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GYNÆCOLOGY

FOR STUDENTS AND
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By T. W. EDEN, M.D., F.R.C.P., F.R.C.S.
AND
EARDLEY HOLLAND, M.D., F.R.C.P., F.R.C.S.

A MANUAL OF MIDWIFERY

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J. & A. CHURCHILL

GYNÆCOLOGY

FOR STUDENTS AND PRACTITIONERS

By

THOMAS WATTS EDEN

M.D., C.M.(Edin.), F.R.C.P.(Lond.), F.R.C.S.(Edin.)

Consulting Obstetric Physician, Charing Cross Hospital; Consulting Surgeon, Chelsea Hospital for Women; Consulting Physician, Queen Charlotte's Maternity Hospital; Examiner in Midwifery to the Universities of Cambridge and Edinburgh

AND

CUTHBERT LOCKYER

M.D., B.S., F.R.C.S., F.R.C.P.

Honorary Gynæcologist, National Hospital, Queen Square; Consulting Obstetric Physician, Charing Cross Hospital and Royal Northern Hospital; Consulting Surgeon, Samaritan Free Hospital for Women; Examiner to the Universities of Cambridge, Leeds, Birmingham, and to the Conjoint Board.

With 556 Illustrations and 32 Coloured Plates.

THIRD EDITION



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PREFACE

TO

THE THIRD EDITION

SINCE the publication of the Second Edition of this book a good deal of work has been done in every branch of the subject with which it deals. In the present edition we have endeavoured to embody this new work, and at the same time to pay due respect to the critics who drew attention to the increasing number of its pages. With the assistance of a slight increase in the size of the page we have been able to reduce the number of pages by one hundred and two; in addition, the number of Plates is increased by eight, and eighteen fresh illustrations have been added to the text. Recent researches on the anatomy of menstruation and of the corpus luteum have been given due prominence both in the text and by way of illustrations. The same may be said of Sampson's investigations, since confirmed by Bailey and others, into the nature of ovarian blood-cysts; a piece of research which has led to the addition of "endometrioma" to ovarian pathology and in consequence to a resetting of the chapter on that debatable subject Adenomyoma. In dealing with the treatment of uterine infections due regard has been paid to the work of Colebrook, Storer, Gordon and others. Addition has been made to the account of ovarian neoplasms, and as regards the origin of epithelial growths of the ovary in general we have again emphasised the important work of Goodall.

Under Displacements the previous account of the anatomy of the pelvic floor has been slightly modified.

On the clinical side of the book, room has been found for a short account of Diverticulitis. The chapter dealing with cancer of the cervix has been completely revised and brought up to date. The Methods of Examination now include an account of Tubal Insufflation. The method of employment of Diathermy and its uses are discussed in connection with the treatment of chronic cervicitis of gonorrhœal origin.

In the operative section, Myomectomy has been described afresh and illustrated anew. Ventrisuspension has been similarly dealt with, whilst a few modifications have been made in the account of the extended abdominal operation of Wertheim.

We desire once more to express our thanks to the artists, Mr. Thornton Shiells and Mr. J. R. Ford, for their valuable aid.

THOMAS WATTS EDEN.
CUTHBERT H. J. LOCKYER.

PREFACE

TO

THE FIRST EDITION

In writing this book the object of the Authors has been to set forth a comprehensive account of the special diseases of women, and to keep an even balance between the pathological and clinical aspects of the work. This balance, at all times difficult to maintain, is, we believe, reached more easily by collaboration between two writers than by the hand of one alone. While it should satisfy the requirements of medical students of all classes, we believe that it will also assist the practitioner to elucidate and to deal with his difficult gynæcological cases.

Thanks to the generosity of our Publishers we have been able to illustrate fully all important pathological conditions, both in their naked-eye and microscopical features. With very few exceptions these illustrations have been prepared from material in our own collections, and most of the originals are to be seen in the Lockyer Collection in the museum of the Charing Cross Hospital Medical School. Use has also been made of a certain number of the illustrations which appeared in a former work on "Gynæcology" written by the senior author.

Coloured plates have been freely used where the presentation of colour was necessary for clearness of teaching.

With regard to the pathology of Chronic Endometritis and the results of Chronic Ovarian Inflammation, certain new views are advanced which may encounter criticism. We are ourselves convinced of their accuracy, and we believe that, when accepted, they will simplify and elucidate subjects upon which considerable confusion had hitherto prevailed.

The scope of the work is somewhat wider than that usually allotted to Gynæcology. Thus Appendicitis is included in the section dealing with Pelvic Infections, for reasons which are set forth in the text and need not be repeated here. Again, the results of Obstetric Infection are dealt with more fully than is usual, and in our opinion this is necessitated by the fact that such conditions so frequently come under the care of the gynæcologist. A practical knowledge of Obstetrics forms an essential part of the training of a

gynæcologist on account of the numerous points at which they overlap, and there is no doubt that Gynæcology has suffered in the past from the incursions of those who are not qualified by training to understand its clinical problems aright.

The classification which we have adopted will, we believe, be found to be convenient clinically, and to promote clearness in teaching. Pathological classifications we rejected because they involve to a greater or less extent the disassociation of conditions which are in close clinical relation. We therefore decided to apply the old Surgical Classification and speak of General Gynæcology, Regional Gynæcology, and Operative Gynæcology. Under these main divisions anatomical subdivisions have been adopted as far as practicable. The first division includes Anatomy and Physiology, Methods of Examination, Prominent Symptoms, Disorders of Development and Function, and Pelvic Infections We believe it is not inappropriate to speak of these subjects as comprising the *general* aspect of Gynæcology.

The Operatic Section could not be made to embrace a full consideration of technical details without exceeding the space within which we desired to work. Operating cannot be learned from books, and we believe that the section will be a sufficient guide for those readers who are accustomed to the general routine of modern surgical work.

To Messrs. Macmillan the Authors tender their grateful thanks for generously allowing them to borrow from the ' New System of Gynæcology,' in advance of its appearance, a considerable number of illustrations including coloured plates.

THOMAS WATTS EDEN.
CUTHBERT H. J. LOCKYER.

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GYNÆCOLOGY

PART I

GENERAL GYNÆCOLOGY

PART I: SECTION I

ANATOMY AND PHYSIOLOGY: DEVELOPMENT: PUBERTY: MENSTRUATION AND THE MENOPAUSE

THE ANATOMY AND PHYSIOLOGY OF THE FEMALE GENITAL ORGANS

GENERAL ANATOMY OF THE FEMALE PELVIC CAVITY

THE true pelvic cavity forms the lowest part of the general abdominal or peritoneal cavity, and is limited above by the brim of the pelvis, below by the pelvic diaphragm. Within this cavity and invested more or less completely by the peritoneum, lie the bladder, the uterus, the Fallopian tubes, the ovaries, and the upper part of the rectum; the lowest part of the great or gastro-colic omentum, some coils of the ileum, and a loop of the pelvic colon also form part of its normal contents. It is further to be borne in mind that in a large proportion of cases the vermiform appendix overhangs the pelvic brim, and lies in close relation to the right ovary and to the outer part of the right Fallopian tube. Piercing the pelvic diaphragm to open upon the perineum are the urethra, the vagina, and the rectal ampulla with the anal canal; these parts lie below the level of the peritoneal reflection, and represent respectively the urinary, genital, and intestinal tracts. A mesial sagittal section through the normal pelvis shows the general relations of the more important organs to one another (Figs. 1 and 2). Immediately behind the pubes lies the bladder, separated from the bone by a little loose and very vascular connective tissue. The urethra appears as a narrow channel which runs in its upper one-third directly downwards, and in its lower two-thirds curves downwards and forwards to end at the meatus urinarius. Behind the bladder lies the uterus; these organs are separated from one another by a reflection of the peritoneum, but below the level of this reflection they are united, over a small area, by cellular tissue. The vagina runs downwards and forwards to end at the vulva; it is united by a variable amount of cellular tissue to the bladder and urethra in front, and to the anterior rectal wall behind. The lower third of the anterior vaginal wall is firmly welded to the posterior urethral wall, making the separation of these structures difficult. Planes of cellular tissue allow of the easy separation by dissection of the structures which they unite to one another; in positions where no cellular tissue is found, separation of the contiguous

organs is more difficult and more likely to be attended by injury to the parts dealt with.

Behind the uterus lies a large peritoneal space which in Figure 3 has been cleared of its contents—omentum, small intestine, and pelvic colon. This space extends backwards to the anterior surface of the sacrum and is in relation inferiorly with the rectum. Placed between the rectum and the

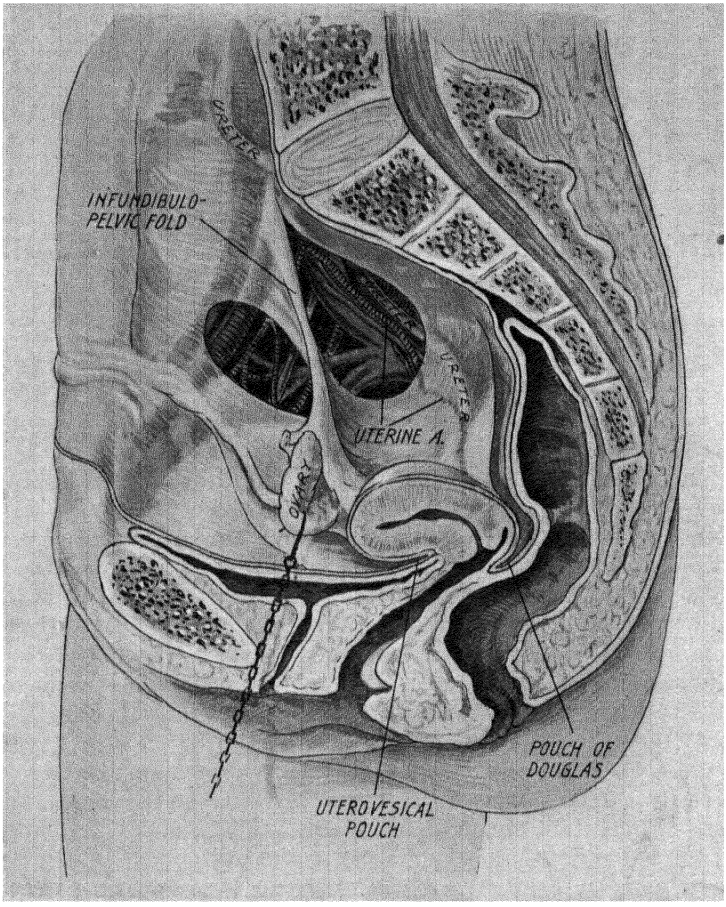


FIG. 1. MESIAL SAGITTAL SECTION THROUGH THE PELVIS OF AN ADULT NULLIPARA (Poirier).

utero-vaginal junction in the lowest part of the floor of this space, is a deep peritoneal fossa which anatomists call the *pouch of Douglas.*

THE MUSCULATURE OF THE PELVIC FLOOR

To avoid repetition, the detailed account of the anatomy of the pelvic floor, including the muscles, will be considered along with the supports of the uterus, cervix, and vagina in the section devoted to "Displacements" (*see* pp. 507 to 510).

THE PELVIC PERITONEUM AND CELLULAR TISSUE

Peritoneum.—In a mesial sagittal section (*see* Figs. 1 and 2) the peritoneum may be traced from the anterior abdominal wall to the spinal column. In Figure 2 the bladder is nearly empty and is seen to lie entirely below the level of the pelvic brim; the peritoneum is seen coming first into relation with the back of the symphysis pubis, and then, rising gently, is reflected

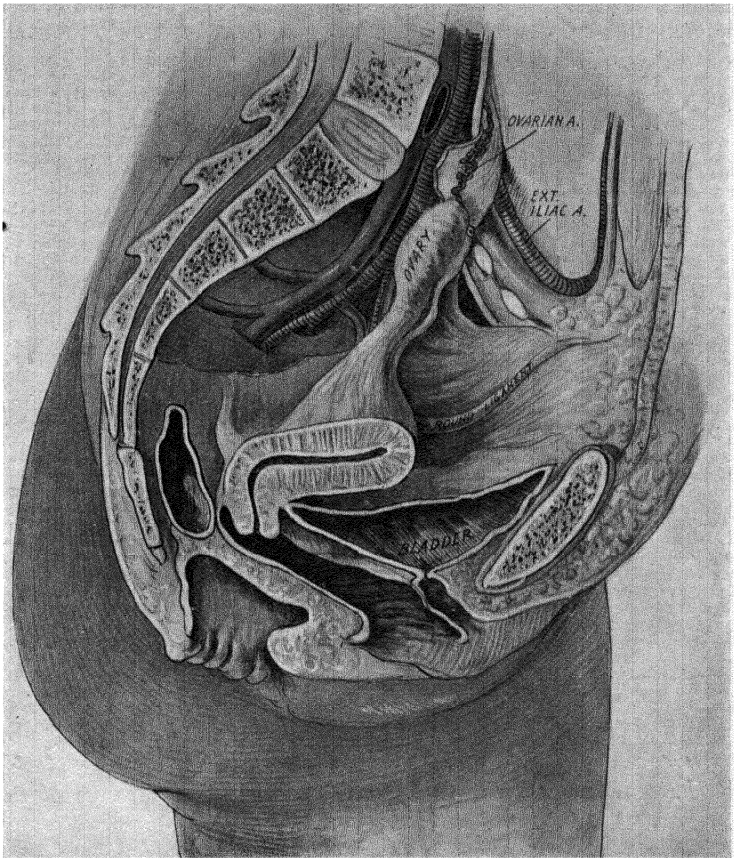


FIG. 2. MESIAL SAGITTAL SECTION THROUGH THE PELVIS OF AN ADULT PAROUS WOMAN (Poirier). Signs of parity are seen in (*a*) the capacious vagina, (*b*) the enlarged ostium vaginæ, (*c*) the laceration of the anterior part of the perineal body.

over the slightly curved fundus of the bladder to a point where the latter comes in contact with the anterior uterine wall. The peritoneum is separated from the bladder wall by a loose layer of connective tissue of considerable thickness, an arrangement which allows marked alterations to occur in the peritoneal relations of this organ when it becomes distended, and consequently rises upwards into the abdominal cavity proper. By the reflection of the peritoneum from the fundus of the bladder upon the uterus a peritoneal fossa or pouch is formed called the *utero-vesical* pouch; when the

bladder is completely empty this pouch is wide but shallow; when the bladder becomes distended the pouch is made narrow but deep.

From the floor of the utero-vesical pouch the peritoneum passes upon the anterior uterine wall, and may be traced over the top of this organ and down its posterior wall to the floor of the pouch of Douglas, which forms the lowest point in the body at which peritoneum is met with. Before reaching this level the peritoneum leaves the uterus, and comes into relation with the upper ½ inch of the posterior vaginal wall, a considerable layer of connective tissue lying between them. To the wall of the uterus the peritoneum is closely united, no cellular tissue being found between them except over a small area of the anterior wall (*see* p. 21). From the floor of the pouch of Douglas the peritoneum is reflected upon the rectum investing first the anterior wall

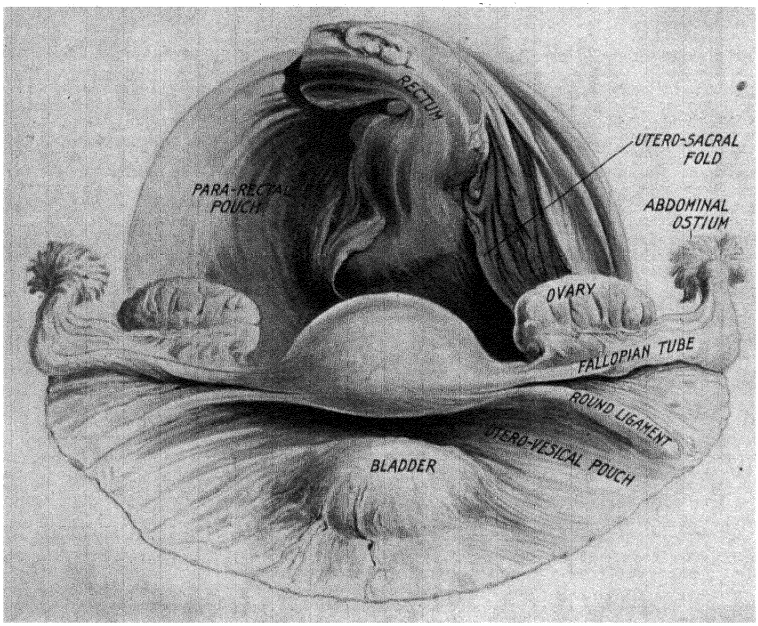


FIG. 3. THE PELVIC ORGANS SEEN FROM ABOVE; FROM A DISSECTION (Charing Cross Hospital Museum).

only, and higher up the anterior and both lateral walls; at the level of the third sacral vertebra in the middle line it is reflected from the rectum upon the anterior surface of the sacrum, and passing upwards over the sacral promontory becomes continuous with the peritoneum covering the posterior abdominal wall. Over the whole of this area a considerable layer of cellular tissue is found beneath the peritoneum.

Examination of the pelvic organs from above (Fig. 3) shows that the pelvic cavity is roughly divided into an anterior and a posterior compartment by the uterus and certain structures directly attached to it, viz. the broad ligaments with the Fallopian tubes and ovaries, and the infundibulo-pelvic folds. These structures together form a curved transverse septum, slightly convex in front, slightly concave behind. The peritoneum covering the floor of the *anterior compartment* may be traced transversely from the

pelvic brim over the lateral part of the pelvic wall to the side of the bladder, and over this organ to the pelvic wall and pelvic brim of the opposite side. Across the top of the bladder it forms a loose transverse fold known as the *transverse vesical fold* (*see* Fig. 3) ; external to the bladder the round ligament of the uterus crosses the floor of this compartment diagonally beneath the peritoneum to reach the internal abdominal ring. In the middle line the floor of this compartment corresponds with the utero-vesical pouch already mentioned. This pouch is sometimes bounded laterally by two antero-posterior peritoneal folds running from the sides of the uterus to the sides of

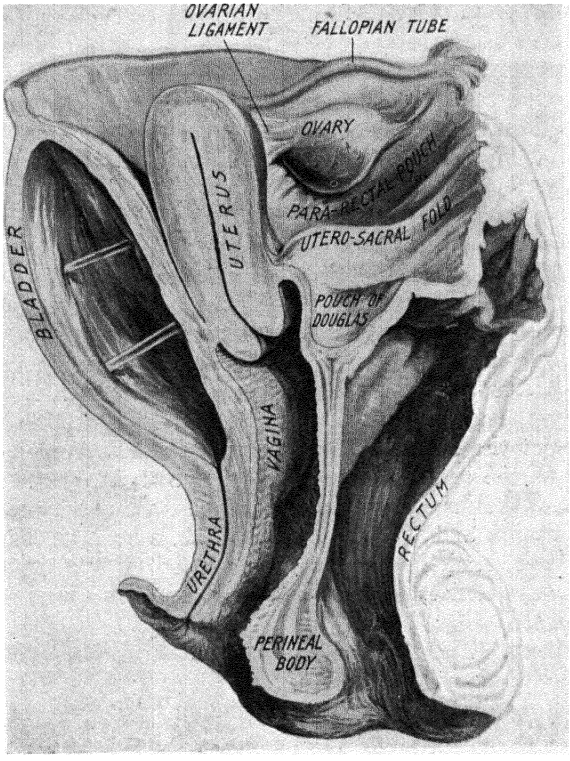


FIG. 4. THE PELVIC ORGANS ; FROM A DISSECTION (Charing Cross Hospital Museum). The pelvic contents have been divided in mesial sagittal section. Note the change of position of the uterus due to distension of the bladder.

the bladder, and called the *utero-vesical ligaments ;* they are, however, feebly developed and inconstant, and can seldom if ever be recognized during operative work. The utero-vesical pouch in normal conditions is only a potential space, for uterus and bladder lie in contact with one another. When the bladder is moderately distended a pair of shallow lateral fossæ may be observed, one on each side of the bladder, named the *lateral vesical pouches* or *para-vesical fossæ.* They are roughly divided into anterior and posterior segments by the round ligaments of the uterus.

