenous appendix with such paucity of symptoms and signs that diffuse peritonitis is mistaken for sub-acute intestinal obstruction and enemata are administered, with the result that the peritonitis becomes disseminated still further.

FIG. 779.—The frequency of perforation in patients over sixty years of age. (*Wolf and Hindmann's statistics.*)

THE DIFFERENTIAL DIAGNOSIS OF ACUTE APPENDICITIS

For purposes of differential diagnosis it is helpful to visualise the body as a house (fig. 780) and compare six parts of the house to the appropriate anatomical regions.

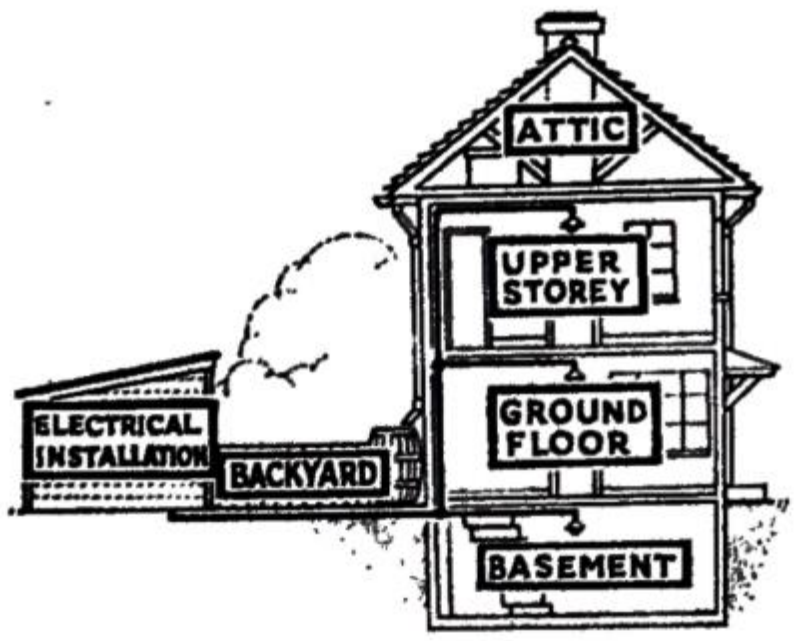

FIG. 780.

1. **The Attic** (i.e. *The Thorax*)

Pneumonia and pleurisy are associated with an increased respiratory rate. Pleurisy inhibits deep inspiration. Some degree of cyanosis is usually present and, not infrequently, the alæ nasi move on respiration. Pleural friction or altered breath-sounds should be detected by a stethoscope.

2. **The Upper Storey** (i.e. *Diaphragm to the Level of the Umbilicus*)

Perforated Peptic Ulcer (notably a perforated duodenal ulcer with duodenal contents passing along the paracolic gutter to the right iliac fossa).—

Robert Bunten Parker, Contemporary. Obstetrician and Gynæcologist, Walsall Hospital, Staffs.

and pain in the groin. This peculiar radiation, combined with the presence of urinary symptoms, serves to distinguish many cases from acute appendicitis. When ureteric colic is due to a stone in the right ureter there is often considerable rigidity in the right iliac fossa. Coughing causes pain in acute appendicitis, but not with a ureteric calculus. An X-ray and an intravenous pyelogram, together with, if necessary, cystoscopy, will reveal the presence of a stone in the ureter or kidney, and also intermittent hydronephrosis, such as that occasioned by a Dietl's crisis. When these conditions have been excluded, it should be recollected that an inflamed retrocæcal appendix adherent to the right ureter can give rise to slight haematuria and a few pus cells in the urine from that ureter. Therefore, if early acute retrocæcal appendicitis cannot be ruled out, it is safer to perform appendicectomy.

Right-sided acute pyelonephritis is accompanied and often preceded by increased frequency of micturition. The pain commences in the right side, and typically is higher and more posterior than that of appendicitis. The temperature is often 102° F. (38·9° C.) or more, and rigors are not infrequent. The enlarged tender right kidney may be palpable. Urgent intravenous pyelography is often of considerable diagnostic assistance.

Acute seminal vesiculitis is frequently confused with acute appendicitis. Often the presence of a urethral discharge is lacking, especially if antibiotic treatment has been given. Should the history of dysuria be concealed by the patient, the differentiation from pelvic appendicitis is difficult unless the clinician, when he examines the rectum, realises that it is the seminal vesical which is acutely tender.

Osteomyelitis of the iliac bone occasionally affects the crest of the ilium. The pain commences in the outer part of the right iliac fossa. Compression of the iliac crest causes acute pain. This is absent in appendicitis.

5. **The Electrical Installation** (i.e. *Central Nervous System*)

The abdominal crises of porphyria which are characterised by violent intestinal colic with constipation, are liable to be precipitated by the administration of barbiturates, the symptoms being produced by areas of intestinal spasm. The urine of these patients is usually orange in colour, which is often dismissed as 'concentrated.' If the specimen of urine is left exposed to daylight for even a short space of time, it becomes coloured amber, particularly near the surface. There are several conclusive laboratory tests for porphyrinuria. A plain X-ray of the abdomen often displays short lengths of intestinal spasm with related gaseous distension of the small and large intestine. In obscure cases of this condition, especially when it is

[illegible] c it is well

[illegible] Pre-herpetic pain of the right tenth [illegible] followed over the same area [illegible] gastric symptoms and rigidity [illegible] eruption may be delayed [illegible] Vesicular crises are

[illegible] Professor of P

pingitis is more medial than that found in acute appendicitis, and is usually bilateral (fig. 781). On a rectal or vaginal examination the enlarged tender Fallopian tubes can be palpated. A smear from the cervix uteri examined microscopically sometimes clinches the diagnosis. In a few cases when the condition is mainly right-sided, the differential diagnosis is so difficult that it is wiser to explore the abdomen.

FIG. 781.—Typical distribution of abdominal tenderness in acute salpingitis.

Ectopic Gestation.—It is unlikely that a *ruptured* ectopic pregnancy, with its well-defined signs of hæmoperitoneum, will be mistaken for acute appendicitis, but the same cannot be said for a right-sided tubal abortion, or more still for a right-sided unruptured tubal pregnancy (fig. 782). In the latter the signs are very similar to those of acute appendicitis, except that the pain *commences* in the right side and there is often a history of a missed period. In tubal abortion signs of intraperitoneal hæmorrhage are likely to be manifest. The patient should be questioned specifically regarding referred pain in the shoulder, and hyperæsthesia is sought in that area a quarter of an hour after the foot of the bed has been raised on blocks. When the internal bleeding has not been excessive the differential diagnosis between acute appendicitis and tubal abortion is not always simple, especially when the history of a missed period is lacking. The abdomen moves well on respiration, there is deep tenderness in the iliac fossa, but seldom rigidity. A vaginal examination reveals the cervix softer than usual, and the fornices are tender; which is of considerable importance, since in inflammatory conditions the tenderness is only posterior and lateral.

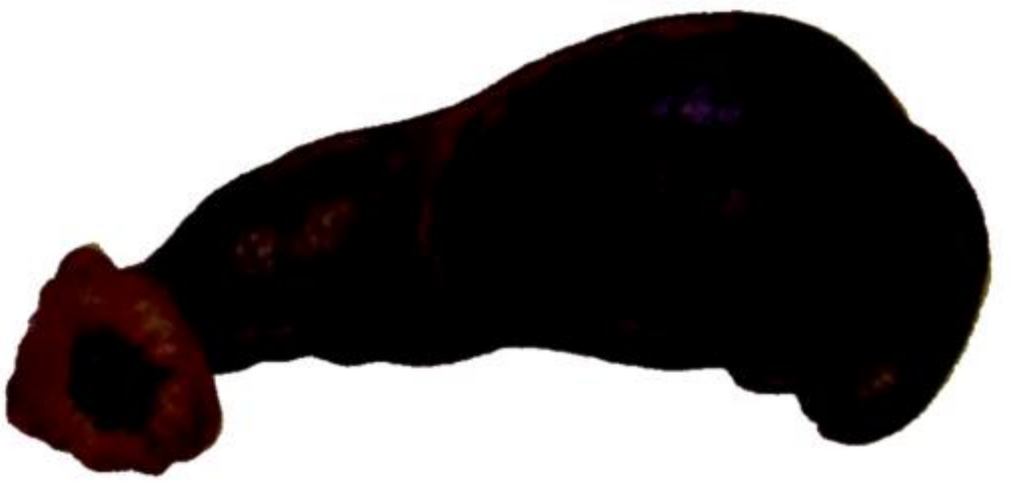

FIG. 782.—Ectopic tubal gestation without rupture. The diagnosis of acute appendicitis was made.

Ruptured lutein cyst (*syn.* apoplectic ovary) occurs particularly during the spring months and in early womanhood. The patient is usually unmarried, or recently married and childless. The signs are similar to those of very early tubal abortion, but of course the history of a missed period is absent, as also is the sign of a soft cervix. In many of these cases it is practically impossible to rule out the possibility of a mild acute appendicitis.

Twisted Right Ovarian Cyst.—When the patient is obese and the cyst is small, unless it can be felt per vaginam or per rectum, appendicitis cannot be ruled out with certainty, although the pain commenced in the right iliac fossa. The differential diagnosis is not of supreme importance, because both conditions require immediate operation.

5. **The Backyard** (i.e. *The Retroperitoneal Structures*)

Right Ureteric Colic.—In both ureteric and appendicular colic the right testis is often retracted. In typical ureteric colic, pain commences in the loin

and passes to the groin. This peculiar radiation, combined with the presence of urinary symptoms, serves to distinguish many cases from acute appendicitis. When ureteric colic is due to a stone in the right ureter there is often considerable rigidity in the right iliac fossa. Coughing causes pain in acute appendicitis, but not with a ureteric calculus. An X-ray and an intravenous pyelogram, together with, if necessary, cystoscopy, will reveal the presence of a stone in the ureter or kidney, and also intermittent hydronephrosis, such as that occasioned by a Dietl's crisis. When these conditions have been excluded, it should be recollected that an inflamed retrocæcal appendix adherent to the right ureter can give rise to slight hæmaturia and a few pus cells in the urine from that ureter. Therefore, if early acute retrocæcal appendicitis cannot be ruled out, it is safer to perform appendicectomy.

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Pre-herpetic pain of the right tenth and eleventh dorsal nerves is localised over the same area as that of appendicitis. The absence of intestinal symptoms and rigidity should distinguish the condition. The herpetic eruption may be delayed for thirty-six to forty-eight hours.

Tabetic crises are now rare. Severe abdominal pain and vomiting

Joseph Dietl, 1804–1878. Professor of Pathology and Therapeutics, Cracow.

usher in the crisis. Argyll Robertson pupils, and the absence of knee-jerks, readily confirm the diagnosis.

Spinal conditions are sometimes associated with acute abdominal pain.[1] Sudden irritation of a posterior nerve root in some phase of Pott's disease may give rise to acute pain in the right iliac fossa. Again, the absence of any intestinal symptoms and the probability of some degree of angular deformity with tenderness of the corresponding spinous process points to the probable diagnosis. A spinal tumour can also give rise to sudden right-sided abdominal pain, and in the absence of any interference with motor function such pain may be mistaken for that of appendicitis. The spinous process over the tumour is often acutely tender.

PERFORATION AND GANGRENE

When perforation or gangrene occurs within twelve to twenty-four hours after the commencement of the attack, as is sometimes the case in acute appendicular obstruction, diffuse peritonitis is liable to result. In non-obstructive appendicitis particularly, and in obstructive appendicitis when perforation or gangrene develops after a period of twenty-four hours, the resulting peritonitis often becomes localised, especially when the appendix lies in a relatively secluded portion of the peritoneal cavity.

LOCAL, DIFFUSING AND DIFFUSE PERITONITIS are discussed in Chapter XXIV.

THE APPENDIX MASS (*syn.* PERI-APPENDICULAR PHLEGMON

On the third day (rarely sooner) after the commencement of an attack of acute appendicitis, frequently a tender lump can be felt in the right iliac fossa beneath some rigidity of the overlying musculature, the other quadrants of the abdomen being free from rigidity or tenderness. Alternatively, the lump is situated within the pelvis. The mass, which at this time is not yet an appendix abscess, and may never become one, is composed mainly of the greater omentum, œdematous cæcal wall, and œdematous portions of the small intestine. In its midst is a perforated or otherwise inflamed vermiform appendix. By the fourth or fifth day the mass becomes more circumscribed. As the rigidity passes off its periphery can be defined clearly and should be outlined with a skin pencil. During the ensuing days (fifth to tenth day) the appendix mass either becomes larger, and an appendix abscess results, or it becomes smaller, and subsides slowly as the inflammation resolves.

Appendix Abscess.—Accompanying the abscess there is variable pyrexia, but the pulse-rate is usually under 100. There is an increased leucocyte count with a relative increase of polymorphonuclear cells. To a great extent the location of the abscess is governed by the position of the appendix. Thus the commonest site of the abscess is in the lateral part of the iliac fossa (extension of retrocæcal suppuration) (fig. 783) and the second most common is in the pelvis (fig. 784). Notwithstanding, an abscess centred over McBurney's point is not so unusual as the percentages of the anatomical

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[1] Never open the abdomen for pain alone (Aleck Bourne).

Douglas Argyll Robertson, 1837–1909. Ophthalmic Surgeon, Royal Infirmary, Edinburgh.
Percival Pott, 1714–1788. Surgeon, St. Bartholomew's Hospital, London.
Aleck William Bourne, Contemporary. Consulting Gynæcologist, St. Mary's Hospital, London.

positions of the appendix would indicate. This is because perforation often implicates the proximal half of an inflamed appendix.

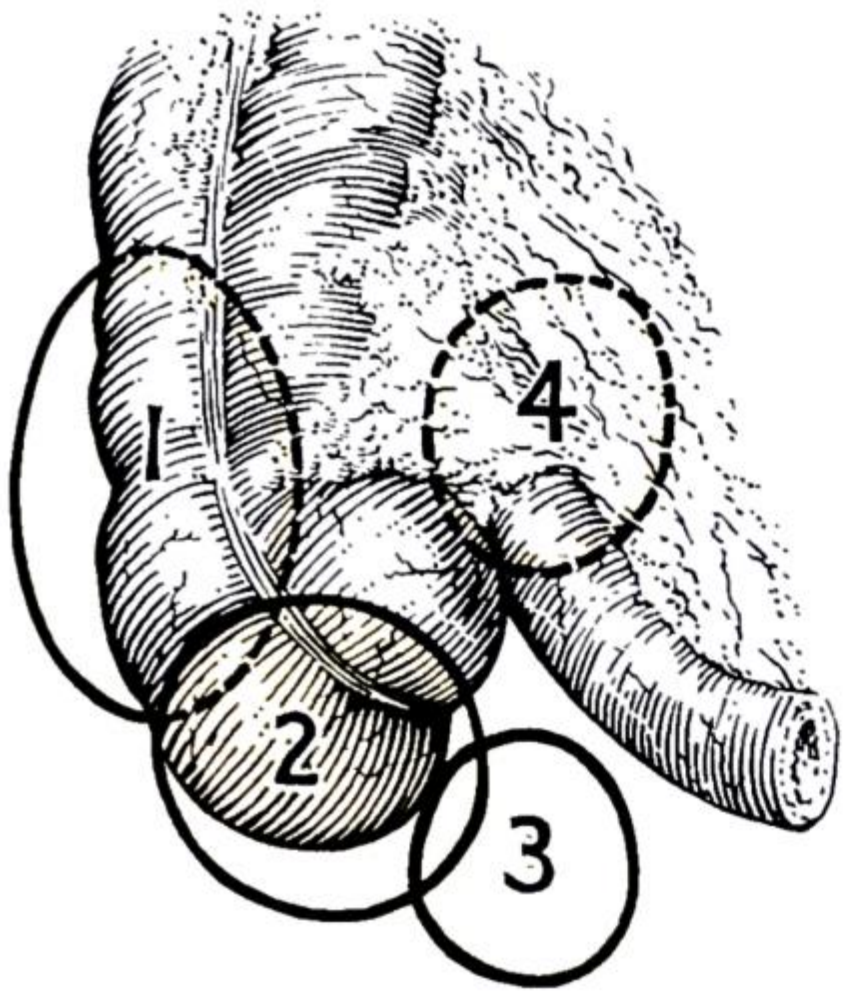

FIG. 783.—Positions of an appendix abscess palpable from the abdomen. 1. Retrocæcal. 2. Subcæcal. 3. Retrorectus (behind the rectus abdominis muscle). 4. Post-ilial (pre-ilial occupies the same position as 4, but lies in front of the ilium).

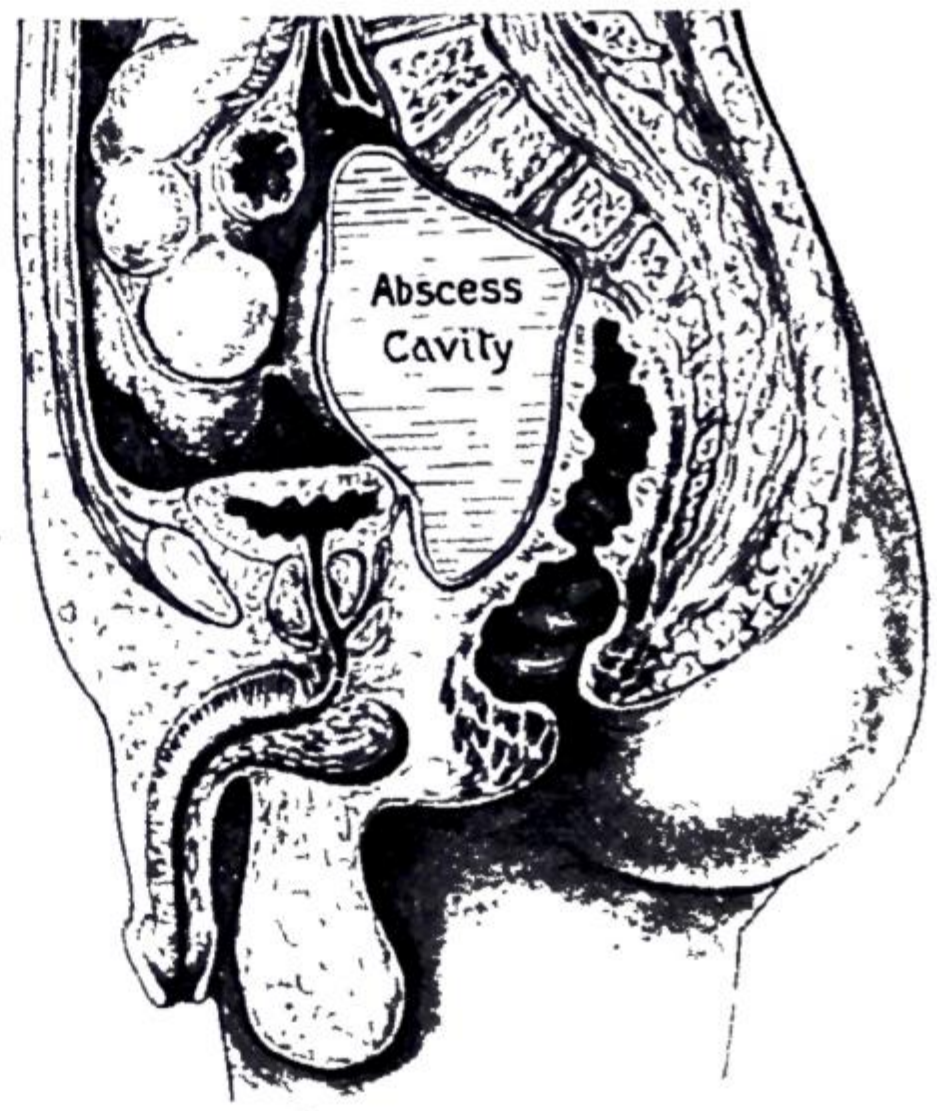

FIG. 784.—Appendix abscess invading the pelvis. Note the relationship to the rectum.

DIFFERENTIAL DIAGNOSIS OF AN APPENDIX MASS

Twisted Ovarian Cyst.—If the patient is examined within twenty-four hours of the commencement of the attack, the diagnosis presents no difficulty, for it is improbable that a definite mass will be found by this time in appendicitis. An appendix mass is fixed in the right iliac fossa or the pelvis; a twisted ovarian cyst is more mobile.

Suppurative Iliac Lymphadenitis.—When right-sided, this condition sometimes simulates an appendix abscess. In the early stage psoas spasm is often in evidence. There is tenderness, some rigidity, and a palpable swelling above the inguinal ligament (fig. 785). Often the inguinal lymph nodes are unaffected. Suppuration of the iliac lymph nodes leads to an extraperitoneal abscess. There is usually a focus of infection due to such lesions as a scratch or a blister in the skin of the lower limb of the affected side.

FIG. 785.—Tender mass connected with suppurating deep iliac lymph nodes.

Perinephric Abscess.—The point of maximum tenderness is in the angle between the last rib and the sacrospinalis. In retrocæcal appendicitis or when there is an abscess following that condition, the tenderness is never present in this angle; it is always below and more lateral.

TREATMENT OF ACUTE APPENDICITIS

The treatment of acute appendicitis is appendicectomy.[1] If the diagnosis is made at an early stage in the attack, and particularly in the absence of a localised mass, all are agreed that the appendix should be removed urgently.

Appendicectomy.—When the diagnosis is certain the grid-iron incision is the best one to be employed. When the diagnosis is in doubt the lower right paramedian incision is preferable because it gives good access to the pelvic organs in the female and, if necessary, it can be readily extended in an upward direction.

The Grid-iron [2] Incision.—An incision from 2 to 6 inches (5 to 15 cm.) in length, according to the musculature of the patient and the amount of subcutaneous fat, is made with its centre over McBurney's point, at right angles to a line joining the anterior superior iliac spine to the umbilicus. In the subcutaneous tissues an arterial twig from the superficial circumflex artery usually requires ligation. The external oblique is incised in the length of the incision. The fibres of the internal oblique and transversus abdominis are separated, and after suitable retraction the peritoneum is opened. If it is found that more room is required, the sheath of the rectus muscle can be incised and the rectus muscle retracted medially. The lowest mortality following appendicectomy for acute appendicitis is associated with the grid-iron incision.

FIG. 786.—Grid-iron incision and paramedian incision.

The paramedian incision is a vertical incision lying parallel to and ½ to 1 inch (1·25 to 2·5 cm.) to the right of the middle line. It commences 1 inch (2·5 cm.) below the level of the umbilicus and ends just above the pubes. The anterior rectus sheath is incised in the line of the incision and the rectus muscle is retracted laterally. Branches of the inferior epigastric vessels may require ligation. The transversalis fascia and the peritoneum are incised together, the peritoneal cavity being opened through the length of the incision. The advantages of the incision have been referred to already. Its disadvantages are (*a*) that it gives poor access to a retrocæcal appendix (it should be possible to diagnose retrocæcal appendicitis pre-operatively); (*b*) if the incision becomes infected its 'trap-door' nature harbours infection.

The split right rectus incision lies in the same situation as the foregoing, the only difference being that the fibres of the rectus muscle are split in the line of the incision. Its advantages are more accessibility to the right iliac fossa and less susceptibility to prolonged infection, because pus deep to the rectus muscle can escape directly to the surface.

Removal of the Appendix.[3]—It will be assumed that the abdomen has been opened by a grid-iron incision. A retractor is placed under the medial side of the peritoneum and the abdominal wall is lifted up. After removing purulent fluid with a mechanical sucker, packing is inserted into the wound on the medial side. Using an abdominal pack, the cæcum is withdrawn. A

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[1] The first surgeon to perform appendicectomy for acute appendicitis was Lawson Tait, in May 1880. The patient recovered. It must also be mentioned that in 1715 Claudius Amyand successfully removed an acutely inflamed appendix from the hernial sac of a boy.

[2] Grid-iron = a frame of cross-beams to support a ship during repairs. The grid-iron incision was described first by McArthur.

[3] Appendicectomy performed before the organ has perforated, or becomes gangrenous, does not require the help of antibiotics.

Robert Lawson Tait, 1845–1899. Surgeon, Hospital for Diseases of Women, Birmingham, England.
Claudius Amyand, 1685–1740. Surgeon, St. George's Hospital, London.
Lewis Linn McArthur, 1858–1934. Surgeon, St. Luke's Hospital, Chicago.

finger may be inserted into the wound to aid delivery of the appendix. Once the appendix has been delivered the cæcum is given to an assistant to hold. Morrant Baker forceps are applied around the appendix in such a way as to encircle the organ and yet not damage it (fig. 787). The mesoappendix is clamped in a hæmostat and severed. Sometimes only one such manœuvre frees the whole of the mesoappendix. When the mesoappendix is broad, the procedure must be repeated with a second, or, rarely, a third, hæmostat. The appendix, now completely freed from its mesoappendix, is crushed near its junction with the cæcum in a hæmostat, which is removed and re-applied just distal to the crushed portion (fig. 788). A ligature is tied around the crushed portion close to the cæcum, and the appendix is amputated.

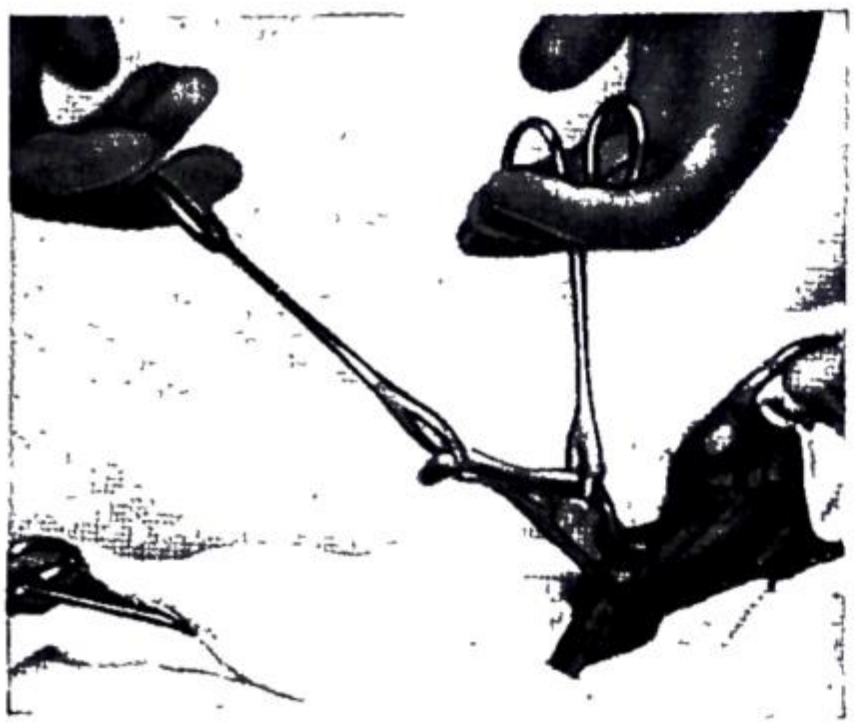

FIG. 787.—Showing the appendix delivered and the mesoappendix displayed.

A purse-string suture is inserted into the caput cæci about ½ inch (1·25 cm.) from the base. This stitch passes through the muscle coat, especially picking up the tæniæ coli. It is left untied until the appendix has been amputated with a scalpel close to the hæmostat, which is still applied to it. The stump is invaginated (fig. 789) while the purse-string suture is tied, thus burying the appendix stump.

FIG. 788.—Appendicectomy. (Inset) Morrant Baker forceps in use.

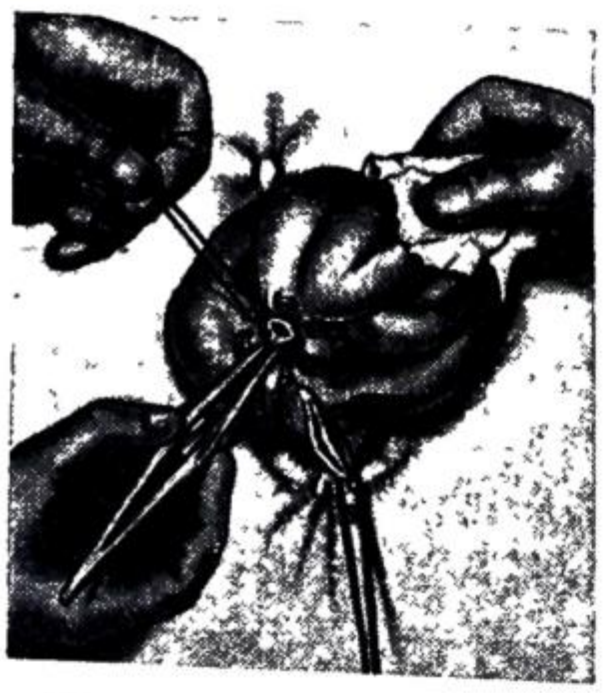

FIG. 789.—Appendicectomy. Inverting the stump of the appendix.

Attention is now directed to ligating the mesoappendix. For this purpose transfixion sutures are safe and cannot slip.

The Appendix Stump: Alternative Methods

1. A minority of surgeons omit the ligature around the base of the appendix. In favour of ligation is that not infrequently the appendicular artery lies very close to the base of the appendix; many cases of severe melæna (some fatal) have occurred as a result of omitting this step. A disadvantage of ligation is that a small intramural abscess sometimes, if not always, forms between the ligature and the purse-string suture; even so, there is no evidence that this does harm.

2. Also with the object of preventing an intramural abscess, other operators omit invagination of the ligated appendix stump. In favour of invagination are the facts that (*a*) a cæcal blow-out (internal fæcal fistula) is less likely to occur and (*b*) adhesions are minimised.

William Morrant Baker, 1839–1896. Surgeon, St. Bartholomew's Hospital, London.

Methods to be Adopted in Special Circumstances.—When the cæcal wall is œdematous, the purse-string suture is in danger of cutting out. If the œdema is of limited extent, this can be overcome by inserting the purse-string suture into more healthy cæcal wall at a greater distance from the base of the appendix. Occasions may arise when, because of extensive œdema of the cæcal wall, it is better not to attempt invagination, in which case the stump of the appendix should be ligated and the cut surface covered by stitching a detached portion of greater omentum over it.

When the base of the appendix is inflamed, it should not be crushed, for fear of distributing infection by way of the lymphatics or blood-stream. It should be ligated close to the cæcal wall just tightly enough to occlude the lumen, after which the appendix is amputated and the stump invaginated.

Should the base of the appendix be gangrenous, neither crushing nor ligation must be attempted. Two stitches are placed through the cæcal wall beneath the base of the gangrenous appendix, which is amputated flush with the cæcal wall, after which these stitches are tied. Further closure is effected by means of a second layer of interrupted sutures.

Retrograde Appendicectomy.—In certain cases, especially when the appendix is retrocæcal and adherent, it is an advantage to commence by dividing the base of the organ between hæmostats. After the stump has been ligated and invaginated, the organ is removed from base to tip.

Drainage is unnecessary when the inflammation is confined to the walls of the appendix. If there is a purulent exudate limited to the immediate vicinity of the cæcum, this can be aspirated, and after appendicectomy the wound is closed. When there is a considerable collection of purulent fluid in the retrocæcal space, drainage is required. As in these circumstances a tube inserted through the fleshy muscles of the flank is liable to engender cellulitis, a Penrose drain[1] brought out through the grid-iron incision (if that incision has been employed) is to be preferred. In cases where purulent fluid has been in contact with the abdominal wound, and especially when there is considerable subcutaneous fat, drainage of the wound with a narrow strip of corrugated rubber, left in place for forty-eight hours, is considered advisable by many. A *tube* is turned and shortened each day, and usually it is removed on the third or the fourth day.

THE MANAGEMENT OF AN APPENDIX MASS

If, for one reason or another, the diagnosis has been delayed until the third or fourth day of the attack, and there is a lump palpable in the right iliac fossa or within the pelvis—an appendix mass—opinions differ as to the best course to adopt for the time being.

The *immediate school* advocate removal of the appendix in the presence (as well as in the absence) of a palpable lump, although even disciples of this school often concede ' unless the patient is recovering from the attack.'

The *delayed* (*Ochsner-Sherren*) *school* maintain that if operation is carried out during the appendix mass stage—before a frank abscess has had time to form—the manipulations are calculated to spread the infection. Moreover, should the mass prove to be in a resolving state (in which event adhesions are exceptionally dense and the involved bowel œdematous and friable) damage resulting in copious hæmorrhage or a subsequent fæcal fistula may

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[1] Penrose drain. Extremely thin (latex) rubber tubing used in conjunction with a gauze wick.

Charles Bingham Penrose, 1862–1925. Professor of Gynæcology, University of Pennsylvania, Philadelphia.

be inflicted. For these reasons they advise instituting a rigid non-operative régime, and while being *prepared* to operate immediately, they only do so if the signs point to the failure of Nature to combat the infection.

The treatment is not merely a postponement of operation; it is not a substitute for operation, but a preparation for it—essentially a surgeon's treatment, to be undertaken only in a surgical hospital, or a correspondingly equipped nursing home. Wherewithal, the treatment should be conducted on the threshold of the operating theatre, but there are circumstances—for instance, in a ship at sea—where conservative treatment would be less dangerous, by reason of these circumstances, than to attempt operation.

SELECTING CASES FOR THE 'DELAYED' TREATMENT

The history is taken, and particular note is made of the number of hours since the onset. The history begins 'ten, twenty-six, fifty-five *hours* ago,' not 'last Thursday' or 'three days ago.' The physical signs are then recorded in diagrammatic form. The extent of the rigidity is marked by shading; the presence of a lump is drawn as near as possible to scale.

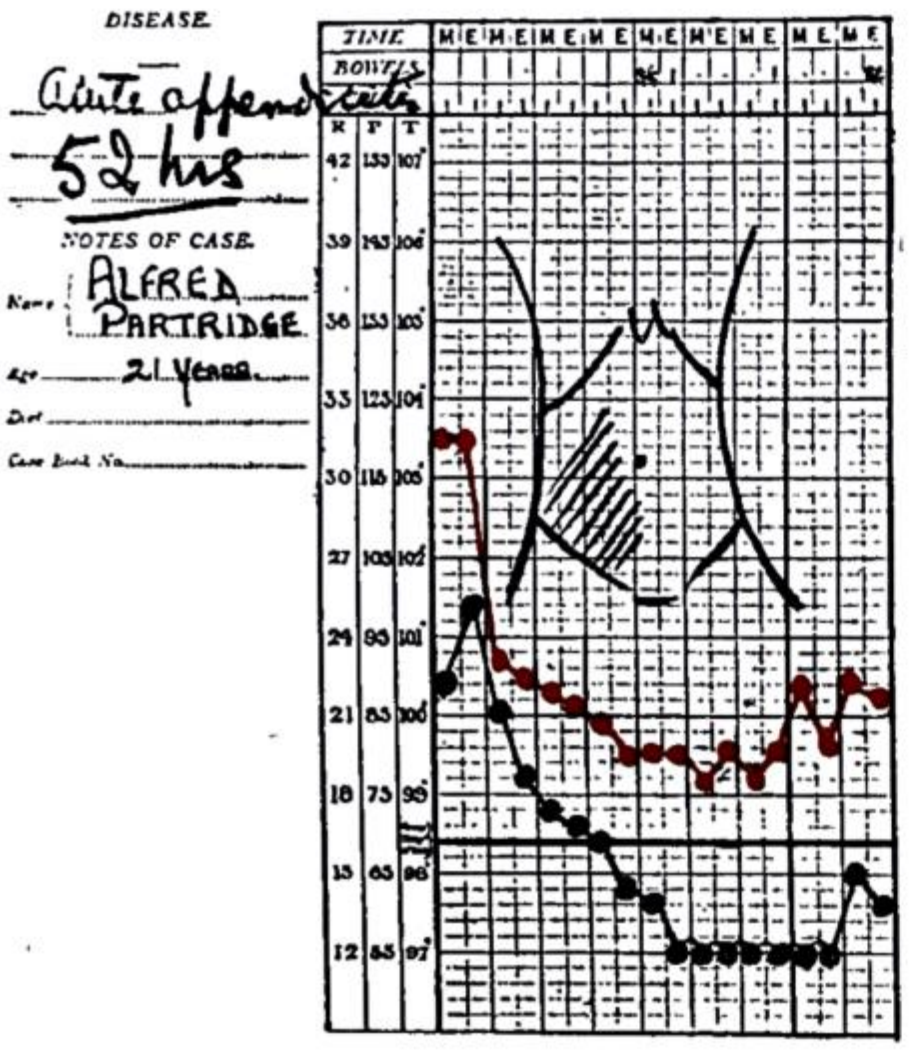

FIG. 790.—The chart of a patient with late acute appendicitis treated by the Ochsner-Sherren method.

In this connection it should be noted especially that sometimes when a patient is first admitted overlying muscular rigidity renders an appendix mass indefinite, or even impalpable. In the majority of such instances, should a lump be present, if the patient is re-examined in two hours' time, lessened apprehension and the warmth of being in bed will reduce guarding of the abdominal wall sufficiently to permit the lump to be felt. This was the case in the patient whose chart is reproduced in fig. 790.

In the absence of complications or intercurrent disease countering immediate operation, the prime requirement that must be fulfilled before the delayed method of treatment can even be contemplated is the presence of a palpable lump.[1]

CONTRAINDICATIONS TO THE 'DELAYED' TREATMENT

1. The diagnosis cannot be made between acute appendicitis and some other intra-abdominal catastrophe normally requiring immediate operation.
2. The signs indicate that the inflammation is still confined to the appendix.
3. The recent ingestion of a powerful purgative may be a justifiable indication for performing an operation which otherwise would be delayed.

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[1] From time to time an appendix mass is felt for the first time when the patient has been anæsthetised. It then requires considerable strength of mind to return the patient to bed without opening the abdomen, but in some instances it is in the patient's interest so to do.

4. When the patient's age is under six years (poor development of the greater omentum and early free perforation of the appendix).

5. When the patient is over the age of sixty-five years more than ordinary bias is directed towards immediate operation, because of the frequency of diffusing peritonitis with minimum classical signs. However, we have treated successfully a large number of patients in the evening of life who had an unmistakable localised mass by the Ochsner-Sherren régime, and the results have not differed from those of less advanced years.

TECHNIQUE OF THE 'DELAYED' TREATMENT

Charts.—As a routine the pulse is recorded every two hours in graphic form on a special chart. In cases where anxiety is felt as to the advisability of continuing the treatment, an hourly chart is employed. Temperature is relatively unimportant, and it is recorded every four hours. Instructions are given to the nurse to report if the patient vomits, and to save the specimen for inspection. Unless the vomitus is a small quantity of clear fluid, no time should be lost in passing and retaining a trans-nasal gastric aspiration tube, in order to keep the stomach empty.

Diet.—*Everything* is excluded by mouth: even sips of water stimulate peristalsis. Mouth-washes are given frequently.

Intravenous dextrose-saline solution is administered, care being taken to give the exact amount required for the individual patient. A fluid intake and output chart is compiled, and from this at the end of twenty-four hours the fluid needs of the patient for the next twenty-four hours are calculated.

On the fifth day of treatment, if the pulse and temperature are satisfactory and the patient feels hungry, oral feeding is commenced. Small feeds of Benger's food, alternating with a cup of meat extract, are given. On the sixth day custard and jelly are allowed. After that the diet is gradually increased.

Application of Local Heat.—The best form is an electrically heated pad. Failing that, the patient is given a well-covered hot-water bottle to apply to the abdomen, but its weight, and the possibility of its bursting or leakage, renders a hot-water bottle much less desirable. Antiphlogistin, although often comforting to the patient, limits the finer perception of the palpating hand.

Drugs.—It should be particularly noted that no morphine or its derivatives are given in border-line cases that are being watched closely for a few hours in order to observe whether the pulse-rate and other signs are tending to settle. Once it has been decided definitely to treat the patient by conservative measures, one dose of omnopon is given. Pain, as opposed to tenderness, is very seldom complained of after the first night of the treatment.

Antibiotic therapy is, of course, employed by both schools. Penicillin, 500,000 units, and streptomycin, 0·5 G., are given intramuscularly twelve-hourly. Alternatively, by adding a total of 500 to 1,000 mg. of oxytetracycline (terramycin) to the contents of the flasks of intravenous dextrose-saline given over a period of each twelve hours, not only is the blood level of antibiotic kept constant, but the patient is spared the pain of repeated intramuscular injections. Two days after the patient is permitted to receive nourishment by mouth, the antibiotic therapy is changed to the oral administration of a tetracycline, e.g. aureomycin 0·5 G. six-hourly for an adult.

Bowels.—The bowels are left confined if they are not opened naturally. On the fourth or fifth day a small glycerol enema is given. No purgatives of any kind are given until resolution is complete—that is, until the temperature and pulse have been normal for a week and pain and physical signs are absent—then liquid paraffin, 2 drachms (8 ml.) twice daily, is prescribed.

WATCHING FOR NATURE'S FAILURE TO COMBAT THE INFECTION

Instructions are given for the nurse in charge to watch the patient and report immediately (1) a rising pulse-rate, (2) vomiting or copious gastric aspirate, (3) pain, and, in the later stages of the treatment, (4) diarrhœa or the passage of mucus in the stools (pelvic abscess).

A rising pulse-rate in the early stages is the most reliable single sign that it is

Frederick Baden Benger, 1840–1903. Pharmaceutical Chemist, Manchester.

dangerous to proceed with the delayed method. If the pulse-rate has increased, or even if it is stationary towards the end of the first twenty-four hours of expectant treatment, operation is indicated.

Vomiting (or copious gastric aspirate) after the first few hours should always be regarded seriously, and this by itself may be a sufficient indication to abandon delayed treatment.

A patient undergoing delayed treatment should not complain of pain, as opposed to tenderness, after the first six hours of such treatment. If he does, there is usually something amiss, and there is a strong indication for operation.

THE OUTCOME

Under the delayed treatment about 90 per cent. of cases resolve without incident and the appendix is duly removed three months after the acute stage has abated, by which time usually the field of operation is singularly free from adhesions. In a few cases where the signs point to failure of the delayed treatment, urgent appendicectomy must be undertaken.

THE TREATMENT OF APPENDIX ABSCESS

The same controversy exists as in the case of an appendix mass. The immediate school proclaim an old and usually wise surgical axiom—" Where there is pus you must let it out." The delayed school state that the rule may be broken in the case of small or moderate-sized appendix abscesses, and the abscess should be opened only if it is becoming larger, or if it fails to resolve (fig. 791).

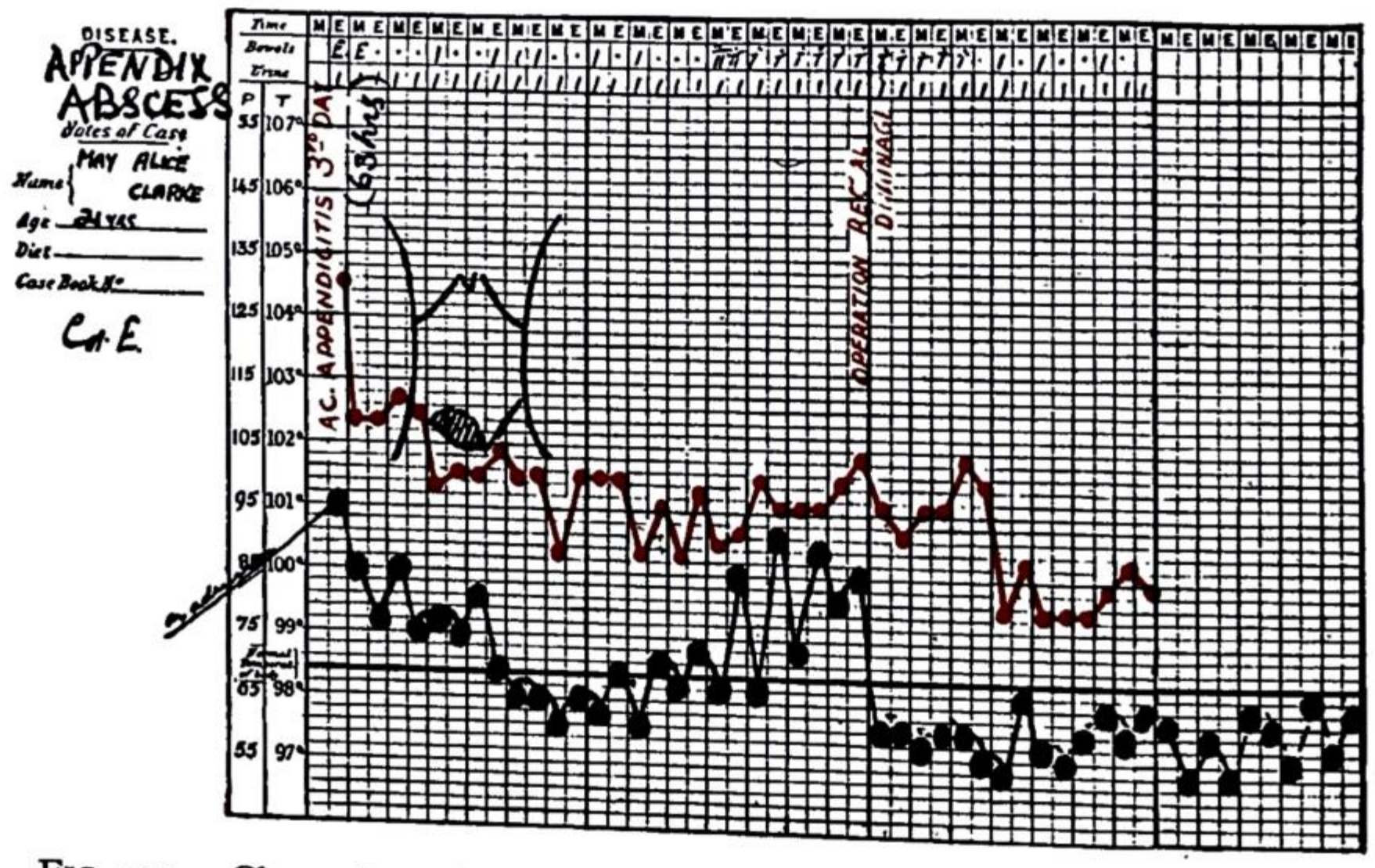

FIG. 791.—Chart of a patient with an appendix mass: in this instance a pelvic abscess formed. The abscess was drained via the rectum.

Indications for Opening an Appendix Abscess.—(1) When the swelling is not getting smaller after the fifth day of treatment, or is increasing in size; (2) when the temperature is swinging above 100° F. (37·8° C.) on several successive days; (3) a pelvic abscess seldom resolves. Repeated rectal examinations are required to determine if it is ready for opening into the rectum (see p. 489).

Opening an Appendix Abscess.—The swelling is palpated under the anæsthetic.

A retrocæcal appendix abscess can be opened extraperitoneally. An incision from 1 to 2 inches (2·5 to 5 cm.) long, depending on the thickness of the abdominal wall, is made over the centre of the swelling, rather nearer the lateral than the medial aspect. The external oblique is incised and the fibres of the internal oblique are divided, instead of being separated, so as to give freer exit to the contents of the abscess. When the peritoneum has been reached the extraperitoneal tissues are separated in an outward and backward direction, until the abscess cavity is entered.

The contents of the abscess are aspirated with a mechanical sucker, if available. In cases where the abscess cavity lies at some distance from the incision, more direct drainage is afforded by a counter-incision in the flank, in which case the original incision may be closed.

A subcæcal abscess can be opened in the same manner, the incision being placed nearer the anterior superior iliac spine.

A pre- or post-ileal abscess can only be reached through the peritoneal cavity When the peritoneum has been opened, gauze packing is inserted so as to isolate the region from the general peritoneal cavity before opening the abscess.

A retro-rectus abscess that cannot be felt per rectum is best reached by a short rectus-splitting incision.

A pelvic abscess is opened into the rectum as described on p. 489.

When it is necessary to drain an appendix abscess, no attempt should be made to perform appendicectomy unless the appendix is lying free in the abscess cavity: usually the appendix is incorporated in the walls of the abscess.

Eventual Appendicectomy.—Following successful drainage of an appendix abscess, arrangements should be made for the patient to return for appendicectomy six months after the wound has healed. It is highly important to explain to the patient that drainage of an appendix abscess is no safeguard against future attacks of appendicitis.

THE PERILS OF PROLONGED ANTIBIOTIC THERAPY IN INTRA-ABDOMINAL SEPSIS

In the first place, the general dangers of antibiotics are encountered: (*a*) To continue with streptomycin for more than six days is to run the risk of incurring vestibular damage. (*b*) Oral antibiotics (especially aureomycin), when administered for ten days or more, are prone to engender the extremely dangerous antibiotic-resistant staphylococcal enterocolitis (see p. 534).

The dangers peculiar to the abuse of antibiotic therapy in cases of an intra-abdominal abscess are:

1. The masking of the general signs (especially the raised temperature) of an intra-abdominal abscess behoves the clinician to make a daily abdominal and pelvic examination, lest an enlarging abscess bursts its confines, perhaps into the general peritoneal cavity.

2. Pus that has been sterilised by antibiotics remains and behaves as a foreign body, and as an irritant. For instance, cases have been reported where one or more sterile abscesses lay among the coils of small intestine, causing most complicated subacute intestinal obstruction.

3. Several instances have been reported whereby a pelvic abscess, by reason of antibiotic therapy, has been converted into granulation tissue, leading to a ' frozen ' pelvis with consequent stricture of the rectum (F. A. R. Stammers).

COMPLICATIONS ARISING AFTER APPENDICECTOMY FOR ACUTE APPENDICITIS

The complications following appendicectomy for acute appendicitis vary with the degree of peritonitis that was present and with the resistance of the patient to the infection. These complications include:

Recent

Residual abscess in the right iliac fossa.

Pelvic abscess (p. 488).

Francis Alan Roland Stammers, Contemporary. Professor of Surgery, University of Birmingham.

Residual abscess in the left paracolic gutter (p. 488).
Subphrenic abscess (p. 489).
Suppuration of the abdominal incision.
Pylephlebitis (p. 400).
Fæcal fistula.
Paralytic ileus (p. 582).
Intestinal obstruction from adhesions (p. 576).
Actinomycosis in the right iliac fossa (p. 542).
Thrombophlebitis of the femoral or ileo-colic vein (pp. 100 and 401).
Pulmonary complications (broncho-pneumonia; empyema; massive collapse of the lung).

Remote

Intestinal obstruction by bands and adhesions (p. 576).
Incisional hernia (p. 703).
Possibly right inguinal hernia if a low grid-iron incision has been employed (p. 693).

★ ★ ★

It is advisable to include the following practical problem:

After an operation for acute appendicitis the condition of the patient is unsatisfactory. The temperature is swinging and the pulse is elevated—signs which foretell pocketing of pus. How would you investigate the case?

1. *Examine the scar or wound and the abdominal wall* for an abscess of the abdominal wall.
2. *Consider the possibility of a pelvic abscess* (p. 488).
3. *Palpate the left iliac fossa* for an abscess in this situation.
4. *Examine the loin* for retrocæcal swelling and tenderness.
5. *Examine the legs*—to exclude the possibility of phlebitis.
6. *Examine the conjunctivæ for an icteric tinge and the liver for enlargement, and enquire if the patient has had rigors*—pylephlebitis.
7. *Examine the lungs*—pneumonia or empyema.
8. *Examine the urine for organisms* (*pyelonephritis*).
9. Lastly, *concentrate diagnostic endeavour upon the possibility of a subdiaphragmatic abscess.*

SUBACUTE APPENDICITIS

Subacute appendicitis is but a mild form of acute appendicitis, and requires no detailed consideration.

RECURRENT APPENDICITIS

Appendicitis is notoriously recurrent. This is perhaps the commonest form of appendicitis—mild subacute attacks which are so often attributed to 'biliousness' or a 'chill on the liver.' The attacks vary in intensity, and the majority of cases ultimately culminate in severe acute appendicitis. If careful histories are taken from patients with acute appendicitis, over two-thirds remember having had milder but similar attacks of pain. This bespeaks the importance of recurrent appendicitis as a precursor of the more serious lesion.

CHRONIC APPENDICITIS

One should be careful to distinguish recurrent from chronic appendicitis. Many cases called 'chronic appendicitis' are typical examples of the

recurrent form of the disease. The very existence of chronic appendicitis has been questioned; certainly, compared with acute appendicitis, it is very uncommon, and is a sequel to acute inflammation. Chronic appendicitis *per se* is symptomless; its most typical symptoms are referred to the stomach and the duodenum, when it takes the form of hyperchlorhydria and pyloro-spasm, or to the colon, when it gives rise to colonic spasm.

Pathology.—Appendices removed from patients suffering from true appendicular dyspepsia usually show a characteristic macroscopical change. There is obliteration of the lumen commencing at the tip and spreading along the organ for a variable distance. The walls of the obliterated portion can be seen to be composed almost entirely of white fibrous tissue (fig. 792). In long-standing cases the greater part of the organ is attenuated from fibrous contracture. It is possible that in relevant cases the distal obliteration of the lumen of the appendix is due to an impoverished blood supply consequent upon sclerosis of the appendicular artery. In a few cases the fibrous changes are seen in the proximal end, but this is more characteristic of the recurrent type of the disease.

FIG. 792.—Chronic obliterative appendicitis.

Diagnosis is difficult. One should remember constantly that in chronic appendicitis there are often no signs in the right iliac fossa—only referred symptoms elsewhere (*vide supra*).

Radiology as an Aid to Diagnosis.—In the case of the vermiform appendix, radiology is not a great diagnostic aid. If the appendix cannot be visualised after an opaque meal, it suggests that its lumen is obstructed; certainly such an appendix should be removed. If it fills and empties, it is indicative that at least part of the organ is healthy—but as nobody can tell the length of a given appendix until the organ has been displayed, there must always be uncertainty in the radiological diagnosis of appendicitis.

Treatment.—After thorough investigation, which includes a barium meal and cholecystography, if a diagnosis of reflex pylorospasm or appendicular dyspepsia has been made, the abdomen should be opened through a para-median incision, so that other organs can be examined. Appendicectomy is carried out.

SPECIAL PATHOLOGICAL FORMS OF SUBACUTE AND CHRONIC APPENDICITIS

Mucocele of the appendix is wont to occur when the proximal end of the lumen slowly becomes completely occluded, usually by a fibrous stricture, and the pent-up secretion remains sterile. The appendix is greatly enlarged; sometimes it contains several ounces of mucus. The symptoms produced are those of mild subacute appendicitis unless infection supervenes, when the mucocele is converted into an empyema. Rupture of a mucocele of the appendix is a cause of pseudomyxoma peritonei (see p. 501).

Diverticula of the Appendix.—Diverticulosis occurs once in about 200 appendices removed by operation. It is clear that these diverticula are not merely extensions of diverticulosis of the colon; some are congenital (all coats); most are acquired (no muscularis layer). Diverticula of the appendix can occur in conjunction with a mucocele. The intramural pressure rises sufficiently to cause herniation of the mucous

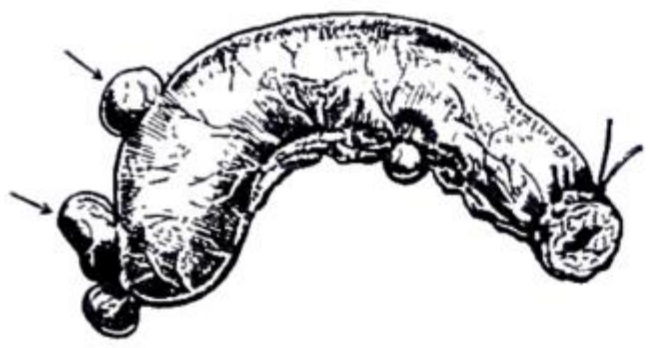

FIG. 793.—Appendicular diverticulosis.

membrane through the muscle coat at several points. More often diverticula (fig. 793) are not found in association with a mucocele, and often there is no demonstrable obstruction to the lumen. Usually the patient gives a history of previous recurrent attacks of appendicitis. It is probable that each diverticulum is the result of damage to the muscle coat by a previous intramural abscess which discharged into the lumen. If encountered during the course of an operation for another condition, a diverticula-bearing appendix should always be removed because, if perchance such an appendix becomes the seat of inflammation, perforation will occur very easily.

Intussusception of the appendix (fig. 794) is a very rare condition, occurring most often in childhood. It can be diagnosed only at operation. The symptoms usually are not acute, and are often present for weeks or months. Untreated, the condition may pass on to an appendiculo-colic intussusception. The appendix may slough, and this accounts for some of the very rare cases in which the appendix is absent.

The treatment is appendicectomy, but if the intussusception cannot be reduced in order to effect this, the cæcum must be opened.

FIG. 794.—Intussusception of the appendix. (*Dr. L. C. D. Hermitte, Sheffield.*)

NEOPLASMS OF THE APPENDIX

Endometriosis of the Appendix.—About 150 cases have been reported. The tumour—a miniature uterus in so far as endometrium is concerned—gives rise to monthly melæna. Occasionally the loss of blood per rectum is sufficient to endanger the patient's life.

Carcinoid tumour (*syn.* Argentaffin carcinoma), which arises in argentaffin tissue (Kulschitzky cells of the crypts of Lieberkühn), can occur anywhere in the gastro-intestinal tract, but most commonly it is situated in the vermiform appendix; indeed, the tumour is found once in about 300–400 appendices subjected to histological examination. Carcinoid tumours are distributed evenly among appendices removed from patients between the ages of sixteen to sixty years. Most of the patients are females (80 per cent.).

