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THE VERMIFORM APPENDIX AND ITS DISEASES

BY

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PREFACE

THIS small volume consists of the extended notes of lectures given to some of the students in the Western Infirmary some years ago. The notes were extended as a help to a junior student of surgery in whom the writer is interested. As they seemed helpful to him in the earlier stages of his curriculum, it is probable they may be of service to others.

The writings of Howard Kelly, Deaver, Sir Wm. Macewen, Renton, Mayo Robson, Moynihan, and others, have been laid under contribution: and some things have been inserted as the result of conversations with some of my colleagues.

The illustrations are by Dr. Arnold Gray and Mr. Hugh L. Parker, to whom my thanks are due.

I am also indebted to Dr. John Morton for correcting the proof-sheets and helping otherwise.

I have endeavoured, in small compass, to give a plain account of the subject as viewed by the surgeons of the present day.

DUNCAN MACARTNEY.

18 NEWTON PLACE,
GLASGOW, *January*, 1908.

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CHAPTER I.

HISTORICAL SKETCH.

Cases of disease of the appendix of an inflammatory nature have been described since the very earliest medical writers drew graphic word-pictures of the signs and symptoms of the malady as we know it now, under the names of the *iliac passion* or the *colic passion*. These names connoted doubtless more forms of bowel trouble than those which affect the vermiform appendix, but with our present knowledge we may safely assume that such cases formed a large preponderance of the number. The *colic passion* was the term applied to acute disease affecting the parts beneath the level of the umbilicus, the *iliac passion* to those above that level. In some instances among the medieval writers the terms were used indifferently. Perhaps the earliest reference to be found on this subject is the aphorism of Hippocrates: "Suppuration after prolonged pain of the parts about the bowels, is bad." Celsus first referred to the iliac and colic passion, noting that the colic passion was oftenest on the right side and was liable to return. Medieval

writers in this part of medicine as in others continually had similar references to abdominal affections, but used the terms iliac passion and colic passion quite indifferently. In the seventeenth century Sydenham described the disease very accurately, drawing attention to the well-known character of the appendicular pain as we know it, diffuse at first, but fixed to one spot as the disease progressed. He further drew attention to its tendency to recur. Through the succeeding centuries frequent descriptions of typical cases of appendicitis, passing on to general peritonitis, are described, and it came to be assumed that the caecum was in some way closely associated with the disease, as the names typhlitis, perityphlitis, paratyphlitis, indicated. Now it seems very hard to believe that it is just about a quarter of a century since the part played by the small appendix was discovered. Often surgeons have been just on the point of discovering the fact, but missed it. There can be no doubt that the very natural fear that surgeons had of cutting through the peritoneum, for long retarded this addition to our knowledge: but it seems very wonderful that post-mortem examinations, which have been systematically conducted in all our large general hospitals for the last half-century, failed to bring it out. The spread of the knowledge of Listerism in time overcame the fear of opening into the peritoneal cavity, and the natural results followed therefrom.

As indicating the views of the appendix and its diseases less than twenty-five years ago, the following quotation from Coats' *Pathology*, may be of use. After describing typhlitis and perityphlitis and care-

fully distinguishing them, he goes on: "The vermiform appendix much more frequently gives rise to acute inflammations around the caecum than the caecum itself does, so that, although the term typhlitis is not applicable, yet perityphlitis is." Then he describes a case of retention-cyst of the appendix with a figure. "But of more importance are the inflammations due to the presence of foreign bodies in the appendage. Any hard substance lying in the caecum may, if small enough, pass into the vermiform appendage. In this way apple, grape, cherry or orange seeds are said to get into it. But much more frequently pieces of hardened faeces are met with, and as these dry and frequently assume the shape and appearance of cherry or orange stones, they are frequently mistaken for them. This occurs all the more because the inspissated faeces are often coated with phosphates, which form a kind of rind.

"The presence of the foreign body causes inflammation of the mucous membrane, and this, from the continued pressure and confined space, readily results in ulceration. The ulcers frequently penetrate through the appendage and lead to peritonitis. As a general rule the appendage has acquired adhesions before actual perforation occurs, and so the peritonitis is limited by the adhesions. But the inflammation is apt to recur, and not infrequently results in the formation of recurring abscesses. The bursting of one of these abscesses into the cavity of the peritoneum often leads to fatal peritonitis. . . . From the relation of the parts it will be seen that a perityphlitis arising from the caecum will usually be

in the subperitoneal tissue, whereas that from the vermiform appendage will be in the peritoneum as the appendage is completely surrounded by peritoneum and has a mesentery. It follows that the latter is much the more dangerous as it is much the more frequent form. It is, indeed, much more frequently a cause of death than is supposed."

That is practically all that is said in the standard work of pathology regarding this disease, in 1883. While the old distinctions between typhlitis, peri-typhlitis, and appendicitis are set down, and while there is a meagreness of detail, yet one cannot but admire the non-committal attitude of our cautious teacher of those days.

Whether appendix-disease is on the increase or not is a subject that would be difficult of solution. As time passes and cases accumulate, the proportion such bear to the total treated in one or more of our large hospitals would likely be found to be fairly constant. It is very highly probable that diseases of the appendix are just as frequent, but not more so now than they were in the past. To the lay mind thay seem to bulk more largely of late years, but that is quite explicable. In making up any statistical account of this disease over a large number of years, certain fallacies in the question would need not to be overlooked: viz. the improving diagnostic powers of the profession regarding this region, the growing popularity of hospitals, etc. In fine, however, the result arrived at would very likely be that inflammation of the appendix and its sequelae are a fairly constant factor in the sum of human ailments.

The earliest mention of the appendix as an organ of the body occurs in the work on anatomy by Berengarius Carpus, Professor of Surgery at Pavia and Bologna, which was published in 1522 A.D. He describes it as growing from the end of the caecum as an "additamentum," "in breadth less than the smallest finger, and of a length three inches or thereabouts." Twenty years after this Vesalius gives several illustrations of the abdominal viscera, in which the appendix is drawn in a curved form at the end of the large bowel. Afterwards confusion as to names was introduced, some anatomists calling the appendix the caecum because of its blind end, others holding on to the original meaning of caecum, which eventually became the recognised term for the end of the large bowel, the little additamentum receiving the name of the appendix vermiformis. This likening the process to a worm is generally supposed to be due to Fallopius.

There are a few names worthy of preservation because of their association with this small part of surgery in its various stages. In 1759 Mestivier reported a case of appendicular abscess due to the presence of a common pin. The pus was evacuated, but the patient died. The following account of the post-mortem examination is given: "The caecum presented nothing extraordinary; it was covered with gangrenous patches. It was not the same with the vermiform appendix. I had scarcely opened it when we found a large pin, very rusty, and so corroded in certain places that the least touch would have broken it: a condition which proceeded, no doubt, not only

from moisture, but from the acrid nature of the material enclosed in the vermiform appendix. After what I have just said it is easy to understand (although the patient had never spoken of swallowing a pin) that the one under discussion had been concealed for a long time in the vermiform appendix of the caecum; and it was undoubtedly this which had irritated the different coats of which the organ is composed, and had given rise to all the patient's symptoms, finally causing the death which ensued."

In 1812 a London physician, Parkinson, reported a case of ulceration of the appendix in a boy of five years of age, where a calculus had obtained entrance to the peritoneal cavity, giving rise to fatal peritonitis.

Wegeler, a German surgeon, in 1813 described a case of appendicitis in a boy of eighteen, in which obstruction of the bowels, with vomiting, faecal at the last, was a marked symptom. In the appendix, which was gangrenous, were found several calculi, one as large as a pigeon's egg. He even gives a chemical analysis of the calculi.

In 1824 Louger-Villermay gave a paper, entitled "Observations pour servir à l'histoire des inflammations de l'appendix cæcale." He described in detail two cases of gangrenous appendicitis.

In the same year Blackadder describes a case of very sudden illness, which on post-mortem examination was seen to be due to the escape of a lumbricoid worm from an ulcer in the appendix.

Melier, a French surgeon, in 1827 reviewed much of what had been previously written, and after describing a case of his own which ended fatally, goes on,

viz.: "In my opinion the faecal matter accumulated in the appendix, which then dilated little by little, becoming first inflamed, then gangrenous, and finally perforated. The earliest symptoms, appearing in the form of colic, are probably accounted for by the inflammation and distention of the appendix; its rupture occasioned the effusion, which was responsible in turn for the peritonitis. The perforation was determined, or at any rate hastened, by the patient's exertion in taking an enema, since it was at this moment that the intense pain began, and immediately afterward the peritonitis set in. Observe, however, that the five cases which form the basis of this paper have been collected in a short space of time, and that two of them were reported by the same physician; these facts entitle us to believe that if such affections have not been more frequently observed it is because the appendix has not received sufficient attention, and because lesions situated in it have been overlooked at autopsies."

Melier further has an experience of a chronic case of appendicitis, which was seen in consultation with Dupuytren, and in a foot-note in his paper he states that "if it were possible indeed to establish the diagnoses of these affections in a certain and positive manner, and to show that they are always circumscribed, the possibility of an operation might be conceived; some day, perhaps, this result will be reached." This man was the pioneer of surgery of the appendix, as it is now understood.

There is little doubt but that there would have been from this date steady progress in the elucidation

of this very important class of diseases had not Dupuytren, the famous French surgeon, whose name was one to conjure with, thrown the great weight of his authority on to the side of those who attributed to the caecum and the adjacent intestine the cause of all the disease that was found in the right iliac region. His view was that the stagnation of faeces in the caecum (due to the direction of the faecal movement being against gravity), and also the narrowness of the ileo-caecal valve, gave rise to inflammation of the bowel itself, from which spread any mischief that was present, to the appendix as a secondary site. And so *à priori* reasoning, coupled with the authority of a large name, again blocked the path of progress.

About 1830, the German surgeons began to be heard from in this field of research, and one cannot fail to be struck with the praiseworthy accuracy of their clinical pictures. The preliminary umbilical pain, followed by the localised iliac pain, the swelling, fever, general peritonitis, collapse, even the tenderness over M'Burney's point, are all clearly and definitely put down. But they never refer to the appendix as the *fons et origo mali.* Typhlitis and perityphlitis are terms that were introduced and popularised by them, and these terms had a full share in keeping the profession stationary, as far as this disease was concerned, for well-nigh forty years. Albers and Puchelt are the German names most intimately connected with this stage of the history of appendicitis. A word often plays a most important part in history, and as said, typhlitis and perityphlitis, though most admirable words from a philological point of view, kept

back the hands of the clock, while progress quickly followed when it was found that the appendix was the seat of disease, and that in spite of the hybrid term "appendicitis," loathed of the classicists in the profession always when looked at, and very often when pronounced. [The pronunciation should be "appendiseetis" or "appendikytis," according as your Latin is of the Scotch or English variety.]

The first clear description (in English) of this subject in the early part of last century is contained in the *Elements of the Practice of Medicine*, by Richard Bright and Thomas Addison. In the few pages they devote to diseases of the appendix occurs the following:

"From numerous dissections it is proved that the faecal abscess thus formed in the right iliac region arises in a large majority of cases from disease set up in the appendix caeci. It is found that the organ is very subject to inflammation, to ulceration, and even to gangrene; and, moreover, that it is occasionally thickened and ulcerated from tubercular deposits. This little worm-like body is often detected in the midst of the abscess, with a perforation at its extremity, or by ulceration higher up in its parietes, a considerable portion of it nearly or entirely separated is found in a disorganised condition among the pus and faeces which fill up the abscess.

"It is possible that the secretions of the appendix itself may sometimes become diseased and give rise to inflammatory action in the part: sometimes we can plainly discover that stricture, amounting even to occlusion of the cavity, has taken place, so that the

extremity has been distended with its own secretions; and this may plainly give rise to inflammation; and at other times we find little oval masses of faeces impacted in the canal, which have pretty obviously produced the irritation; sometimes a cherry-stone or other seed has been detected in the appendix, but one of the most common causes is undoubtedly the formation of a peculiar concretion, which is moulded to the extreme cavity of the canal, and which is composed of layers or coats of earthy phosphates, with occasional alternate layers of animal secretions or of faecal matter."

Even the account of their medical treatment of the condition is exact and masterly, and but for the introduction of this "typhlitis" element the description is almost as it would be now.

We come now to the time of Hancock, who in 1848 operated for disease of the appendix before any definite swelling was noticeable. He diagnosed appendicitis from the other conditions present, and had the courage to operate, and that too with success. There is no doubt that this is the first carefully prearranged appendectomy known, and Hancock's name would have lived but for the fact that he was too far ahead of his fellow-surgeons. Remembering that at this time "antisepsis" was still unborn, one can easily understand how in an operation that involved the peritoneum he would have few followers, and so his work and name were forgotten.

Nearly twenty years passed before anything noteworthy in the history of this disease occurred, when Willard Parker of New York wrote a description of

some few cases he had, in which he taught the absolute necessity of early operation. To wait till fluctuation was noticed was to wait too long. He took up the same position as Hancock had done in the earlier part of the century. But the result was different: Listerism was now believed in: the peritoneum had in a measure lost its terrors for the surgeon: it was a repetition of Hancock's sowing, but the soil was now better and the seed grew.

Up to 1875 a list of about twenty cases includes all the cases of abscess of the appendix operated on before fluctuation was detected.

Other names in later years are associated with making the procedure more popular, such as Juilliard, Burchard, Lawson Tait, Mikulicz, Krönlein, Charter Symonds, Morton of Philadelphia, Treves, M'Burney, and others.

This by no means pretends to be a history of the developments that lead to the present treatment of diseases of the appendix, but is a fairly trustworthy sketch of the main events and most noteworthy workers who have made appendectomy what it now is.

CHAPTER II.

ANATOMY AND PHYSIOLOGY.

THE situation of the appendix-base as regards the abdominal wall is in a very large majority of cases fairly indicated by the position of M'Burney's point —the junction of the middle and outer thirds of the line joining the umbilicus and the anterior superior process of the ilium. In some rare cases the appendix is wanting, in a few it has been found away from its usual site, in the left iliac region, on a level with the umbilicus, near the stomach, and so forth. Most of the variations of situation are due to some arrestment or abnormality of development of the intestinal tract, which alters the relative position of the parts. The end or tip of the appendix may be above or below, behind or in front of, to right or to left of, the base of the organ. Taking the base as centre, the tip may be anywhere in that sphere of space whose centre is immediately underneath M'Burney's point, the radius being the length of the organ. The length varies from 1 cm. to 23 cm., but the average length in the male adult is 8·3 cm. ($3\frac{1}{3}$ inches). In children it is smaller,

and reaches its maximum length in the third decade of life. In the female adult it is on the average 8 cm. in length. The average diameter is 6 mm. at the base, and 5 mm. at the apex in the male, and proportionally less in the female.

Berry's examination of the organ in the lower animals (Fishes, Amphibians, Birds, and some Mammals), showed that the essential element in the organ, or its equivalent where a definite structure was absent, was lymphoid tissue, of the same nature as the human tonsil. The higher in the scale of vertebrates one examines, the more definitely this tissue is located in a particular portion of the intestine. Comparative anatomy would point to the appendix being, not a degraded structure or disused part in the more highly organised animals, but quite the reverse, a specialised portion of the intestinal tract—an intestinal tonsil.

The appendix is composed of four layers or coats, serous, muscular, sub-mucous, and mucous layers, analogous to those of the large and small intestines in its near neighbourhood. The serous layer, which covers the larger part of the organ closely—the part uncovered being the portion where the peritoneum leaves it to unite in forming its mesentery—consists of large, polyhedral, flat cells with numerous stomata between, which lead to the sub-serous lymph-spaces. The presence of these numerous stomata is of importance, in view of the fact that infection may thus travel from the lumen of the appendix into the general peritoneal cavity without any gross lesion being discovered in the walls of the organ. [One

of the writer's very early cases was one in which the peritoneal cavity was filled with pus. Post-mortem examination discovered pus in the appendix, but no visible lesion in the organ by which it could have passed into the cavity.] The deeper part of the serous layer is of fine connective tissue, which binds the peritoneal surface to the outer portions of the muscular layer.

The muscular layer, like that of the intestines, is in two parts, the outer longitudinal, the inner circular. The outer or longitudinal layer consists of bands of muscular fibres running, as the name implies, lengthways in the organ, in discontinuous groupings not unlike the bands in the caecum. In the intervening spaces between those bands are found connective tissue, blood-vessels, and lymphatic spaces. These gaps are important in the spread of infection, as noted already in the case of the stomata in the peritoneal layer. The inner or circular muscular layer consists of thick, firm and continuous muscular rings.

The sub-mucous layer is composed of fibro-elastic, connective tissue, many small blood-vessels, some fat, and lymphatics. The mucous layer is the usual membrane, composed of cylindrical epithelium cells arranged on a connective-tissue basement-membrane with tubular glands and lymphoid follicles, which latter are the essential part of the organ. The tubular glands are situated in a network of very fine connective tissue; they are racemose in appearance, and are confined entirely to the mucous layer. They do not penetrate to the muscular layer, which the

lymphoid follicles do. The lymphoid follicles, which are visible to the naked eye, are very numerous (nearly 200 in the ordinary appendix according to Lockwood), round or ellipsoidal in shape, and, as mentioned, penetrate to the muscular layers. At the opening of the appendix into the caecum, there sometimes is found a floating layer of mucous membrane containing lymphoid tissue, which is said to act as a closure-agent of the tube, and has been described by Gerlach, and called Gerlach's valve, but it is by no means constantly present. It is highly probable that the opening of the appendix into the caecum being very frequently at an acute angle, one lip of the mucous lining of the caecum protrudes more than the other, partially overlapping the opening; and that such a condition is due to the accident of the manner in which the two parts are united. This Gerlach's valve seems to have no importance either physiologically or pathologically.

Blood-supply: this is derived from the posterior ileo-caecal artery, which is formed from branches of the superior mesenteric artery. The branch or branches reach the organ between the layers of the meso-appendix, and have always to be specially dealt with in appendectomy. In the female there has been described a branch from the ovarian artery, which anastomoses with the smaller branches of the ileo-caecal artery. The veins correspond with the arteries, but being dependent they are very liable to become quickly engorged under any excitement of the parts.