The *posterior compartment* is much larger and deeper than the anterior (*see* Figs. 3, 4, and 19) ; in clinical usage this compartment is called the pouch

of Douglas, although by the anatomist this name is reserved for the deep peritoneal fossa between the rectum and the cervico-vaginal junction. The peritoneal floor of this compartment may be traced transversely from the pelvic brim down the lateral pelvic wall to the line of origin of the pelvic diaphragm, and thence over the sloping pelvic diaphragm to the right utero-sacral ligament, clearly discernible as a well-defined fold or ridge running backwards and outwards from the uterus to the sacrum (*see* Figs. 4 and 19). Over this fold the peritoneum dips nearly vertically downwards to form the anatomical pouch of Douglas, ascends the opposite side to reach the left utero-sacral ligament, and so over the pelvic diaphragm to the opposite lateral pelvic wall and pelvic brim. The peritoneum which covers the anterior surface of the sacrum is reflected over the sides and anterior surface of the rectum, but does not form a complete mesentery ; at the level of the pouch of Douglas the anterior surface only of the rectum has a peritoneal covering.

The posterior compartment is divided by the utero-sacral folds into three fossae—the anatomical pouch of Douglas, and the right and left *para-rectal fossae* (*see* Figs. 3 and 4). The right para-rectal fossa is much more capacious than the left in consequence of the latter being largely filled up by the pelvic colon and the upper part of the rectum. The mesentery of the pelvic colon has an oblique attachment to the posterior wall of the left para-rectal fossa. Each para-rectal fossa is bounded in front by the posterior surface of the broad ligament, to which is attached the ovary (*see* Figs. 3, 4, and 19). The depth of the pouch of Douglas is variable ; its anterior wall usually corresponds to the upper $\frac{1}{2}$ to $\frac{3}{4}$ inch of the posterior vaginal wall, and its floor is situated about $2\frac{1}{2}$ inches above the anus. Its upper limits are formed by the utero-sacral ligaments, which when strongly developed slightly constrict the entrance to it. Owing to the divergent direction of these ligaments the entrance is wider behind than in front. It is obvious that the floor of the pouch of Douglas may be reached with the finger both through the vagina and the rectum, a much larger area being accessible through the latter canal than through the former (*see* Fig. 4). Under pathological conditions the size, position, and relations of this fossa are capable of wide alterations.

Cellular Tissue. The pelvic cellular tissue is continuous with the subperitoneal cellular tissue of the abdominal cavity ; comparatively thin in the upper part of the pelvis, it is most abundant in the pelvic floor, where it fills up all the intervals between the viscera, and forms the supporting medium for the large number of vessels, nerves, and lymphatics which pass to and from them. Anteriorly the pelvic cellular tissue is continuous with the subperitoneal cellular tissue of the anterior abdominal wall, laterally with that of the iliac fossa ; it communicates with the extra-pelvic cellular tissue through the obturator and sacro-sciatic foramina ; investing the round ligament it is connected, through the inguinal canal, with the subcutaneous fat of the labium majus, and through the mesentery of the pelvic colon it becomes continuous with the cellular tissue of the general abdominal cavity. It also surrounds the ureters, and through these it is connected with the fatty capsule of the kidney. Numerous lymphatic glands lie embedded in it, but these will be referred to more fully later on.

The cellular tissue is most abundant in relation to the cervix, where it forms the *parametrium* of Virchow ; on both sides, and in relation to the bladder, large masses of cellular tissue are found ; posteriorly between the

cervix and the pouch of Douglas it is less abundant. The anterior and posterior surfaces of the uterine body have no cellular-tissue covering, the peritoneum resting upon the muscular layer.

The general distribution and relations will be followed in Fig. 5, from which it appears that the cellular tissue is located mainly in relation to the posterior pelvic compartment. Around the bladder only a thin layer is found, but at the sides of the uterus it is abundant, forming a thick lateral wedge of tissue interposed between the bladder and the sacro-sciatic notches. From this position the cellular tissue may be traced backwards to the anterior surface of the sacrum, which receives a thick covering, the rectum being completely surrounded. Anteriorly the cellular tissue is most abundant

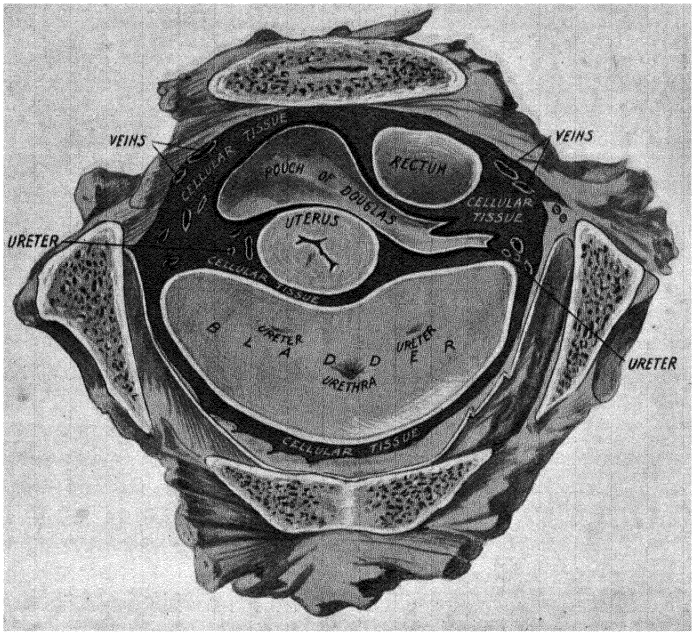


FIG. 5. HORIZONTAL SECTION THROUGH THE PELVIS TO SHOW THE CELLULAR TISSUE. It also shows the relation of the openings of the ureter and the urethra at the trigone of the bladder. (Martin.)

between the bladder and the posterior surface of the pubes. Embedded in the lateral masses of cellular tissue lie the ureters with the uterine arteries and veins, and the large veins of the pampiniform plexus.

The pelvic cellular tissue is for the most part a loose non-resistant structure, but in certain directions it becomes condensed into strong fibrous tissue. This occurs chiefly in relation to the large venous plexuses and arteries, where it forms well-defined perivascular sheaths. Both arteries and veins are connected up with the internal iliac vessels on the one hand, and with the viscera lying in the floor of the pelvis on the other. The perivascular sheath thus becomes an important element in supporting the uterus and the other pelvic organs in their normal position (*see also* pp. 507 to 510).

The pelvic course of the ureter lies entirely in the cellular-tissue planes

and may be traced from the sacro-iliac synchondrosis, which it reaches in company with the ovarian artery, down the lateral pelvic wall to the broad ligament; here it runs at a deep level in close relation to the posterior layer of that ligament up to the posterior vaginal wall. Thence it passes to the base of the bladder in close relation to the cervico-vaginal attachment. It is enveloped in cellular tissue throughout, and carries its own nutritive vessels. The uterine vessels cross it obliquely in passing from without inwards to reach the cervix at about the level of the internal os, the artery being placed above the ureter (*see* Fig. 18, p. 24). One or two small lymphatic glands, which may be found enlarged in operations for cancer of the cervix, are also present in the base of the broad ligament.

Surgical Anatomy. The pelvic peritoneal cavity may be reached from below, either through the utero-vesical pouch, or through the pouch of Douglas, by a vaginal incision. In opening the former (anterior colpotomy) the first structure to be cut is the anterior vaginal wall; then by blunt dissection through the cellular tissue lying between the bladder and the cervix the former organ is displaced and the floor of the utero-vesical pouch may be seized with forceps and divided. It will be borne in mind that in thus displacing the base of the bladder upwards, the ureters which pierce it will also be carried to a higher level, whereby injury to them may be more easily avoided. In opening the pouch of Douglas (posterior colpotomy), after the vaginal wall has been divided, a layer of cellular tissue of very variable thickness is encountered, and must be separated by blunt dissection in order to reach the peritoneum. No important viscus is here endangered (*see* Fig. 4). In a multipara the peritoneum is more easily reached both in front and behind than in a nullipara, owing to the stretching which results from pregnancy and labour.

Under pathological conditions the relations of the anterior and posterior peritoneal pouches may undergo great alteration. Thus in prolapse, the floors of the utero-vesical pouch and the pouch of Douglas may lie outside the vulva (*see* Fig. 334, p. 532); a tumour lying in the pouch of Douglas may depress it almost to the level of the anus, and at the same time displace the uterus forwards towards the pubes. An effusion in one of the lateral masses of cellular tissue will displace the uterus to the opposite side. Inflammation in any part of the pelvic cellular tissue may pass, by direct continuity, all round the pelvic cavity, and also extend to the anterior abdominal wall, to the iliac fossa, to the retroperitoneal abdominal cellular tissue, and so up to the kidney (*see* Fig. 146, p. 229) and to the diaphragm; or it may pass through the sacro-sciatic foramen into the buttock, or through the obturator foramen to the front of the thigh. Collections of pus in the pelvis may also be evacuated spontaneously into any of the hollow pelvic viscera, viz. the bladder, the vagina, or the large intestine.

THE UTERUS

General Anatomy and Relations. When isolated from its attachments the uterus is seen to be a pyriform or pear-shaped organ consisting of an upper broad and a lower narrow portion. The lower portion is called the *cervix;* the upper portion, the *body*. The junction of the two is indicated upon the outer surface by a slight constriction known as the *isthmus*. The cervix is cylindrical in shape and measures about 1 inch in length. The body is broader above than below and its transverse exceeds its antero-posterior

measurement. The broad upper extremity is convex, markedly so in the sagittal plane, slightly in the coronal plane. The greatest transverse diameter of the body lies a little below the top of the uterus, and the part above this diameter is distinguished as the *fundus*. The curved outline of this part of the uterus, broad from side to side, is characteristic and is clearly recognizable by palpation on clinical examination. At the extremities of the greatest transverse diameter the Fallopian tubes join the body. This point is known as the *cornu* or *angle* of the uterus. Besides the Fallopian tubes two other structures are attached to the uterine cornua, viz. the round ligaments and the ovarian ligaments. These three structures are not in the same plane but are arranged from above downwards in the order—tube, round ligament, ovarian ligament; and from before backwards in the order—round ligament, Fallopian tube, ovarian ligament (*see* Fig. 22). In a nulliparous woman the anterior surface of the body is flat, the posterior distinctly convex. In women who have borne children, both are convex.

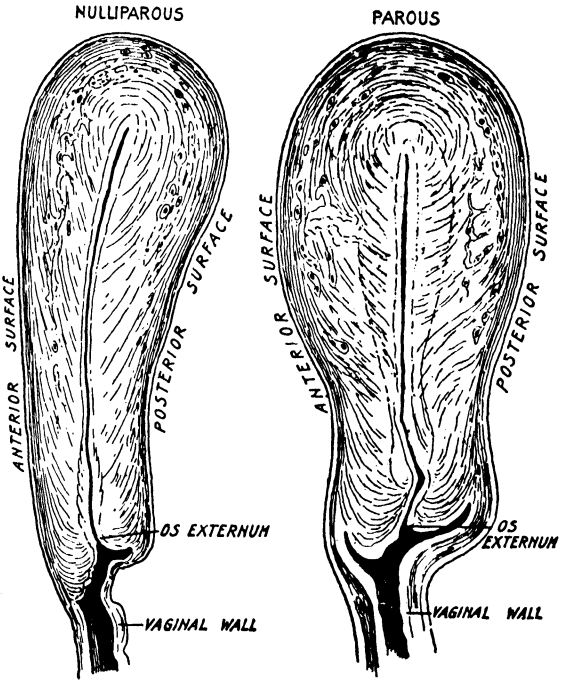


FIG. 6. THE UTERUS IN SAGITTAL SECTION; post-mortem specimens.

Externally the uterine body is covered with peritoneum (*vide infra*). In its interior is a potential cavity lined with a mucous membrane, the *endometrium*. The cavity contains only a small amount of secretion produced by the mucous membrane. During menstruation, however, blood accumulates in it, while in pregnancy and in certain morbid conditions it increases greatly in size.

The uterine cavity communicates below with the vagina through an aperture in the cervix, called the *os externum*. Above it is continuous with the lumina of the Fallopian tubes, and through these channels the uterus communicates with the peritoneal sac. The genital tract—Fallopian tubes, uterus and vagina—constitutes a continuous canal which forms a direct channel of communication between the surface of the body and the pelvic peritoneal cavity, an anatomical arrangement which accounts for the frequency with which infection of the pelvic peritoneum from without occurs in women. ~~In men~~, such infection is, relatively speaking, of rare occurrence.

The cervix is divided for descriptive purposes into two parts; the lower part projects into the vagina and is called the *portio vaginalis*, the upper part

lies above the cervico-vaginal attachment and is called the *supra-vaginal cervix*. The cervix is approximately cylindrical in shape and through its centre runs the cervical canal, a narrow channel with flattened walls, which communicates above with the body-cavity through the *os internum*, and opens below into the vagina through the external os. In a nullipara the vaginal portion or the *portio*, as it is commonly called, is shaped like an inverted cone upon the apex of which is the os externum, forming a circular or transverse aperture. After child-birth the external os is a long, more or less patulous, transverse slit (*see* Pl. XVc., p. 366), and often the *portio* is greatly modified in size and shape by laceration and certain resultant changes. The external os may then present one or more deep lateral clefts (*see* Figs. 317 and 318, p. 505), or from more numerous tears it may be cut up into several segments of unequal size and shape. Over the surface of the *portio* the vaginal mucosa is reflected and is firmly attached to the cervical tissues. The epithelial cover-

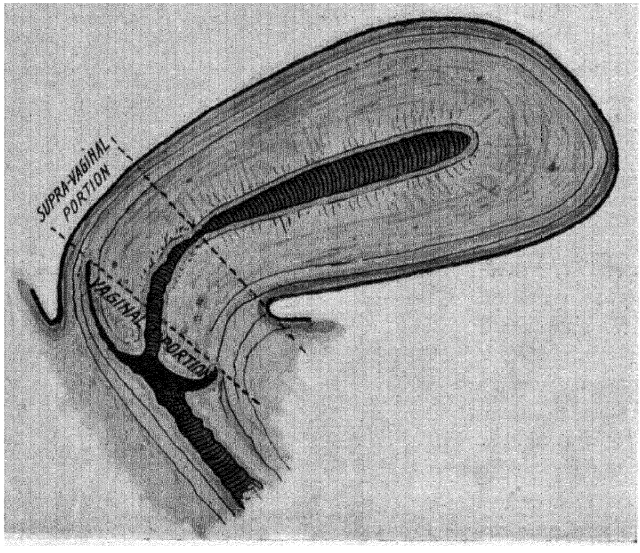


FIG. 7. THE DIVISIONS OF THE CERVIX (diagrammatic).

ing of this part of the cervix is therefore the same as that of the vaginal walls. In front the cervix is united to the bladder by a layer of loose cellular tissue. At the sides it is in contact with the lateral masses of the pelvic cellular tissue.

In a nulliparous woman the length of the whole uterus from fundus to os externum is 3 inches, while the length of the cavity is $2\frac{1}{2}$ inches. In a woman who has borne several children these measurements are usually exceeded by $\frac{1}{2}$ inch or more. The length of the cervix is about 1 inch. The uterine wall is thickest at the fundus and thinnest where the cervix joins the body, varying from $\frac{1}{2}$ to $\frac{3}{4}$ inch. The uterus of a nullipara weighs from $1\frac{1}{2}$ to 2 oz.; that of a multipara from 2 to $2\frac{1}{2}$ oz.

When the whole uterus is laid open in coronal section its cavity is seen to be funnel-shaped (Fig. 8). The cavity of the body is triangular with the apex below, the upper angles being prolonged into the Fallopian tubes, the lower angle into the cervical canal. In a parous woman it is larger and more

roomy than in a nullipara. The cavity of the cervix in a nullipara is spindle-shaped on coronal section. In a parous woman, the external os, being permanently widened by child-birth, is much larger than the internal os. Where the body-cavity is continued into the cervix there is a narrowing of the lumen which forms the *os internum*.

When examined *in situ* the body of the uterus will be seen to incline slightly forwards from the cervix so that the axis of the organ forms a curve open widely in front, and equal to an obtuse angle of about 160°. In nulliparae this angle is often much more acute and may be reduced even below 90°, but this modification is in nearly all cases associated with some other abnormality, such as deficiency in size (*see* p. 513). Sometimes the bend is backwards instead of forwards. In the fœtus the uterine axis forms a straight line (*see* Fig. 20). As a rule the uterus is median in position in the pelvic cavity. Occasionally it has a lateral inclination, the body being directed towards one side, the cervix towards the other. In the erect attitude and with the bladder empty, the body of the uterus is strongly anteverted and lies nearly horizontal in the pelvis, the fundus being just below the level of the upper border of the pubes, the os externum at the level of the ischial spines. Distension of the bladder displaces the uterus upwards and backwards, carrying it farther away from the abdominal wall. Distension of the rectum displaces it upwards and forwards. Variations of posture, and muscular effort, also affect its position. In bi-manual examination under anæsthesia, the uterus can be freely moved in all directions within the pelvis, and the cervix may be drawn down almost to the vulva.

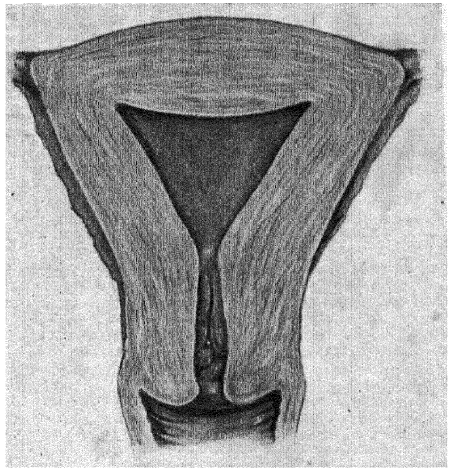


FIG. 8. NORMAL UTERUS OF A NULLIPARA. The uterus has been bisected in coronal section. The cavity of the body is triangular, that of the cervix is spindle-shaped.

Structure. The mucous membrane lining the cavity of the uterus is called the *endometrium*. In the body (corporeal endometrium) it is smooth, polished, and pale yellowish-pink in colour; with a lens the openings of glands may be seen upon it. In the cervix (cervical endometrium) it is thrown into transverse folds with intervening sulci; a median ridge runs along the anterior and posterior walls (Fig. 8), and at these ridges the transverse folds end. The whole arrangement roughly resembles the branchings of a tree, and the name *arbor vitae* was given to it by the old anatomists. The average thickness of the endometrium in a healthy adult woman is about 2 mm. After the climacteric it undergoes shrinkage.

The endometrium of the *body of the uterus* has no submucous layer, and its glands penetrate into the muscular wall, so that although it can be

partially scraped away, it will not peel off. The structures which make up this membrane are (1) epithelium (surface and glandular); (2) stroma or interstitial tissue; (3) blood-vessels and lymphatics. Nerve endings have not hitherto been demonstrated.

The *epithelium* of the corporeal endometrium consists of a single layer of columnar ciliated cells resting on a basement membrane. The cilia are said to appear first at puberty and disappear at the climacteric. They are seldom observed in pathological conditions. The surface-epithelium is invaginated at certain points, and these invaginations extend through the whole depth of the stroma and often into the superficial muscular strata. They form the glands of the corporeal endometrium. Their cells are of moderate height, and the nuclei are unequally placed, being sometimes in the centre and sometimes in the basal third of the cell, according to the date in the menstrual cycle at which the section was taken (*see* p. 81). They therefore differ from those of the cervical glands, where the cells are higher and the nuclei lie only at the base (*see* Fig. 13).