FIG. 795.—Carcinoid tumour of the distal third of appendix. The solid bulbous tip is characteristic. (*Dr. L. C. D. Hermitte, Sheffield.*)

In many instances the appendix is removed because of symptoms of subacute or recurrent appendicitis. The tumour can occur in any part of the appendix, but it frequently does so in the distal third of the organ (fig. 795). The neoplasm feels moderately hard, and on slitting up the appendix it can be seen between the intact mucosa and the peritoneum, replacing the muscular coats. There is no mistaking it, because it is of a bright yellow colour, due to contained lipoid. Microscopically it is a spheroidal-cell carcinoma containing granules that frequently stain with ammoniacal silver salts. Unlike carcinoid tumours arising in other parts of the intestinal tract, in only 4 per cent. of cases does the tumour give rise to metastases, and it is most exceptional for metastases from an argentaffin carcinoma of the vermiform appendix to secrete sufficient

Nicholas Kulschitzky, 1856–1925. Professor of Histology, Kharkov, Ukraine.

hormone to produce the characteristic symptomatology described on p. 544. Carcinoid tumour is ten times more common than other forms of carcinoma of the vermiform appendix.

Columnar-cell Carcinoma.—In 50 per cent. of cases the first manifestation of this rare lesion is perforation of the appendix with either diffuse peritonitis or local abscess formation. This growth is similar in every way to that of carcinoma of the colon, and metastases are not infrequent. Owing to the small lumen of the appendix, luminal obstruction occurs early, and is a means of calling attention to the lesion. When perforation does not occur, the tumour grows until there is a mass in the region of the caput cæci, in which case it is often impossible to state whether the neoplasm originated in the appendix or in the cæcum, even after a careful pathological examination. Carcinoma of the appendix causing intussusception of the cæcum has been reported.

Colloid Carcinoma.—The whole appendix is involved and greatly enlarged. At first sight it may appear like a mucocele, but it is firm and solid. The growth is of average grade malignancy.

Sarcoma is extremely uncommon.

Treatment of Neoplasms of the Appendix.—Appendicectomy suffices in carcinoid tumour. In colloid carcinoma removal of the appendix, together with 1 inch (2·5 cm.) of the related cæcal wall, has given satisfactory results. In other forms of neoplasm right hemicolectomy should be undertaken.

CHAPTER XXVIII

THE RECTUM AND ANAL CANAL

HAMILTON BAILEY

EXAMINATION OF THE RECTUM

DIGITAL examination of the rectum is invaluable, and in cases where rectal disease is suspected it must be performed as a routine. Examination with a proctoscope (fig. 796) is also of paramount importance, but only the anal canal and a small part of the lower rectum can be inspected with this instrument. A sigmoidoscope is necessary for thorough visualisation of the rectum.

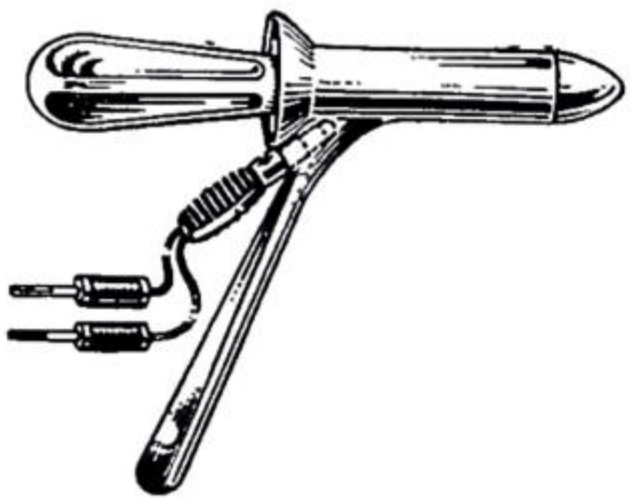

FIG. 796. — An illuminated proctoscope.

SURGICAL ANATOMY OF RECTUM AND ANAL CANAL

The anatomical anal canal extends from the anal valves to the anal verge [1].

The surgical anal canal commences at the level where the rectum passes through the pelvic diaphragm (fig. 797) and ends at the anal verge.

Anal Canal Musculature:

The internal sphincter is a thickened continuation of the circular muscle coat of the rectum. This involuntary muscle commences where the rectum passes through the pelvic diaphragm, and ends just within the anal orifice, where its lower border can be felt. The internal anal sphincter is 1 inch (2·5 cm.) long and 2 to 4 mm. thick. When exposed during life, it is pearly-white in colour, and its individual transversely placed fibres can be seen clearly. Spasm and contracture of this muscle play a major part in fissure and several other anal affections.

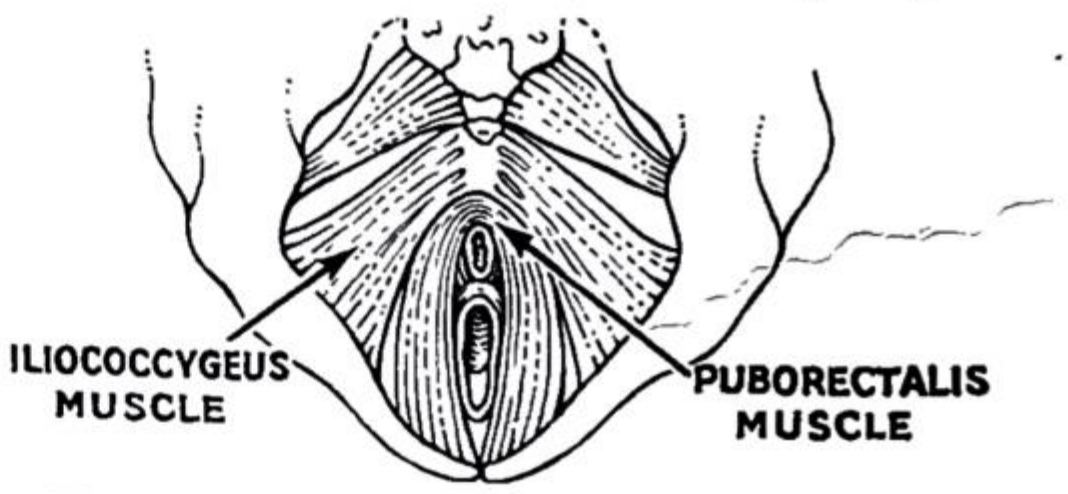

FIG. 797.—The pelvic diaphragm in a female, showing the principal components of the levator ani muscle. (*After P. L. Scheer.*)

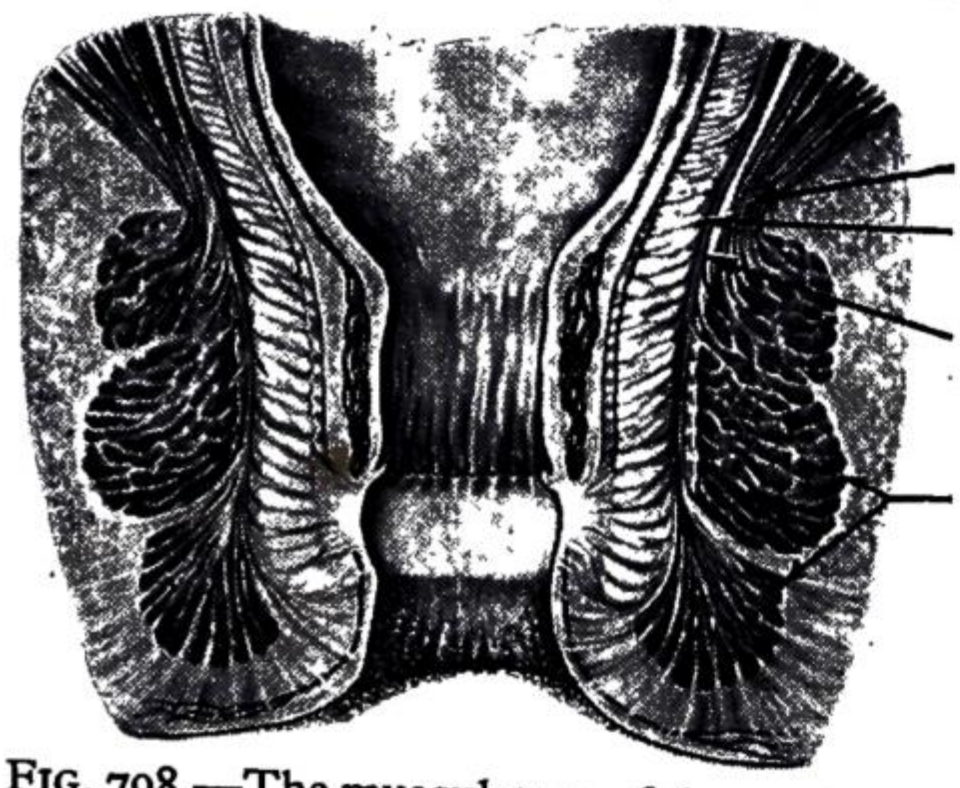

FIG. 798.—The musculature of the anal canal. (*After Naunton Morgan.*)

The conjoined longitudinal muscle is a continuance of the longitudinal muscle-coat of the rectum intermingled with fibres from the pubo-rectalis. Some of its fibres pass through the internal sphincter (fig. 798) to reach the submucous space, and are inserted into the fibrous tissue beneath the anoderm, but they mainly fan out through the lowest part of

[1] Anal verge = the external or distal boundary of the anal canal.

the external sphincter, to be inserted into the true anal and perianal skin, thus constituting the **corrugator cutis ani of Ellis.** Other fibres pass more laterally across the ischio-rectal fossa, while anteriorly fibres of this muscle are inserted into the triangular ligament, the urethra, and the apex of the prostate, thus constituting the **recto-urethralis muscle.**

The external sphincter, formerly subdivided into a deep, superficial, and subcutaneous portion is now considered to be one muscle (J. C. Goligher). Some of its fibres are attached posteriorly to the coccyx, while anteriorly they are inserted into the mid-perineal point in the male, whereas in the female they fuse with the sphincter vaginæ. In life the external sphincter is pink in colour, and homogenous.

The conjoined longitudinal muscles, by traversing the internal and external sphincters to reach their insertions, serve to brace these sphincters.

The Mucous Membrane.—The *pink* columnar epithelium lining the rectum extends through the ano-rectal ring into the surgical anal canal. The mucosa of the surgical anal canal is attached loosely to the underlying structures, and covers the internal hæmorrhoidal plexus. Passing downwards where it clothes the series of 8 to 12 longitudinal folds known as the columns of Morgagni, the mucous membrane becomes cubical and *red* in colour (fig. 799); above the anal valves the mucous membrane becomes *plum coloured*. Just below the level of the anal valves there is an abrupt, albeit wavy, transition to squamous epithelium, which is *parchment colour*. This wavy junction constitutes the dentate line. The squamous epithelium lining the anatomical anal canal is thin and shiny, and is known as the anoderm. The anoderm passes imperceptibly into the pigmented skin of the anus.

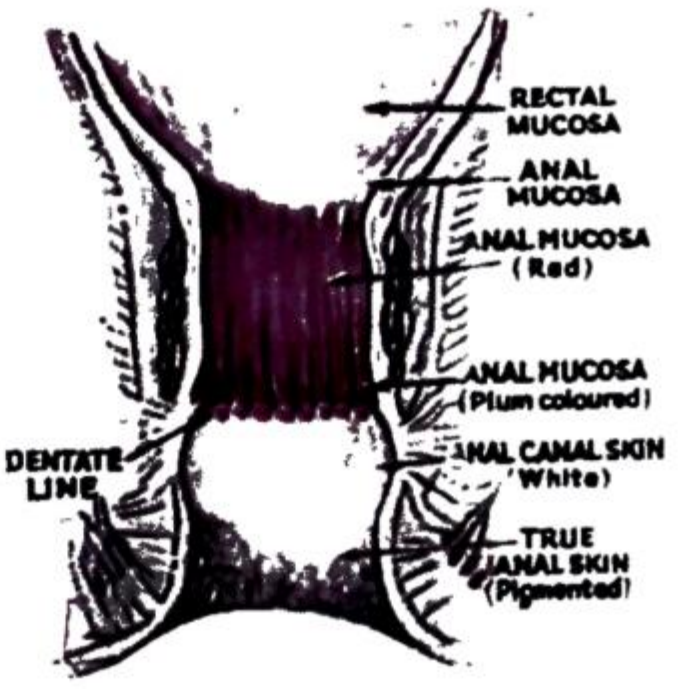

FIG. 799.—The lining membrane of the anal canal. (*Inspired by Naunton Morgan.*)

Below the dentate line the anoderm is attached very firmly indeed to deeper structures.

The dentate line is a most important landmark both morphologically and surgically. It represents (1) the site of fusion of the proctodæum and post-allantoic gut, and (2) the position of the anal membrane, remnants of which may frequently be seen as anal papillæ situated on the free margin of the anal valves. The dentate line separates :

Above	*Below*
Cubical epithelium	from squamous epithelium
Autonomic nerves	from cerebrospinal nerves
Non-sensitivity	from extreme sensitivity
Portal venous system	from systemic venous system

The anal valves of Ball are a series of transversely placed semilunar folds linking the columns of Morgagni. They are functionless remnants of the fusion of the post-allantoic gut with the proctodæum.

The crypts of Morgagni (*syn.* anal crypts) are small pockets between the inferior extremities of the columns of Morgagni. Into several of these crypts, mostly those situated posteriorly, opens one **anal gland** by a narrow duct. This duct bifurcates, and the branches pass outward to enter the internal sphincter muscle, where often there is situated an ampulla (fig. 800). Issuing from this ampulla there are three to six tubular sub-branches that extend into the intermuscular connective tissue, where they end blindly. As a rule it is the caudad[1] branch that is furnished with sub-branches, whereas the cephalad branch remains a solitary simple tubule and therefore, when infected, is more likely to discharge its purulent contents along the lumen of the duct than to form an abscess. In some lower animals these glands secrete an odoriferous substance during the rutting season ; in man their function, if

FIG. 800.—Anal gland with duct opening into a crypt of Morgagni.

[1] Caudad = toward a cauda or tail ; opposite to cephalad.

George Viner Ellis, 1812–1900. Professor of Anatomy, University College, London.
John Cedric Goligher, Contemporary. Professor of Surgery, University of Leeds.
Sir Charles Ball, 1851–1916. Professor of Surgery, University of Dublin.
Giovanni Battista Morgagni, 1682–1771. Professor of Medicine and Anatomy, Padua. He held the chair for fifty-six years.

any, is obscure. Some of their cells have been shown to give a positive staining reaction for mucin, but as the lining epithelium is mainly cubical, the mucus-secreting propensity of the anal glands must be extremely small. Infection of an anal gland can give rise to an abscess, and in the opinion of a number of surgeons, infection of an anal gland is the most common cause of ano-rectal abscesses and fistulæ.

FIG. 801. — Houston's valves as seen through a sigmoidoscope.

The Rectum.—The rectum extends from the third sacral vertebra to the ano-rectal ring. It describes three lateral curves, two concave to the left (hence the *left* lateral position for sigmoidoscopy) and one concave to the right. The relative shortness of the longitudinal muscle coat forms the **valves of Houston** that are so much in evidence in sigmoidoscopy (fig. 801).

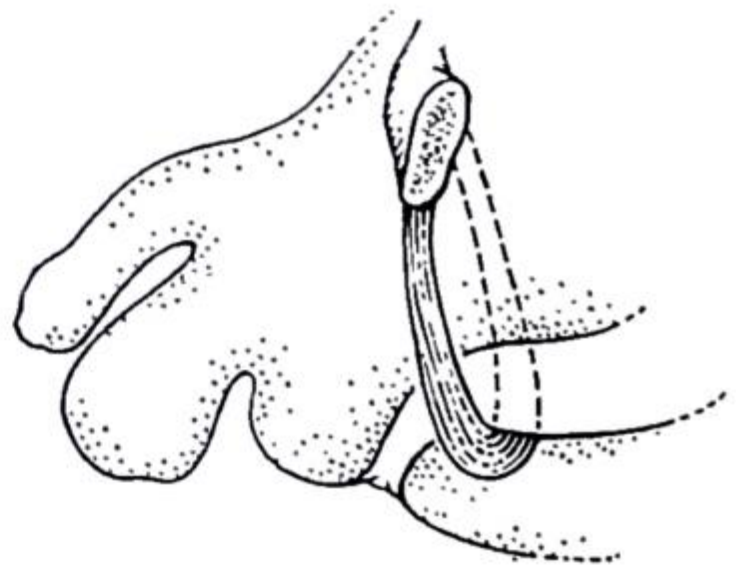

FIG. 802.—The disposition of the pubo-rectalis muscle.

The ano-rectal ring marks the junction between the rectum and the anal canal. It is formed by the fusion of the pubo-rectalis muscle (fig. 802), external sphincter, conjoined longitudinal muscle, and internal sphincter. The ano-rectal ring can be clearly felt digitally, especially on its posterior and lateral aspects. Division of the ano-rectal ring results in permanent incontinence of fæces.

THE BLOOD SUPPLY AND LYMPHATIC DRAINAGE OF THE RECTUM AND THE ANAL CANAL

The superior hæmorrhoidal artery is the direct continuation of the inferior mesenteric artery and constitutes the chief arterial supply to the rectum. Opposite the third sacral vertebra the artery divides into a right and a left branch (fig. 803), which descend on the postero-lateral wall. About half-way down the rectum each branch subdivides and pierces the rectal wall. The terminal branches run straight downwards, each in a column of Morgagni.

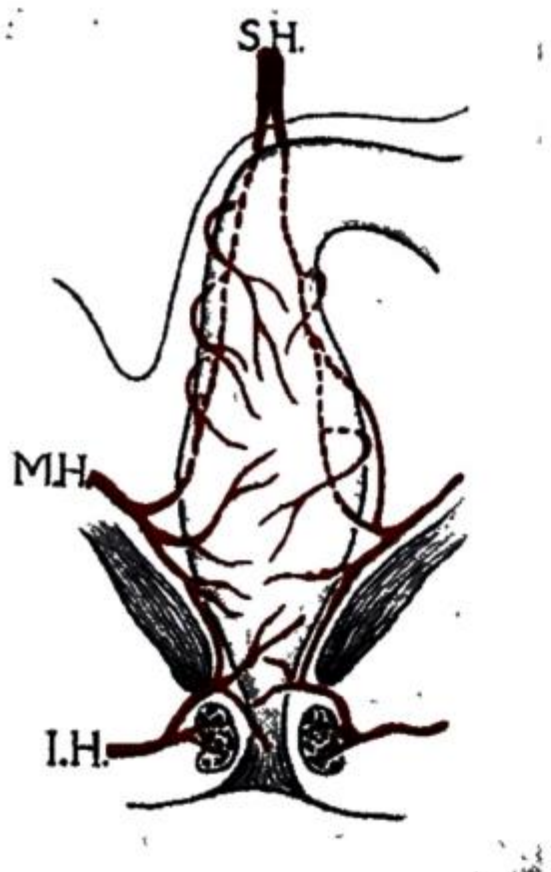

FIG. 803.—The arterial supply of the ano-rectum. S.H., superior hæmorrhoidal artery; M.H., middle hæmorrhoidal artery; I.H., inferior hæmorrhoidal artery.

The middle hæmorrhoidal artery arises on each side from the internal iliac artery and supplies the muscle coat of the mid rectum. These arteries anastomose freely with the superior and inferior hæmorrhoidal arteries.

The inferior hæmorrhoidal artery arises on each side as a branch of the internal pudendal artery, as this artery enters Alcock's canal. Crossing the upper part of the ischio-rectal fossa, it breaks up into branches which supply the anal sphincters, anal canal, and the skin of the anal margin.

The internal hæmorrhoidal venous plexus lies in the loose submucosa of the anal canal and extends from the level of the dentate line to that of the ano-rectal ring. The plexus drains into about six collecting veins which are situated in the submucosa of the rectum. About half-way up the rectum these branches pass through the rectal wall, and having reached the outside of the rectum, they unite to form the **superior hæmorrhoidal vein,** an important tributary of the portal vein. The **middle hæmorrhoidal veins** are small and drain into the internal iliac veins.

The external hæmorrhoidal venous plexus lies under the skin of the anal canal below the dentate line and beneath the skin of the anal margin. Communicating veins pass from the external hæmorrhoidal plexus to the internal hæmorrhoidal

John Houston, 1802–1854. Physician, City of Dublin Hospital. Benjamin Alcock published the details of his canal in 1836. He was dismissed from his post as Professor of Anatomy at Cork in 1855 (for breach of Anatomy Acts), and disappeared in America.

plexus beneath the anoderm. The lower part of the external hæmorrhoidal plexus drains into the internal pudendal veins and from thence into the internal iliac veins, thus providing a communication between the portal and systemic venous systems.

The Lymphatics of the Ano-rectum :

The collecting lymphatic vessels of the surgical anal canal are divided into two networks, one beneath the mucocutaneous lining and the other related to the muscular coats. Although these are distinct systems, it becomes apparent that there is plentiful intercommunication between them, particularly along the points of penetration of the muscular walls of the anal canal by blood-vessels. From these networks emerge three sets of **lymphatic trunks** referable to the lower, middle, and upper thirds of the anal canal.

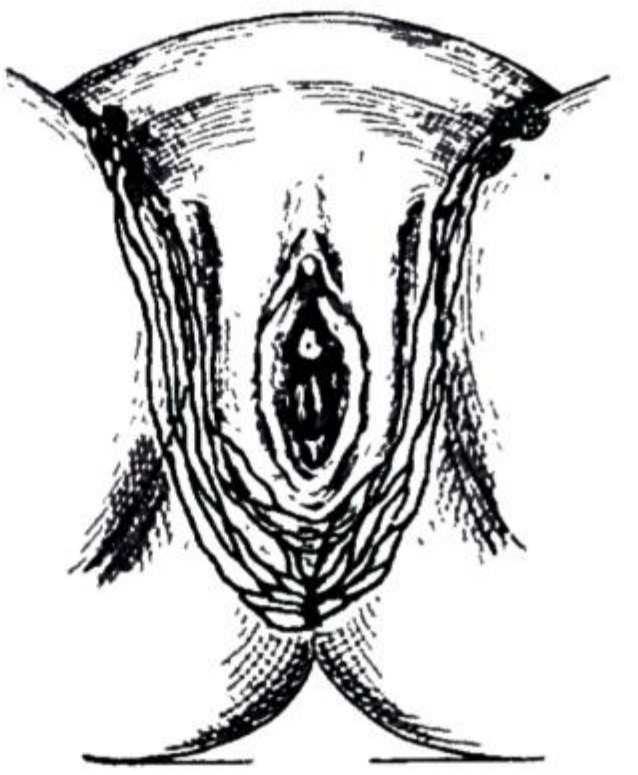

FIG. 804. — Lymphatic trunks from the anus and the lower part of the anal canal draining into the inguinal lymph nodes. (*After M. P. C. Sappey.*)

1. *Those of the inferior zone* give rise to three to five lymphatic trunks on each side which run to the groins, and terminate in the inguinal lymph nodes (fig. 804) and thence to the external iliac and obturator lymph nodes. Other efferent lymphatic trunks accompany the inferior hæmorrhoidal vessels through the ischio-rectal fossa, to terminate in the external iliac or hypogastric lymph nodes. The dentate line has often been described as a dividing line between visceral and somatic lymphatics : recent observations disprove this oft-repeated statement.

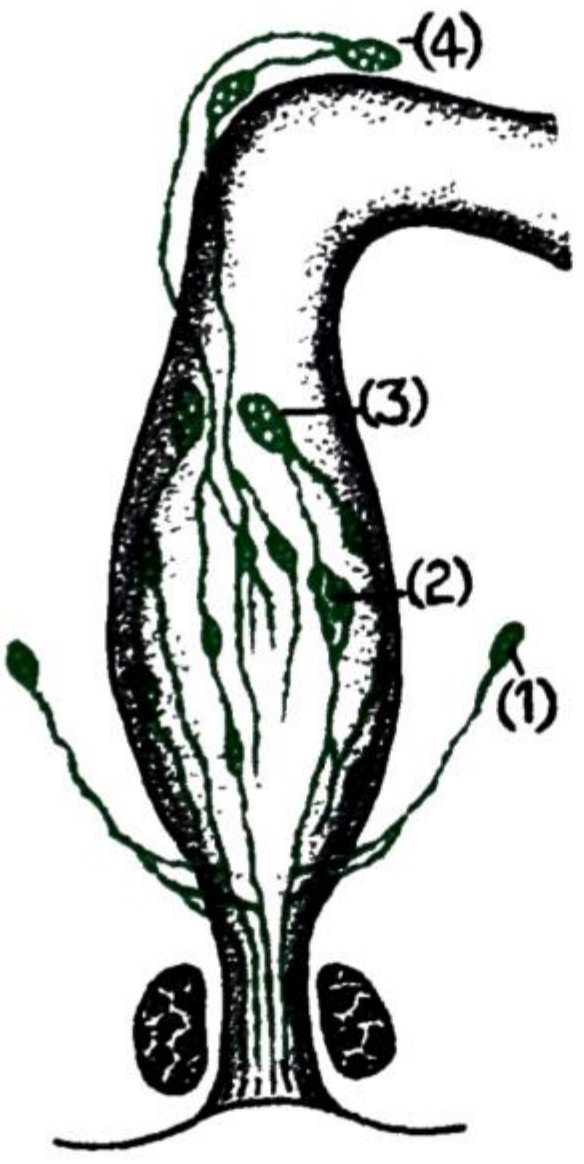

FIG. 805.—The collecting lymphatics of the ano-rectum from behind. The inferior collecting tributaries passing to the inguinal lymph nodes are not represented. (*After H. Rouvier.*)

2. *Those of the Middle Zone.*—Lymphatic trunks, with frequently the interposition of lymphatic nodes, accompany the middle hæmorrhoidal vessels and the lateral ligaments of the rectum. These lymphatic trunks pass to the lymphatic nodes lying along the internal iliac vessels (fig. 805).

3. *Those of the Upper Zone.*—The submucosal ramifications are particularly numerous in the columns of Morgagni, and are continuous with the lymphatics of the lower part of the rectum proper, with which their efferents are identical.

The Lymphatics of the Rectum Proper.—The lymphatic plexuses of the rectum proper are divided into an intra- and an extramural group. The intramural system is redivided into two fairly distinct territories at the level of the middle valve of Houston. The lower part of the plexus drains downwards to join the lymphatic trunks that follow the middle hæmorrhoidal vessels (fig. 805 (1)); the upper trunks follow the superior hæmorrhoidal vessels to the lymph nodes in the meso-rectum and meso-colon. The extramural plexus drains into a group of 4 to 7 lymph nodes situated above the levator ani, in the region of the ampulla, in close relation to the rectal wall. These are the para-rectal lymph nodes of Gerota (fig. 805 (2)). Larger lymph nodes are situated more superiorly at the level of the third piece of the sacrum (fig. 805 (3)), opposite which the superior hæmorrhoidal artery bifurcates. Proceeding upwards, the lymphatic trunks of both plexuses pass to nodes situated at the origin of the superior hæmorrhoidal artery (fig. 805 (4)) and the sigmoidal arteries. From thence the lymphatic trunks pass to the uppermost nodes grouped around the origin of the inferior mesenteric artery. The frequency of involvement of the last-named depôt in carcinoma of the rectum is uncertain.

There is seldom, if ever, metastasis along the lateral or inferior lymphatic pathways from a carcinoma situated *above* the ampulla of the rectum. Hence, in general it can be stated that the higher the growth the more confined are its metastases. This

Dumitru Gerota, 1867–1939. Professor of Surgery, Bucharest, Rumania.

is the foundation for the justification of restorative resection in cases of carcinoma high in the rectum.

EMBRYOLOGY

Early in embryonic life there is a common chamber—the cloaca—into which open the hind gut and the allantois. The cloaca becomes separated into the bladder and post-allantoic gut (rectum) by the down-growth of a septum (fig. 806). About this time an epiblastic bud, the proctodæum, grows in towards the rectum. Normally, fusion between these two structures occurs during the third month of intrauterine life.

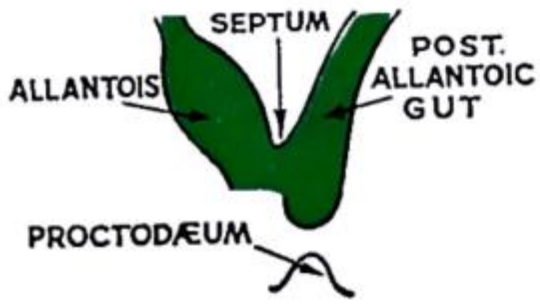

FIG. 806.

CONGENITAL ABNORMALITIES

Imperforate Anus.—One infant in 4,500 is born with an imperforate anus, or with imperfect fusion of the post-allantoic gut with the proctodæum. There are four varieties of this abnormality (fig. 807).

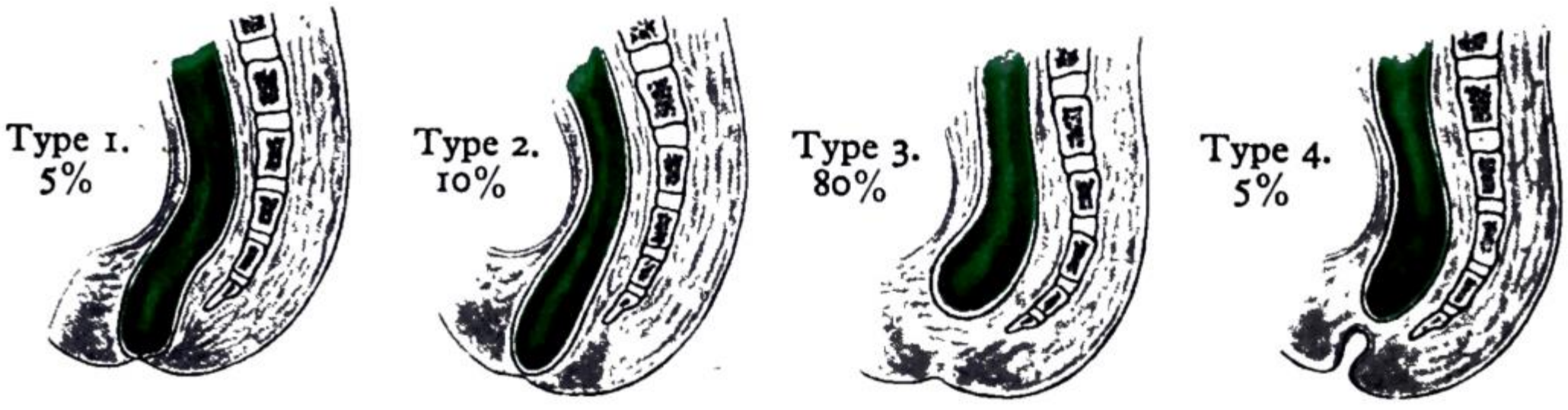

FIG. 807.—Imperforate anus.

Type 1.—There is a stricture of the anus, due to incomplete rupture of the anal membrane.

Type 2.—The anus is separated from the rectum by an intact, thin, bulging membrane.

Type 3.—The rectum ends blindly at a variable distance from the perineum.

Type 4.—The top of the anal canal is separated from the rectum by a septum or, more usually, a gap.

Regardless of the type of ano-rectal malformation, the external sphincter is nearly always present.

In about half the cases belonging to Type 3 the rectum opens by a fistulous communication (fig. 808) into the bladder or the urethra in the male,

FIG. 808.—Associated fistulæ: (*a*) Recto-vesical. (*b*) Recto-urethral. (*c*) Recto-vaginal (usually in the lower third of the vagina or near the fourchette). (*d*) Perineal, known in the female as the ' shot-gun ' perineum.

the vagina in the female, or on to the perineum in either sex. In the male the communicating fistula is most often at the verumontanum.

Clinical Features:

Type 1 is characterised by the passage of ribbon-like stools. On occasions the anal orifice is so minute that only a speck of meconium marks its presence. Abdominal distension is often in evidence.

Types 2 *and* 3.—Within a few hours of birth it is usually apparent that there is no anal opening, for the meconium is discharged from an abnormal exit. Sometimes these obvious facts are overlooked for two or three days, by which time the infant is in the throes of intestinal obstruction. If a recto-vaginal fistula is present, meconium issues from the vulva. A recto-vesical fistula manifests itself by the passage of meconium per urethram with the urine, or as a constant dribble. The anal region, which is marked by a dimple, should be inspected and palpated. If the dimple bulges when the child cries, and particularly if the anal membrane is dark (meconium abutting against it), it is certain that the case is one of a simple septum.

Type 4.—The normal appearance of the anus frequently accounts for a considerable delay in arriving at the correct diagnosis.

X-ray Examination.—Six hours after birth sufficient air has collected in the large intestine to cast an X-ray shadow. With a metal button or a coin strapped to the site of the absent anus, or a metal bougie inserted into the blind anal canal, the infant is radiographed in the inverted position. The gas in the rectum will rise to the top and indicate the distance between the site of the metal indicator and the blind end of the rectum (fig. 809). This method, though useful, is sometimes vitiated by a plug of meconium in the rectum causing an apparent gap far in excess of that actually present.

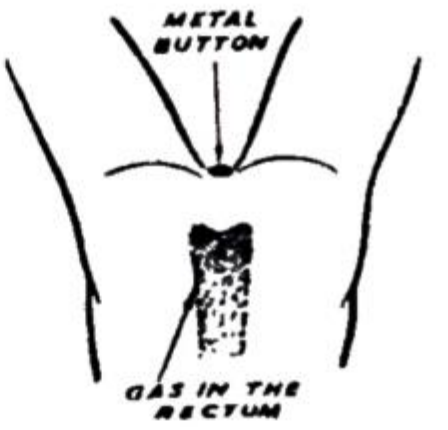

FIG. 809.—From an X-ray film. (*After O. H. Wangansteen.*)

Treatment:

Type 1.—Gentle daily dilatations should continue until full calibre has been attained. Dilatation at increasing intervals should continue for years.

Type 2.—A cruciform incision is effective. To excise the membrane and unite the edges of the mucous membrane to the skin gives a more perfect result.

Type 3.—Urgent relief of intestinal obstruction is imperative.

Immediate Operation.—A left lower paramedian incision permits exposure of the blind distal end of the hind gut. In 50 per cent. of males there is a communication with the prostatic urethra (fig. 808(*b*)) or the bladder (fig. 808(*a*))—usually the former. This fistula should be doubly ligated, and divided, so that the renal tract suffers no more infection from the bowel. Right transverse colostomy is then performed through a small transrectus incision. In cases where a communication with the urinary tract can be excluded, laparotomy is unnecessary; a blind transverse colostomy through a transrectus incision will relieve the obstruction.

In the relatively few cases where it can be proved radiologically that the blind end of the rectum lies 2 cm. or less from the perineum, a perineal operation can be undertaken. With a urethral catheter in place as a guide, an incision is made from the centre of the anal dimple to the tip of the coccyx. The objective is to mobilise the rectal pouch sufficiently to bring it down to the perineum without tension. The pouch is then opened and the mucous membrane sewn to the skin edges. The divided sphincter is approximated and the posterior part of the incision is closed with drainage.

Subsequent Elective Operation[1].—When a temporary colostomy has been performed, an operation to construct an anal canal in the normal anatomical situation can be carried out subsequently, say at the age of eighteen months. The abdomen is opened by a left lower paramedian incision. Once the rectum has been mobilised thoroughly, the perineal stage of the operation is similar to that described above. Throughout this extensive operation the patient is supported by an intravenous drip of blood and dextrose-saline solution.

Type 4 is managed in the same way as type 3. At the second operation the rectum must be mobilised by the abdominal route and the strictured portion excised. End-to-end anastomosis between the rectum and the anal canal is carried out. More conservative measures are followed by an intractable stricture.

Recto-vaginal Fistula.—Provided the orifice is adequate, or can be dilated, it is expedient to postpone operation until the child is about three years of age. In other circumstances early transverse colostomy is necessary. At the elective operation the termination of the rectum is detached from the vagina and implanted into the anal region, after dissection of the latter to receive it.

In a high percentage of cases, imperforate anus is associated with other congenital abnormalities, especially of the urinary organs, and nearly half the deaths in cases of imperforate anus are due to other malformations.

Sacro-coccygeal teratoma, although rare, is among the most common of the large tumours seen during the first three months of life. The frequency of the precoccygeal region for the development of a teratoma is explained by the fact that this area is the site of the ' primitive knot,' a group of totipotent cells that retain their totipotentiality longer than any others save the sex anlage. Females are overwhelmingly more often affected than males.

FIG. 810.—Congenital sacro-coccygeal teratoma. The tumour was excised successfully.

The tumour, which arises between the sacrum and the rectum, is firmly attached to the coccyx, and occasionally to the last piece of the sacrum. At the time of birth some of these tumours are huge, and in 20 per cent. of all cases the infant is still-born. In most instances the tumour is large (fig. 810), but in a few it is small enough to pass unnoticed until either by its growth a swelling appears, or a complication ensues. It is this variety that is prone to become malignant, usually at about ten months of age.

Treatment.—The neoplasm should be removed soon after birth; delay is liable to result in fatal ulceration, infection, rectal or urinary obstruction, or a malignant change.

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[1] When the infant is in excellent condition, some surgeons perform an abdomino-perineal rectification of the abnormality as a one-stage procedure.

Operation.—Excision is undertaken through a longitudinal elliptical incision, the coccygeal attachment being left until the last. The coccyx must always be excised; occasionally the last piece of the sacrum must be removed also. Should there be a fistula between the tumour and the rectum, as a rule this is small, and can be closed safely without performing colostomy. The dead space in the pelvis is drained, the skin is united, and a pressure dressing applied.

When the operation is undertaken soon after birth, the prognosis is good.

Post-anal Dermoid.—The space in front of the lower part of the sacrum and coccyx is occupied by a soft, cystic swelling—a post-anal dermoid cyst—which is regarded as a simple form of teratoma. Hidden in the hollow of the sacrum, it is unlikely to be discovered unless a sinus communicating with the exterior is present, or develops as a result of inflammation. Such a cyst usually remains symptomless until adult life, when it is prone to become infected. Exceptionally, by its very size, it gives rise to difficulty in defæcation. The cyst is discovered by rectal examination.

FIG. 811.—Post-anal dermoid cyst with sinus. Injected with lipiodol. Sinus and cyst excised.

Differential Diagnosis.—Especially in a child, an anterior sacral meningocele must be excluded. The latter enlarges when the child cries, and is frequently associated with paralysis of the lower limbs, and incontinence. When a discharging sinus is present, a post-anal dermoid will probably be mistaken for a pilonidal sinus, unless pressure over the sacro-coccygeal region with a finger in the rectum causes a flow of sebaceous material, and/or injection of lipiodol and radiography reveals a bottle-necked cyst in front of the coccyx (fig. 811).

Treatment is complete excision of the cyst, and sinus if present. In the case of large cysts it is necessary to remove the coccyx in order to gain access.

Post-anal Dimple (*syn.* Fovea Coccygea).—A dimple, sometimes amounting to a short, blind pit, in the skin beneath the tip of the coccyx is noticed from time to time in the course of a clinical examination: A. A. Klass observed it in 9 per cent. of a large number of recruits. A dimple in this situation has the same significance as a dimple at other sites; it represents nothing more than a local fixation of skin by collagen fibres to underlying structures. Such a dimple is a possible starting-point of a pilonidal sinus.

PILONIDAL SINUS

Although a pilonidal sinus has no connection with the rectum or the anal canal, its proximity to the latter renders this common clinical entity an appropriate subject for discussion at the present juncture.

Ætiology.—The army of supporters of the congenital theory of the origin of pilonidal sinus has become reduced to a corporal's guard.

That, in rare instances, a sinus in the ano-coccygeal area *is* congenital must be allowed, but in these rare instances of proven congenital origin the sinus is not necessarily pilonidal (appertaining to a nest of hairs). It could be (*a*) a sinus connected with a post-anal dermoid, referred to above, or (*b*) a sinus resulting from a persistent caudal remnant of the original neural canal. The latter occurs in the sacral rather than the coccygeal region, and is definitely connected with the spinal theca. On this account, meningitis is frequently a terminal event in early life.

The reasons for the remarkable switch from the congenital to the acquired theory of origin of pilonidal sinus can be summarised thus:

1. Interdigital pilonidal sinus is an occupational disease of men's hairdressers, the hair within the interdigital cleft or clefts being the customers'.

Alan Arnold Klass, Contemporary. Associate Surgeon, Winnipeg General Hospital, Canada.

Instances of pilonidal sinus of the axilla and of the umbilicus have been reported.

2. The age incidence of the appearance of pilonidal sinus (82 per cent. occur between the ages of twenty and twenty-nine years) is at variance with the age of onset of congenital lesions in general (fig. 812).

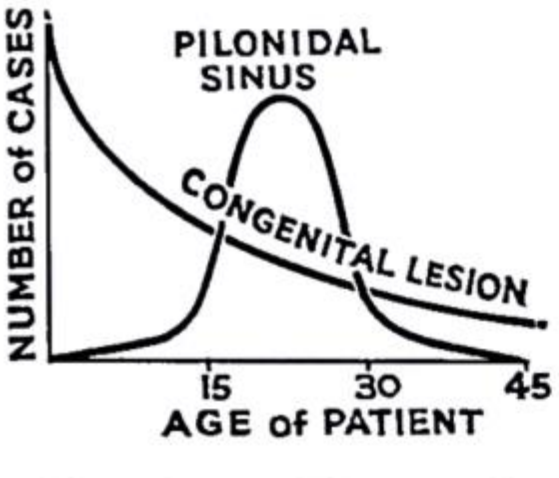


FIG. 812.—The age incidence of pilonidal sinus contrasted with the general incidence of congenital lesions. (*After A. A. Klass.*)

3. Hair follicles have never been demonstrated in the walls of the sinus.

4. The hairs projecting from the sinus are dead hairs, with their pointed ends directed towards the blind end of the sinus.

The mode of origin of a pilonidal sinus is now believed to be as follows:

On sitting, the buttocks take the weight of the body, and move independently, or together. Hairs broken off by friction against clothing, and shed short hairs, whether they originate from the nape of the neck, back, or buttocks, tend to collect in the cleft of the nates and/or a post-anal dimple. Furthermore, it is suggested that the use of toilet paper may contribute to hair entangled in fæcal matter being swept into the cleft; pilonidal sinus is extremely rare in those races that employ ablution after defæcation. By reason of the shearing action of the buttocks, which is increased by sitting on a hard seat, and especially by vibration of a vehicle, loose hair travels down the intergluteal furrow, to penetrate the skin or the open mouth of a sudoriferous gland, such glands being more active in early manhood. It is not yet clear whether the initial entry of hairs through the skin is a primary event, or follows the softening of the skin due to pustular or other forms of dermatitis. Once a sinus has formed, intermittent negative pressure of the area may suck other loose hairs into the pit. So common was pilonidal sinus among jeep[1] riders in the 1939–45 war that it became known as 'jeep disease.'

* * *

Probably the wave of enthusiasm for the acquired theory has been carried too far. That some cases of pilonidal sinus are congenital seems indisputable, e.g. those occurring in young children. Again, occasionally a long, coiled lock of hair is removed which could not possibly have entered from without.

Pathology.—The sinus extends into the subcutaneous planes as a bulbous diverticulum. Branching side channels are not infrequent. A stratified squamous epithelial lining, of varying degrees of integrity, is found in about half the cases. Hair shafts are found either (*a*) lying loose in the sinus, (*b*) embedded in granulation tissue, or (*c*) deep in mature scar tissue in three-quarters of the cases. Foreign body giant cells in association with dead hairs are common.

Clinical Features.—There is a chronic or recurring sinus in the middle line about the level of the first piece of the coccyx (fig. 813). Typically a

[1] Jeep—U.S. Army reconnaissance motor vehicle.

tuft of hairs projects from its mouth. The discharge from the sinus or sinuses is often blood-stained, contains foul sebum, and sometimes hairs. The condition can be confused with fistula-in-ano.

As has been indicated already, symptoms usually commence between eighteen and twenty-five years of age : patients presenting later in life always give a history dating back to this period.

FIG. 813.—Pilonidal sinus. *(Mr. R. S. Lawrie, London.)*

Males with this condition outnumber females by four to one, the females being on an average three years younger than the males ; this corresponds to the earlier maturation of the female. The condition rarely occurs in blondes ; many of the patients are exceptionally hairy and are usually obese. In spite of the preponderance in dark-haired persons, whose hair is stiffer than the silky blonde (J. B. Oldham), the condition is practically confined to white races. The complaint is of a discharge, pain, or a tender swelling at the bottom of the spine. Even at the height of an attack of inflammation the constitutional symptoms are slight. Often there is a history of repeated abscesses in the region that have discharged spontaneously or have been incised. The primary sinus may have one, or as many as six, openings, all of which are strictly in the middle line between the level of the sacro-coccygeal joint and the tip of the coccyx. Unlike a fistula-in-ano, the sinus passes upwards and forwards towards the sacrum. It does not reach bone, but ends blindly near the bone. When an abscess forms (fig. 814), it may discharge through a primary sinus ; more frequently it points and bursts, or is incised to one side of the middle line, thus forming a secondary sinus.

FIG. 814.—Infected pilonidal sinus with secondary abscess to the left of the middle line. *(W. B. Gabriel.)* *(Rectal Surgery.)*

Conservative Treatment.—Patients reporting for the first time with mild symptoms can sometimes be cured by conservative measures, which consist of frequent washing of the parts with a detergent and water, and applying equal parts of witch hazel and alcohol. In hot weather the area should be kept shaved. Long sitting, e.g. driving a car, is avoided if possible. These measures, tried on a large scale in the U.S. Army, proved tolerably successful—more successful than similar attempts in civil life, because the sufferer could be relegated to duties that were unlikely to aggravate the condition.

Treatment of an Acute Exacerbation.—If rest, sitz baths, local dressings, and the administration of a broad spectrum antibiotic fails to bring about resolution, the abscess should be opened through a comparatively small incision. Provided all hairs and granulation tissue are removed from the abscess cavity, there is an excellent prospect of curing the lesion. In all other circumstances an elective operation must be planned.

Operation should be performed only when the inflammation has been controlled by the measures indicated already.

James Bagot Oldham, Contemporary. Surgeon, Royal United Hospitals, Liverpool.

Pre-operative Treatment.—In hairy individuals pre-operative depilation of the skin of the area by X-rays is highly desirable. Pre- and post-operative antibiotic treatment must be given.

Block dissection with suture was based upon the theory that pilonidal sinus is a congenital condition. The multiplicity of techniques that have been advocated suggest that no single one is dependable, and all suffer from the disadvantage that if breakdown of the wound occurs, secondary healing is likely to take longer than if no attempt had been made to suture the wound. Although individual surgeons have recorded lower figures, the general recurrence rate is about 12 per cent.

Eventration (Marks's Operation).—The patient is placed on the operating table, for preference in the 'jack-knife' position.——→

After inserting a director, the cavity is laid open along its length. If diverticula are present, they also are unroofed. All hair and débris must be removed. In this way all sinuses are exteriorised. Bleeding-points are not tied, but only clamped. At the end of the operation the hæmostats are removed, and a piece of ribbon gauze moistened with 1 : 1000 adrenaline is used to pack the wound. A pressure dressing is applied. After six hours the pressure dressing is removed, and gauze moistened with saline solution is placed over the ribbon gauze. The following day the whole dressing is removed, and moist dressings are continued as an out-patient. Twice weekly the wound is inspected for bridging, or for the presence of any sinus that has been overlooked. In eight to ten days the wound has filled with healthy granulations, by which time a tulle gras covering is all that is necessary. The average time for complete epithelialisation is twenty-three days, but possibly this can be speeded by skin grafting. Employing eventration, the recurrence rate is less than 2 per cent.

Recurrent Pilonidal Sinus.—One of three possibilities accounts for this disappointment. (1) A diverticulum of the main channel has been overlooked at the primary operation. (2) New hairs enter the skin or the scar. (3) When the natal fold is deformed by scarring following block dissection, the least trauma causes tearing of the scar, and the resulting crevice becomes contaminated with coliform and cutaneous bacteria. This accounts for many so-called recurrences (M. M. Marks). If the acquired theory is to be accepted, an obvious requirement in remote post-operative treatment is that further drilling of the skin by hairs should be stopped by a depilatory dose of X-rays, or by the use of a depilatory cream.

INJURIES

The rectum and anal canal may be injured in a number of ways, all of which are uncommon.

1. By falling in a sitting posture on to a spiked or blunt-pointed object. The up-turned leg of a chair, handle of a broom, floor-mop, hoe, pitchfork, or a broken shooting-stick (fig. 815) are among the objects that have resulted in rectal impalement.

FIG. 815.—Rectal impalement by a broken shooting-stick. The late Ivor Back encountered three examples.

2. By the fœtal head during childbirth.
3. During the faulty administration of an enema by a syringe fitted with a bone, glass, or vulcanite nozzle.

Mark M. Marks, Contemporary. Chief Proctologist, Menorah Hospital, Kansas City, Missouri, U.S.A.
Ivor Back, 1879–1951. Surgeon, St. George's Hospital, London.

4. During sigmoidoscopy, usually when examining a patient suffering from ulcerative procto-colitis or amœbic dysentery.

5. 'Split Perineum.' A lacerated wound of the perineum, involving the anal canal, is an occasional pillion-riding accident.

6. Injuries due to warfare.

7. Compressed-air rupture (page 519).

Diagnosis.—When there is a history of rectal impalement, the first interrogation should be, " Has the patient passed urine since the accident? " The anus having been inspected, the abdomen should be palpated. If rigidity or tenderness is present, early laparotomy is imperative. Prior to the operation a urethral catheter is passed. If the urine is blood-stained and/or the quantity recovered is small, it is most desirable to undertake retrograde cystography (see p. 809).

Treatment.—After the patient has been anæsthetised, the rectum is examined carefully with a finger and a speculum, especial attention being directed to the anterior wall. Left lower laparotomy is then performed. If an intraperitoneal rupture of the rectum is found, the perforation is closed with sutures. Should blood be present beneath the pelvic peritoneum it is necessary to mobilise the recto-sigmoid, which allows a good deal of the rectum to be drawn upwards, thus permitting the perforation below the pelvic diaphragm to be closed securely. A perforation in the bladder also can be sutured *via* this avenue. After closing the laparotomy wound, left iliac colostomy is performed through a separate grid-iron incision. In cases where the bladder has been injured, suprapubic cystostomy (or, perhaps better, perineal cystostomy) is performed in addition.

These vital steps having been accomplished, if there is a lacerated wound of the perianal tissues or the anal canal, débridement of the wound must be carried out, and a wide soft rubber tube inserted into the anal canal, and anchored there.

The importance of antibiotic therapy need not be stressed. Supportive intravenous fluid therapy is highly important.

FOREIGN BODIES IN THE RECTUM

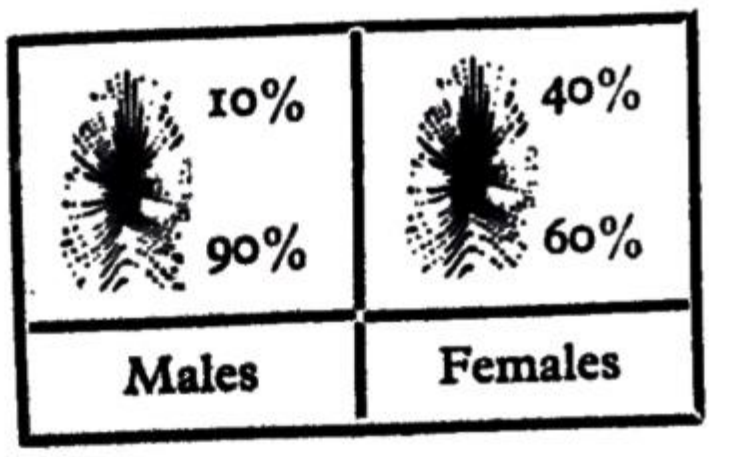
The variety of foreign bodies which have found their way into the rectum is hardly less remarkable than the ingenuity displayed in their removal. A turnip has been delivered per anum by the use of obstetric forceps. A stick firmly impacted has been withdrawn by inserting a gimlet into its lower end. A tumbler, mouth looking downwards, has several times been extracted by filling the interior with a wet plaster of Paris bandage, leaving the end of the bandage protruding, and allowing the plaster to set. With the patient under full anæsthesia, a large two-cell electric torch has been manœuvred past the sacral promontory into waiting fingers below that structure.

If insurmountable difficulty is experienced in grasping any foreign body in the rectum, recourse should be made early to a left lower laparotomy, which allows that object to be pushed from above into the waiting assistant's fingers in the rectum. If there is considerable laceration of the mucosa a temporary colostomy is advisable.

ANAL FISSURE (*syn.* FISSURA-IN-ANO)

Definition.—An elongated ulcer in the long axis of the anal canal.

Location.—The site of election for an anal fissure is the mid-line posteriorly. The next most frequent situation is the mid-line anteriorly. The relative distribution of fissure in these two sites is ——→



Only occasionally is a fissure present in the lateral wall of the anus.

Ætiology.—The cause of anal fissure, and particularly the reason why the mid-line posteriorly is so frequently affected, is not completely understood. A probable explanation is as follows: the posterior wall of the rectum curves forwards from the hollow of the sacrum to join the anal canal, which then turns sharply backwards. During defæcation the impact of a hard fæcal mass is mainly on the posterior ano-

rectal angle (fig. 816) in which event the overlying epithelium is greatly stretched, and, being relatively unsupported by muscle, is placed in a vulnerable position when a scyballous mass is being expelled. Possibly some cases are due to tearing down of an anal valve of Ball. As shown by the above percentages, an anterior anal fissure is much more common in women; particularly in those who have borne children. This can be explained by the lack of support of the anal mucous membrane by a damaged pelvic floor.

One cause of anal fissure is certain—an incorrectly performed operation for hæmorrhoids in which too much skin is removed. This results in anal stenosis and tearing of the stricture when a hard motion is passed.

FIG. 816.—Probable mechanism of tearing of the anal mucosa in the case of a posterior fissure.

Pathology.—An anal fissure can be acute or chronic. Furthermore, the lesion can be situated either at a low or a high level. A high-level lesion is placed entirely within the anal canal, and extends through the dentate line. The great majority of anal fissures are of the low-level variety.

Acute anal fissure is a deep tear through the skin of the anal margin extending into the anal canal. There is little inflammatory induration or œdema of its edges.

Chronic anal fissure is characterised by inflamed indurated margins, and a base consisting of either scar tissue or the lower border of the internal sphincter muscle. The ulcer is canoe-shaped, and at the inferior extremity frequently there is a tag of skin, which more often than not is œdematous. This tag is known picturesquely as a sentinel pile—'sentinel' because it guards the fissure. Similarly, but less constantly, at the superior extremity there is an enlarged, œdematous and fibrotic anal papilla.

To this triad must be added two more lesions—one constantly, and one inconstantly, present. The first is chronic spasm of the involuntary musculature of the internal sphincter. In long-standing cases this muscle becomes organically contracted by infiltration of fibrous tissue. The second (inconstant) additional lesion is brought about in this way. The sentinel pile becomes undermined, and gives rise to a subcutaneous abscess. The abscess bursts, or is opened by a small incision, and there results a cutaneous fistula. Fig. 817 shows the full quintuplet, (1) the canoe-shaped ulcer, together with (2) the sentinel pile; (3) the hypertrophied anal papilla; (4) a cutaneous fistula; and (5) the internal sphincter which is either in spasm, or contracted by fibrous infiltration in the floor of the ulcer (unnumbered).

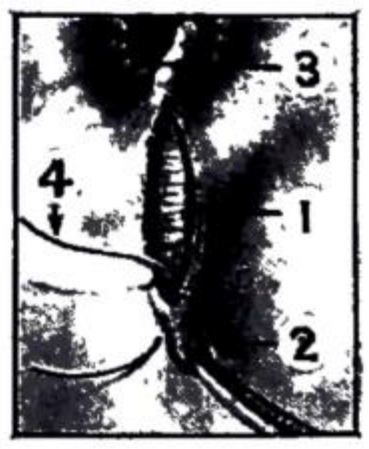


FIG. 817.—Chronic anal fissure replete with all the related lesions described in the text.

Anal fissure frequently is associated with internal hæmorrhoids.

Clinical Features.—The condition is more common in women, and generally occurs during the meridian of life. It is uncommon in the aged, because of muscular atony; on the other hand anal fissure is not rare in children, and is sometimes encountered during infancy.

Pain is *the* symptom—sharp agonising pain during defæcation, often overwhelming in intensity and lasting an hour or more. The deeper the fissure

the longer does the excruciating pain continue. As a rule it ceases suddenly, and the sufferer is comfortable until the next action of the bowel. Periods of remission for days or weeks occur. Exacerbations are due to renewed suppuration in the fissure. Reflex pain down the thighs simulating sciatica sometimes occurs. In extreme cases reflex frequency of micturition is not unusual.

Stools are frequently streaked with blood. In well-established cases of fissure they are narrow because the anus is narrowed, and are short, with a 'nipped-off' appearance, caused by sudden muscular spasms.

Discharge.—A slight discharge of serum accompanies fully established cases. A purulent discharge follows if a subcutaneous abscess bursts into the anal canal or externally.

Pruritus often accompanies anal fissure.

On Examination.—Frequently, in cases of some standing, a sentinel skin tag can be seen. This, together with a typical history and a tightly closed, puckered anus (fig. 818), is almost pathognomonic of the condition. By gently parting the margins of the anus, the lower end of the fissure can sometimes be displayed.