The lymphatics make their way through the

gaps in the muscular tissue into the meso-appendix, and thence into the glands lying behind the ascending colon, or those along the line of the iliac vessels.

The lymphatic vessels of the intestines accompany the branches of the superior mesenteric artery, and after passing through a varying number of glands lying between these branches, have a common termination in the glands round the origin of the artery at the root of the mesentery. The varying glands are in three groups: (1) mesenteric, lying between the layers of the mesentery draining the small intestine; (2) meso-colic, lying between the layers of the transverse meso-colon and draining the transverse colon; (3) ileo-colic, lying behind the parietal peritoneum in the space bounded by the attachment of the mesentery below and to the left, the transverse meso-colon above, and the ascending colon to the right. This third group is of most interest to us just now. This group of glands in the space described runs along the course of the ileo-caecal artery and its various branches. The artery is surrounded from its origin to its division by a chain of lymphatic glands, varying from ten to twenty. The chain is continuous with the glands round the superior mesenteric artery. While this chain is continuous as a rule, it is found often convenient to divide it into an upper and a lower group. Where the ileo-colic artery divides into its terminal branches each branch has its own little group of associated glands: (1) anterior ileo-colic; (2) posterior ileo-colic; (3) appendicular; (4) ileal; (5) right colic.

These names indicate their topography and the special regions they drain. As to (3), the appendicular gland, it lies between the layers of the meso-appendix at or near its free border, in close proximity to the appendicular artery: it is found anywhere along the course of the little artery. Jamieson and Dobson, whose paper is the most recent on the subject, found that the lymph spaces in and around the appendix could be injected by inserting the needle into the submucosa. They believe that there is not only free communication between the various systems of plexuses, but also between one part of a plexus and another. They do not see how an infected area is isolated from the rest of the organ by the arrangement of its lymphatics. The lymph vessels which arise in the appendix divide into three sets: one set drains the appendix from tip to near its root: the other two sets arise from vessels round the root. The vessels forming the first set number from eight to fifteen; leaving the appendix-wall they enter the meso-appendix, and ascend between its layers with the branches of the appendicular artery to its main stem, round which they form a leash of four to six vessels. These accompany the artery to its origin, where they meet the lower group of the main ileo-colic chain. Many of them end in the glands of this group; others, however, ascend to the glands of the upper group, in which they end at variable levels. In some cases a gland in front of the duodenum is seen to be injected by vessels running directly from the appendix: these vessels may arise from any

part of the appendix, and quite as frequently from its proximal as from its distal portion. The root of the appendix is drained by an anterior and posterior set; the anterior set pass over the anterior surface of the caecum and enter the ileo-colic fold. They pass by the glands in this furrow, and end in glands of the lower ileo-colic group. The posterior vessels pass behind the caecum to the posterior ileo-caecal group. The practical importance of the above-stated facts is striking. We find a large agglomeration of lymphatic glandular tissue devoted to a comparatively small portion of the alimentary canal. It is evident that this mass of glands is of great importance, and that its defensive powers will frequently be called on. The massing together of such numbers of lymphatic glands in this special corner is not a haphazard business; it is only natural to suppose that they are there because their protective work is there to be done. It is natural to suppose that during acute appendicitis some of these glands will be inflamed, though it is certain that it must be extremely rarely that any of these inflamed glands go on to suppuration. It would be interesting in operating on an inflamed but not suppurating appendix to make a digital exploration along the line of ileo-colic glands to discover any possible enlargement.

The nerve-supply comes from the sympathetic system—the superior mesenteric plexus, the branches of which supply the ileo-colic artery, extending to the appendix. The seat of pain which is most usual is that known as M'Burney's point, and is determined by a reflex action. Irritation of the

organ is reflected back to the plexus, which is related by branches to that part of the spinal cord giving off the lower dorsal and upper lumbar nerves. Sherren states that this reflex pain occurs oftenest in the distribution area of the eleventh dorsal nerve. If irritation is more severe, the reflex action may radiate further, and the pain may be referred to the right thigh, testicle, or lumbar region. Or, again, motor phenomena may be the manifestation of the irritation as flexion of the thigh, frequent urination, spasm of a single muscle, or a group of abdominal muscles.

The various angles or bays formed by the parts in the neighbourhood of the appendix are described under the heading of fossae—ileo-colic, ileo-caecal, and sub-caecal fossae. Lockwood and Rolleston have called special attention to them, but they have little if any practical importance to the operating surgeon.

The ileo-colic fossa lies in front of the mesentery in the angle between ileum and colon.

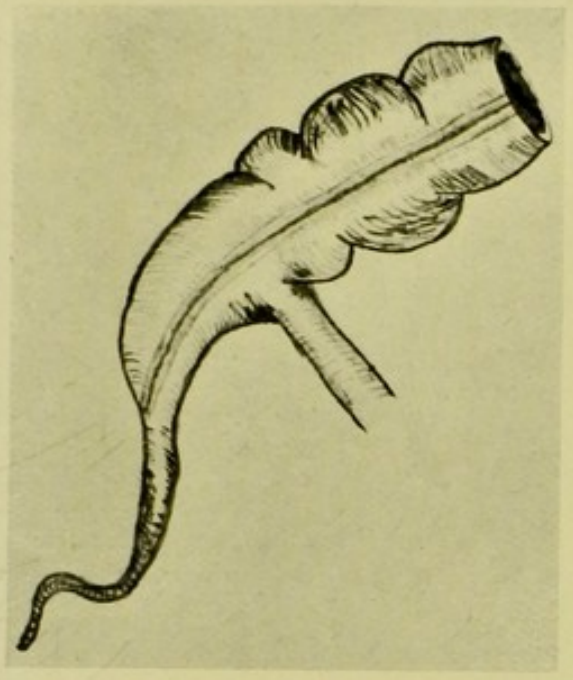
The ileo-caecal fossa lies behind the angle of junction of ileum and caecum.

The sub-caecal fossa is sometimes non-existent: when present it is a depression beneath the caecum and below and external to the meso-caecum and meso-appendix.

A point of much greater surgical importance is the variety of forms of the caecum and the mutual arrangement and relation of caecum and appendix. Four varieties are described (see diagram). That marked No. 3 is the normal, occurring in over 90 per cent. of the cases examined. This form is described by Treves as follows:

"In the caecum of the third type that part of the caput coli that lies to the right side of the anterior band grows quite out of proportion to the part placed to the left side of the band as the parts appear when placed *in situ*. Moreover, the anterior wall of the caecum becomes more developed than the posterior wall. As a result the true apex of the caecum is turned more and more to the left, until at last it is placed in close proximity to the ileo-caecal junction, and can be only recognised by noting the point of origin of the appendix. The highly developed part to the right of the anterior band becomes so dependent and prominent that it forms a new or false apex to the caecum, and it is indeed to this projection that the anatomical term 'apex' is usually applied. Moreover, from the undue development of the anterior wall the root of the appendix (the true apex) is carried towards the posterior aspect of the caput, and by these changes the caecum of the third type is produced." In other words, the appendix arises in the very large majority of cases from the postero-internal aspect of the caecum, at a point about 2 cm. below the lower border of the ileum, just where that viscus enters the larger bowel.

Function of Caecum and Appendix. Much of a very definite nature cannot yet be written on this subject as it needs careful and prolonged investigation. After the operation of appendectomy had been freely and frequently performed there grew up a strong disposition to regard the appendix as an absolutely useless—if not harmful—structure, subserving no useful purpose in the human economy: because so



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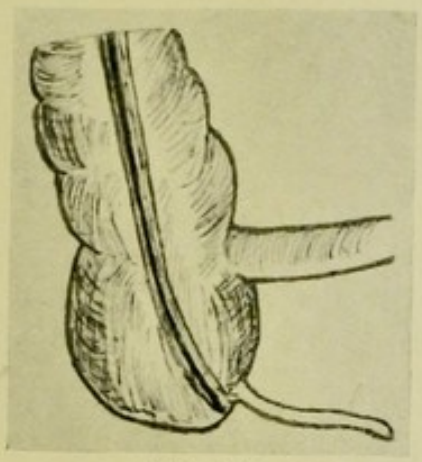

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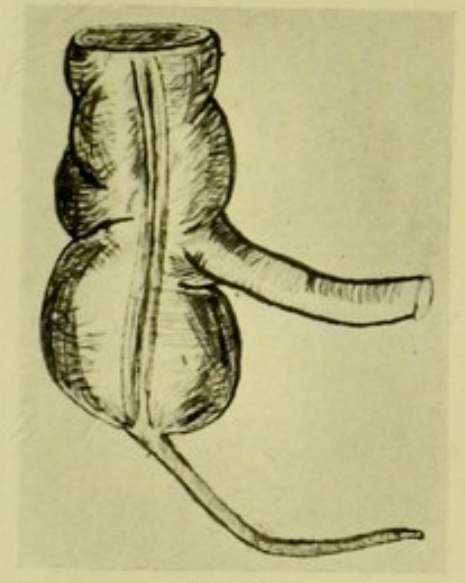

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TYPES OF CAECUM AND APPENDIX: (No. 3 is the commonest).

many people were in evidently good health with no appendix, and in much better health than with the kind of appendix they had possessed. This of course was soon seen to be too rough and ready a mode of reasoning, because those who reasoned thus entirely forget the wonderful powers of compensation that occur in every part of the body, and that the removal of the appendix simply gave the opportunity to such compensatory powers as the intestines possess in common with other portions of the body, to come into action. Analogous conditions are known to physicians and surgeons alike, in cases which lead to gastro-enterostomy, valvular defects of the heart, removal of one organ, as kidney, eye, testicle, etc. In the first mentioned condition, where the stomach is practically put out of the way of helping digestion, the process is completed by the intestines doing not only their own but the stomach's work as well; while no one would maintain that because life could be carried on in a patient with one kidney, that a second kidney is supernumerary.

A priori one would be justified in supposing from its microscopical structure that a definite part was played by this small organ in some stage of digestion. Consisting as it does mainly of lymphoid tissue freely supplied with blood, it is a known fact that the appendix possesses the power of copiously secreting a glairy, yellowish, adhesive fluid in which white blood corpuscles abound. When the writer was lifting a diseased appendix out of the abdomen at operation, after an acute attack had passed off, an ulcer in the wall of the appendix gave way and the area of operation

was flooded with a fluid as described, issuing from the ruptured ulcer and coming from within the appendix, which was larger and more swollen than normal. The fluid was odourless and kept oozing out till the ligature was applied round the base of the organ, stopping the blood-supply and the secretion. Professor Sir Wm. Macewen of Glasgow has had a few opportunities of watching the behaviour of the caecum and appendix in a case, where part of the abdominal wall and of the intestine were removed in an explosion, and in an article to the *Lancet* describes the results of his observations as follows:

"In some patients immediately upon taking food into the stomach there was a caecal movement commencing from below upwards, as if expulsive. In one instance this seemed to correspond to peristaltic action of the small intestine, but in others such movements in the small intestine could not be discovered, and in them it followed the ingestion of food too quickly to permit of the peristalsis acting through the whole length of the small intestine. It was, therefore, regarded as probably due to reflex action. Once this movement was excited in the caecum it traversed the colon, and in one instance at least it reached as far as the sigmoid flexure. Some of these caecal movements originate in the appendix, the undulating movement running upward from the appendix and causing the contraction of the caecum. There were other movements in the caecum, the point of origin of which was not ascertained.

"At a variable interval after a meal—one or two hours—peristaltic effects in the colon ensued, resulting

in the extrusion of its contents, and shortly after a clear thick fluid was poured from the secreting caecal surface, and in several instances was seen to exude in considerable quantity from the appendicular orifice. As far as could be ascertained there was no cause for this flow other than a reflex action, possibly stimulated by the presence of food and the exudation from the upper part of the small intestine.

"First it was seen that there was a considerable flow of glairy mucus from the appendix and the caecal surface, which did not constantly exude, or at least did so to a greater extent shortly after food was introduced into the stomach, and to a marked extent just before food began to pass through the ileo-caecal valve. On one occasion quite a stream of fluid poured from the appendix just before the chyme began to pass through the ileo-caecal valve. When chyme passed through this valve it did so in small quantities at a time, and there were occasional pauses in which the ileo-caecal valve seemed to close, probably by a reflex action. This fluid from the caecum and appendix was invariably alkaline."

The same writer further thinks, in discussing the nervous supply of the parts, that the appendix may easily "initiate the larger movements of the caecum by first inducing movements in the appendix, and that inhibition of these movements may cause caecal disturbance. The same agency by control of the vascular supply will regulate the exudation from the appendix and that in accordance with the impulse from the small intestine."

Again: "the glands of Lieberkühn are far more

numerous and better developed in the upper part of the colon, the caecum, and the appendix than in the small intestine . . . and the secretion of the appendix viewed alone in this sense would be a valuable aid to digestion."

"One of the functions of the appendix may be to maintain cultures of these organisms in a fit state to perform their function on the pabulum poured into the caecum. On the inhibition of this function the germs may be capable of damaging the coats of the caecum and appendix, which have been thereby lowered in vitality. When a purgative action has produced its effects and cleared out most of the germs from the caecum and colon those in the appendix will still maintain a fresh culture for renewed action.

"The bacillus coli communis, which is the surgeon's terror, serves in its proper place a beneficent purpose in effecting the disintegration of some of the undigested matter, but when uncontrolled by the healthy organs and their exudations is apt to cause ravages in the tissues, and to produce toxins which are lethal. If from inhibition of the appendicular and caecal movements or the want of exudation of the succus entericus, or if the caecum receives material which the succus entericus cannot digest, a stasis occurs in the contents of the caecum, and the constipation which is so often a feature of appendicitis ensues. At a later stage fermentative disintegration of the faecal contents with absorption of toxines and damage to the wall of the parts are apt to ensue. These are followed by diarrhoea, which is sometimes curative.

"Doubtless the appendix and caecum are affected together, but just as pyogenic organisms affecting the

throat spread by continuity of structure to the middle ear and mastoid cells, and produce serious damage there long after the throat has healed, so the appendicular inflammation once started may continue to produce serious effects within the appendix after the caecum has recovered from the primary effect."

Lastly: "For many years I have believed that the caecum and appendix are of value in digestion. The facts pointing in that direction have accumulated slowly, and are not all garnered. Many require still to be investigated"

The above copious quotations give the gist of the first serious attempt, of which there is any record, to investigate a most vital if small part of the subject of digestion. They may form a starting point for a renewed research to enable us to grasp more clearly that most complex and recondite subject, digestion.

Obliteration of the Appendix. Berry is of opinion that after, or about middle age, the appendix becomes as a rule obliterated, whether as a physiological or a pathological process is not yet clear. Considering that the essential structure of the organ is lymphoid tissue, which is a tissue prone to disappear after youth, it might be looked on as a natural or physiological process. Others consider the obliteration to be a pathological result of a previous catarrhal attack. Certainly the number of diseased appendices met in the course of a surgeon's work reaches its maximum in patients about twenty years of age, and rapidly diminishes after thirty. It is rare in the elderly, and this would at least point to a cessation or marked diminution of activity as age comes on.

CHAPTER III.

PATHOLOGY OF THE VERMIFORM APPENDIX.

HAVING reviewed the imperfectly known facts and not yet proved theories in connection with the function of the appendix in health, we now pass on to consider the changes in the structure of the organ as revealed in the post-mortem theatre or on the operating-table, and the effects produced by such changes. The various pathological conditions found fall naturally into the following groups:

1. Abnormalities—in structure, in position, in size.
2. Tumours of the appendix (including cysts).
3. Foreign bodies in the appendix.
4. Inflammation of the appendix.

The only abnormality in structure that has been described hitherto is the persistence of the embryonic or foetal type of caecum and appendix, as figured in No. 1 of the four types of caecum. Treves, Struthers, Bennet and Rolleston, and Berry describe examples. Abnormality of position is much more commonly met with. In cases of arrest of development of the caecum the appendix may occupy any position along

the whole track of the normal colon. Such out-of-the-way situations of the organ are of importance from the point of view of the operating surgeon, who naturally reasons on the theory of highest probability, and does not expect to find the appendix away from the iliac fossa. In right-sided hernia, both inguinal and femoral, the possibility of the appendix being among the hernial contents should always be borne in mind. Few surgeons but have seen the appendix in both femoral and inguinal hernias. In such cases the mesentery of both caecum and appendix are longer than normal, doubtless due to nature's efforts to meet the demands put on the structures in the parts; the elongation of the mesentery being the result not the cause of the hernia. In a few cases the appendix has been found in a hernia on the left side. Several examples of hernia of the appendix into the retro-caecal fossa have been recorded by Lockwood, Macalister, Dunn and others. This form of hernia is of interest because of this misplacement of the organ being a cause of inflammation of the appendix. Atrophy of the appendix is found after middle age, but whether as a physiological or a pathological change is not yet clear, as stated above.