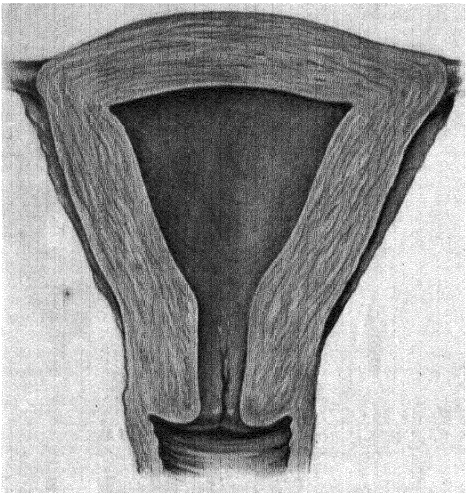
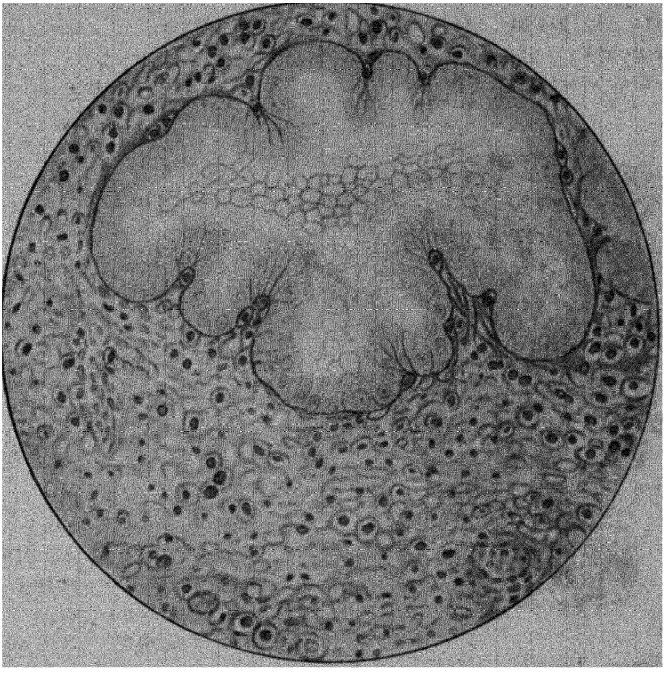


FIG. 9. NORMAL UTERUS OF A PAROUS WOMAN. The uterus has been freed from its attachments and bisected in coronal section.

The glands are simple tubular structures, vertical in their superficial portion, slightly wavy, tortuous or spiral in the deeper part of their course. They are narrow where they open on to the surface, and become wider in the deeper parts, where they occasionally branch; but more common than branching is invagination of a portion of the gland-wall into the lumen, so that on section a small ring appears within a large one (*see* Fig. 11). The cilia of the cells may be traced into the upper part of the tubule, but they soon disappear and are not seen in the deeper portions. It has long been taught that the glands of the corporeal endometrium have no basement-membrane to their epithelium, but this is not correct. By suitable staining methods a basement-membrane can be demonstrated as shown in Plate I. The cells secrete mucus. The amount of the secretion is very scanty, and goblet-cells are not usually found except when the membrane is inflamed and just before and during menstruation, when the mucus is abundant. Mucus therefore forms an important constituent of the menstrual fluid.

The stroma or interstitial tissue is composed of a network of embryonic mesoblastic tissue, in which are cells of irregular shapes and sizes. Their nuclei are relatively large, almost filling the cell-body; they contain one or more well-marked nucleoli. The usual shape of a stroma-cell is bluntly elliptical, but it may be round or fusiform. There is no definite arrangement



NORMAL ENDOMETRIUM (PREMENSTRUAL PHASE). Stained by Mallory's polychrome methylene blue. The basement-membrane of the gland-epithelium is stained deep blue; the network of collagen-fibres in the stroma is stained a paler blue, whilst the stroma-cells are orange-coloured. The blood-corpuscles in the capillaries are stained yellow. Note the fern-like projections into the gland, and the mucus (stained blue) in the gland-lumen.

To face page 14.

of the cells beyond the fact that they often aggregate in whorls around the gland-tubules and the blood-vessels. They appear to vary according to their position, being larger near the surface, where the network is more open, and smaller nearer the muscle. The network supporting the cells is composed of collagen-fibrils and is best seen in sections stained by Mallory's polychrome methylene blue (*see* Pl. I.). In addition to the above irregular stroma-cells, there are others resembling round lymphocytes (*see* Fig. 12). To these the stroma owes its lymphoid appearance, and some authorities regard them as young formative connective-tissue cells. Whatever their origin they are present in great numbers, and from their resemblance to mononuclear and polynuclear leucocytes they make the diagnosis of a true inflammatory process difficult. In addition to the cells, the collagen-meshes often contain granular material which is probably coagulated serum.

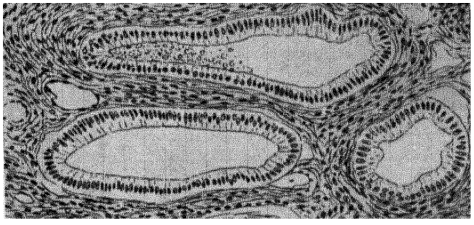


FIG. 10. THE GLANDS OF THE CORPOREAL ENDOMETRIUM (high power), showing a clear zone of cell-protoplasm between the basement membrane and the nuclei.

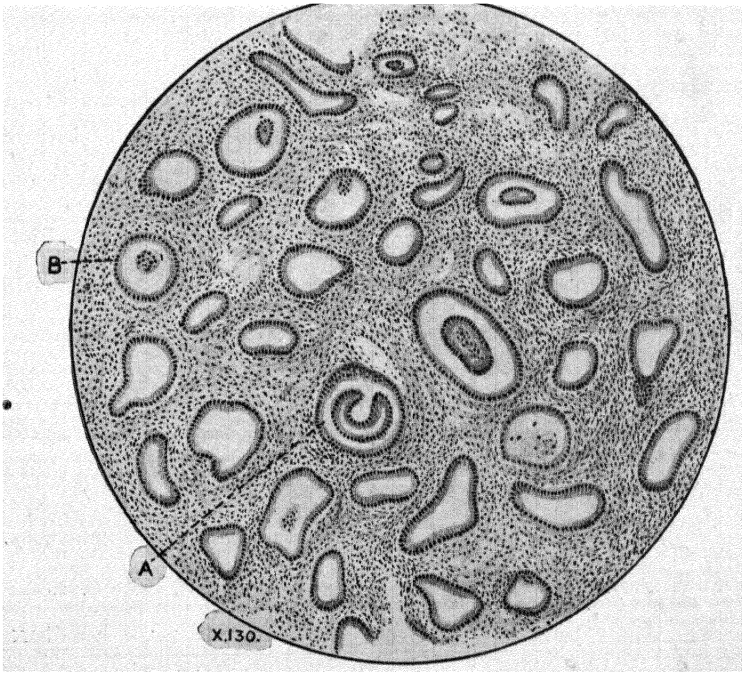


FIG. 11. CORPOREAL ENDOMETRIUM (× 130) SHOWING INVAGINATION OF THE GLAND-WALLS WITHIN THE LUMINA. A. shows complete invagination of a tubule. B. shows an invaginated tubule cut through its tip. Note that all the nuclei are basal.

Blood-vessels. Wide capillaries, composed of a single layer of endothelium (*see* Pl. I.), run through the whole thickness of the endometrium ; some are placed vertically and may branch, others run a horizontal course. Deep in the stroma the vessels may become tortuous. The normal stroma, however, contains no vessels with fibromuscular walls.

As the structure of the corporeal endometrium varies with the menstrual

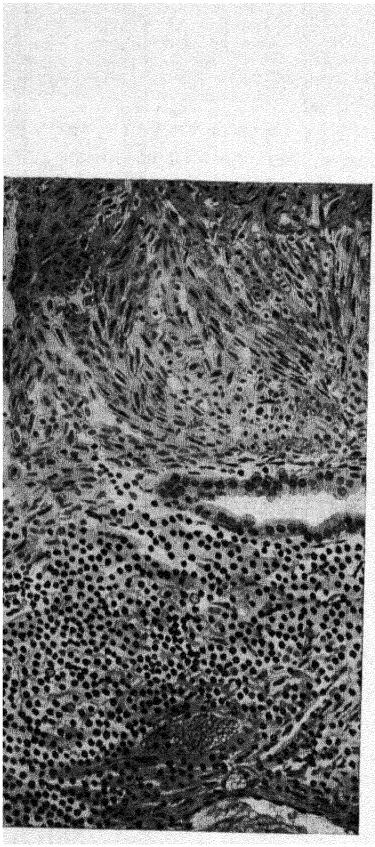


FIG. 12. THE STROMA OF THE CORPOREAL ENDOMETRIUM. In the lower part of the figure the lymphoid appearance of the stroma is well shown.

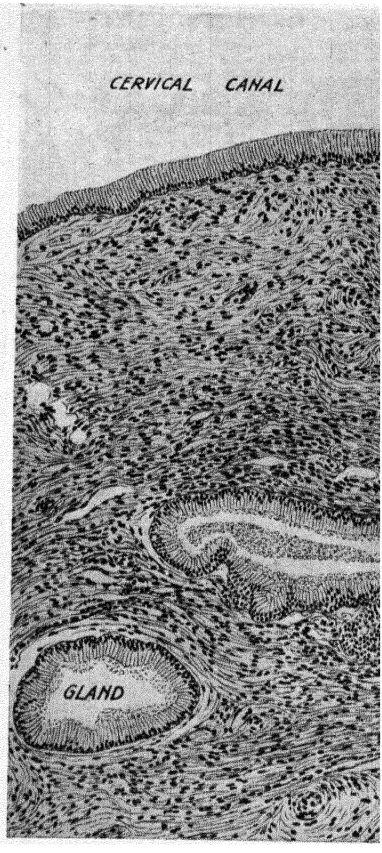


FIG. 13. SECTION THROUGH THE CERVICAL ENDOMETRIUM. The surface-epithelium consists of a single layer of high palisade cells ; the stroma is less cellular and contains much more fibrous tissue than that of the uterine body.

cycle, no single picture can be made to present all its physiological characteristics, so that for further information on this important structure the student is referred to the section dealing with the Anatomy of Menstruation (*see* p. 79).

The Cervical Endometrium. Like that of the body of the uterus this membrane consists of a surface-epithelium, with stroma and glands. The epithelium consists of a single layer of high palisade epithelial cells (*see*

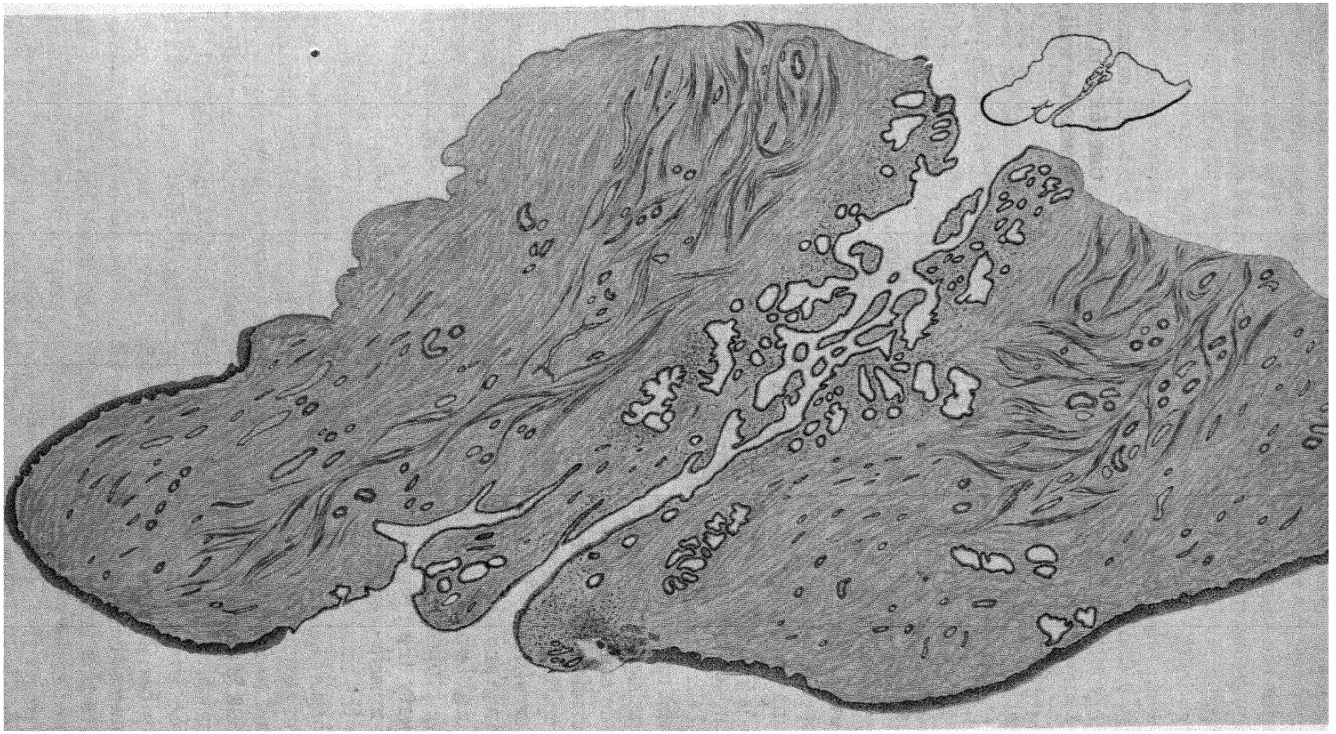


FIG. 14. SHOWING A SAGITTAL SECTION THROUGH THE VAGINAL PORTION OF THE CERVIX. The squamous epithelium of the vaginal surface is continuous at the margin of the external os with the columnar epithelium of the cervical canal. The appearance of the normal cervical endometrium should be specially noted. The anatomical folds resemble an archipelago when cut across. The inset shows the outline of the section cut for microscopic examination.

Fig. 13), and is continuous at the internal os with that investing the cavity of the uterine body. The individual cells are much higher than those of the body, and their nuclei are basal, not centrally situated. The investing epithelium covers the elevations known as the arbor vitae, and at the external os fuses with the squamous epithelium of the *portio*. It is also continuous with the epithelium of the glands which lie in great numbers in the stroma.

The stroma presents a striking contrast to that of the corporeal endometrium, since in the cervix there is no specialized arrangement required for menstruation. The glands do not expand and subside under the influence of an ovarian stimulus, and therefore there is no need for a soft expansile bed of embryonic tissue to surround them. The stroma, therefore, is composed of tissue closely resembling that of the general fibro-muscular wall of the cervix into which it insensibly passes (*see* Fig. 14).

The cervical glands are much more numerous than those of the body. Some are simple, but most are compound racemose structures which penetrate deeply into the fibro-muscular tissue and communicate with the surface upon which they pour their secretion. Dilatation of the terminal portions is frequently seen, and these dilated parts may enlarge, forming small retention cysts, visible and palpable upon the surface of the cervix, the so-called Naboth's ovules (*see* Fig. 15). Occasionally one of these follicles may be found to open upon the surface of the *portio*. The cervical glands produce an abundant secretion which is rich in muci, alkaline in reaction, clear, colourless, viscid, and tenacious.

The point of transition between the palisade epithelium of the cervical mucosa and the squamous epithelium covering the *portio* is found, as already stated, at the external os (*see* Fig. 14). Exceptions may occur in the fœtus, for the cylindrical epithelium may spread over the surface of the *portio*. In the adult the same variation may occur in the pathological condition called cervical 'erosion.' In some cases, on the other hand, extension of the squamous epithelium into the cervical canal has been observed in the adult.

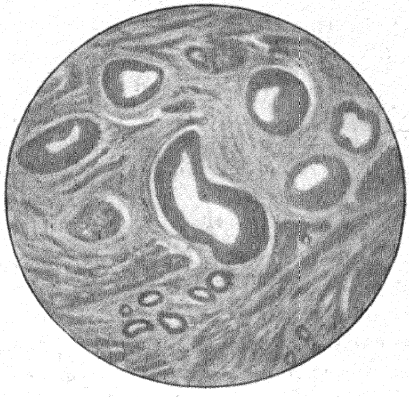
The Musculature. By far the greater part of the uterine wall consists of plain muscle and fibrous tissue. In the body the muscle-fibres are arranged in well-defined bundles separated by planes of well-developed fibrous tissue. The relative proportions of muscle and fibrous tissue vary with age; thus before puberty the proportion is as 2 to 3; after puberty a great relative increase of muscle occurs, the proportion being as 3 to 2 (Pl. II.); after the climacteric the muscle gradually diminishes until the proportion of 2 to 3 is again reached (Pl. II.). The high proportion of muscle thus occurs during the period of sexual activity, when it is required for the control of menstrual bleeding, and to form the basis of uterine hypertrophy in pregnancy.

In the cervix muscular and fibrous tissues are interwoven to form a dense reticulum in which individual bundles or planes cannot be distinguished. In the body the arrangement is more definite. Thus Tandler (as quoted by Quain) describes (1) a *subserous*, (2) a *vascular*, and (3) a *submucous* muscle layer, but states that these layers are difficult to separate one from another, and in places this is impossible, since they are so much interwoven. The best developed is the vascular layer, the arrangement of which is principally circular (in rings) (Fig. 16). The other two layers are comparatively thin.

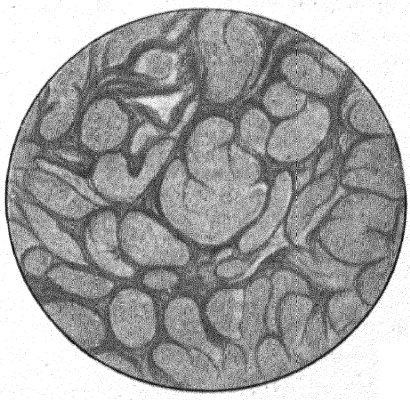
The musculature is best studied in the gravid uterus at term, when the fibres have increased in length from $\frac{1}{100}$ inch to $\frac{1}{40}$ inch, and to this hypertrophy, hyperplasia, or increase in number, of fibres, is probably added. The



A. Musculature of Virgin Uterus after Puberty.



B. Musculature of Senile Uterus after Menopause.



The sections were stained by Van Gieson's method. The muscle appears yellow and the fibrous tissue red in colour. The elastin is not differentiated. For the estimation of the amount of elastic tissue at the various stages of life, see numerous Plates in the section on Chronic Metritis, page 376.