Because of the intense pain it causes, digital examination of the anal canal should not be attempted at this stage unless (*a*) the fissure cannot be seen (high-level fissure) or (*b*) it seems imperative to exclude some intrarectal condition. In these circumstances the local application of a surface anæsthetic such as 5 per cent. xylocaine on a pledget of cotton-wool, left in place for about five minutes, will enable the necessary examination to be made. In early cases the edges of the fissure are impalpable; in fully established cases a characteristic crater which feels like a buttonhole can be palpated. On account of the intolerable pain it produces, proctoscopy should not be attempted.

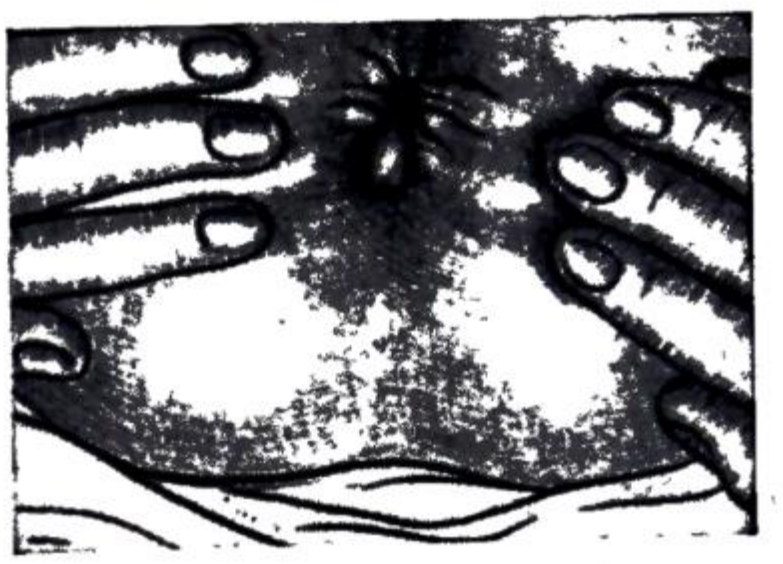


FIG. 818.—Sentinel pile associated with fissure. Puckering of the anus characteristic of fissure is also shown.

Differential Diagnosis:

Multiple fissures, especially in an infant, raise a suspicion of (congenital) syphilis, but they also are a complication of congenital stricture of the rectum.

An anal chancre, which occurs in about 1 : 500 cases of primary chancre, is often situated at the posterior margin of the anus (fig. 819). Sometimes the lesion is dual and symmetrical. Pain is not so much in evidence, and there is more discharge and more induration than in a case of acute anal fissure. As a history of infection is usually lacking, it is advisable to take a scraping from the base of any indurated anal fissure of recent origin and examine the exudate by dark-ground illumination for spirochætes.

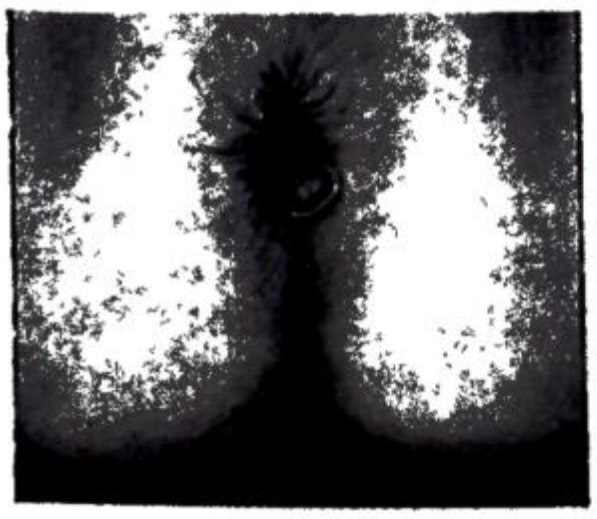


FIG. 819.—Anal chancre.

Secondary Syphilis.—A lesion resembling an anal fissure sometimes is seen in secondary syphilis. It occurs in any quadrant of the anus. It is neither exquisitely tender, nor is it indurated. The lymph nodes of the groin are frequently somewhat enlarged and shotty.

Carcinoma of the anus in its very early stages sometimes simulates a fissure. If real doubt exists, unquestionably the lesion should be excised under general anæsthesia and submitted to histological examination.

Proctalgia fugax gives rise to attacks of severe ano-rectal pain at irregular intervals and not necessarily commencing during defæcation. The pain is due to spasm of the levator ani and sphincter muscles, and its cause is obscure. The administration of sedatives to relieve the pain is all that can be done.

Rectal crises of tabes dorsalis are extremely uncommon. They are usually accompanied by diarrhœa and sometimes by rectal hæmorrhage. In every case of unexplained pain in the anal region the nervous system should be examined.

Treatment.—The pain of an anal fissure is so great that usually the patient demands relief; consequently many patients with an acute fissure present early. In cases of *acute anal fissure* conservative measures are frequently successful, particularly so in juvenile patients.

Conservative Treatment :

1. Treatment of constipation, which is best combated with a hydrating agent (dioctyl sodium sulphasuccinate) which promotes retention of water in fæces. This drug is a great advance on the administration of liquid paraffin, one disadvantage of which is seepage through the anus.

2. Xylocaine, 5 per cent., or nupercaine 10 per cent., in a non-greasy base is inserted when the pain is severe, and especially before defæcation is expected.

3. Immediately prior to defæcation a water-soluble lubricant such as lubafax (Burroughs Wellcome) is introduced into the anal canal.

When the patient suffers from prolapsing internal hæmorrhoids in addition to the fissure, considerable improvement can be obtained by injecting the hæmorrhoids. Usually infiltration anæsthesia is required for the passage of the proctoscope.

In infants 1 per cent. amethocaine on a pledget of cotton-wool wrapped round an orange-stick inserted into the anus several times a day is extremely effective, provided the mother can be taught to undertake the treatment, and she carries it out regularly. In other circumstances in-patient treatment must be arranged.

Indications for Operation.—Should conservative measures prove ineffective or should the patient develop an allergy to the local anæsthetic, operation is indicated, as also in all cases of chronic anal fissure.

Internal Sphincterotomy (Eisenhammer).—The operation can be conducted as an out-patient, employing local anæsthesia. The previous evening a mild aperient is given, and diet is restricted on the day of operation. Two or three hours before operation a large, low-pressure enema of tap water is given. The patient lies in the left lateral position and an assistant retracts the upper buttock. The skin is washed and shaved and painted with colourless flavine solution. Two per cent. procaine is introduced into the anal skin posteriorly, and 5 ml. is deposited external to the external sphincter. The perianal muscles are infiltrated with anæsthetic solution on either side, and the anal subcutaneous tissue is infiltrated, a total of 30 ml. solution being employed. Strong pressure is now applied with a pad of cotton-wool to distribute the solution. The rectum is swabbed out with dettol solution, and dried through a proctoscope. A large Sims' speculum is substituted for the proctoscope. Two ml. of local anæsthetic is injected submucosally along the left lateral line of the anal canal from ¼ inch (6 mm.) above the dentate line to the anal verge. A straight incision is made along this line, commencing ¼ inch above the dentate line, between two columns of Morgagni. The incision extends downwards to the outer edge of the subcutaneous part of the external sphincter muscle (fig. 820(*a*)). This incision is about

Stephen Eisenhammer, Contemporary. Proctologist, Johannesburg.
James Marion Sims, 1813–1883. Surgeon to and Founder of the State Hospital for Women, New York.

1 inch (2·5 cm.) long, and exposes the subcutaneous tissues throughout its length (fig. 820(*b*)). By digital palpation, the tense lower border of the internal sphincter is located. The submucous venous areolar tissue is then divided until the internal sphincter becomes visible. It is recognised by its closely banded, pearly white transverse fibres (fig. 820(*c*)). Pressure with gauze swabs soaked in adrenaline solution is a great help in securing a bloodless field, and thereby being enabled to define the anatomy with accuracy. The internal sphincter is then divided from above downwards with a scalpel. The division completed, the pink conjoined longitudinal muscle becomes apparent in the floor of the wound (fig. 820(*d*)). The division of the internal

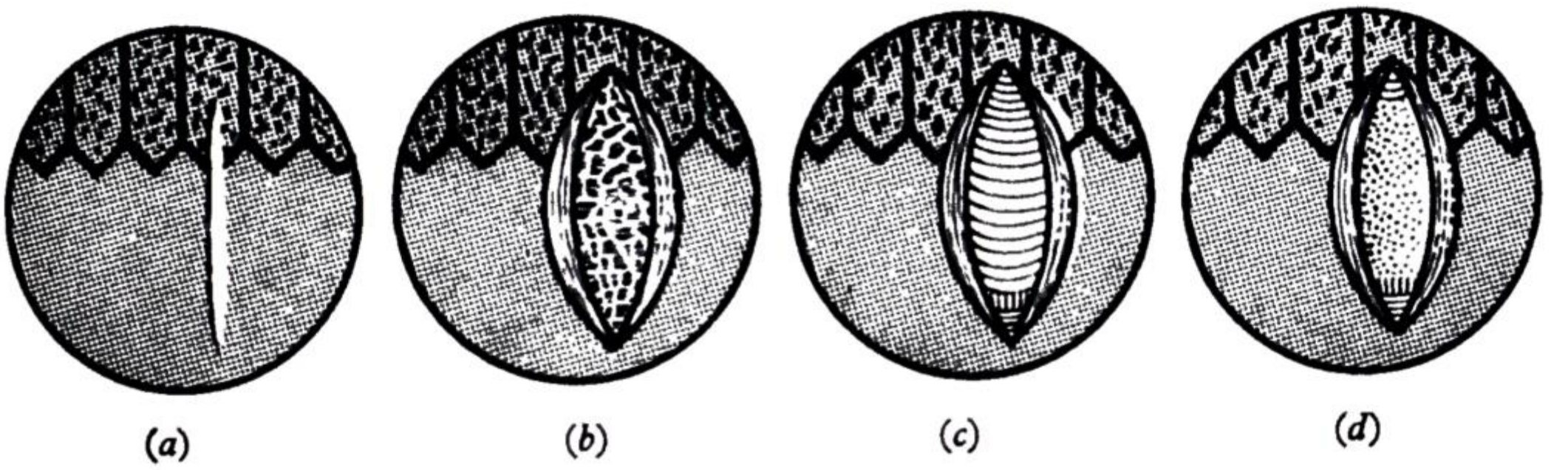


FIG. 820.—Internal sphincterotomy. (*a*) Incision; (*b*) Subcutaneous tissues exposed; (*c*) Exposure of the internal sphincter; (*d*) Internal sphincter divided, exposing the conjoined longitudinal muscle. (*After S. Eisenhammer.*)

sphincter is completed—the severance of the superior ¼ inch (6 mm.) of its fibres being conducted submucosally. A full-sized anal dilator is passed. After the director has been removed the sphincterotomy wound is trimmed. The outer edges are excised to form a very narrow triangle, the base being external. The fissure itself now receives attention. The sentinel pile, the skin edges of the fissure, and the over-hanging polyp are excised with curved scissors.

Finally a piece of oxycel is placed in the anal canal so as to cover the wounds, and a dressing of gauze moistened with a mild antiseptic such as flavine is applied externally, with a corner of the gauze tucked into the anal orifice.

After-treatment.—The patient is sent home by ambulance, and as soon as he is in bed an appropriate sedative, e.g. omnopon, grains ⅓ (20 mg.), is injected hypodermically by his doctor or a nurse. 100 mg. of pethidine is left by his bedside to be taken during the night if he is in pain. On the second night liquid paraffin, or better the hydrating agent referred to previously, is given by mouth, and after the bowels have opened the patient takes daily baths and passes an anal dilator until the wounds have healed, which usually takes about three weeks. Despite the presence of the wounds, as a rule there is little or no pain. The final results are excellent.

HÆMORRHOIDS (*syn* PILES)[1]

Hæmorrhoids are varicose veins occurring in the ano-rectum, and originating in the plexuses formed by radicles of the superior, middle, and inferior hæmorrhoidal veins.

Such hæmorrhoids may be **external** or **internal**—external or internal to the anal orifice. The external variety are covered by skin, while the internal variety are clothed by mucous membrane. When the two varieties are associated, they are known as **intero-external** hæmorrhoids. Hæmorrhoids are again divided into two great classes—*those that arise without any underlying cause*, and *those that are* '*symptomatic.*' By symptomatic is meant that

[1] *Pila* (Latin) = a ball.

the hæmorrhoids are a symptom of some other condition or disease, to wit :

- Symptomatic (secondary) Hæmorrhoids
  - Pregnancy.
  - Uterine fibroids.
  - Straining at micturition
    - Prostatic obstruction.
    - Stricture of the urethra.
  - Inferior vena caval congestion
    - Cardiac disease.
    - Pulmonary disease.
  - Portal hypertension (rarely a cause).
  - Carcinoma of the rectum.

Symptomatic hæmorrhoids appear (*a*) commonly during pregnancy. Pregnancy piles are due to compression of the superior hæmorrhoidal vein by the pregnant uterus. The same effect can be produced by uterine fibroids, especially if the uterus is retroverted, or by a large ovarian cyst filling the pelvis. (*b*) From straining on micturition consequent upon an enlarged prostate or a stricture of the urethra. (*c*) Theoretically, venous hypertension, both portal and systemic, should greatly predispose to hæmorrhoids. Nevertheless, contrary to the usual belief, in no less than one hundred and twenty-eight consecutive cases of portal hypertension, A. I. McPherson did not encounter a single example of hæmorrhoids that could be attributed to portal cirrhosis. This is all the more remarkable when the frequency with which bleeding œsophageal piles complicates portal hypertension (see p. 414) is taken into consideration. (*d*) Carcinoma of the rectum, by compressing or causing thrombosis of the superior hæmorrhoidal vein, gives rise to hæmorrhoids (fig. 821) sufficiently often to warrant it being a routine procedure to examine the rectum and the recto-sigmoid junction for a neoplasm in every case of hæmorrhoids.

FIG. 821.—Carcinoma of the rectum associated with hæmorrhoids. A not infrequent diagnostic pitfall.

The great majority of hæmorrhoids are not symptomatic, and the description that follows concerns hæmorrhoids that are *not* a manifestation of some underlying cause.

Internal hæmorrhoids, which include intero-external hæmorrhoids, are exceedingly common. Essentially the condition is a varicosity of the internal hæmorrhoidal plexus, but because of the communication between the internal and external hæmorrhoidal plexuses, if the former becomes varicose, the latter is liable to become involved in cases of some standing.

Ætiology : *Hereditary.*—The condition is so frequently seen in members of the same family that there must be a predisposing factor, such as a congenital weakness of the vein walls or an abnormally large arterial supply to the hæmorrhoidal plexus.

Varicose veins of the legs and hæmorrhoids often occur concurrently.

Morphological.—In quadrupeds gravity aids, or at any rate does not retard, return of venous blood from the rectum. Consequently venous valves are not required. In man, the weight of the column of blood unassisted by valves produces a high venous

Archibald Ian Stuart McPherson, Contemporary. Surgeon, Royal Infirmary, Edinburgh.

pressure in the lower rectum, unparalleled in the body. Except in a few fat, old dogs, hæmorrhoids are exceedingly rare in animals.

Anatomical.—(1) The collecting radicles of the superior hæmorrhoidal vein lie unsupported in the very loose submucous connective tissue of the rectum. (2) These veins pass through muscular tissue and are liable to be constricted by its contraction during defæcation. (3) The superior hæmorrhoidal veins being tributaries of the portal vein have no valves.

Exciting Causes.—Straining accompanying constipation or that induced by over-purgation is considered to be a potent cause of hæmorrhoids. Less often the diarrhœa of enteritis, colitis, or the dysenteries aggravates latent hæmorrhoids.

Occupations that entail much standing have some bearing on the occurrence of hæmorrhoids.

Pathology.—Internal hæmorrhoids are arranged in three groups at 3, 7, and 11 o'clock with the patient in the lithotomy position (fig. 822). These are known as the left lateral, the right posterior, and the right anterior hæmorrhoid. In between these three principal hæmorrhoids there may be smaller, subsidiary hæmorrhoids. Each principal hæmorrhoid can be divided into three parts :

FIG. 822.—Typical third-degree hæmorrhoids. Note their 3, 7, and 11 o'clock positions. (*St. Mark's Hospital collection.*)

The pedicle is situated in the rectum just above the ano-rectal ring. As seen through a proctoscope, it is covered with pale pink mucosa through which large tributaries of the superior hæmorrhoidal vein can be seen. Occasionally a pulsating artery can be felt in this situation.

The internal hæmorrhoid, which commences at the ano-rectal ring and ends at the pectinate line. It is bright red or purple, and covered by mucous membrane.

An external associated hæmorrhoid lies between the pectinate line and the anal margin. It is covered by skin, through which blue veins can be seen, unless fibrosis has occurred. This associated hæmorrhoid is present only in well-established cases.

Entering the pedicle of each internal hæmorrhoid is a terminal branch of the superior hæmorrhoidal artery. Very occasionally there is a hæmangiomatous condition of this artery—an 'arterial pile.' [1]

Clinical Features.—*Bleeding*, as the name hæmorrhoid implies, is the principal and earliest symptom. At first the bleeding is slight ; it is bright red and occurs during defæcation, and it may continue thus for months or years. Internal hæmorrhoids are said to be the commonest cause of anæmia in men. Hæmorrhoids that bleed at stool but do not prolapse are called *first-degree hæmorrhoids.*

Prolapse is a much later symptom. In the beginning the protrusion is slight and occurs only at stool, and reduction is spontaneous. As time goes on the hæmorrhoids do not reduce themselves, but have to be replaced digitally by the patient. Hæmorrhoids that prolapse only on defæcation are known as *second-degree hæmorrhoids.* Still later prolapse occurs during the day,

[1] An 'arterial pile' is likely to occur in a patient with *systemic* hypertension. That being so, bleeding from it might well be Nature's blood-letting. The sphygmomanometer will give the answer.

apart from defæcation, when the patient is tired or exerts himself. Hæmorrhoids that prolapse apart from defæcation are called *third-degree hæmorrhoids*. By now the hæmorrhoids have become a source of great discomfort and a cause of a feeling of heaviness in the rectum. Finally, in some cases the hæmorrhoids become permanently prolapsed.

Discharge.—A mucoid discharge is a frequent accompaniment of prolapsed hæmorrhoids. It is composed of mucus from the engorged mucous membrane, sometimes augmented by leakage of ingested liquid paraffin.

Pain is absent unless complications supervene.

On inspection there may be no evidence of internal hæmorrhoids. In more advanced cases redundant folds or tags of skin can be seen in the position of one or more of the three primary hæmorrhoids. When the patient strains, internal hæmorrhoids may come into view transiently, or if they are of the third degree they prolapse and remain prolapsed.

Palpation.—Internal hæmorrhoids can seldom be felt unless they are thrombosed. Possibly very large uncomplicated internal hæmorrhoids are palpable, but who can say if some thrombosis has not occurred in these apparent exceptions to the rule?

FIG. 823.—Internal hæmorrhoids seen through a proctoscope.

Proctoscopy.—A proctoscope is passed to its fullest extent and the obturator is removed. The instrument is then slowly withdrawn. Just below the ano-rectal ring internal hæmorrhoids, if present, will bulge into the lumen of the proctoscope (fig. 823).

Summarising:

First-degree Hæmorrhoids.—The veins are increased in number and size.

Second-degree Hæmorrhoids.—The still larger hæmorrhoids prolapse during defæcation.

Third-degree Hæmorrhoids.—Prolapse occurs at the least provocation.

Fourth-degree Hæmorrhoids.—The hæmorrhoids become permanently prolapsed.

Complications:

Profuse hæmorrhage is not rare. Most often it occurs in the early stages of the second degree. The bleeding occurs mainly externally, but it may continue internally after the bleeding hæmorrhoid has retracted or has been returned. In these circumstances the rectum is found to be full of blood.

Strangulation.—One or more of the internal hæmorrhoids prolapse and become gripped by the external sphincter. Further congestion follows because the venous return is impeded. Second-degree hæmorrhoids are most often complicated in this way. Strangulation (fig. 824) is accompanied by considerable pain, and is often spoken of by the patient as an 'acute attack of piles.'[1] Unless the internal hæmorrhoids can be reduced within an hour or two, strangulation is followed by thrombosis.

FIG. 824.—Strangulated internal hæmorrhoids.

[1] An 'acute attack of piles' also embraces a thrombotic pile (see p. 635) and an inflamed anal skin tag.

FIG. 825.—Strangulated internal hæmorrhoids with thrombosis.

Thrombosis.—The affected hæmorrhoid or hæmorrhoids become dark purple or black (fig. 825) and feel solid. Considerable œdema of the anal margin accompanies thrombosis. Once thrombosis has occurred the pain of strangulation largely passes off, but tenderness persists.

Ulceration.—Superficial ulceration of the exposed mucous membrane is a usual accompaniment of strangulation with thrombosis.

Gangrene occurs when strangulation is sufficiently tight to constrict the arterial supply of the hæmorrhoid. The resulting sloughing is usually superficial and localised. Occasionally a whole hæmorrhoid sloughs off, leaving an ulcer which heals gradually. Very occasionally massive gangrene extends to the mucous membrane within the anal canal and rectum.

Fibrosis.—After thrombosis, internal hæmorrhoids sometimes become converted into fibrous tissue. The fibrosed hæmorrhoid is at first sessile, but by repeated traction during prolapse at defæcation, it becomes pedunculated and constitutes a fibrous polyp that is readily distinguished by its white colour from an adenoma, which is bright red. Fibrosis following transient strangulation commonly occurs in the subcutaneous part of a primary hæmorrhoid. Fibrosis in an external hæmorrhoid favours prolapse of an associated internal hæmorrhoid.

Suppuration is uncommon. It occurs as a result of deep infection of the thrombosed hæmorrhoid. Throbbing pain is followed by perianal swelling, and a perianal or submucous abscess results.

Pylephlebitis (*syn.* Portal Pyæmia).—Theoretically infected hæmorrhoids should be a potent cause of portal pyæmia and liver abscesses (see p. 400). Although cases do occur from time to time, this complication is surprisingly infrequent unless the unpardonable error of performing hæmorrhoidectomy while the hæmorrhoids are in an inflamed state is perpetrated.

TREATMENT OF INTERNAL HÆMORRHOIDS

Palliative treatment is recommended when the hæmorrhoids are a symptom of some other condition or disease. The bowels are regulated by a hydrating agent or liquid paraffin, ½ ounce (15 ml.) twice a day, and if necessary a small dose of cascara evacuant at night. Lubafax or a cream of equal parts of zinc oxide and castor oil, inserted into the rectum from a collapsible tube fitted with a nozzle, at night and before defæcation, is of service.

In cases of strangulation, thrombosis, and gangrene, conservative measures should be the unwavering rule. If the patient is seen soon after strangulation has occurred, treatment can be commenced by reducing the hæmorrhoids under thiopentone anæsthesia. Once they are thrombosed, if hæmorrhoids are replaced they prolapse almost immediately, consequently it is futile to attempt this manœuvre. In these circumstances the following measures give satisfactory results : the patient is put to bed and the foot of the bed is raised on blocks. One-quarter grain (15 mg.) of morphine is administered intravenously, after which the anal region is shaved and the prolapsed mass is irrigated with a weak antiseptic solution. A quantity of gauze soaked in normal saline solution is applied to the anus, covered with jaconet, and kept in position by a four-tailed bandage. The dressing is changed every four hours. Liquid paraffin is given three times a day, and antibiotic therapy is administered and continued for as long as necessary. If the bowels have not acted by the third day, a glycerine enema is given through a catheter. About the third or fourth day the œdema and inflammation will usually have

apart from defæcation, when the patient is tired or exerts himself. Hæmorrhoids that prolapse apart from defæcation are called *third-degree hæmorrhoids*. By now the hæmorrhoids have become a source of great discomfort and a cause of a feeling of heaviness in the rectum. Finally, in some cases the hæmorrhoids become permanently prolapsed.

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FIG. 824.—Strangulated internal hæmorrhoids.

[1] An 'acute attack of piles' also embraces a thrombotic pile (see p. 635) and an inflamed anal skin tag.

the external hæmorrhoid is well defined; (5) when arterial pulsation can be felt in the pedicle. These are indications for hæmorrhoidectomy.

HÆMORRHOIDECTOMY

Forty-eight hours' pre-operative treatment is necessary. An aperient, a little more than the patient usually takes, or, if none is habitually taken, ½ drachm (2 ml.) of cascara evacuant, is given on the evening forty-eight hours prior to the operation. On the following morning a small dose of effervescent saline is given before breakfast. On the evening before the operation a soap-and-water enema is administered, and the anal region is shaved. On the morning of the operation the rectum is washed out with water by means of a funnel and tube attached to a catheter.

Ligation and Excision.—With the patient in the lithotomy position the internal hæmorrhoids are prolapsed by traction on the skin tags related to the hæmorrhoids, or on the skin of the anal margin. Each primary internal hæmorrhoid is dealt with as follows: the internal hæmorrhoid is picked up with dissecting forceps and traction is exerted. Traction displays a longitudinal fold (the pedicle) above the hæmorrhoid. Each pedicle is grasped in a fine-pointed hæmostat, as also is each external hæmorrhoid or skin tag connected with each primary hæmorrhoid. These pairs of hæmostats, when held out by the assistants, form a triangle. The operator takes the left lateral pair of hæmostats in the palm of his hand and places the extended forefinger in the anal canal to support the internal hæmorrhoid. In this way traction is applied to the skin of the anal margin. With scissors, a V-shaped cut is made (fig. 828 (A)),

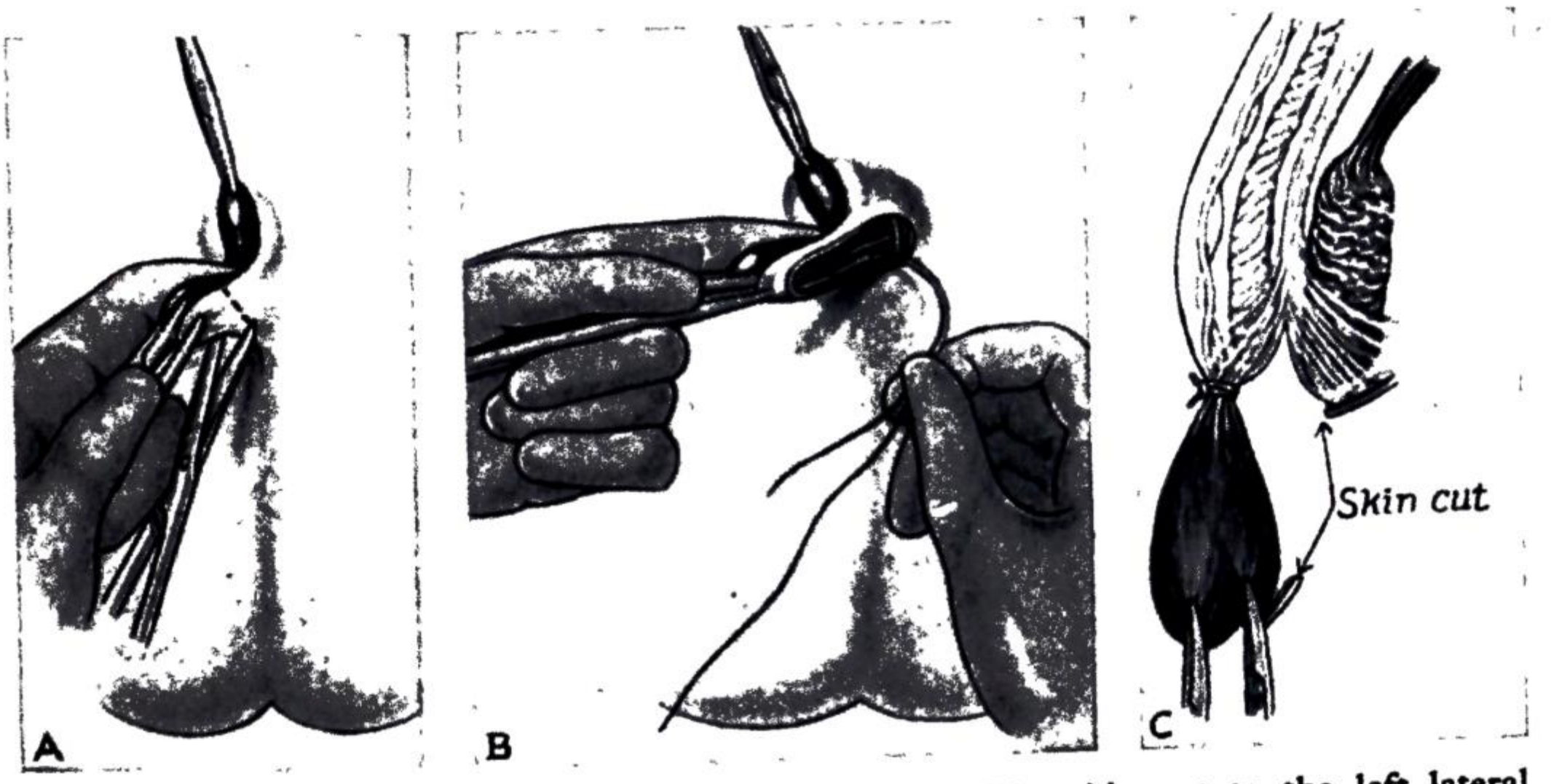

FIG. 828.—Ligature and excision of hæmorrhoids: (A) The skin cut to the left lateral hæmorrhoid; (B) Transfixion of the pedicle; (C) Ligation.

each limb of which is placed on either side of the skin-holding hæmostat. This cut traverses the skin and the corrugator cutis ani. Exerting further traction a little blunt dissection exposes the lower border of the internal sphincter. A transfixion ligature of No. 3 chromic catgut is applied to the pedicle at this level (fig. 828 (B)). Each hæmorrhoid having been dealt with in this manner (fig. 828 (C)) they are excised ½ inch (1·25 cm.) distal to the ligature, the ends of which are cut about ½ inch from the knot. Secondary hæmorrhoids are ligated and excised separately. The stumps of the ligated hæmorrhoids are returned to the rectum by tucking a piece of gauze into the anal canal with closed scissors.

The margins of the skin wounds are so trimmed as not to leave overhanging edges, viz.——→

Bleeding subcutaneous arteries having been secured, a ½-grain (30-mg.) morphine suppository is placed in the rectum, a rubber drainage tube with a diameter of ½ inch (1·25 cm.) is inserted through the anus, and the corners of three pieces of petroleum-jelly gauze are tucked into the anus alongside

the tube so as to cover the areas denuded of skin. A pad of gauze and wool, and a firmly applied T-bandage, complete the operation.

Post-operative Treatment.—The tube is removed after twenty-four hours, care being taken not to disturb the three pieces of petroleum-jelly gauze. A mild aperient is given on the evening of the second post-operative day and an olive-oil enema on the following morning, with which the dressings usually come away ; if not, they are removed. Baths and dressings are carried out twice a day after the first bowel movement. The wounds are irrigated with hydrogen-peroxide solution delivered by a tube from a douche can, and moist packing is tucked into the anal canal for ½ inch (1·25 cm.), the aim being to fill lightly each of the skin wounds. On the seventh day a finger is passed into the rectum. On the eighth day and until the wounds have healed, a St. Mark's Hospital dilator is passed daily. The patient can leave hospital on the fourteenth day. Dressing of the wound must continue. In the later stages a dry dressing is employed during the day and a zinc and castor-oil dressing at night. The wounds heal in three to six weeks.

Post-operative Complications :

Reactionary hæmorrhage is much more common than secondary hæmorrhage. The hæmorrhage may be mainly or entirely concealed, but will become evident on examining the rectum.

Treatment.—A suitable dose of morphine is given intravenously. A 16F. Foley's catheter with a 30 c.c. balloon is inserted through the anus towards the rectal ampulla for 4 inches (10 cm.) ; proctoscopy is not required for the insertion. The balloon is inflated with either air or water, and the inflation tube is clamped. Downward traction is exerted by strapping the catheter to a buttock so that pressure is exerted above the ano-rectal ring. Counter-pressure from below is maintained by means of a perineal pad and a T-bandage. The balloon exerts pressure on the hæmorrhoidal vessels while the catheter permits the escape of flatus or blood, and should bleeding recommence, its amount can be observed. Irrigation with 1 ounce (30 ml.) of saline solution from time to time will ensure patency of the catheter. The patient's blood is grouped, and preparations are made for blood-transfusion, should it be required.

As a rule the catheter can be dispensed with in twenty-four hours. Exceptionally, the patient must be taken to the operating theatre and the bleeding-point secured by under-running with a ligature on a needle. Should a definite bleeding-point not be found, suspected areas are under-run in this way.

Secondary hæmorrhage is uncommon ; when it occurs, it does so about the seventh or eighth day after operation. In this instance a better method is to wind gauze around one end of a tube ½ inch (1·25 cm.) in diameter and 4 inches (10 cm.) long, to a thickness that will just pass the proctoscope. The proctoscope is passed, and the tube, with the dry gauze tampon, is inserted into the rectum and the proctoscope is removed. A large safety-pin is placed through the tube, and gauze is wound around the tube between the anal margin and the safety-pin. Other details of treatments are similar to the above.

Retention of urine is not unusual after hæmorrhoidectomy in male patients, and frequently it is precipitated by the presence of a rectal tube, or pack, or both. Before resorting to catheterisation, the patient should be assisted to a hot bath, and it is more than likely he will be able to pass urine into the bath, especially if a full dose of pethidine has been administered beforehand.

HYPERTROPHIED ANAL PAPILLA

Anal papillæ occur at the dentate line, and are remnants of the ectodermal membrane that separated the hind-gut from the proctodæum. As these papillæ are present in fully 60 per cent. of patients examined proctologically, they should be regarded as normal structures. Anal papillæ can become elongated, as they frequently do in the presence of internal hæmorrhoids. Occasionally an elongated anal papilla or papillæ is found without hæmorrhoids, and is sometimes the cause of pruritus. An elongated anal papilla associated with pain and/or bleeding at defæcation, is sometimes encountered in infancy. At any time of life, hæmorrhage into a hypertrophied anal papilla can cause sudden rectal pain. Prompt examination sometimes reveals blood-clot being extruded from a ruptured papilla.

A prolapsed papilla may become nipped by contraction of the sphincter mechanism

Frederic Eugene Baisal Foley, Contemporary. Urologist, Miller and Ancker Hospitals, St. Paul, U.S.A.

after defæcation. It is possible that repeated traction on the pedicle of an anal papilla results in an anal fissure.

Treatment.—Using a slotted proctoscope, elongated papillæ without hæmorrhoids should be crushed and excised after injecting the base with local anæsthetic. When elongated papillæ complicate internal hæmorrhoids, this is an indication for operative treatment of the hæmorrhoids, as well as excision of the elongated papillæ.

EXTERNAL HÆMORRHOIDS

Unlike internal hæmorrhoids, external hæmorrhoids comprise a conglomerate group of distinct clinical entities.

1. **Acute external plexus hæmatoma** is commonly termed a 'thrombotic pile.' It is a small hæmatoma occurring in the perianal subcutaneous connective tissue, usually superficial to the corrugator cutis ani muscle. The condition is due to the bursting of an anal venule consequent upon straining at stool, coughing, or lifting a heavy weight.

The condition appears suddenly and is very painful, and on examination a tense, tender swelling which looks like a small overripe cherry is seen (fig. 829). The hæmatoma is usually situated in a lateral region of the anal margin. Untreated this hæmatoma may :

Resolve.
Suppurate.
Fibrose, and give rise to a cutaneous tag.
Burst and extrude the clot.

FIG. 829.—' Thrombotic ' pile.

In the majority of cases resolution or fibrosis occurs. Indeed, this condition has been called ' a five-day, painful, self-curing lesion ' (E. T. C. Milligan).

Provided it is seen within thirty-six hours of the onset, a perianal hæmatoma is best treated as an emergency. Under local anæsthesia the hæmorrhoid is bisected and the two halves are excised together with ½ inch (1·25 cm.) of adjacent skin. This leaves a pear-shaped wound which is allowed to granulate. The relief of pain is immediate and a permanent cure is certain. On rare occasions in which a perianal hæmatoma is situated anteriorly or posteriorly it should be treated conservatively because of the liability of a skin wound in these regions to become an anal fissure.

2. **Associated with internal hæmorrhoids** = intero-external hæmorrhoids. These have been discussed already (p. 628).

3. **Dilatation of the veins of the anal verge** becomes evident only if the patient strains, when a bluish cushion-like ring appears. This variety of external hæmorrhoid is almost a perquisite of those who lead a sedentary life. The only treatment required is an adjustment in habits of the patient.

4. **A redundant fold of skin** or a cutaneous tag at the anal margin, when unassociated with internal hæmorrhoids, is probably due to a bygone perianal

Edward Thomas Campbell Milligan, Contemporary. Consulting Surgeon, St. Mark's Hospital, London.

hæmatoma. Such a tag (or tags), which often produces pruritus, should be excised under local anæsthesia.

5. **A 'sentinel' pile** is associated with a fissure-in-ano, and has been discussed on p. 624.

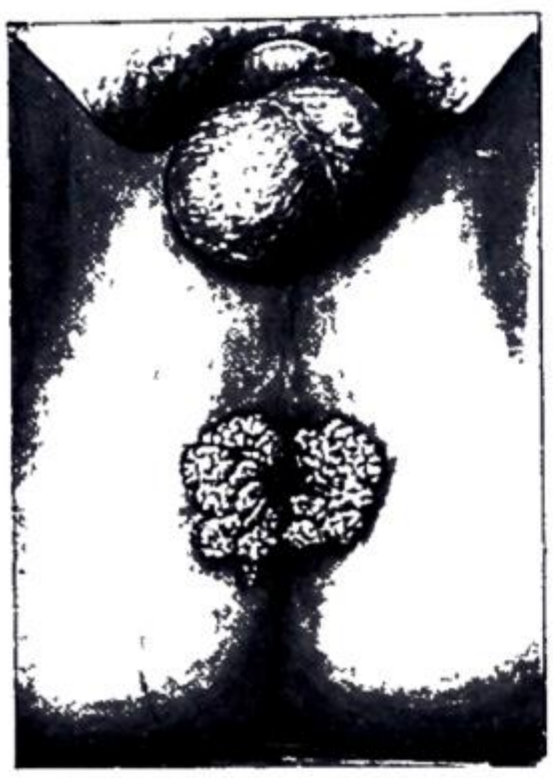

FIG. 830.—Condylomata ani.

SOME CONDITIONS THAT SIMULATE EXTERNAL HÆMORRHOIDS

Anal warts are usually multiple and present the same characteristics as warts elsewhere. Occasionally they accompany gonococcal proctitis. Simple warts respond well to treatment by applications at weekly intervals of 25 per cent. podophyllin in liquid paraffin. After three or four applications, if there are any residual warts they should be excised.

Condylomata (fig. 830) have a smoother surface and are more pedunculated than the foregoing. Also they are usually moist, with a glairy discharge. There are likely to be other signs of secondary syphilis present, and the Wassermann reaction is positive.

Hypertrophic tuberculide of the anus is rare. These are multiple yellowish-brown papillomatous excrescences, and in some respects resemble a squamous-celled carcinoma. This is usually a primary form of tuberculosis, and the diagnosis is seldom established until microscopic examination of the excised specimen has been undertaken.

PRURITUS ANI

There is an intractable itching around the anus. The causes are very numerous and varied:

1. *Lack of cleanliness, excessive sweating, and wearing woollen underclothing* are common causes.

2. *An anal or perianal discharge* which renders the anus moist. The causative lesions include an anal fissure, fistula-in-ano, prolapsed internal or external hæmorrhoids, and excessive ingestion of liquid paraffin.

3. *A vaginal discharge*, especially due to the trichomonas vaginalis, can cause irritation of the anus.

4. *Parasitic Causes.*—Threadworms (*Enterobius vermicularis*) should be excluded, especially in young subjects. Scabies and pediculosis pubis may infest the anal region. When the anal skin shows some form of dermatitis which has a well-defined border, mycotic diseases of the skin due to yeasts and fungi should be suspected. Microscopic and cultural examinations of muco-pus taken from the region are necessary to establish the diagnosis in this instance.

5. *Allergy* is sometimes the cause, in which case there is likely to be a history of other allergic manifestations, such as urticaria, asthma, or hay-fever.

6. *A Raised pH of the Fæces.*—It would appear that the incidence of perianal dermatitis varies with the pH of the fæces; the more acid the stool and the perianal skin, the less frequent is the occurrence of perianal dermatitis.

7. *A Psychoneurosis.*—It is alleged that in a few instances neurotic individuals become so immersed in their complaint that a pain-pleasure complex develops, the pleasure being the scratching. Possibly this is true, but such a syndrome should not be assumed without firm grounds for coming to the conclusion that this nebulous hypothesis is a strong probability.

August von Wassermann, 1866–1925. Director of the Institute for Experimental Therapy, Berlin.

Treatment is directed to removing the cause. Other methods include :

Hygienic Measures.—Wet cotton-wool should be substituted for toilet paper. Soap is avoided, and replaced by a detergent. These measures alone, combined with wearing cotton cellular underwear and applications of calamine lotion, are all that is necessary to cure some cases.

The following résumé is directed mainly to those frequent instances where no obvious reason for the itching can be demonstrated. The best sedative appears to be the alkaloid reserpine, derived from the mother substance Rauwolfia serpentina. This has a tranquilising effect on many anxious patients, but is without direct effect on the pruritus itself. The dose is 0·25 mg. daily, which is adjusted according to the response.

Hydrocortisone.—In cases with dermatitis, *and only in cases with dermatitis*, prednisone, applied topically in a cream of 0·5 per cent. is often beneficial, but often after discontinuation of the therapy the pruritus is liable to return, in which event 5 per cent. xylocaine ointment can be substituted for a time.

Strapping the buttocks apart (fig. 831) is a most useful procedure, expecially when the pruritus is acute. It can be tried also in chronic cases when the opposing surfaces are moist. The strapping must be renewed every three days, and is worn so long as the patient finds it beneficial.

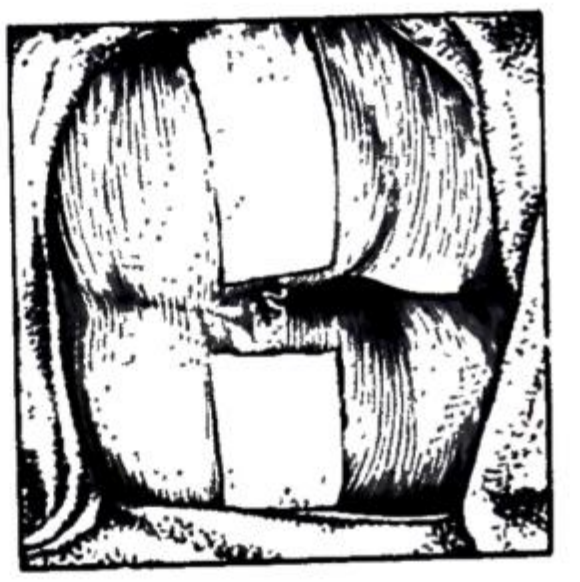

FIG. 831.—Strapping the buttocks apart. (*After E. S. R. Hughes.*)

Tattoo-neurectomy.—Tattooing is of no value in pruritus not associated with moist lichenified pruritic skin. With this proviso, it yields good results. The neurectomy prevents post-operative pain, and is in itself a good, though temporary, expedient for combating the intolerable itching.

The pre- and post-operative treatment is similar to that described below. A thick paste of mercuric sulphide (cinnabar) is made with distilled water. The tattooing machine is preferably an instrument with a light, flexible shaft designed for surgical use. The paste is applied to the skin and the tattooing, which must extend well beyond the pruritic zone, is performed through the paste.

Usually the skin is very friable, and after tattooing has been completed a curved mosquito hæmostat is introduced through the skin at four points on the periphery of the tattooed area, and its jaws are opened and closed in the subcutaneous tissues, so as to sever the cutaneous nerves of the whole area, including a small portion within the anal verge.

Operative Treatment.—Apart from the removal of, or other operative measure for, a concomitant lesion of the ano-rectum which is thought to initiate or contribute to the pruritus, when other measures fail to bring permanent relief the advisability of performing an operation to endeavour to rid the patient of the pruritus should be considered. It should be noted that the operation about to be described is *not* recommended in the presence of moist dermatitis.

The clover-leaf operation consists of removal of a large piece of pruritic skin from each quadrant of the perianus, viz.——→

Pre-operatively a daily enema is given, and 250 mg. of oxytetracycline (terramycin) is administered orally *bis die* for three to five days. Shaving is undertaken after the patient has been anæsthetised. R. Turell has

Robert Turell, Contemporary. Associate Surgeon, and Chief of the Rectal Clinic, Mount Sinai Hospital, New York,

found this operation curative in one hundred and ten instances of otherwise refractory pruritus ani *not associated with cutaneous changes*. E. S. R. Hughes covers the denuded areas with a skin graft, in the same manner as he recommends for fistula-in-ano.

PROLAPSE OF THE RECTUM — Partial / Complete

Partial Prolapse.—The mucous membrane and submucosa of the rectum protrude outside the anus for not more than between $\frac{1}{2}$ and $1\frac{1}{2}$ inches (1·25 and 3·75 cm.). When the prolapsed mucosa is palpated between the finger and thumb, it is evident that it is composed of no more than a double layer of mucous membrane (cf. complete prolapse). The condition occurs most often at the extremes of life—in children between one and three years of age, and in elderly people.

In Infants.—The direct downward course of the rectum, due to the as yet undeveloped sacral curve (fig. 832) predisposes to this condition. The presence of a rectal adenomatous polyp must be excluded.

FIG. 832.—The absence of the normal sacral curve predisposes to rectal prolapse in an infant (cf. fig. 816).

In children, often partial prolapse commences after an attack of diarrhœa, as a result of severe whooping cough, or from loss of weight and consequent diminution in the amount of fat in the ischio-rectal fossæ.

In adults usually the condition is associated with third-degree hæmorrhoids. In the female a torn perineum predisposes to prolapse, and in the male straining from urethral obstruction. In old age, both partial and complete prolapse are due to atony of the sphincter mechanism.

Partial prolapse also is liable to follow an operation for fistula-in-ano where a large portion of muscle has had to be divided, in which event usually the prolapse is localised to the damaged quadrant and is seldom progressive.

Prolapsed mucous membrane is pink (see fig. 834); prolapsed internal hæmorrhoids are plum coloured, and more pedunculated.

Treatment:

In Infants and Young Children: (1) *Digital Reposition.*—The mother must be taught to replace the protrusion. The distal two-thirds of the index finger is wrapped in Kleenex tissue. The finger is inserted into the protrusion, and the mass is eased into place. Gently the finger is withdrawn, leaving the Kleenex tissue to disintegrate. In cases of malnutrition, dietetic adjustments are necessary.

2. *Submucous Injections.*—If digital reposition fails after six weeks' trial, injections of 5 per cent. phenol in almond oil are carried out under general anæsthesia.

Technique.—The submucosa at the apex of the prolapse is injected circularly, so as to form a raised ring, up to 10 ml. of the solution being injected. A similar

Edward Stuart Reginald Hughes, Contemporary. Surgeon to Out-Patients, The Royal Melbourne Hospital, Melbourne.

injection is made at the base of the prolapse. Alternatively, if the prolapse cannot be brought down, the injections are given through a proctoscope.

As a result of the aseptic inflammation following these injections, the mucous membrane becomes tethered to the muscle coat.

3. *Thiersch's Operation.*—When the prolapse persists in spite of these measures, Thiersch's operation (see p. 640) is almost certain to succeed. In infants, insertion of the little finger into the anus before the wire is tied is recommended.

In Adults : (1) *Submucous injections* of phenol in almond oil occasionally are successful in cases of early partial prolapse.

(2) *Excision of the Prolapsed Mucosa.*—When the prolapse is unilateral the redundant mucosa can be excised after inserting and tying Goodsall's ligature (fig. 833) which, after the needles have been cut off, permits the base of the prolapsed mucous membrane to be ligated in three portions lying in juxtaposition. When necessary, the operation is combined with hæmorrhoidectomy, and if the pedicle of one or more of the hæmorrhoids is broad, Goodsall's ligature is applied to it.

FIG. 833.—Goodsall's ligature.

Complete prolapse (*syn.* procidentia) is less common than the partial variety. The protrusion consists of all layers of the rectal wall. It is more than 1½ inches (3·75 cm.) and commonly as much as 4 to 6 inches (10 to 15 cm.) in length. On palpation between the finger and the thumb the prolapse feels much thicker than a partial prolapse, and obviously consists of a double thickness of the entire wall of the rectum. Any prolapse over 2 inches (5 cm.) in length contains anteriorly between its layers a pouch of peritoneum, viz.—→ on this account a complete prolapse must be categorised as a sliding hernia occurring through the pelvic diaphragm (A. V. Moschcowitz). When large, the peritoneal pouch contains a loop (or loops) of small intestine which returns to the general peritoneal cavity with a characteristic gurgle when the prolapse is reduced. The prolapsed mucous membrane (fig. 834) is often arranged in a series of circular folds. Complete prolapse is uncommon in children. In adults it can occur at any age. Women are six times more often affected than men. Many of the patients suffering from this condition are obese; the smaller number who are thin show signs of general visceroptosis. In women with extensive perineal tears, prolapse of the rectum may be associated with prolapse of the uterus.

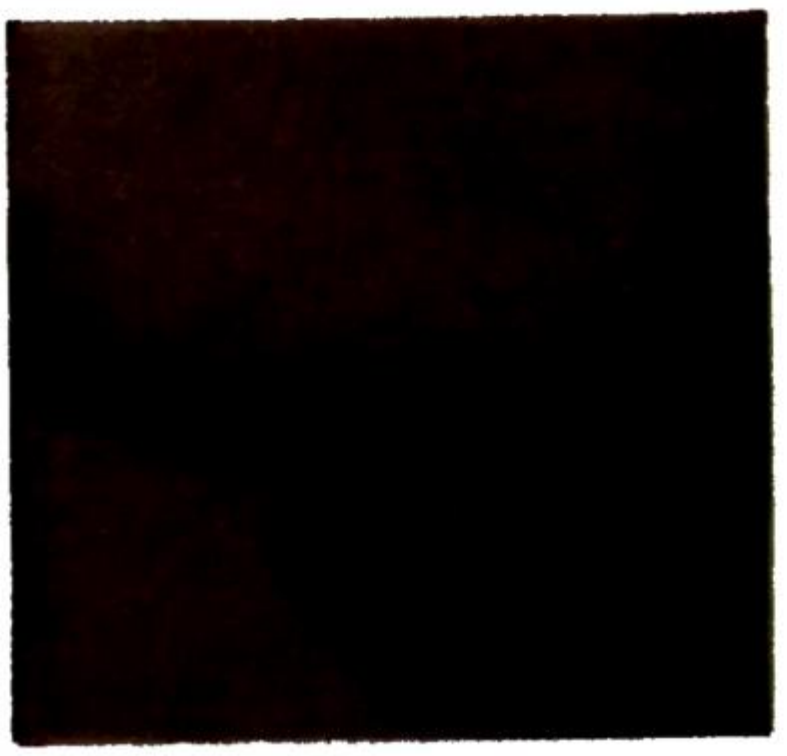

FIG. 834.—Complete rectal prolapse. (*Professor Sir Ernest Finch.*)

Differential Diagnosis.—In the case of a child with abdominal pain, prolapse of the rectum must be distinguished from **ileo-cæcal intussusception** protruding

David Henry Goodsall, 1843–1906. Surgeon, Metropolitan Hospital, London.
Alexis Victor Moschcowitz, 1866–1933. Surgeon, Mount Sinai Hospital, New York.

FIG. 835.—Partial prolapse of the rectum.

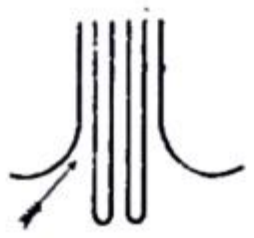

FIG. 836.—Ileo-cæcal intussusception protruding from the anus.

from the anus. Figs. 835 and 836 make the differential diagnosis clear. In **recto-sigmoid intussusception** in the adult there is a deep groove (2 inches (5 cm.) or more) between the emerging protruding mass and the margin of the anus.

Treatment.—The Thiersch operation can be recommended in elderly patients, in those suffering from injury or disease of the spinal cord, and in the feeble-minded, in whom the condition is relatively common, as well as in very early life (in the circumstances described on p. 639).

The Thiersch Operation.—Pre-operatively a daily enema is given, and 250 mg. of oxytetracycline (terramycin) is administered orally *bis die* for three to five days. A short incision is made in the mid-line anteriorly and posteriorly about ½ inch (1·25 cm.) from the anal verge. Large-bore hollow needles are inserted one at a time through the posterior wound, in such a way as to encircle the anus ½ inch from the orifice (fig. 837 (1)), until their points emerge from the anterior wound (fig. 837 (2)). A malleable silver wire, gauge 19 or 20, is introduced through the points of the needles. The needles are withdrawn. The assistant introduces his index finger into the anal canal (fig. 837 (3)), and the surgeon tightens the wire around the finger by twisting the ends of the wire. The finger is withdrawn and the ends of the wire are clipped short, and bent back. The wound is then closed. Antibiotic treatment is continued for several days. A glycerol suppository or a low-pressure enema is given as required post-operatively. Confinement to bed is unnecessary.

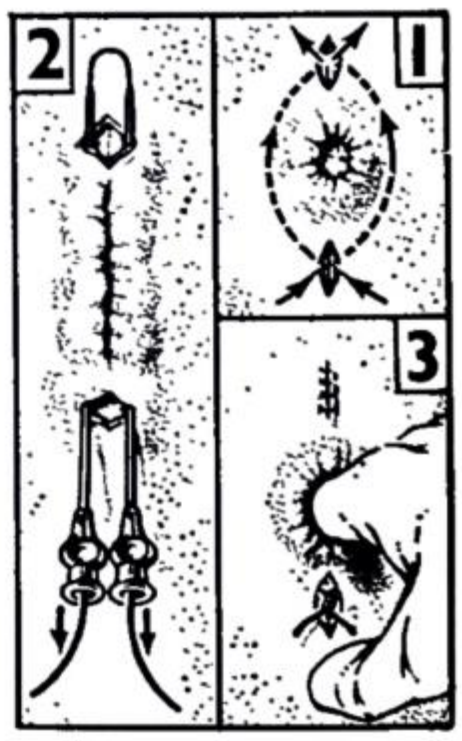

FIG. 837.—The Thiersch operation (Dodd's modification).

By and large, the results of Thiersch's operation are remarkably successful. In about 50 per cent. of cases the wire breaks; it is, however, easily removed and the operation can be carried out several times, at intervals, on the same patient. Its main disadvantage is that spurious incontinence of fæces caused by fæcal impaction is wont to occur in all age groups. Constipation must, therefore, be guarded against vigilantly.

FIG. 838.—Extraperitonealisation of redundant recto-sigmoid. (*After J. Lahaut.*)

Operative Suspension of the Prolapsed Bowel.—Of many operations designed to cure complete prolapse of the rectum, the following procedure is relatively simple. It is recommended in patients with complete prolapse who are otherwise in good health and in the prime of life.

Lahaut's Operation.—The abdomen is opened through a left lower paramedian incision. The operating table is placed in a head-down position, and the intestines are packed away from the pelvis. A circular incision is made around the rectum through the peritoneum covering the pelvic floor, care being taken not to sever the middle hæmorrhoidal vessels. The prolapsed rectum is liberated and drawn into the peritoneal cavity. A cuff of pelvic peritoneum is attached to the rectum as low as possible. The second step of the operation consists of extraperitonealisation of the redundant portion of the rectum and the distal portion of

Karl Thiersch, 1822–1895. Professor of Surgery, Leipzig.
Harold Dodd, Contemporary. Surgeon, King George Hospital, Ilford.
Jules Lahaut, Contemporary. Surgeon-in-Chief, Hôpital du Pont Canal, Mons, Belgium.

the sigmoid colon. This is accomplished by dissecting the medial and lateral leaves of the anterior parietal peritoneum from the abdominal wall, ligating and dividing the inferior epigastric vessels during the procedure. The peritoneal coat now being free from the anterior abdominal wall, its cut edges are sutured behind the rectum and the sigmoid (fig. 838). The anterior rectus sheath and the skin are then closed in front of the redundant bowel. Adhesions soon develop between the exteriorised gut, the peritoneum, and the abdominal muscles. The long-term results of this operation are extremely good.

ANAL INCONTINENCE

Congenital.—(*a*) In cases of imperforate anus partial or complete lack of the sphincter mechanism is the exception rather than the rule ; (*b*) patulous anus associated with mental deficiency.

Traumatic.—By far the most frequent cause is a complication of a complete perineal tear during parturition. Other injuries resulting in a torn anal sphincter are extremely rare.

Post-operative.—(*a*) After the ano-rectal ring has been severed during an operation for a high fistula-in-ano ; (*b*) following conservative perineal resection of the rectum for carcinoma, an operation that cannot be recommended.

Associated with advanced complete prolapse with atony of the sphincter.

Interruption of the reflex arc responsible for sphincter control in diseases of the nervous system, notably neuro-syphilis (e.g. tabes dorsalis).

Carcinoma of the Anus involving the Sphincter.

Treatment :

Partial incontinence often can be remedied by the Thiersch operation (see p. 640). This also is the operation of choice in cases of complete incontinence associated with mental deficiency.