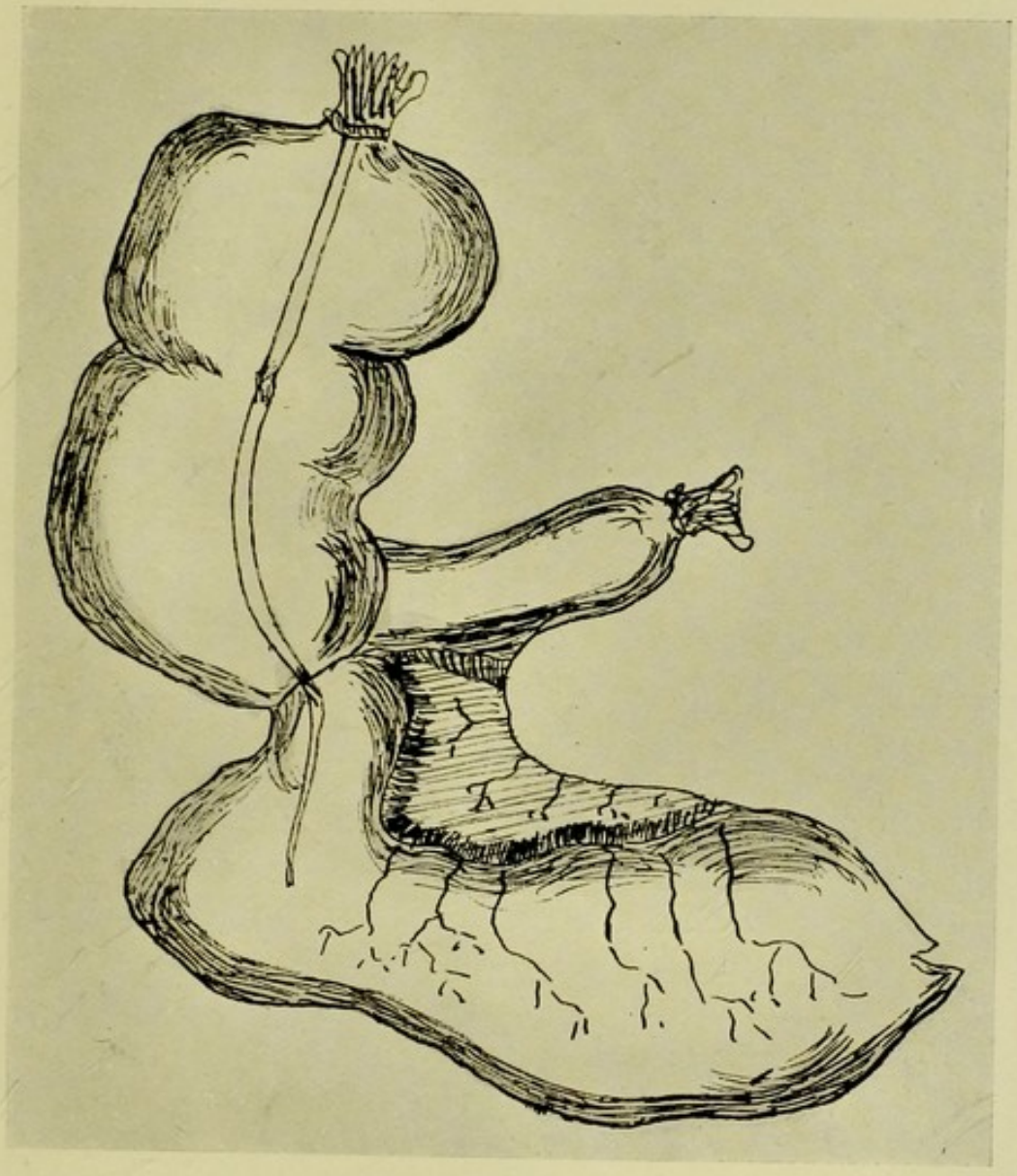
Of tumours of the appendix cysts are most common, though they are not a frequent condition. Such fluid tumours have been described by Coats, Sherren, Shoemaker and others. In an organ that is so filled with tubular glands it would be strange if cystic tumours were not found. The closure of the end of one of the follicles by some slight inflammatory attack is quite a likely occurrence, and would lead to the

formation of a retention-cyst. Berry holds that there is a definite relationship between inflammation of the appendix and these cysts of the appendix. The figure is from that in Coats' *Pathology* illustrating the case he described.

"The contents usually become serous, so as to constitute a dropsy of the appendix, but they may continue mucous in character and form a thickish jelly." (Coats.)

Other tumours of the appendix are excessively rare. Cancer, sarcoma and tubercle of the organ are met with extremely rarely, and as part of a more generalised form of these diseases, in their secondary extension.

Foreign Bodies. In the surgical literature of this subject that was in vogue thirty years ago the variety of things described as found in this little blind alley of an organ was truly polytechnic. Cherry-stones, grape-stones, sloe-stones, teeth, pins, needles, etc., were all noted as being found there, but chiefly cherry-stones predominated. During the last seventeen years the writer has been operating as one of the emergency surgeons of the Western Infirmary, and hundreds of cases of appendix disease have come under his care and never a truly foreign body (*i.e.* a body introduced from without) has been found in any of them. The common concretions (faecal) which originate in the appendix are the only foreign bodies ever found in the writer's experience. They look like date-stones, torpedo-shaped, and doubtless their shape gave rise to the descriptions. But there have been reported a few cases of needles and pins having found their way into



CYST OF APPENDIX (COATS).

the appendix and setting up inflammation, necessitating operative interference for their removal. But calculi are very frequent in diseased appendices. They are composed of phosphatic salts surrounding a central core of inspissated mucus, the whole stained yellowish brown with the colouring matter of the faeces. Their torpedo-like shape is determined by the shape of the cavity in which they are formed. It would seem that a small nucleus of mucin is formed within the appendix, and on this nucleus, phosphatic salts of lime are deposited, as in calculi in the bladder or urethra. The concretions form from the first within the appendix and grow from deposits secreted from the blood supply in the part of the organ nearest the focus where the calculus originates.

Appendicitis. Inflammation (slight or severe, more or less acute or chronic) is the most frequent pathological condition to which the appendix is subject. The forms in which this process occur are the simple catarrhal, the chronic inflamed form, the ulcerative, and the gangrenous. They differ only in degree of intensity, or in the stage to which the process has arrived.

The catarrhal form of inflamed appendix is not very often seen except by those whose operative rule is to remove the appendix as soon as the diagnosis of appendicitis is made. Those attacks of a mild type that recover under rest and opiates are assumed to be catarrhal, and are so in a large majority, but after events show that they are not all correctly named. In such mild cases the mucous membrane is engorged with blood and thickened, the secretion is increased,

and the whole organ enlarged. The various walls may become, and often are, involved in the process, and on the serous surface wandering vessels in a state of engorgement may be traced. The organ is so small that the likelihood of an inflammatory attack being confined to the mucous membrane alone is very small; its minute anatomy shows such ample opportunities for any inflammation-producing virus spreading through its entirety. Indeed that is what does happen: the muscular and serous structures are found participating in the changes. In the purely catarrhal form when the inflammatory process has reached its height the signs begin to disappear gradually till the organ resumes its normal appearance. Clinically such a condition is rare; the recurrence of similar attacks as time goes on points to more or less grave changes of structure, so that one is forced to believe that the purely catarrhal form, implicating only the mucous membrane, is a very excessive rarity.

The acutely inflamed appendix in which all parts of the organ are involved is clinically well known. In macroscopic appearance it is as described above. In its microscopic appearance there is found a large infiltration of inflammatory cells in the retiform tissue of the mucous membrane, disappearance of Lieberkühn's glands from the pressure of the inflammatory products, and the mucous membrane is so infiltrated as to have its lining layers destroyed. The same aggregation of cells occurs in the submucous, muscular, and serous layers, especially in the immediate neighbourhood of the blood vessels, which are, as one would expect, somewhat dilated. Should the aggregation of these

cells become gradually absorbed there is left behind an increase of the connective tissue of the parts; and this constitutes the first step towards the formation of the chronic form of appendicitis, in which, by repeated attacks of ordinary inflammation, the appendix gradually becomes largely composed of inflammatory or scar-tissue, not confined to the organ alone, but spreading all round to the neighbouring tissues, forming adhesive bands therewith. This occurs simultaneously with the destruction of the proper tissue elements. It is this form of changed appendix we find on operating on those cases that have had many attacks of appendicitis, with, in the intervals, slight pain, or even it may be only a consciousness of "having an appendix," as one of my patients, a medical man, described it. Where definite adhesions have formed, the pain is often very severe; or one might put it, when in a case where there have been several attacks of undoubted appendicitis with, in the intervals, attacks of severe pain, without rise of temperature,one may almost certainly look for adhesions. In this chronic variety the organ is harder to the touch, firmer, whiter, and larger in every dimension. If the operation is done during an acute attack it may be inflamed and red, but otherwise the description holds good. The canal in this form is very often closed by adhesions, or narrowed, and may contain calculi. The contracted or obliterated parts point to previous ulceration of the mucous membrane, which has healed by cicatrisation of the affected portion. According to the amount of this tissue and its position the appendix is displaced, kinked, buckled on itself, twisted to one or other side, or even drawn downwards till it lies on

the caecum, to which it may be entirely attached. With the obliteration of the cavity in the distal part cystic dilatation may occur or calculi may form. The various forms of cystic dilatation have been described by different observers, such as Coats, Kelynack, Bland-Sutton, etc., but that quoted above from Coats is typical.

The microscopic appearance of a section of chronically inflamed appendix is similar to that found in other parts that have been the seat of repeated attacks of inflammation. There is always a superabundance of cell-infiltration, as well as of connective or scar tissue, with at some places the disappearance, at others an excess of muscular elements or submucous tissue. Pressure effects produced by the contraction of the scar tissue accounts in part for the disappearance of some of the structures of the organ. The mucous membrane may have been destroyed by the inflammatory action, and its place is taken by cicatricial tissue. Such a conversion of mucous membrane into scar may form a node obliterating the canal at that part, breaking the continuity of the canal. Engorgement of the whole organ with cell infiltration makes for its general enlargement and hardening, and thus interferes with its movements of peristalsis.

The ulcerating appendix is the commonest form that the surgeon is called on to deal with. Ulceration begins at the mucous surface, and may remain there; or, should the virulence of the infective process be strong enough, or the resisting power of the other tissues deficient, the ulceration may go on to perforation. The naked-eye appearance of such an appendix

shows the whole organ inflamed, especially in the region of the ulcer; the contents are pus-like, consisting of broken-down tissue with normal secretion and inflammatory effusion mixed, the whole mucous membrane being red and engorged. There may be a localised collection of pus in a shut-off portion of the tube, or there may be a largely dilated appendix filled with pus distending the part till it resembles in size a piece of small intestine. Where perforation has occurred the opening is usually of a ragged, irregular shape, whence the contents escape, creating an acute inflammation of the parts in the immediate neighbourhood. As an effect of this a barrier of lymph is thrown out all round the escaped contents, thus localising the seat of mischief and preventing general infection of the peritoneal cavity. Happily, this localisation is effected in the large majority of cases, a small percentage of the whole suffering from general infection at once—the so-called explosive cases. Microscopic appearances are what one finds in the neighbourhood of ulceration in other parts. There is a marked engorgement of the vessels in the area surrounding the ulcer, with marked serous, cellular, and hemorrhagic infiltration of the parts around. The serous outpouring may extend far beyond the primary origin. Quite lately the writer operated on a case of ulcerative appendicitis where the structures of the abdominal wall beneath the skin were covered and permeated with coagulated serum. Each muscle had on it, and through it, and beneath it, thick layers of this colourless coagulum well round the seat of the appendix.

Gangrenous appendicitis is the most advanced form of inflammation of the part where, either from the excessive virulence of the infection or from some accident which suddenly shuts off the blood-supply of the organ in whole or in part, the organ, or part of it, becomes gangrenous. The affected portion suddenly becomes the seat of moist gangrene, turning greenish-black in colour, with dirty patches of lymph adhering to it in places, and of a most foul and faecal odour. It sometimes occurs so quickly as to merit the description referred to above, as the explosive or fulminating variety: the surrounding tissues have not time to erect a restraining barrier of inflammatory lymph, and the general cavity of the peritoneum is invaded at once. The occurrence of kinks or twists, or other displacements of the "buckling" variety, often forms the predisposing cause of this special and dreaded form of attack. The microscopic appearances are those of moist gangrene anywhere.

Tubercular disease of the appendix is very exceptional. In general tubercular peritonitis of the miliary kind, some small masses of tubercle are found on the appendix, as on other parts of the peritoneum. The serous covering of the organ shares the disease with the rest of the peritoneum. The disease is hardly ever met with primarily in the appendix.

CHAPTER IV.

PATHOLOGY (CONTINUED).

ACTINOMYCOSIS of the appendix has been found in a few cases. It is the result of the pathogenic action of the ray fungus or streptothrix actinomyces. It may follow on the ingestion of infected meal-corn or barley, or indirectly through the abdominal muscles, or diaphragm, or by metastasis from another source. This form of disease may occupy different stages, the intestinal stage lasting variously weeks or months; next, the tumour-stage; then the fistulous stage, when the disease spreads to other parts—the loin, hip, or abdominal wall, giving rise to multiple sinuses or fistulae; and, lastly, the stage of repair, when it may heal spontaneously or by surgical procedure. But it may go on from bad to worse to a fatal ending.

Tumours of the Appendix. We have already referred to cysts of the appendix, which are comparatively rare, considering the apparently abundant facilities for the formation of retention-cysts. The cyst described and figured by Coats is typical of this form of fluid tumour.

Myoma of the appendix has been described. Deaver has noted two cases, in one of which myoma of the appendix was present with a uterine myoma, both being dealt with at the same operation. In this case part of the tumour had become cretaceous. In the other a single nodule was discovered, having the typical muscle structure of myoma.

As far back as 1893 Lefforgue had searched the literature of the subject, and found record of only seventeen cases of tumours of the appendix. One lipoma, one myoma, two lymphadenomas, two hydatid cysts, nine carcinomas, and two imperfectly defined malignant tumours, were among the total list. On the whole, tumours of the appendix must be considered rare, especially simple tumours. Even malignant growths are very infrequently met. The statistics of the Pathological Institute of Vienna General Hospital for twenty-four years, 1870-1893, during which time 41,838 post-mortem examinations were made, contain the statement that of all these 3585 were carcinoma, 343 were cases of intestinal carcinoma, and of these again only 2 cases had their origin in the appendix. In the past few years greater attention has been paid to the occurrence of malignant disease of the appendix, and the total recorded up to 1905 has been about 40 cases altogether of primary carcinoma of this organ. The microscopic appearance is, viz.: "The new growth consists of cells, which, infiltrating the submucosa, are arranged in solid masses or nests of varying size and conformation. They are mostly very small; a few, however, are relatively large. Some are roundish in outline, others are very irregular.

The individual cells are epithelial in appearance; they are of moderate size, and their nuclei are vesicular and stain well. The supporting stroma consists of the altered submucosa, which shows but a very slight amount of inflammatory reaction. In certain sections there is a slight amount of infiltration of the muscular coats, with small numbers of the tumour cells" (Deaver).

One notable feature of the few cases that have occurred is, that the age of the patients with this malignant disease of the appendix is, like many similar cases having cancer in other parts of the intestinal tract, decidedly under what is usually accepted as the cancer age—60 per cent. of them being under the age of 30.

So many various conditions are associated with the onset of inflammatory disease of the appendix that it would seem to be well nigh impossible to mention one outstanding phenomenon as being the *fons et origo mali*; but there is little doubt that the principal causative condition is whatever interferes with the outflow from the organ. It has been said that the commonest cause of appendicitis is a pre-existing attack. One can understand this: given a first attack, its effect is left in the scar-tissue that follows inflammation here as elsewhere. The subsequent contraction of this new-formed tissue makes for narrowing of the calibre of the appendix and the greater accumulation of its contents behind the narrowing. In this retained discharge is found a most suitable nidus for the cultivation of the common colon bacillus as well as other pyogenic organisms; and from these

conditions may arise any of the pathological lesions that we are called on to treat. Even the presence of calculi, which by their very presence damage the mucous membrane and enhance the liability to septic absorption, is primarily due to retained mucous discharge, which forms the centre of the calculus formation. The calculus is by no means the primary cause of an attack. The degradation of the wall of cavity and its contents, prone thereby to become virulent, is quite comparable to the conditions met in inflammatory disease of the middle-ear or of the gall-bladder. In middle-ear affections, when the Eustachian tube is closed, though it may only be temporarily, by the ulceration and accompanying inflammatory swelling in the fauces during an attack of scarlet fever, the middle-ear is for the time converted into a closed cavity where easy incubation of pyogenic germs is carried out, with results well known to every one. So with the gall-bladder; abscess follows here also, when the duct is closed from any cause. So, too, in cases of stricture of the urethra, we find the parts behind the stricture very prone to inflammation, though the bladder has the ureters and kidneys behind it, making it not altogether a closed cavity. In the appendix, calculi, twists, kinks, bucklings of the organ, all play a part in retaining the contents, but the primary cause of the first attack of appendicitis is whatever first gives rise to retention of the discharge, which ought to have free outflow. Whether it be an overloaded caecum, introducing an actual mechanical hindrance to the exit of the tube's contents, or by its presence causing a slight catarrh of the lips of the aperture,

and so temporarily closing the orifice, it is not possible to dogmatise. This would be quite analogous to the explanation given of catarrhal jaundice so frequently met in children and young adults, where the ingestion of unsuitable food causes an inflammation of the mucous membrane in the pyloric region, so temporarily closing the bile-duct at its outlet. In fine, whatever the primal cause may be, one cannot escape from the conclusion that the beginning of the mischief is due to some circumstance that interferes with the free drainage of the cavity, and the overloaded caecum is as likely a first cause as any that has yet been put forward.

As long as the inflammatory products remain within the appendix no great harm can result; but what so very often happens is, the peritoneal covering of the organ becomes the seat of septic inflammation, either as the direct result of ulceration from the mucous membrane through the walls, or by the penetration of bacilli from mucous to serous surface. This is the beginning of appendicular peritonitis. The commonest condition by far that the surgeon is called on to deal with is the next stage of this inflammation, where pus has formed in a localised abscess near the diseased portion of the appendix. It has been found that the peritoneum possesses wonderful properties in the way of protecting the body from the effects of inroads of germs. It has been found to have a considerable degree of germicidal power in its own serum; and what is of greater service even is its vast capacity for absorbing bacteria before they can do much harm. When these

germs are absorbed into the lymphatic stream or the blood stream phagocytic action comes into play, and this is all done before any localised septic mischief has obtained a hold. Should more virulent material be effused than the peritoneum can deal with in this manner, it has a further protecting power in its ability to throw up barriers of plastic lymph all round the area of infection in an incredibly short space of time. This lymph unites in one continuous surface the structures in the immediate neighbourhood, separating this portion of the peritoneal cavity from the rest of the body cavity, and having within its circumscribing area the focus of infection with its products. This constitutes the appendicular abscess. If allowed to carry on its natural history the termination of the case may be one of several: the pus and broken-down tissue within the artificially formed cavity may increase to such a tension as to break through the plastic wall and form other foci throughout the peritoneal cavity. Each of these foci may become a similar abscess. Or the pus may make its way upwards through the body-wall and evacuate itself through an opening in the skin. Or it may ulcerate its way into bowel, bladder, or in the female, may evacuate itself through a Fallopian tube and the uterus. Again, the pus may escape and be led up behind the colon till it becomes sub-diaphragmatic. Should the abscess cavity be large and the wall give way to a considerable extent, the peritoneal cavity may be practically filled with pus before the peritoneum has been able to secrete its buttresses of lymph, and a fatal general peritonitis ensue. A rare ending

to the story is where the cavity's wall holds firm till the virulent action within determines itself, and gradual absorption of most of the abscess occurs, a little fatty debris being all that is left to show where the abscess had been.