To face page 18

subserous lamina (Fig. 16) is then found to consist of a thin superficial sheet immediately beneath the peritoneum and of incomplete strata situated more deeply. The sheet is formed of longitudinal bands, which pass from the

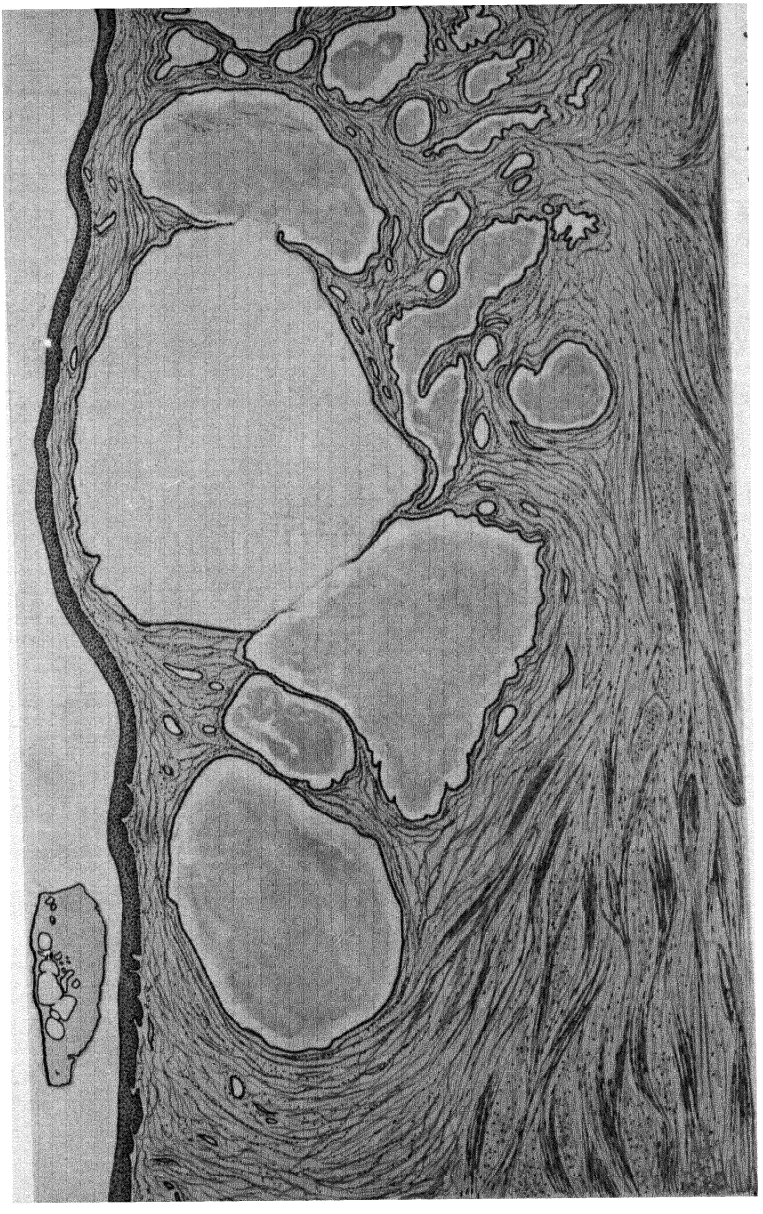


FIG. 15. SECTION OF THE VAGINAL PORTION OF THE CERVIX, showing dilatation of the glands and the formation of Naboth's follicles. The inset shows the naked-eye appearance of the section.

cervix upwards anteriorly over the uterine body, and arching over the fundus pass downwards on the back of the uterus to become lost on the posterior wall of the cervix and in the utero-sacral folds. Laterally, the fibres of this

muscle-sheet pass into the broad ligaments, where they run on to the round ligaments, ovarian ligaments, and Fallopian tubes. According to Bonney,

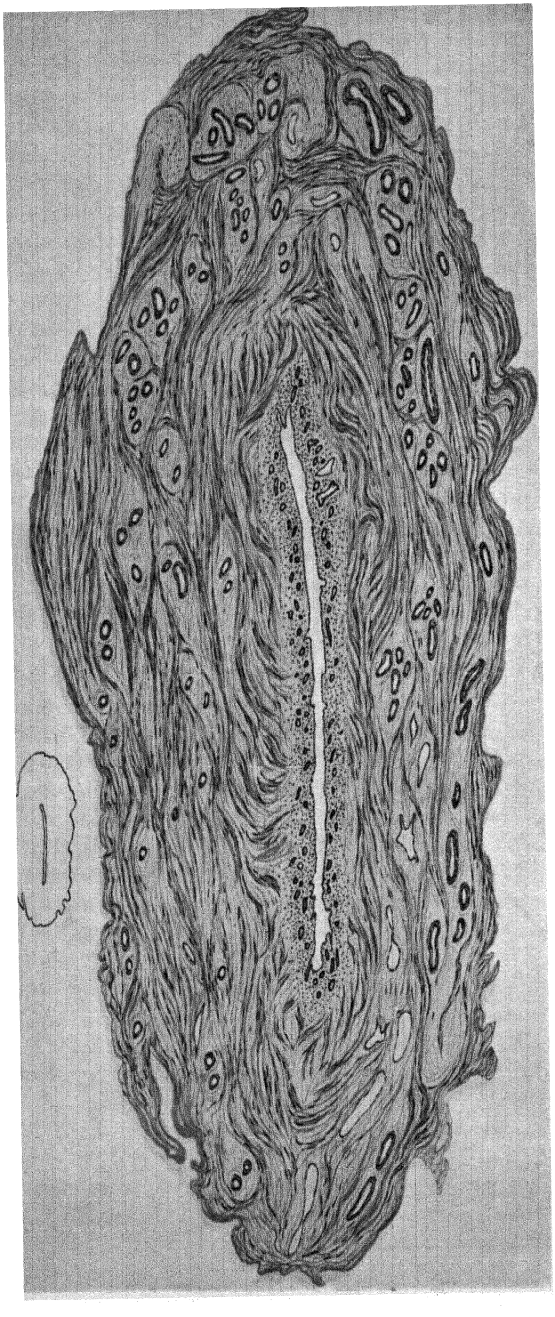


FIG. 16. TRANSVERSE SECTION THROUGH THE UTERINE BODY, showing the arrangement of the musculature. The submucous layer is the thickest, and its deepest fibres may be regarded as representing a *muscularis mucosæ*. External to this, the vascular layer is represented by circular bundles around the blood-vessels; it is thicker posteriorly. The subserous (external) layer is thinnest of all.

this same longitudinal muscle-sheet can be traced downwards in front over the cervix to blend with the fibres of the pubo-cervicalis muscle in the mid

line and with the transverse cervical (cardinal) ligaments at the sides.[1] The *vascular lamina* is thickest posteriorly (Fig. 16); it also arches over the fundus and runs irregularly or in circles around the blood-vessels, the position of the vessels corresponding to the submucous areolar tissue of other hollow viscera. The *submucous lamina* consists of numerous concentric rings round the openings of the Fallopian tube, the widest circles of which meet in the middle of the uterus (*see* legend of Fig. 16), whilst lower down they form the sphincters of the os internum and os externum.

Elastic Tissue. There is very little elastic tissue in the normal nulliparous uterus, but what exists is distributed as follows: (1) a thin lamina (*elastica interna*) in the inner coat of the arteries; (2) a certain amount in the middle coat of the veins; (3) a certain amount in the form of fine fibrils between the muscle-bundles (*see* Pl. XIX., p. 377). In cases of subinvolution a marked excess of elastic tissue is found, which forms one of the most characteristic features of this condition (*see* Pl. XVIII., facing p. 377).

The *blood-vessels* penetrate all the fibro-muscular planes, but are best studied in the vascular lamina, where large arterial and venous channels are seen. The arteries run a spiral course, and for their size possess very thick walls. In the uterus of adults, vessels are frequently found showing well-marked degenerative changes. It is probable that such changes form part of the normal process of involution, and being arrested at a certain point, become permanent. After the climacteric hyaline degeneration occurs, involving all the coats of the arteries (Pl. II.b).

The Lymphatics and Nerves. The uterus is abundantly supplied with lymphatics and nerves. The former will be considered along with the other pelvic lymphatics. The nerves of the uterus come from the sympathetic system, through which the organ is brought into intimate relation with the central nervous system and also with the other abdominal viscera.

The Peritoneum. The peritoneal coat of the uterus completely covers the fundus and is reflected thence on to the round ligament and Fallopian tubes. The anterior and posterior surfaces of the body are completely covered with peritoneum, but upon the lateral aspect a considerable part has no peritoneal covering. The bare area is roughly triangular in shape with the apex above, the base below at the level of the os internum (*see* Fig. 18). The cervix has no peritoneal covering on the front and sides, but the posterior surface of the supra-vaginal portion is covered by the peritoneum which passes from the back of the uterus down to the floor of the pouch of Douglas (Fig. 19, p. 25). Generally speaking, the peritoneum is firmly adherent to the subjacent muscle, but upon the lower part of the anterior wall, extending for about ½ inch above the internal os, there is an upward extension of cellular tissue beneath the peritoneum, which allows of its being stripped off the uterine wall. This area indicates the position in which the lower uterine segment is developed towards the end of pregnancy.

The Uterine Attachments. The attachments of the uterus may be enumerated as follows:—

(1) The broad ligaments.
(2) The round ligaments.
(3) The utero-sacral ligaments.

[1] The pubo-cervical muscle-sheet, as described by Bonney, will be again referred to in the section on Prolapse (*see* p. 531).

(4) The transverse ligaments of the cervix.

(5) The cervico-vaginal insertion.

The Broad Ligaments. These are double folds or duplications of peritoneum continuous with that covering the uterus, and reflected from it at its lateral borders. They are developed from the lateral parts of the urogenital or mesonephric folds. As seen in the living subject or in the cadaver, they form loose lateral folds which run from the uterus outwards and slightly backwards to the pelvic brim. When stretched, the broad ligament is roughly quadrilateral with upper, outer, lower and inner borders. The upper border is free and contains the Fallopian tube between its folds as far as the abdominal ostium, which is intra-peritoneal. From this point to the pelvic wall the upper border is free and is distinguished as the *infundibulo-pelvic fold.* Developmentally it is the *ligamentum suspensorium ovarii* or *plica mesonephrica diaphragmatica* (*see* p. 67), and the ovarian vessels run in the upper one-third of this fold. The outer border is attached to the lateral pelvic wall along a line running obliquely from the external iliac vessels downwards, forwards and inwards to the pelvic floor. The inner border is attached to the sides of the uterus and is reflected on to the vaginal fornices. The lower border is short and unequal, the posterior peritoneal fold passing to a lower level than the anterior. In the normal position of the uterus the broad ligament is inclined forwards, so that its surfaces are directed, the one upwards and backwards, the other downwards and forwards (*see* Fig. 18)

The ovary is attached to the posterior peritoneal layer of the broad ligament; from the inner pole of the ovary to the cornu of the uterus runs the *ligamentum ovarii proprium*, a strong sub-peritoneal band of muscular and fibrous tissue (*see* Fig. 17). The ovarian attachment divides the posterior surface of the broad ligament into an upper and a lower portion. The upper portion which lies between the Fallopian tube and the ovary is called the *mesosalpinx;* it is thin, translucent, contains little cellular tissue, and in it is found the parovarium (epoöphoron) with the beginning of the duct of Gartner. The lower part (*mesometrium*) is much thicker than the upper and widens rapidly as the pelvic floor is approached, so that the base contains a large amount of cellular tissue in which lie vessels and other important structures.

The anterior surface of the broad ligament is shallow and is crossed by the round ligament which runs obliquely beneath the peritoneum from the uterine angle to the internal abdominal ring. The peritoneum is reflected over the bladder and utero-vesical ligaments to the anterior pelvic wall. The peritoneum forming the posterior surface of the broad ligament descends much deeper than that on the anterior aspect and is reflected over the utero-sacral ligaments and pararectal folds to the posterior pelvic wall; it is also continuous with the peritoneum covering the pouch of Douglas.

Morphologically the broad ligaments correspond with the mesentery of the intestine and are developed in a similar manner. They serve to tether the uterus while not impeding its mobility within a certain range. Between the layers of the broad ligament are enclosed a number of important structures. In the upper part are found the Fallopian tube, the round ligament, the ovarian ligament, the parovarium (epoöphoron), branches of the ovarian artery, and the anastomotic branch of the uterine artery. In the lower part are found the ureter, the uterine vessels, the duct of Gartner, one or two small lymphatic glands, and a thick but variable mass of cellular tissue.

The relations of these structures are illustrated diagrammatically in Figure 18.

The Round Ligaments. These are a pair of slender cordlike structures, which arise from the anterior aspect of the uterine cornua and pass at first downwards and outwards beneath the anterior peritoneal layer of the broad ligament; then curving forwards and slightly upwards they cross to the internal abdominal ring. Passing down the inguinal canal they split up and become attached to the subcutaneous tissues of the labia majora. The peritoneal covering of the round ligament is lax and allows of the ligament being freely raised from its bed, so that it can be made use of in various surgical procedures.

The round ligaments are composed almost entirely of plain muscle. As seen in the living subject they are lax structures of variable thickness. They may in some instances be nearly as thin as a surgical probe; in others,

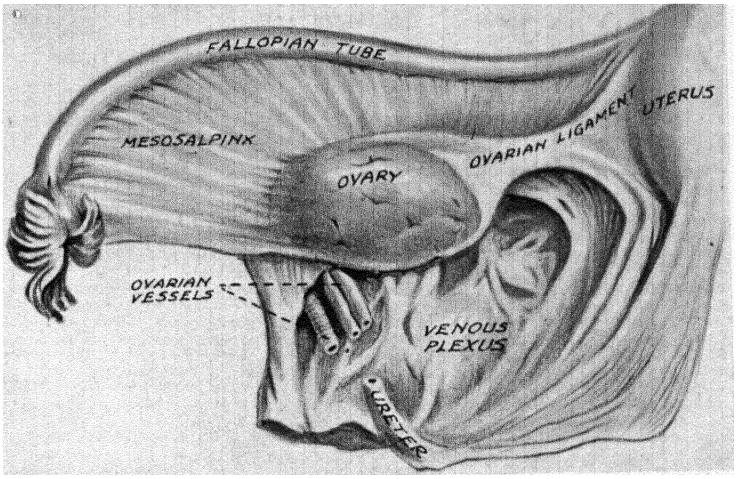


FIG. 17. THE POSTERIOR ASPECT OF THE BROAD LIGAMENT. A. Infundibulo-pelvic fold (*ligamentum suspensorium ovarii*) (Charing Cross Hospital Museum).

nearly as thick as a lead pencil. The course is curved, and they leave the abdominal cavity at a point which may be, and often is, on a plane posterior to that of the fundus of the normal anteverted uterus. These anatomical points indicate that they play but a subsidiary part as normal uterine supports. Developmentally, they are structures corresponding to the *gubernaculum testis* in the male (*see* p. 77). During pregnancy they undergo remarkable hypertrophy, from which it may be inferred that they are by no means functionless structures.

The Utero-sacral Ligaments. These structures consist of a duplication of peritoneum containing a variable amount of firm, fibrous tissue intermingled with some muscle fibres, which are derived from the outer longitudinal sheet investing the uterus. When divided during operative work they are seen to be firmer and stronger than the other 'ligaments' of the uterus (*see* Fig. 19). They run from the posterior aspect of the sides of the cervix at the level of the internal os, backwards to the anterior surface of the lower end of the sacrum, the rectum curving upwards over the ligament of

the left side. As they run backwards, they diverge slightly from one another. They form the upper boundaries of the lateral walls of the pouch of Douglas and divide the posterior pelvic compartment into three fossæ (*see* Figs. 2, 3, and 19). In the living subject they vary greatly in thickness, being in some cases much better developed than others. They tether the cervix to the posterior pelvic wall, and when well developed may offer resistance to excessive forward displacement of the cervix. A small branch of the uterine artery accompanies each ligament. These ligaments can be palpated through

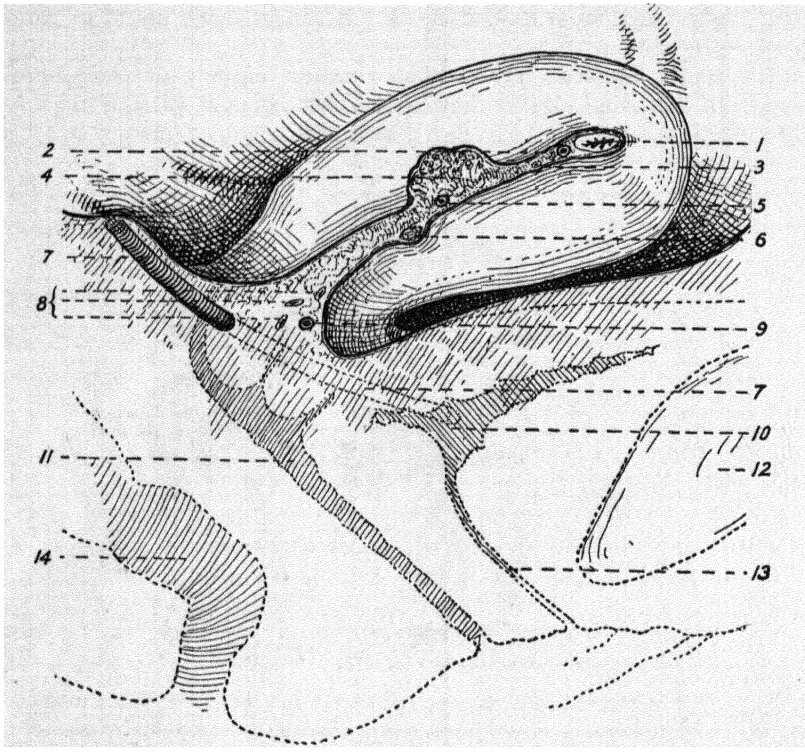


FIG. 18. SECTION THROUGH THE BROAD LIGAMENT ABOUT 1 INCH OUTSIDE THE UTERINE BORDER (diagrammatic). 1. Fallopian tube. 2. Tubal branch of ovarian artery. 3. Parovarian (epoöphoritic) tubule. 4. Ovary. 5. Ovarian artery. 6. Round ligament. 7. Ureter. 8. Uterine veins. 9. Uterine artery. 10. Bladder. 11. Vagina. 12. Symphysis pubis. 13. Urethra. 14. Rectum.

the rectum, and when thickened by inflammatory or other morbid processes they will be readily felt.

The Transverse Ligaments of the Cervix (*ligamenta transversales colli* or *ligamenta cardinalia*). These structures, described by Mackenrodt, are bands of firm, fibrous tissue which form specialized parts of the visceral layer of the pelvic fascia. Arising in the neighbourhood of the ischial spines, they pass through the pelvic cellular tissue and are attached to the sides of the cervix and to the lateral aspects of the vaginal walls. Unlike the other uterine ligaments, they have no special peritoneal covering. According to some anatomists they form part of the sheaths of the uterine arteries, which

reach the uterus at about the same level. According to Bonney, these structures, termed the cardinal ligaments, are strengthened by muscle-fibres continuous with the subserous muscular lamina of the uterus. This author lays particular stress upon the value of this sheet of muscle and considers that the central part, which he calls the pubo-cervicalis muscle, together with the cardinal ligaments form an anterior "pelvic shelf" which bears up the bladder.

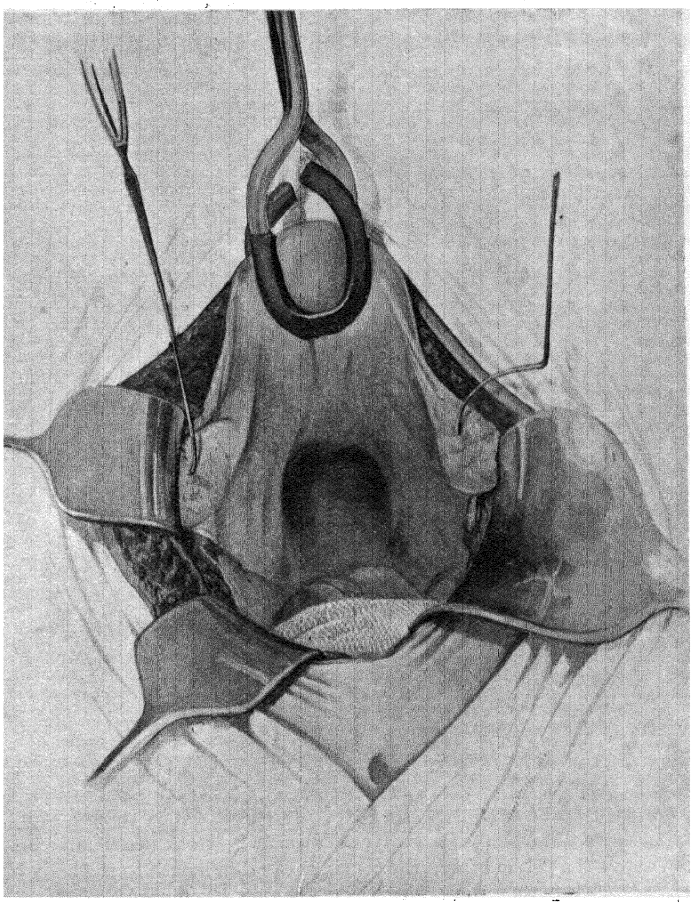


FIG. 19. SHOWING THE UTERUS DRAWN FORWARD AND THE OVARIES HELD ASIDE IN ORDER TO DEMONSTRATE THE POUCH OF DOUGLAS AND THE UTERO-SACRAL FOLDS, AS SEEN DURING OPERATION WITH THE PATIENT IN THE HIGH PELVIC POSTURE.