Partial and often complete incontinence due to parturition is particularly amenable to operative treatment. Posterior perineorrhaphy with repair of the torn edges of the sphincter often restores complete normality.

Complete incontinence from other causes frequently has been remedied by constructing a new sphincter from the *gracilis muscle*. The proximal end of the muscle, together with its nerve supply, is left attached. The distal end of the muscle is passed through a prepared tunnel around the anal canal (fig. 839), and sutured to itself. Alternatively, Schoemaker's operation can be performed.

FIG. 839.—Utilising the gracilis muscle to construct an anal sphincter. (*After J. Pickerell.*)

Schoemaker's Method of Constructing a Sphincter Ani.—Through bilateral oblique incisions extending from the coccyx to the greater trochanters, the inferior margin of each gluteus maximus is exposed. A bundle of this muscle 1½ inches (3·8 cm.) in width is severed at its insertion, and dissected free with preservation of the nerve supply. The gluteal bundles are passed through tunnels undermined in front and behind the anus, and are sutured to the contralateral ischium, and to each other.

PROCTITIS

Inflammation is sometimes limited to the rectal mucosa ; at others it is associated with a similar condition in the colon (procto-colitis). The inflammation can be acute or chronic. The symptoms are tenesmus, the passage of blood and mucus and, in severe cases, of pus also. In early cases of the dysenteric group of procto-colitis diarrhœa is much in evidence, but in other forms of proctitis, although the patient has a frequent intense desire to defæcate, the amount of fæces passed at a time is small. Acute proctitis is

Jan Schoemaker, 1871–1940. Professor of Surgery, The Hague, Netherlands.

usually accompanied by malaise and pyrexia. On rectal examination the mucosa feels swollen and is often exceedingly tender. Proctoscopy is seldom sufficient and sigmoidoscopy is the more valuable method of examination. Skilled pathological assistance is required to establish or exclude the diagnosis of specific infection by bacteriological examination and culture of the stools, examination of scrapings or swabs from ulcers, and serological tests. When early carcinoma cannot be excluded, biopsy is necessary.

Proctitis Due to Specific Infections :

Bacillary dysentery.—The appearance is that of an acute purulent proctitis with multiple small shallow ulcers. The examination of a swab taken from the ulcerated mucous membrane is more certainly diagnostic than is a microscopical examination of the stools. Proctological examination is painful ; agglutination tests may render it unnecessary.

Amœbic dysentery.—The infection is more liable to be chronic, and exacerbations after a long period of freedom from symptoms often occur. Proctoscopy and sigmoidoscopy are not painful. The appearance of an amœbic ulcer is described on p. 535. Scrapings from the ulcer should be transferred to a test-tube containing warm normal saline solution and sent to the laboratory for immediate microscopical examination.

Amœbic granuloma presents as a soft mass, usually in the recto-sigmoid region. This lesion is frequently mistaken for a carcinoma. Sigmoidoscopy shows an ulcerated surface, but the mass is less friable than a carcinoma. A scraping should be taken, preferably with a small sharp spoon on a long handle, and the material collected sent for immediate microscopical examination, as detailed above. If doubt exists, a provocative dose of emetine may cause cysts of the amœbæ to appear in the stools. A biopsy is also required.

It should be noted that amœbic granuloma of the rectum is from time to time encountered in a patient who has never even visited a country in which the disease is endemic. Persons living in old people's institutions are the most frequent to harbour this deceptive lesion.

Tuberculous proctitis is nearly always associated with active pulmonary tuberculosis, and is often complicated by a tuberculous fistula-in-ano or tuberculous ulceration of the anus. Submucous rectal abscesses burst and leave ulcers with an undermined edge (fig. 840). A hypertrophic type of tuberculous proctitis occurs in association with tuberculous peritonitis or tuberculous salpingitis. This type of tuberculous proctitis requires biopsy for confirmation of the diagnosis.

FIG. 840.—Tuberculous ulceration of the rectum. Sigmoidoscopic appearance.

Gonococcal proctitis occurs in both sexes as the result of rectal coitus, and in the female from direct spread from the vulva. In the acute stage the mucous membrane is hyperæmic and thick pus can be expressed as the proctoscope is withdrawn. In the early stages the diagnosis can be readily established by bacteriological examination, but later, when the infection is mixed, it is more difficult to recognise. Specific treatment is so effective that local treatment is unnecessary.

Lymphogranuloma Inguinale.—The modes of infection are similar to those of gonococcal proctitis, but in the female infection spreading from the cervix uteri via lymphatics to the pararectal lymph nodes is common. The proctological findings are similar to those of gonococcal proctitis. The diagnosis of lymphogranuloma inguinale should be strongly suspected when the inguinal lymph nodes are greatly enlarged, although the enlargement may be subsiding by the time proctitis commences. Frei's intradermal test is positive in 95 per cent. of cases and the complement-fixation test is even more accurate.

Primary syphilis is very rare. A primary chancre situated on the anal or rectal mucosa is easily overlooked. The inguinal and iliac lymph nodes are greatly enlarged. By the time the symptoms of proctitis are manifest, the Wassermann reaction

William Frei, 1885–1943. Professor of Dermatology, Berlin. As a result of the Nazi régime, he migrated to New York.

will be strongly positive. More than one venereal infection may be present at the same time.

'Strawberry' lesion of the recto-sigmoid is due to an infection by *Spirochæta vincenti* and *Bacillus fusiformis*. In the presence of vitamin C deficiency (and often hypochlorhydria) this lesion can arise *ab initio*; when there is no lack of vitamin C, usually it is secondary to some other diarrhœa-producing infection, notably dysentery. The condition can be either acute (especially in children) or chronic, the latter being more usual. The leading symptom is diarrhœa, often scantily blood-stained. In acute cases there is pronounced dehydration, and a corresponding general reaction. Occasionally the diagnosis can be made by the demonstration of the specific organisms in the stools. More often sigmoidoscopy is required. The characteristic lesion is thickened, somewhat raised mucosa with superficial ulceration in the region of the recto-sigmoid. The inflamed mucous membrane oozes blood at numerous pin-points, giving the appearance of an over-ripe strawberry. A swab should be taken from the lesion and examined for Vincent's and fusiform organisms. Swabs from the gums and the throat are also advisable.

Treatment.—Acetarsol (stovarsol) 0·25 G. orally *bis die* for ten days together with vitamin C is almost specific (A. G. Shera). In adult patients carbarsone suppositories, one inserted into the rectum each evening for ten days, and repeated after one week, is also curative.

Rectal bilharziasis is caused by the *Schistosoma mansoni*, which is endemic in many tropical and subtropical countries, and particularly in the delta of the Nile. The disease passes through three stages:

Stage 1.—A cutaneous lesion develops at the site of entrance of the cercariæ [1].

Stage 2 is characterised by pyrexia, urticaria, and a high eosinophilia.

Both these stages are frequently overlooked.

Stage 3 is due to deposition of the ova in the rectum (much more rarely in the bladder) and is manifested by bilharzial dysentery. On examination in the later stages papillomata are frequently present. The papillomata, which are sessile or pedunculated (fig. 841), contain the ova of the trematode, the life-cycle of which resembles that of *Schistosoma hæmatobium* (see p. 819).

Untreated, the rectum becomes festooned, and prolapse of the diseased mucous membrane is usual. Multiple fistulæ-in-ano are prone to develop.

FIG. 841. — Bilharzial papilloma. *(The late Dr. H. P. Keatinge, Cairo.)*

Treatment of proctitis necessitates confinement to bed. It will be appreciated that in most instances specific treatment can be given once the cause has been elucidated. Local instillations of 5 ounces (150 ml.) of olive oil are soothing. Suppositories of succinyl-sulphathiazole are often beneficial.

The specific treatment for the dysenteries, tuberculosis, gonorrhœa, lymphogranuloma inguinale, and syphilis are described in the appropriate sections of this book.

General Treatment of Bilharziasis Mansoni.—(*a*) *Tartar emetic* (potassium antimony tartrate) is given intravenously on alternate days, ½ grain (30 mg.) at the first

[1] Cercariæ = a parasite of freshwater snails.

Jean Hyacinthe Vincent, 1862–1950. Professor of Medicine, Val-de-Grâce (Military) Hospital, Paris.
Arthur Geoffrey Shera, Contemporary. Pathologist, Eastbourne Hospital Group, Eastbourne.
Theodor Maximilian Bilharz, 1825–1862. Professor of Zoology, Cairo.
Sir Patrick Manson, 1844–1922. Practised in Hong Kong. Later Physician to the Dreadnought Hospital, Greenwich.

injection, increasing by ½ grain until a dose of 2 grains (130 mg.) has been reached, the total dose being 21 grains (1,360 mg.). For this treatment the patient must be in fairly good condition, i.e. a hæmoglobin not below 60 per cent. Alternatively :

(*b*) *Fouadin, Stibophen, or Repodral* (all of which are preparations of antimony) is given intramuscularly. A robust adult receives a daily injection of 5 ml. for ten days. In long-standing cases the dose is reduced by half, and given on alternate days. These preparations deteriorate and become dangerous, and should not be used after six months from the date of manufacture.

(*c*) *Miracil D or Nilodin* is given by mouth, one 200 mg. tablet t.d.s. for twenty days. These are drugs of great promise, and are safer than antimony (A. Halawani).

Local Treatment.—When the papillomata persist in spite of general treatment, they must be treated in the same manner as other papillomata (see p. 654).

Non-specific proctitis is an inflammatory condition affecting the mucosa, and to a lesser extent the submucosa, confined to the terminal 3 to 6 inches (8 to 15 cm.) of the alimentary canal.

Ætiology is unknown. The concept that the condition is a mild and limited form of ulcerative colitis (although actual ulceration is not present) is the most acceptable hypothesis that has been put forward up to the present time.

Clinical Features.—The patient is usually middle-aged, and complains of the passage of blood in the motions, the amount of blood lost being small. Often the complaint is one of diarrhœa, but on closer questioning it transpires that usually one relatively normal action of the bowels occurs each day, although it is accompanied by some blood. During the day the patient attempts to defæcate, with the passage of flatus and a little blood-stained fæcal matter ; it is this that is interpreted as diarrhœa (E. S. R. Hughes). On rectal examination the mucosa feels warm and smooth. Often there is some blood on the examining finger. Proctoscopic and sigmoidoscopic examination shows inflamed mucous membrane of the rectum, but no ulceration. The inflammation extends for only 5 or 6 inches (12·5 or 15 cm.) from the anus, the mucosa above this level being quite normal.

Treatment.—The cause being unknown, treatment is without avail. Antibiotic therapy, suppositories, and soothing retentive enemas have no real effect on the course of the disease, which fortunately is self-limiting. The main endeavour should be directed to the improvement in the general health and reassurance that the condition is not dangerous.

Ulcerative Procto-colitis.—Proctitis is present in a high percentage of cases of ulcerative colitis, and the degree of severity of the rectal involvement may influence the type of operative procedure (see p. 533).

Proctitis due to herbal enemata is a well-known clinical entity to those practising in tropical Africa. Following an enema consisting of a concoction of ginger, pepper, and tree-bark administered by a witch doctor, a most virulent proctitis sets in. Pelvic peritonitis frequently supervenes. Not infrequently a complete gelatinous cast of the mucous membrane of the rectum is extruded. Very large doses of morphine, together with streptomycin, often prevent a fatal issue if commenced early (C. Bowesman). Temporary colostomy would seem to be advisable.

ANO-RECTAL ABSCESSES

In 60 per cent. of cases the pus from the abscess yields a pure culture of *Esch. coli* ; in 23 per cent. a pure culture of *Staphylococcus aureus* is obtained. In diminishing frequency, pure cultures of *Bacteroides*, a streptococcus, or *B. proteus* are found. In half of all cases the infection is mixed. An indolent abscess, particularly an indolent ischio-rectal abscess, without constitutional symptoms is likely to prove to be tuberculous. In a high percentage of cases—some estimate it as high as 90 per cent.—the abscess commences as an infection of an anal gland. Other causes are penetration of the rectal wall, e.g. by a fish bone, a blood-borne infection, or an extension of a cutaneous boil. Doubtless, at some time or another, each of these is responsible for the abscess, but as far as the evidence goes, none can be said

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Charles Bowesman, Contemporary. Lately Surgical Specialist, Kumasi Hospital, Kumasi, Ghana.

to be a common cause. The frequency with which the track of a fistula-in-ano leads to an anal crypt is the basis of the conjecture that the parent abscess commenced in an anal gland.

Should an ano-rectal abscess be allowed to burst spontaneously, or should it be opened in an incorrect manner, a frequent aftermath is a fistula-in-ano. For this reason alone, ano-rectal abscess becomes a highly important subject. Moreover, as the bacterial flora that account for the abscess are for the most part derived from the rectum, no reliance can be placed on antibiotic therapy alone. In 3 per cent. of cases the patient's blood gives a positive culture, and consequently any given ano-rectal abscess, if not drained expeditiously, may endanger life.

Differential Diagnosis.—An abscess connected with a pilonidal sinus, and an abscess of a Bartholin's gland, and an abscess of Cowper's gland (see p. 864) are the only conditions with which an ano-rectal abscess is likely to be confused.

Classification of Ano-rectal Abscesses.—Owing to recent changes in the conception of the anatomy of the ano-rectal musculature, the classification of ano-rectal abscesses has been revised. The newer classification, upon which modern methods of treatment rest, will be described; it follows closely that evolved by S. Eisenhammer (fig. 842).

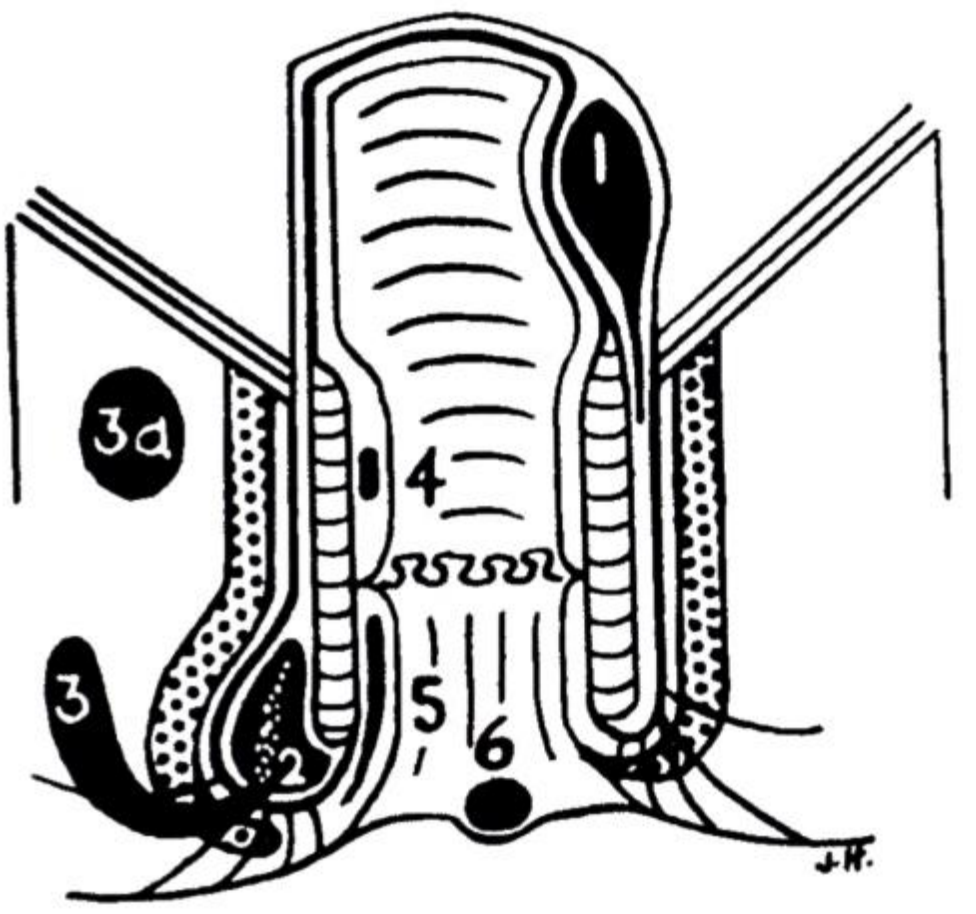

FIG. 842.—Ano-rectal abscesses. 1. High intermuscular; 2. Low intermuscular; 3. Ischio-rectal from an extension of 2; 3a. Blood-borne ischio-rectal abscess; 4. Submucous abscess; 5. Abscess beneath the anoderm; 6. Subcutaneous abscess. (*After S. Eisenhammer.*)

In all varieties save one, early operation is imperative, and adequate drainage must be provided if a fistula is to be prevented. Antibiotic therapy (penicillin and streptomycin) is given three-quarters of an hour before operation, and continued for two or three days, or longer if necessary.

1. **High intermuscular ano-rectal abscess** (10 per cent.) is situated deep to the internal sphincter, and occupies the upper part of the intermuscular space, being confined below by intersecting fibres of the combined longitudinal muscle (see fig. 798). In most instances the abscess is the result of suppuration in a cephalad moiety of an anal gland (see fig. 800) and, as explained already, this moiety is a non-branching duct that does not readily harbour pus—hence the comparative rarity of this variety of abscess.

Men between forty and fifty-five years of age are the usual sufferers. The pain an abscess occasions is considerable; the patient cannot sit in comfort, and defæcation is often agonising. Constitutional symptoms are pronounced. If the pus is not evacuated the abscess may (*a*) burst into the rectum by penetrating the internal sphincter and the overlying mucous membrane; (*b*) spread to the whole, instead of being confined to a part, of the intermuscular space, and thenceforth behave like a low intermuscular abscess.

Thomas Bartholin, 1616–1680. Professor of Anatomy, Medicine, and Mathematics, Copenhagen.
William Cowper, 1666–1709. Surgeon, London.

The diagnosis is made in the early stages by digital examination of the rectum, when an acutely tender, rounded cystic lump about the size of a walnut is felt above the level of the dentate line (fig. 842 (1)), generally in the posterior quadrant.

Treatment.—No time should be lost in evacuating the pus in the following manner :

Operation.—Access is obtained by inserting a Sims' speculum.

A short longitudinal incision is made over the lower border of the internal sphincter, extending downwards for ½ inch (1·25 cm.). A blunt-pointed director is passed deep to the internal sphincter into the main abscess cavity, and pus flows. The abscess having been emptied, the incision is enlarged sufficiently to allow digital exploration. This accomplished, the mucous membrane is freed by blunt dissection from the internal sphincter which is divided from below upwards, under direct vision, on to the director. The division is continued to the uppermost limit of the abscess cavity. Bleeding-points, which are not numerous, are controlled preferably by diathermy. No drainage tube is employed.

The local after-treatment is similar to that of sphincterotomy for fissure-in-ano (see p. 627).

2. **Low Intermuscular Anal Abscess** (80 per cent.).—This is the most common abscess of the region. It results from suppuration in the caudadly directed moiety of an anal gland. Persons of all ages are affected, and the condition is not uncommon, even in infancy and childhood. The constitutional symptoms are less pronounced than in the high variety, and because the pus can expand the walls of this part of the intermuscular space comparatively easily, the pain this abscess occasions is less severe than in the high variety. The early diagnosis is made in precisely the same manner as that described above, the sole difference being that the abscess lies low in the anal canal (see fig. 842 (2)). Untreated, frequently the abscess burrows towards the surface and presents subcutaneously (fig. 843) below the lower border of the internal sphincter.

FIG. 843.—Perianal abscess. (*Mr. W. B. Gabriel, London.*)

Treatment.—The principles of treatment differ in no respect from those described above. Should the abscess have implicated the perianal skin, the involved skin is best excised as described below.

3. **Ischio-rectal abscess** (6 per cent.) can arise in one of two ways. In more than half the cases it is an extension laterally through the external sphincter of a low intermuscular anal abscess (fig. 842 (3)). In the remainder, the infection is either lymphatic or blood-borne (fig. 842 (3a)). As the interlacing fibres of the conjoined longitudinal muscle intersect the space to commence with infection is not total. However, the fat with which the ischio-rectal fossa (fig. 844) is filled is vulnerable because it is poorly vascularised ; consequently it is not long before the whole space becomes involved. The ischio-rectal fossa communicates with that of the opposite side via the post-sphincteric space, and if an ischio-rectal abscess is not evacuated early, involvement of the contralateral fossa is not uncommon.

An ischio-rectal abscess gives rise to a tender, brawny induration palpable on the corresponding side of the anal canal and the floor of the fossa. Constitutional symptoms are severe, the temperature often rising to 102° F. (38·9° C.). Men are affected more often than women. In comparatively early cases there is no redness of the skin.

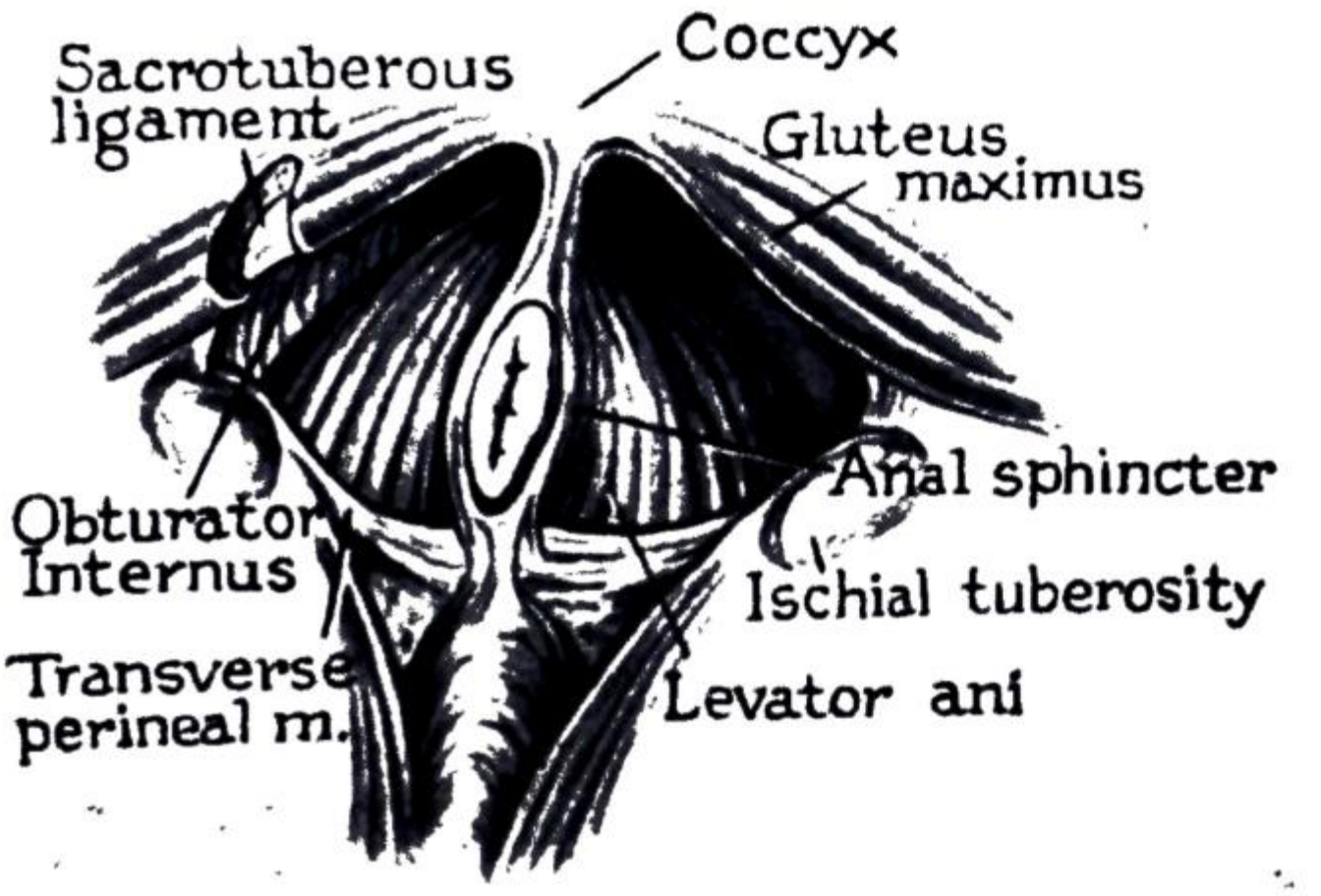

FIG. 844.—The ischio-rectal fossa. (*After G. L. Kratzer.*)

Treatment.—Operation should be undertaken early—as soon as it is certain that an abscess is present in this area—remembering that antibiotic therapy often masks the general signs.

Operation.—A +-shaped incision (fig. 845 inset) is made into the abscess. An adequate portion of skin that includes most, if not all, of the floor of the abscess is excised (fig. 845). The cavity is explored, and if septa exist they should be broken down gently with a finger and, what is most important, the granulation tissue lining the walls of the abscess is removed by the finger wrapped in gauze. This is done for two purposes (*a*) to permit antibiotics administered systemically to reach the abscess cavity; (*b*) so that the mouth of an opening leading to the intermuscular space, if present, can be seen. If a finger is now passed into the anal canal and pressure exerted on its lateral wall, should pus exude from an opening in the ischio-rectal fossa, the fact that the abscess belongs to category 3, as opposed to 3a, is established, and sphincterotomy should be performed. The whole cavity is packed very lightly with gauze wrung out in 1 : 2,000 bradosol solution, or any alternative weak antiseptic favoured by the operator. A T-bandage is applied. The subsequent after-treatment does not differ from that of the other forms of ano-rectal abscess.

FIG. 845.—Excision of the skin forming the floor of the ischio-rectal fossa is an essential step in the efficient treatment of an ischio-rectal abscess.

When the cavity has become filled with granulation tissue, skin grafting expedites final epithelialisation.

4. **Submucous abscess** occurs above the dentate line (fig. 842 (4)). It is rare, and should it occur (e.g. after the injection of hæmorrhoids) it always resolves.

5. **Abscess beneath the anoderm** (2 per cent.) originates in a superficial branch of an anal gland, and occupies the subcutaneous space beneath the anoderm below the dentate line (fig. 842 (5)). Its treatment is to incise the overlying anoderm under vision.

6. **Subcutaneous (External) Abscess** (2 per cent.).—The leading example of a perianal subcutaneous abscess is a posterior abscess (fig. 842 (6)) associated with a fissure-in-ano, described on p. 624.

FISTULA-IN-ANO

A fistula-in-ano is a track, lined by granulation tissue, resulting from an ano-rectal abscess which burst spontaneously or was opened inadequately (fig. 846). The fistula continues to discharge, seldom if ever healing permanently without surgical aid, because of constant reinfection from the anal canal or the rectum, inadequate drainage, and repeated movement of the related musculature. An ano-rectal abscess may, and sometimes does, produce a sinus the orifice of which has the appearance of a fistula, but it does not communicate with the anal canal or the rectum. Strictly speaking, by definition this is *not* a fistula, but a sinus.

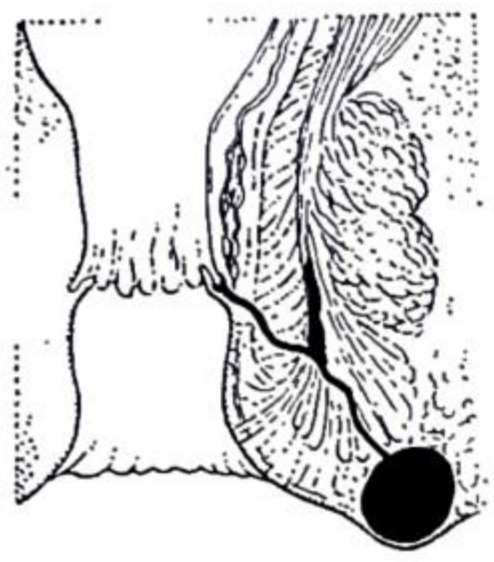

FIG. 846.—Demonstrating how readily simple incision of an abscess near the anus can result in a fistula-in-ano.

Clinical Features.—Commonly the principal symptom is a persistent purulent discharge that irritates the skin in the neighbourhood and causes discomfort. Often the history dates back for years. So long as the opening is large enough for the pus to escape, pain is not a symptom. Frequently there is a solitary external opening, usually situated within $1\frac{1}{2}$ inches (3·75 cm.) of the anus, presenting as a small elevation with granulation tissue pouting from the mouth of the opening. Sometimes superficial healing occurs ; pus accumulates and an abscess again forms and discharges through the same opening, or a new opening. So there may be present two or more external openings, usually grouped together on the right or left of the middle line, but occasionally, when both ischio-rectal fossæ are involved, an opening is seen on each side, in which case there is often intercommunication between them (fig. 847). As a rule there is much induration of the skin and subcutaneous tissues around the fistula.

FIG. 847.—Horseshoe fistula-in-ano. Both ischio-rectal fossæ involved. Nearly always there is only one internal orifice.

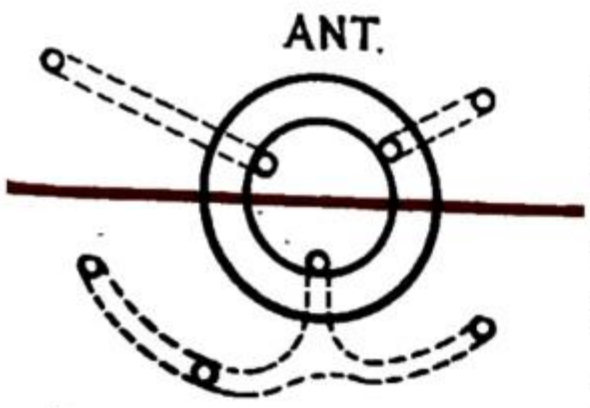

FIG. 848.—Illustrating Goodsall's rule.

Goodsall's Rule.—Fistulæ with an external opening in relation to the anterior half of the anus tend to be of the direct type (fig. 848). Those with an external opening or openings in relation to the posterior half of the anus, which are much more common, usually have curving tracks, and may be of the horseshoe-variety.

Rectal Examination.—Not infrequently an internal opening can be felt as a nodule on the wall of the anal canal. Irrespective of the number of external openings, there is almost invariably but one internal opening.

Proctoscopy sometimes will reveal an internal opening of the fistula. A hypertrophied papilla is suggestive that the internal orifice lies within the crypt related to the papilla (see fig. 850).

Probing.—In the past it was the universal practice to probe a fistula in the ward or the out-patient department. Such manœuvres accomplish nothing, are painful, and are liable to reawaken dormant infection. Furthermore, if probing is performed without the utmost gentleness, or if the patient, experiencing pain, makes a sudden jerk, there results a false passage which complicates the condition still further. Probing must be postponed until the patient is under an anæsthetic in the operating theatre.

Radiography of the thorax should be undertaken and the possibility of pulmonary tuberculosis considered, despite the fact that today it will be found in only a very small proportion of patients with fistula-in-ano.

The injection of lipiodol, or other opaque medium, along the sinus, prior to radiography, has little to recommend it. The radiographs thus obtained are seldom illuminating, and the procedure is likely to cause a recrudescence of inflammation.

Special Clinical Types of Fistulæ-in-ano :

1. **An anomalous pilonidal sinus** can extend to the anal verge, and there mimic a fistula-in-ano. The criteria of diagnosis are absence of an opening within the anal canal, a subcutaneous and far-reaching posterior disposition of the sinus, the absence of an indurated area of the anal wall or a visible internal orifice, and possibly the presence of hair in the discharge.

2. **Fistula connected with an Anal Fissure.**—Unlike the usual fistula-in-ano, pain (due to the fissure) is a leading symptom. The fistula is very near the anal orifice, usually posterior, and the external opening is often hidden by the sentinel pile (see also fig. 817, p. 624).

3. **Fistula with an internal opening above the ano-rectal ring** is due, almost invariably, to penetration by a foreign body or intraluminar incision of a high intermuscular abscess erroneously thought to be submucous.

4. **Tuberculous.**—If induration around a fistula is lacking, if the opening is ragged and flush with the surface, if the surrounding skin is discoloured and the discharge is watery, it strongly suggests that the fistula is due to a tuberculous infection. In more than 30 per cent. of patients suffering from pulmonary tuberculosis, virulent tubercle bacilli are present in the rectum. About 2 to 3 per cent. of fistulæ-in-ano are tuberculous, but in sanatoria and village settlements for tuberculous patients the incidence is higher. Histo-pathological examination supplies the only criterion of importance as to whether the tissue removed is tuberculous granulomatous tissue. Staining serial sections, and examining every third one, is a reliable method of ascertaining whether the tissue removed is tuberculous (C. L. Martin).

5. **Fistulæ with many external openings** may arise from tuberculous proctitis, ulcerative proctocolitis, bilharziasis, and lymphogranuloma inguinale with a fibrous rectal stricture. Colloid carcinoma sometimes complicates fistulæ-in-ano.

6. **Colloid Carcinoma arising within Perianal Fistulæ.**—Colloid carcinoma of the rectum is notoriously liable to be complicated by perianal fistulæ. In some instances the fistulous condition, with its discharge of colloid material, overshadows the primary carcinoma, and not a few unfortunate patients have had their condition diagnosed for a

FIG. 849.—Perianal fistulæ due to colloid carcinoma. No primary in the rectum. (*C. E. Dukes and C. Galvin.*)

Clement L. Martin, Contemporary. Surgeon, Mercy Hospital and City of Chicago Municipal Tuberculosis Hospital, Chicago.

time as an inflammatory fistula-in-ano. If a primary tumour is present in the rectum, usually it can be detected and its nature established by biopsy. It is possible, and C. E. Dukes has established conclusively that colloid carcinomatous fistulæ can develop without a primary neoplasm in the rectum (fig. 849). He regards such cases as examples of colloid carcinoma developing in a reduplicated portion of the intestinal tract.

Treatment by operation for fistula-in-ano was known in the first century A.D. That the fistulous track must be laid open from its termination to its source was a rule promulgated by John Arderne more than 500 years ago. Today, pre-operative treatment by antibiotic and cleansing enemata is to be regarded as a necessity.

The operation can best be described in stages :

Step 1.—When the patient has been anæsthetised, he is placed in the lithotomy position or in the prone jack-knife position, according to the preference of the operator. By bidigital palpation under anæsthesia, it is often possible to obtain more information concerning a fistula than can be learned from probing ; it is surprisingly easy to insert a probe through the wall of the track. Unfortunately, many inexperienced operators find it more reassurring to create a false passage than to risk criticism for not being able to demonstrate the internal opening. Careful bidigital palpation of the peri-anal tissues will often reveal a cord-like induration, representing the track, which will lead the intra-anal finger towards the proximal opening. Rather than insert a probe through the distal orifice at this stage, it is better to endeavour to find the internal opening via a proctoscope. If the internal opening still cannot be seen, the insertion of a probe retrogradely into an anal crypt, especially one with a nearby hypertrophied papilla, often reveals the internal portion of the track (fig. 850). The injection of methylene blue or other dye into the external mouth of the fistula before commencing the cutting part of the operation is not recommended, for it is unnecessary, and the result is sometimes confusing.

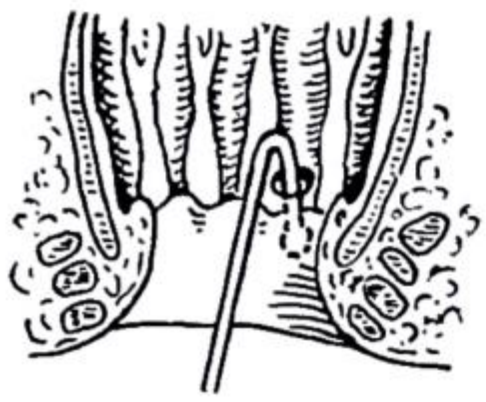

FIG. 850. — Retrograde probing of an anal crypt sometimes reveals the internal orifice of the fistula.

Step 2.—A probe-pointed director (fig. 851) is inserted into the distal orifice, and it is advanced delicately until it reaches a point where it does not pass readily. The track is opened along the director, and bleeding is controlled.

FIG. 851.—A director with a probe-pointed malleable extremity is a useful instrument.

Step 3.—If it is not at once evident in which direction the track passes, granulations are wiped away with gauze (it is seldom necessary to use a curette). Often this will leave a granulation-filled spot at one site only. Gentle probing at this spot frequently will give the clue to the continuation of the fistula. The director is reinserted, and again followed with the knife for a short distance. This procedure is repeated until the entire track, and any side channels, is laid open. As far as possible, all muscle is divided at right angles to its fibres. In the rare event of the track passing above the ano-rectal ring, cutting should cease at the level of the dentate line, and from thenceforth the operation is conducted as directed below. In most instances probing and laying open the track can be repeated until the entire track is laid open. Pursuing this course, if there is no internal opening the track will become bereft of granulations on wiping it. As a rule the internal opening can be demonstrated either by direct inspection through a proctoscope, or by a bent probe inserted into an anal crypt. In the latter circumstance the internal portion of the track is excised in continuity.

Step 4.—The edges of the track are trimmed, 1 to 3 mm. of tissue being removed —a step that makes post-operative packing unnecessary after the first twenty-four to thirty-six hours. E. S. R. Hughes advocates primary split skin grafting of the wound resulting from fistulotomy. The grafts are taken from the inner aspect of the thigh

John Arderne, 1307–1390. Practised surgery in Newark, and later in London.
For treating successfully Louis XIV's fistula-in-ano, Charles Félix, barber-surgeon to the Court, received a fee of a farm, 300,000 livres, and a title. 300,000 livres today would be worth between £12,000 and £15,000.

and applied to the anal wound, being stitched to the skin edges and to each other in the depths of the wound. Tulle gras is then superimposed, and a firm pack of cotton-wool applied. The first dressing is done on the fifth post-operative day.

When skin grafting is not employed, digital dilatation of the anus, or the passage of a St. Mark's Hospital dilator, every other day prevents pocketing or bridging of the granulating wound.

Treatment of a High-level Fistula.—When the fistula runs deep to the entire ano-rectal ring a two-stage procedure must be employed.

Operation.—The lower border of the ano-rectal ring having been reached by uncovering the sinus in the manner described, all tissue between the skin and the anal canal is divided, leaving the ano-rectal sphincter as a bridge across the cavity made by the incision. A seton is inserted above the muscle and through the remainder of the fistulous track (any type of heavy unabsorbable suture material can be employed), and the seton is threaded through the eye of a bendable probe that has been insinuated along the track over the sphincter muscle, viz.—

The probe having been disengaged, the ends of the suture are knotted *very loosely*. The wound is packed lightly, and the patient returned to bed. The seton (fig. 852) remains in place until the sphincter is supported firmly by newly-formed granulation tissue. From twenty to fifty days are required for the solid filling of the wound with granulation tissue.

If the seton is of braided stainless steel wire, which consists of twisted multiple component wire threads, it has a cutting edge when it is sawn to and fro. The patient can attend as an out-patient, and at each weekly visit, by untwisting the wire and grasping each end in a hæmostat, a little of the sphincter is severed. In due course all the tissue is cut through. When sectioned in this manner union of one part of the muscle occurs before the next is divided ; in other words, at no time do the severed ends gape asunder. Thus this method accomplishes complete division without jeopardising continence.

FIG. 852.—Seton *in situ* in a case of high fistula-in-ano.

Treatment in Other Special Circumstances.—In cases of tuberculosis, lymphogranuloma inguinale, and ulcerative colitis, operation should not be undertaken until the primary cause has been brought under control. In fistulæ due to colloid carcinoma, block dissection of the fistulous tracks in continuity with excision of the rectum offers the only prospect of eradicating the disease.

NON-MALIGNANT STRICTURE OF THE RECTUM AND ANAL CANAL

- Congenital
- Spasmodic
- Organic

1. **Congenital :**

(*a*) A stricture at the level of the anal valves, due to incomplete obliteration of the proctodeal membrane, sometimes does not give rise to symptoms until early childhood.

(*b*) Patients who have had an operation for imperforate anus in infancy may require periodic ano-rectal dilatation.

2. **Spasmodic :**

(*a*) An anal fissure results in spasm of the internal sphincter, which in time becomes fibrotic.

(*b*) Rarely, a spasmodic stricture accompanies pseudo-Hirschsprung's disease (see p. 518).

3. **Organic :**

(*a*) *Post-operative stricture* sometimes follows hæmorrhoidectomy performed incorrectly, and is rather frequent after sleeve resection of a portion of the rectum for a neoplasm.

(*b*) *Irradiation stricture* is an aftermath of irradiation proctitis.

(*c*) *Senile Anal Stenosis.*—A condition of chronic internal sphincter contraction is sometimes seen in the aged. Increasing constipation is present with pronounced straining at stool. Fæcal impaction is liable to occur. The muscle is rigid and feels like a tight umbrella-ring. There is no evidence of a fissure-in-ano.

The treatment is internal sphincterotomy.

(*d*) *Inflammatory Stricture.*—By far the most frequent cause of a *tubular* inflammatory stricture of the rectum is lymphogranuloma inguinale, and 80 per cent. of the sufferers are women. Frei's reaction is usually positive. This variety of rectal stricture is particularly common in Negro races, and may be accompanied by elephantiasis of the labia majora. Stricture of the rectum also complicates ulcerative procto-colitis ; in this instance the stricture is *annular*, and often more than one is present.

Clinical Features.—Increasing difficulty in defæcation is the leading symptom. The patient finds that increasingly large doses of aperients are required, and if the stools are formed, they are ' pipe-stem ' in shape. In cases of inflammatory stricture, tenesmus, bleeding, and the passage of muco-pus are superadded. Sometimes the patient comes under observation only when subacute or acute intestinal obstruction has supervened.

Rectal Examination.—The finger encounters a sharply defined shelf-like interruption of the lumen at a varying distance from the anus. If the calibre is large enough to admit the finger, it should be noted whether the stricture is annular (fig. 853) or tubular. Sometimes this point can only be determined after dilatation. When free bleeding occurs after dilatation of a supposed inflammatory stricture, carcinoma should be suspected (Grey Turner), and a portion of the stricture should be removed for microscopical examination.

FIG. 853.—Simple annular stricture of the rectum.

Treatment :

Prophylactic.—The passage of an anal dilator during convalescence after hæmorrhoidectomy greatly reduces the incidence of post-operative stricture. Efficient treatment of lymphogranuloma inguinale in its early stages should lessen the frequency of rectal stricture from that cause.

Dilatation by Bougies.—For anal and many rectal strictures dilatation by bougies at regular intervals, combined at first with lavage, is often satisfactory and occasionally curative. When the stricture is in the lower two-

George Grey Turner, 1877–1951. Professor of Surgery, Post-graduate Medical School, London.

thirds of the rectum, Hegar's dilators are suitable for this purpose. *Stricture of the upper third of the rectum should never be treated by dilatation* because of the risk of extra- or intra-peritoneal perforation of the bowel.

When the cause of the stricture is lymphogranuloma inguinale, general treatment of the infection by sulphathiazole and aureomycin is a most important part of the treatment.

Internal proctotomy is necessary as a prelude to dilatation of a tight annular stricture. Guided by the finger, a blunt-pointed bistoury is inserted through the stricture and from four to six cuts are made in posterior and postero-lateral directions, viz : ⟶

Colostomy must be undertaken when a stricture is situated in the upper third of the rectum, when a stricture is causing intestinal obstruction, and in advanced cases of stricture complicated by fistulæ-in-ano. In selected cases this can be followed by restorative resection of the stricture-bearing area. If this step is anticipated, the colostomy should be placed in the transverse colon.

Excision of the rectum is required in some resistant cases due to lymphogranuloma inguinale, when the associated proctitis persists in spite of general treatment.

BENIGN TUMOURS OF THE RECTUM

Adenoma is the commonest benign tumour of the rectum. Histologically it is composed of tubular glands similar to the glands of Lieberkühn, situated on a fibromuscular stroma.

In children it occurs as a bright-red, slightly lobulated, pedunculated tumour in the lower rectum, and is commonly termed a rectal polyp. At the time of presentation usually the child is between one and six years of age, which suggests that the neoplasm commences to grow soon after birth. Nearly always the patient is brought for advice because of the passage of bright-red blood or blood-stained mucus per rectum. If the pedicle is long enough, the adenoma appears at the anus during defæcation, causing tenesmus and pain. On digital examination of the rectum a mobile, rounded lump is felt, the stalk of which can often be hooked beneath the finger, permitting the bulbous end of the tumour to be withdrawn from the anus.

In a number of instances the patient is cured by self amputation of the polyp, by which is meant that a parent brings the polyp to the doctor—proof indeed that it has become detached, probably by becoming entrapped by the sphincter after defæcation. In 25 per cent. of these instances the base of the pedicle can be seen on proctological examination, and should be fulgurated. In other circumstances the polyp should be treated by excision (see p. 654).

The occurrence of carcinoma in an adenomatous polyp of a juvenile patient has been reported from time to time.

In adults an adenoma may give rise to similar symptoms, and it can occur at any age. Often adenomata are multiple, and are found on routine proctoscopy and sigmoidoscopy in cases of rectal hæmorrhage attributed to

Alfred *of Obstetrics and Gynæcology, Freiburg.*
Johann *–1756. Anatomist, Berlin. He demonstrated his anatomical preparations in*
London, *R.S.*

hæmorrhoids. Such adenomata are often sessile and sometimes pedunculated (fig. 854). An adenoma of the pelvic colon not infrequently causes a local intussusception, and only on sigmoidoscopy is its true high origin discovered.

FIG. 854.—Rectal polypi seen through a sigmoidoscope. (*W. R. Warner & Co., Ltd.*)

Differential Diagnosis.—Multiple adenomata of the rectum may be a part of *multiple colonic polyposis*, either hereditary or acquired (p. 545), and sigmoidoscopy, together with contrast radiography of the colon, is necessary to exclude this condition. Multiple adenomatous polypi must also be distinguished from inflammatory *pseudo-polyposis* occurring as a complication of ulcerative colitis, and from those of hypertrophic tuberculosis. With the exception of those occurring in children, adenomata are prone to become *carcinomatous*. The sign of malignancy, if the tumour can be felt, is induration of its base. Probably its malignant nature will be detected microscopically after local excision. Recurrence after complete removal of an adenoma is proof that a malignant change in its base has occurred. Adult patients suffering from adenoma of the rectum must be examined sigmoidoscopically at intervals after the tumour has been excised, in order to detect possible recurrence.

Treatment.—A solitary pedunculated adenoma situated in the lower two-thirds of the rectum is removed easily by drawing it down, ligating its base by transfixion, and dividing the pedicle with a diathermy knife. Pedunculated adenomata too high to be delivered through the anus can be removed by a diathermy snare through a sigmoidoscope. Sessile adenomata can be destroyed by a stiff insulated electrode applied through a sigmoidoscope.

Papilloma occurs in middle-aged or elderly patients. It is a villous tumour with finger-like projections, viz.——→

Histologically it consists of columnar epithelium on a fine connective tissue stroma. It is more velvety in appearance, and when within reach of the finger it feels smoother than an adenoma. Untreated, the tumour grows to a large size and sometimes encircles the rectum completely. While papillomata often eventually becomes carcinomatous, they may remain innocent for years. The most typical symptom is the passage of considerable amounts of clear mucus with bleeding occurring at intervals. All villous tumours are potential carcinomata. These growths, although less common than adenomata, have a slightly greater malignant potentiality. In 10 per cent. of specimens of carcinoma of the rectum removed by excision, the growth originated in a papilloma (C. E. Dukes).

Differential Diagnosis.—In patients who have resided in Egypt or another country where bilharzial infestation is rife, bilharzial papilloma must be excluded.

Treatment.—Diathermy coagulation is satisfactory in cases of small papilloma, but the patient must be examined at regular intervals, for recur-

Cuthbert Esquire Dukes, Contemporary. Director of Research Laboratories, St. Mark's Hospital, London.

rence is common. For large papillomata, especially the sessile variety, excision of the rectum is the only curative treatment. Some cases (not, as a rule, those invading the anal canal) are suitable for conservative resection of the rectum.

Fibroma (*syn.* fibrous polyp) is not uncommon. *It is not a neoplasm,* but is due to fibrosis of a thrombosed hæmorrhoid.

Benign lymphoma, which occurs as a circumscribed movable nodule, firm but not hard, and greyish-white to pink in colour, is essentially submucosal. This neoplasm, which occurs at all ages and in both sexes, has no definite capsule. Notwithstanding, complete local excision is curative.

Endometrioma is not exceedingly rare, and as a rule it is diagnosed as a carcinoma. This neoplasm produces either a constricting lesion of the recto-sigmoid, or a tumour invading the rectum from the recto-vaginal septum. The latter variety gives rise to a very tender submucous elevation of the rectal wall. Endometrioma occurs in females, usually between twenty and forty years of age ; less often at the menopause. Dysmenorrhœa with rectal bleeding are the main symptoms. On sigmoidoscopy endometriosis involving the recto-sigmoid junction usually presents as a stricture with the mucous membrane intact. Should the correct pre-operative diagnosis be established by biopsy, bilateral salpingo-öophorectomy is not infrequently followed by regression of the tumour, rendering resection either unnecessary (as has been reported on numerous occasions) or sufficiently significant to justify purely local excision.

Hæmangioma of the rectum, which is an uncommon tumour, is a cause of serious and, if the neoplasm is large, sometimes fatal hæmorrhage. When localised in the lower part of the rectum or anal canal, a hæmangioma can be excised after applying Goodsall's ligature (see p. 639). When the neoplasm is diffuse, or lying in the upper part of the rectum, the symptoms simulate ulcerative colitis, and often the diagnosis is missed for a long period. At other times the neoplasm is mistaken for a vascular carcinoma, an error which, fortunately, is not often a cause for serious regret, because the correct treatment of an extensive hæmangioma is excision of that portion of the ano-rectum bearing the neoplasm. Lesser procedures nearly always are followed by recurrence and renewed loss of blood.

Other rare benign tumours of the rectum include submucous lipoma, leiomyoma, and amputation neuroma. The last can follow hæmorrhoidectomy or some other operation on the anal canal. All can be cured by local extirpation of the tumour.

MALIGNANT TUMOURS OF THE RECTUM

Carcinoid Tumour.—Although it must be categorised as a malignant tumour, carcinoid tumour of the rectum, as far as its lethal properties are concerned, can be looked upon as a gradation between a benign tumour and a carcinoma. Formerly considered very rare, such a large number of carcinoid tumours of the rectum have been reported during recent years that a latter-day aphorism is ' keep carcinoid in mind when an atypical neoplasm of the rectum is encountered.' Like benign lymphoma, carcinoid tumour originates in the submucosa, the mucous membrane over it being intact. Consequently it seldom produces evidence of its presence in the early stages, when it appears as a small plaque-like elevation. The incidence of clinical malignancy, i.e. the occurrence of metastases, of these tumours in the rectum is 10 per cent. This is much less than that for carcinoid tumour of the small intestine (see p. 544) but it is greater than that of carcinoid tumour of the vermiform appendix (see p. 610). Multiple primary carcinoid tumours of the rectum are not infrequent. In common with carcinoid tumours elsewhere, the neoplasm is slow of progression, and usually metastasises late.

Treatment.—Resection of the rectum is advisable if the growth is more than 1 inch (2·5 cm.) in diameter, if recurrence follows local excision, or if the growth is fixed to the peri-rectal tissues. In every case a thorough search must be made for multiple lesions. Even when metastases are present in the liver, there is hope. A patient with metastases in the liver, in whom the primary neoplasm had been extirpated, survived thirteen years following intra-arterial injections of nitrogen mustard (F. W. Ellis).

Frank Wood Ellis, Contemporary. Surgeon, Veterans' Administration Hospital, Long Beach, California.

Carcinoma of the rectum is the fourth most common variety of malignant tumour found in women, and its frequency in men is surpassed only by carcinoma of the stomach, although in some countries it is equalled by carcinoma of the bronchus.

Origin.—The carcinoma commences as a nodule of atypical columnar epithelium, the rapidly proliferating cells of which extend on the surface by exuberant growth at its edges. Similar changes occur on the deep (submucosal) surface of the nodule. The less malignant varieties continue to extend towards the lumen; the more malignant varieties soon become necrotic in their centre, and give place to an ulcer with indurated, everted edges. In about 30 per cent. of cases operation specimens show that in some part of the bowel that has been removed, in addition to the carcinoma, there is one or more adenoma or papilloma, proof indeed that adenoma and papilloma of the rectum are pre-carcinomatous conditions. In approximately 3 per cent. of cases there is more than one carcinoma present.

Pathological Histology.—Three types of carcinoma of the rectum are recognised:

1. Adenocarcinoma (the most common variety); 2. Colloid carcinoma; 3. Anaplastic carcinoma.

Local spread occurs circumferentially rather than in a longitudinal direction, which rarely extends more than 1 to 2 cm. up and down the rectum. Usually a period of six months is required for involvement of one-quarter of the circumference, and eighteen months to two years for complete encirclement, the annular variety being common at the recto-sigmoid junction. After the muscular coat has been penetrated the growth spreads into the underlying fat, but is still limited by the fascia propria (peri-rectal fascia). Eventually, rarely before eighteen months from the commencement of the disease, the fascia propria is penetrated. If penetration occurs anteriorly, the prostate, seminal vesicles, or the bladder become involved in the male; in the female the vagina or the uterus are invaded. In either sex, if the penetration is lateral, a ureter may become implicated, while posterior penetration involves the sacrum and the sacral plexus.

Lymphatic Spread.—Enlargement of lymph nodes from bacterial infection is more frequent than enlargement from metastasis, and microscopical examination is required to detect carcinomatous involvement of the nodes. Lymphatic spread from a carcinoma of the rectum above the peritoneal reflexion occurs almost exclusively in an *upward* direction; below that level to within 1 to 2 cm. of the anal orifice the lymphatic spread is still *upwards*, but the first halting place is in the para-rectal lymph nodes of Gerota. The exception to this rule is when the neoplasm lies within the field of the middle hæmorrhoidal artery, i.e. between 4 and 8 cm. from the anus, in which case primary *lateral* spread along the lymphatics that accompany the middle hæmorrhoidal vein is not infrequent. *Downward* spread is exceptional, drainage along the subcutaneous lymphatics to the groins being confined, for practical purposes, to the lymphatic nodes of the peri-anal rosette and the epithelium lining the distal 1 to 2 cm. of the anal canal.

Metastasis at a higher level than the main trunk of the superior hæmorrhoidal artery occurs only late in the disease. A radical operation should ensure that the high-lying nodes are removed by ligating the inferior mesenteric artery and vein at the highest possible level, compatible with preserving the blood supply to the descending and iliac colon.

Venous Spread.—As a rule spread via the venous system occurs late, except in that portion of the anal canal where the anoderm is firmly adherent to deeper structures (see fig. 799). Anaplastic and rapidly growing tumours in younger patients are much more liable to spread in this way than tumours of relatively low malignancy. The principal sites for blood-borne metastases are : liver (34 per cent.), lungs (22 per cent.), adrenals (11 per cent.). The remaining 33 per cent. is divided among the many other locations where secondary carcinomatous deposits are wont to lodge.

Peritoneal dissemination may follow penetration of the peritoneal coat by a high-lying rectal carcinoma.

Stages of Progression.—As a rule carcinoma of the rectum does not metastasise early. From specimens removed at operation, C. E. Dukes classifies carcinoma of the rectum into three stages (fig. 855).

(A) The growth is limited to the rectal wall (15 per cent.).

(B) The growth is extended to the extra-rectal tissues, but metastasis to the regional lymph nodes has not yet occurred (35 per cent.).

(C) There are secondary deposits in the regional lymph nodes (50 per cent.). These are subdivided into C^1 where the para-rectal lymph nodes alone are involved, and C^2 where the nodes accompanying the supplying blood-vessels are implicated.

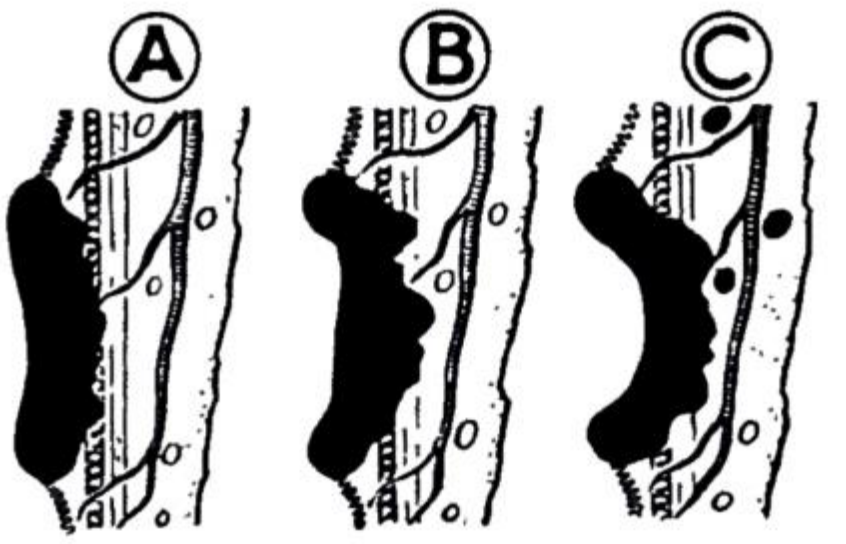

FIG. 855.—The three cardinal stages of progression of the neoplasm. (*After Cuthbert Dukes.*)

This does not take into account cases that have metastasised beyond the regional lymph nodes or by way of the venous system.