This circumscribed abscess is the condition, as noted before, that one meets most commonly in surgical practice, where this part is concerned. The contents of the abscess vary in appearance and character, from those of "laudable pus" to a dirty, brownish serum, but they all as a rule have the faecal distinctive odour that marks the presence of the colon bacillus. The appendix is not as a rule easily made out, as it, with the other adjacent parts—colon, caecum, ileum, and omentum—is covered with the artificial wall of lymph so often referred to. This wall is like wash-leather, greyish-white in colour and somewhat tough in texture. It can be stripped off the underlying structure, revealing a hyperaemic roughened surface on which it has been secreted. The appendix may occasionally be found loose in the cavity or there may be flakes of detached necrotic tissue. When the action of the bacteria is especially virulent, or the resisting power of the tissues very low, it is common to find gases (of decomposition possibly) present in the contents of the cavity. Perhaps it is clearer to put it that where gases are found present in the abscess cavity, we are dealing with cases that are graver in their condition than in those where no gases exist. Whatever be the source of these gases, whether due to special bacteria or the result of analytical changes in the debris, they are bad cases where you find such.

The site of such abscesses varies as the position of the appendix itself varies: it is most common in front of the caecum, but it may be in the pelvis, post caecal, sub-diaphragmatic, or, getting its way through diaphragm, may simulate empyema or pulmonary abscess. As a rule, the quantity of pus is not great, a few ounces being the measure; exceptionally a large quantity may form, and with the increased pressure arising therefrom causes ulceration of some of the surrounding tissues that form the wall, abdominal muscles, caecum or colon, bladder, etc.

Multiple abscesses may be met. Their mode of origin has been referred to. A little leakage from the primary abscess starts a new abscess in some other part of the cavity: a further leakage may start a third abscess: and so there may be many separate collections of pus scattered through the peritoneal cavity.

More usually when the primary abscess wall gives way it does so largely, and the contents are quickly scattered over the area before the peritoneum can effect barrage. The peristaltic movements of the intestine aid the general dissemination of the abscess contents. In this virulent form of peritonitis the peritoneal layer shows dull and lustreless, with here and there patches of viscid ill-formed lymph. Any union between the various coils of intestine is very loose, the exudate being soft and friable. The pus is seldom of the creamy, "laudable" kind, but oftenest thin, yellowish, or brownish and faecal in odour. Again, in some of the most rabid and severe cases gas may be present, as when the original lesion is a gangrenous appendix.

CHAPTER V.

BACTERIOLOGY, Etc.

In the abscesses that are found in and near the appendix by far the most frequent organism found is the *bacillus coli communis.* As long as the function of digestion is being carried on normally this bacillus is quite harmless; but should a cessation of the intestinal current take place, as in strangulated hernia, or intussusception of intestine, then the wall of the bowel having been injured by the congestion which occurs in both conditions, the bacillus acquires the power of penetrating the damaged walls, assuming a virulence which in its normal condition it has not. So when stagnation of the appendicular contents occurs the damage so done to the walls of the appendix permits the migration of this organism in its virulent state with the well-known results. Other pus-producing organisms are sometimes found with the *bacillus coli communis,* viz. *staphylococcus aureus, staphylococcus albus, streptococcus pyogenes,* but the vast majority have the colon bacillus alone.

The following table gives an estimate of the relative frequency with which pyogenic organisms are found (Deaver):

ACUTE APPENDICITIS.

	Cases.	Per cent.
Bacterium coli communis alone,	93	72·656
B.C.C. and staphylococcus aureus,	17	13·28
B.C.C. and streptococcus pyogenes,	6	4·69
Bacillus pyocyaneus,	6	4·69
Staphylococcus pyogenes albus alone,	3	2·344
Staphylococcus pyogenes aureus alone,	1	·78
B.C.C. and staphylococcus pyogenes citreus,	1	·78
No growth,	1	·78
	128	100

There is a similar table for chronic appendicitis, which differs only in the fact that the first line, instead of having a percentage of 72·6, has nearly 90 per cent., in which bacillus coli communis is found alone.

Mechanics, etc., of Appendicitis. There are certain factors in the anatomy and physiology of the appendix that have such a close bearing on the causation of inflammation of the organ as to demand consideration as possible predisposing causes. First, there is the meso-appendix, which varies in size, thickness and position. It may surround the appendix completely and quite closely and be of a size, length, and breadth to permit the organ to lie in a straight or very slightly curved line. Or its two layers may diverge at quite a measurable distance from it before lapping round the tube, leaving a canal of triangular section beneath the organ. This peculiarity may

determine the direction of pus forming in the part of the appendix uncovered by peritoneum, such pus-collection becoming post peritoneal, not an unusual sequel of appendicitis. Again, the meso-appendix may be attached to the caecal half of the organ, or it may be very short in length as compared with the length of the appendix. Such conditions give rise to more or less sharp bendings, or bucklings of the process on itself. Such twistings or bendings would, of course, interfere with the free emptying of the viscus, which is a first step towards the pathological changes we are discussing.

Then, again, the great length of the appendix as compared with its breadth also makes for difficulty in evacuation of its contents. The length is usually about twenty times the diameter of the lumen. Should from any cause inflammation arise in part of the organ the disproportion between length and breadth of the canal at the affected portion would be still greater, because the effect of the inflammation is to narrow the lumen still further. In chronic cases the lumen is in all cases less than normal.

In early life the structure of the appendix shows a large amount of lymphoid tissue in the mucous and submucous layers, of the same kind as occurs in the tonsil. This form of tissue is prone to inflame, as is witnessed in the frequent attacks of tonsillitis, simple and ulcerative, to which young people are subject. It is quite within the sphere of natural assumption that a like proneness to inflammation occurs for the same reason in the appendix, which has been, from its structure, called an abdominal tonsil. Ribbert states

that up till the thirtieth year the lymphoid follicles retain their ordinary position and state, but after that age they become atrophied and fewer in number. Further, the epithelial surface by which infection may be absorbed is very extensive compared with the size of the appendix. The crypts of Lieberkühn also afford convenient lurking places in which bacteria may rest and flourish.

The blood-supply of the appendix is of a very precarious nature, unlike the arrangement of fixed and copious vessels that supply the intestines, large and small. It can easily be understood how a quick bending of the appendix, or a sudden swelling within its lumen, could block the circulation and lead to gangrene of its distal portion.

As referred to above, Gerlach's valve, where it exists, might if inflamed and swollen help to block up the outlet, and prevent the drainage of the viscus. But this point needs clearing up.

Involution of the appendix occurs in a number of cases before the thirtieth year. This is a gradual atrophy of all the tissues from the tip to the root of the process. The bearing that this degradation of structure has on the causation of appendicitis lies in the fact that such tissue has lessened resisting powers to the inroads of inflammatory agencies.

In fine, the predisposing causes set forth are such factors as interfere with the drainage of the organ, affect its blood-supply, or lower the vitality of any of its tissues.

The exciting causes of inflammation of the appendix may be the same as those exciting inflammation in

other parts, viz. chemical, bacterial, or mechanical irritants. Chemical irritants rarely excite appendicitis, though lead-poisoning has been cited as a cause. Influenza, enteric fever, rheumatism, etc., have been given as exciting causes of the disease; the irritant effects of these poisons at least have attributed to them the power of depressing the vitality of the tissues, and so causing them the more readily to succumb to the attacks of the ever-ready bacilli. The part played by bacteria has already been sufficiently noticed. Finally, as to the causative relation between appendicitis and mechanical agencies there can be no doubt. Injury inflicted on the abdominal wall has been so frequently and immediately followed by typical attacks of appendicitis as to warrant the truth of the dictum, *post hoc, propter hoc.* The other mechanical cause that may be cited is the presence of foreign bodies. Of late years particular notice has been paid to this point, and the number of undoubted cases credibly reported of foreign bodies being found in the appendix is very small. The list perhaps totals forty or fifty. By foreign bodies are meant substances that have been swallowed and found their way into the small organ. They comprise pins, needles, tooth-brush bristles, small shot, fish-bones. Such bodies would certainly produce inflammatory symptoms and lead to operation. By foreign bodies we do not mean the calculi that are so frequently found. These are phosphatic calculi, formed layer by layer on a nucleus of inspissated mucus that has been retained in the cavity of the organ. They are usually brown in colour, shaped like a torpedo or a date-stone without

the cleft, not at all like a cherry-stone, in size from a millet-seed to that of a date-stone, or occasionally larger. They are soft, and when dry readily crumble. They receive their colour from the faecal matter in the immediate neighbourhood. These calculi owe their origin and growth largely to inflammatory changes in the part which brings the additional blood-supply to the part to cause their growth. As time goes on when they have become a fair size their very presence and pressure on the organ that gave them birth produces in many cases a process of ulceration in the wall of the appendix, where bacteria may swarm and work out their will. So that in the beginning they are an effect of inflammatory action, later on they may become a cause thereof.

CHAPTER VI.

ACUTE APPENDICITIS.

Symptoms. The outstanding symptoms of an attack of acute appendicitis are pain, tenderness on pressure, rigidity of the muscles over the appendix, with, it may be, nausea or vomiting, changes in pulse, temperature and respiration-rate, and change in facial appearance. But of these the three first named are most to be attended to.

Pain. The pain may be at first sudden in its onset, and distributed over the abdomen or referred to the umbilicus, just as the pain of strangulated hernia is often first located there. Within twenty-four hours it changes its seat, and becomes localised to the part of the abdominal wall over the organ. It may be steady, but oftener it is colicky in character, and described as cutting or grinding. No relief is given by compressing the abdomen as in colic: any relief that is obtained is by flexing the thigh on the abdomen and bending the body forwards; in fact, by relaxation of the parts. The seat of the pain varies with the position of the appendix. If the appendix

is behind the caecum the pain may be referred to the loin or the lower ribs; if in the pelvis the pain may be felt down the genitals or right thigh: if it lie in the course of the anterior crural nerve the pain may be referred to the thigh, even as low as the knee. The cause of the pain seems to be the efforts of the peristaltic force to get the contents of the organ extruded into their proper outlet, the caecum. The efforts of this rhythmic muscular contraction on the part of an inflamed organ accounts both for the severity and the colicky nature of the pain.

Tenderness on pressure is elicited, as superficial and deep. There is usually a hyperaesthetic area, which may be delimited by gentle pressure and seated in the skin itself. It may extend from umbilicus outwards and downwards, even passing on to the upper surface of the thigh. But the deep tenderness on pressure is a much more common and more reliable sign of appendicitis than the cutaneous pain. It is most common at a point two inches from the anterior superior spinous process on the line joining this process to the umbilicus. As can be easily understood, with variation in the site of the appendix the spot of increased tenderness varies also.

Muscular rigidity over the appendicular region is perhaps the best sign of activity of the disease: it commences early and remains steadily present, only beginning to slacken off when the acuteness of the attack is passing away. It is a reflex action, brought about by the pain in the appendix, affecting first the sympathetic and then the roots of the spinal nerves

supplying the muscles in this hypogastric triangle. It is nature's effort at keeping the diseased part at rest, by putting the muscles on guard.

These three signs, pain, tenderness on pressure, and muscular rigidity, are the most important phenomena on which to make a diagnosis.

Nausea, even vomiting, are very frequently present, but not by any means invariably. There may also be constipation or even diarrhoea.

Temperature-changes are decidedly of importance, but there is no steady behaviour on the part of the temperature in many cases. We may have cases with very little rise of temperature going steadily on even to suppuration. Generally the temperature is over 101° F. early in the attack, and for three or four days may rise one degree or so above that at night and fall similarly below it in the morning till the fifth or sixth day, and a gradual descent of the temperature then marks the subsidence of the inflammatory condition. A marked rise of the temperature may occur with the onset of pus-formation; or a very marked fall of the temperature suddenly, with a rise in the pulse rate, is even more of a danger signal, pointing to sudden perforation and shock. In many cases the temperature remains high all the time, and comes down gradually with the passing off of the attack, which is proved thereby to be of the simple or catarrhal form: in others a very slight rise of temperature marks the whole course of the attack, until a very sudden rise or abnormal fall points to one of the disastrous forms of the disease. It might be held that the absolute temperature is not of so much

clinical importance as the variations. Where these are extensive (three degrees or so) and sudden, danger is to be apprehended.

Much the same may be said about pulse-rate. As long as the pulse-rate and temperature keep their usual febrile relation the case is going on fairly well, provided the beat is full and strong and regular, but if the pulse becomes too rapid in proportion to the temperature, or is weak or irregular or easily compressible, then the patient is in a correspondingly serious condition. The rapidity and weakness of the pulse is a strong index of the gravity of the case.

Respiration-rate teaches us very little of itself either as to the nature or gravity of the attack.

The general appearance of the patient may help in forming an opinion as to his condition. The anxious expression of the face in the early stages of the attack is quite characteristic: one can read on his face that he is distressed and in pain. In the later stages, when marked and extensive peritonitis has occurred, the facies abdominalis is present and well marked. He prefers to lie on his right side with his right thigh flexed to relax the affected parts. He may lie on his back, but always with the thigh bent. There is also an evident desire not to be disturbed or moved. Usually also the tongue is furred, and there may be perspirations, especially when pus has formed. Rigors occur too, but not frequently, on the formation of pus. The onset of pus-formation here is less marked by rigors than in any other part of the body. In dealing with appendicitis the most difficult question to answer is whether pus be present or not. No sign exists on

which a thoroughly reliable answer to this question can be given. The presence of swelling, seen or felt in the abdomen or per vaginam or rectum, temperature or pulse changes, blood-count, cessation or increase of pain, or tenderness on pressure, not any one or combination of any of these signs is an infallible rule regarding the presence of pus.

On physical examination by inspection a slight fulness may be noted over the region implicated. Again, if obstruction of the bowels have existed for some days the inflation of the intestines by gas may obscure the swelling that would otherwise be visible. On palpation the pain on deep pressure will be noticed, and the sense of resistance by the muscles on guard will also be made out. By palpating other parts of the abdominal wall the differences in the resisting power will be made more clear. Rectal or vaginal examination should always be made, and a swelling, or at least a difference of resisting power, can be easily recognised. Percussion gives out a relatively dull note over the inflamed area, due at first to the engorgement of the parts with blood, later on owing to inflammatory effusion, or in the more advanced stages due to the presence of a collection of pus. But all that percussion gives is this relatively dull note—its explanation is not given. Exceptionally the note may be tympanitic if the abscess cavity contains gas, or there may be a distended coil of intestine in front of the inflamed area.

Leucocyte-count. Nothing of a very definite character can be derived from the leucocyte-count as a reliable aid to diagnosis. A high count, 20,000 or thereby,

early in an attack of appendicitis which has been diagnosed by other means, would point in most cases to the formation of pus, or even of gangrene. In the later stages of an ordinary attack which has gradually tapered off in the severity of the symptoms it would point to the formation of a localised abscess. When a generalised peritonitis has occurred a low leucocyte-count is more favourable than a high count. It may be that the former indicates a higher resisting power. The opsonic index might help in a condition such as this. In cases where there is a difficulty as to typhoid fever or appendicitis, of course great stress would be laid on Widal's reaction on the one hand and the leucocyte-count on the other. The leucocytes in typhoid fever are always low early in the disease, and always tend to go lower. Further than that definite information cannot be obtained from the leucocyte-count.

CHAPTER VII.

DIFFERENTIAL DIAGNOSIS.

THE immense variety of structures in the abdominal cavity and the variability of the topography of the organs make the diagnosis of abdominal conditions excessively difficult in some cases. Some solve the Gordian knot by the alluring exploratory incision, which, while certainly a speedy means of solving a diagnostic difficulty, is, or ought to be, kept as truly a *dernier ressort*. In diagnosis of pathological conditions anywhere the result is arrived at by balancing probabilities, and nowhere are the probabilities more numerous than in the peritoneal cavity, as every operating surgeon could testify. Appendicitis in its acute form has always its three strongly marked signs —pain, tenderness on pressure, and muscular rigidity, with more or less fever. These three phenomena should always be present in the surgeon's mind as pointing indubitably to disease of the appendix; the absence of any or all of them would set him searching elsewhere.

CONDITIONS THAT SIMULATE ACUTE APPENDICITIS.

Intussusception of Bowel. The acute form of this condition occurs chiefly in young children under eight years of age. It occurs without warning except in a very few cases. The collapse is very profound, especially in the very young. The pain too is very severe, and is usually colicky, and is, as a rule, confined to the region of the caput caecum. The swelling is usually sausage-shaped, and is in this region. Constipation is not very marked: there is almost always passage of blood-stained faeces. Per rectum a tumour may be felt, the prolapsed portion of the intestine. The vomiting that occurs comes on later than in other cases of obstruction. Temperature is subnormal, pulse quick and feeble. The intestines do not become distended until peritonitis comes on.

The pain at a definite localised part, the tenderness on pressure, and especially the muscular rigidity which mark an attack of appendicitis, are not present.