The Cervico-vaginal Insertion. The uterus is attached more firmly to the vagina than to any other structure. The upper end of the vagina is inverted, forming a cup-shaped depression which receives the vaginal portion of the cervix. The fibro-muscular tissues of the cervix and vagina are intimately blended, and the stratified epithelium of the latter is continued over the cervical surface up to the external os. Separation of the cervix from the vagina is impossible, except by cutting, as there is no intervening

plane of cellular tissue, and the continuity of the two organs is complete. This intimate union between vagina and cervix forms the principal support of the vaginal tube, but below, in its lower one-third, the vagina is further supported by the fibres of the levatores ani, whilst the upper two-thirds are further stabilised by the transverse cervical ligaments (Bonney).

The Pelvic Floor. As already stated on page 4, the structures composing the pelvic floor and the general supports of the pelvic viscera will be more conveniently described in a later section dealing with Displacements (*see* pp. 507 to 510).

The Uterus at Different Periods of Life. In the *fœtus* at about the seventh

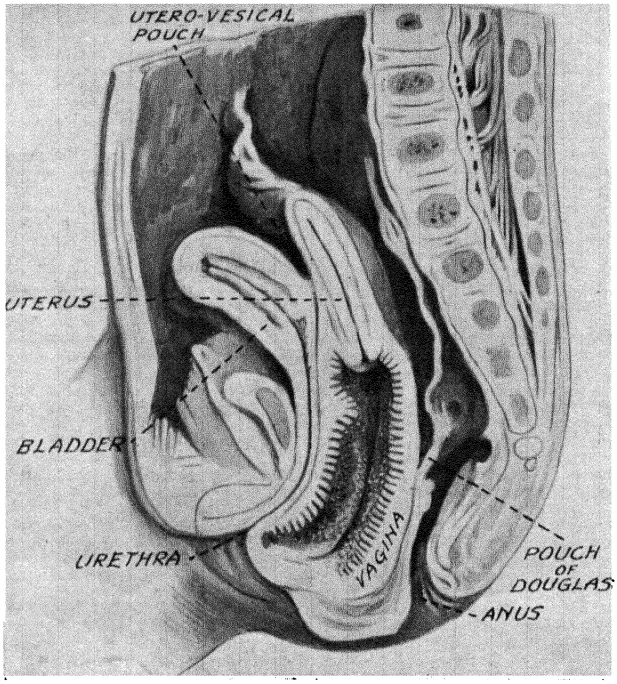


FIG. 20. SAGITTAL SECTION OF THE FŒTAL PELVIS OF SEVEN TO EIGHT MONTHS, DEVELOPMENT (Charing Cross Hospital Museum). Both uterus and bladder extend above the pelvic brim; the cervix is equal in length to the body of the uterus; the vaginal rugæ are very prominent.

month the uterus lies above the pelvic brim, *i.e.* at a higher level than in the adult. *The cervix is about equal to the body in length*, and the arrangement of the cervical endometrium, known as the arbor vitæ, has already appeared. The uterine axis is straight and nearly vertical. At *puberty* the uterus begins to grow rapidly, the body more rapidly than the cervix, until the adult proportion of 2 : 1 have been reached. The angle between the body and the cervix has now appeared; the whole organ has become anteverted and has sunk until it lies below the level of the pelvic brim. The proportion of muscle in the wall of the uterine body increases greatly, but this is not seen in the cervix to the same extent.

After *child-bearing* the uterus, as a rule, remains permanently enlarged;

the cervix shows traces of more or less extensive lacerations, and the external os is enlarged (*see* Figs. 317, 318, p. 505). The wall of the organ on section is seen to have increased in thickness, both mucous membrane and musculature participating in this change. The uterine cavity is also larger than in a nullipara (*see* Fig. 9, p. 14). In the musculature, arteries with thickened walls are usually to be found; sometimes the chief thickening is in the intima, and vessels thus affected may become obliterated; in others the media and adventitia are the seat of the thickening. This thickening is due to a deposit of hyalin in the fibro-muscular tissue of the vessel-wall. Around the vessels the supporting fibrous tissue is largely replaced by elastic tissue

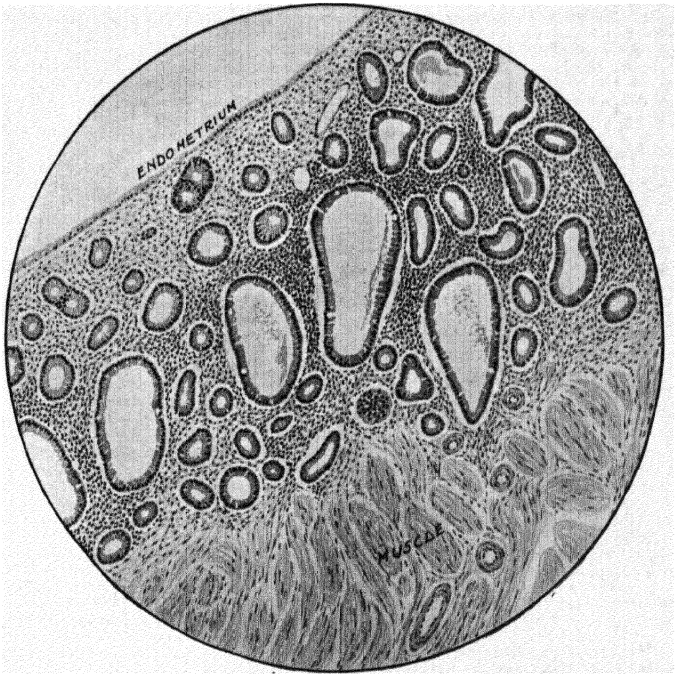


FIG. 21. THE ENDOMETRIUM AFTER THE CLIMACTERIC. Multipara, aged 68. The mucosa is thin, and many of the glands are dilated, but their epithelium is well preserved.

which can be demonstrated by Weigert's elastic-tissue stain (*see* Pl. XVIII., facing p. 377).

After the *menopause* the uterus shrinks in size and in weight. The shrinkage is especially evident in the cervix, for the *portio* usually disappears, leaving the os externum as a small aperture flush with the surface of the vaginal wall. The endometrium also atrophies (*see* Fig. 212, p. 362), but this process is very slow, and in a woman who has passed the menopause for several years a fairly thick endometrium with numerous glands and well-formed epithelium may be found (*see* Fig. 21). Many of the arteries in the musculature become obliterated, and patches of calcareous degeneration may appear in their coats (Pl. II.b, opposite p. 18). Much of the muscle in the uterine wall disappears, being replaced by fibrous tissue.

THE FALLOPIAN TUBES

Representing morphologically the upper non-united portions of the Müllerian ducts, the Fallopian tubes are continuous with the uterus below, while the upper ends lie free in the pelvic peritoneal cavity. Each tube is attached to the corresponding cornu of the uterus, and measures from 4 to 4½ inches in length. At first it runs horizontally outwards from the uterus, then at the junction of its inner and middle thirds, it turns backwards and, describing a curve directed upwards, backwards and inwards, it surrounds the outer pole of the ovary. In infancy the tube is slightly convoluted, but this disappears by the time puberty is reached. For descriptive purposes the tube is divided into three portions: the *interstitial* or *uterine* portion

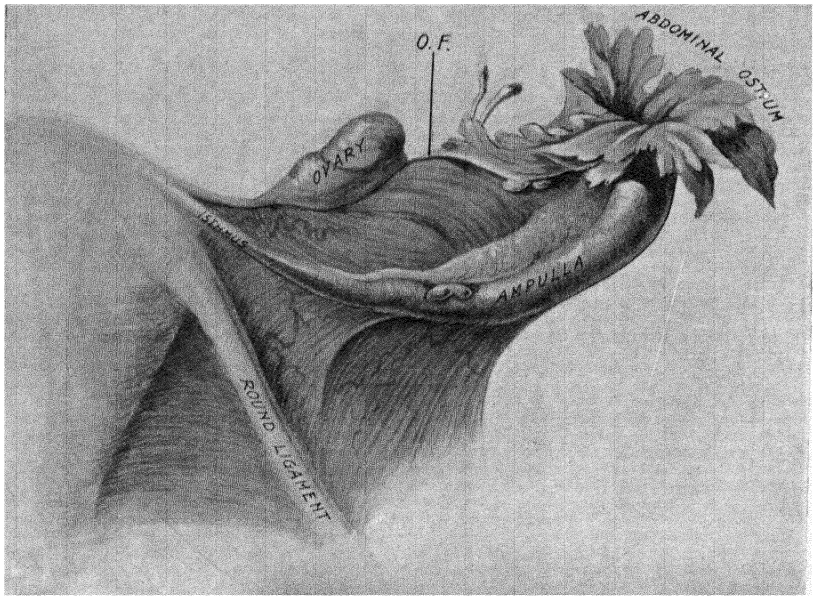


FIG. 22. THE FALLOPIAN TUBE (Richard). The figure also shows the relations of the three structures which are attached to the uterine cornu, viz. the ovarian ligament, the Fallopian tube, and the round ligament. O.F., Ovarian Fimbria.

passing through the uterine wall, about ½ to ¾ inch in length; then the *isthmus*, a narrow cylindrical portion corresponding to the inner third (*see* Fig. 22); lastly, the *ampulla*, which corresponds to the curved portion, and has the shape of a very narrow funnel gradually widening to its termination. The upper free end of the tube forms the *abdominal ostium;* around it the tube-wall is divided in a digitate manner into a number of *fimbriae* (*see* Fig. 22), one of which is longer than the rest, and usually reaches the ovary with its tip (*ovarian fimbria*). The interstitial portion is very narrow, having a lumen of 1 mm. in diameter; the isthmus is somewhat wider, while the ampulla gradually enlarges to a diameter of 4—5 mm. before reaching the abdominal ostium, which opens directly into the peritoneal cavity.

Structurally the tube consists of an outer peritoneal coat, a middle

muscular coat, and a lining of mucous membrane. It lies between the layers of the broad ligament, the upper border of which forms its outer coat; accordingly the floor of the tube, corresponding to about one-sixth of its circumference, has no peritoneal covering, but lies in the interval between the layers of peritoneum (*see* Fig. 18). The part uncovered by peritoneum is greater in the isthmus than in the ampulla. Beneath the peritoneum is a thin layer of highly vascular and loose cellular tissue (the *subserosa*), which is most abundant along the floor of the tube.

The muscular wall is thicker in the outer than the inner part of the tube. The muscle is non-striated and arranged in three layers: a thin, outer longitudinal layer; a thick, middle circular layer, and an incomplete inner

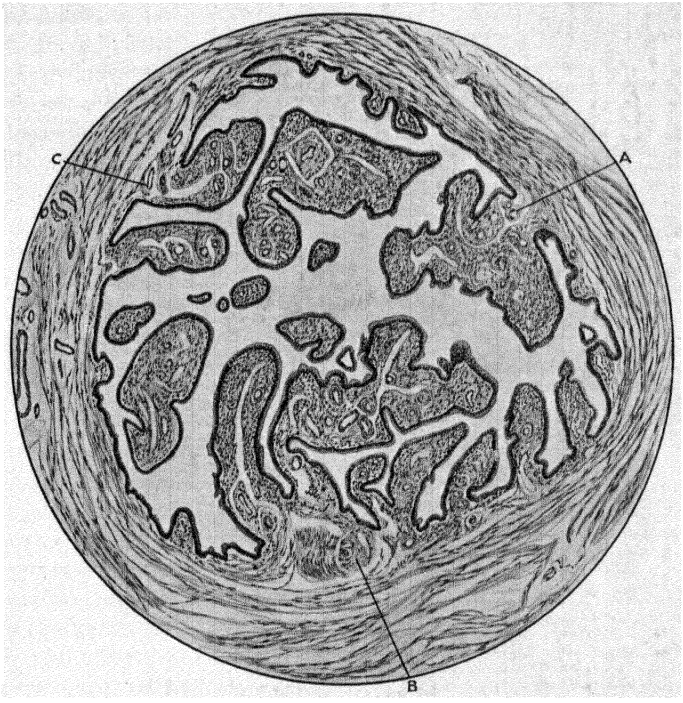


FIG. 23. TRANSVERSE SECTION THROUGH THE ISTHMUS OF THE FALLOPIAN TUBE. A, B, C, suggest the situation of the three primitive folds.

layer, which is also longitudinal and passes into the plicæ of the mucosa. There is no *submucosa*, so that the mucous membrane rests directly on the muscle.

The mucous membrane is continuous at one end of the tube with the endometrium, at the other with the peritoneum. It consists essentially of a single layer of columnar, ciliated epithelium, supported by a very thin layer of cellular tissue. There are no glands in the tubal mucosa. The general characters of the mucous membrane differ in different parts of the tube, but from end to end it is traversed by three well-defined longitudinal folds, the first of which develops in the fourth month of fœtal life, whilst the secondary and tertiary folds are to be found at about the seventh month. In the interstitial portion these folds are simple and shallow; in the isthmus

they are more numerous and not simple, but divided (*see* Fig. 23); in the ampulla they form a complex arborescent mass of curling, slender processes, known as the *plicæ* (*see* Fig. 24). The plicæ consist of a central core of finely interlaced connective tissue containing round and spindle cells: there are also a few elastic fibres and muscle-fibres. Some of these plicæ are simple, but the majority are compound, and some of the latter attain a considerable thickness; in the intervals between them the tube-wall is covered with but a thin layer of mucous membrane. The lumen of this part of the tube accordingly consists of a complicated system of branching channels or interstices between the plicæ, with numerous *culs-de-sac* in all parts. When the abdominal end is reached the plicæ become smaller, the mucosa covering the fimbriæ showing comparatively few of them.

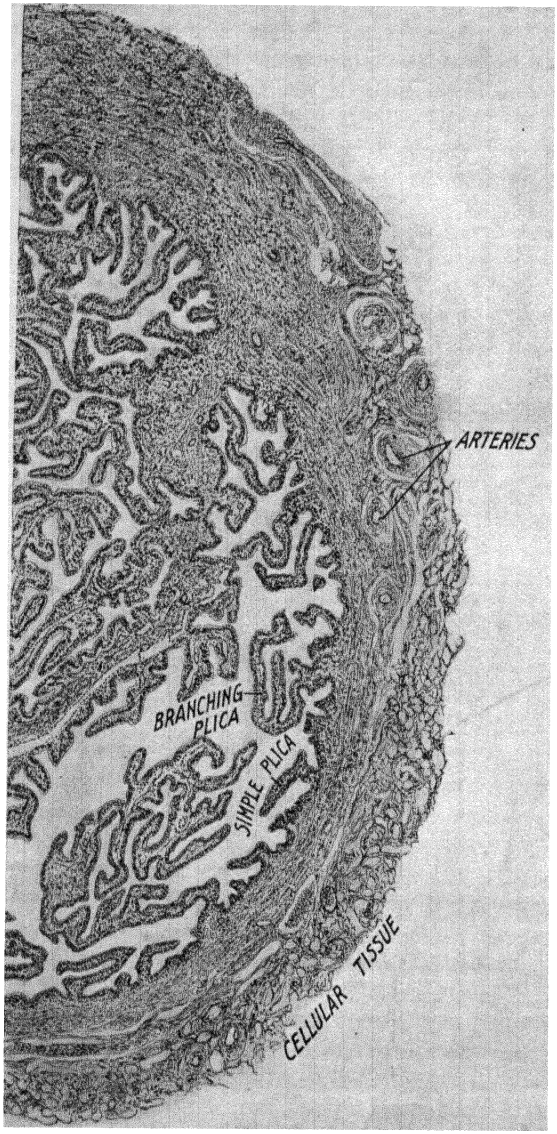


FIG. 24. THE AMPULLA OF THE FALLOPIAN TUBE BISECTED.

The tubal epithelium consists of a single layer of columnar ciliated cells; the ciliæ are best developed in the ampullary portion, and their direction of movement is towards the uterus. Some of the cells are not ciliated but are concerned in the production of the tubal secretion, which is scanty, except in the premenstrual phase. Under normal conditions there is no tubal hæmorrhage during menstruation, but under pathological conditions we have found evidence that this may occur.

Occasionally a secondary or *accessory abdominal ostium*, surrounded by

fimbriæ, may be found upon the dorsal aspect of the ampullary portion (*see* Fig. 56, p. 69). Occasionally, also, *diverticula* may be found in the same part of the tube, forming short tributaries of the main lumen; they are lined with a plicated mucous membrane, identical with the general tubal mucosa.

The tube is supplied with blood in the greater part of its extent from the tubal branches of the ovarian artery; the innermost part of the isthmus is supplied from the anastomotic branch of the uterine artery (*see* Fig. 48, p. 60). The lymphatics pass into the lumbar glands (*see* p. 64).

The continuity of its lumen with the uterine cavity below and the peritoneal cavity above, renders the tube liable to infection from both directions. Ascending infection is seen in gonorrhœa and sepsis, the morbid process spreading by direct continuity from the endometrium (*see* Pl XI., p. 258). Descending infection may be seen in the case of tubercle (*see* p. 270), and possibly of malignant disease of the ovary or some other abdominal organ (*see* p. 574). Further, direct infection from the bowel or the vermiform appendix may occur when the tube becomes adherent to these organs (*see* p. 549). These considerations explain the extraordinary frequency with which the tubes become the seat of inflammatory changes. The anatomical conformation of the tubal mucosa favours the retention of infective material, and the development of the inflammatory process; the small size of the uterine portion prevents anything like free drainage through the uterus from taking place. The numerous interstices between the tubal plicæ, and the occasional occurrence of diverticula, may help to explain the detention of the fertilized ovum in the tube, which leads to tubal pregnancy.

THE OVARY

The ovary is an organ which belongs to the class of ductless glands. It is developed from the genital streak which consists of proliferative cœlomic entoderm on the median aspect of the mesonephros (p. 66). In a young nullipara it is thin and flattened, resembling an almond; in older women it becomes larger, and more rounded in outline. Until ovulation begins its surface is smooth, later it becomes irregular from protrusion of ripening follicles and retention cysts. Scarring also occurs from repeated ruptures of ripe follicles; at the climacteric the ovary is often found so much roughened as to be likened to a peach-stone. Its general shape is oval. In an adult woman during the child-bearing period of life, it varies a good deal in size and appearance. When it contains a mature Graafian follicle it becomes larger and more congested. Its normal position is in the pelvic cavity, close to the lateral pelvic wall, where it is in relation in front with the external, and behind with the internal, iliac artery. In multiparæ it is often found at a lower level than this, and may lie upon the floor of the pouch of Douglas.

The ovary is suspended from the back of the broad ligament (*see* Figs. 19 and 22) by a linear attachment corresponding to the *hilum* of the organ. Here the peritoneum ceases and gives place to the proper epithelial covering of the ovary, the line of transition being often recognizable to the naked eye as the *white line* of the ovary. To the uterine cornu it is slung by a well-developed, somewhat flattened, band of muscle and fibrous tissue, the *ligamentum ovarii proprium* (*see* Fig. 17). This ligament receives its blood-supply from the anastomotic branch of the uterine artery, which runs below

it. The ovary has no peritoneal covering, and its attachments are such as to allow of a considerable range of mobility. One of the fimbriæ of the abdominal ostium of the tube—the *ovarian fimbria* (Fig. 22)—usually touches the outer pole of the ovary, but does not afford it support.

The average size of the ovary in the adult is about $1\frac{3}{4}'' \times 1'' \times \frac{1}{2}''$, but healthy ovaries of nearly double this size are not uncommonly encountered.

The general characters of the ovary are best studied in specimens taken at some part of the child-bearing period of life (*see* Fig. 17, and Pl. III., p. 32). The outer surface is generally smooth and polished ; not infrequently one or several small translucent cysts may be seen to protrude slightly from the surface ; these are retention cysts formed by non-dehiscence or degeneration of Gräafian follicles. A recent corpus luteum may appear as a dark plum-coloured protrusion occupying a considerable area of the ovarian surface.