Histological Grading.—In the great majority of cases carcinoma of the rectum is a columnar-celled adenocarcinoma. The more nearly the tumour cells approach normal shape and arrangement, the less malignant is the tumour. Conversely, the greater the percentage of cells of an embryonic or undifferentiated type, the more malignant is the tumour. Broders' histological classification into four grades has been simplified by C. E. Dukes into three grades :

Low grade = well-differentiated tumours	11 per cent.	Prognosis good.
Average grade	64 per cent.	„ fair.
High grade = anaplastic tumours . .	25 per cent.	„ poor.

Colloid carcinoma is present in 12 per cent. of cases. There are two forms ; much the more frequent is secondary mucoid degeneration of an adenocarcinoma. Histologically the glandular arrangement is preserved and mucus fills the acini. This

Albert Compton Broders, Contemporary. Pathologist, Mayo Clinic, Rochester, U.S.A.

type is of average malignancy. In a small number of cases the tumour is a primary mucoid carcinoma. The mucus lies within the cells, displacing the nucleus to the periphery, like the seal of a signet ring. Primary mucoid carcinoma gives rise to a rapidly growing bulky growth which metastasises very early and the prognosis of which is very bad. See also Colloid Carcinoma arising in a Fistula-in-ano (p. 649).

Clinical Features.—Carcinoma of the rectum occurs most frequently between forty and seventy years of age. It is not uncommon earlier in life, and of recent years more cases below the age of forty have been recorded than formerly. When the disease commences in youth, in spite of radical treatment death usually results within a year. Carcinoma of the rectum occurs nearly twice as commonly in men as in women and it can attack any portion of the rectum (fig. 856). Usually early symptoms are so slight that more often than not the patient does not seek advice for six months or more.

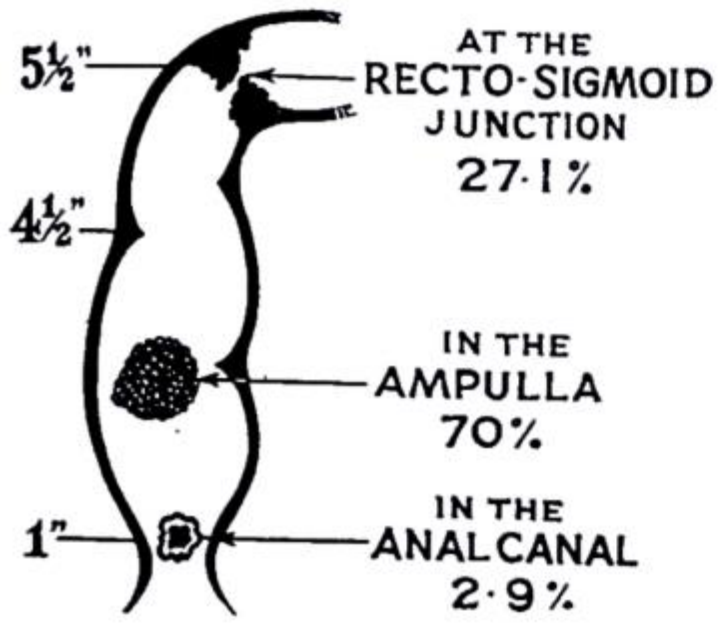

FIG. 856.—Sites of carcinoma of the rectum. (*Cancer Research Committee's findings.*)

Bleeding is the earliest and most constant symptom. There is nothing characteristic about the time at which it occurs, neither is the colour nor the amount of blood so passed distinctive: often the bleeding is slight in amount, and occurs at the end of defæcation, or is noticed because it has stained underclothing. Indeed, more often than not the bleeding in every respect simulates that of internal hæmorrhoids[1], and it is lamentable that, in spite of oft-repeated exhortations not so to do without examining the rectum, too often the patient's doctor prescribes a salve while the growth advances from stage one to stage two. Exceptionally, bleeding is copious, and clots are passed. Another departure from the more usual is the passage of blood of a darker hue, which sometimes occurs when the carcinoma is situated in the region of the recto-sigmoid junction.

Alteration in bowel habit is the next most frequent symptom, and the commonest deviation from normality is increasing constipation. The patient finds it necessary to take, or to supplement, the usual dose of aperient, and as a result a tendency towards diarrhœa ensues. A frequent symptom is a sensation that defæcation is incomplete; consequently the patient endeavours to empty the rectum several times a day (spurious diarrhœa), often with the passage of flatus and a little blood-stained mucus ('bloody slime'). A patient who has to get up before the accustomed hour in order to defæcate, and one who passes blood and mucus in addition to fæces[2], is usually found to be suffering from carcinoma of the rectum. Usually it is the patient with an annular carcinoma at the pelvi-rectal junction who suffers with increasing constipation, and the one with a cauliflower growth in the ampulla of the rectum with early morning diarrhœa (John Bruce).

Pain.—In the early stages pain is singularly absent, but pain of a colicky character accompanies advanced growths of the recto-sigmoid and is due to

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[1] Hæmorrhoids and carcinoma sometimes co-exist (see fig. 821).
[2] 'Early morning bloody diarrhœa.'

John Bruce, Contemporary. Regius Professor of Surgery, University of Edinburgh.

some degree of intestinal obstruction. When a deep carcinomatous ulcer of the rectum erodes the prostate or bladder, there is severe pain. Pain in the back, or sciatica, occurs when the growth presses upon or invades the sacral plexus.

Abdominal examination is negative in early cases. Especially when an advanced annular growth is situated at the recto-sigmoid junction, signs of obstruction to the large intestine are likely to be present. By the time the patient seeks advice metastases in the liver may be palpable (fig. 857). When the peritoneum has become studded with secondary deposits, ascites will be present. On rare occasions a hydronephrosis, due to implication of a ureter by the primary growth, is discovered.

FIG. 857. — Massive irregular enlargement of the liver. Rectal examination revealed a carcinomatous ulcer on the right side of the ano-rectal junction. Hard lymph node in right Scarpa's triangle. The patient has a left inguinal hernia and a right saphenous varix.

Rectal Examination. — In approximately 90 per cent. of cases the neoplasm can be felt digitally : in early cases as a plateau or as a nodule with an indurated base. When the centre ulcerates, a shallow depression will be found, the edges of which are raised and everted ; this, combined with induration of the base of the ulcer, is a frequent and an unmistakable finding. At a later stage the ulcer becomes crateriform, and its edges, although indurated and everted, are flatter than at an earlier stage. By this time the rectal wall is fixed to deeper structures. By bimanual examination it may be possible to feel the lower extremity of a carcinoma situated in the recto-sigmoid junction. After the finger has been withdrawn, if it has been in direct contact with a carcinoma, it is covered with blood, or muco-purulent material tinged with blood. When a carcinomatous ulcer is situated in the lower third of the rectum, sometimes involved lymph nodes can be felt as one or more hard oval swellings in the extra-rectal tissues posteriorly or postero-laterally above the tumour. In females a vaginal examination should be performed, and when the neoplasm is situated on the anterior wall of the rectum, with one finger in the vagina and another in the rectum, very accurate palpation can be carried out.

Sigmoidoscopy is required in order to visualise a carcinoma of the rectum. This examination is of cardinal importance when the neoplasm is beyond the reach of the finger.

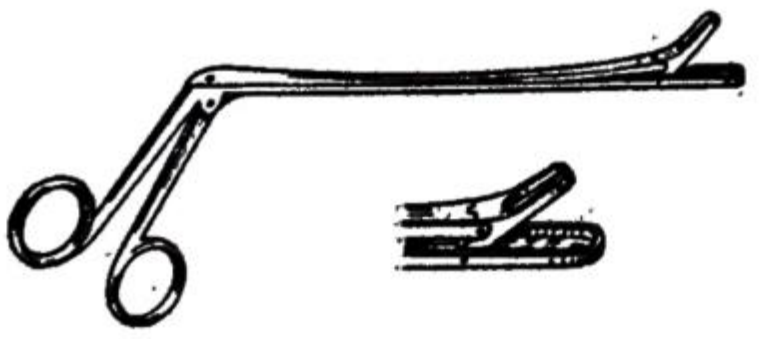


FIG. 858.—Yeomans' biopsy forceps.

Biopsy.—Employing biopsy forceps (fig. 858) by way of a sigmoidoscope, a portion of the edge of the tumour is removed. If possible another specimen from the more central part of the growth is obtained also. Expert histological examination will not only enable the

Frank C. Yeomans, Contemporary. Emeritus Professor of Proctology, New York Polyclinic Medical School.

diagnosis of carcinoma to be confirmed, but the tumour can be graded as to its relative malignancy.

Barium enema is not required except (*a*) in rare instances when sigmoidoscopy is unsatisfactory because of spasm, (*b*) in cases of suspected carcinoma of the pelvi-rectal junction when sigmoidoscopy fails to reveal the growth because of spasm of the bowel below it, and (*c*) when multiple adenomatous polyposis of the colon must be excluded.

Differential Diagnosis.—When a seemingly benign **papilloma** or **adenoma** shows evidence of induration or friability, it is certain that malignancy has occurred, even in spite of biopsy findings to the contrary. On the other hand, biopsy is invaluable in distinguishing carcinoma from an **inflammatory stricture** or an **amœbic granuloma,** which simulates a carcinoma very closely. The possibility of a neoplasm being an **endometrioma** should always be entertained in patients with dysmenorrhœa. Finally, the importance of bearing in mind the possibility of a **carcinoid tumour** in atypical cases has been emphasised already. In the last four instances biopsy frequently will establish the correct diagnosis.

TREATMENT

It is conceded universally that a combined (abdominal and perineal) excision offers an excellent prospect of prolonged survival if extirpation is carried out comparatively early, and because of the extreme suffering that is entailed if the neoplasm is allowed to remain, unless the patient is totally unfitted for a major operation, some form of excision of the rectum is mandatory.

Apart from co-existent disease or senile enfeeblement, the only prohibitions to excision of the rectum are widespread distant metastases and extensive peritoneal deposits. Many instances have been reported where a presumed solitary primary metastasis in the liver has been resected, either at the time of excision of the rectum, or subsequently. Even when metastases in the liver are irremovable, resection of the rectum is often justifiable, and there are numerous instances where after that procedure the patient has survived in comfort for a year or two.

Usually a combined (abdominal and perineal) excision is conceded to offer the best prospect of eradicating the disease. The indications for other procedures, and methods of carrying them out, will be discussed later (see p. 663).

The combined operation can be carried out as an abdomino-perineal procedure (Ernest Miles), by which is meant that the abdominal part of the operation is undertaken first, or a perineo-abdominal (Gabriel), where the perineal stage is performed before the abdominal stage, or as the synchronised procedure, where two operating teams work simultaneously.

The advantages claimed for the perineo-abdominal over the abdomino-perineal are (1) the lateral ligaments of the rectum being divided from below facilitates the delivery of the growth ; (2) with the true pelvis empty (see fig. 861), approximation of the edges of the peritoneum in the depths of the pelvis presents no difficulty, whereas if the true pelvis contains the mobilised bowel with a bulky growth, it can be very difficult ; (3) asepsis is less endangered when disconnection of the tumour-bearing bowel is carried out after the abdomen has been closed.

Five days pre-operative preparation of disinfection of the alimentary tract by sulphasuccidine or antibiotics, similar to that employed for partial colectomy (see p. 549), is required. Before commencing the operation in the male, a gum-elastic catheter is tied into the urethra.

William Ernest Miles, 1869–1947. Surgeon, The Cancer Hospital (now called the Royal Marsden Hospital), London.

Perineo-abdominal Operation :

Preliminary exploratory laparotomy through a right lower paramedian incision is performed. The liver and the peritoneum are examined for metastases. The degree of fixity of the growth is established from above, and it is often found to be less than was anticipated from a rectal examination. If the growth is operable, the abdominal wound is closed by four strong through-and-through sutures tied over a roll of gauze. A sterile folded towel is placed over the gauze and retained in position by two pieces of adhesive strapping.

Perineal Stage.—The patient is turned into the left lateral position. After a small piece of gauze has been placed in the anal canal, the anus is firmly closed by two purse-string sutures of stout silk. An elliptical incision is made around the anus and the posterior end of the incision is inclined towards the right buttock (fig. 859 inset) so as to provide a slightly lateral scar subsequently. The posterior part of the incision is deepened and the coccyx is disarticulated and retracted forwards. The left forefinger is insinuated under the levator ani which is divided lateral to the finger, at first on one side and then on the other. The apex of skin anterior to the anus is grasped in a hæmostat, which serves as a retractor, and by scissors and gauze dissection the wound is deepened, when the catheter within the membranous urethra will be felt. Both in the male and the female a plane of cleavage will be found between the rectum and the prostate or the rectum and the vagina, respectively. This plane having been determined, the strong median raphé of the perineum is divided, after which the rectum can be stripped from the prostate or the vagina. This accomplished, the posterior part of the wound is deepened. The strong fascia of Waldeyer, which arises from the lower sacral vertebræ and is inserted into the upper part of the anal canal, is severed. The middle sacral artery will probably need ligation. The rectum can then be stripped off the sacrum by gauze dissection, aided here and there by dividing bands of fascia with scissors, until the level of the sacral promontory is almost reached. The mobilised rectum is enclosed in a sterile rubber glove which is secured by two strong silk sutures. By pulling the rectum downwards, and further dissection above the level of the prostate or vagina, the pouch of Douglas or the recto-vesical peritoneal pouch is seen. It is opened, keeping close to the bowel (fig. 859). With long blunt-ended scissors, the opening is enlarged on either side of the recto-sigmoid and the opening is extended upwards on each side of the recto-sigmoid as far as can be reached. The lateral ligaments of the rectum are now divided and the middle hæmorrhoidal vessels ligated if necessary (if they are small, ligation is not required). The rectum, with its superior hæmorrhoidal vessels intact, is now freed ; it is swabbed with flavine and pushed into the peritoneal cavity. Closure of the floor of the peritoneum is commenced anteriorly with a running suture of No. 1 chromic catgut. After three or four stitches have been placed, the last is locked. The point of the needle pierces a small swab ; the excess of catgut is wound around the swab, and the swab with the needle and suture

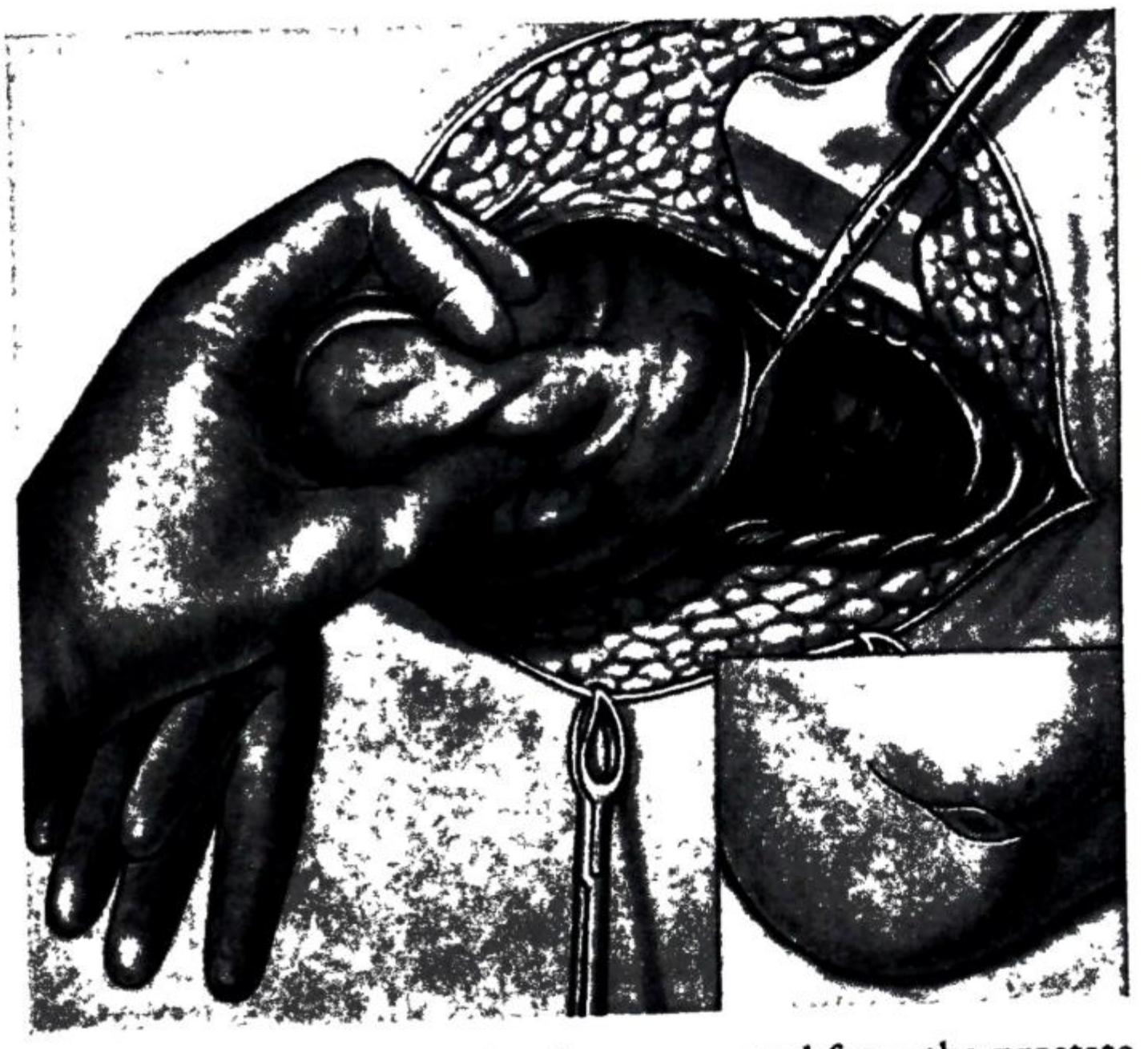


FIG. 859.—The rectum has been separated from the prostate and the recto-vesical peritoneal pouch is being opened. *Inset:* The skin incision. (*After W. B. Gabriel.*)

Heinrich Wilhelm Gottfried von Waldeyer-Hartz, 1836–1921. Professor of Anatomy, Berlin.

attached is pushed into the peritoneal cavity. After attending to hæmostasis of the perineal wound, it is closed anteriorly and posteriorly around a large drainage tube which is later connected to a water-sealed bottle. If hæmostasis is unsatisfactory, or when the wound has been infected by perforation of the bowel during the dissection of an adherent growth, the posterior part of the wound is left open and a special rubber bag, which does not adhere to the wound, is inserted, followed by gauze packing. In either event a large dressing of gauze and wool is applied, and a triangular bandage and a many-tailed abdominal binder are left in place.

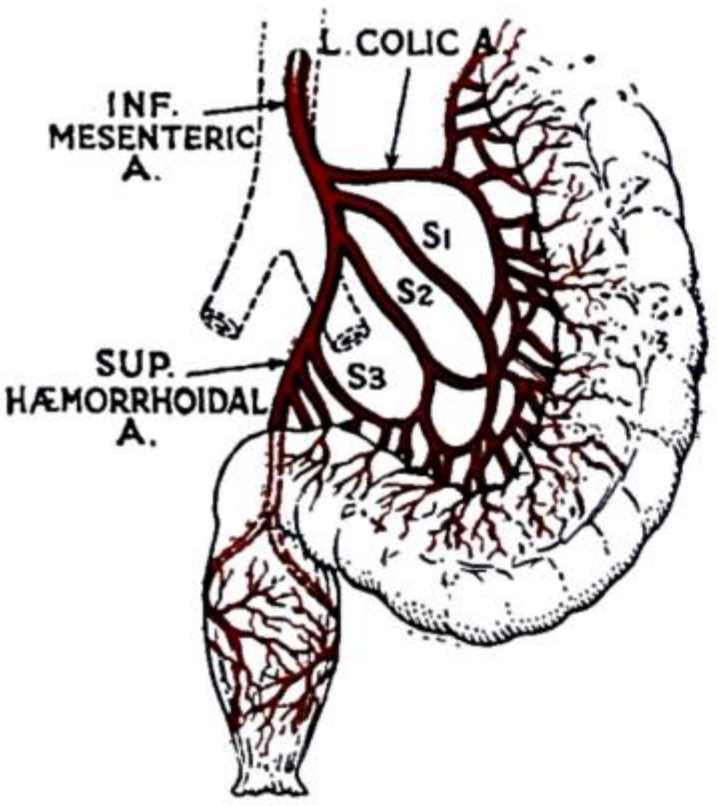


FIG. 860.—The inferior mesenteric artery. S_1 S_2 S_3 = sigmoid branches.

Abdominal Stage.—The patient is now turned on to his back and the table is tilted into a moderate Trendelenburg's position. A drip blood transfusion is commenced. The abdominal wound is reopened and the small intestine is packed away from the pelvis. The rectum, covered by the rubber glove, is withdrawn. After further upward extension of the incisions in the peritoneum on either side of the bowel, the sigmoid and then the pelvic colon is withdrawn. By exerting traction on the bowel, the mesocolon and its contained blood vessels can be defined clearly. In order to effect complete extirpation of the lymphatic field, the inferior mesenteric artery (fig. 860) is ligated at its origin : in a small proportion of cases where the collateral circulation along the marginal arteries proves inadequate this entails sacrificing the descending colon. At the site of the proposed colostomy a muscle-splitting incision 4 inches (10 cm.) long is made, the fibres of the internal oblique being divided at right angles. That portion of the colon selected for the colostomy is drawn out of this incision and the paracolic gutter is encircled with a running suture, which is not tied until the pelvic colon and the rectum have been passed through the incision up to the stitch ; the stitch is then tied, thereby closing the lateral space. The bowel is left lying on the abdominal towels (fig. 861 inset). Closure of the pelvic floor (fig. 861), which was commenced from below, is completed. The paramedian incision is closed. The colon, emerging from the smaller incision, is sutured to the peritoneum and the internal oblique. The mesocolon is ligated 1½ inches (3·75 cm.) above the surface, and at this point the intestine is clamped and divided with a diathermy knife. The clamp having been removed, a No. 15 rubber catheter is sutured into the open mouth. After dressings have been placed on the abdominal wounds, the bandage and binder that were left in place are fastened in position.

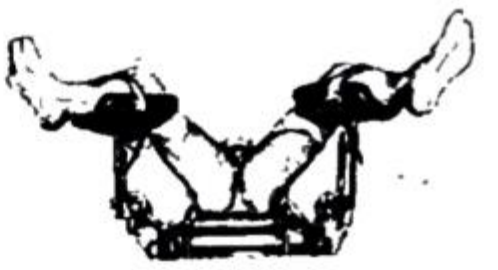
FIG. 861.—The cut edges of the pelvic peritoneum are being united over the space filled by packing left after excision of the rectum. *Inset:* The rectum and pelvic colon drawn through the left iliac incision to form a terminal colostomy. (*After W. B. Gabriel.*)

After-treatment.—The patient is returned to bed and the foot of the bed is raised on blocks for six to twelve hours, blood transfusion being continued as neces-

Friedrich Trendelenburg, 1844–1924. Professor of Surgery, Leipzig.

sary. The urethral catheter is connected with a water-sealed bottle. In many cases the catheter can be removed after forty-eight hours but it may have to be reinserted if voluntary micturition is not re-established after twenty-four hours' trial of intermittent catheterisation as required. The catheter is removed from the colostomy after twenty-four hours, and the colostomy opening is trimmed on the tenth day.

Combined Synchronised Excision of the Rectum.—With the patient in Trendelenburg-lithotomy position, the legs being supported in special crutches designed by Lloyd-Davies———→ access is afforded to the abdomen and the perineum at the same time. Two surgeons operate simultaneously, one performing the perineal dissection and the other the abdominal portion of the operation. This reduces considerably the time expended in performing the operation, and obviates turning the patient. A disadvantage is that the operation is often followed by prolonged dysuria due to damage of the nervi erigentes, but the fact that the synchronised method results in a greatly increased resectability-rate must be taken into consideration.



Less Extensive Operations :

Abdominal Radical Restorative Resection.—In cases of carcinoma of the rectum situated above the peritoneal reflection, lymphatic spread is virtually confined to the upward paths, and wide resection of the bowel with its lymphatic field, followed by end-to-end anastomosis and preservation of the sphincter mechanism is both justifiable and highly desirable.

This apparently ideal treatment was, and still is, unpopular in many quarters because it has been found that local recurrence occurred in a formidable percentage of cases. It has now been substantiated that the so-called recurrences are due, for the most part, to local implantation of free malignant cells into the distal segment that is to be preserved, the survival and rooting of these cells being favoured by disinfection of the intestine by sulphasuccidine and antibiotics. Naunton Morgan has shown that when a suitable clamp is placed at least 2 inches (5 cm.) below the neoplasm, and the rectum is irrigated with a solution of 1 : 500 mercury perchloride and dried thoroughly before division of the gut, and the lumen of the proximal end and the edges of both segments are swabbed with the same solution before anastomosis, the incidence of local recurrence is reduced precipitously.

Restorative resection should be performed only when the tumour is high in the rectum, i.e. at least 4 inches (10 cm.) above the anal orifice, and even then it should neither be attempted if the build of the patient, and/or the anatomy of the colon and its vascular supply, threatens to make restoration of the continuity of the alimentary canal difficult, nor in a young subject in whom these neoplasms rapidly grow and recur.

The perineal operation (Lockhart-Mummery) does not remove the lymphatic field in relation to the inferior mesenteric artery, and it is reserved mainly for poor-risk patients when the neoplasm is situated in the lower third of the rectum.

Palliative colostomy is indicated only in cases giving rise to intestinal obstruction, or where there is gross infection of the neoplasm.

More Extensive Operations.—When the carcinoma of the rectum has spread to contiguous organs, oft-times the radical operation can be extended to remove these structures. Thus in the male, where the spread is usually to the bladder, a total cystectomy and resection of the rectum can be effected. In the female the uterus acts as a barrier preventing spread from the rectum to the bladder. Accordingly, a total hysterectomy should be undertaken in addition to excision of the rectum. Should the bladder be involved, then pelvic evisceration must include that structure. Pelvic evisceration for carcinoma of the rectum is justifiable only when the surgeon is reasonably confident that the growth can be removed *in toto*. When the growth is of

Oswald V. Lloyd-Davies, Contemporary. Surgeon, St. Mark's Hospital, London.
Clifford Naunton Morgan, Contemporary. Surgeon, St. Mark's Hospital, London.
John Percy Lockhart-Mummery, 1875–1957. Surgeon, St. Mark's Hospital, London.

high-grade malignancy, so great is the likelihood of local recurrence that pelvic evisceration is contraindicated.

Pelvic Evisceration (Brunschwig's operation).—The aim is to remove all the pelvic organs, together with the internal iliac and the obturator groups of lymph nodes (fig. 862). The lithotomy-Trendelenburg position facilitates the procedure, and ligation of both internal iliac arteries diminishes the blood loss. Rarely is it possible to preserve sufficient peritoneum to form a pelvic peritoneal floor, and the small intestine fills the bared pelvis. Especial care must therefore be taken to suture accurately the perineal skin, and avoid pressure necrosis of the perineal incision by nursing the patient on alternate sides. Both ureters are transplanted into the mobilised upper sigmoid colon, and about 3 inches (7·5 cm.) of viable colon is made to protrude through the abdominal wall in order to form a spout. A split skin graft applied to the protruding colostomy helps to prevent trauma of the bowel. The disadvantages of a wet colostomy are formidable, and some exponents of this operation prefer to perform cutaneous ureterostomy rather than to construct a cloaca.

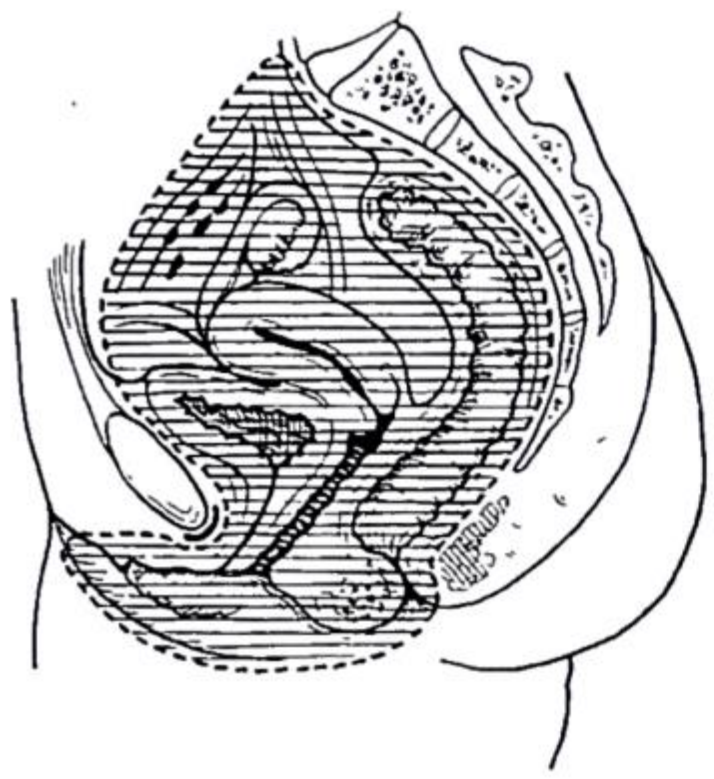


FIG. 862.—Radical pelvic evisceration, indicating the extent of the dissection and the viscera removed.

MALIGNANT TUMOURS OF THE ANUS

Carcinoma of the anus differs from carcinoma of the rectum in histological structure, behaviour, and the requisites for curative treatment. This is mainly because of its abundant lymph drainage, both superficial and deep (see figs. 804 and 805).

Squamous-celled Carcinoma.—The average age (forty-eight years) of patients with carcinoma of the anus is five years below that of the average age of patients presenting with carcinoma of the rectum proper. Because of its superficial situation the presence of the lesion is recognised by the patient,

FIG. 863.—Neglected papillomata of the anus which have become malignant. The patient was a woman of forty-three years of age and symptoms had been present for eight years.

who more often than not presents early. The exception to the rule is when radiation carcinoma develops in the anal and perianal skin of a patient unwisely treated with lightly filtered X-rays for pruritus ani. The chronic radiation dermatitis becomes so familiar to the patient that too often he

Alexander Brunschwig, Contemporary. Surgeon, Memorial Hospital for the Treatment of Cancer and Allied Diseases, New York.

does not perceive the superimposition of carcinoma. Simple papillomata (anal warts) sometimes take on a carcinomatous change (fig. 863).

Basal-celled Carcinoma.—Of twenty-eight cases occurring at the Mayo Clinic, seven were basaloid small-celled carcinomata that occurred near the dentate line, and showed a high degree of malignancy. With these exceptions, basal-celled carcinomata are found predominantly at the anal margin. The distal lesions are of relatively low malignancy.

Melanoma.—According to world statistics, 1·6 per cent. of all melanomata are located in the anal epithelium. Melanoma of the anus presents as a bluish-black soft mass that frequently has been confused with a thrombotic pile, and unfortunately is incised on account of that belief. Such trauma, followed by the trauma of defæcation, incites the tumour to rapid and unbridled metastasis. Left undisturbed, it ulcerates, and with the appearance of ulceration the colour of the tumour changes from blue to black. As ulceration proceeds, the black colour may be lost, but the metastases are laden with melanin. The inguinal lymph nodes are involved early. Unless a melanoma is excised at an early stage, it disseminates by way of the blood-stream.

Treatment :

Radiotherapy.—Either low-voltage contact X-rays or interstitial gold radon seeds, 2 millicuries each, placed 1·5 cm. apart at the base of a small tumour, should be employed only in the following types of cases (G. T. Pack) :

1. Early papillary or basal-celled carcinoma of low-grade malignancy.
2. Advanced lesions that have recurred after operation.
3. In an inoperable case, with the hope of converting an inoperable carcinoma into one that is resectable.

Operation.—With the above exceptions, all cases should be treated by the radical operation described below.

Radical operation for malignant disease of the anus must be even more radical than that obtaining for the average case of carcinoma of the rectum. A curative operation, therefore, comprises removal of the area of skin shown in fig. 864, together with a block dissection of the inguinal nodes and a radical abdomino-perineal

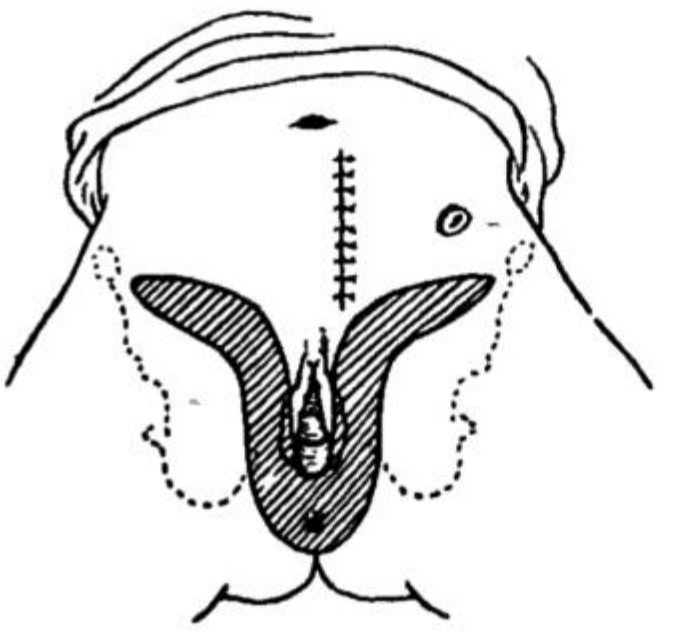


FIG. 864.—Radical operation for carcinoma of the anus, showing the area of skin removed. In the male the lower half of the scrotum is included. *(After G. T. Pack and J. C. Baldwin.)*

excision of the rectum. The results of this formidable operation, which is founded on sound premises based on pathology, gives more favourable results than has been generally believed. It should be noted that dissection of the lymph nodes of the groin or groins is carried out only when involvement of the nodes can be recognised clinically, or when a doubtful node, submitted to frozen section at the time of the operation, proves to be involved. As has been emphasised already, patients with carcinoma of the anus often present early, and in about four out of every seven patients the inguinal nodes are not involved clinically. Should they become so later, dissection of the groin is carried out.

The Mayo Clinic, Rochester, Minnesota, is the largest private clinic in the world (1,928 beds).
George Thomas Pack, Contemporary. Surgeon, Memorial Hospital for Cancer and Allied Diseases, New York.

CHAPTER XXIX

THE UMBILICUS AND THE ABDOMINAL WALL (EXCLUDING HERNIA)

HAMILTON BAILEY

THE UMBILICUS

The umbilical cord takes shape during the second month of fœtal life by an elongation of the body stalk. It is composed of Wharton's jelly, covered by ectoderm, and within it are to be found the following structures :

The allantois arises as a diverticulum from the yolk-sac, and is one of the first structures to become differentiated in the embryo. Long after the yolk-sac has given origin to the primitive alimentary canal, the allantois can be observed as a long, narrow, tubular structure communicating with the cloaca, passing out of the cœlom, through the umbilicus, into the umbilical cord, and ending blindly near the placenta. By the time of birth the portion outside the body has disappeared ; the part within the body forms the urachus and all the bladder, except the trigone.

The vitello-intestinal (*syn.***omphalo-mesenteric**) **duct** is a tubular outgrowth of the yolk-sac from which the fore-, the mid- and the hind-gut are derived (fig. 865).

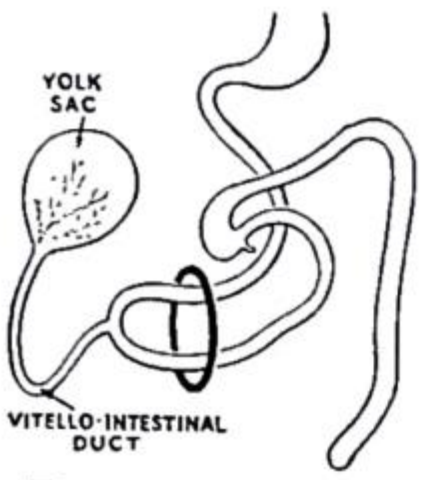


FIG. 865.—Alimentary canal of an embryo, showing the vitello-intestinal duct attached to the yolk-sac.

In 98 per cent. of cases, by the time the embryo is 12 mm. in length (about forty-four days old) the vitello-intestinal duct atrophies and disappears, but its accompanying blood-vessels persist. The omphalo-mesenteric artery becomes the superior mesenteric artery, and the corresponding vein the portal vein.

The Umbilical Vein.—Originally there are two umbilical veins, but early in fœtal life the right one atrophies and disappears. The umbilical vein is of large size, and carries oxygenated blood from the placenta to the fœtal liver where, having given off branches, it bifurcates. One bifurcation joins the left portal vein, while the other passes on as the ductus venosus to empty its contents into the inferior vena cava.

FIG. 866.—Seven months' fœtus, showing disposition of the umbilical vessels and the allantois from within the abdomen. (*After Max Brödel.*)

The umbilical arteries (fig. 866) pass from the internal iliac arteries near their commencement to, and through, the umbilicus, and in a spiral fashion traverse the umbilical cord, to join the placental plexus.

The fibrous ring of the umbilicus is situated in the blended aponeurosis of the linea alba at, or below, the centre of that line. It is filled with scar tissue in which are embedded the remnants of the umbilical vein, the umbilical arteries, the vitello-intestinal duct, and the allantois. After delivery, in the early days of infancy, while the umbilicus is in the process of becoming a consolidated scar, with the exception of the allantois (see above), the disused structures just referred to shrink into impervious cords. These cords diverge from the abdominal aspect of the umbilicus into extraperitoneal fatty tissue, and produce peritoneal folds. Upwards, in the free edge of the falciform ligament, runs the ligamentum teres (the obliterated umbilical vein) to the longitudinal fissure of the liver. Directly downwards to the apex of the bladder runs the urachus (obliterated allantois) (see fig. 875), while obliquely downwards and outwards pass the obliterated hypogastric (umbilical)

Thomas Wharton, 1614–1673. Physician, St. Thomas's Hospital, London

arteries to join the internal iliac arteries near their origin. Usually more cicatrisation occurs in the urachus than in the other structures; this causes the umbilical scar to be pulled downwards, and as a consequence the upper part of the umbilicus becomes its weakest point.

Lymphatics.—The umbilicus is well supplied by lymphatic vessels that drain into both groins and both axillæ (fig. 867). To emphasise this point, the following case will be quoted:

During an epidemic of smallpox a society lady wished to be revaccinated 'where the scar wouldn't show.' She selected an area just beneath the umbilicus. The inoculation was carried out in accordance with her wishes. Four days later she was confined to bed with painful adenitis of both groins and both axillæ.

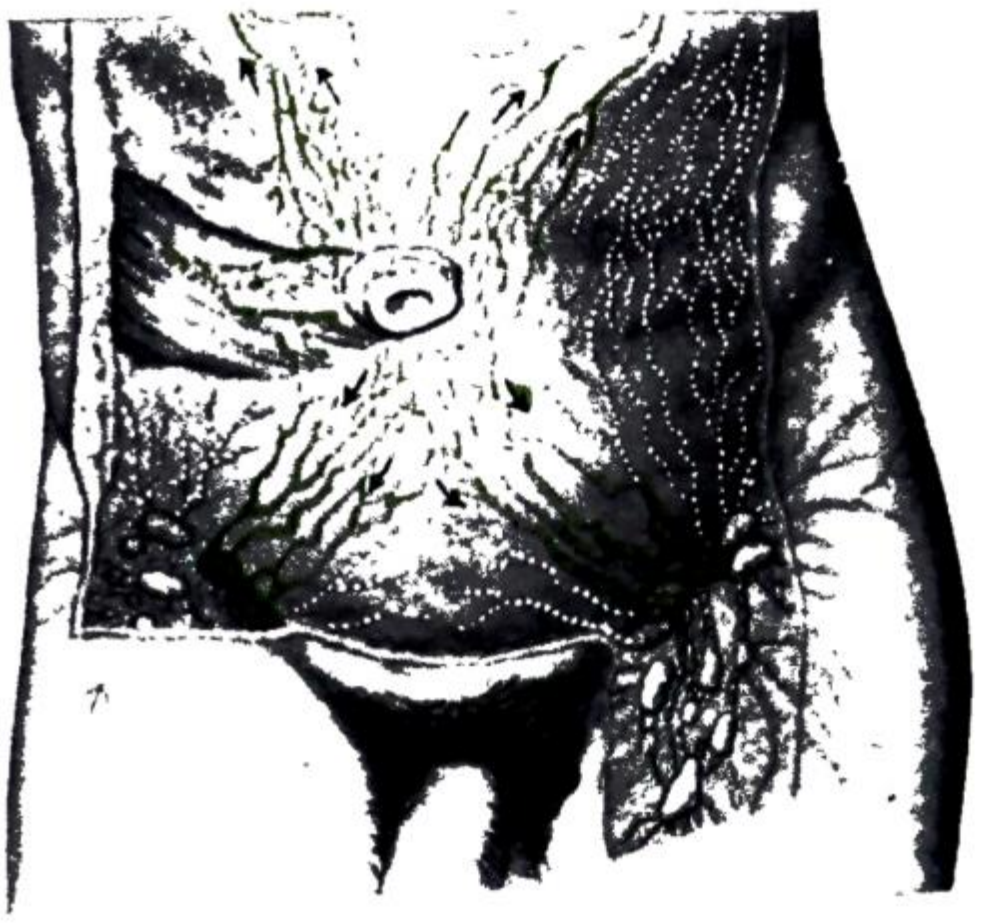


FIG. 867.—The lymphatics of the umbilicus. (*After Cuneo.*)

DISEASES OF THE UMBILICUS

- **Inflammations**
  - Infection of the stump of the umbilical cord (omphalitis).
  - Umbilical granuloma.
  - Umbilical dermatitis.
- **Fistulæ**
  - Fæcal
    - Patent vitello-intestinal duct.
    - Tuberculous peritonitis.
    - Neoplastic ulceration from the transverse colon.
  - Urinary = Patent urachus.
  - Biliary.
- **Neoplasms**
  - Benign
    - Enteroteratoma.
    - Endometrioma.
  - Malignant
    - Primary Carcinoma
    - Secondary Carcinoma
      - Stomach.
      - Colon, including the rectum.
      - Ovary and uterus.
      - Breast.

Hernia (see p. 699).
Umbilical calculus.

INFLAMMATIONS

Infection of the Umbilical Cord.—By the 3rd or 4th day of life the stump of the umbilical cord is found to be carrying staphylococci in over 50 per cent. of babies born in maternity hospitals. The strict asepsis observed during severance of the cord makes this source of contamination highly improbable. Infection, then, must be by contact, or airborne. J. Jellard advocates painting the stump of the cord daily with triple dye [1] until it separates. This, she has found, reduces not only the number of cases of omphalitis, but minimises appreciably the incidence of skin and naso-pharyngeal infections among the infant patients in the ward. Less commonly the stump of the umbilical cord harbours streptococci, and several epidemics

[1] Crystal violet, 10 grains (0·6 G.); brilliant green, 10 grains (0·6 G.); proflavine hemisulphate, 5 grains (0·3 G.); water to 10 ounces (280 ml.).

Janet Jellard, Contemporary. Assistant Bacteriologist, Public Health Laboratory, Plymouth.

of puerperal sepsis in maternity hospitals have been traced to the umbilical cord of one infant in the nursery thus infected.

In cases where the umbilicus is patently infected (omphalitis), either of these organisms and commonly *Esch. coli* in addition, are responsible.

Omphalitis.—As might be expected, the incidence of this condition is much higher in communities that do not practise aseptic severance of the umbilical cord. When the stump of the umbilical cord becomes inflamed, with antibiotic therapy—terramycin for choice, because the infecting staphylococcus is often penicillin-resistant—usually the inflammation remains strictly localised. By employing warm moist dressings the crusts separate, giving exit to pus. Exuberant granulation tissue is then usually in evidence, and requires the application of silver nitrate. In more serious infections of the umbilicus in new-born infants infection is liable to spread along the defunct hypogastric arteries or umbilical vein (see fig. 866), when, in all probability, one or other of the following complications will supervene :

1. **Abscess of the abdominal wall** occurs particularly in connection with a partially obliterated hypogastric artery. If gentle pressure is exerted below or above the navel, and a bead of pus exudes at the umbilicus, a deep abscess associated with one of the defunct umbilical vessels is present. If, on investigating the umbilical opening with a fine probe the sinus leads downwards, the probe is removed and a grooved director substituted. The abdominal wall is divided on to the groove of the director ; in this way the abscess is drained and the peritoneum is protected. In the case of an abscess of the abdominal wall above the umbilicus it is usually advisable to drain it by a direct incision in the middle line.

2. **Extensive ulceration of the abdominal wall** is usually due to a synergic infection, and is treated in the same way as post-operative subcutaneous gangrene (see p. 674).

3. **Septicæmia** can occur from organisms entering the blood-stream via the umbilical vein. Jaundice is often the first sign. An abscess in the abdominal wall above the umbilicus should be sought. In other respects the treatment of this grave complication follows the usual lines (see p. 7).

4. **Peritonitis** carries a particularly bad prognosis. If an abscess of the abdominal wall is present, it should be drained. In the first place the treatment of the peritonitis is by the Ochsner-Sherren method. Should an appreciable amount of peritoneal fluid accumulate it should be drained by the insertion of an intraperitoneal suprapubic drainage tube.

In both of the last two complications blood transfusions and intravenous antibiotics are indicated.

Umbilical Granuloma.—Chronic infection of the umbilical cicatrix which continues for weeks causes granulation tissue to pout at the umbilicus. There is no certain means of distinguishing this condition from a commencing enteroteratoma, except biopsy, a procedure which is not justifiable. Usually an umbilical granuloma can be destroyed by one application of a silver nitrate stick followed by dry dressings. An enteroteratoma (see p. 670) soon recurs, in spite of these measures.

Dermatitis of and around the umbilicus is common at all times of life. Fungus and parasitic infections are more difficult to eradicate from the umbilicus than from the skin of the abdomen. Sometimes the dermatitis is consequent upon a discharge from the umbilicus, as is the case when an umbilical fistula is present.

Umbilical calculus, often black in colour, is composed of desquamated epithelium which becomes inspissated and collects in a deep recess of the umbilicus. A time is reached when it gives rise to inflammation, and often a blood-stained discharge. The treatment is to dilate the orifice and extract the calculus. In order to prevent recurrence, it may be better to excise the umbilicus without attempting to remove the stone.

UMBILICAL FISTULÆ

The umbilicus being a scar, and, moreover, a central abdominal scar, it is understandable that a slow leak from any viscus is liable to track to the surface at this point.

For instance, an enlarged inflamed gall-bladder perforating at its fundus has been known to discharge its contents, including gall-stones, through the umbilicus. Again, an unremitting flow of pus from a fistula at the umbilicus of a middle-aged woman led to the discovery of a length of gauze left in the peritoneal cavity during hysterectomy five years previously. Another source of a purulent discharge from the umbilicus is illustrated in fig. 868.

FIG. 868.—This patient, aged sixty-two, complained only of a purulent discharge from the umbilicus. A lump could be felt in the position outlined. Perforated carcinoma of the transverse colon.

Added to this, very occasionally the vitello-intestinal duct or the urachus remains patent ; consequently it has been remarked aptly that the umbilicus is a creek into which one of many fistulous streams may open.

The vitello-intestinal duct occasionally persists, and gives rise to one of the following conditions :

1. It remains patent (figs. 869 and 870 (*a*)). The resulting umbilical fistula discharges mucus and, rarely, fæces.

FIG. 869.—Patent vitello-intestinal duct opening into the umbilicus. (*After A. L. Taylor.*)

(*b*) A small portion only of the duct near the umbilicus remains unobliterated. This gives rise to a sinus that discharges mucus. The epithelial lining of the sinus often becomes everted to form an enteroteratoma (see p. 670).

2. Sometimes both the umbilical and the intestinal ends of the duct close, but the mucous membrane of the intervening portion remains, and an intra-abdominal cyst develops (fig. 870 (*c*)).

(*a*) (*c*) (*d*) (*e*)

FIG. 870.—Anomalies connected with the vitello-intestinal duct : (*a*) umbilical fistula ; (*b*) umbilical sinus (not illustrated) ; (*c*) intra-abdominal cyst ; (*d*) intraperitoneal band ; (*e*) Meckel's diverticulum adherent to the sac of a congenital umbilical hernia.

3. With its lumen obliterated or unobliterated, the vitello-intestinal duct provides an intraperitoneal band (fig. 870 (*d*)) which is a potential danger, for intestinal obstruction is liable to occur. The obstruction results from a coil of small intestine passing under or over (fig. 871), or becoming twisted round, the band.

FIG. 871.—Vitello-intestinal duct causing intestinal obstruction.

4. Such a band may contract and pull a Meckel's diverticulum into a congenital umbilical hernia (fig. 870 (*e*)).

5. A vitello-intestinal cord connected to Meckel's diverticulum, but not attached to the umbilicus, becomes adherent to, or knotted around, another loop of small intestine, and so causes intestinal obstruction.

6. Sometimes a band extending from the umbilicus is attached to the mesentery near its junction with a distal part of the ileum. In this case the band is probably an obliterated vitelline artery, and is not necessarily associated with a Meckel's diverticulum.

Treatment.—A patent vitello-intestinal duct should be excised, together with a Meckel's diverticulum, if such be present, preferably when the child is about six months old. When a vitello-intestinal band gives rise to acute intestinal obstruction, after removing the obstruction by division of the band, it is expedient, when possible, to excise the band and to bury the cut ends.

A patent urachus seldom reveals itself until maturity, or even old age. This is because the contractions of the bladder commence at the apex of the organ and pass towards the base. A patent urachus, opening as it does at the extreme apex of the bladder, is closed temporarily during micturition, and so the potential urinary stream to the umbilicus is cut off. So it comes about that the fistula remains unobtrusive until a day when the organ is overfull, usually due to some form of obstruction, e.g. an enlarged prostate (fig. 872).

Treatment.—Usually treatment should be directed to removing the obstruction to the lower urinary tract. If, after this is remedied, the leak continues or a cyst develops in connection with the urachus, umbilectomy and excision of the urachus down to its insertion into the apex of the bladder, with closure of the latter organ, is indicated.

FIG. 872.—Umbilical urinary fistula. Patent urachus. (Chronic retention of urine due to an enlarged prostate.)

NEOPLASMS OF THE UMBILICUS

Enteroteratoma (*syn.* umbilical adenoma, raspberry tumour) is commonly seen in infants (fig. 873), but only occasionally later in life. The condition is due to a partially (occasionally a completely) unobliterated vitello-intestinal duct. Mucosa prolapsing through the umbilicus gives rise to a raspberry-like tumour, which is moist with mucus and tends to bleed.

Treatment.—If the tumour is pedunculated, a ligature can be tied around it, and in a few days the polypus drops off. Should the tumour reappear after this procedure, umbilectomy is indicated. Sometimes a patent vitello-intestinal duct, or more often a vitello-intestinal band, will be

Johann Friedrich Meckel (The Younger), 1781–1833. Professor of Anatomy and Surgery, Halle.

found associated with a Meckel's diverticulum. The Meckel's diverticulum and the attached cord or duct should be excised at the same time as the umbilicus. Histologically the tumour at the umbilicus consists of columnar epithelium rich in goblet cells.

FIG. 873. — Enteroteratoma of the umbilicus.

Endometrioma occurs in women between the ages of twenty and forty-five. There has been much speculation as to how endometrial tissue comes to occupy the skin of the umbilicus. Because the tissue is situated *in* the skin, sequestration of endometrial tissue seems an unlikely explanation ; that the tumour is an example of epigenesis[1] surmounts the difficulties of explaining how an embryological rest[2] could become intradermal. As a rule an umbilical endometrioma is a primary neoplasm occurring in the skin of the umbilicus, and on histological examination it is found to consist of endometrial glands occupying the same plane as the sudoriferous glands, and opening on to the surface in the same way. The umbilicus becomes painful, and bleeds at each menstruation, when the small fleshy tumour between the folds of the umbilicus becomes more apparent. Occasionally an umbilical endometrioma is accompanied by endometriomata in the uterus or ovary. When, as is usually the case, the tumour is solitary, umbilectomy will cure the condition.

Primary carcinoma of the umbilicus is rare. Treatment is excision of the umbilicus and block dissection of such regional lymph nodes as are palpable or become so at a later date.

FIG. 874. — Secondary nodule at the umbilicus in a case of carcinoma of the stomach.

Secondary carcinoma at the umbilicus (fig. 874) is not very uncommon, but is always a late manifestation of the disease. The primary neoplasm from which it is derived is often situated in the stomach, colon or ovary, but a metastasis from the breast, probably transmitted along the lymphatics of the round ligament of the liver, is sometimes located here.

THE ABDOMINAL WALL

Tearing of the inferior epigastric artery occurs in three dissimilar types of individual, viz. elderly women, often thin and feeble ; athletic, muscular men, usually below middle age ; and pregnant women, mainly multipara late in pregnancy. The site of the hæmatoma is most often below the level of the linea semicircularis (semilunar fold of Douglas), where the posterior sheath of the rectus abdominis is lacking (fig. 875) ; infrequently it is the superior epigastric artery that is torn. In most cases it is the tearing asunder of an epigastric artery and possibly the corresponding vein that is the causative lesion ; rupture of the adjacent muscle-fibres plays an insignificant part.

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[1] The theory that development starts from a structureless cell.
[2] A rest = A fragment of embryonic tissue that has been retained within the adult organism.
James Douglas, 1675–1742. Physician to Queen Caroline, wife of George I.

Clinical Features.—Unless there is bruising of the overlying skin or ecchymoses are present, which is unusual in early cases, the diagnosis is difficult. The possibility of tearing of the epigastric vessels should always be considered when, following a bout of coughing, an exquisitely tender lump appears in relation to the rectus abdominis.

Differential Diagnosis.—The conditions for which the hæmatoma is frequently mistaken are, in the female, a twisted ovarian cyst, and in both sexes, when the lump is on the right side, an appendix abscess. The sign most likely to be of value in differentiating a hæmatoma of the abdominal wall from these conditions, namely tensing the abdominal musculature, is often inapplicable because of the pain it causes. Again, the differential diagnosis between a spontaneous hæmatoma of the abdominal wall and a strangulated Spigelian hernia (see p. 708) is sometimes impossible. The absence of vomiting suggests a hæmatoma, and the presence of resonance over the swelling favours a Spigelian hernia, while a plain radiograph of the abdomen sometimes gives positive evidence of the latter.

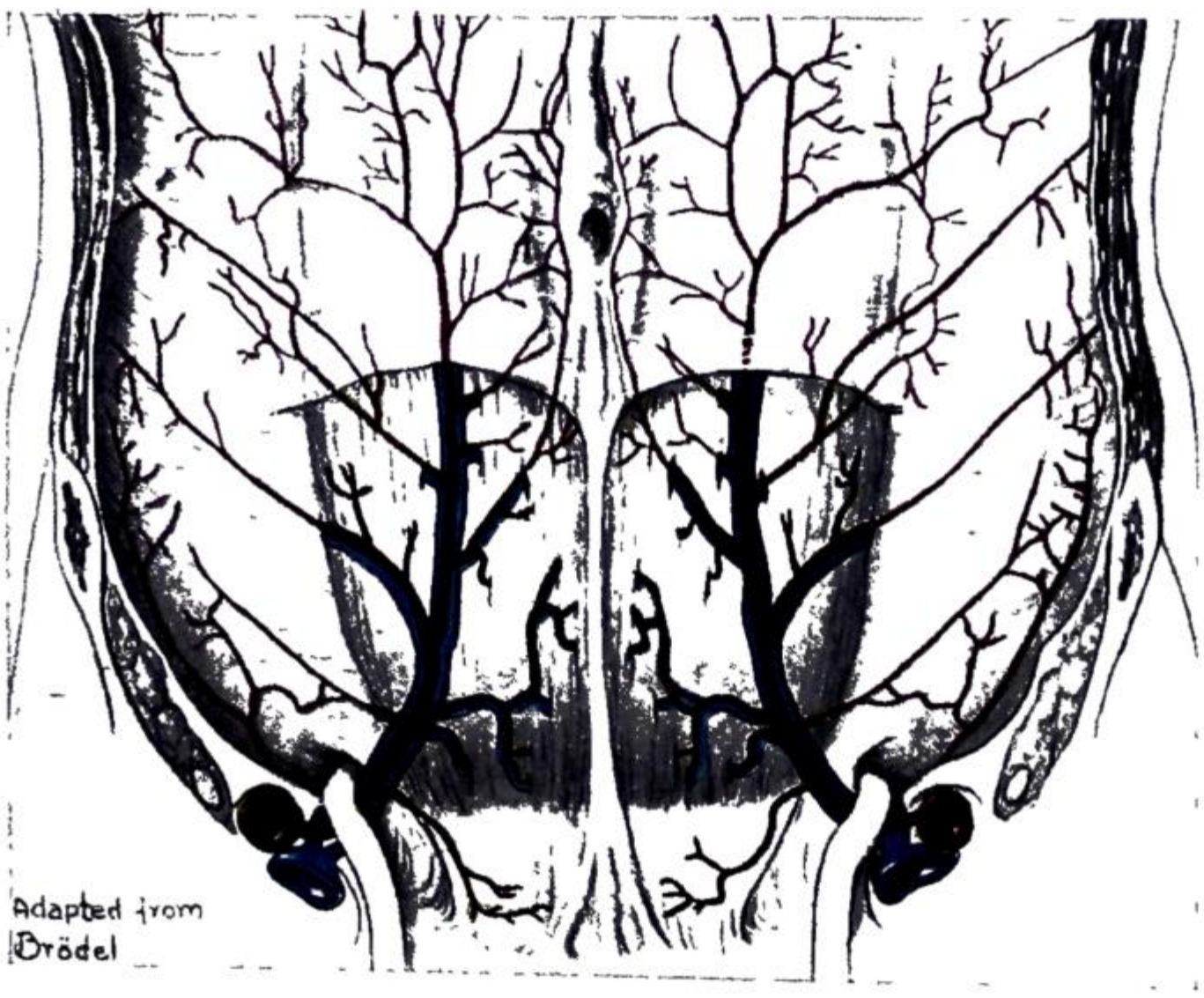

FIG. 875.—The inferior epigastric vessels and the lineæ semicirculares. The urachus and obliterated hypogastric arteries are also well shown.