Intestinal Obstruction. In this form of abdominal disease the leading symptoms are as follow. Patient is suddenly seized with pain in the abdomen, referred usually to the umbilical area. At first it is usual to find it colicky in that there are slight relaxations, but the longer it lasts it tends to become more steady. There is constipation marked and complete after the rectum has been cleared of what may have been there before the onset of the attack. Vomiting occurs early and at first consists of the contents of the stomach, then bile-stained fluid, then intestinal contents. The

lower down the seat of obstruction is the more faecal will the vomiting finally become. Shock is a marked sign from the beginning of the attack, and persists till relief is obtained. Pulse is quick, temperature is subnormal until sufficient damage is done to the intestine at the seat of obstruction to admit of the entrance of pyogenic organisms, and then the temperature rises. Thirst is very marked, out of all proportion to what the temperature would indicate. Early in the history there is no swelling of the abdomen, and no tenderness nor rigidity. These signs appear after a few days, when peritonitis begins as a second stage in the history of the case.

There is, in the majority of such cases, a history of one or more previous attacks of abdominal illness, with pain, feverishness, etc., which really were due to tubercular peritonitis; and the adhesions that were the result of those past attacks are the exciting cause of the strangulation in the present condition.

In strangulated hernia, the story is quite the same as above, but the presence of the tender swelling over one of the hernial openings clears up the diagnosis.

Sometimes in strangulated bowel in its earlier state the marked congestion of the part due to the interference with the circulation is the cause of a relatively dull note on percussion. Later on, as the bowel distends, this disappears.

Acute Perforation of Stomach. This is marked by a very sudden access of pain in the epigastrium, of a stabbing, agonising character. It is at once attended with an extreme degree of shock, the pulse being rapid and thin, breathing shallow and quick, with intense

thirst, while the patient's face is colourless or livid, with a cold moisture over its surface. The expression of the face is as of one terror-stricken. Locally, besides the pain, there is extreme tenderness on pressure, at first in the epigastrium, but later over the whole abdomen, and the patient shrinks from the touch of the examiner's hand. There also is marked muscular rigidity over the upper abdominal muscles, which by and bye involves the whole abdomen as the contents of the stomach spread through the cavity, giving rise to peritonitis. Should the contents make their way towards the right iliac fossa there would be peritonitis there which would in some degree resemble appendicitis, but that is only an incident in a larger set of events. It is not often that the stomach contents make their way in that direction. The matters escaping from a duodenal ulcer are more prone to pass downwards along the colon. After the contents have been in the peritoneal cavity for a short time and peritonitis comes on, the temperature rises and the bowels begin to distend rapidly, so that the liver dulness may be made to disappear. Vomiting occurs in half of the cases, and sometimes there is a little blood in the vomit. There is almost always an antecedent history of stomach trouble.

Perforated Duodenal Ulcer. Where this occurs you also get a history of previous stomach trouble: pain coming on two hours or so after taking food, not a few minutes after, as in stomach ulcer. There may also have been occasions of vomiting of blood or melaena. There is pain in the epigastrium, going through to the inter-scapular region. The signs of

perforation are not to be distinguished from those of the like accident in gastric ulcer. As remarked under the heading of perforated gastric ulcer, the contents of the duodenum going out of the perforation are more likely to make their way to the right iliac region, led thereto by the colon.

Intestinal Colic. In this condition there is spasmodic pain moving from part to part of the abdomen with no rise of temperature, and it is relieved by pressure. It usually begins in the umbilical region, and spreads to other parts. It is spasmodic in character, reaching a crisis and then perhaps gradually disappearing entirely, to recur after an interval. The passage of flatus or faeces gives relief. The face shows evidence of suffering, being pale and drawn, with cold sweat; while the pulse is normal in number but weak. The absence of pain in a fixed part, relief on pressure, and no muscular rigidity in the hypogastrium sufficiently distinguish this illness from appendicitis.

Acute Enteritis. Inflammation of some part of the mucous membrane of the intestines may be of any degree from the mildest to the most severe. The symptoms vary according to the part involved, and according to the intensity of the attack. If the seat of mischief be in the lower parts of small intestine or in colon, then diarrhoea is a marked sign. It may be very copious, watery, with a few flakes of faeces. There may also be blood present, especially if the lower end of rectum is inflamed, or the seat of hemorrhoids. If the upper parts of the canal be the seat of the affection diarrhoea is not marked, as reabsorption

of the inflammatory products occurs in the lower part of the bowel. Usually there is fever present, which comes on suddenly at the commencement of the attack. Pain also is present, and is of a colicky nature, relieved by pressure. It is mainly due to the distension of the bowels by gas, that forms more rapidly from the inflamed surface.

Vomiting is a very rare symptom unless the stomach is also participating in the diseased condition.

There is usually to be obtained a history of injudicious dieting before the attack.

Generally speaking, there is a greater or less degree of indefiniteness of symptoms, but certainly no localised pain nor muscular rigidity such as appendicitis presents.

Enteric Fever. If enteritis has vague symptoms, enteric fever in the matter of vagueness is much worse. One would be inclined to say that of the ordinary ailments the medical man is called on to treat there is none that gives more difficulty in its detection than this insidious disease. As a rule its onset is very gradual, a general malaise, slight rise of temperature in the evening, some little pain in the abdomen, perhaps diarrhoea, general listlessness, a dull stupid expression of the face, but no pointed, definite sign. It takes as a rule a week's steady observation to clearly diagnose this fever unless one happens to be taking part in an epidemic. Then the expected is likely to happen. There very commonly is pain in the iliac region, where search is made for the gurgling on pressure, but in many cases there is no pain. One would think that the history of a case of enteric fever

would put it out of the category of possible "appendicitis." There is an absence of suddenness in the onset, the pain and tenderness on pressure are never so acute, and there is an absence of the muscular rigidity that is such a constant sign of acute inflammation of the appendix. And yet the variety of sign and symptom in enteric fever is so great that surgeons have, time and again, been called to operate on cases of enteric fever, and wisely advised delay till time should clear up the doubts in the attendant's mind. The opposite holds as well, appendicitis cases have been sent to enteric wards. The writer operated on one not very long ago.

Of conditions of the gall-bladder that may simulate appendicitis, **empyema** and **phlegmonous cholecystitis** are the most likely. In empyema of the gall-bladder, the cause of which is the presence of gall-stones blocking the duct, there is almost always a history of precedent attacks of biliary colic with accompanying jaundice. There may be rigors at the beginning, and certainly during the course of the attack, with a greater or less rise of temperature. The pain is in the epigastrium or through to the right scapular region. There is a visible swelling under the margin of the liver, with tenderness on pressure and muscular rigidity in that area. The gall-bladder may become adherent to the abdominal wall, and the suppuration may make its way directly out through the adhesions. Or it may travel along the suspensory ligament and discharge at the umbilicus, or even be diverted towards the region of the appendix. So that it is only in ignorance of the history of the case that this

aberration in its later stages is likely to be mistaken for appendicitis.

In phlegmonous cholecystitis the attack is of sudden onset, with very acute pain on the right side of the upper abdomen, which quickly becomes general. There is intense shock, pulse quick and feeble, breathing shallow, fixation of the upper abdomen by the muscles becoming rigid, and the face has the usual agonised expression. The peritonitis, local at first, soon becomes general, and tympanites quickly ensues. With these there is usually persistent vomiting. There usually is some rise of temperature, but the rise is not commensurate with the extent of the danger, rather the opposite. Here, again, attention to the mode of onset of the disease is a great help against mistakes in diagnosis. In this condition the pain and tenderness on pressure begin in the gall-bladder region, extending therefrom as the peritonitis spreads; in appendicitis the like signs begin in the right iliac region and spread thence. Mayo Robson states that in acute gall-bladder cases there is a point of special tenderness at the junction of the upper two-thirds and the lower third of a line joining the ninth rib to the umbilicus; a point comparable to the well-known M'Burney's point.

Kidney Affections. Renal colic has been mistaken for the like pain in appendicular disease. This pain, like appendicular colic, comes on very suddenly, is connected with some injudicious form of diet, and may have as a concomitant a rise of temperature even up to 102° F. But the pain here begins in the kidney region, extends down the ureter to the testicle, which

latter is usually also the seat of pain, and is dragged upwards by reflex action. There is also nausea and vomiting. The pulse may be a little hurried, but it is usually fairly strong, and never out of harmony with the rise of temperature. As positive signs there is always a certain amount of abnormality in the bladder action: there may be scantiness of urine, or the urine may be blood-stained or contain a considerable quantity of blood. Even a small calculus may pass and give a definite clue to the diagnosis. In the majority of cases there may be a history of previous attacks of a similar kind, which would of itself divert attention from the appendicular region. And there would certainly be an absence of the usual history of pain, etc., in the iliac region, which are, after all, the cardinal signs of inflammation of the appendix. Again, even to wearisome iteration, it must be said that the history of every suspicious case must be carefully gone into, and mistakes will thus be avoided. The practical surgeon is sometimes too anxious. Much good would accrue to his self-satisfaction if he spent more time at the bedside getting the story of the illness, and this applies especially to the abdominal surgeon.

Kidney Abscess. If the abscess is of the nature of pyelitis, examination of the urine, with its clearly defined sediment of pus, would largely help to a correct diagnosis. There will also be a previous history of pain along the ureter into the testicle, recurrent febrile attacks, and likely a long history of ill-health, to distinguish the condition from acute appendicitis. The absence of the definite signs of an

inflammation of the appendix would further guide the attendant to a right conclusion.

If the abscess is round the kidney, and from there has travelled downwards towards the lower lumbar region, there would be greater cause for supposing it to be an abscess connected with the appendix in its post-caecal position, and were no attention paid to the condition of the kidney and urine, nor to the previous history, mistakes might arise. For, judged on the appearance the parts present at the time the abscess has formed, there is nothing to distinguish between the two except the story of the events that led up to the present condition of things.

Uterine Conditions. The first of these pathological conditions that would lead to difficulty is the common one of painful menstruation, due to congestion of the ovaries. Pain may be on both sides and localised to a small area in the iliac regions at, or even before, the beginning of the menstrual flow. If the painful spot be pressed from without the muscles become rigid to protect the underlying, congested part. Should the right ovary be alone affected pressure over the left organ does not cause the same pain, nor the muscular contraction. Vaginal examination shows that the uterus is unaffected, but pressure of the finger on the ovary, with the other hand bearing steadily on the abdominal wall, enables the tender organ to be felt between the two hands. The uterus is drawn towards the affected ovary, making the vaginal roof on that side more full and tense. There may be increase of the pulse rate but no rise of temperature.

The pain is lower down than M'Burney's point: its

occurrence coincides with the menstrual period: it recurs every month, passing off as the physiological activity of the ovary diminishes.

The graver stage of this condition is even more likely to be mistaken for acute appendicitis—the stage of oophoritis. Here you find symptoms and signs, as in the congestive stage, but more severe, and in addition you have a febrile temperature. Bimanual examination, the finger of one hand by preference in the rectum, can get the ovary between the two examining hands and delimit its size and note by tenderness and pressure whether this is the affected part or not.

Cases have been reported where an appendix abscess has formed, and in its growth implicated the Fallopian tube through which the contents of the abscess were finally discharged. Such cases must have been very difficult problems in diagnosis.

Undescended Testicle. A testicle that is not beyond the external ring may, on receiving some slight injury or from some other cause, be caught firmly by the muscles that form the canal and give rise to somewhat confusing symptoms. There is sudden access of pain of a peculiarly sickening character: there is often vomiting, and nausea between the periods of vomiting. There is extreme tenderness on pressure, and the muscles are on guard. The history may help you to a solution: he has had similar attacks before. The little gland can be felt in the canal, which is considerably below M'Burney's point; and the presence of only one testicle in the scrotum are guiding points in arriving at the true state of matters.

These are among the most likely forms of disease for which appendicitis may be mistaken. According to different records it would seem that "every ill that human flesh is heir to" has been somewhere or other labelled as the disease under consideration, viz.: sciatica, acute osteomyelitis of ilium, sepsis in the broad ligament, haematoma of right iliac fossa, etc., and dislocation of the hip, pleurisy, locomotor ataxia, not to speak of a more likely ailment, hysteria. But enough has been written for the purpose of setting forth the differential diagnosis.

CHAPTER VIII.

CHRONIC APPENDICITIS.

CHRONIC appendicitis is the term applied to a very varied set of conditions. After an acute attack, which has passed away leaving no pain nor swelling behind it, in a few months a similar attack may come on, going through a similar history and again leaving no trace behind. This may be followed by a third attack, or a fourth and so on. Again, after a first attack the pain may remain more or less persistent, even after the fever and swelling have disappeared, when a second attack may come on, to be followed by a quiescent period but with some pain. So a third attack may supervene. Then we find cases where there has been no known acute attack but very persistent pain, varying in intensity, but not causing the patient to lie up. Even there are cases where the patient has had no more than a consciousness of having an appendix. All these varieties are grouped under the heading of chronic appendicitis. It is among cases of this variety that difficulty of diagnosis occurs most frequently. If a credible history of an acute attack or attacks is

obtained, then the diagnosis can be fairly well arrived at. But if we have nothing to go on but the pain, it is necessary that careful review of the possible causes of such pain in the neighbourhood should be made. In the female, ovaritis and salpingitis chronica may simulate appendicitis chronica, but for the disturbed menstrual conditions, the exaggeration of the pain during the menses, and the pain in these conditions being rather nearer the middle line and on a slightly lower level than in appendicitis.

Tubercular disease of a gland or glands in the caecal region has been mistaken for chronic appendicitis, and only discovered at operation. The search for the tubercle bacillus in other parts of the body might obviate the mistake, but that is rarely done. The presence of nodular swellings with effusion would certainly correct such a possible error, but unless the gland is sufficiently swollen to be felt through the abdominal wall it is very difficult to distinguish the two conditions.

When the chronically inflamed appendix is exposed we find quite a variety of conditions. Usually we have adhesions to the parts around, caecum, small intestine, omentum, abdominal wall, etc. The pain complained of is usually in proportion to the number and extent of adhesive bands. As before noted, kinks and twists, or thickenings are found in the organ itself. In some of these so-called chronic cases when the organ is opened up we may get a calculus, or even pus, which have lain quiet but presumably ready to exhibit their potentialities when the necessary exciting cause should arise. One of the last "chronic" appendices the writer removed was quite healthy, except its

extreme end, which was enlarged to the size of a hazel nut, adherent to omentum and to the abdominal wall, from which it had to be peeled by the finger-nail. The patient, at our first interview, insisted on the fact that his first attack followed immediately on his using his salmon-rod, with the butt against that part of his abdominal wall when playing a fish he had hooked. He was well before he caught on to his salmon, and he went home with difficulty after landing his fish, and lay up for some weeks. On careful enquiry, while that was his first serious attack, he had had severe pain in the region on several previous occasions, but was never off work. The case illustrates what is said in another place as to the effect of violence as a contributory cause of appendicitis.

One case of this quiet variety was very striking. A patient came under the writer's care who had had three separate distinct attacks, but was now in the quiescent state; no fever and but slight discomfort. On opening the abdomen the appendix practically came out of its own tension and movement, but its size was so great as to look like a well-filled portion of small intestine. It needed careful examination of the adjacent parts to make sure it was the appendix. It was ligatured in two places and incised between. When the removed portion was examined it was found to be filled with pus, two ounces at least, its mucous membrane ulcerated in patches and seemingly ready to give way on the slightest provocation. But there was the pus present, and it had presumably been there from the preceding acute attack some months before, and yet there was positively no indication of

the presence of pus. That is the most marked case of pus being present and undiscovered till operation in the writer's experience. The others were similar, but had a much smaller quantity of pus. In such cases of chronic appendicitis, excluding recurrent attacks, the patient never feels well, nor looks well. He is often depressed and easily fatigued, troubled with intestinal and stomachic disturbances, and that too no matter how careful he is with his diet or with the state of his bowel action. In the vast majority of these cases the good result of operation is shown in the rapid improvement in the patient's health and sense of well-being, increase of weight, and improvement in his mental outlook. In some few there is no improvement either in the local condition or the general state of his health, and one can only come to the conclusion that the appendix has not been the cause of the mischief. Some would put such cases into the neurotic category, which contains so many unexplained cases of both medicine and surgery.

In hysteria, should appendicitis be the disease mimicked there will be found excessive hyperaesthesia over the abdominal wall when first the surgeon examines: but by degrees, as the patient's attention is withdrawn from the part under examination, the hyperaesthesia disappears and even marked pressure fails to elicit the deep tenderness. Muscular rigidity, which is often produced at first examination, also by degrees passes off. Further, there will not be any history of gastro-intestinal disturbance as in the real cases. The reflexes will be found exaggerated.

Carcinoma in the region may give rise to more or less steady pain, not unlike the ill-defined cases of chronic appendicitis. As the cancerous growth enlarges there may be recurrent attacks of severe pain, with concomitant signs of intestinal obstruction. There are no inflammatory signs. When the tumour can be felt, the constitutional signs of cancer, rapid wasting, weak and quick pulse, general cachexia, etc., have declared themselves. Attacks of constipation, alternating with diarrhoea, with mucous and blood in the stools, sufficiently differentiate it from any of the appendicular inflammatory affections.

Sarcoma is occasionally found in this region and its symptoms and signs are as in carcinoma, though the progress of the disease is more rapid.

CHAPTER IX.

TREATMENT.

When acute appendicitis is diagnosed without doubt from the presence of the well-known symptoms and signs, the present state of our knowledge, or want of knowledge, regarding the future progress of this condition leads us logically to the one form of treatment, viz. excision of the appendix. The following reasons, among others, lead us to this conclusion. Prognosis in the case of appendicitis is the most hopeless kind of prophesying. It is not possible to say at the beginning of an attack how it will end. What looks like a simple catarrhal attack may within a few hours become one of the explosive variety, leading quickly to generalised peritonitis, and most likely to a fatal termination. Short of that, without any possibility of foretelling, it may end in the very common appendicular abscess, which of course necessitates operation, under the most disadvantageous conditions. In many such cases operation has to be repeated for the cure of a hernia in the scar, for an unhealed track leading down to the appendix, or it may be for a faecal

fistula left from the abscess. Operation on abscess of the appendix is being viewed now in a much more unsatisfactory light than it was a few years back. Not so long ago it was taught that the appendix once having suppurated gave no further trouble; that the pus in many cases was the disintegrated mass of the appendix, and once the pus ceased to flow the trouble was over. "The wish was father to the thought." Every now and again there crop up cases of further trouble with appendices that were not removed at the time of operation on the abscess when it first formed. Removal at that time, unless the appendix is just within immediate view and reach, is best not attempted. But it should be removed later on, when the first wound is firmly cicatrised and the patient has become restored to a fair measure of strength. So that operation when pus has formed round the appendix is performed under very bad conditions: there is always the possibility of some of the pus finding its way into other parts of the abdomen, or even by absorption becoming general.