When the ovary is bisected the cut surface is roughly oval in shape, the attached border (hilum) being straight. The gland is usually divided

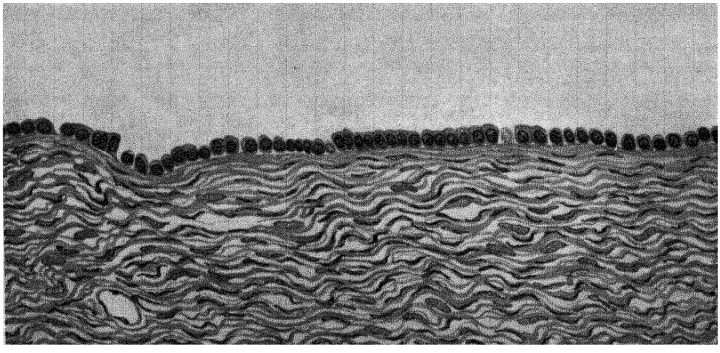
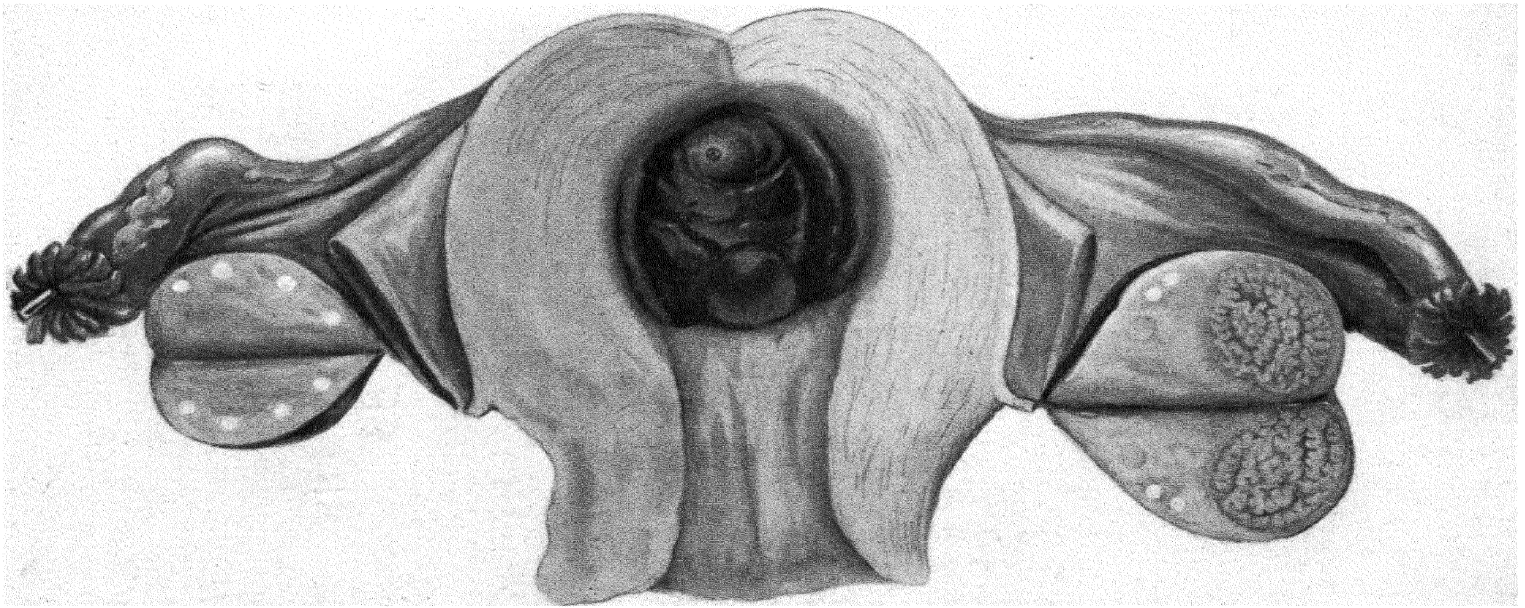


FIG. 25. THE GERM-EPITHELIUM OF THE OVARY IN THE ADULT, AND THE SUBJACENT TUNICA ALBUGINEA THICKENED BY CHRONIC INFLAMMATION (high power).

for descriptive purposes into three areas : (a) *the cortex ;* (b) *the medulla ;* (c) *the hilum.* The *cortex* is the superficial area, crescentic in shape, forming the peripheral part of the gland. Immediately beneath the epithelial covering lies a layer of condensed fibrous tissue, often visible to the naked eye as a pale line, representing the *tunica albuginea.* The cortex contains the Gräafian follicles, and is, therefore, physiologically the most important part of the gland ; morphologically it is distinguished as the *oöphoron* (egg-bearer). The *medulla* lies within the cortex, and is continuous with the hilum. It contains plain muscle, fibrous tissue, nerves, blood-vessels, lymphatics, traces of the medullary rays and of the *rete ovarii,* structures which are well developed in some animals, and which will be referred to later. The *hilum* attaches the ovary to the broad ligament ; through it pass the structures already mentioned as found in the medulla. Upon the surface of the hilum is found the ' white line ' of transition from peritoneum to ovarian epithelium already referred to.

The blood-supply is from the ovarian artery, which runs to the ovary along the outer free edge of the broad ligament, or infundibulo-pelvic fold.

PLATE III



UTERUS (GRAVID) AND APPENDAGES REMOVED IMMEDIATELY AFTER DEATH FROM GANGRENOUS APPENDICITIS. The uterus is opened from the front and shows an early embryo *in situ*. The left ovary contains a corpus luteum of pregnancy. In the right ovary are seen several atresic Gräafian follicles.

To face page 32.

The vessels all enter at the hilum. The lymphatics drain into the lumbar chain of glands on the sides of the spinal column (*see* p. 64).

The nerve-supply of the ovary has been the subject of some dispute, but certain points are now definitely settled. The nerves arise from the sympathetic and enter at the hilum with the blood-vessels, being arranged in definite bundles. Within the ovary they break up into three sets of fibres. One set, *vascular fibres*, accompanies the vessels and is very numerous, forming a network around them. Another set proceeds direct to the follicles, *follicular fibres*, and is disposed concentrically around them, but does not penetrate further than the *theca interna*. The third set is distributed in the interstitial tissues—*interstitial fibres*, and groups of small cells, resembling ganglion cells, are found near them. The function of the ovarian nerves is, probably, in the main vasomotor (Abel and McIlroy).

Histology. The surface of the ovary is covered with a single layer of cubical epithelium, the *germ-epithelium* (*see* Fig. 25). Careful preparation of the tissue is required to demonstrate the existence of these cells, which are very readily destroyed by preparation, but traces of them can be found in almost all cases up to the age of the menopause. The epithelium rests upon a basement-membrane, which in turn rests upon the tunica albuginea, which encloses and protects the body of the gland. The tunica albuginea is not clearly definable until puberty. At first it is thin, consisting only of three layers of cells. In later life it is thickened by the addition of two or three laminæ of fibrous tissue. It cannot be stripped off, as its fibres are continuous with the connective tissue of the cortex.

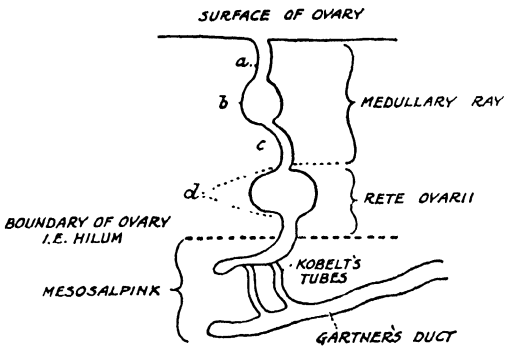


FIG. 26. DIAGRAM TO TRACE THE COURSE OF THE TUBULAR DOWNGROWTH OF GERMINAL EPITHELIUM FROM THE CORTEX TO THE HILUM OF THE OVARY (Goodall) *a*, *b*, *c* = medullary ray. The cortical portion '*a*' atrophies and disappears. The second portion '*b*' becomes the Graafian follicle. The third portion '*c*' atrophies more or less, and may or may not be absorbed. *d* = *Rete ovarii*. From its lower portion several tubules unite into one which passes out of the ovary to join up with the glomeruli of the Wolffian body.

At times there are found in the hilum small imperfect tubules lined with low cubical epithelium, often known as the *cords of Kölliker* or *rete ovarii*. These tubules were long regarded as relics of the embryonic tubules of the Wolffian body, but according to Goodall they are derivatives of the embryonic entoderm of the genital streak. The diagram forming Figure 26 is intended to be explanatory of the latter view; it is to be noted that acceptance of such a theory excludes the possibility of Wolffian cysts being formed within the hilum of the ovary (*see* p. 597).[1]

[1] For further consideration of this subject the student is referred to a paper by Goodall, "The Origin of Epithelial Tumours of the Ovary," *Proceedings Roy. Soc. Med* (Obstet. Section), Vol. XIII., pp. 63–95.

The cortex contains the essential elements of the ovary, the Gräafian follicles; they lie embedded in a stroma, and have special characters. The number of Gräafian follicles present in the ovary of a fœtus at term has been estimated at 10,000. Post-natal formation of follicles never occurs. The stroma is highly cellular; only in two portions, viz. beneath the germ-epithelium and along the lines of the vessels, are connective-tissue fibres to be found. The remainder of the cortex is not fibrillar, but consists of an aggregation of cells, some round, some fusiform, others polygonal, many of which show delicate processes. They contain large, round or oval nuclei, and are to be regarded as modified connective-tissue cells. Their varied characters must be borne in mind in connection with the microscopical detection of inflammatory processes and certain new growths.

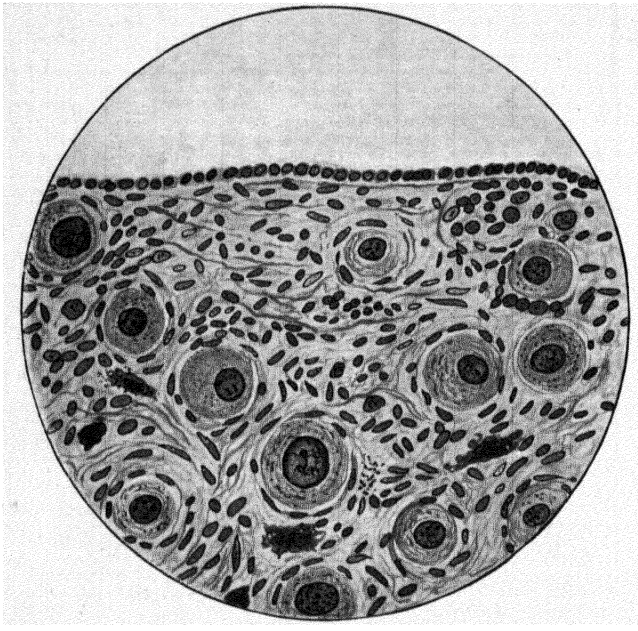


FIG. 27. THE CORTEX OF THE OVARY OF A CHILD (Stevens), showing the capsular epithelium, and the numerous primordial follicles, containing egg-cells.

In lower mammals the interstitial (stroma) cells of the ovary are much larger and more numerous than in the human ovary, and they are probably of considerable physiological importance.

The cortex is divisible into four layers. Externally is the layer of capsular epithelial cells; underneath this comes the *tunica albuginea;* the third layer contains the *primordial* follicles, which are very irregularly arranged and exist in large numbers even in the adult; this gradually merges into the fourth layer, which contains the older follicles, some being visible to the naked eye.

The Gräafian Follicle. The structure of the Gräafian follicle will be best understood by tracing its development from a primordial follicle through the process of maturation up to the formation and retrogression of the corpus luteum.

Primordial follicles are formed at an early period of embryonic life by

the downward growth of small processes from the germ-epithelium into the underlying mesoblast-cells. These processes are attacked by the mesoblast-cells and cut up into small portions, known as egg-nests. These again in turn become further broken up, until finally a large number of structures appear, each of which consists of (1) a large central cell, the oöcyte, or egg-cell; (2) a single layer of flattened epithelial cells surrounding it; (3) outside this a condensed layer of mesoblast-cells, which forms a rough capsule. This is the primordial follicle. Figures 27 and 28 show that at this stage the follicle, which is not visible to the naked eye, contains no fluid and is not separated from the stroma by any clear space. The egg-protoplasm of the primordial follicle has no cell-membrane, it is quite naked and shows a fine network on a clear ground-substance. The egg-nucleus, however, has a definite membrane and contains an eccentric nucleolus. Occasionally two egg-cells are found

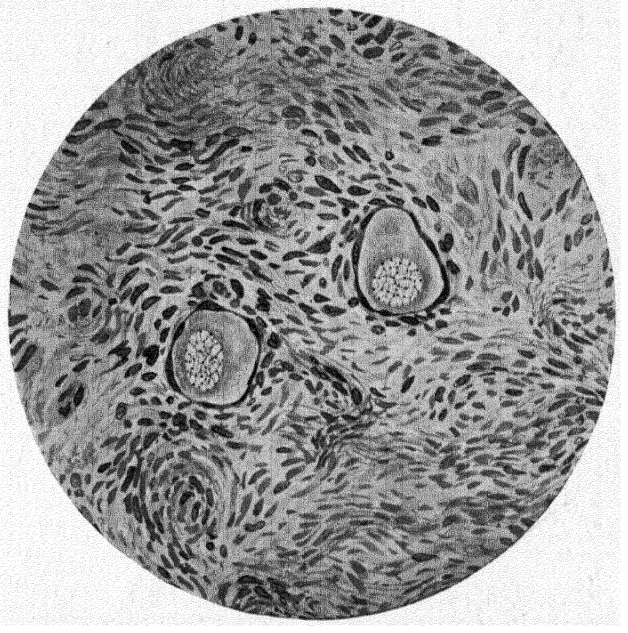


FIG. 28. THE CORTEX OF THE OVARY OF AN ADULT, showing two primordial follicles, containing egg-cells. The stroma is highly cellular.

in a single follicle. In the fœtal ovary none but primordial follicles are found. The primordial follicles lie immediately under the capsular epithelium, never in the medulla.

By the thirty-sixth week of intrauterine life, liquefaction begins to occur in them, and peripherally they become differentiated from the surrounding stroma by a capsule. The liquefaction results in the formation of a thin serous fluid containing albumen: it is called *liquor folliculi.*

Follicles such as the above are present in large numbers after puberty. The majority remain dormant, but some of them undergo a further process of maturation, ending in rupture, and upon this depends the important function of ovulation. Mature follicles are seldom found until after puberty; certainly no corpora lutea have ever been found before this age. It follows

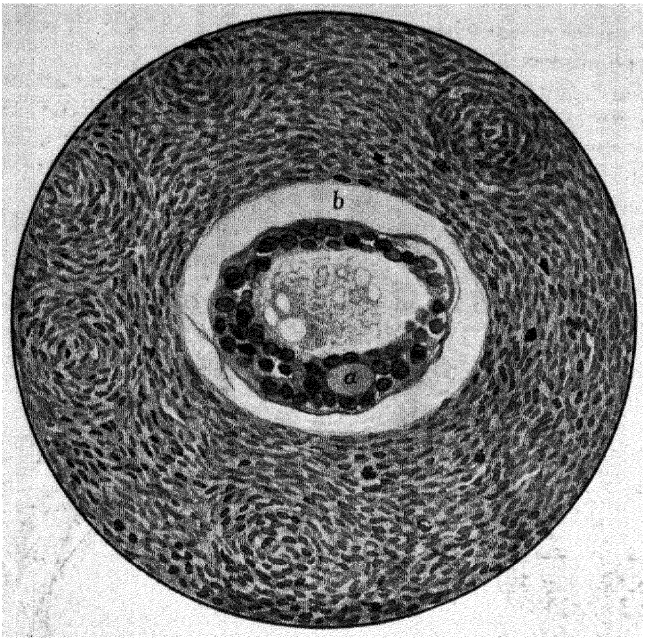


FIG. 29. GRÄAFIAN FOLLICLE FROM THE OVARY OF AN ADULT. The large clear cell, *a*, is the egg-cell; the central space is occupied by liquor folliculi. At *b* is seen the double layer of cells forming the membrana granulosa. The shrinkage from the wall of the follicle is the result of hardening the tissue.

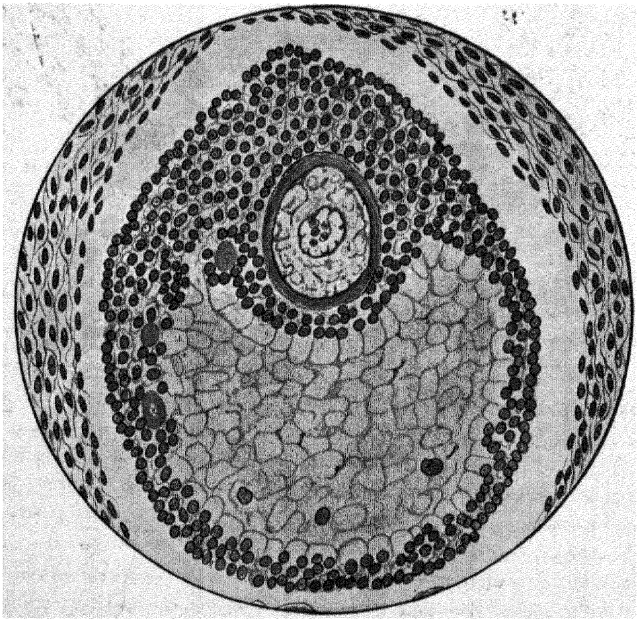


FIG. 30. RIPENING GRÄAFIAN FOLLICLE (Stevens). An early stage showing the formation of the liquor folliculi by liquefaction of the membrana granulosa-cells. The egg-cell has greatly increased in size, and the zona pellucida has developed around it.

from what has been said that only in the adult ovary are all three kinds of follicles to be observed.

As a rule, a single Gräafian follicle ripens in one ovary at intervals of about four weeks. The physiological bearings of this periodic process will be again referred to in connection with the theories of menstruation (p. 87). Occasionally two follicles ripen simultaneously, either in the same or, it may be, one in each ovary.

The Process of Maturation. Starting with the dormant follicle the

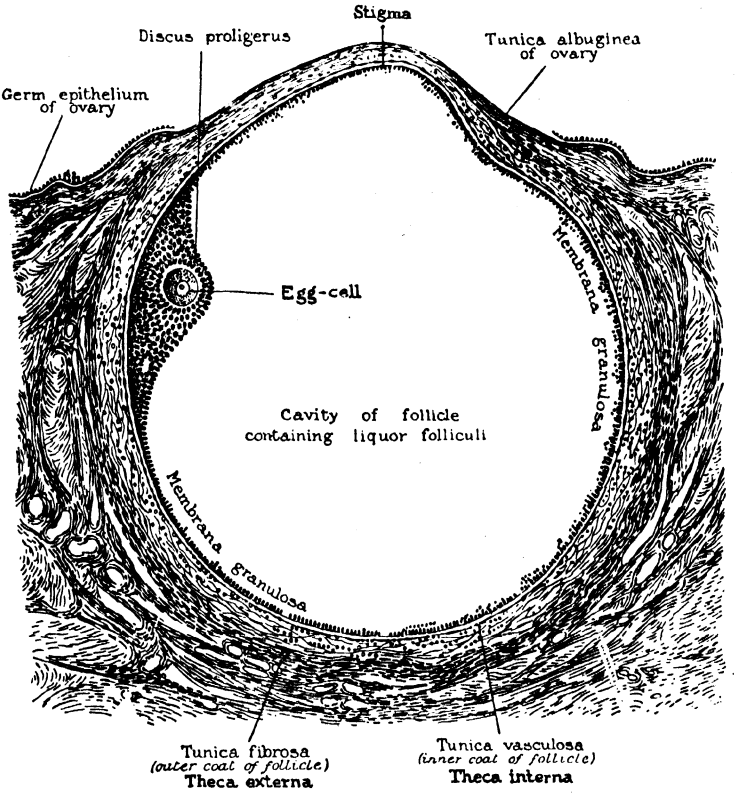


FIG. 31. RIPENING GRÄAFIAN FOLLICLE (LATER STAGE) PROTRUDING UPON THE SURFACE OF THE OVARY (Bumm). The discus proligerus is approaching the stigma.

details of the ripening process are as follows: the central or egg-cell increases in size, and a uniform strong capsule, showing fine radial striation, called the *zone pellucida*, is developed around it (*see* Fig. 30). The zona pellucida is divided from the protoplasm of the egg-cell by the perivitelline space, in which the egg-cell is free to move. The originally central nucleus is now pushed more and more towards the surface of the egg-cell by the development of its cytoplasm. The nucleolus is said to show amœboid movement. The cells derived from the follicular epithelium proliferate freely, forming, at first, a wall of many cell-layers, and later a solid mass of closely packed cells surrounding the egg-cell. As previously stated, liquefaction takes place among these cells, and an eccentric cavity filled with

fluid is produced (*see* Fig. 30). The effect of this change is to divide the cells into two portions: (1) a cluster of protecting cells immediately surrounding the egg-cell so that it never comes into contact with the liquor folliculi, distinguished as the *discus proligerus* (*see* Fig. 31); (2) a stratified layer lining the wall of the follicle, called the *membrana granulosa*. An inter-cellular network has been traced from the cells of the discus to the radial striæ of the zona pellucida, and this is thought to be concerned with the nutrition of the egg-cell.