As a Complication of Pregnancy.—Tearing of the inferior epigastric artery is a supremely important diagnosis during pregnancy. If operation is performed for this condition, the fœtal mortality is 25 per cent. On the other hand, the danger to the life of the mother must receive prior consideration. Surprising to relate, the hæmorrhage into this closed space from this comparatively small artery has proved fatal.

Treatment.—It is true that, with rest, resolution of a comparatively small hæmatoma is probable, but occasionally under expectant treatment renewed hæmorrhage has caused the hæmatoma to rupture into the peritoneal cavity; therefore it is safer to operate early.

Adrian van der Spiegel, 1578–1625. Professor of Anatomy and Surgery, Padua.

Operation consists in evacuating blood and clot, and ligating bleeding vessels, if such can be identified. Usually it is futile to attempt to repair torn muscle—the stitches merely cut out. The sheath of the rectus muscle and skin are closed with interrupted sutures. When both ends of the torn vessels cannot be found and ligated, or when there is oozing, corrugated rubber drainage of the wound is essential.

DISRUPTION OF AN ABDOMINAL WOUND

In 1 to 2 per cent. of cases a laparotomy wound bursts open and viscera are eventrated. The peak incidence of the catastrophe is during the 6th and 8th days after operation (fig. 876). The predisposing causes are hasty suture (from necessity), infection, persistent cough, abdominal distension, leakage of pancreatic enzymes, delayed healing in malignancy, and the too early removal of deep sutures, which should remain in place for ten days. The wounds of patients with hypoproteinæmia unite tardily.

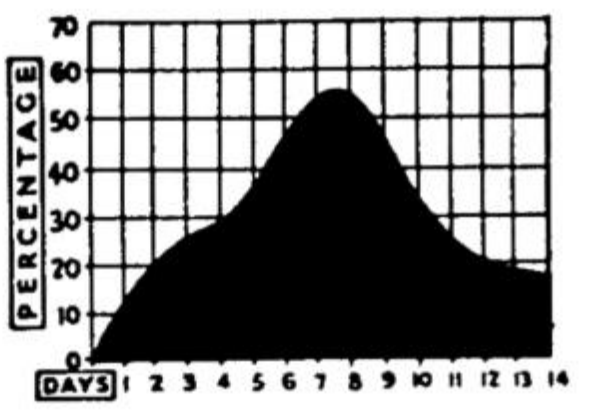

FIG. 876.—Time of disruption of the abdominal incision. (*Tweedie and Long's statistics.*)

It is interesting and instructive to note that upper abdominal incisions disrupt more frequently than lower abdominal incisions, and that the suture material employed appears to have no bearing on the incidence of the disaster. Those surgeons who use stainless steel wire sutures have the same incidence of burst abdomen as those employing catgut, cotton, silk, or nylon (R. C. Long).

In most cases dehiscence of the deeper layers occurs some days before the wound actually bursts asunder; indeed, it is probable that one or more of the peritoneal stitches snap or become untied within the first three days of operation. Sometimes the damage is done while the patient is coming round from the anæsthetic; a most potent factor in this respect is the violent coughing reflex set up if an endotracheal tube is withdrawn while the patient is but lightly anæsthetised.

Prophylaxis.—When infection of the wound has supervened, or in other conditions in which it is thought that the stitches are liable to give way, the abdominal wall should be supported by 'corsets' of adhesive plaster. In debilitated and aged subjects wound healing is retarded: the ingestion of vitamins, particularly vitamin C, and a high protein diet is indicated in such cases.

Clinical Features.—An otherwise unexplained, copious serosanguineous (pink) discharge from the wound is a forerunner of a burst abdomen in fully 50 per cent. of cases. It is the most pathognomonic sign of impending wound disruption, and it signifies that intraperitoneal contents are lying extraperitoneally. The patient often volunteers the information that he "felt something give way." Pain and shock are often singularly absent. Less frequently the wound breaks open more quietly, revealing a mass of reddish tissue beneath.

Treatment.—When the wound has disrupted, prompt action is imperative. Protruding intestine should be covered with a warm saline-soaked pack, followed by ample cotton-wool and a firm many-tailed bandage. The

Richard Calver Long, Contemporary. Surgeon, Royal Victoria Hospital, Montreal.

patient must not be left for one moment. He is exhorted, if possible, not to cough; should he desire to cough the hands of a doctor or nurse must support the abdomen. In any event, such support must be sustained during the whole time the patient is being anæsthetised.

Operation.—Each protruding coil of intestine is washed gently with saline solution, and returned to the abdominal cavity. Lastly, protruding greater omentum is treated similarly and spread over the intestine. The abdominal wall having been cleansed, it is approximated by through-and-through sutures of braided nylon, strong silk, or stainless steel wire. The abdominal wall is supported by imbricated strips of adhesive plaster encircling the anterior two-thirds of the circumference of the trunk. Antibiotic therapy is, of course, started as soon as practicable.

Contrary to what might be thought, peritonitis rarely supervenes.

INFECTIONS

Cellulitis can occur in any of the planes of the abdominal wall.

Superficial cellulitis is usually discovered when an abdominal wound is inspected because of pyrexia. The earliest sign is when the stitches become embedded in the œdematous skin. Later there is a blush extending for a variable distance from the incision or the stitch holes. On palpation with the gloved hand usually one area is found to be more indurated and tender than the remainder. A stitch should be removed from the immediate vicinity, and if pus or sero-pus escapes it is sent for bacteriological examination.

Laparotomy corsets should be applied and the wound covered with a dry dressing. While awaiting the bacteriological report one of the tetracyclines is administered. No further stitches are removed unless there are definite indications for so doing.

Spreading cellulitis is most often due to intestinal leakage, especially of the large intestine. Unless free drainage is provided down to the site of a leaking anastomosis a fatal issue is extremely probable.

Deep cellulitis is characterised by brawny œdema towards one or both flanks, and not infrequently of the scrotum or vulva as well. Antibiotic therapy is the mainstay of treatment. When tenderness persists, an incision dividing the muscles carefully, layer by layer, until pus or purulent fluid is encountered, is often advisable.

FIG. 877.—Progressive post-operative bacterial synergistic gangrene in a young Negress, cured by bacitracin. (*Dr. F. L. Meleney Miami.*)

Progressive post-operative bacterial synergistic gangrene is fortunately a rare complication after laparotomy, usually for a perforated viscus (notably perforated appendicitis). It has also occurred after drainage of an empyema thoracis. About ten days after the operation the skin in the immediate vicinity of the wound exhibits signs of cellulitis. Within a few days a central purplish zone with an outer

brilliant red zone can be distinguished, and the whole region is extremely tender. A few days later the purplish area becomes gangrenous and looks like suède leather. Slowly the condition advances (fig. 877). The gangrenous skin liquefies, exposing underlying granulation tissue. As a rule the constitutional symptoms are mild, although if the condition persists, as a result of pain and toxæmia, the general condition deteriorates. F. L. Meleney has shown that this unrelenting disease is due to the synergic action of microærophilic non-hæmolytic streptococci and (usually) *Staphylococcus aureus hæmolyticus*.

Treatment.—The usual antibiotics are of little avail, but systemic bacitracin, 10,000–20,000 units intramuscularly every six hours, with local applications of bacitracin in the form of a moist dressing in a concentration of 500 units per ml., 1 to 4 times daily, often brings the condition under control. Without such treatment, frequently the gangrene spreads to the flanks, and the patient dies of inanition.

NEOPLASMS OF THE ABDOMINAL WALL

Desmoid tumour is a tumour arising in the musculo-aponeurotic structures of the abdominal wall, especially below the level of the umbilicus. It is a completely unencapsulated fibroma, and is so hard that it creaks when it is cut. Some cases recur repeatedly in spite of apparent adequate excision.

Ætiology.—Eighty per cent. of cases occur in women, many of whom have borne children, and the neoplasm occurs occasionally in scars of old hernial or other abdominal operation wounds. Consequently, trauma—e.g. the stretching of the muscle fibres during pregnancy or possibly a small hæmatoma of the abdominal wall—appears to be an ætiological factor. On the other hand, as the tumour occurs, though infrequently, in young persons and even in infants, it must be regarded as a neoplasm, not necessarily arising in inflammatory fibrous tissue.

Pathology.—The tumour is composed of fibrous tissue containing multinucleated plasmodial masses resembling foreign-body giant-cells. It is usually of very slow growth, tending to infiltrate muscle in the immediate neighbourhood, but eventually it undergoes a myxomatous change: it then increases in size more rapidly. Metastasis does not occur. Unlike fibromata elsewhere, no case has been recorded in which a sarcomatous change has taken place.

Treatment consists in excision of the neoplasm with a surrounding margin of at least ½ inch (1·25 cm.) of healthy tissue. Unless the tumour is excised widely, recurrence commonly takes place. After removal of a large desmoid tumour repair of the defect in the abdominal wall by fascial or whole buried skin graft is required. These tumours are but feebly radio-sensitive.

FIG. 878.—Giant-celled sarcoma of the abdominal wall.

Sarcoma of the abdominal wall is rare, and is usually of the giant-cell variety (fig. 878). Radiotherapy is the best form of treatment, but recurrence is usual.

Frank Lamont Meleney, Contemporary. Professor Emeritus of Clinical Surgery, Columbia University, New York.

CHAPTER XXX

HERNIA

HAMILTON BAILEY

AN external abdominal hernia is a protrusion of a viscus, usually within a peritoneal sac, through a weak area in the abdominal wall. The anatomical sites through which herniation is possible are shown in fig. 879.

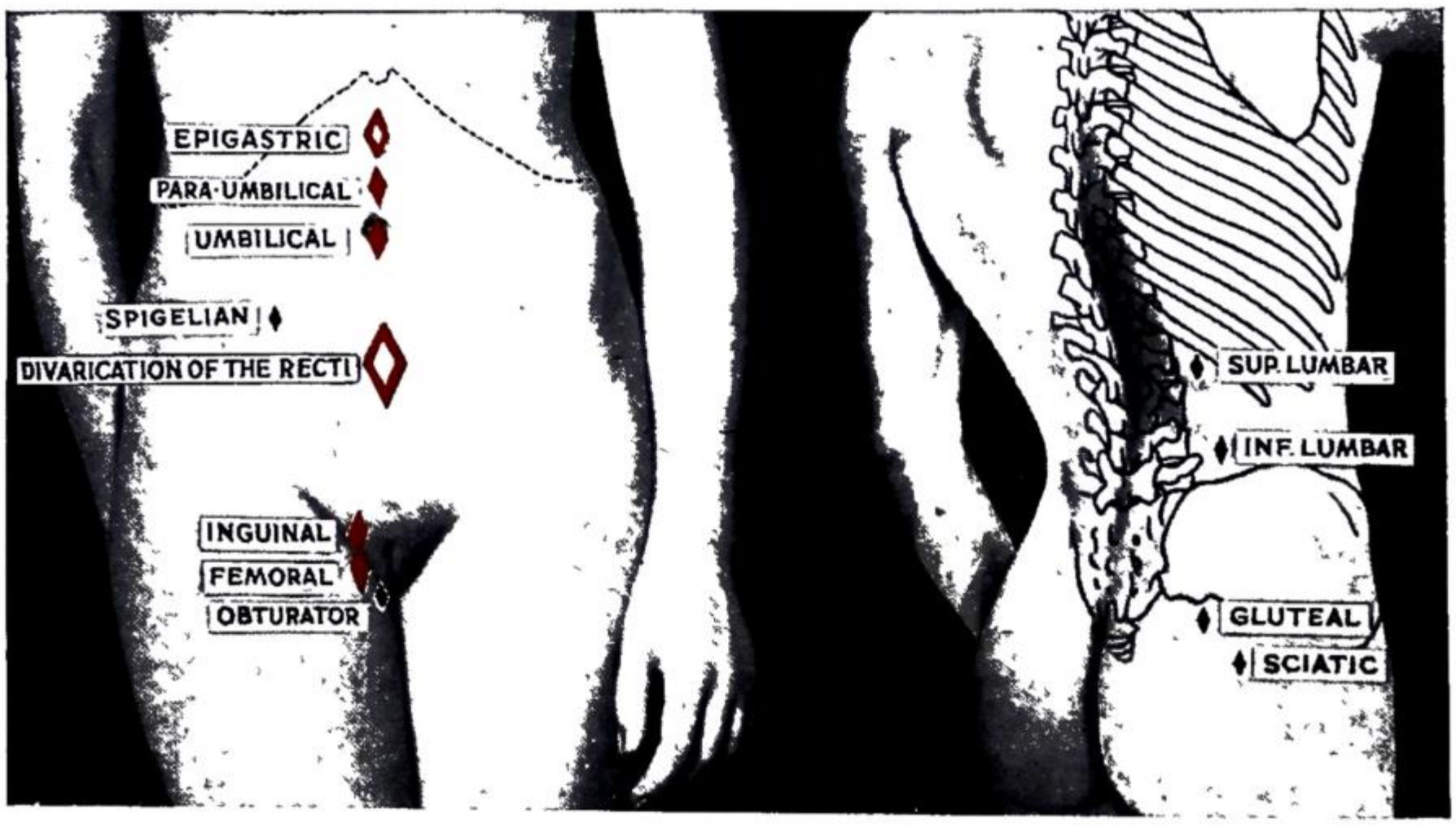

FIG. 879.—Primary external herniæ. Red = common. White = not unusual. Black = exceedingly rare.

At least twenty out of every thousand male inhabitants of Great Britain have a hernia (Sir Arthur Keith). The three varieties of external herniæ commonly encountered are inguinal, femoral, and umbilical. Much the most frequent of these is inguinal, which occurs in 73 per cent. of cases; then comes femoral, in about 17 per cent. of cases, followed by umbilical, which occurs in about 8·5 per cent. This leaves 1·5 per cent. for the rarer forms. In this reckoning post-operative incisional hernia has not been included.

Ætiology.—In the great majority of cases no cause for the hernia can be elucidated. It is highly probable that most oblique inguinal herniæ occur into a congenital pre-formed sac.[1] Any condition that raises intra-abdominal pressure is liable to be followed by a hernia. Thus whooping cough is a predisposing cause in childhood, and a chronic cough favours the development of a hernia in an adult. The stretching of the abdominal musculature during pregnancy is another factor in the production of a hernia, particularly a femoral or an umbilical hernia. Straining on micturition

[1] The 'saccular' theory of hernia was evolved by Hamilton Russell, 1860-1933, Surgeon, Alfred Hospital, Melbourne.

Sir Arthur Keith, 1866–1955. Curator of the Museum, Royal College of Surgeons of England.

consequent upon a stricture of the urethra or a fibrous prostate may precipitate a hernia, as also straining on defæcation due either to simple constipation or, in some instances, to a cicatrising neoplasm of the colon or rectum. Increasing obesity favours the development of an umbilical hernia in an adult. A powerful muscular effort or strain, such as that occasioned by lifting a heavy weight, often causes an inguinal hernia to descend into a preformed sac.

Accidental muscular strain as a cause of hernia is a question frequently disputed in the law courts. If it can be proved that undue muscular strain has been incurred during and because of the plaintiff's work, and the clinical features and/or operative findings are consistent with a recent origin of the hernia, usually compensation is allowed.

Pathological Anatomy.—As a rule, a hernia consists of three parts—the sac, the contents of the sac, and the coverings of the sac.

The sac consists of a diverticulum of peritoneum which is divided into a mouth, neck, body, and fundus (fig. 880). In most cases the neck is well-defined, but in certain direct inguinal herniæ and in many incisional herniæ it is practically non-existent. The body of the sac varies very greatly in size and is not necessarily occupied. The sac resembles parietal peritoneum, but in many cases occurring in infancy and childhood it is more delicate than the parietal peritoneum with which it is continuous.

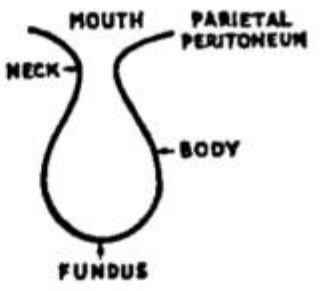

FIG. 880.—The various parts of a hernial sac.

In old-standing cases, especially after many years of pressure by a truss, the wall of the sac is comparatively thick and even (in places) of cartilaginous consistency.

Contents.—It has been said that every abdominal viscus except the liver[1] and the pancreas has been found at times among the contents of a hernial sac. The most common contents of a hernial sac is one or more of the following:

1. Omentum = omentocele (*syn.* epiplocele).
2. Intestine = enterocele. Usually small intestine, but, in some instances, large intestine or the vermiform appendix.
3. A portion of the circumference of the intestine = Richter's hernia.
4. A portion of the bladder, or a diverticulum of the bladder, is sometimes present in addition to other contents in a direct inguinal, a sliding inguinal, and in a femoral hernia.
5. Ovary with or without the corresponding Fallopian tube.
6. A Meckel's diverticulum = Littre's hernia.
7. Fluid. As a part of ascites, or as a residuum thereof. Blood-stained fluid accompanies strangulation.
8. Loose bodies, such as detached small portions of greater omentum or appendices epiploicæ, that have become detached after undergoing axial rotation.

Coverings are derived from the various layers of the abdominal wall through which the sac passes. In long-standing cases they become atrophied from stretching and so amalgamated that they are indistinguishable one from another.

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[1] Even a portion of the liver is present in the sac of a large exomphalos (see p. 699).

August Gottlieb Richter, 1742–1812. Surgeon, Göttingen, Germany.
Gabriello Fallopio, 1523–1562. Professor of Anatomy, Surgery and Botany, Padua.
Johann Friedrich Meckel (The Younger), 1781–1833. Professor of Anatomy and Surgery, Halle.
Alexis Littre, 1658–1725. Surgeon and Unofficial Teacher of Anatomy, Paris. Littre described 'Meckel's' diverticulum in a hernial sac before Meckel was born. (N.B. Littre has no accent.)

Classification.—A fundamental classification of herniæ, irrespective of their site, is as follows:

1. *Reducible.*
2. *Irreducible.* (*Complication of* 1.)
3. *Obstructed*[1].
4. *Strangulated.* } (*Complications of* 2.)
5. *Inflamed.*

REDUCIBLE HERNIA

The hernia either reduces itself when the patient lies down, or can be reduced by the patient or by the surgeon. The physical signs of reduction vary somewhat with the nature of the contents of the sac.

Intestine gurgles on reduction. The first portion is more difficult to reduce than the last.

Omentum is doughy, and the last portion is more difficult to reduce than the first.

Bladder.—There is often frequency of micturition, and possibly the hernia decreases in size after the bladder has been emptied.

IRREDUCIBLE HERNIA

A hernia is said to be irreducible when its contents cannot be returned to the abdomen, and there are no other serious symptoms. Usually such a condition is brought about by adhesions between the sac and its contents or from overcrowding within the sac. Irreducibility without other symptoms is almost diagnostic of an omentocele. Femoral and umbilical herniæ are most often thus complicated. An inguinal hernia is not often irreducible, but in long-standing cases it is sometimes only partially reducible. Any degree of irreducibility predisposes to strangulation.

OBSTRUCTED HERNIA

An obstructed hernia is an irreducible hernia containing intestine the lumen of which is obstructed from without or from within; but the blood supply to the obstructed loop is unimpaired. The symptoms are less severe and the onset more gradual than is the case in strangulation, but more often than not the obstruction culminates in strangulation. As a rule no clear distinction can be made between obstruction and strangulation in herniæ; consequently the safe course is to assume that strangulation is imminent and treat the case accordingly.

Incarcerated Hernia.—Especially in the U.S.A., the term 'incarceration' is often used loosely as an alternative to obstruction or strangulation. As emphasised already, the term 'incarceration' should be employed only when it is considered that the lumen of that portion of the *colon* occupying a hernial sac is blocked with fæces. In that event the scyballous contents of the hernia should be capable of being indented with the finger like putty—a very rare phenomenon.

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[1] The term 'incarcerated' should be reserved for impaction of fæces within large intestine occupying an enterocele (see p. 679).

STRANGULATED HERNIA

A hernia becomes strangulated when the blood-supply of its contents is seriously impaired, rendering gangrene imminent. Gangrene may occur as early as five or six hours after the onset of the first symptoms of strangulation.

Although inguinal hernia is six times more common than femoral hernia, the greater liability of a femoral hernia to strangulate is apparent by referring to fig. 881. It should be noted that ventral herniæ, including umbilical, para-umbilical, and incisional herniæ, also strangulate comparatively frequently.

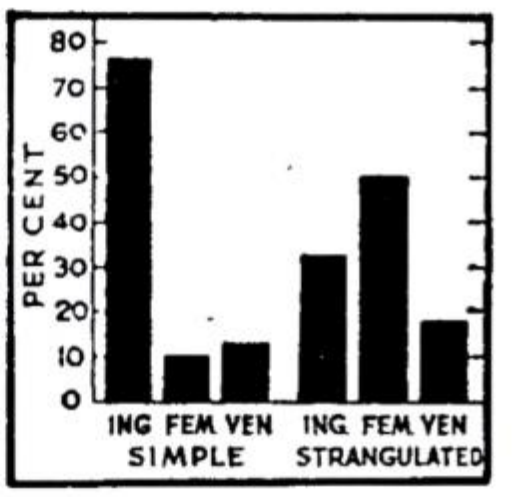

FIG. 881.—Hospital admissions of cases of simple and strangulated hernia; inguinal, femoral, and ventral. (*After D. M. Douglas.*)

Strangulated Enterocele.

Pathology.—The intestine is obstructed, and in addition its blood supply is constricted. At first only the venous return is impeded. The wall of the intestine becomes congested and bright red, and serous fluid is poured out into the sac. As the congestion increases, the intestine becomes purple in colour. As a result of increased intestinal pressure the strangulated loop becomes distended, often to twice its normal diameter. As venous stasis increases, the arterial supply becomes more and more impaired. Ecchymoses appear under the serosa. Blood is effused into the lumen of the loop, and also through the serosa, causing the fluid in the sac to become blood-stained. The shining serosa becomes dull and covered by a fibrinous, sticky exudate. By this time the walls of the intestine have lost their tone; they feel flabby, and are very friable. The lowered vitality of the intestine favours migration of bacteria through the intestinal wall, and the fluid in the sac becomes teeming with bacteria. Gangrene appears, first at the convexity of the loop and next at the rings of constriction (fig. 882), which become deeply furrowed and grey in colour. From the antimesenteric border the gangrene spreads upwards, and the colour changes, which vary from black to grey or green, are due to decomposition of blood in the subserosa. If the strangulation is unrelieved, perforation of the wall of the intestine occurs, either on the convexity of the loop or at the seat of constriction. The mesentery involved in the strangulation undergoes thefollowing changes: it becomes congested and hæmorrhagic, and thrombosis of its vessels occurs. Finally it, too, becomes gangrenous. Peritonitis spreading from the sac to the peritoneal cavity is a usual terminal event.

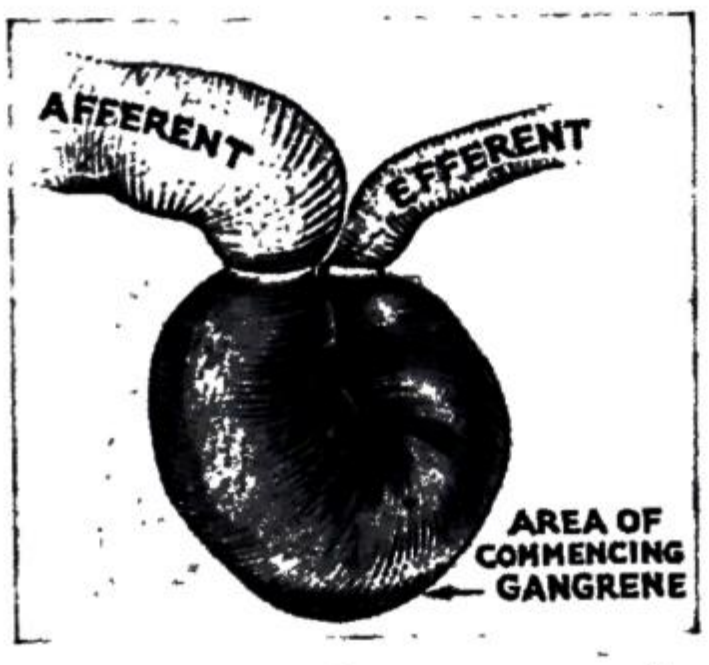

FIG. 882.—Gangrene usually first commences at the antimesenteric border of the intestine and next at the areas of constriction.

Clinical Features.—Pain comes on suddenly, and is at first situated over the hernia. Generalised abdominal pain soon supervenes; it is paroxysmal in character and is often located mainly at the umbilicus. Vomiting is forcible and usually oft-repeated. The hernia is tense, extremely tender,

and there is no impulse on coughing. In cases of strangulation of the small intestine it is quite common to obtain a good fæcal result from an enema, and even from a second enema, but eventually absolute constipation results. Unless the strangulation is relieved, the paroxysms of pain continue with increasing severity; they do not stop until peristaltic contractions cease. With the onset of gangrene the pain ameliorates, and when paralytic ileus (often the result of peritonitis) develops, the pain ceases and abdominal distension becomes evident. Spontaneous cessation of pain is therefore of grave significance.

Strangulated Richter's Hernia (*syn.* Strangulated Partial Enterocele). —The symptoms are not as severe as the foregoing, the patient may not vomit, or vomits only once or twice. Intestinal colic occurs, the bowels are often opened normally, or respond to an enema; absolute constipation is delayed until paralytic ileus supervenes. For these reasons gangrene of the knuckle of bowel (fig. 883) often has occurred before operation is undertaken. This form of hernia is particularly common in strangulated femoral hernia (p. 698).

FIG. 883. — Gangrenous Richter's hernia from a case of strangulated femoral hernia.

Strangulated Omentocele.—The initial symptoms are similar to those of a strangulated enterocele, but the recurring attacks of generalised abdominal pain are not maintained. Vomiting may be absent and there need not be constipation. The findings on palpation of a strangulated omentocele are similar to those of strangulated enterocele. Unlike intestine, omentum can subsist on a very meagre blood supply. The onset of gangrene is therefore correspondingly delayed, and it occurs first in the centre of the fatty mass. Unrelieved, a bacterial invasion of the dying contents of the sac will almost certainly occur. Infection is limited to the sac for days, and sometimes for weeks. This often terminates in extension of peritonitis from the sac to the general peritoneal cavity, and although deterioration of the patient's general condition takes place more slowly, ultimately the prognosis is nearly as grave as that of unrelieved strangulated enterocele.

INGUINAL HERNIA

SURGICAL ANATOMY

The superficial inguinal ring, a triangular aperture in the aponeurosis of the external oblique, lies ½ inch (1·25 cm.) above and ½ inch lateral to the pubic tubercle (X) viz. →

The normal superficial inguinal ring will not admit the tip of the little finger.

The deep inguinal ring, which lies ½ inch (1·25 cm.) above the inguinal (Poupart's) ligament, midway between the symphysis pubis and the anterior superior iliac spine, is a U-shaped condensation of the transversalis fascia incomplete above. When the deep inguinal ring is viewed from the anterior aspect, no opening is visible in the undissected state because the transversalis fascia is prolonged

François Poupart, 1661–1708. Surgeon, Hôtel-Dieu, Paris.

from the margins of the aperture around the cord as the infundibuliform fascia. The competency of the deep inguinal ring depends upon the integrity of this fascia, and the dual shutter-like[1] action of the overlying transversus abdominis and internal oblique muscles.

The Inguinal Canal.—In infants the superficial and deep inguinal rings are almost superimposed, and the obliquity of this canal is slight. In adults the inguinal canal, which is about 1½ inches (3·75 cm.) long, is directed downwards and medially between the superficial and deep inguinal rings. In the male the inguinal canal transmits the spermatic cord, the ilio-inguinal nerve, and the genital branch of the genito-femoral nerve. In the female the round ligament takes the place of the spermatic cord.

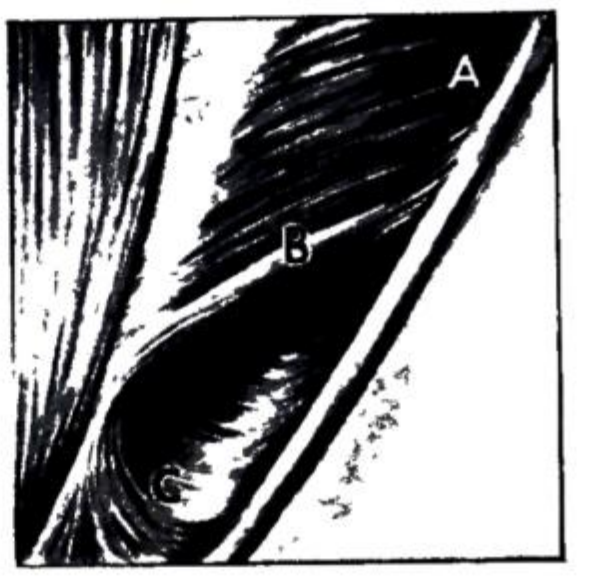

FIG. 884.

Boundaries of the Inguinal Canal.—Those fibres of the internal oblique that take origin from the outer two-thirds of the inguinal ligament arch over the spermatic cord (or round ligament), the superior fibres being inserted into the outer edge of the sheath of the rectus abdominis. The inferior fibres, becoming tendinous, blend with the transversus muscle to become the conjoint tendon, which is inserted into the crest of the pubis. Thus the internal oblique (fig. 884) forms (A) part of the anterior wall, (B) the roof, and, as the conjoined tendon, (C) part of the floor of the inguinal canal. Applying this knowledge, it is easy to remember the boundaries of the inguinal canal, viz. :

Anteriorly.—External oblique aponeurosis ; Poupart fibres of **internal oblique.**

Posteriorly.—**Internal oblique** (here conjoined tendon); inferior epigastric artery; fascia transversalis.

Superiorly.—**Internal oblique.**

Inferiorly.—Inguinal ligament.

Through the internal abdominal ring and down the inguinal canal passes an oblique inguinal hernia.

OBLIQUE (*syn.* INDIRECT) INGUINAL HERNIA

An oblique inguinal hernia is the most common of all forms of hernia. Many subscribe to the belief that an oblique inguinal hernia, at whatever age it appears, occurs into a preformed sac which is a partially or completely patent processus vaginalis. Normally, shortly before birth the processus vaginalis becomes obliterated, at first at the deep inguinal ring, and a little later immediately above the upper pole of the epididymis ; the tunnel of peritoneum between these two points becomes a narrow fibrous cord. Failure of obliteration at the first or at both of these sites results in an oblique inguinal hernial sac.

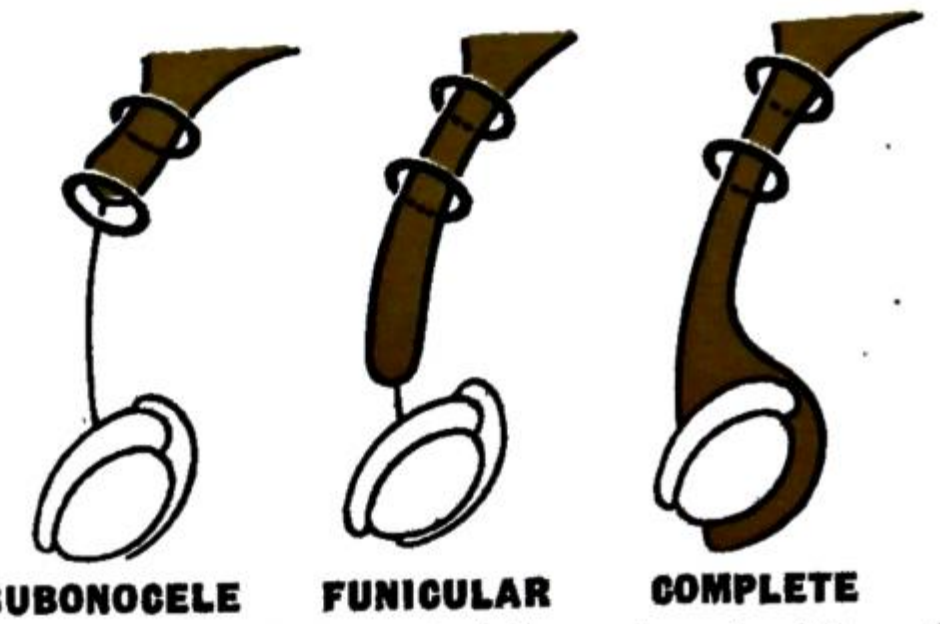

FIG. 885.—Varieties of oblique inguinal hernia.

In the first decade of life inguinal hernia is more common on the right side in the male. This is no doubt associated with the later descent of the right testis (see p. 902). After the second decade left inguinal herniæ are as

[1] A hypothesis that has not been substantiated by electrical stimulation of the muscles in question.

frequent as right. The hernia is bilateral, or ultimately becomes so, in nearly 30 per cent. of cases.

There are three types of oblique inguinal hernia (fig. 885):

1. **Bubonocele.**—The hernia is limited to the inguinal canal, the processus vaginalis having been obliterated at the superficial inguinal ring. This type of hernia is seen commonly in young adults with a short history.

2. **Funicular.**—The processus vaginalis is closed only at its lower end, just above the epididymis. When the sac is occupied, the contents of the sac can be felt separately from the testis, which lies below the hernia. The funicular variety is common in adults who give a history of inguinal hernia of some standing.

3. **Complete** (*syn.* Scrotal).—There is a persistence of the prenatal condition before the processus vaginalis becomes obliterated, nevertheless a complete inguinal hernia is rarely present at birth. Commonly encountered in infancy, it may not appear until adolescent or adult life. The testis appears to lie within the lower part of the hernia.

Clinical Features.—An oblique inguinal hernia can appear at any age, but it does so most frequently in infancy, childhood, or in early adult life. Males are at least twenty times more commonly affected than females.

FIG. 886.—Left inguinal bubonocele.

In the early stages of the development of the hernia when the sac is still limited to the inguinal canal (bubonocele), the diagnosis presents some difficulty. Often the patient complains of pain in the groin or referred pain to the testicle when he is performing heavy work, or taking strenuous exercise. The patient is asked to cough; if a hernia is present there will be a transient bulging over the inguinal canal, which is better seen (fig. 886) than felt. In males the superficial inguinal ring can be palpated by invaginating the little finger into the scrotum. The presence of an enlarged superficial inguinal ring without a visible bulging and without an expansile impulse when the patient coughs is not evidence of the presence of a potential hernia.

FIG. 887.—Oblique left inguinal hernia which became apparent when the patient coughed, and persisted until it was reduced.

When an oblique inguinal hernia has become large enough to reach the scrotum or labium majus, it produces a swelling that appears at first intermittently. In these circumstances the swelling often becomes apparent when the patient coughs, and it persists (fig. 887) until it is reduced. When the hernia cannot be made to come down at the time of the examination, an impulse can be seen and felt over the inguinal canal. On invagination of the scrotum the superficial inguinal ring will be found large enough to

admit the little finger. Local pain is unusual in a fully developed inguinal hernia unless complications have occurred.

As time goes on, unless it is supported by a truss, the hernia comes down as soon as the patient assumes the upright position. In large herniæ (fig. 888) there is a sensation of weight, and dragging on the mesentery may produce epigastric pain. If the contents of the sac are reducible, the inguinal canal will be found to be commodious.

FIG. 888. — Bilateral oblique inguinal herniæ which have descended into the scrotum.

In infants the swelling appears when the child cries. Sometimes an inguinal hernia is translucent in infancy and in early childhood, but never in an adult.

Differential Diagnosis.—An inguinal hernia must be distinguished from :

In the Male.

(*a*) *A vaginal hydrocele* (see p. 913).

(*b*) *An encysted hydrocele of the cord* (see p. 913).

(*c*) *A femoral hernia* (see p. 694).

(*d*) *An incompletely descended testis occupying the inguinal canal* (see p. 903). An inguinal hernia is often associated with this condition.

(*e*) *A lipoma of the cord.* This is often an extremely difficult, but unimportant, diagnosis. It is usually not settled until the parts are displayed by operation.

FIG. 889.—Hydrocele of the canal of Nück. The swelling is irreducible, and brilliantly translucent.

In the Female.

(*a*) *A hydrocele of the canal of Nück* (fig. 889) is the commonest differential diagnostic problem.

(*b*) *A femoral hernia.*

TREATMENT OF OBLIQUE INGUINAL HERNIA

A Truss: *In Infants.*—Until the age of three months, or longer if there is some contraindication to operation, inguinal herniæ should be controlled by a truss. The only satisfactory truss is a horseshoe-shaped one of solid rubber (fig. 890). It should never be removed, but lifted to allow cleansing of the skin beneath it. It is renewed when necessary. In a small percentage of cases an apparent cure results from pressure of the truss, which presumably causes the walls of the sac to become adherent.

FIG. 890. — Infant's horseshoe-shaped truss.

In adults, when operation is contraindicated because of cardiac, pulmonary, or other systemic disease, or when operation is refused, a rat-tailed spring truss (fig. 891) with a perineal band to prevent the truss slipping will, with due care and attention, control a

Anton Nück, 1650–1692. Anatomist, Leiden, Holland.

small or moderate-sized inguinal hernia. A truss must be worn continuously during waking hours, kept clean, and in proper repair, and renewed when it shows signs of wear. A properly-fitting truss controls the hernia when the patient stands with his legs wide apart, stoops, and coughs violently. However, as E. L. Farquharson stresses, often the pad of a truss is seen to lie to the side of the swelling, where the pressure it exerts is both useless and harmful. In these circumstances the truss is a menace, for it increases the risk of strangulation.

FIG. 891.—Rat-tailed truss.

For an irreducible hernia a bag truss is sometimes employed, but as a rule operation should be urged in cases of irreducibility, because of the danger of strangulation.

Operative Treatment.—In the absence of any contraindication, undoubtedly operation is the method of choice. It can, if necessary, be undertaken under local anæsthesia in adult patients.

Inguinal Herniotomy.[1]—Excision of every vestige of the sac, including its neck and any diverticulum of the sac, if such be present, constitutes a fundamental step in every operation for the cure of an oblique inguinal hernia. On the other hand, excision of the sac without reconstruction of the inguinal canal is inadequate, except in infants and very young children.

Inguinal Herniotomy in an Infant.—Owing to the superimposition of the superficial and deep inguinal rings, it is often unnecessary to open the inguinal canal.

Mitchell Banks's Operation.—A short incision (1 to 2 cm.) is made over the lower part of the inguinal canal. The sac is identified as described below, and after it has been isolated as far as the extraperitoneal fat, it is twisted two or three times before transfixing (fig. 892), ligating, and excising it.

Seeing that the sac is gossamer-like and often adherent to the spermatic cord, its isolation is much more difficult than in the adult. Should it become torn before separation is complete, the tear is liable to extend beyond the neck—a complication that renders subsequent stages of the operation very difficult.

The results of this operation (which is performed seldom outside Great Britain) are excellent, and recurrences are rare. Particularly when the hernia is left-sided, the chances that a hernia is present on the right side as well are 70 per cent.; therefore, in these circumstances, usually exploration of the opposite inguinal canal is advisable.

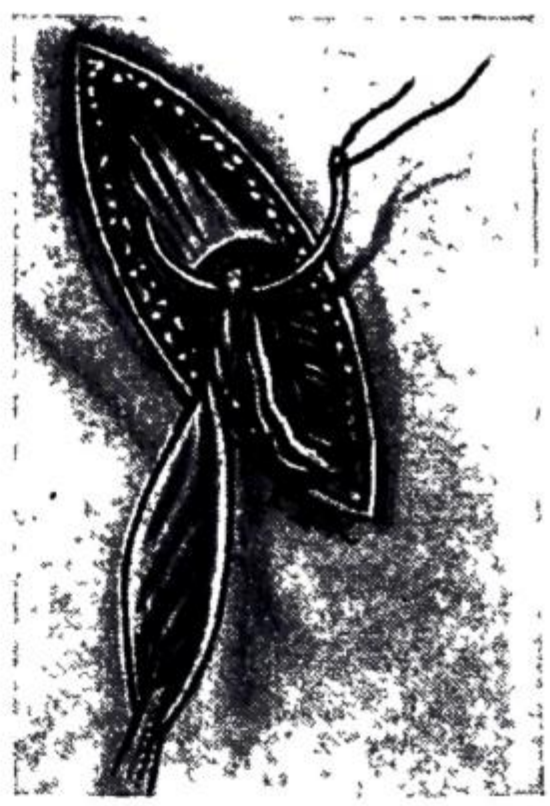

FIG. 892.—Inguinal herniotomy in an infant. The Mitchell Banks's operation.

Inguinal herniorrhaphy can be looked upon as the standard method for the cure of oblique inguinal hernia in all patients (infants and very young children excepted) whose musculature is at least fairly good. Essentially the operation consists of two steps: (*a*) excision of the sac; (*b*) reconstitution of the inguinal canal.

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[1] Originally the term herniotomy meant cutting the constriction of a strangulated hernia; it is now the accepted term for excision of a hernial sac.

Eric Leslie Farquharson, Contemporary. Surgeon, Royal Infirmary, Edinburgh.
Sir William Mitchell Banks, 1842–1904. Surgeon, Royal Infirmary, Liverpool.

An incision is made in the skin and subcutaneous tissues ½ inch (1·25 cm.) above and parallel to the medial two-thirds of the inguinal ligament. In large irreducible herniæ the incision is extended into the upper part of the scrotum. After dividing the superficial fascia, the external oblique aponeurosis and the superficial inguinal ring are identified. The external oblique aponeurosis is incised in the line of its fibres, so as to open the inguinal canal. The structures beneath the external oblique aponeurosis are separated from its deep surface before completing the incision into the superficial inguinal ring, which is divided. In this way the ilio-inguinal nerve is safeguarded. A hæmostat is applied to each cut edge of the external oblique aponeurosis, and by blunt dissection the upper leaf is separated from the internal oblique. The lower leaf is likewise dissected until the inner aspect of the inguinal ligament is seen (fig. 894). The cremaster muscle is dissected from the inguinal ligament and the spermatic cord is separated from it by blunt dissection. The cord is then hooked on the forefinger, and the sac is usually readily apparent because of its pearly-white colour. The internal spermatic fascia is incised and the underlying sac is picked up with a hæmostat and separated from surrounding structures with dissecting forceps.

1. *If the hernia is a bubonocele*, the fundus is soon apparent and the whole sac can be separated easily from the vas and spermatic vessels.

2. *If the hernia is of the funicular variety*, with a little more dissection the fundus can be reached, but its extremity must be freed by sharp dissection, after which the sac is separated from the spermatic cord (fig. 895) as high as possible.

3. *If the hernia is of the scrotal variety*, it is expedient to open the sac and reduce any of its contents into the general peritoneal cavity. At the upper margin of the incision into the sac the lateral walls can be divided transversely, their upper edges being secured in hæmostats. Exerting traction on each lateral wall, an incision is made with a fine-pointed scalpel through the posterior wall of the sac, care being taken not to wound the pampiniform plexus. The upper margin now constitutes a complete ring of the sac wall (fig. 893) which can be separated from the cord like a bubonocele. Unless this method is adopted, a thin-walled sac is liable to tear in a vertical direction.

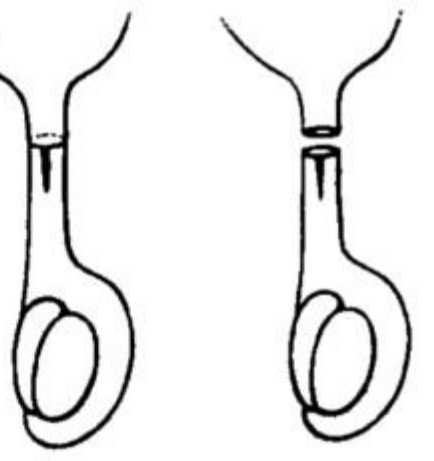

FIG. 893.—Complete inguinal hernia. Method of detaching a collar of the sac. The body of the sac is left *in situ*.

Isolating the Neck of the Sac.—Whatever type of sac is encountered, it is necessary to free its neck by blunt and gauze dissection until the parietal peritoneum can be seen on all sides of the mouth of the sac. Only when the extraperitoneal fat is encountered and the inferior epigastric vessels are seen on the medial side has the dissection reached the required limit. If it has not been done already, the sac is opened. In adults, the finger is passed through the mouth of the sac and Hesselbach's triangle is palpated from within, thereby excluding or confirming the presence of a concomitant direct inguinal hernia. The neck of the sac is transfixed (fig. 896) and ligated as high as possible, and the sac is excised ½ inch (1·25 cm.) below the ligature The cremaster muscle is re-approximated to the inguinal ligament.

Bassini's method[1] of reconstruction of the inguinal canal has been practised very widely for many years. The conjoined tendon is sutured to the inguinal ligament *behind* the spermatic cord, and the external oblique aponeurosis is reunited *in front of* the spermatic cord. In order to obtain good results, the conjoined tendon must be well developed and the space between it and the inguinal ligament must be narrow enough to permit the approximation of the latter to the former to be made without tension; a relaxing incision in the rectus sheath (see fig. 898) (Tanner's slide) may be required to achieve this essential requirement. *Unabsorbable* sutures are employed; a good method of passing the first two sutures is shown in fig. 897, and all stitches constituting the posterior layer are passed before they are tied (fig. 898). The spermatic cord is replaced and the external oblique aponeurosis is reunited over it, preferably in an imbricated manner. The subcutaneous tissue and the skin are approximated, and dressings are retained by a spica bandage.

It should be noted that in a few cases the conjoined tendon is almost absent, and the internal oblique aponeurosis is inserted entirely into the sheath of the rectus

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[1] Many modifications of this operation have been described, and are practised.

Edoardo Bassini, 1844–1924. Professor of Surgery, University of Padua.
Norman Cecil Tanner, Contemporary. Surgeon, Charing Cross Hospital, London.

INGUINAL HERNIORRHAPHY

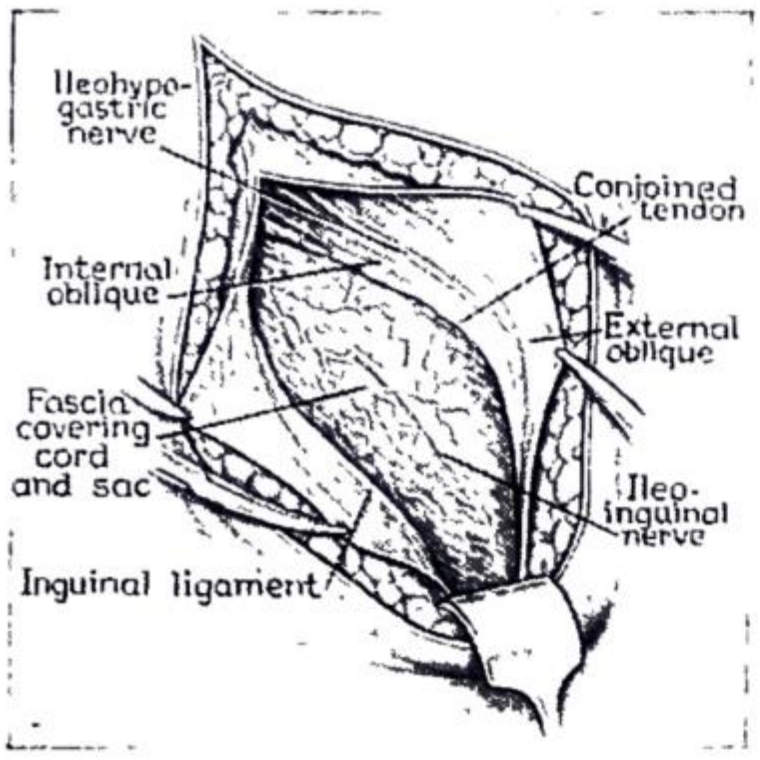


FIG. 894.—The inguinal canal has been opened. Note the disposition of the nerves.
(*After W. L. Estes Jnr.*)

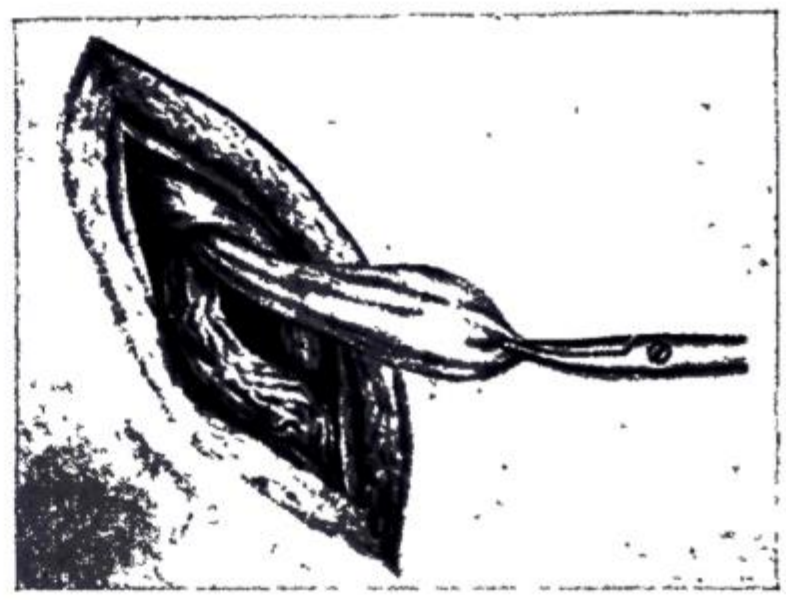


FIG. 895.—The sac has been dissected from the vas and spermatic vessels.

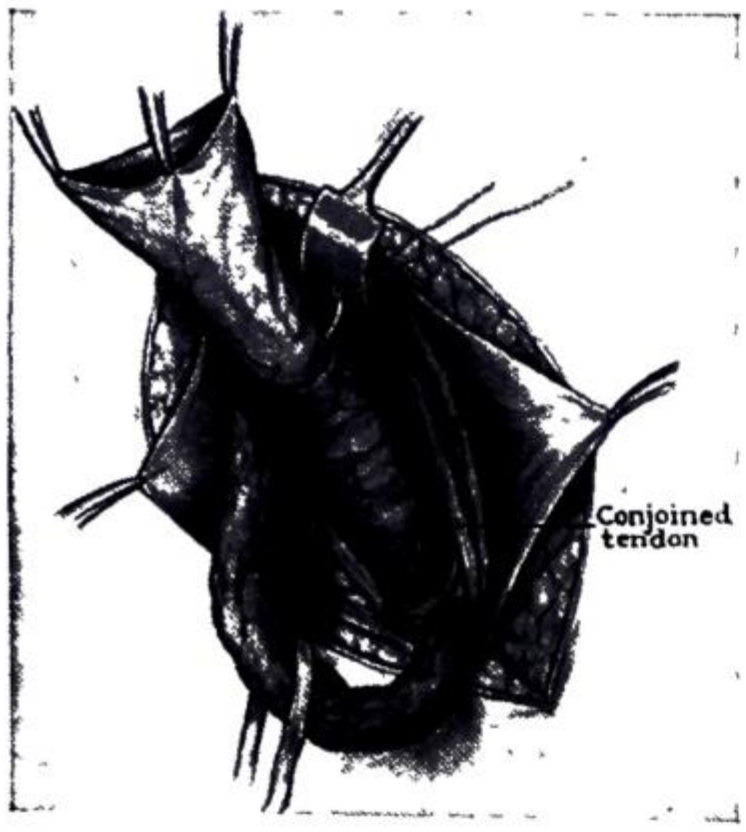


FIG. 896.—Transfixion of the neck of the sac for ligation and excision.

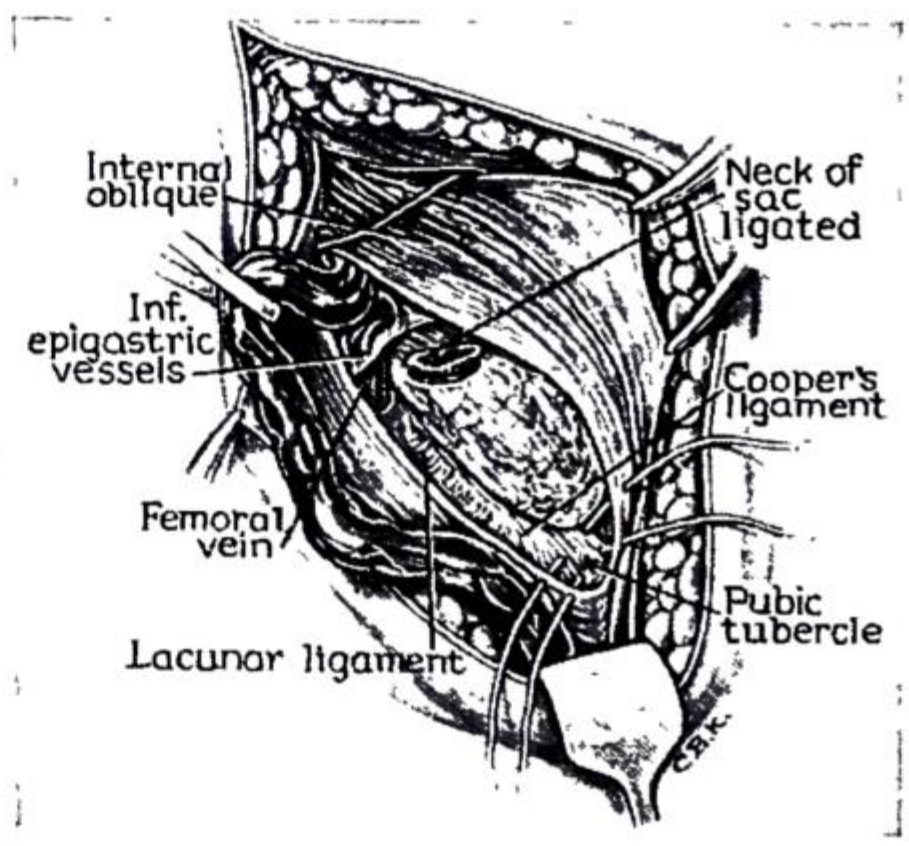


FIG. 897.—The neck of the sac has been ligated. The commencing sutures of the repair are passed as shown.
(*After W. L. Estes Jnr.*)

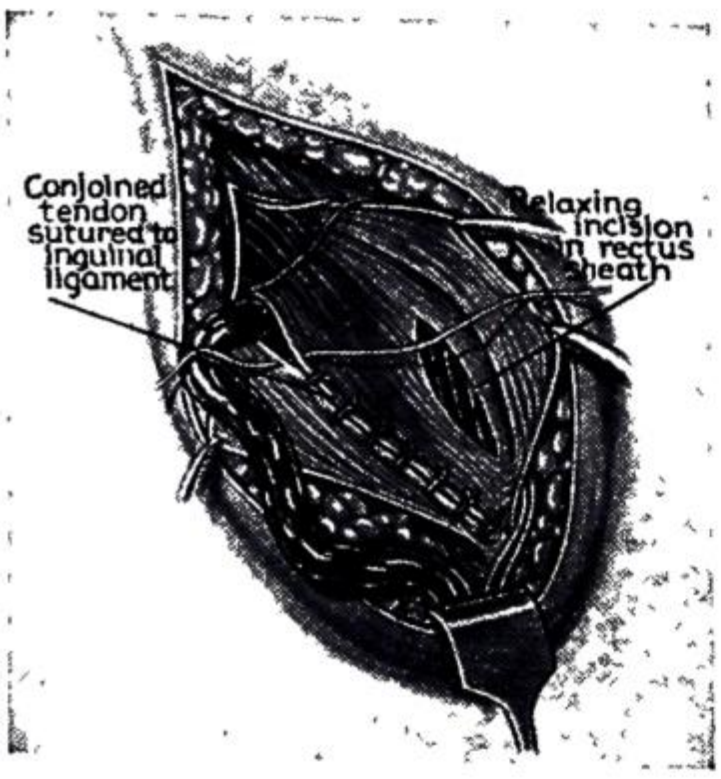


FIG. 898.—Bassini's operation. The conjoined tendon has been approximated to the inguinal ligament. (*After W. L. Estes Jnr.*)

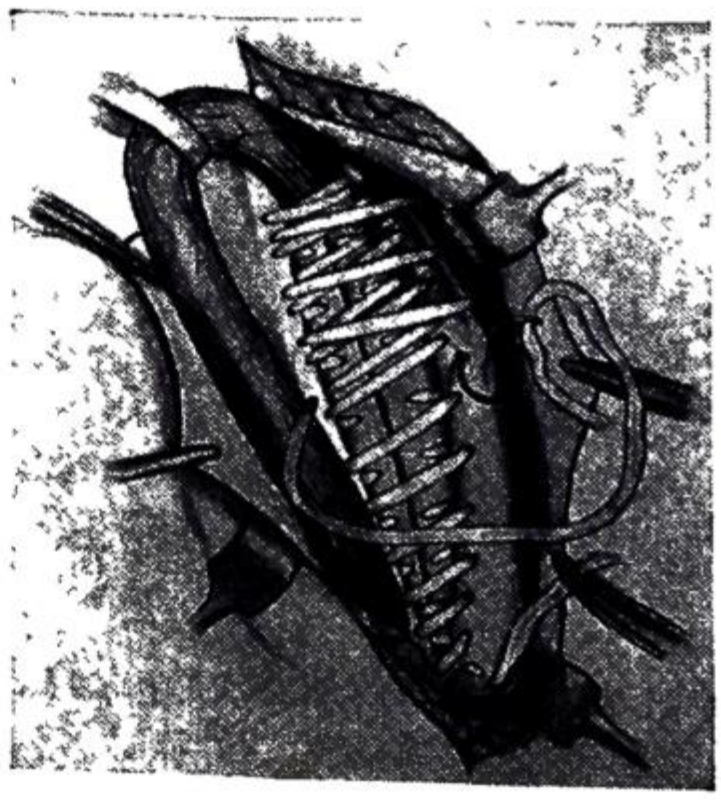


FIG. 899.—Darning the posterior wall of the inguinal canal with floss nylon.
(*After Rodney Maingot.*)

abdominis ; such cases, as well as those where the fascia is friable or the musculature poorly developed, as well as recurrent cases, call for a more elaborate form of repair.