But, it may be argued, 80 per cent. do not go on to pus formation. The inflammation subsides, and in a few weeks the patient is as well as ever. But the great majority of these cases will have recurrences, and at any one of these recurrences there is the possibility of a surgical calamity. For nothing tends more to an attack of appendicitis than a previous attack.

In the earlier days of appendectomy's history it was a kind of unwritten rule to wait till the first attack passed off by subsidence if it would; and even a second attack would be carefully watched in the same

way. Then the patient would be strongly urged to consent to operation. Unfortunately, the first attack did not in many cases pass off in the hoped-for manner, and operative measures were employed because they could not be avoided; and so the inefficient procedure of operating on the abscess had to be adopted. Any surgeon who has had to deal with a few cases of the explosive variety most clearly understands the poignant regret of not having operated in time. One might say that very few regret having operated compared with the many whose great wish is that they had operated. In a text-book for house-surgeons, where strangulated hernia and his duty therein was being discussed, the author lays down as an axiom for the houseman's guidance: "When in doubt, send for your chief." The chief arrived, and he had a similar axiom up his mental sleeve: "When in doubt, operate." And they were both very good working axioms that have led to very happy results. The time may come when the exact pathological condition of a diseased appendix may be known from the signs and symptoms present: but that time is not yet; and till that time arrives the surgeon who operates whenever appendicitis is clearly evidenced will have the best results for his patients and the most satisfaction for himself.

If the operation is done before pus has formed, it is just as simple and clean a procedure as waiting till the attack has passed over for a few months: even easier, for you are free in the early case of any difficulty from inflammatory adhesions, such having had no time to form.

That, be it noted, is the only logical position for the surgeon to take up in the face of the great fact that we have no certain knowledge of what the condition of the appendix is by the time that appendicitis has declared itself. But it will be long before this conclusion will be universally acted on. Even were the attendant convinced of the necessity of immediate operation, he has to consult the patient's wishes, the friends' consent, and to note the possible inability to obtain an operator at once, or a similar inability to have the patient brought to a convenient place for operation. Further, a concomitant attack of some other disease—enteric fever, Bright's disease, diabetes, pneumonia, etc.—would also militate against the carrying out of the above logical rule, and palliative measures would have to be adopted. The mode of treatment to be adopted in such case is the medical treatment.

The keynote of this form of treatment is to keep the parts involved as much at rest as possible. Confinement to bed is, of course, essential. If it is at all a sharp attack, the patient will have learned that himself. There is no necessity, for the first day or two, to give food of any kind: at most, very small sips of milk or of hot water if thirst be complained of. At the onset sickness or nausea is usually complained of, and to keep filling the stomach with fluids would only exaggerate this, or tend to bring it back if it had passed away; so that everything is done to avoid retching (which disturbs the whole abdominal contents). Should vomiting be present, the application of a mustard leaf to the epigastrium and the withholding

of fluids entirely, might be necessary. For the pain, hot fomentations might be applied to the part, but not fly-blisters. In view of possible operation, it is well to keep the skin clean: it would be an added unnecessary danger to have to operate through a space of raw cuticle reeking with sepsis. For the action of the bowels, an enema daily should suffice: the bowels can in this way be relieved with the minimum of disturbance, and usually such relief is very grateful to the patient. Should the physician be very anxious to "keep the patient's strength up" from the first, feeding by the lower bowel may be carried out. Beef-tea and brandy, beef suppositories, milk suppositories, etc., may be tried in turn, remembering that the rectum in such a mode of feeding needs to be cleared out with an enema of boric solution, or salt and water, daily or every second day, to avoid the irritation of the bowel that is so apt to ensue. There should be no call for purgatives: but if the first enema has failed, a dessert-spoonful of castor oil might be given, to be followed a few hours after by a second enema.

The pain may not be controlled by the fomentations. In that case give a hypodermic injection of morphia ($\frac{1}{4}$ gr. down to $\frac{1}{8}$th, according to age of patient), even at the expense of running foul of that fetish, "masking the symptoms." You have already completed your diagnosis. If you intend to operate why have your patient suffer more than need be? If you wish to watch your patient till serious and grave symptoms arise, it is not on the absence of pain you are going to place reliance. In the case of a bursting appendix, absence of pain, even without the exhibition of

morphia, is doubtless an index of impending disaster, but it is on the other symptoms which are not affected by the drug that you are basing your treatment. Any sudden rise or fall in temperature is to be noted, and especially an increased rate of the pulse, more so if it be associated with a sudden drop in the temperature. Either such a condition, or a steady progressive rise of both together, would warn you that the waiting policy is ended. So that the reason commonly adduced against giving morphia, that it masks the symptoms, is not strong enough to exclude the use of a most helpful medicine.

If the case turns out to be one of the ordinary class, where by the fourth or fifth day the symptoms begin to subside, temperature coming down, pulse getting stronger and pain becoming less, there will also be a gradual return of appetite. For the next week or so the diet should be exclusively fluid; when the temperature has been normal for a few days the dietary may be increased, steamed fish, scrambled egg, custard, or such like being added.

For future guidance the patient should be carefully enjoined to watch against any errors of diet such as would cause intestinal disturbance of any kind. Simple, plain food and not too much of it, and at regular intervals, must be the regimen. And, above all, the state of the bowels must be carefully attended to. Daily movement should be secured, if necessary, by some slight aperient—cascara, liquorice or Gregory's powder, for example—but constipation must be avoided. It is well also to insist on the patient avoiding fatigue, exposure to wet or cold, or any condition generally

supposed to give rise to "chill." Many attacks of a recurrent nature are attributed to such conditions as above named.

With the above instructions given one can give no guarantee that another attack will not come, even if all the instructions are faithfully carried out. Accordingly, extirpation of the diseased organ should be strongly advised. It is the only safe procedure, and if undertaken when the patient is in ordinary fair health, in the hands of one familiar with surgical methods the operation is not regarded as by any means of a serious nature.

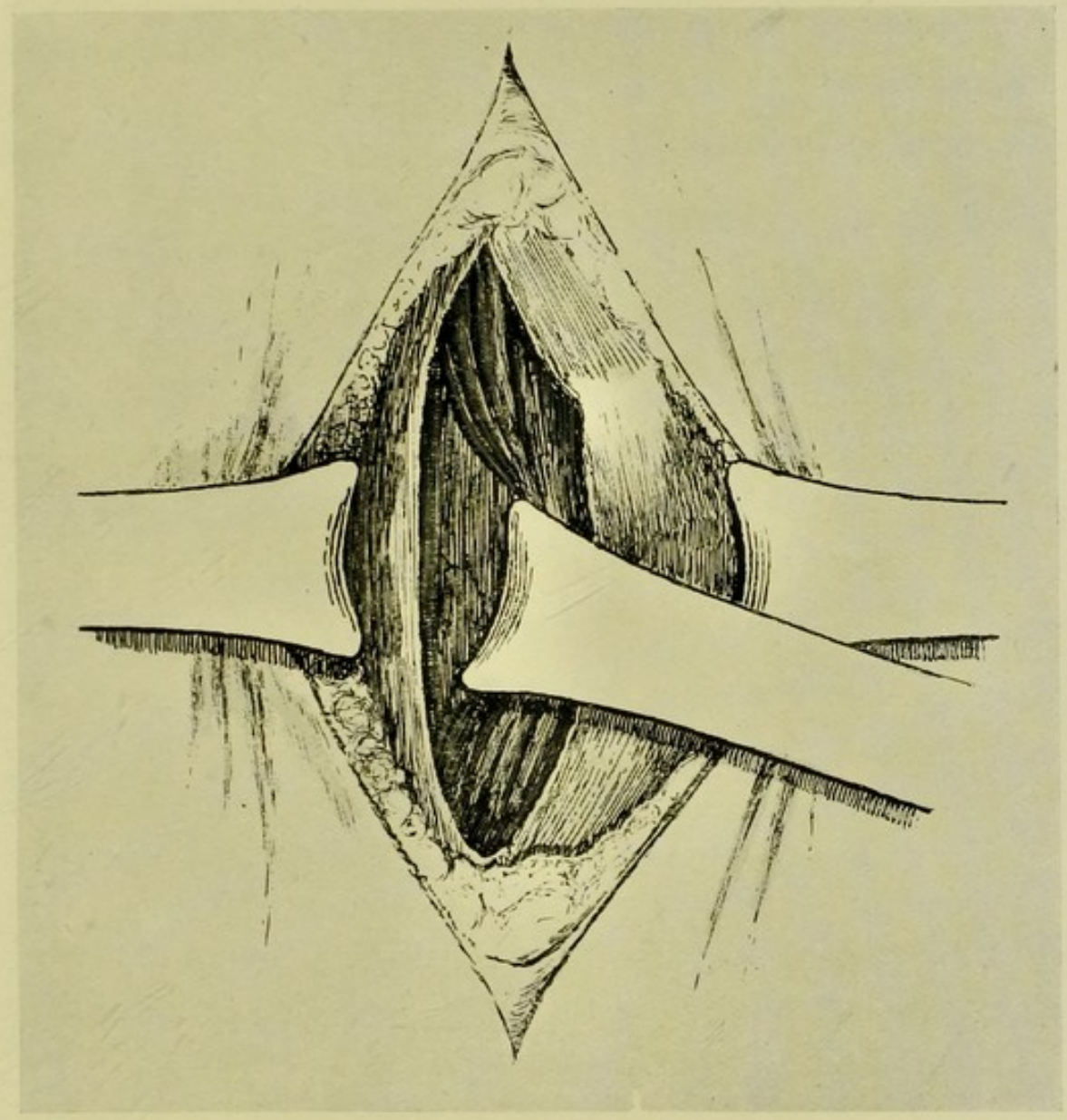
CHAPTER X.

TREATMENT (CONTINUED).

Operation may be undertaken during an attack of appendicitis or after the attack has passed off, and the parts are in a state of quiescence. In the former class of cases the preparation is often of a hurried character, because of the gravity of the patient's condition, and consists of shaving the abdominal wall, pubes, and well down the thighs, the parts having previously been scrubbed with soap and warm water with a nail-brush, dried, then washed with turpentine, dried with sterilised gauze, washed with methylated spirit, which is also rubbed off by means of dried swabs. A carbolic dressing, lint wrung out of carbolic solution, 1-20, is then put on the area of operation, gutta-percha tissue or jaconet over it, and the whole fixed by a sterile bandage. If the surgeon is not to be for some hours, or in the case of a young person, carbolic solution, 1-40, or even less, might be used. In these urgent operations any further preparation, as of the bowels, is not, as a rule, feasible. In quiescent cases a more extended stage of preparation is carried out.

Besides the local cleansing, which may be done on each of the two nights preceding the operation, a carbolic dressing (1-40) is kept on for 48 hours before operation, renewed each night. A fresh (1-20) dressing is applied an hour or two before operation. The patient has had his bowels freely moved by two successive doses of castor oil before the day of operation and an enema on the morning of the operation.

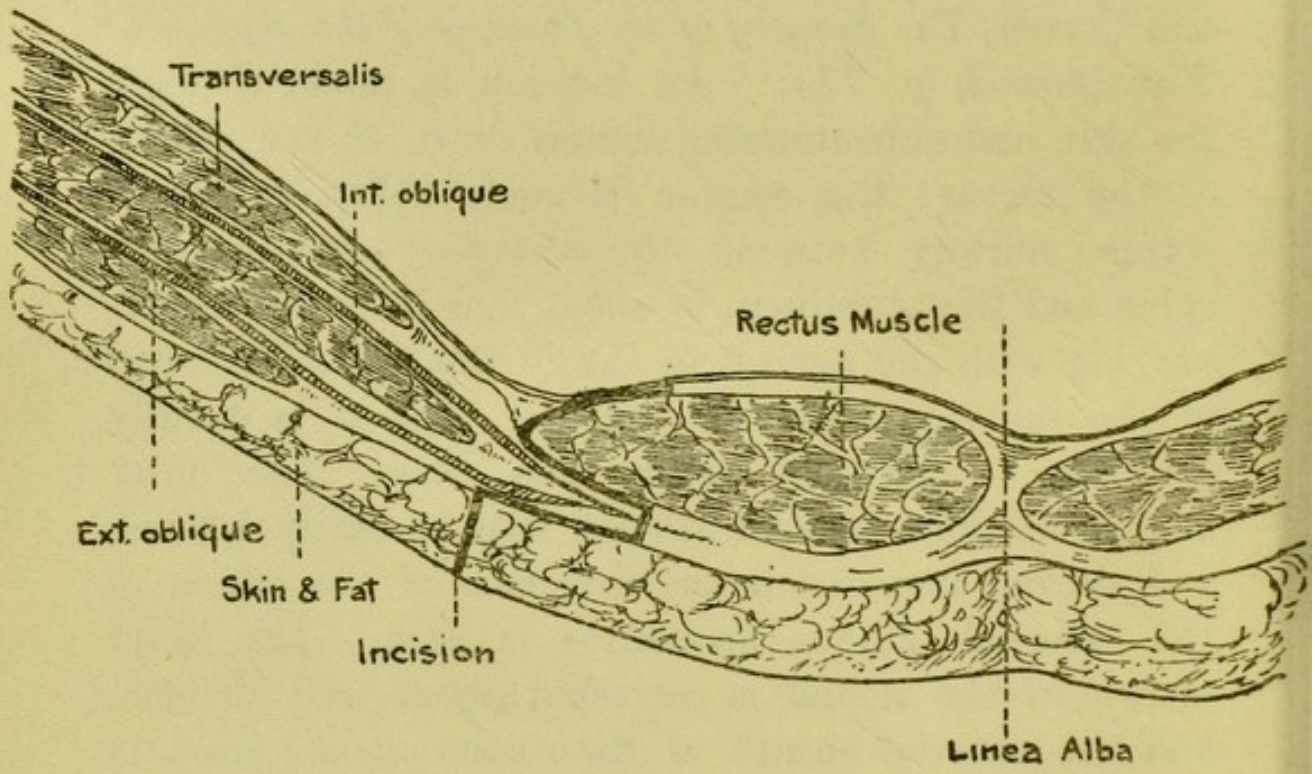
When the patient is in the theatre, which should be at a temperature of over 65° F., an assistant cuts off the bandage and removes the dressing as soon as the patient is well under the influence of the anaesthetic. He then gives a final washing to the area of operation, using again soap and water with the nail-brush, turpentine (some do not use this in the final cleansing), methylated spirit, and carbolic solution, drying off each solution before the next is applied. The cleansing of operator's, assistants', and nurses' hands is carried out in the same way in most cliniques, with little variations, according to the view of the surgeon. Washing in copious running warm water, with plenty of soap, and a free use of the nail-brush for a matter of ten minutes, is the first and possibly most important step in the measure. Then the hands may be steeped in either carbolic solution (1-20) or solution of perchloride of mercury for a few minutes (3), dried on a sterilised towel, and then rubbed freely with methylated spirit. A final dip in solution of carbolic (1-40) is indulged in by some. But there seems to be no fixed rule yet observed, except the copious and careful scrubbing with soap and water, paying especial attention to the crevices about the nails.



RECTUS MUSCLE EXPOSED AND RETRACTED: PERITONEUM SHOWN.