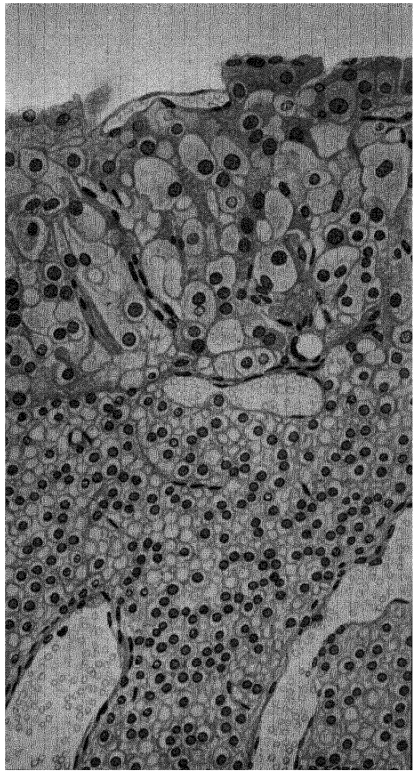


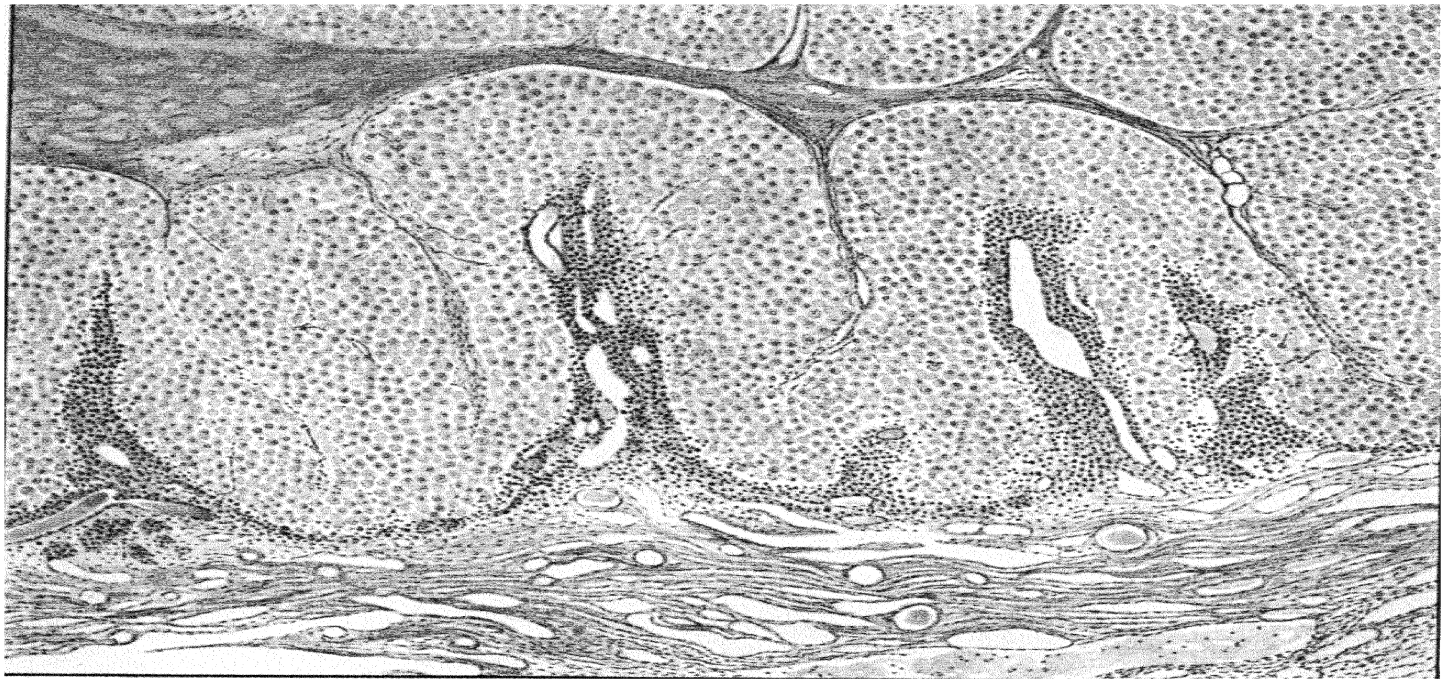
FIG. 32. YOUNG CORPUS LUTEUM (after W. Shaw), showing (A) large polyhedral true lutein cells developing from (B) the granulosa cells. These large cells become yellow in colour due to a fatty or lipoid yellow pigment called "lutein" being deposited within them.

The follicle now increases greatly in size, and the quantity of fluid it contains also rapidly increases. Around the follicle is now formed a capsule consisting of two layers, the outer called *theca externa* or tunica fibrosa; the inner, *theca interna* or tunica vasculosa. This capsule, which is apparent at the thirty-sixth week of intrauterine life, is formed from condensation of the ovarian stroma, which lies in contact with the follicular epithelium.

The next stage in follicular development is the proliferation of the cells of the theca interna and extreme congestion of this vascular coat. The thecal cells increase not only in number but in size, and will be referred to later on as theca-lutein or para-lutein cells. Meanwhile the follicle is enlarging by increase in the liquor folliculi due to transudation from the hyperæmic thecal vessels. It is also approaching the surface of the cortex, and during this migration the site of attachment of the discus proligerus with the egg-cell changes its position, inclining more and more towards the point of future rupture, a pale transparent spot known as the stigma (*see* Fig. 31). At the time of rupture the ovum and liquor escape and the cavity collapses; it does not fill with blood at this stage (W. Shaw). Subsequent events after rupture may be included under a description of—

The Corpus Luteum. The ripening follicle from the moment of rupture may be termed an early corpus luteum. At this time the follicle is lined with granulosa cells outside, which are (1) a capillary network, (2) a zone of granular epithelioid cells—the theca-lutein cells—which have their origin from the theca interna. The next stage in maturation consists in the transforma-

PLATE IV.



CORPUS LUTEUM SHOWING (1) CONVOLUTIONS OF LARGE GRANULOSA LUTEIN CELLS; (2) SMALL THECA-LUTEIN CELLS (PARA-LUTEIN CELLS) SURROUNDING AND ALSO FORMING TUFTS OR SEPTA BETWEEN THE FOLDS OF THE FORMER. The theca-lutein cells are derived from the theca interna or tunica vasculosa. (W. Shaw.)

To face page 39.

tion of the granulosa-cells into the large polyhedral " true " lutein cells (*see* Fig. 32), and these make up almost the entire bulk of the mature follicle. The relationship of these large granulosa-lutein cells to the theca-cells can be seen in Plate IV. It will be noticed that the theca-cells during their proliferation have formed tufts or spurs which project into the lumen of the follicle, and these have come to lie as septa between the columns of granulosa-lutein cells which are proliferating at the same time. Thus both types of lutein cell will be found in the convolutions, but the contribution from the smaller para- or theca-lutein cells is very scanty, nearly the whole of the cavity being occupied by the large " true " lutein cells derived from the granulosa.

Wilfred Shaw describes the early corpora lutea as tiny structures too small in fact to be detected except by means of microscopic examination



FIG. 33. ORGANIZING CORPUS LUTEUM (after Wilfrid Shaw), showing a wide zone of granulosa (true) lutein cells.

of serial sections. Shaw's earliest specimen was obtained within a day or two of rupture (between the fourteenth and seventeenth days after the commencement of the last period); in this specimen the granulosa-lutein cells—true lutein cells—were still proliferating (Fig. 32), showing that the egg-cell had only recently escaped. By the nineteenth day after the commencement of the last period the proliferation of the true lutein cells will have reached its maximum (Shaw), producing a body which is greyish-yellow in colour and which consists of (1) a small cavity lined by (2) a convoluted zone of large clear polyhedral cells, which are invested by (3) a capillary network and by (4) a zone of theca-lutein cells derived from the internal vascular coat of the capsule (*see* Fig. 33).

As stated above, nearly the whole of the corpus luteum is made up of the convolutions of true lutein cells, the thecal cells forming but a thin peripheral zone which projects into and helps to form the convolutions. Some

whilst there seems no doubt whatever that the menstrual and reproductive functions are controlled by the large " true " lutein cells, which are derived from the granulosa cells and which make up the bulk of a corpus luteum.

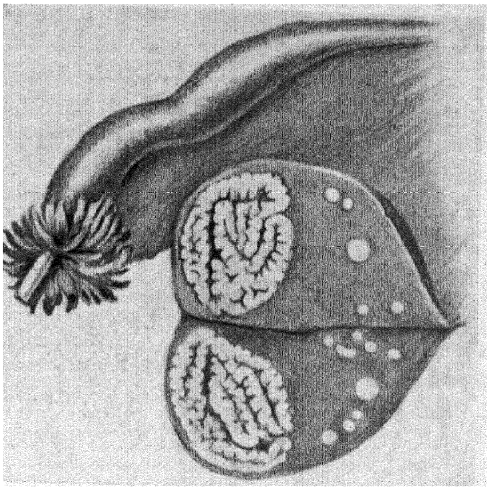


FIG. 35. CORPUS LUTEUM AS SEEN WITHIN 14 DAYS OF FERTILIZATION (*see* Plate III).

The Ovary at Different Periods of Life. It has already been indicated that the structure of the ovary varies at different periods of life. Thus in *childhood* the organ is smooth, solid, about the size of an unshelled almond,

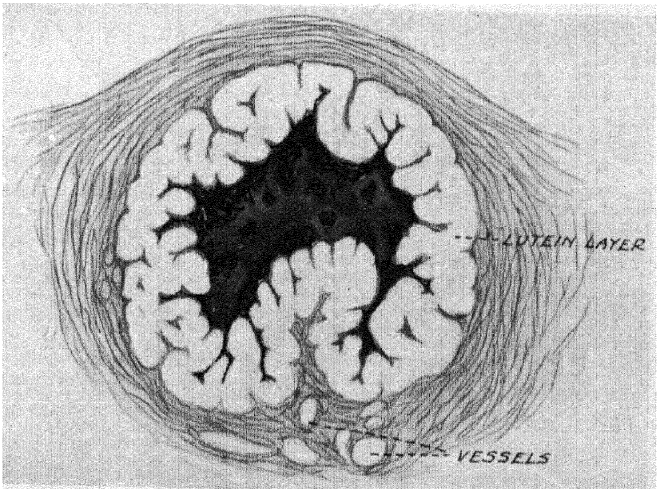


FIG. 36. RETROGRESSIVE CORPUS LUTEUM CONTAINING A SMALL BLOOD-CLOT.

and on microscopic examination is seen to contain a great number of primordial follicles with some complete, and a few imperfectly ripened ones ; but, as Stevens has shown, rupture of these follicles does not occur. In *adult life* the ovary is larger, pinkish in colour, often contains several small

cysts which bulge upon its surface, and microscopically presents large numbers of complete follicles in various stages of the ripening process, in addition to recent or old corpora lutea. The stroma is highly cellular. In *advancing age* the ovary is smaller than at any other period, hard in consistence, white and shrivelled; on microscopic examination no follicles can be found in it, but hyaline areas representing old *corpora albicantia* (Fig. 34), and known as corpora restiformia, together with the remains of atresic follicles such as the corpus candicans and corpus fibrosum, may be seen; the stroma consists largely of well-formed, wavy fibrous tissue, and the arteries show either thickening of their walls or complete obliteration from endarteritis.

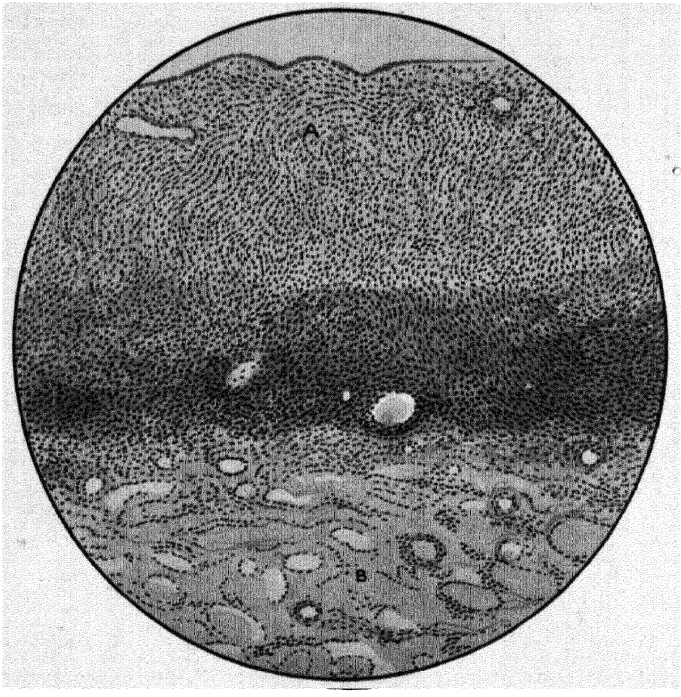


FIG. 37. THE OVARY OF A WOMAN OF 56 YEARS. A, Cortex. B, Medulla. The Gräafian follicles have entirely disappeared. The cortex contains a large proportion of fibrous tissue. The capsular epithelium is flattened instead of being cubical.

The capsular epithelium can sometimes be demonstrated even in old women; the cells are then nearly flat instead of cubical (*see* Fig. 37).

The Epoöphoron or Parovarium. The parovarium or organ of Rosenmüller is a vestigial structure situated between the layers of the upper part of the broad ligaments, usually named the *mesosalpinx*. It corresponds to the epididymis and the vas deferens in the male, and represents the remains of the cranial segment of the mesonephros from which the Wolffian body and its duct are developed. In the broad ligament of an adult woman it can readily be seen with the naked eye by separating tube and ovary from one another, and allowing a good light to pass through the translucent mesosalpinx (*see* Fig. 38). In the child it is ill-formed, but grows steadily thereafter, until in middle life it reaches its highest point of development. It

consists of a varying number of vertical tubules (usually twelve) which appear as blind extremities near the hilum of the ovary, ascend towards the tube and then fuse with a larger horizontal tubule running at right angles to them. The outer end of the latter tubule is blind and sometimes divides into several branches which are named *Kobelt's tubes ;* the inner part passing towards the uterus bends downwards, and running between the layers of the broad ligament reaches the vaginal fornices and may sometimes be traced along the anterior vaginal wall as far as the vulva. This long tube is the homologue of the vas deferens, and is named *Gartner's duct.*

The wall of the epoöphoritic or parovarian tubules consists of plain muscle, and a distinct lumen lined by columnar, ciliated epithelium persists (*see* Fig. 39). Cystic dilatations are not infrequently seen in the adult. The vertical and horizontal tubules of the parovarium proper can almost invariably be found ; the downward prolongation forming Gartner's duct is often absent. Attached to the mesosalpinx below the abdominal ostium

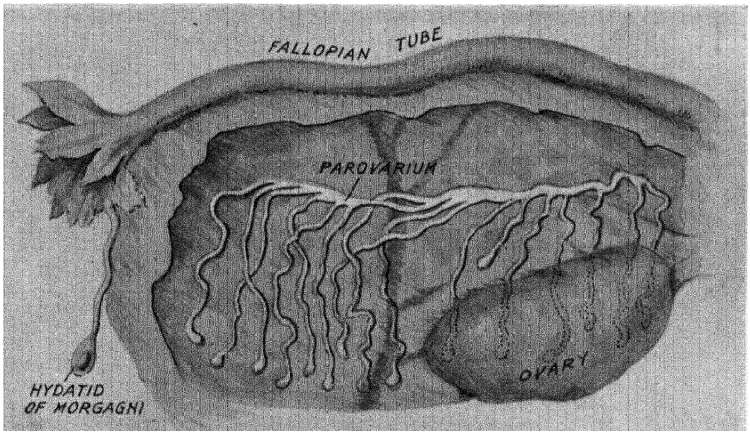


FIG. 38. THE EPOÖPHORON OR PAROVARIUM (ORGAN OF ROSENMÜLLER) EXPOSED BY DISSECTION OF THE MESOSALPINX.

of the tube is usually found a small pediculated cyst the size of a pea—the *Hydatid of Morgagni* (Fig. 38). It represents a degenerate, dropsical, tubal fimbria, and is therefore pronephric in origin (*see* p. 69).

THE FUNCTIONS OF THE OVARY

The outstanding function of the ovary is that of *ovulation ;* the process includes the storage of ova in a condition of latency, the ripening of the protective Gräafian follicles, leading to their rupture and the consequent discharge of the ova into the peritoneal cavity. Upon this function depends the occurrence of gestation and the continuance of the species : it is therefore one of the most important functions of the body. The histology of the maturation and dehiscence of the follicles, and the subsequent repair of injury to the tissues, has already been described. The formation of the corpus luteum is, however, something much more important than a reparative process ; lutein cells are elements as strongly characteristic of the ovary as are Gräafian follicles, for they occur in no other organ and their presence

suffices for the recognition of the tissues in which they are found as ovarian tissue. The corpus luteum is only formed during the sexually mature period of life, and it is closely correlated with the process of menstruation as well as that of reproduction.

It may be regarded as proved that the discharge of the egg-cell occurs at about the fourteenth to the seventeenth day of the menstrual cycle, the calculation being made from the first day of the previous menstrual period. From the seventeenth to the twenty-seventh day of the menstrual cycle the corpus luteum is active, the characteristic lutein cells being developed and maintained in large numbers. During the same part of the cycle the endometrium is undergoing the active changes which have been previously described

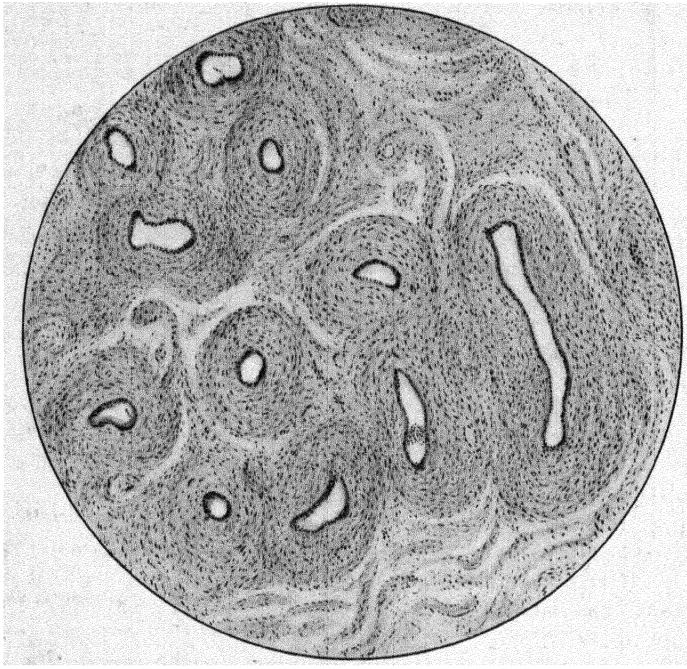


FIG. 39. THE NORMAL EPOÖPHORON OR PAROVARIUM IN TRANSVERSE SECTION × 105. Note the thickness of the muscular walls of the tubules.

as those of the pre-menstrual phase (pro-œstrus). It may be assumed that these and other co-incident changes in the uterus are induced by a hormone produced by the active corpus luteum. If fertilisation has not taken place the corpus luteum undergoes involution and begins to show degenerative changes about the twenty-seventh day; following this, within a period of forty-eight hours, the endometrium undergoes necrotic changes which result in menstrual hæmorrhage and exfoliation. These necrotic changes in the endometrium may conceivably be brought about either by the cessation of production of the activating hormone, or by the production in the involuting corpus luteum of an antagonist which overcomes the activating principle and directly induces the necrosis. On the other hand, if fertilization does occur both the corpus luteum and the endometrium continue their active development, resulting in an increase in size of the former, and in the transformation of the pre-menstrual endometrium into the decidua of pregnancy.