Reconstituting the Posterior Wall of the Inguinal Canal with Floss Nylon (Maingot).—Meticulous asepsis is necessary. The instruments used are discarded and replaced by freshly sterilised ones after making the skin incision, after completing the dissection, and again when about to close the skin incision. The operation is indicated particularly when the musculature is poor. As can be seen in fig. 899, the loose darning is conducted from the neighbourhood of the pubic tubercle to the deep inguinal ring, and back to the starting-point, thus forming a lattice. The external oblique aponeurosis is approximated beneath the spermatic cord. The disadvantage of the operation is that if the wound becomes infected, long-continued suppuration ensues.

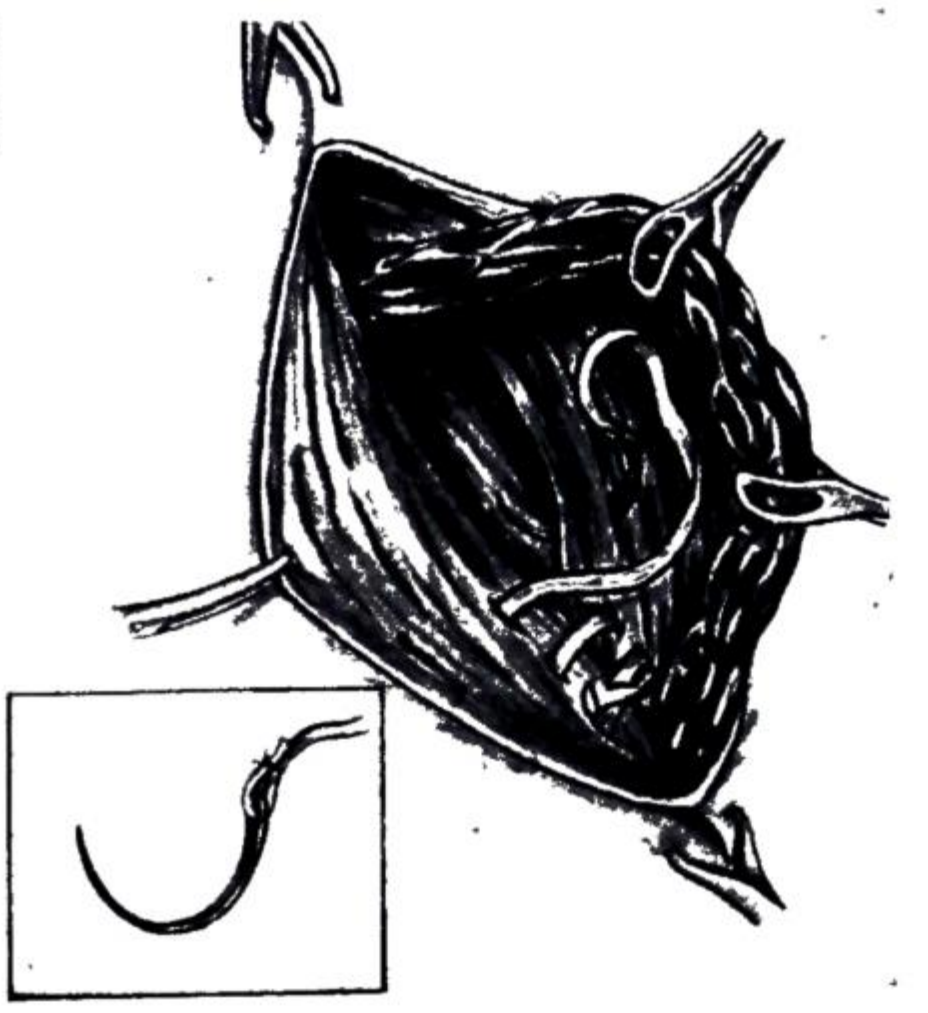


FIG. 900.—Hernioplasty. Strip of fascia lata being used to darn the walls of the inguinal canal. Inset: Method of attaching strip of fascia to the needle.

Hernioplasty with living fascia:

(*a*) *McArthur's Operation.*—A strip of fascia ½ inch (1·25 cm.) wide is cut from the upper leaf of the external oblique aponeurosis and, if necessary, a second strip from the lower leaf. The strip is left attached at its pubic end, the lateral end being severed where the aponeurosis becomes muscular. The free end of the strip is attached to a needle having an especially large eye (Gallie's needle) (fig. 900 inset). The living suture is darned into the posterior wall of the inguinal canal. The external oblique aponeurosis is approximated over the cord. This procedure is applicable in patients with a fairly good abdominal wall.

(*b*) *Gallie's Graft.*—When the external oblique aponeurosis is poorly developed and friable, a strip of fascia is obtained from the outer side of the thigh. This can be obtained through a long incision, or by means of a fasciatome which cuts a strip from the fascia lata through a small skin incision. The fascial suture is used to darn the inguinal canal (fig. 900) in the same way as in (*a*).

FIG. 901.—Reinforcing the posterior wall of the inguinal canal with a whole-thickness skin graft.

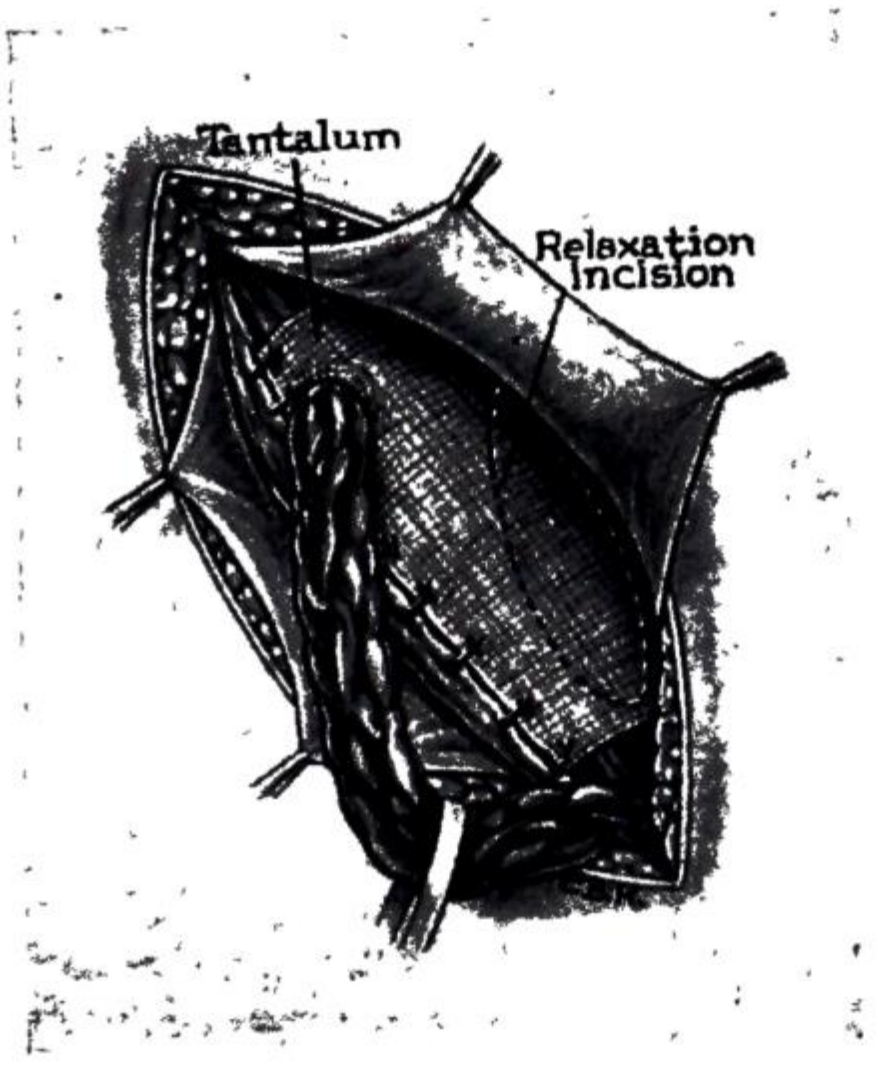


FIG. 902.—The entire area, including the relaxation incision, has been reinforced by a piece of tantalum gauze. (*After A. R. Koontz.*)

Rodney Maingot, Contemporary. Surgeon, Royal Free Hospital, London.
Lewis Linn McArthur, 1858–1934. Surgeon, St. Luke's Hospital, Chicago.
William Edward Gallie, Contemporary. Emeritus Professor of Surgery, Toronto.

(*c*) *Fascial Patch.*—When the defect is large, and especially in recurrent cases, a fascia-patch transplant derived from fascia lata sometimes is employed.

Hernioplasty with Skin (Mair) (fig. 901).—The disadvantage of the original whole-thickness skin graft was the rather frequent development of a dermoid cyst or cysts. Especially in Germany, the deeper layers only of the skin are used for the hernioplasty, while the superficial layers are employed to cover the skin defect on the thigh. The split in the skin graft is effected by a dermatome. By employing this technique it is alleged that cyst formation is infrequent.

Tantalum Gauze.—As can be seen in fig. 902, the gauze is placed over the posterior layer of sutures of a Bassini repair and over the relaxing incision in the rectus sheath. The gauze is attached to the inguinal ligament below, and a slot is cut in it to accommodate the spermatic cord. The external oblique aponeurosis is approximated over the gauze, but under the cord. The advantage of tantalum gauze over all other methods of hernioplasty is that it does not give rise to trouble in the presence of infection. It remains in place, and often eventually the repair is just as strong as if there had been no infection (A. R. Koontz).

STRANGULATED INGUINAL HERNIA

Strangulation of an inguinal hernia occurs at any time during life, and in both sexes. Oblique inguinal herniæ strangulate commonly; the direct variety but rarely. Sometimes a hernia strangulates on the first occasion that it descends; more often strangulation occurs in patients who have worn a truss for a long time, and in those with a partially reducible or irreducible hernia. Because of the comparatively more yielding character of the constricting agent, when strangulation occurs it is less precipitate in an inguinal hernia than when strangulation occurs in an umbilical, or especially a femoral, hernia. In order of frequency, the constricting agent is: (*a*) the neck of the sac; (*b*) the external abdominal ring; (*c*) adhesions within the sac.

Contents.—Usually small intestine is involved in the strangulation; the next most frequent is omentum; often both are implicated. For large intestine to become strangulated in an inguinal hernia is of the utmost rarity, even when the hernia is of the sliding variety (see p. 691).

Strangulation during Infancy.—The incidence of strangulation of an inguinal hernia during the first year of life is high, and it occurs five times more often in females than in males. This astounding disparity is explained easily—in no less than 90 per cent. of cases of strangulated inguinal hernia occurring in female infants the contents of the sac is an ovary, or an ovary plus its Fallopian tube.

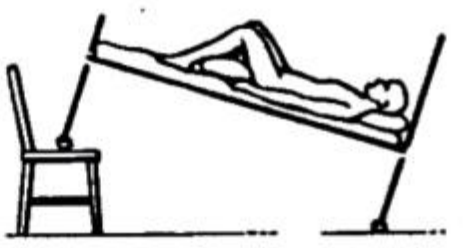
FIG. 903.

Maydl's hernia (*syn.* Hernia-in-W) (fig. 903) is a rare variety of strangulated inguinal hernia. While the symptoms and signs resemble those of an ordinary strangulated enterocele, local tenderness over the hernia is not so great. At operation two comparatively normal-looking loops of intestine are present in the sac. After the obstruction has been relieved the strangulated loop will become apparent if traction is exerted on the medial limbs of the loops occupying the sac.

Treatment of Strangulated Inguinal Hernia.—As a rule treatment by emergency operation is undertaken. Only in very early and previously reducible cases is it permissible to attempt taxis.

George B. Mair, Contemporary. Surgeon, Law Junction Hospital, Lanarkshire, Scotland.
Amos Ralph Koontz, Contemporary. Surgeon, Johns Hopkins Hospital, Baltimore, U.S.A.
Carl Maydl, 1853–1903. Professor of Surgery, Prague.

Postural Treatment.—While arrangements are being made for the operation, provided not more than six hours have elapsed, it is a good practice to raise the foot of the bed and administer a full dose of morphine or omnopon. In a few instances the hernia reduces itself, rendering immediate operation unnecessary.



In a few well-known children's hospitals the same principles are invoked in the case of an infant. The patient is given a sedative, and then slung to a Balkan beam[1] or to the bed-rail by its feet (the judgment of Solomon position) for no longer than three hours. In 75 per cent. of cases reduction is effected, and there appears to be no danger of gangrenous intestine being reduced (Irvine Smith).

Taxis is a method that is justifiable in the following circumstances :

(*a*) *During infancy* when strangulation has been present for less than six hours. The digits of one hand are used to form a funnel leading to the external abdominal ring, while those of the other grasp the lowest part of the swelling. Gentle squeezing is carried out with one hand alternating with the other. Even if taxis is successful, operation should not be long delayed.

(*b*) *In adults* only when the hernia was previously completely reducible and has been irreducible for *less than four hours*. During the attempt the thigh must be flexed and internally rotated, so as to relax the pillars of the external abdominal ring. Unskilled taxis is fraught with many dangers.

Dangers of Taxis.—1. Reduction-en-masse (fig. 904). "The sac, together with its contents, is pushed forcibly back into the abdomen ; and as the bowel will still be strangulated by the neck of the sac, the symptoms are in no way relieved" (Sir Frederick Treves).

2. Contusion or rupture of the intestinal wall.

3. Reduction into a loculus of the sac.

4. The sac may rupture at its neck and reduction of the contents be effected, not into the peritoneal cavity, but extraperitoneally.

FIG. 904. — Reduction-en-masse.

Operation.—As has been intimated already, operation just as soon as the patient has been rendered fit to undergo it by gastric aspiration and intravenous fluid therapy is by and large the treatment of election in all cases. Each and all of the foregoing methods are expedients that have a place in treatment, but even when one or other of them is successful, operation before the patient leaves hospital is still desirable, for otherwise the chances are that the hernia will strangulate again.

Inguinal Herniotomy for Strangulation.—The incision is the same as that described for inguinal herniotomy. The external oblique aponeurosis is exposed, and the sac, with its coverings, is seen issuing from the superficial inguinal ring. In all but very large herniæ it is possible to deliver the body and fundus of the sac together with its coverings and (in the male) the testis on to the surface. Each layer covering the anterior surface of the body of the sac near the fundus is incised, and if possible it is stripped off the sac. When the sac has been incised, the fluid therein is mopped up or aspirated very thoroughly, for it is often highly infected. The external oblique aponeurosis is incised and the superficial inguinal ring is divided. Returning to the sac, a finger is passed into the opening, and employing the finger as a guide, the sac is slit up along its length. If the constriction lies at the superficial

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[1] An overhead beam or bar for applying extension to a fractured femur, first used in the Balkan theatre of war 1914–1918.

Irvine Battinson Smith, Contemporary. Senior Surgical Registrar, The General Infirmary, Leeds.
Sir Frederick Treves, 1853–1923. Surgeon, The London Hospital.

inguinal ring or in the inguinal canal, it is readily divided by this procedure. When the constricting agent is at the deep inguinal ring, by applying hæmostats to the cut edge of the neck of the sac and drawing them downwards, and at the same time retracting the internal oblique upwards, it may be possible to continue slitting up the sac over the finger beyond the point of constriction. When the constriction is too tight to admit a finger, a grooved director is inserted and the constriction, as well as the neck of the sac, is divided with a hernia knife under vision. Once the constricting agent has been divided, the strangulated contents can be drawn down. Devitalised omentum is excised after being securely ligated in small sections. Viable intestine is returned to the peritoneal cavity. Doubtfully viable and gangrenous intestine is dealt with as described in Chapter xxvi. If the hernial sac is of moderate size and can be separated easily from its coverings, it is excised, as hæmostats secure the rim of the peritoneum at its mouth, which is closed by a purse-string suture. When the sac is large and adherent, much time is saved by adopting the principle described for obviating excision of the body of a scrotal hernia (see fig. 893). Having closed the mouth of the sac, if the condition of the patient is good a simple form of herniorrhaphy can be carried out.

RECURRENT INGUINAL HERNIA

Although some individual series show a recurrence-rate of under 1 per cent., it is safe to say that the general rate of recurrence is 10 per cent. This is due in part to the fact that inguinal hernia, being a common and a relatively uninteresting condition, tends in many clinics to be relegated to the end of the operating list; that being so, the operation is not always performed by a surgeon of experience. Seventy-five per cent. of recurrent inguinal herniæ are of the oblique variety (fig. 905). In most instances the recurrence takes place within a year, but it may occur five years or more after the operation.

FIG. 905.—Recurrent oblique inguinal hernia.

The following summarises the principal causes of recurrence :

Pre-operative.—Faulty selection of cases (e.g. those with Malgaigne's bulging, see fig. 908) or chronic bronchitis.

Operative.—Faulty technique.

(*a*) Failure to ligate the neck as high as possible. A collar of extraperitoneal fat is the guide for the correct site for the ligation.

(*b*) Tying stitches too tightly so that intervening tissues are devitalised.

(*c*) Imperfect hæmostasis, predisposing to infection.

(*d*) The use of absorbable sutures in the repair of the inguinal canal.

Post-operative.—The common causes of a recurrence are (*a*) infection of the wound; (*b*) persistent cough; (*c*) heavy lifting before three months after herniorrhaphy; (*d*) prostatic obstruction; (*e*) straining at defæcation.

Treatment.—Unless there is some reason why further operation is unlikely to be successful, e.g. chronic cough, re-operation performed carefully with special precautions against recurrence, e.g. fascial graft, tantalum gauze, is often indicated.

The Spermatic Cord as a Barrier to Effective Closure of the Inguinal Canal.—All surgeons subscribe to the view that removal of the testis aids in an effective repair in the case of recurrent inguinal hernia, sliding hernia, and some large direct herniæ. All would agree that if permission is asked of the patient, he refuses more often than not. On this account A. R. Koontz resects that part of the cord lying between the deep and superficial inguinal rings, and in a very large experience

he has found that if the bed of the testis is not disturbed, the collateral circulation is sufficient to prevent atrophy of the testis. Post-operatively there is a little swelling and pain in the testis, but this subsides if the scrotum is supported for a few days.

SLIDING HERNIA (*syn.* HERNIE-EN-GLISSADE)

One to 3 per cent. of all inguinal herniæ are of the sliding variety.

As a result of slipping of the posterior parietal peritoneum on the underlying cellular tissue, the posterior wall of the sac is not formed of peritoneum alone, but by the sigmoid colon on the left, the cæcum on the right and, perchance, on either side by a portion of the bladder. It should be clearly understood that the cæcum, appendix, or a portion of the colon *wholly within* a hernial sac does not constitute a sliding hernia. A small bowel sliding hernia occurs once in 2,000 cases ; a sacless sliding hernia once in 8,000 cases.

Ætiology.—Except in isolated instances, a sliding hernia does not set out as such, but rather, in the course of time, a hernia (nearly always an oblique inguinal hernia) becomes a sliding hernia in the following way : in the first place there is a gradual increase in the size of the hernia, but this alone cannot cause it to slide. Even more important is the presence of a congenital anatomical variation in the attachment of the sigmoid, whereby the convexity of

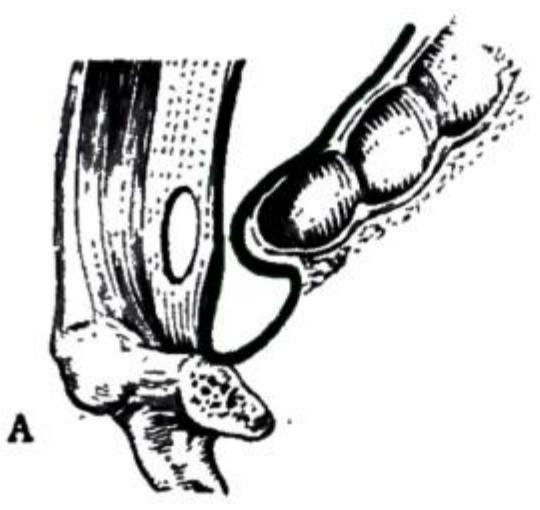


FIG. 906A.—The stage set for a sliding hernia.

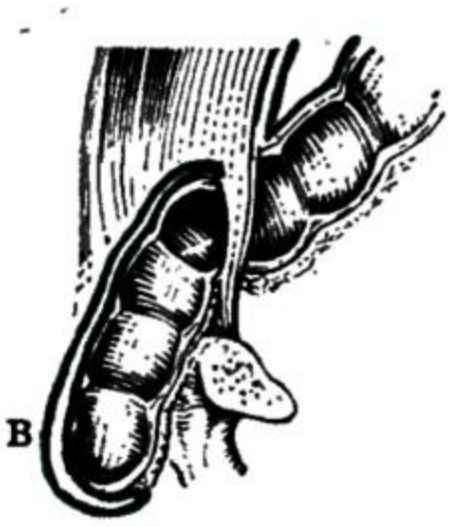


FIG. 906B.—Fully developed left sliding hernia.

FIG. 906C.—Right-sided sliding hernia.

the loop lies close to the deep inguinal ring (fig. 906A), as also an insecure attachment of the parietal peritoneum to the underlying cellular tissues, whereby the viscus can drag its anchor (fig. 906B). When a sliding hernia occurs on the right side (fig. 906C) it does so only in one of the 5 per cent. of individuals who have a cæcal mesentery (E. A. Ryan). There is little doubt that provided the above anatomical variants are present, increasing flabbiness of the abdominal musculature and obesity are accessory factors in the metamorphosis of a simple inguinal hernia into a sliding hernia. When a sliding femoral hernia occurs the postero-internal wall of the sac is composed of a portion of the urinary bladder.

Clinical Features.—A sliding hernia occurs almost exclusively in males. Five out of six sliding herniæ are situated on the left side ; bilateral sliding herniæ are exceedingly rare. The patient is nearly always over forty, and often past fifty years of age, the incidence rising until a zenith of 10 per cent. is reached at eighty years or over. There are no clinical findings that are pathognomonic of a sliding hernia, but in every large globular inguinal hernia descending well into the scrotum of a patient well past his prime, where control by a truss has been poor for some time and the truss causes pain, a sliding hernia

Ernest Anthony Ryan, Contemporary. Surgeon, Shouldice Clinic, Toronto. This Clinic specialises almost exclusively in the treatment of herniæ.

should be suspected. If the patient and his hernia tally with this description, and in addition the patient is obese and his hernia is left-sided and reducible, and the deep inguinal ring is found to be enlarged and lax, the chances of the hernia being a sliding one are high.

A barium enema has been advocated as a means of demonstrating large bowel within the sac, but it must be realised that a positive finding does not exclude large intestine being a content rather than a component of the sac wall.

Sliding femoral hernia of the bladder is not uncommon, but that of the large bowel is very rare indeed.

Occasionally large intestine is strangulated in a sliding hernia; more often non-strangulated large intestine is present behind the sac containing strangulated small intestine.

Treatment.—A sliding hernia is difficult to control with a truss, and as a rule the hernia is a cause of considerable discomfort. Consequently operation is often indicated, and in spite of the high average age of the patients, provided the operation is performed correctly, the results are good.

Operation.—It is unnecessary to remove any of the sliding hernial sac provided it is freed completely from the cord and the abdominal wall, and that it is replaced deep to the repaired fascia transversalis. In most instances it is desirable to resect a portion of the spermatic cord (see p. 692) in order to effect a secure repair. All attempts to dissect the colon free from the peritoneum under the impression that there are adhesions should be avoided studiously.

The penalty of neglecting this injunction is often peritonitis or a faecal fistula resulting from necrosis of the devascularised portion of the colon.

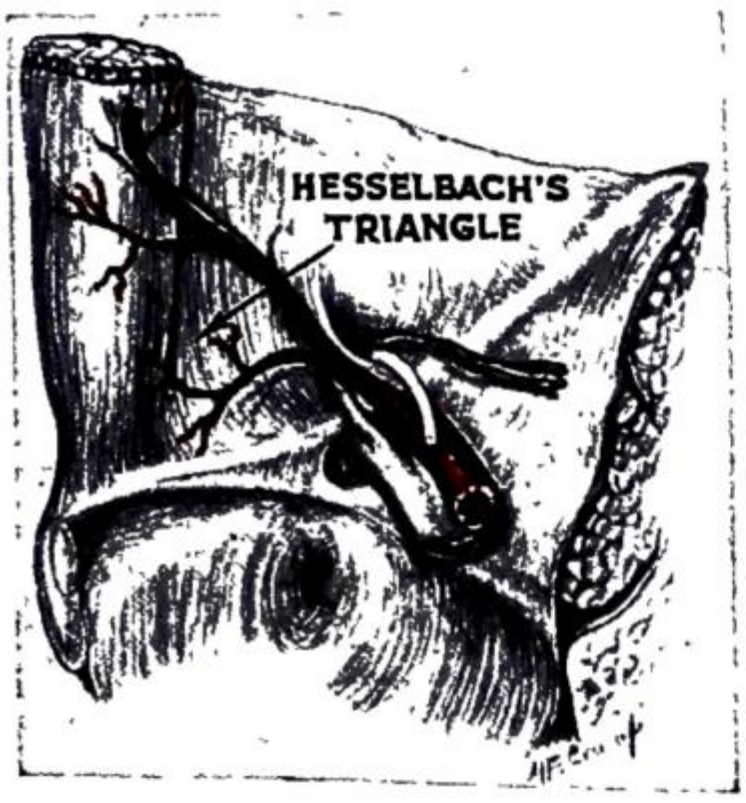


FIG. 907. — A direct hernia breaks through Hesselbach's triangle.

DIRECT INGUINAL HERNIA

Hesselbach's triangle (fig. 907) is bounded medially by the outer margin of the rectus abdominis, laterally by the inferior epigastric artery, and below by the medial half of the inguinal ligament. Through this triangle passes a direct inguinal hernia.

Between 10 and 20 per cent. of inguinal herniæ are direct.

A direct inguinal hernia is always acquired. The sac leaves the abdomen through Hesselbach's triangle. Sometimes the sac passes through a defect in the conjoined tendon to enter the inguinal canal through its posterior wall; at others it carries an atrophied conjoined tendon in front of it. In a few cases the conjoined tendon is congenitally absent, the internal oblique being inserted entirely into the sheath of the rectus abdominis. Often the patient is an elderly man with poor abdominal musculature, as shown by the presence of Malgaigne's bulgings (fig. 908). Predisposing factors are a chronic cough, straining, and heavy work. Exceptionally, a direct hernia appears in a young man with well-developed abdominal musculature; then, possibly, its origin is traumatic.

Franz Kaspar Hesselbach, 1759–1816. Professor of Surgery, Würzburg.
Joseph François Malgaigne, 1806–1865. Professor of Surgery, Paris.

Direct herniæ rarely attain a large size, and they do not descend into the scrotum because they are behind the transversalis fascia. In contradistinction to an oblique inguinal hernia, a direct inguinal hernia lies behind the spermatic cord. A finger inserted into the superficial inguinal ring passes directly backwards into the abdomen. The inferior epigastric artery lies lateral to the aperture, but because of its small size and the nature of its coverings, it cannot be felt. "Those who pretend to feel it surrender themselves to a flattering delusion" (J. F. Macready).

FIG. 908.—Malgaigne's bulgings.

At operation the distinguishing features of a direct inguinal hernia are that the sac lies medially to the inferior epigastric artery, and the spermatic cord is not attached to the wall of the sac. The sac is often smaller than the hernial mass would indicate, the protruding mass being composed, to a large extent, of extraperitoneal fat. Fifty-five per cent. of direct inguinal herniæ are bilateral (R. W. Murray) (fig. 909). Direct inguinal herniæ rarely become strangulated.

FIG. 909.—Bilateral direct inguinal herniæ.

Injury to the ilio-hypogastric or ilio-inguinal nerves during the gridiron operation for appendicitis appears to be associated with the development of a right inguinal hernia, usually, but not necessarily, of the direct variety. Especially the Italian school hold that it is not so much damage to one or other of the nerves that is the cause of right inguinal hernia following appendicectomy, but rather failure to repair the fascia transversalis.

Treatment.—A *small* direct inguinal hernia is not necessarily an indication for operation. Frequently the hernia causes no symptoms; in addition, the risk of strangulation is very small indeed. For this type of hernia an adder-headed spring truss (fig. 910) is frequently satisfactory. For herniæ that are enlarging, and those that have occurred in comparatively young adults, especially when the patient is engaged in a strenuous occupation, operation must be advised.

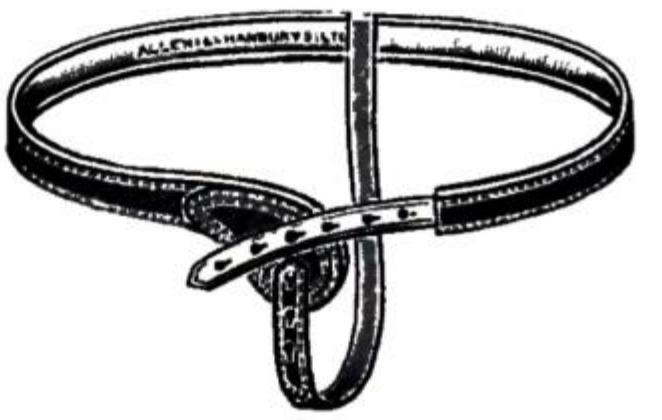


FIG. 910.—Adder-headed spring truss.

Operation.—It is important to fortify the weakened area in Hesselbach's triangle by a four-layer technique. The first layer is made by imbricating the transversalis fascia with at least three interrupted sutures of unabsorbable material. The second layer is provided by suturing the conjoined tendon to the inguinal ligament or, as some prefer, to the ligament of Astley Cooper. A relaxing incision (Tanner's slide) may be required. The third and fourth layers consist of the divided medial and lateral leaves of the external oblique, which are overlapped. The cord is brought

J. F. C. H. Macready, 1850–1907. Surgeon to the Great Northern (now Royal Northern) Hospital, London.
Robert William Murray, 1860–1940. Surgeon, David Lewis Northern Hospital, Liverpool.
Sir Astley Cooper, 1768–1841. Surgeon, Guy's Hospital, London.

out subcutaneously, or what is often preferable is that the part of the spermatic cord traversing the inguinal canal (see p. 884) is resected.

Funicular direct inguinal hernia (*syn.* prevesical hernia) is a hernia of prevesical fat and a portion of the bladder that occurs through a small oval defect in the medial part of the conjoined tendon just above the pubic tubercle. In this form of direct inguinal hernia, which is not rare, the superficial inguinal ring usually is not enlarged, and the hernia, which is smaller than the usual direct inguinal one, is often diagnosed clinically as being indirect. Should the superficial inguinal ring be large enough to admit a little finger, the defect referred to can be felt. This variety of direct inguinal hernia occurs principally in elderly males ; occasionally it becomes strangulated.

Treatment.—In the case of a funicular direct inguinal hernia, unless there are definite contraindications, operation should always be advised, and the results are excellent.

DUAL (*syn.* SADDLE-BAG ; PANTALOON) HERNIA

There is a direct and an oblique hernia present on the same side. The inferior epigastric vessels separate the two sacs. The condition is not a rarity, and is stated to be a rather common cause of recurrence, one of the sacs having been overlooked at the time of operation. By traction on the oblique sac, the direct sac can often be drawn lateral to the inferior epigastric vessels, thus converting the two sacs into one.

FEMORAL HERNIA

Femoral hernia is the third most common type of hernia ; it is o'ertopped for second place by ventral hernia. It accounts for about 20 per cent. of herniæ in women, and 5 per cent. in men. The overriding importance of femoral hernia lies in the facts that it cannot be controlled by a truss, and that of all herniæ it is the most liable to become strangulated.

Surgical Anatomy.—The femoral canal, which occupies the most medial compartment of the femoral sheath, is shaped like a truncated cone→ and extends from the femoral ring above to the saphenous opening below. It is ½ inch (1·25 cm.) long, and ½ inch wide at its base, which is directed upwards. The femoral canal contains fat, lymphatic vessels, and the lymph node of Cloquet. It is closed above by the septum crurale, a condensation of extraperitoneal tissue pierced by lymphatic vessels, and below by the cribriform fascia.

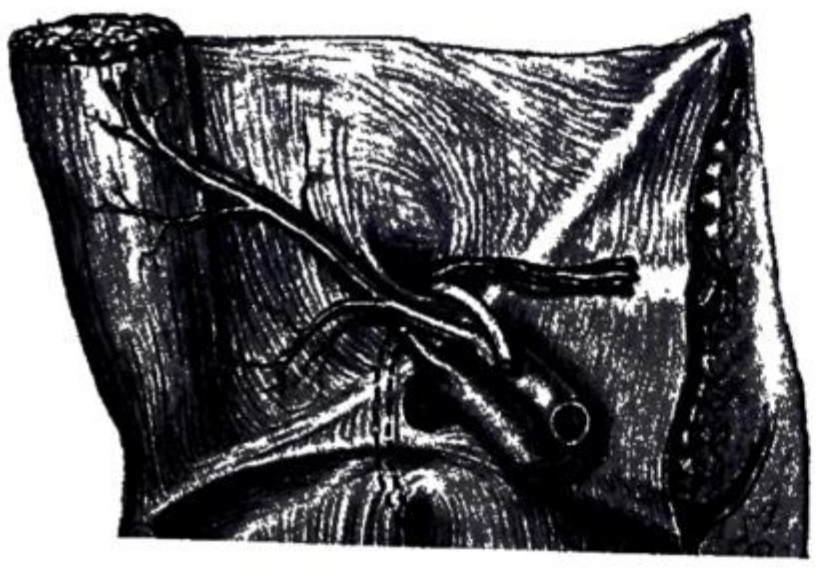


FIG. 911.—The femoral ring and its immediate neighbourhood from within. The dotted structure is an abnormal obturator artery.

The femoral ring (fig. 911) is bounded :

Anteriorly by the inguinal ligament.

Posteriorly by Astley Cooper's (pectineal) ligament, the pubic bone, and the fascia over the pectineus.

Medially by the concave knife-like edge of Gimbernat's (lacunar) ligament (fig. 911), which is also prolonged along the ilio-pectineal line as Astley Cooper's ligament.

Laterally by a thin septum separating it from the femoral vein.

Jules Germain Cloquet, 1790–1883. Professor of Clinical Surgery, Paris.
Antonio Gimbernat y Arbos, 1742–1790. Professor of Anatomy and Surgeon to the Santa Cruz Hospital, Barcelona.

Ætiology.—Because a diverticulum of peritoneum passing into the femoral canal has never been found at necropsy on a new-born infant, and because femoral hernia is extremely rare in the early years of life, most consider that it is an acquired condition.

In spite of this seemingly sufficient evidence the controversy continues. Protagonists of the *saccular theory* are wont to quote R. W. Murray, who found an empty femoral peritoneal sac in 23 per cent. of adult necropsies. In further support of the *acquired theory* it can be stated that femoral hernia is exceptional in dogs, but when it does appear it is relatively frequent in canine performers that walk on their hind-legs.

Sex Incidence.—It is untrue to state that femoral hernia is much more common in females, the proportion being only about 2 : 1 ; also it is untrue to state that the greater frequency in women is due to the female pelvis being larger—the false pelvis (the part most concerned in femoral hernia) is slightly smaller in the female than the male (J. A. Panton). The real point is that femoral hernia occurs a little more often in nullipara than in men, due to the iliopsoas muscle being less developed in the female. The condition is more prevalent in women who have borne children than in nullipara.

Pathology.—A hernia passing down the femoral canal descends vertically as far as the saphenous opening. Because of the attachment of the superficial fascia to the lower part of the circumference of the saphenous opening, the hernial sac is directed forwards, pushing before it the cribriform fascia ; it then curves upwards towards the inguinal ligament (fig. 912). While it is confined to the inelastic walls of the femoral canal the hernia is necessarily narrow, but once it escapes through the saphenous opening into the loose areolar tissue of the groin, it expands, sometimes considerably. A fully distended femoral hernia assumes the shape of a retort (fig. 913), and its bulbous extremity is often above the inguinal ligament. By the time the contents have pursued so tortuous a path they are usually irreducible, if not strangulated.

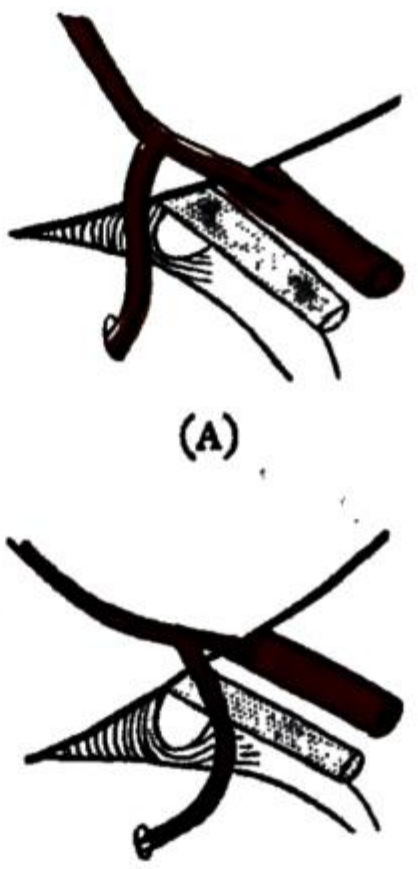
FIG. 912.—The path taken by a large femoral hernia.

FIG. 913.

Throughout an operation for the repair of a femoral hernia, *on the lateral side* the femoral vein, with the internal saphenous vein emptying into it, must be protected. *On the medial side* of the neck of the sac the bladder must be identified and avoided.

Sometimes a portion of the bladder finds its way down the femoral canal, usually in association with a sliding femoral hernia. The condition should be strongly suspected when two sacs are found.

An abnormal obturator artery arising from the inferior epigastric artery is present in fully 25 per cent. of cases. In its dangerous form (fig. 914) it was a source of great anxiety to a former generation of surgeons who practised the 'lower' operation for strangulated femoral hernia. With the full exposure of the neck of the sac afforded by the inguinal route, this blood-vessel ceases to perturb the operator.



(A)

(B)

FIG. 914.—Abnormal obturator artery. (A) Dangerous form. (B) Non-dangerous form.

Clinical Features.—Femoral hernia is very rare before the fifteenth year. Between twenty and forty years of age the prevalence rises, and continues to old

John Allison Panton, 1894–1945. Surgeon, Southport Infirmary, Lancashire. He conducted this enquiry when he was Demonstrator of Anatomy at the Victoria University of Manchester.

FIG. 915.—Right femoral hernia.

age. The right side (fig. 915) is affected twice as often as the left, and in 20 per cent. of cases the condition is bilateral. The symptoms to which a femoral hernia gives rise are less pronounced than those of an inguinal hernia; indeed, a small femoral hernia may be unnoticed by the patient or disregarded for years, until perhaps one day it strangulates. Adherence of greater omentum sometimes causes a dragging pain, but the most usual complaint in an uncomplicated femoral hernia is the presence of a swelling. Although occasionally a very large sac is present, on the whole a femoral hernia is small and, especially in the obese, is liable to escape detection unless on clinical examination it is sought specifically.

FIG. 916.—The patient has a left inguinal and a right femoral hernia.

Differential Diagnosis

A reducible femoral hernia has to be distinguished:

(*a*) *From an Inguinal Hernia*

1. The swelling as seen when the patient stands is more laterally placed than that of an inguinal hernia (fig. 916). In typical cases the swelling is manifestly below the inguinal ligament.

2. The neck of an inguinal hernia lies above and medial to the pubic tubercle, that of a femoral hernia below and lateral. If the tubercle of the pubis cannot be detected easily, the tendon of the adductor longus should be followed upwards.

3. When the tip of the little finger is insinuated into the superficial inguinal ring and the inguinal canal is found to be empty, then obviously the swelling cannot be an oblique inguinal hernia.

(*b*) *From a Saphena Varix.*—A saccular enlargement of the termination of the saphenous vein without obvious varicose veins in the neighbourhood is liable to be mistaken for a reducible femoral hernia. Both swellings appear when the patient stands and both disappear when she lies down. In both there is an impulse on coughing. A saphena varix (fig. 917) will, however, impart a fluid thrill to the examining fingers when the patient coughs, or when the saphenous vein below the varis is tapped with the fingers of the other hand. Usually a venous hum can be heard when a stethoscope is applied over a saphena varix.

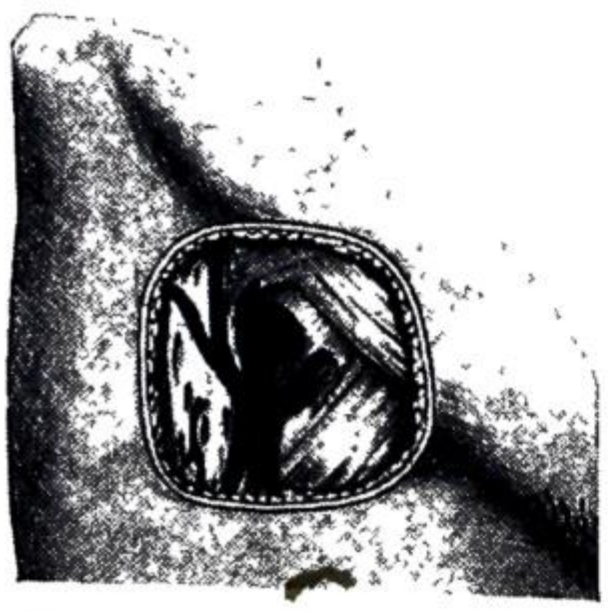


FIG. 917.—Saphena varix.

(*c*) *From a Psoas Abscess.*—An examination of the

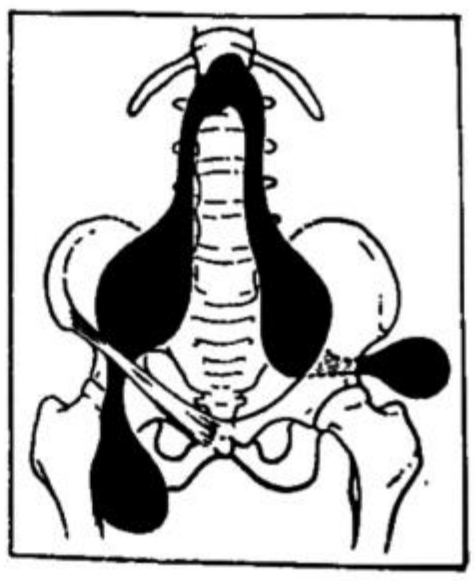


FIG. 918.—A psoas abscess appearing beneath the inguinal ligament may simulate a reducible femoral hernia. Likewise, when it points in the buttock, a gluteal hernia has been suspected. (*After J. F. Calot.*)

back will usually clarify the diagnosis. In addition there is often a fluctuating swelling—an iliac abscess—which communicates with the swelling in question (fig. 918).

(*d*) *From a distended psoas bursa.* The bursa is less apparent when the thigh is flexed.

(*e*) *From an obturator hernia* (see p. 709).

An **irreducible femoral hernia** (fig. 919) has to be distinguished:

(*a*) *From an Irreducible Inguinal Hernia.*—Even when it overlaps the inguinal ligament, a femoral hernia always lies to the lateral side of the pubic tubercle.

(*b*) *From an Enlarged Femoral Lymph Node.*—If there are other enlarged nodes in the region the diagnosis is tolerably simple, but when Cloquet's lymph node alone is affected the diagnosis may be impossible unless there is a lead, such as an infected wound or abrasion on the corresponding limb or on the perineum.

FIG. 919.—An irreducible femoral hernia with its fundus overlying the inguinal ligament.

(*c*) *From Rupture of the Adductor Longus* (with hæmatoma).—If there is no superficial bruising, the diagnosis can be extremely difficult.

(*d*) *From a lipoma.*

(*e*) *From a femoral aneurism.*

(*f*) *From a Hydrocele of a Femoral Hernial Sac.*—The neck of the sac becomes plugged with omentum or by adhesions, and a hydrocele of a pre-existing hernial sac (fig. 920) results.

FIG. 920.—Hydrocele of a femoral hernial sac. The patient previously had ascites, which abated under treatment.

Laugier's femoral hernia (*syn.* hernia ligamenti lacunaris Gimbernati) is a hernia occurring through a gap in the lacunar ligament. The diagnosis is based on the unusual medial position of a small femoral hernial sac. The patients have all been more than forty years of age and nearly always the hernia has been strangulated.

Narath's femoral hernia is a rarity; it occurs only in patients with congenital dislocation of the hip and is due to lateral displacement of the psoas muscle. The hernia occurs behind the femoral vessels and consequently is hidden.

Strangulated Femoral Hernia.—It cannot be emphasised too strongly that not only does a femoral hernia become strangulated frequently, but often gangrene develops rapidly. This is accounted for by the narrow, unyielding femoral ring. In 40 per cent. of cases the obstructing agent (fig. 921) is not Gimbernat's (lacunar) ligament but the narrow neck of the femoral sac itself (Sir Henry Souttar). The frequent occurrence of a *Richter's hernia* (see p. 680) also must be stressed.

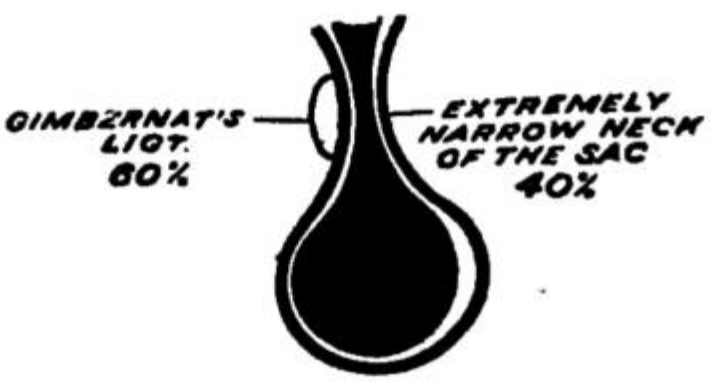


FIG. 921.

TREATMENT OF FEMORAL HERNIA

A femoral truss is highly unsatisfactory in that it becomes displaced when the thigh is flexed. Furthermore, the great liability of a femoral hernia to strangulate is sufficient reason for urging the patient to have herniorrhaphy performed.

Operative Treatment.—The low operation, the inguinal (Lotheissen's) operation, and the high operation all have their advocates, but the inguinal

Stanislas Laugier, 1799–1872. Surgeon to the Hôtel Dieu, Paris.
Albert Narath, 1864–1924. Professor of Surgery, Heidelburg.
Sir Henry Souttar, Contemporary. Consulting Surgeon, The London Hospital.
Georg Lotheissen, 1868–1941. Surgeon, Kaiser Franz Josef Hospital, Vienna.

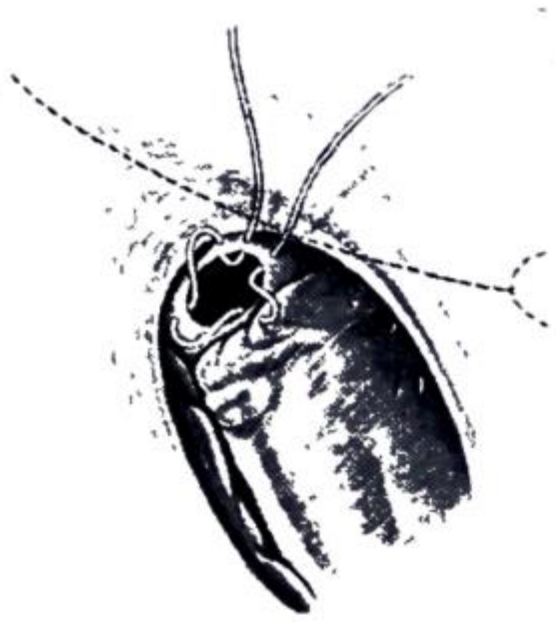


FIG. 922.—The low operation. Purse-string suture of the femoral hernial orifice. (*After W. J. Lytle.*)

(Lotheissen's) operation is the most popular. In all cases the bladder must be emptied immediately before commencing the operation.

The Low Operation.—The sac is exposed in the thigh, preferably by an incision parallel to and above the inguinal ligament. After isolating the sac and dealing with its contents, if any, the neck of the sac is ligated as high as possible and is allowed to retract above the femoral ring. The femoral hernial orifice is then closed with a purse-string suture (fig. 922).

Lotheissen's Operation.—The inguinal canal is opened as for *inguinal* herniorrhaphy. Attention is focused on the area X (fig. 923). The transversalis fascia is incised to the medial side of the epigastric vessels and the opening is enlarged. The peritoneum is now in view; one must be certain that it *is* the peritoneum and not the bladder or a diverticulum thereof. The peritoneum is picked up with dissecting forceps, and incised. It is now possible to ascertain if any intraperitoneal structure is entering the femoral sac. Should the sac be empty, hæmostats are placed upon the edges of the opening into the peritoneum, and by gauze dissection the sac is withdrawn from the femoral canal. An empty sac can be delivered easily; in the event of the sac being occupied, the technique described under strangulated femoral hernia should be followed.

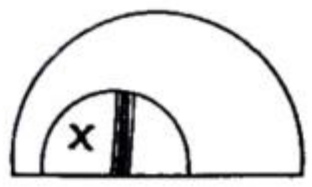


FIG. 923.

Plastic Repair of the Abdominal Wall.—The objective is to bring the conjoined tendon to the ilio-pectineal line, and thus form a shutter. While protecting the external iliac vein with the left forefinger, three unabsorbable sutures are passed through the periosteum and Cooper's ligament overlying the ilio-pectineal line (fig. 924). The retractor having been removed, the long ends of the sutures are passed from within, outwards, through the conjoined tendon, and tied, thus approximating the conjoined tendon to the ilio-pectineal line. If approximation cannot be effected without tension, a Tanner slide (see p. 685) will facilitate this step. The incised external oblique is sutured and the edges of the skin are approximated.

FIG. 924.—Method of placing the deep sutures referred to in the text. The finger is protecting the femoral vein.

Strangulated Femoral Hernia.—It is necessary to modify some of the steps of the operation. As soon as the external oblique has been exposed, the inferior margin of the wound is retracted strongly, thereby displaying the swelling. The coverings of the sac are incised and peeled off one by one, until the sac, dark from contained blood-stained fluid, is apparent. The sac is incised, and the fluid that escapes is mopped up with great care. The retractor is removed and the operation is continued above the inguinal ligament in the same way as described already. Once the peritoneum has been opened above the inguinal ligament, one can peer within and see exactly what is entering the sac. With suitable retraction, Gimbernat's ligament is sought, and with a scalpel guided by a director this ligament is nicked in one or two places. Should the obstruction lie in a narrow neck of the sac, the beak of a hæmostat is insinuated from within the abdomen, and with great care the neck is stretched. The contents of the sac can now be delivered, and are dealt with *secundum artem*, as described on p. 564.

The High (McEvedy) Operation.—A vertical incision is made over the femoral canal and continued upwards for 3 inches (7·5 cm.) above the inguinal ligament. Through the lower part of the incision the femoral sac is identified, and cleared thoroughly.

Peter George McEvedy, 1890–1951. Surgeon, Ancoats Hospital, Manchester.

The upper part of the incision exposes the inguinal ligament and the rectus sheath. The superficial inguinal ring is identified, and an incision 1 inch (2·5 cm.) above the ring and parallel to the outer border of the rectus muscle is deepened through the musculo-aponeurotic layers until the extraperitoneal space is encountered. By gauze dissection in this space the hernial sac entering the femoral canal can be identified easily. Should the sac be empty and small, it can be drawn upwards; when it is large, the fundus is opened below, and its contents, if any, dealt with appropriately before delivering the sac upwards from its canal. In either event the empty sac is freed from the extraperitoneal tissue and its neck is ligated. An excellent view of Astley Cooper's (pectineal) ligament is obtained and the conjoined tendon is sutured to it with non-absorbable sutures, as described above. The incision is closed in layers.

An advantage of the operation is that if resection of intestine is required, ample room can be obtained by opening the peritoneum. The disadvantage of the operation is that if suppuration occurs a ventral hernia is not a very unusual aftermath.

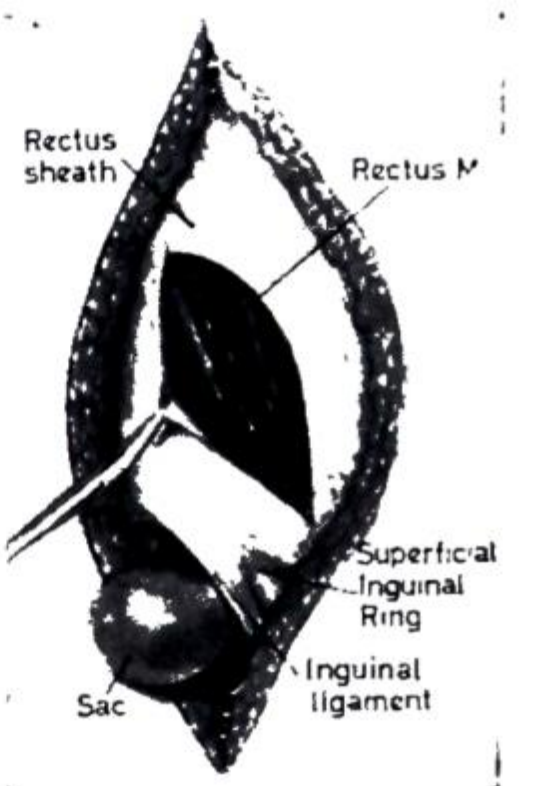


FIG. 925.—Mc-Evedy's operation for femoral hernia.

UMBILICAL HERNIA

FIG. 926.—Exomphalos. The delicate sac burst during delivery.

Exomphalos (*syn.* omphalocele) occurs once in every 6,000 births; it is due to failure of all or part of the mid-gut to return to the cœlom during early fœtal life. Sometimes a large sac ruptures during birth (fig. 926). When the sac remains unruptured, it is semi-translucent, and although very thin it consists of three layers—an outer layer of amniotic membrane, a middle layer of Wharton's jelly, and an inner layer of peritoneum. There are two varieties of exomphalos:

FIG. 927.—Exomphalos minor.

Exomphalos Minor.—The sac is relatively small and to its summit is attached the umbilical cord (fig. 927). Inadvertently a loop of small intestine or a Meckel's diverticulum has been included in the ligature applied to the base of an umbilical cord containing this protrusion.

Exomphalos Major.—The umbilical cord is attached to the inferior aspect of the swelling (fig. 928), which contains a large amount of small and large intestine, and nearly always a portion of the liver. Half the cases belong to this group.

FIG. 928.—Exomphalos major.

Treatment: (*a*) *Exomphalos Minor.*—It is necessary only to twist the cord, so as to reduce the contents of the sac through the narrow umbilical opening into the peritoneal cavity, and to maintain them there by strapping applied firmly. In spite of a sero-purulent discharge from beneath it, on no account must the strapping be removed for fourteen days (Denis Browne).

Ambroise Paré, 1510–1590, the great French Military Surgeon, was the first to describe exomphalos.
Thomas Wharton, 1614–1673. Physician, St. Thomas's Hospital, London.
Denis Browne, Contemporary. Surgeon, Hospital for Sick Children, London.

(*b*) *Exomphalos Major.*—Operation within the first few hours of life is necessary, otherwise the sac will burst. In order to prevent further distension of the contents of the sac, the infant should not be fed. A few newborn infants with a ruptured sac have survived following immediate operation and antibiotic therapy. When possible, a drip blood-transfusion is given, and continued throughout the operation.

Operation.—It must be realised that most of the contents of the sac have never been housed within the abdominal cavity; consequently that cavity is unduly small, and to attempt to replace the contents of the sac is like endeavouring to put 2 lb. of sugar into a 1 lb. bag—a feat that so often results in respiratory embarrassment, compromise of venous return, and possibly intestinal obstruction. It is necessary to create flaps of skin by undermining the subcutaneous tissue on either side, so that the edges of the flaps can be brought together over the sac. If necessary counter-incisions must be made in the loins to permit closure. For several days following the operation it is advisable to carry out aspiration through an indwelling gastric tube, in order to relieve and prevent distension. If the patient survives the construction of this protective cutaneous coverage, repair of the hernia can be delayed for months, or even years. When the time comes for the second operation, it is surprising to find that the peritoneum and the muscles can be drawn together and closed in layers.

Congenital Umbilical Hernia.—On rare occasions a well-developed umbilical hernia is present at birth; the condition is believed to be due to intra-uterine epithelialisation of a small exomphalos.