There is quite a variety in the operations that may be done, but those most commonly performed are the so-called "Gridiron" operation, with which M'Burney's name is associated, and Battle's operation. The latter is the method preferred by the writer, because it inflicts least damage on the muscular structures of the abdominal wall. Following is his description (Battle and Corner, *The Surgery of the Diseases of the Appendix Vermiformis*, p. 77): "An incision is made through the skin and subcutaneous tissues down to the sheath of the rectus: this section is made obliquely downwards midway between the anterior superior iliac spine and the umbilicus, is about four inches in length, varying with the deposit of fat in the abdominal wall of the individual, and is placed so that it is equally extended above and below this line. The outer margin of the rectus sheath can now be easily defined, and during inspiration the direction of the action of the external oblique aponeuros is seen. The inner margin of the wound is retracted about half an inch, and the anterior sheath of the rectus opened close to the retracted inner margin for the full extent of the excision. The rectus muscle is now drawn inwards, being separated from the outer part of the sheath with a few touches of the knife. Occasionally one of the lineae transversae requires to be separated from the sheath. Running across the posterior layer of the sheath can usually be seen the dorsal nerves, with accompanying vessels. The deep epigastric artery and vein run upwards under the retracted muscle to the inner side, and it is well to define these vessels, otherwise the vein may be punctured in the later suturing

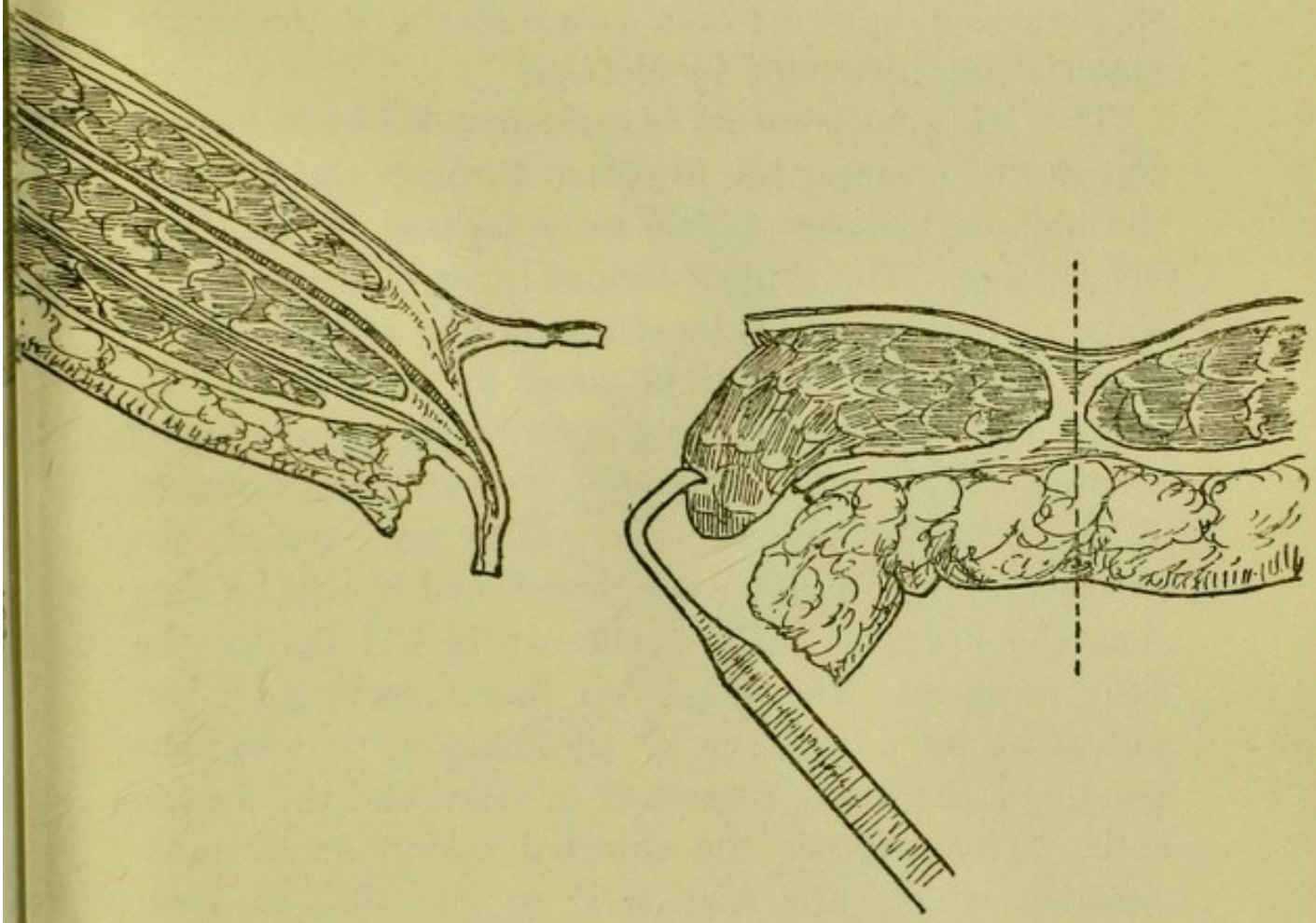
of the sheath. Another anatomical point of importance is the level of the transversalis fascia as regards the wound, for it strengthens the posterior layer of the sheath and makes the hold of the suture much firmer if the opening into the peritoneal cavity can be confined to the part covered by it. In most instances the incision can be made through the posterior sheath



CROSS-SECTION OF ABDOMINAL WALL SHOWING THE INCISION BY THE SIDE OF RECTUS MUSCLE AS IN BATTLE'S OPERATION.

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

the wound, both superficial and deep, can be extended to any required distance. After the appendix has been removed by the method which is considered best, and the peritoneum cleansed, the posterior layer of the sheath and peritoneum can be sutured in the

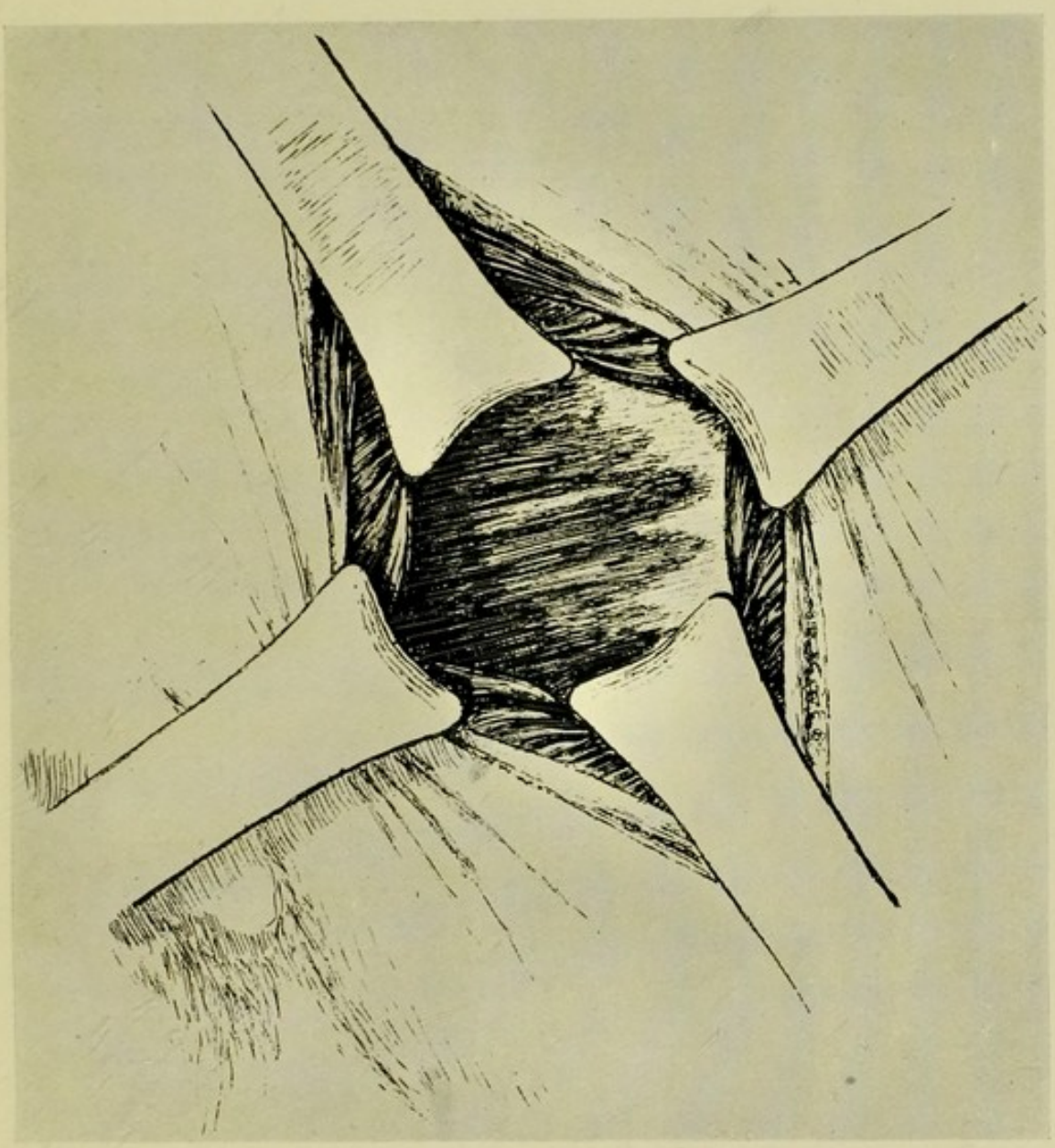


OPENING INTO ABDOMEN IN BATTLE'S OPERATION.

usual manner. . . . The uninjured rectus is now permitted to fall back into its usual bed; the anterior layer of the sheath is closed by three or six interrupted (·00) silk sutures, and the skin and superficial wound by a continuous horse-hair stitch. Union takes place throughout by first intention, and the horse-hair stitch is removed on the eighth day."

Excepting in the suturing material used, that is practically the most common procedure in appendectomy. Most surgeons suture the peritoneum and sheath with absorbable catgut sutures, and for the skin sutures salmon-gut is used. An attack of chloroform-sickness would put a rather severe strain on the suture material recommended by Battle.

The Gridiron operation as recommended by M'Burney consists of opening the abdomen through the fibres of the oblique muscles, which are separated by splitting, not cutting. The skin is divided by an oblique incision three or four inches in length according to the amount of abdominal fat, beginning about an inch and a half above and internal to the anterior superior spinous process of the ilium, and goes downwards and inwards. When skin and subcutaneous tissue are divided, the external oblique muscle is exposed, and it will be seen that the fibres of that muscle are in the line of the skin incision. The fibres of this muscle are then separated by a director or the fingers, or even the handle of the knife, retractors inserted and the muscle split. This exposes the internal oblique and transversalis, which are also split in the line of their fibres, a line very nearly perpendicular to that of the original incision. In separating the fibres, as little force as possible should be employed, so as to have the cleavage lines as clean as may be, and free from any ragged or jagged ends of torn muscle-fibre. The edges are then pulled apart by a pair of blunt retractors and the peritoneum is exposed. This membrane is pinched up by means of a pair of dissecting forceps and incised laterally, that is with the flat of

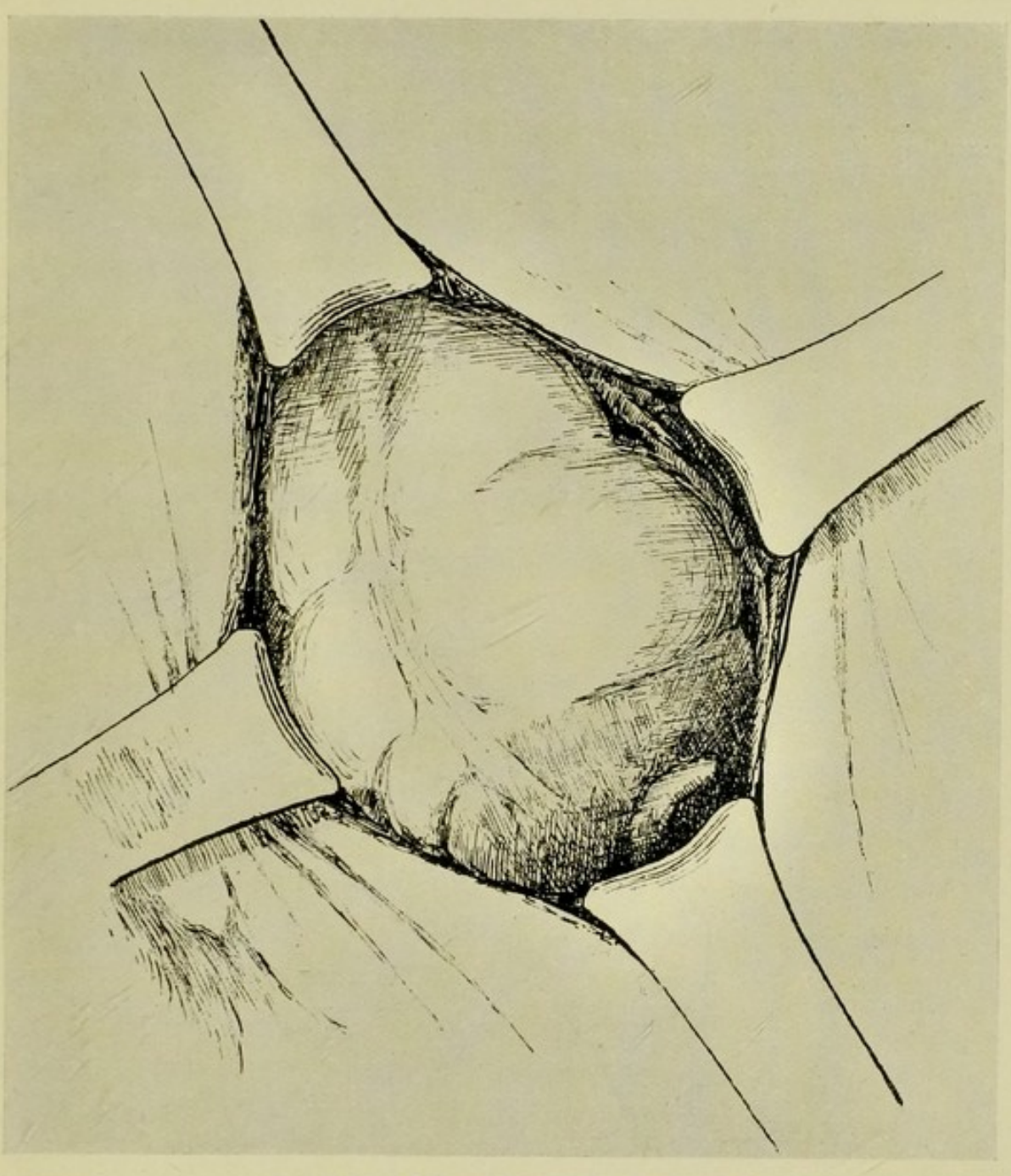


TRANSVERSALIS MUSCLE EXPOSED, THE OBLIQUE MUSCLES RETRACTED.

the blade parallel to the abdominal wall. When the peritoneum is opened a director may be inserted and an incision made on it, first upwards and then downwards, for a total distance of about two inches. Bleeding having been stopped by pressure forceps, retractors may be withdrawn, the edges of the peritoneum having been grasped by pressure forceps or sutured with a guiding suture of salmon-gut to be the more easily delimited and held apart. The finger is then inserted and the appendix searched for. In many cases it is easily recognised and withdrawn, especially if the attacks that have led to operation have affected the appendix alone and have not led to adhesion to the surrounding parts. If, however, as frequently happens, the appendix is not found at once, the caecum is the next thing to look for, and it usually is easily hooked into the wound by the operator's forefinger. It is recognised by the longitudinal bands which pucker the viscus, and always lead downwards to the base of the appendix. Having recognised the caecum, follow down the part by eye and finger till an irregular mass is felt. And this is not uncommon. This is the appendix, with adhesions binding it to the structures in the neighbourhood. The precautions to be observed here are, viz. separate the involved area in case the remains of an old abscess, or an unsuspected acute abscess, are present. This is best done by surrounding the suspected area with small squares of sterilised gauze. If the parts are firmly fixed grasp any portion of the appendix, base or apex, that you are sure of, and ligaturing it, proceed to free it from its adhesions. A good plan for freeing the

appendix, once you have got part of it, is with the finger tip, covered with gauze, to scrape the adhesions from the appendix, but do not exert force. Patience and care will enable you to free the buried organ. Where hemorrhage occurs use pressure forceps, and keep the operation area clean and dry. If, as frequently happens, the omentum is attached to the appendix in any part, it is safer to ligature the omentum near its attachment to the appendix in two places and cut between the ligatures. If any force has to be used, use it on the appendix, not on the parts that are to be left. Usually the tip of the appendix is the first part seized, and the stripping proceeds thence; but not infrequently the tip is buried among adhesions and cannot at first be reached. In such cases it is wise to seize the base of the appendix, ligature it in two places, cut between the ligatures, leaving the ends long, to facilitate future steps. If in the stripping process fluid pus is discovered it should be carefully wiped out, and, as the surrounding parts have been guarded, packing the cavity lightly will need to be done. But if there is found the dried remains of an abscess it is sufficient to wipe the debris out with antiseptic gauze, carefully. As this debris is sterile there is no need for packing or drainage.

Removal of the Appendix. When the appendix has been freed from its surroundings, it, with part of the caecum, is lifted from the abdominal cavity and separated from the tissues in the neighbourhood by layers of sterile gauze. The appendix may be removed in various ways. First, it may be ligatured close to the caecum by passing a threaded needle through the



CAECUM AND APPENDIX IN WOUND.

mesentery near its base, avoiding any visible blood-vessel. The double thread is cut at the needle, making two ligatures, which are separated a little and tied, and then the appendix is cut between them. Another ligature is passed through the same aperture, and similarly a double ligature is tied round the mesentery of the appendix and an incision made between. A single ligature may suffice next the caecum, and incision made distally to the ligature. But great care must be taken at this stage of cutting through the mesentery that no bleeding point is left unsecured. Several calamities in this simple operation have followed from hemorrhage from some small vessel left unsecured at this stage of the operation. When the appendix is separated the stump left shows two distinct coats, the outer or serous coat, which retracts, leaving the other, the musculo-mucous coat, a white, firm circular membrane, outstanding. The serous coat is stripped further from the protruding mucous and muscular layer, and with curved scissors this musculo-mucous portion is cut off, as much of it as will allow the serous coat to cover in its stump. Before covering in the stump it is customary to put a drop of pure carbolic acid from the end of a probe on the mucous stump, wiping the excess off in a short time. The serous covering is then brought over the antisepticised end, and sutured either with a few interrupted sutures or a short continuous catgut suture.

Or, the appendix having been freed and the mesentery ligatured, a strong crushing pair of forceps is applied to the appendix near its base, practically crushing and separating the coats underlying the serous

covering. A ligature is then applied on the caecal side of the blades of the compressor and the appendix cut off. The edges of the stump are then sewed together as in the "sleeve" operation.

Or, the appendix having been removed, a purse-string suture is passed out and in round the appendix-base as it spreads into the caecum. This suture is tightened, while the stump of the appendix is pushed into the caecal tissue in such a way that the suture brings serous surface in contact over the top of the buried stump.

Each method of treatment of the stump has its advocates. Whichever method you adopt, carry it out thoroughly and it will be successful. The less of the appendix that is left behind the better, as cases have occurred where a half-inch stump has been the seat of disease and necessitated a second operation.

All bleeding points having been secured, the closure of the wound is now to be effected. The peritoneum is repaired by a continuous suture of catgut or some absorbable material. In the gridiron operation it is claimed that the muscular fibres fall together when the retractors are withdrawn, as if they had never been separated. But it is well to suture the separated fibres. Finally the skin is sutured by several salmon-gut sutures, according to the length of the incision.

A sterile or antiseptic dressing is applied with gamgee tissue or wood-wool pad and a roller bandage or body-binder with bridles applied. In ten days the dressing may be renewed—even in seven days if there is any discomfort—and the alternate stitches removed. The remaining stitches, should all go well, may be

removed from fourteen to seventeen days after operation.

No more dressing than what has been indicated is necessary, but if the temperature rises, or there is pain and discomfort, or if staining appears, then there is necessity for looking at the wound in case anything has gone wrong.