Umbilical Hernia of Infants and Children.—It is estimated that one out of six English babies develops an umbilical hernia. The ratio of males to females is 2:1. Usually such a hernia is symptomless, but sometimes forcing out the hernia by crying causes pain, which makes the infant cry the more. In these cases the vicious cycle must be broken. Small herniæ are spherical; those that increase in size tend to assume a conical shape (fig. 929) and are present apart from crying. Obstruction or strangulation of an umbilical hernia in a patient below the age of three years is extremely uncommon, although cases requiring resection of intestine have been recorded at a very early age.

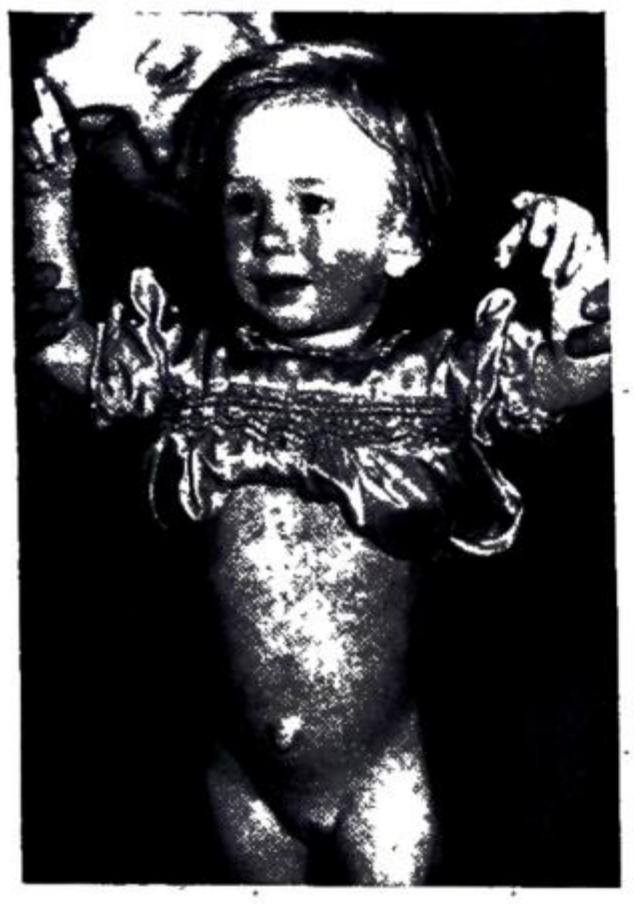


FIG. 929.—Infantile umbilical hernia.

Treatment.—Conservative treatment is successful in 93 per cent. of cases.

(*a*) **Masterly Inactivity.**—When the hernia protrudes a quarter of an inch (6 mm.) or less, and it is symptomless, reassurance of the parents is all that is necessary, for in a very high percentage of cases the hernia will be found to disappear spontaneously during the first few months of life.

(*b*) **Strapping.**—Should the hernia protrude more than a quarter of an inch effective strapping greatly enhances the cure rate.

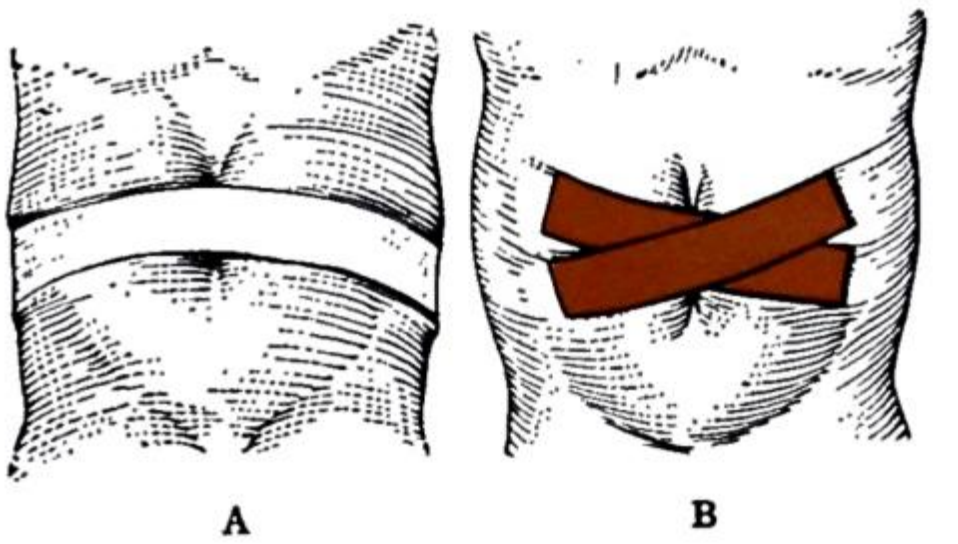
Strapping dermatitis must be guarded against. First a skin test, to ascertain if the patient is sensitive to adhesive plaster, should be carried out. This being negative, the strapping can be applied in one of two ways. In both, the skin is painted with

Tinct. benzoin co. to increase adhesion. In both, an assistant reduces the hernia by pinching the skin into a vertical fold over the hernia before the strapping is pulled tight. Inextensile strapping is employed in all cases.

Method 1.—2-inch (5-cm.) strapping is taken right round the infant's abdomen, so as to overlap at the back (fig. 930A).

Method 2.—Two pieces of 1-inch (2·5-cm.) plaster are applied in an X-shaped manner (fig. 930B).

Method 3.—If the child is sensitive to plaster, the strapping is applied sticky side out by method 1, and is powdered after it has been applied, or transparent cellotape can be used.



A B

FIG. 930.—Methods of strapping an umbilical hernia in an infant.

The plaster must be worn continuously and the child is washed (not bathed) during the whole period of treatment. As a rule the plaster commences to become loose after a fortnight, and must be changed. The treatment is continued for from three to six months. After six months of age, probably strapping is useless. Even if an apparent cure results, should the child develop pertussis or bronchitis, the strapping must be reapplied.

FIG. 931.—The incision is made in the form of a half-circle $\frac{1}{3}$ inch (8 mm.) from the hernia. (*After L. F. Watson.*)

Herniorrhaphy.—In cases where the strapping fails to effect a cure, operation is required, and it should be carried out, preferably, about the age of two years.

Operation.—In infants, umbilical herniorrhaphy consists of a small curved incision immediately below the umbilicus (fig. 931). The skin cicatrix is dissected upwards, and the neck of the sac is isolated as it emerges through the linea alba. After being pinched, to ensure that it is empty of contents, the sac is ligated by transfixion, and excised. The defect in the linea alba is closed with two unabsorbable sutures, and the skin is united. Gauze, covered by two strips of adhesive plaster, completes the operation.

Para-umbilical Hernia in Adults.—It should be noted that in adults a hernia does not occur through the umbilicus. It is a protrusion through

FIG. 932.—Small.

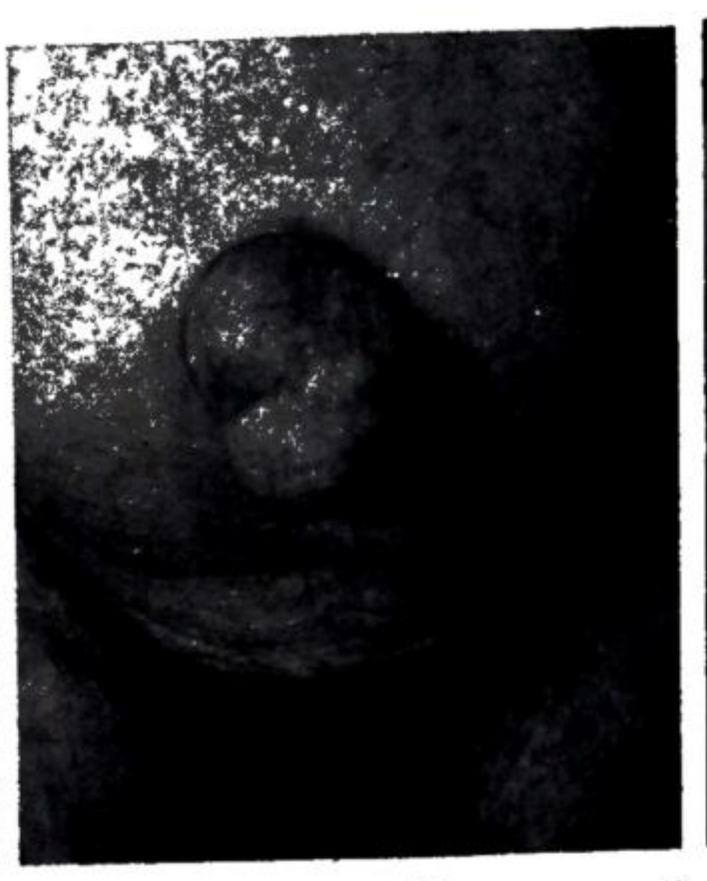


FIG. 933.—Large.

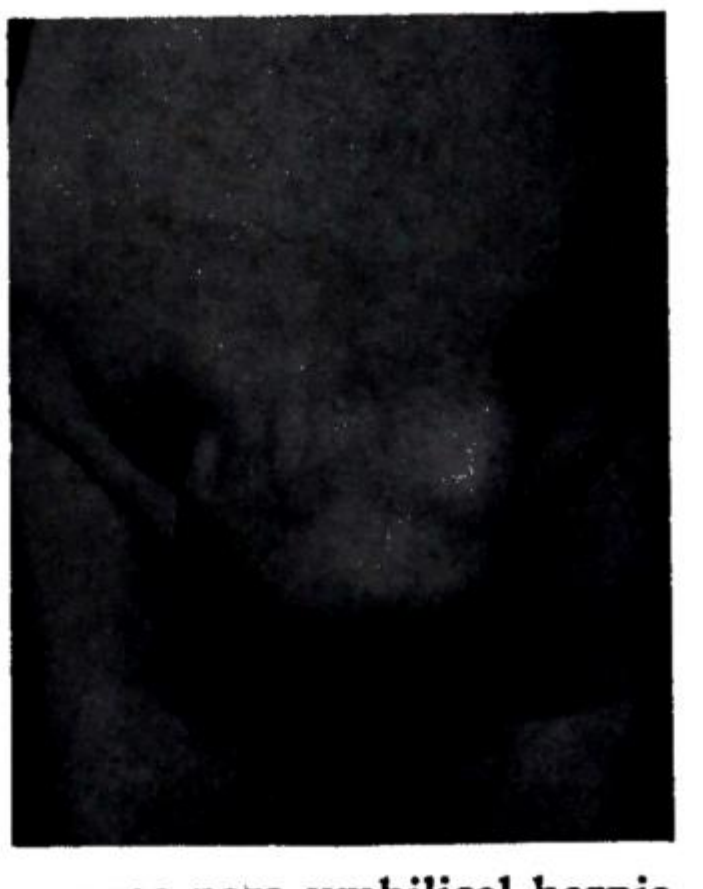


FIG. 934.—Immense para-umbilical hernia

the linea alba just above the umbilicus or, occasionally, just below that structure; it is therefore a para-umbilical hernia (fig. 932). As a para-umbilical hernia enlarges, it becomes rounded or oval in shape (fig. 933) with a tendency to sag downwards. Para-umbilical herniæ increase steadily

in size and frequently attain very large dimensions (fig. 934). The neck of the sac is often remarkably narrow as compared with the size of the sac and the volume of its contents, which consist of greater omentum often accompanied by small intestine and, alternatively or in addition, a portion of the transverse colon. In old-standing cases the sac sometimes becomes loculated due to adherence of omentum to its fundus.

Clinical Features.—Women are affected five times more frequently than men. The patient is usually corpulent and between the ages of thirty-five and fifty. Increasing obesity with flabbiness of the abdominal muscles is an important factor in the production of a para-umbilical hernia, and in women repeated pregnancy favours its occurrence. These herniæ soon become irreducible because of omental adhesions within the sac. A large umbilical hernia causes a local dragging pain by its weight. Gastro-intestinal symptoms are common and are sometimes due to traction on the stomach or transverse colon. Often there are transient attacks of intestinal colic due, almost certainly, to sub-acute intestinal obstruction. In old-standing cases intertrigo of the adjacent surfaces of the skin (fig. 935) is a troublesome complication.

FIG. 935.

Treatment.—Umbilical trusses are difficult to keep in position, and so far as controlling the hernia is concerned an abdominal belt, with or without a special pad attached, is very little better. Untreated, the hernia increases in size, and more and more of its contents become irreducible. Eventually, in not a few instances, strangulation occurs. It is for these reasons that early operation should be advised in nearly all cases. When the patient is obese and the hernia is symptomless, operation can be postponed with advantage until weight has been reduced. The laxity of the abdominal wall during the early puerperium makes it a most opportune time to perform umbilical herniorrhaphy.

Mayo's Operation for Umbilical Hernia.—A transverse elliptical incision is made about the umbilicus (fig. 936). The neck of the sac is defined and opened.

FIG. 936.—Para-umbilical hernia showing Mayo's incision.

FIG. 937.—Mayo's operation for umbilical hernia.

The contents passing through the neck is examined carefully piece by piece. Omentum is ligated and divided; intestine is reduced into the abdomen. As soon as the contents have been dealt with, the neck of the sac is amputated. The peritoneum and the aponeurosis on both sides of the umbilical ring are incised transversely for 1 inch (2·5 cm.) or more—sufficiently to allow an overlap of 2 or 3 inches (5 or 7·5 cm.).

William J. Mayo, 1861–1939, Surgeon, Mayo Clinic, Rochester, U.S.A., described the operation in 1894.

Three to five mattress sutures are then inserted as shown in fig. 937. When this row of mattress sutures has been tied, the overlapping upper margin is stitched to the sheath of the rectus abdominis and the midline aponeurosis. It is important to denude this area of fat before stitching the flap in position. The fat and skin are then approximated and the abdomen supported by a firm bandage. The patient should be confined to bed for at least fourteen days, and if she has a tendency to bronchitis, which is not unusual, it is wise to prescribe antibiotic therapy and to order respiratory gymnastics.

A few operators, dissatisfied with the results of Mayo's operation (which is acclaimed generally to be satisfactory), prefer to employ the fascial flap operation depicted in fig. 942. Another expedient, especially valuable in recurrent cases, is to stitch the overlapping upper margin (resulting from the tying of the sutures depicted in fig. 937) to the rectus sheath with a strip of fascia lata.

Additional Lipectomy.—In patients with a para-umbilical hernia associated with a large pendulous, fat-laden abdominal wall the operation can, with great advantage, be combined with lipectomy by fashioning the incisions shown in fig. 936 to embrace a larger area of the fat-laden superficial layers of the abdominal wall.

Strangulation is a frequent complication of a large para-umbilical hernia in adults. Owing to the narrow neck and the fibrous edge of the linea alba, gangrene is liable to supervene unless early operation is carried out.

Operation.—In early cases the operation does not differ from that for non-strangulated cases. Gangrenous contents are dealt with as in other situations. If a portion of the transverse colon is gangrenous, it should be exteriorised by the Paul-Mikulicz' method (see p. 551) and the gangrenous portion excised. If the ring is large enough to transmit the limbs of the colon unhampered, it is left alone; otherwise it is enlarged.

Rupture of a para-umbilical hernia following ulceration of its covering probably occurs much more commonly than is indicated by reported cases. In spite of immediate operative repair prognosis is not so favourable as in cases of disruption of a laparotomy wound because the complication is unlikely to arise in hospital.

INCISIONAL HERNIA (*syn.* VENTRAL HERNIA; POST-OPERATIVE HERNIA)

Ætiology.—The most usual cause of an incisional hernia is quiet, partial disruption of the deeper layers of a laparotomy wound during the immediate, or very early, post-operative period. It is more than probable that such an event will pass unnoticed, for the skin stitches remain intact. A sero-sanguinous discharge from a laparotomy incision should always be a signal of this happening, and a call for systematic palpation of the immediate proximity of the incision, with the examiner duly masked and gloved. Re-suture of the deeper disrupted layers of the incision obviates the more difficult repair of an established ventral hernia later on. Incisional hernia occurs most often in obese individuals, and a persistent post-operative cough and post-operative abdominal distension are its precursors. There is a high incidence of incisional hernia following operations for peritonitis because, of necessity, the wound becomes infected. In this instance a correct pre-operative diagnosis, by permitting a relatively small incision over the focus, e.g. a grid-iron incision, and the accommodation of a necessary drainage tube in a stab incision, as opposed to placing such a tube through the laparotomy wound, reduces the frequency of its occurrence.

These are the causes of incisional hernia. The concept that the hernia occurs during late convalescence is erroneous. Provided the main nerves to the abdominal musculature have not been cut, a soundly healed laparotomy scar will withstand the buffeting of any walk of life, and even of repeated pregnancy.

Clinical Features.—Incisional hernia presents no difficulty in diagnosis. There are great variations in the degree of herniation. The hernia may occur through a small portion of the scar, often the lower end. More frequently there is a diffuse bulging of the whole length of the incision. A postoperative hernia, especially one through a lower abdominal scar, usually increases in size steadily, and more and more of its contents become irreducible. Sometimes the skin overlying it is so thin and atrophic that normal peristalsis can be seen in the underlying coils of intestine. Attacks of subacute intestinal obstruction are common, and strangulation is liable to occur at the neck of a small sac or in a loculus of a large one.

Treatment.—*Palliative.*—An abdominal belt is sometimes satisfactory, especially in cases of a hernia through an upper abdominal incision.

Operation.—Many operative procedures have been advocated. Two only will be detailed here; one suited particularly to the upper abdomen, and one for the lower abdomen. Both have been tested in the crucible of experience, and have not been found wanting.

Pre-operative Measures.—In order to obtain a lasting repair, very special preparation is required. If the patient is obese, reduction by dieting should precede the operation. To attempt to return the contents of a very large hernia to the main abdominal cavity if it has not been there for several years is to court danger, unless weight reduction has been effected. In these circumstances, not only is there a risk of failure of the hernioplasty, but there is a greatly increased risk of paralytic ileus from visceral compression, and of pulmonary complications from elevation of the diaphragm.

In order to increase the capacity of the (contracted) general peritoneal cavity for the reception of eventrated viscera that for long have been extracœlomic, the induction of a pneumoperitoneum, after reduction and maintenance of reduction of the contents of the hernia by strapping, has been recommended recently.

Langenskiöld's Operation.—An elliptical incision is made through normal skin so as to embrace the stretched scar. The superficial layers are dissected off the

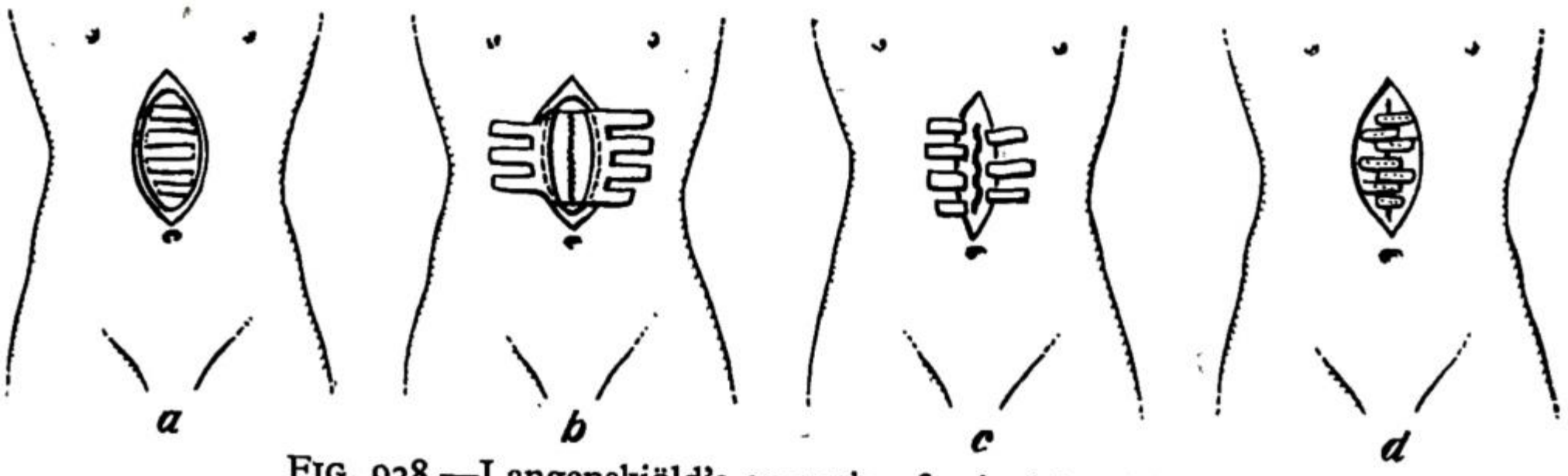


FIG. 938.—Langenskiöld's operation for incisional hernia.

abdominal wall laterally, until sound abdominal wall is displayed on either side of the gap. The skin and scar tissue is dissected off the hernial sac, which is opened transversely. After adherent structures have been freed and returned to the abdominal

Fabian Langenskiöld, Contemporary. Formerly Professor of Surgery, University of Helsingfors, Finland.

cavity, the hernial sac is further opened by several parallel incisions, so as to create a number of strips about 2 cm. wide, which are detached at one end, alternating between right and left (fig. 938(*a*)). The peritoneum is closed (fig. 938(*b*)), if possible. The strips are drawn through slots about 2 cm. from the opposite margin of the orifice of the hernia, and tightened (fig. 938(*c*)). The strips can either be folded back and fastened with additional sutures (fig. 938(*d*)) or they can be tied together in pairs before being fastened to the fascia of the anterior abdominal wall with stitches.

In the case of a small hernia, the operation can be conducted as depicted in fig. 942.

Cattell's Operation for Incisional Hernia.—The preliminary steps of the operation are similar to those described above until the sac is exposed. Often the sac is deficient in places, and greater omentum or intestine is adherent to the under-surface of the skin, which must be dissected from intestine with great care. Greater omentum can be ligated and divided, leaving a portion of it attached to the skin. The sac having been freed of adherent contents and viscera having been returned to the abdominal cavity, the opened sac is held up and its neck is defined clearly from the inner aspect. Repair of the abdominal wall in five layers is then commenced. (1) The peritoneum and the abdominal wall are approximated at the neck with an interlocking suture of thick chromic catgut, including all layers of the abdominal wall that are attached to the hernial ring (fig. 939A). An incision is made through sac as shown by the dotted line in fig. 939A. (2) The cut edges of the base of the sac are approximated with unabsorbable sutures. An elliptical incision is made 2 cm. lateral to the previous suture line. (3) The medial borders of the incision are approximated. The lateral edges of the fascia are freed from the overlying muscles for some distance and this fascial layer is approximated with interrupted sutures at the upper and lower ends of the wound. This is done to relieve tension on the muscles. (4 and 5) The muscles and the remaining fascial layer are approximated by alternating stitches (fig. 939B). Should it be found the final fascial layer is under tension, this is relieved by counter-incisions placed well laterally. The fat and the skin are approximated.

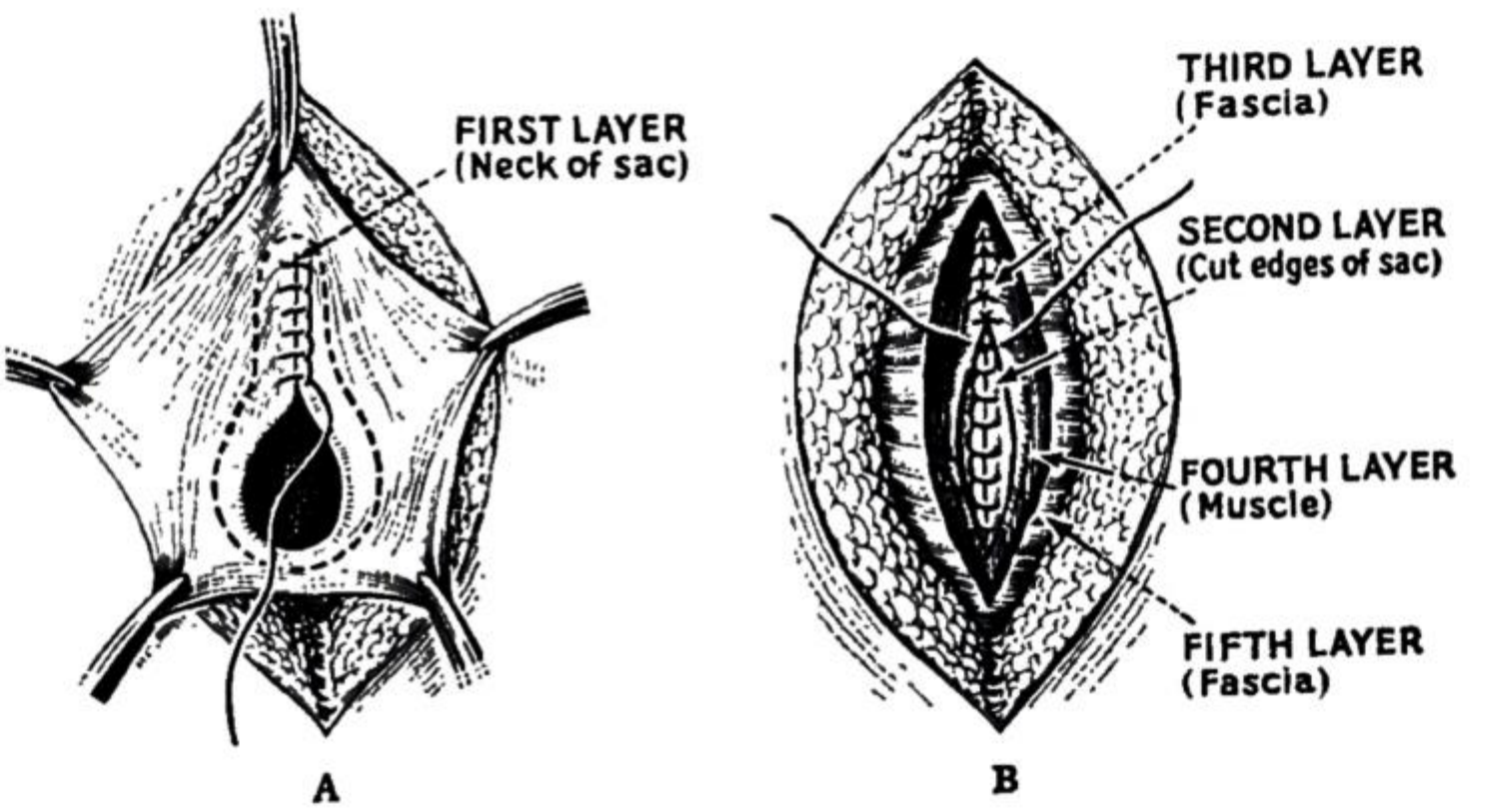


FIG. 939.—A. The closure of the hernial defect from inside the sac. Dotted line indicates the excess sac. B. Approximation of the third layer. (*After R. B. Cattell.*)

Post-operative Treatment.—Continuous gastric decompression should be employed, and nothing by mouth allowed until the bowels have functioned. Early ambulation is to be discouraged but exercises, especially of the legs, are to be encouraged. The patient should not resume strenuous exercise for three months.

EPIGASTRIC HERNIA

An epigastric hernia is one which occurs through the linea alba anywhere between the xiphoid process and the umbilicus, but most often midway between these structures. Such a hernia commences as a protrusion of extraperitoneal fat through the linea alba, where the latter is pierced by a (small) blood-vessel.

A swelling the size of a pea consists of a protrusion of extraperitoneal fat

Richard B. Cattell, Contemporary. Chief Surgeon, Lahey Clinic, Boston, Mass.

only (fatty hernia of the linea alba (fig. 940)). If the protrusion enlarges, it drags a pouch of peritoneum after it, and so becomes a true epigastric hernia. Not infrequently one or more fatty herniæ of the linea alba, no larger than an orange pip, are situated above or below the more evident swelling. Rarely is the mouth of the hernia large enough to permit a portion of a hollow viscus to enter it ; consequently, as a rule, either the sac is empty or it contains a small portion of greater omentum.

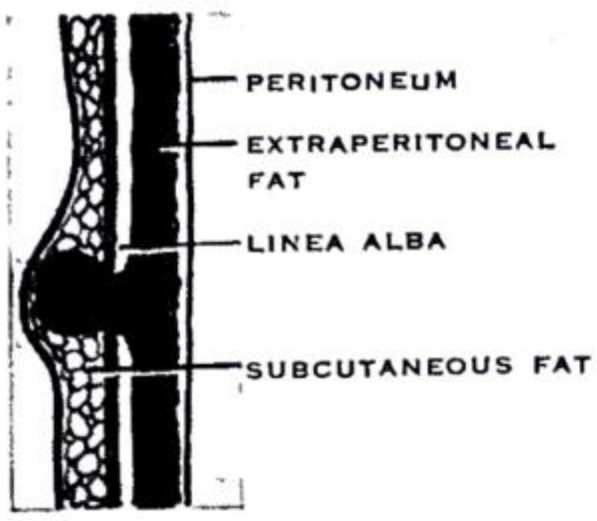


FIG. 940.—Fatty hernia of the linea alba.

Ætiology.—It is probable, nay almost certain, that an epigastric hernia is the direct result of a sudden strain tearing the interlacing fibres of the linea alba.

Clinical Features:

(*a*) *Symptomless.*—A small fatty hernia of the linea alba can be felt better than it can be seen, and may be symptomless, being discovered only in the course of routine abdominal palpation.

(*b*) *Painful.*—Sometimes such a hernia gives rise to attacks of local pain, worse on physical exertion, and tenderness to touch and tight clothing, explained only by the contents becoming nipped sufficiently to produce partial strangulation. Patients with these symptoms are usually male manual workers between thirty and forty-five years of age.

(*c*) *Referred Pain.*—When an epigastric hernia attains the size of a hazel nut (fig. 941) it contains a pouch of peritoneum ; then it is not uncommon to find that the patient, who may not have noticed the hernia, complains of pain suggestive of a peptic ulcer. On the other hand, a patient suffering from a gastric or duodenal ulcer may attribute all his symptoms to an epigastric hernia.[1] When the symptoms are pain related to food, with nausea and vomiting, and the usual full investigations for peptic ulcer and cholecystitis prove negative, and the patient has an epigastric hernia, it is well proved that such a hernia can produce these symptoms, the explanation being that a portion of greater omentum entrapped in the hernia causes traction on the stomach. In these circumstances epigastric herniorrhaphy will cure the patient.

FIG. 941.—Epigastric hernia.

(*d*) *Incisional epigastric hernia* occasionally follows a midline upper laparotomy incision. Often its physical characteristics are identical with the epigastric hernia described.

Treatment.—If the hernia is giving rise to symptoms, operation should be undertaken.

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[1] In a high percentage of cases of epigastric hernia there is coexistent upper abdominal pathology.

Operation.—An adequate vertical incision is made over the swelling, exposing the linea alba, which is examined throughout its length for possible subsidiary minor herniations. The protruding extraperitoneal fat is cleared from the hernial orifice by gauze dissection. If the pedicle passing through the linea alba is slender, it is separated on all sides of the opening by blunt dissection. After ligating the pedicle the small opening in the linea alba is closed by unabsorbable sutures. When a hernial sac is present it is opened and any contents reduced, after which the sac is excised before repairing the linea alba.

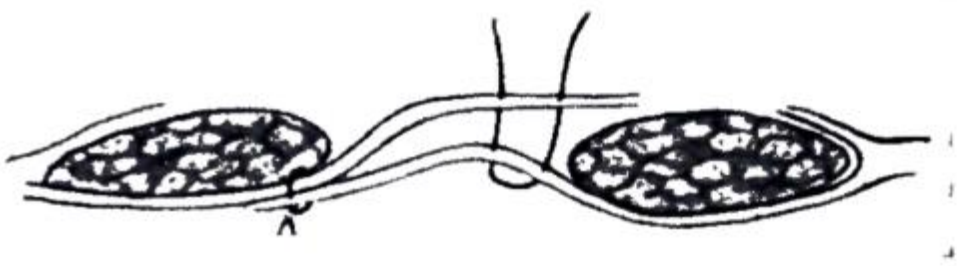

FIG. 942.—Method of repairing a gap in the linea alba. (*After Charles Wells.*)

In the case of an incisional epigastric hernia with a gaping hole in the linea alba, the opening can be closed effectively by imbrication of transverse flaps cut from the anterior rectus sheath (fig. 942).

DIVARICATION OF THE RECTI ABDOMINIS

Divarication of the recti abdominis is seen principally in elderly multiparæ. When the patient strains, a gap can be seen between the recti abdominis below the umbilicus; through this gap the abdominal contents bulge. When the abdomen is relaxed the fingers can be introduced between the recti.

Treatment.—An abdominal belt is all that is required.

Occasionally a similar condition is met with in babies, only the divarication exists above the umbilicus. No treatment is necessary; as the child develops, usually a spontaneous cure results.

RARE EXTERNAL HERNIÆ

In order of increasing rarity, these comprise interparietal, obturator, lumbar, perineal, gluteal, and sciatic herniæ. If incisional herniæ in the relevant regions are included, as they should be, the order becomes changed to interparietal, lumbar, perineal, obturator, gluteal, and sciatic, and it is in this sequence that they will be discussed.

Interparietal Hernia (*syn.* Interstitial Hernia).—Lack of knowledge of this condition is the cause of misdiagnosis and mismanagement. An interparietal hernia has a hernial sac that passes between the layers of the anterior abdominal wall. The sac may or may not be associated with, or communicate with, the sac of a concomitant inguinal or femoral hernia.

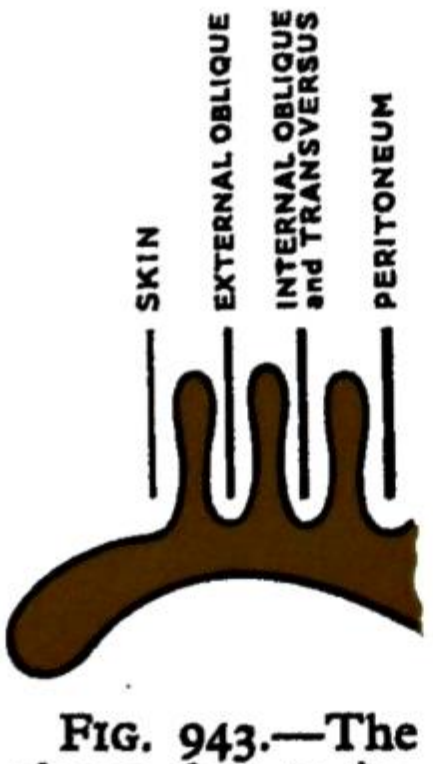

FIG. 943.—The planes that an interparietal hernia may occupy.

Varieties (fig. 943):

1. **Properitoneal** (20 per cent.).—Usually the sac takes the form of a diverticulum from a femoral or inguinal hernia, but the femoral or inguinal hernia can be quite distinct from the properitoneal hernia.

2. **Intermuscular** (60 per cent.).—In this form of hernia the hernial sac passes between the muscular layers of the anterior abdominal wall. The most common situation is between the external oblique and internal oblique muscles; in this instance the sac is nearly always bilocular, and usually it is associated with an inguinal hernia.

3. **Inguino-superficial** (20 per cent.).—In this variety the hernial sac passes through the external abdominal ring, and then expands beneath the superficial fascia of the anterior abdominal wall or the thigh.

Ætiology.—It is believed that sometimes an interparietal hernia is congenital, but more often it is acquired due to the wearing of a truss or to the blocking of the super-

ficial inguinal ring by (1) an incompletely descended testis, (2) a hydrocele of the cord, or (3) a hydrocele of the canal of Nück. The incidence of the association of an inguino-superficial interparietal hernia with an incompletely descended testis is very high.

Clinical Features.—In all varieties, the incidence in the male is higher than in the female, viz. 3:1 in the properitoneal and intermuscular varieties, and 14:1 in the inguino-superficial variety. When an interparietal hernia is encountered in a man, he is usually between thirty and forty years of age, whereas a woman with this condition is, as a rule, twenty years older. Most patients with this condition present with intestinal obstruction, due to obstruction or strangulation of the hernia. In these circumstances the cause of the obstruction should be apparent in the intermuscular and inguino-superficial varieties, but in the properitoneal variety, as no swelling is likely to be apparent, delays in diagnosis occur and consequently the mortality in this variety is high. Moynihan considered that *reduction-en-masse* is always the result of the transference of strangulated intestine from an inguinal or femoral loculus into a properitoneal sac.

Treatment.—Usually operation becomes imperative because of intestinal obstruction. In all cases of inguinal and femoral hernia a finger should be introduced into the sac with the object of detecting a loculus, and thus forestalling possible strangulation of an unsuspected interparietal hernia.

A Spigelian hernia is a special variety of interparietal hernia. The Spigelian fascia is the aponeurosis intervening between the muscular part of the transversus muscle and the rectus sheath. A Spigelian hernia is one occurring through the Spigelian fascia, commonly at the level of the arcuate lines, but A. R. Koontz reported seven instances where the hernia occurred above the level of the umbilicus. The fundus of the sac, clothed by extraperitoneal fat, sometimes lies beneath the internal oblique muscle, where it is virtually impalpable. More often it advances through that muscle and spreads out like a mushroom between the external and internal obliques; in this situation it gives rise to a somewhat more evident swelling (fig. 944). The patient is often corpulent, and usually over fifty years of age, men and women being affected equally. Typically, a soft, reducible mass will be encountered lateral to the rectus muscle and below the umbilicus. After reduction a small oval defect can often be felt in the abdominal wall. Because of the rigid fascia surrounding its neck, strangulation is common. In a stout female, to differentiate a strangulated Spigelian hernia from a twisted ovarian cyst or a hæmatoma due to the tearing of the inferior epigastric artery may be impossible.

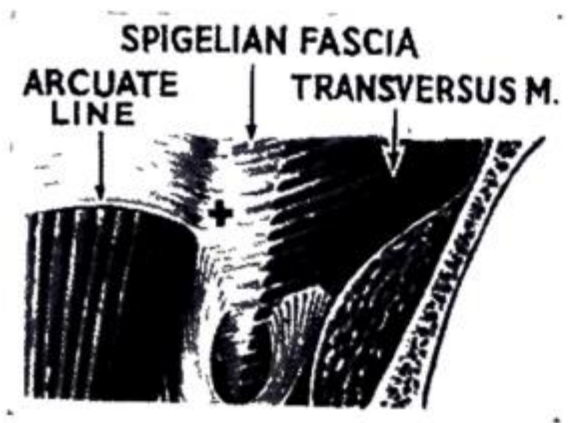

FIG. 944.—The most usual site for a Spigelian hernia.

Treatment.—Even in the absence of strangulation operation upon a Spigelian hernia always should be advised. Repair is simple. The external oblique aponeurosis is split. After isolating the sac, dealing with any contents, and ligating and excising it, the transversus, internal oblique, and external oblique muscles are approximated in layers.

Lumbar Hernia.—Most primary lumbar herniæ gain exit through the inferior lumbar triangle of Petit (fig. 945), bounded below by the crest of the ileum, laterally by the external oblique, and medially by the latissimus dorsi. Some come through the superior lumbar triangle, which is bounded by the twelfth rib above, medially by the sacrospinalis, and laterally by the posterior border of the internal oblique. A few appear through abnormal openings in the muscles and fasciæ that occur occasionally anywhere in the lumbar region.

FIG. 945.—Inferior lumbar hernia.

An extensive incisional lumbar hernia sometimes follows an operation upon a kidney in which the organ was infected, and in which the wound suppurated postoperatively.

Lord Moynihan, 1865–1936. Surgeon, The General Infirmary, Leeds.
Adrian van der Spiegel, 1578–1625. Professor of Anatomy and Surgery, Padua.
Jean Louis Petit, 1674–1750. Director Académie de Chirurgie, Paris.

Differential Diagnosis.—A lumbar hernia must be distinguished from:
(*a*) A cold abscess pointing in this position.
(*b*) Phantom hernia due to local muscular paralysis (fig. 946). Lumbar phantom herniæ can result from many conditions which interfere with the nerve-supply of the affected muscles. I have seen a phantom lumbar hernia following herpes zoster.

FIG. 946.—Phantom hernia following anterior poliomyelitis.

Treatment.—A primary lumbar hernia is, as a rule, comparatively small, and does not entail an extensive operation for its repair. On the other hand, in the case of a post-operative lumbar hernia it is not uncommon for a considerable amount of muscle and fascia to slough, and the resulting hernia is impossible to repair unless fascial flaps are raised to cover the defect (fig. 947). When necessary, the operative area can be reinforced still further by stitching in place a piece of tantalum gauze.

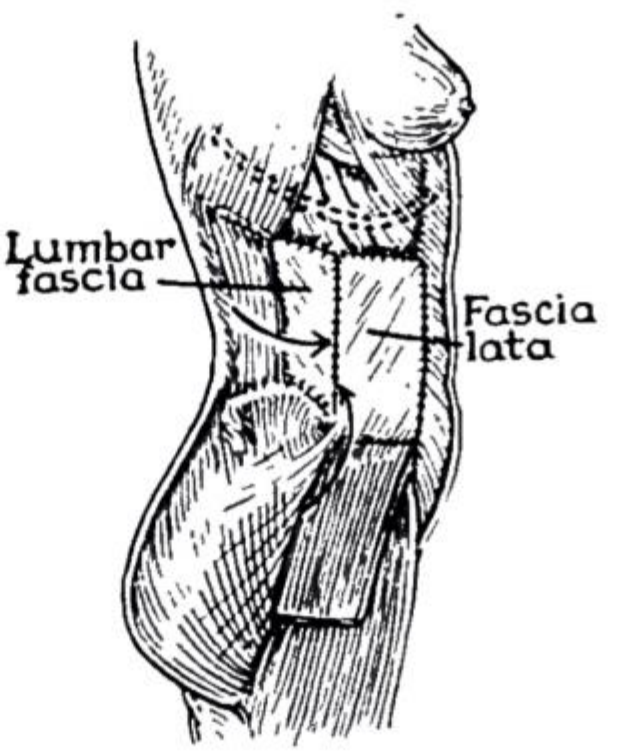

FIG. 947.—Method of repairing a lumbar hernia. (*After C. N. Dowd.*)

Perineal hernia (*syn.* hernia through the pelvic floor) is not uncommon in the ageing dog—a reducible swelling appears immediately lateral to the anus. In human beings, except as a complication following excision of the rectum, perineal hernia is most uncommon.

Several varieties are encountered:

(*a*) **Antero-lateral perineal hernia** occurs exclusively in women and passes through an opening anterior to the transversus perinei muscle to enter the labium majus. It is more frequent than

(*b*) **Postero-lateral perineal hernia,** which passes through the levator ani to enter the ischio-rectal fossa. This variety is more common in women, but occasionally occurs in men.

These herniæ are nearly always reducible and seldom strangulate. The anterior variety, which reduces backwards and upwards, must be distinguished from an inguinal hernia, which reduces from the labium majus into the inguinal canal. The condition must be differentiated from a lipoma occurring in the labium majus or the ischio-rectal fossa; such a lipoma is irreducible and painless.

Treatment.—A combined operation is generally the most satisfactory. The hernia is exposed by an incision directly over it. The sac is opened and its contents are reduced. The sac is cleared from surrounding structures and the wound is closed. With the patient in semi-Trendelenburg position, the abdomen is opened and the mouth of the sac is exposed. The sac is inverted, ligated, and excised, and the pelvic floor is repaired as well as possible.

(*c*) **Median sliding perineal hernia** is a complete prolapse of the rectum (see p. 639).

(*d*) **Post-operative hernia through a perineal scar** is not uncommon after excision of the rectum. The onset may be at any time after the operation, but is more common after a year or more. Many asymptomatic herniæ of this kind are overlooked because the patient is not examined in the erect posture. When symptoms are present they include considerable pain on sitting, a feeling of perineal pressure when walking, and sometimes a swelling in the perineum. It can be repaired by excising the scar, freeing and reducing the contents into the peritoneal cavity, closing the opening in the peritoneum, and approximating the edges of the levator ani, if sufficient of this muscle can be identified. A flap of the gluteus maximus muscle and fascia is freed, and sutured in such a way as to form a sling to support the closed peritoneum. The skin is then closed over the area with interrupted sutures, and dressings are followed by a pad and firm supporting perineal binder.

Obturator Hernia.—The hernia, which passes through the obturator canal, occurs six times more frequently in women than in men. Most of the patients are over sixty years of age.

The swelling is liable to be overlooked because it is covered by the pectineus. It

Friedrich Trendelenburg, 1844–1924. Professor of Surgery, Leipzig.

seldom causes a definite swelling in Scarpa's triangle, but if the limb is flexed, abducted, and rotated outwards, sometimes the hernia becomes more apparent. The leg is usually kept in a semi-flexed position and movement increases the pain. In more than 50 per cent. of cases of strangulated obturator hernia pain is referred along the obturator nerve (fig. 948) to its geniculate branch (Howship-Romberg sign). On vaginal examination the hernia sometimes can be felt as a tender swelling in the region of the obturator foramen.

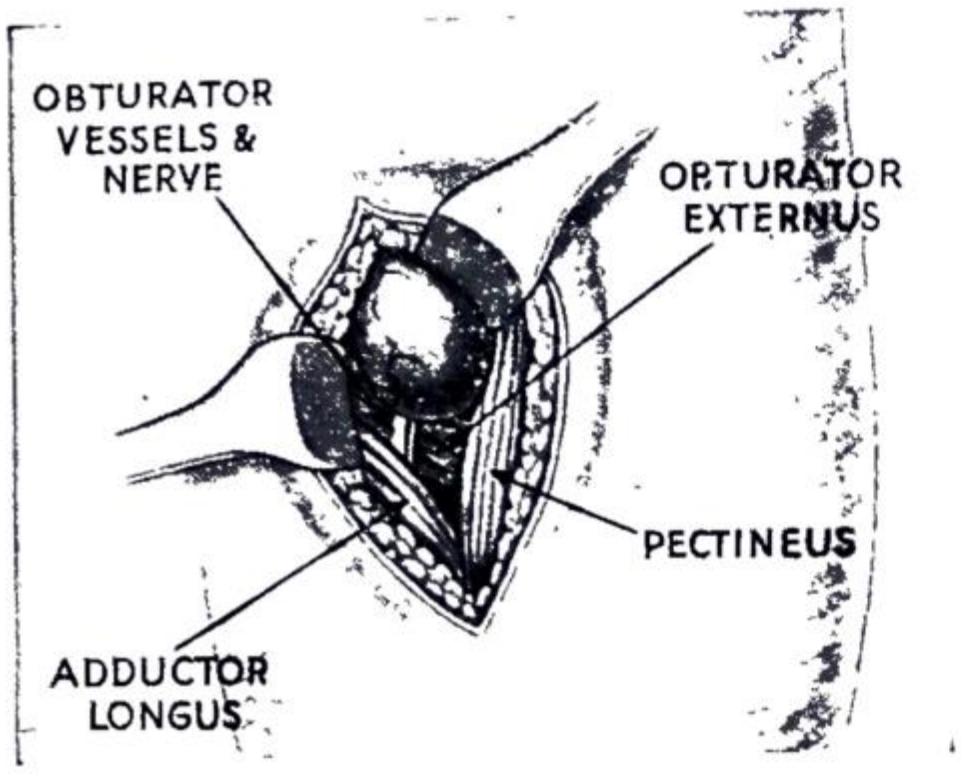

FIG. 948.—The relationships of an obturator hernia. (*After Sir Cecil Wakeley.*)

Cases of obturator hernia which have been reported have usually been cases of strangulation; in about 40 per cent. the nature of the hernia has been recognised before operation. Strangulation in this situation is often of the Richter type (see p. 680).

Treatment.—The best method of dealing with a strangulated obturator hernia is as follows: (*a*) perform lower laparotomy (on the side of the lesion, if known). Tilt the operating table suitably by the head. Confirm the diagnosis; (*b*) if the diagnosis is confirmed, adopt full Trendelenburg's position; (*c*) the constricting agent is the obturator fascia. Taking every precaution to avoid spilling infected fluid from the hernial sac into the peritoneal cavity, this fascia can usually be stretched sufficiently to allow reduction by inserting suitable forceps through the gap in the fascia and opening the blades with care. If incision of the fascia is required, it is made parallel to the obturator vessels and nerve; (*d*) the contents of the sac are dealt with *secundum artem*; (*e*) the broad ligament is stitched over the obturator foramen in order to prevent recurrence; (*f*) the abdominal wall is closed.

Gluteal and Sciatic Herniæ.—A *gluteal hernia* passes through the greater sciatic foramen, either above or below the piriformis.

A *sciatic hernia* passes through the lesser sciatic foramen.

Swellings beneath the gluteus maximus cause great difficulty in diagnosis because their individual character is masked by the overlying mass of muscle.

Differential diagnosis must be made between this condition and—

(*a*) A lipoma beneath the gluteus maximus.
(*b*) A tuberculous abscess.
(*c*) A gluteal aneurism.

All doubtful swellings in this situation should be explored by operation. The swelling is approached by splitting the fibres of the gluteus maximus. After isolating the hernial sac, opening it, and dealing appropriately with any contents, the neck of the sac is ligated, and the sac is excised. A flap of fascia raised from the covering of the piriformis muscle is used to close the opening through which the hernia extruded. Like an obturator hernia, occasionally a gluteal or sciatic hernia is discovered in the course of laparotomy for intestinal obstruction.

Antonio Scarpa, 1752–1832. Anatomist and Surgeon, Venice.
John Howship, 1781–1841. Surgeon, Charing Cross Hospital, London.
Moritz Heinrich Romberg, 1795–1873. Director, University Polyclinic, Berlin.

CHAPTER XXXI

URINARY SYMPTOMS. INVESTIGATION OF THE URINARY TRACT. ANURIA

HAMILTON BAILEY

URINARY SYMPTOMS

THREE symptoms, a veritable triple alliance, accompany most urinary affections. They are pain, increased frequency, and hæmaturia.

Pain associated with affections of the urinary tract embraces :

Renal pain is usually a dull ache situated mainly in the costo-vertebral angle, but also in the upper and outer quadrant of the abdomen.

Ureteric pain is the well-known colic [1] passing from the loin to the groin.

Vesical pain varies from slight suprapubic discomfort to strangury, which is agonising pain referred to the external urinary meatus, accompanied by an intense desire to micturate, but resulting in the expulsion (by straining) of only a few drops of blood-stained urine.

Prostatic and seminal vesicular pain is deep-seated in the rectum ; it is often referred to the perineom, but sometimes the suurapubic region or to one pr both iliac fossæ, or to one or both the sacro-iliac joints.

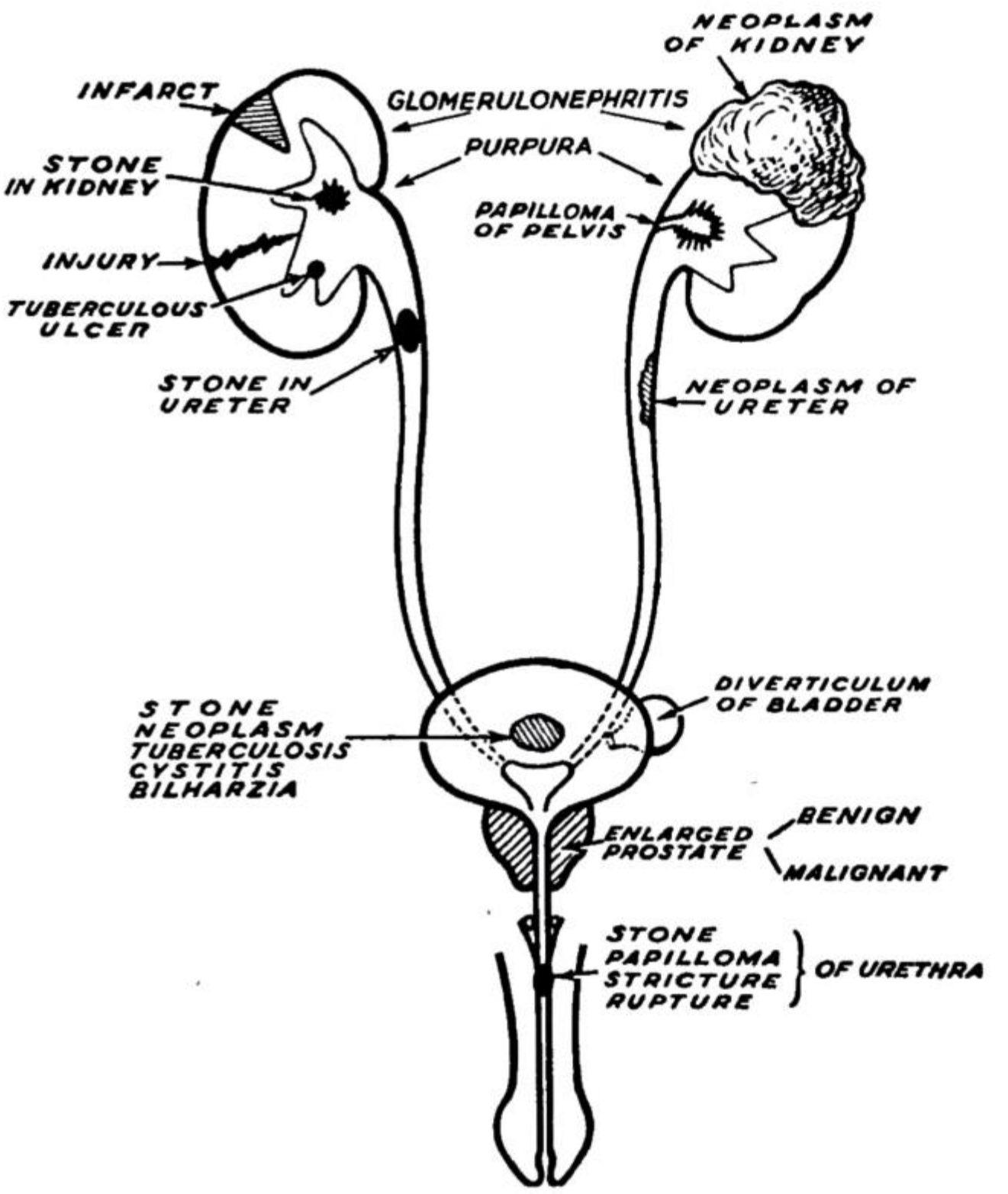

FIG. 949.—The more common causes of hæmaturia.

Urethral pain is scalding, and occurs during micturition.

Increased Frequency.—The patient states that micturition is frequent. Of greater significance is the number of times he has to rise at night to empty his bladder. In the clinical history the record of such an enquiry is usually entered thus $\frac{D}{N} = \frac{?}{3}$.

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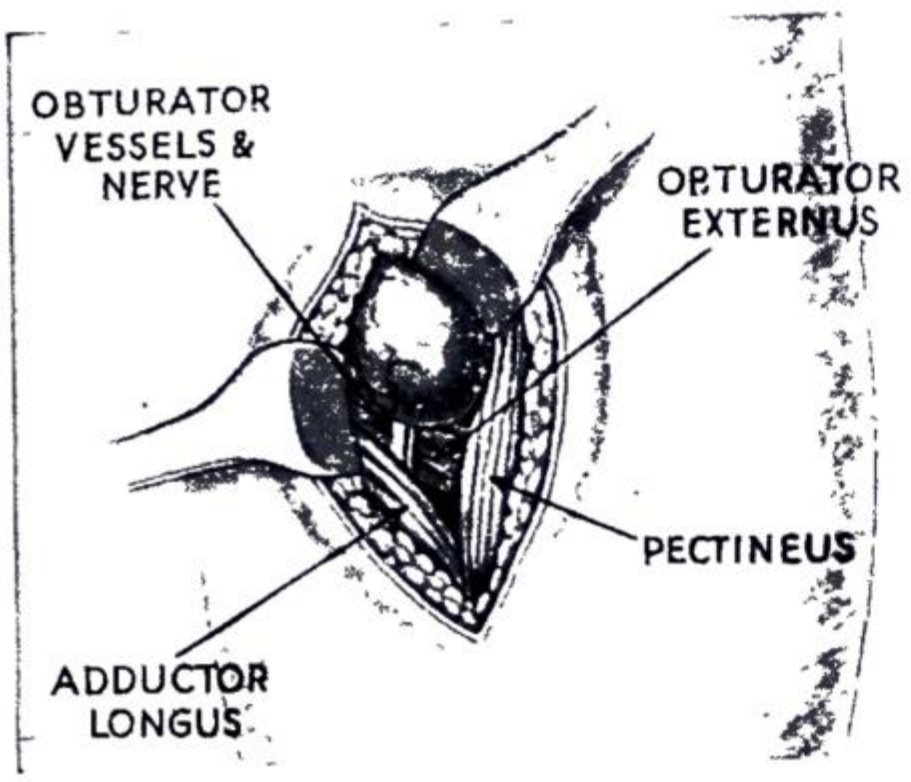
[1] Renal colic is a term that is deeply rooted. Pain passing from loin to groin should be called ureteric colic, for obviously that is more accurate.

seldom causes a definite swelling in Scarpa's triangle, but if the limb is flexed, abducted, and rotated outwards, sometimes the hernia becomes more apparent. The leg is usually kept in a semi-flexed position and movement increases the pain. In more than 50 per cent. of cases of strangulated obturator hernia pain is referred along the obturator nerve (fig. 948) to its geniculate branch (Howship-Romberg sign). On vaginal examination the hernia sometimes can be felt as a tender swelling in the region of the obturator foramen.



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