Appendicular Abscess. In a small number of cases it is not possible, as the foregoing remarks indicate, to tell definitely that pus has formed. But in a considerable number, where you find a gradually increasing pulse and temperature, or where the temperature suddenly drops while the pulse goes quickly up, and the swelling and dulness on percussion still remain, you have a very shrewd notion that pus is present, and operation is definitely called for. This is the condition that the emergency surgeon of a general hospital is most frequently called on to treat. Little time is given for preparation, either general or local. The local treatment is all that is possible. The parts are shaved and carefully cleaned with soap and water, turpentine, and spirit of wine, and a dressing of lint wrung out of 1-20 carbolic solution applied till the surgeon comes, as stated above.

When the patient is anaesthetised the surgeon cuts down on the swelling, observing no rules about the muscular covering of the abscess. When he gets to the peritoneum this is cut through in the ordinary way by pinching up the peritoneum by means of dissecting forceps and cutting crosswise or on the flat. If, when the peritoneum is entered, pus flows out of the incision, good and well, but if not, or in any case, the

peritoneum is incised above and below the point of entrance. Should the pus have not escaped, careful search is made with the exploring finger gently moving over the parts, which are brought into view by a light near the abdomen. The finger naturally notes the normal structures and as easily finds the adhesions, which it breaks down, the operative area being surrounded by sterilised gauze. When the pus flows up by the side of the exploring finger it is carefully wiped away, while the finger enlarges the opening into the pus-cavity and explores its boundaries.

The pus is then clearly and carefully wiped out. If the cavity containing the pus goes well down to the lumbar region an additional incision may be made in the lumbar area, and a tube or a draining line of tissue drawn through. But if the cavity does not go far back it may be packed with a few pieces of sterilised gauze. The writer is in the habit of packing the cavity with gauze wrung out of carbolic solution (1-40). In any case the packing is not to be pushed in with force. For, after all, packing is put into wounds as a drain. The drainage is to be effected by capillary action. Too firm packing would interfere with this. No search should be made for the diseased appendix more than the most casual. If it is seen floating in the loose debris it may be seized and ligatured. But there must be no minute search made for it, for fear of tearing up the adhesions that delimit the cavity of the abscess. If the abscess cavity is large, then it would be well to dress the wound and renew the packing daily, but in a large number of cases it is found sufficient to dress the part

on alternate days. It is very noteworthy to observe how quickly the cavity contracts and becomes a healthy granulating wound. When the discharge has got to an irreducible minimum it is customary to bring the edges together by sutures, leaving only a comparatively small opening at the centre of the incision, through which drainage is secured. Some surgeons insert sutures at the time of operation, leaving the ends untied till the stage above referred to is reached.

Should there be more than one localised abscess separate incisions are made over the prominent parts, and the abscess-cavity treated as above.

It is well to state again that though an appendicular abscess is opened and dealt with as we have described, the diseased appendix is still left behind. In the earlier teaching we were told that the occurrence of an abscess meant the destruction of the appendix and that a recurrent abscess would not take place. But this is not so. A considerable minority do have further trouble, and appendectomy has to be done at a later stage. The best results will be obtained by the surgeon who insists on the removal of the appendix after the abscess has quite healed.

Diffuse Purulent Peritonitis. This perhaps best describes the later stage of appendicular abscess, when it has ceased to be a localised collection of pus. Such a condition as general peritonitis, where every part of the peritoneum is acutely inflamed, doubtless does occur. Happily, it is not at all frequent. When it does happen it bespeaks an excessive virulence on the part of the septic infection, and a minimum power

of resistance on the part of the tissues. The whole abdominal cavity has become infected before any part of it has had time to throw up the protective walls of lymph that help to limit the spread of the infection. The more common form of this extension of the disease that we meet is where there are many foci at different parts of the abdominal cavity, mainly in the lower half of the cavity without very definite lanes of continuity connecting them. In such a condition time has been given to allow the parts to make some effort to block the process of general infection. The intestines are everywhere deeply injected, and their surface is covered with little adherent pieces of lymph. The various coils of viscera are even bound together at parts: the intestines become paralysed and filled with gas and thus pressing on one another, everything tends to localisation of the infection. With such a large area in an acutely inflamed state there is, of course, a copious secretion of fibrino-purulent and fluid material.

Diagnosis. The outstanding sign of this condition is one that cannot be described, the appearance of the patient's face. The distress and anxiety of his look, the evident appearance of illness, the pinched nose, sunken eyes, greyish pallor of face, present a picture which once seen is never forgotten. Description is weak, but see it once and you can never forget it. Beyond this general look, you may find the pulse over 120; temperature may or may not correspond. The abdomen is tympanitic, tender to the touch all over, with an absence of the localised tenderness that marks the ordinary appendicular abscess. There is also dis-

tinct nausea and vomiting: the bowels are obstructed, though gas may be passed.

Where the peritoneal cavity suffers from general infection by pus, the operative measures are more severe, and somewhat different. The abdomen is opened by a median incision above and below the umbilicus as far as may be found necessary. The appendix must be sought for and removed, so as to get rid of the source of the poison. Copious lavage of the intestines with salt solution or boric solution must then be carried out until the solution runs pure. Very gentle handling of the intestines must be the rule, and no efforts should be made at stripping off the lymph that has coagulated on the serous wall of the viscera. These coagula are barriers thrown up by the tissues to limit absorption of the virus. Disembowelling the patient and washing and stripping the intestines is never done now. When the solution runs clear part of it may be sponged out, but it is well to leave a considerable portion of the warm antiseptic within the abdomen. Incisions should be made in both flanks, and short thick drainage tubes inserted. The median incision is then sutured, and dressings applied. There are few cases in operation where speed is a very desirable quality: speed is too often associated with slovenliness. But in this particular surgical calamity speed in working is pre-eminently desirable. The surgeon in all these cases is working on an excessively narrow margin of hope, and the time taken for operation may be the determining factor of safety or the reverse.

CHAPTER XI.

POST-OPERATIVE TREATMENT.

When the operation is completed there still remains the careful nursing of the patient, with attention to the wound, dieting, and the numberless details that go to the successful piloting of the case to safety. Firstly, let it be said, the credit to be gained by hustling the patient out of his bed prematurely for the purpose of breaking or keeping up some short-time record is by no means worth the risk the patient is bound to run. What is first to be watched for after operation is any sign of shock. In ordinary cases this is a negligible quantity, and needs no special treatment; but occasionally it occurs, and then it is to be met by the usual remedies, hot bottles round the patient, with sips of warm water or weak stimulant, while the foot of the bed is raised on blocks. Hypodermic injections of small doses of strychnine may also be given at two-hourly intervals till the returning strength of pulse and colour of face shows that the collapse is passing off. Chloroform-sickness in this operation may supervene as in others, and

calls for prompt treatment. In the mere act of sickness the wound should be firmly supported by nurse's hand while patient's head is turned to the side. If in a short time the vomiting does not cease, sips of warm water, bits of ice, not to be sucked but swallowed in the solid state, soda water or champagne in small amounts, may be tried in turn, with a sinapism over the stomach. Another early and common condition is pain: this is very frequently complained of, and is wisely met with by giving a hypodermic injection of morphia ($\frac{1}{6}$th or $\frac{1}{4}$ gr.) in adults. In children a few drops of Battley's solution may be given, the dose of course depending on the age of the patient. The pain should be treated in this way for not more than forty-eight hours after the operation, as by that time it is quite bearable, and continuing the sedatives longer does harm in retarding healing. It is hardly necessary to state that the patient must be kept absolutely quiet for a time and have no anxious friends or relatives in his room for three or four days at least. He is kept lying on his back with his knees slightly bent—a pillow beneath them affects this without any effort on his part—so as to relax the abdominal muscles. In strong healthy men who have just become patients straight from their everyday active work, we find frequent complaints of pain in the muscles of the back due to the prolonged and fixed dorsal position. A change of position occasionally on to the right side gives great relief; but care must be taken that the patient exerts no effort in changing the posture; he must be passive while nurse moves him round. A more distressing

symptom is the ballooning of the intestines, due to their filling with gas, causing the patient intense pain and discomfort of a choking kind. This is due to the partial paralysis of the bowel-muscle, owing to the change of posture and change of patient's habits, and is a most annoying condition to treat. Exhibition of carminatives, of small frequent doses of sulphate of magnesia, the use of a rectal tube, enemas, raising the patient's head, have all been tried with varying success. The intestines in time come back to their normal tone, and the distressing symptoms pass off.

When three or four days are gone, and the temperature is now normal (there is usually a slight reactionary rise in the course of the second day) the case rarely gives any further anxiety. The temperature remains normal, the pulse becomes steady, fuller and slower, the patient's face shows a placidity of aspect that notes that all's well. In the matter of the bladder's action occasionally the catheter is required on the evening of the operation-day, and perhaps night and morning for a day or two after; but this is exceptional. As to the bowel-action, surgeons differ, but the common rule is to have the bowels moved by castor-oil on the fifth or sixth day, and daily thereafter till the normal condition arrives. In "clean" cases—where the abdomen has been closed after operation—there is no call to dress the case for seven or eight days. Some allow of no redressing for three weeks, when the dressing is removed, and with it the parts of the absorbable sutures lying outside of the tissues, when the wound is found firmly cicatrised.

Which is very pretty and interesting from a quasi-scientific point of view, but it is not hygienic to allow the patient's skin to be bathed and his linen changed weekly, all but the square foot of skin in the operation-area. That part needs washing and changing every week just as much, if not more, for bare comfort's sake. And so weekly dressing is advocated. Some of the stitches may be removed at the first dressing, some at the second, and the remainder at the third dressing.

In cases where a drain-packing has been inserted, it is well to dress every second day for the first eight or ten days; when the granulations have formed, and the discharge is what would be expected from a simple granulating wound, then less frequent dressing would suffice.

Whenever there is a rise of temperature to over 100° F. after the third day, or where discharge comes through the dressing, or if the patient suffers pain or local discomfort, the wound must be exposed and examined. A stitch abscess may show itself, or the whole wound may be fiery and inflamed. If evidence of pus-formation in or near the wound exists, then free evacuation must be effected, even if the whole wound is opened up, cleaned out and packed.

It is mistaken economy to use a small dressing. It is well to cover a considerable area round the wound, covering abdomen, hip and thigh with gamgee cotton, and bandaging the whole carefully with roller bandages. The rollers are to be preferred to the body-binder, which is apt to ruck up even when bridled round the perinaeum. It is marvellous how a

restless patient can wriggle a dressing off the wound unless it is put on large and firmly bandaged.

In cases where there has been diffuse peritonitis, the head of the bed should be raised. The patient breathes more easily and the position is best for drainage.

The diet of the patient is an important item in the treatment. For the first day after the operation, until the stomach has overcome the chloroform and shock-effects of the operation, there is no call to give anything. If a mistake in this matter occurs, it is usually one of over-feeding. A day or two's abstinence from food will do no harm—quite the reverse. On the second day milk in small quantities may be given frequently, on subsequent days enlarging the quantities and lengthening the intervals till the sixth day or so, when the bowels have been moved. Custard may then be given, in a day or two pounded or steamed fish, beef soup, scrambled eggs, etc., may be gradually added to the dietary. Till the end of the third week it is best to confine the patient to white diet. After that ordinary food can be given quite freely, as by this time he is allowed to sit up for a little.

The early complications of this operation are, then, those symptoms associated with the anaesthetic, the shock, severe pain, extension of the inflammatory symptoms, and hemorrhage. The earlier on the list have already been referred to. If peritonitis extends there will be a corresponding rise of temperature, with thirst, distress, pain: the tenderness on pressure over the abdominal wall will also be greater, and there will be tympanitis. In short, the infection which at operation was local, has become extended and more general,

and the condition has become one of the forms of general peritonitis already referred to, the treatment of which has already been discussed. The inflammatory condition, however, may be still local as at the operation, but of a more intense kind, gangrene, *e.g.* the wound of operation having been infected by the virulent material from the abscess. Here treatment must be local and vigorous. The wound freely exposed, and its surface plied with strong antiseptic lotions frequently, carbolic solution (1-20), peroxide of hydrogen, mercury solutions, etc., till the dead and dying tissues are removed, and the wound assumes a healthy, granulating appearance.

Hemorrhage may occur from any of the vessels that have been severed in skin, connective tissue, muscular wall, omentum possibly, or from the vessels in the meso-appendix. It is well to make it a rule to keep the operative area always clean and dry; if each step of the procedure is carried out thoroughly, and every bleeding point secured this complication should not occur. Particularly in the deeper parts of the wound, most especially within the abdominal cavity every bleeding point should be ligatured. When hemorrhage does occur it is usually very insidious, as it is from a very minute vessel. For the first day or two the patient may only show that he is not comfortable: if the hemorrhage is within the cavity the otherwise unexplained gradual rise of temperature is perhaps the first definite symptom that gives the cue to what is wrong. There will be restlessness also, but unless the quantity of blood effused is very great, marked pallor and jactitation are not present:

and rarely is the quantity so large. But whatever amount is extravasated it soon becomes septic, and herein lies the great danger. Very soon it is possible by percussion, and a sense of resistance near the wound, to detect the presence of a mass that should not be there, and the indications are now plain. The wound must be opened up, the clot evacuated, the bleeding point if possible secured; if not visible do not put off time searching for it. It is safer to pack the wound and arrange for free drainage of the part, even by an additional incision in the flank, through which another packing drain or drainage tube should be inserted. The proneness of blood-clot under such conditions to become infected makes the careful surgeon view the case now as a septic wound—or one almost certain to become so. Should the source of the hemorrhage be more superficial, as in the wall-structures, evacuation of the clot, ligaturing the bleeding vessel and temporary packing would suffice.

There have been recorded some cases of copious hemorrhage from the bowel following on the operation of appendectomy by the purse-string suture method. As some of them occurred five or more days after operation, it is difficult to understand how oozing from the inverted stump could have been the cause of the bleeding. It has also happened in cases where crushing of the appendix was the method employed. It is possible that in some of these cases a vessel temporarily closed while without the abdomen, may re-open when restored to its normal position, and when the circulation becomes stronger in the reactionary period following operation.

The next group of possible sequelae are those which begin a week or more after the operation, and are due to re-formation of abscess in or near the original seat of mischief, onset of phlebitis embolism or ileus. The re-formation of an abscess, due to some of the pus from the original abscess having found a lodgment in some recess of the cavity, or migrated to somewhere in the near neighbourhood, would give a repetition of the signs and symptoms already discussed, and lead to the appropriate treatment. Thrombosis of one of the veins in the abdominal wall, or by pressure of the retractors on some of the branches of the common iliac vein, occurs now and again. This formation of a thrombus, if the patient is kept very quiet, may be the beginning and end of the matter; but if the thrombus gets loose, and is cast off into the venous stream, the next step is in all likelihood the formation of a hemorrhagic infarction in the lung. It would be out of place here to enter into a detailed account of the signs, symptoms, treatment, etc., of this condition, which is fully dealt with in medical text-books. Within a few weeks of operation the patient may suddenly show the symptoms of intestinal obstruction. It will usually be found that an inflammatory band in the neighbourhood of the appendix is compressing a loop of intestine, and causing the obstruction. Or this complication may be delayed for months, and be of the latest group of sequelae, in which we find sinuses, fistulae, and hernia.

The difference between the unhealed track, called a sinus, and a faecal fistula is that in the latter, whether faeces find their way out through the track or not,

there is a communication between the cutaneous surface of the abdomen and the mucous lining of the bowel. A sinus may be left after the operation, and is due to something septic at the bottom of the wound. It commonly is a necrotic portion of the appendix, which in time is discharged, and complete healing follows. It may also be due to a silk ligature that has been used at the time of operation, and becoming surcharged with septic matter remains as an irritant, keeping the sinus open till the ligature is got rid of. If a calculus is making its way through the unremoved appendix, until it has come away the sinus will persist. In the few such that have come to the writer's notice there was an unhealthy amount of vascular granulations round the mouth of the sinus, and a fairly copious, dark, faecal-smelling discharged. As another cause of persistence of the sinus the presence of such bodies as a piece of gauze, or pair of forceps, might be suggested.

Faecal fistulae result in such cases—clean cases—as have presented unusual difficulty in getting the appendix out of a dense mass of adhesions. As remarked before, where any force is to be used such force should be directed against the part to be removed, *i.e.* the appendix, not against the tissues to be left behind. When the appendix has been removed in such a case, the edges of adhesions that have been disturbed should be carefully reunited by suture after any bleeding points have been secured. When a faecal fistula has been established, it is not advisable to set about repairing the breach at once. Time and careful cleansing of the parts in many cases suffice to effect a

closure. If, however, after a fair trial of some weeks' duration the fistula still persists, operation must be tried. No hard and fast rules can be set down for this condition, but, generally speaking, after the parts have been carefully cleansed and the sinus plugged, the process consists of dissecting round the mouth of the sinus and downwards till the bowel is reached. Remove the thickened track of tissues flush with the bowel wall and suture the breach in the wall by two or three rows of catgut sutures. Some surgeons prefer to short-circuit the bowel, by cutting into the abdomen in the middle-line, performing an entero-colostomy, which does very well. It minimises the risk of septic infection. Faecal fistulae are more commonly met with in cases where abscess has formed. That is due to the destructive effect of the septic matter acting on the bowel wall; the mechanical effect of pressure of the abscess contents on the structures that form its wall is doubtless in part also a cause of the bowel giving way.

The common late sequel of operation, especially in abscess cases, is hernia. Where the abdominal muscles have been separated, and not, owing to the conditions of the case, brought together, the wound heals by granulation, and the scar consists of a greater or less surface of inelastic connective tissue. When the patient resumes work the want of elasticity in this scar shows, as time goes on, in its thinning and stretching, till a distinct hernia is formed. The thinning of the scar may go on till finally it gives way, and omentum or other contents of the abdomen may be extruded. When hernia has definitely formed it is

wise to obviate such a grave condition as has been mentioned by operation. The cicatrix is to be completely excised and the various muscular elements on both sides of the wound freely exposed and sutured together. In some cases at first sight it looks as if the tissues could not be approximated, but by freeing adhesions and applying plenty of soft catgut ligatures carefully it is wonderful how the gap can be closed bit by bit. A month's rest in bed should follow on this operation, and other two months of very quiet life, with the abdomen supported by a light, firm bandage over a pad, to protect the tender tissues, should be advised.

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