Further, there is now abundant experimental and clinical proof that if the influence of the corpus luteum is withdrawn by excision or destruction in the early months of pregnancy the developing pregnancy ovum will perish and be thrown off. The earliest observation of this kind was made in 1911 by Fraenkel, who, experimenting with pregnant rabbits, found that after destruction of the corpus luteum by ignipuncture, abortion almost invariably followed. His observations have been repeated and amplified by Whitehouse and other workers.

The controlling influence upon pregnancy which the corpus luteum has thus been proved to possess has given rise to the hypothesis that menstruation should be regarded biologically as the abortion of a " false pregnancy." Certain animals, *e.g.*, bitches, after a period of heat which has not led to impregnation, manifest many of the symptoms of pregnancy such as mammary activity and abdominal enlargement, which terminate in a kind of false labour ; it would appear that in these instances a condition of " false pregnancy " definitely arises.

So far the functions of the corpus luteum can be clearly defined. There is also evidence, although it is not so conclusive, that the corpus luteum secretes a third hormone the function of which is to activate the pituitary body. At the same time the passage of the increased pituitary secretion into the circulation is inhibited and storage occurs. The result of the storage is that when the end of pregnancy is reached and the corpus luteum of pregnancy begins to involute, there is a free liberation of pituitary secretion which comes to be present in the circulation in relative excess, and to this excess are attributed, firstly, the activation of the uterine muscle which results in labour, and secondly, the activation of the mammary glands which results in the engorgement of these glands, that is characteristic of the early puerperium.

Hypotheses such as these could obviously only be put to direct test if the active principles were isolated and prepared in a form suitable for experimental work.

A certain amount of progress can now be recorded in this direction. An extract capable of producing " œstrus " in mice, rats, and guinea-pigs, was first isolated in 1922 by Allen and Doisy. Subsequent work has shown that this principle exists not only in the corpus luteum, but also in the Gräafian follicles and in the ovarian stroma. It may be that this principle is present in relatively greater strength in the developing corpus luteum than in any other ovarian element, but this point is as yet unproved. From the corpus luteum has also been prepared (although only in an impure state) an antagonistic principle which is capable of inhibiting the occurrence of œstrus in the animals mentioned above. (Parkes.) It would, therefore, appear that the corpus luteum, when in its developing stage, produces an activating hormone, and when in its involuting stage it produces an inhibiting principle, these two being direct antagonists to one another. It will, perhaps, be possible to demonstrate the truth of this view by preparing separate extracts from the corpus luteum : (*a*) in the developing phase, (*b*) in the involuting phase of its life-cycle. It would appear that this has not yet been done.

It must not be assumed that the production of the internal ovarian secretion is the function solely of the corpus luteum. The œstrus-producing hormone is present in the Gräafian follicles and in the ovarian stroma. It has also been detected in the placenta. There is a certain amount of evidence also that the hormone which activates the pituitary body may be

produced elsewhere than in the corpus luteum. It is at any rate highly probable that the hormone produced by the ovary in the "follicular" phase of its activity, in which the Gräafian follicle is maturing, may be quite different from that produced in the "luteal" phase, *i.e.*, during the development and subsequent involution of the corpus luteum. This is the probable explanation of the striking experimental observation that an immediate liberation of pituitary secretion may be produced in a pregnant animal by the injection of an "ovarian extract," presumably prepared during the follicular phase.

Effects of Removal of both Ovaries. These effects have been studied chiefly in rabbits and guinea-pigs, also to a less extent in cows, cats, dogs, and monkeys; they differ somewhat in different species, and also in individuals of the same species, but they may be generally stated as follows: As regards the *local* effects, the animals cease to go into heat periodically, or to show the periodic proœstrus (rut); the uterus undergoes well-marked atrophy, which affects chiefly the muscular coats, and to a less extent the endometrial glands; the cylindrical epithelium, however, persists. The mammæ also undergo atrophy in most animals. If the ovaries are removed during pregnancy there is a marked tendency to abortion in some animals (rabbits). In addition it is generally agreed that there is a distinct tendency to the excessive formation of adipose tissue.

If the experiment is performed upon young animals (before puberty) the genital organs tend to retain the infantile type, and there is a tendency to overgrowth of the skeleton and of the adipose tissue of the body generally, the animals becoming abnormally large and abnormally fat.

As regards the effects upon the other *endocrine glands*, the experimental work is still incomplete. Fairly definite results have been obtained in respect of the thyroid and the pituitary; in connection with the adrenals, the thymus and the pineal gland, the work is less conclusive.

Thyroid. An enormous increase of colloid takes place, the staining reactions of which are not the same as those found in other enlargements, such as that which accompanies pregnancy and exophthalmic goitre. These changes are more marked in rodents than in carnivora.

Pituitary. Blair Bell claims to have observed indications of increased activity, *e.g.* an increase of the eosinophile cells in the *pars anterior* and *pars intermedia*. Certain facts which have been observed by Marshall and Dixon in studying the interactions of endocrine secretions appear to show that the "active" ovary, *i.e.* one containing a corpus luteum, is able to inhibit the passage of pituitary secretion into the blood-stream. During pregnancy the pituitary is therefore temporarily put out of action under the influence of the large corpus luteum of pregnancy. It is reasonable to suppose that removal of the ovaries in young animals may cause some increase in the pituitary in consequence of the removal of a normal antagonistic force. There is also experimental evidence which suggests that the ovary may produce a stimulating as well as an inhibitory action on the pituitary (*vide supra*).

Clinical observation of the results of the operative removal of both ovaries in women of sexually mature age confirms the experimental findings in several important points. First, complete amenorrhœa and sterility invariably occur if the removal of the ovaries has been complete. Apparent exceptions have been from time to time recorded, and some of these have ultimately been explained by the discovery that a piece of ovarian tissue

remained, due either to the operation having been incomplete, or to the existence of accessory ovarian tissue in an abnormal situation. In all probability, the same explanation holds good for all such cases. A minute portion of ovarian tissue remaining suffices to keep up the menstrual function for a time. Secondly, atrophy of the uterus occurs, although this result appears to ensue much more slowly than in animals. Thirdly, there is often, although not always, a marked tendency to the excessive formation of adipose tissue; but as in animals so in women, this change differs considerably in degree in different individuals.

The Results of Ovarian Grafting. Numerous observations have now been made, both experimentally and clinically, upon this subject, and the results are definite and uniform. The graft is made preferably with a portion of the ovary of the same individual (*autoplastic graft*); it may be made, however, with the ovary of another of the same species (*heteroplastic graft*); experiments with the ovary of a different species have been negative. A thin slice of tissue should be used, and it should be imbedded in the most vascular site available. In animals the subperitoneal tissue and the abdominal wall have been largely used; in women the muscular layer of the parieties has been usually employed. A secondary blood-supply is rapidly formed which maintains the nutrition of the grafts; nutrition in this artificial position is, however, defective, and degenerative changes occur which ultimately destroy the ovarian tissue. The Gräafian follicles are first affected, they become cystic, and their epithelium degenerates; in rabbits the interstitial cells, which are numerous and important, persist much longer than the follicles. That the grafts are functionally active is shown by a series of facts which have been demonstrated by various observers. Thus pregnancy has occurred both in animal experiments and in women (Morris); this is, of course, only possible when the site of the graft permits of the passage of the liberated ovum into the peritoneal cavity. Ovulation has been demonstrated in rabbits, and it has been shown that the uterus does not undergo atrophy as is usually the case after oöphorectomy. In animals previously castrated, ovarian grafts may arrest uterine and mammary atrophy, and even cause these organs again to increase in size, while in castrated monkeys recurrence of the proœstrum has been similarly induced. Clinically it has been shown that ovarian grafts diminish the severity of the climacteric symptoms after oöphorectomy, especially if the uterus has been left so that menstruation may continue (Tuffier). When the uterus has been removed as well, grafting has not much effect upon climacteric phenomena, which fact appears to indicate that these are due as much to the cessation of menstruation as to loss of the internal ovarian secretion.

The existence of an internal ovarian secretion is to be regarded as a well-established physiological fact. It controls menstruation and gestation, promotes the secondary development (*i.e.* after puberty) of the other sexual organs and maintains them in a state of functional activity, influences the general metabolism of the body in certain definite directions, and is also probably correlated in its activities with the internal secretion of certain other members of the class of endocrine glands.

THE VAGINA

The vagina forms the lowest segment of the genital canal and extends from the vaginal portion of the cervix to the vulva. Normally its anterior

and posterior walls fall in and come in contact with one another, so that the lumen is represented by a transverse slit wider at the sides than in the middle. When distended it becomes roughly cylindrical. The general direction of the vagina is from above downwards and forwards, with a slight anterior concavity. The posterior wall is accordingly rather longer than the anterior—4 inches and 3 inches respectively. The vagina is surrounded by a vascular connective-tissue sheath (which contains some plain muscle fibre, also *vide infra*), which is thicker in a nulliparous than in a parous woman. The upper extremity of the vagina, being closed by the cervico-vaginal junction, is often called the roof. It is partly inverted by the cervix, which projects into the centre of the canal. Round the cervix the vaginal walls are arched, *i.e.*, concave, and four sections are distinguished, called respectively the anterior, posterior, right and left *vaginal fornices*. Of these, the posterior is the deepest and most capacious. The anterior is the shallowest, the lateral fornices being intermediate in depth. Immediately behind and above the posterior fornix lies the pouch of Douglas. Immediately above the anterior fornix lies the bladder (*see* Figs. 1 and 2). The lateral fornices are in contact with the masses of cellular tissue filling up the bases of the broad ligament.

The lower extremity is continuous with the vulva at the *ostium* or *introitus vaginae*. In the virgin, this end is partly closed by the hymen which indicates the vulvo-vaginal junction. In the parous woman, the transition from vagina to vulva is not sharply defined, and the hymen has disappeared. As a rule the entrance to the vagina is concealed by apposition of the labia; when the perineal body has been extensively damaged, however, the lower end of the vagina remains open.

The anterior vaginal wall, in its upper half, comes into relation with the base of the bladder; in its lower half, the urethra is closely united to it. The bladder is usually separable from the vagina owing to the connective-tissue and muscular strata which lies between them. The muscle-sheet intervening between the bladder and vagina is formed by the pubo-cervicalis muscle which forms the central part of what Bonney terms the anterior "pelvic shelf." In the para-vaginal connective tissue Bonney claims to have discovered a muscle-sheet which extends from the cervix and transverse cervical ligaments down to the junction of the middle and lower thirds of the vagina (*see also* p. 509). The urethra, in its lower two-thirds, is closely incorporated with the outer layers of the vaginal wall and can only be separated by cutting. The posterior vaginal wall is related in its upper one-third to the floor of the pouch of Douglas (*see* Fig. 1); in the middle one-third to the rectal ampulla, and its lower one-third to the perineal body. Under normal conditons it is separated from all these structures by a layer of cellular tissue. In parous women, owing to infection of cellular tissue following obstetric lacerations, firm union may occur between the rectal and vaginal walls. The ureters lie in close relation to the lateral and anterior fornices (*see* Fig. 18). When thickened, as in tuberculous disease, they may be palpated in this situation. The uterine and vaginal arteries run close to the upper part of the lateral vaginal walls, where their pulsation may often be distinctly felt.

In the nulliparous woman both anterior and posterior walls are crossed on their mucous surface by transverse folds, or rugæ, which are most pronounced in the lower one-third of the anterior wall. After repeated child-

bearing, or when stretched from prolapse, these become wholly or partly obliterated. In some cases a median ridge runs vertically along both anterior and posterior walls. It is called the *median vaginal column.* In the fœtus the transverse folds are more pronounced and more numerous than in the adult, and the median columns are well marked (*see* Fig. 20, p. 26).

Structure. The vaginal walls consist of three layers: (1) epithelium; (2) sub-epithelial connective-tissue; (3) muscle (*see* Fig. 40).

The vaginal *epithelium* is of the stratified squamous type, resembling skin, and three layers of cells can be distinguished in it. The deepest layer consists of one or two rows of low columnar cells with single large nuclei. Above these lie several layers of typical prickle cells. Near the columnar layer these are small and closely packed together. Nearer the surface, they are larger and more definitely polygonal, with ladders between them, formed by the united processes of contiguous cells. The superficial layers consist of flattened cells with few nuclei and indistinct outlines, *i.e.* cells that have undergone keratoid changes. Many layers of degenerated cells may be seen in process of separation from the surface. Many of the cells in this layer are vacuolated.

As a rule there are no glands to be found in the vaginal mucous membrane, but elementary glandular structures have in a few instances been detected by different observers. These may, however, have been derivatives of the lower part of the Wolffian duct, or may have been formed from the basal layer of the stratified epithelium in inflammatory conditions (*see* p. 343).

The sub-epithelial *connective-tissue* is dense and fibrous in character, and from it well-marked digitate processes pass upwards into the deep layers of the epithelium. Sometimes, on the other hand, the deep surface of the epithelium sends out shallow digitate processes, which project into the sub-epithelial tissues. This is especially well marked on the vaginal portion of the cervix (*see* Fig. 297, p. 471). This layer contains numerous vessels of large size.

The *muscular* layer consists in the main of circular fibres of plain muscle. Longitudinal fibres are also found outside these, but are relatively ill-developed. Outside the muscular wall is a loose sheath of connective-tissue in which fibres of the levatores ani are found in the lower one-third of the vagina, and muscle fibres continuous with the longitudinal serous lamina of the uterine muscle in the upper two-thirds. The vaginal arteries and their companion veins also run in this loose fibro-muscular sheath.

The Vaginal Secretion. This consists mainly of a transudation through the epithelial layer from the blood-vessels. A certain amount of admixture of secretion from the cervix also takes place. Its naked-eye characters are variable. In children and in healthy nulliparous women it forms a whitish, flaky material of pultaceous consistence, which is especially abundant in the fornices, and resembles smegma. It is faintly acid in reaction. In parous women with a patulous vaginal ostium, this kind of secretion is not seen. In the case of most parous women the secretion is thin, yellowish-white in colour, and neutral or alkaline in reaction. On microscopical examination the secretion is seen to contain epithelial squames, leucocytes, bacteria, and cellular *débris.*

The bacteriology of the vaginal secretion has been the subject of much dispute, but the following points appear to be now fairly well settled.

(1) In the white, flaky, acid secretion of children, virgins and healthy pregnant women, a specific bacillus can be found, the *Vaginal bacillus* of Döderlein. This organism grows only in acid media, and lactic acid can always be found in the secretion when it is present. Döderlein's view was that lactic acid was produced by the bacillus in its growth, by a fermentative process. More recently, however, it has been shown that this substance is present in the contents of a hæmatocolpos, which are sterile and contain no organisms whatever. This would seem to indicate that lactic acid *may be* produced without the aid of bacterial action, but the conditions in a closed hæmatocolpos differ so widely from those of the open vagina that conclusions drawn from the one cannot be applied to the other.

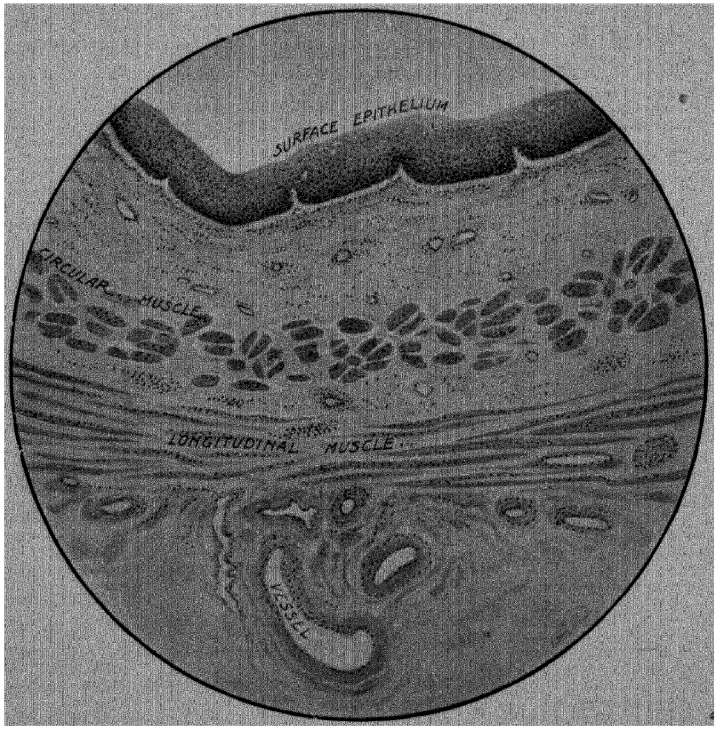


FIG. 40. LONGITUDINAL SECTION THROUGH THE VAGINAL WALL.
Taken near the upper end of the canal.

(2) Pyogenic organisms are also sometimes found in the secretion of apparently healthy women; it is doubtful whether they are really pathogenic, they appear to exist as saprophytes, and to be incapable of producing infection when inoculated in animals.

(3) The healthy vaginal secretion probably plays a protective *rôle*, antagonizing such bacteria as the pyogenic cocci, either by destroying them or by inhibiting their activity. By its discoverer, the vaginal bacillus was regarded as the active protective agent of the secretion, and to it was attributed a bactericidal power, which was exerted by maintaining an acid reaction in the secretion. If lactic acid can be produced in the secretion independently of the bacillus this view must be modified.

(4) Under certain circumstances, and especially when for any reason the secretion becomes alkaline, saprophytic organisms present may become capable of renewing their virulence, or other organisms introduced from without may grow, multiply, and perhaps spread to the upper parts of the genital tract This in part accounts for the unusual liability of the genital tract to infection during menstruation, child-birth and the early puerperium.

From the bacteriological point of view the genital canal may be divided practically into two parts, one containing bacteria, and the other being sterile. The former includes the vestibule, vagina, and lower part of the cervical canal, the latter the upper part of the cervical canal, the uterine cavity, and the tubal lumina. The sterile condition of the upper portion is explained by (1) the plug of mucus which lies in the cervical canal and which, owing to its poorness in albuminoids, furnishes no nutriment for micro-organisms, (2) the leucocytes which are found in great numbers in the cervical secretion at the level of the internal os, and act as destroyers of bacteria.

THE VULVA

The following parts have to be described in connection with the vulva: the mons Veneris, the labia majora, the labia minora, the clitoris with its prepuce, the vestibule with the urinary meatus, the ostium vaginæ, the hymen and the perineal body.

The **labia majora** are antero-posterior folds developed by duplication of the skin at the sides of the cloaca (p. 75), from the pubes they run backwards and gradually become lost at the sides of the perineal body. They are only seen in their fully developed state in the period of life characterized by sexual activity, when they contain a large amount of subcutaneous fat. They then form thick folds, apposed to one another in the middle line, and passing anteriorly into a pad of skin and subcutaneous fat which covers the pubes, and is known as the *mons Veneris*. The outer surfaces of the labia, and the whole of the mons Veneris are covered with hair, which first appears at puberty, and after the climacteric becomes grey and scanty, and may almost entirely have disappeared as old age is reached. The usual shape of the hirsute area is triangular, the base lying about $\frac{1}{2}$ inch above the symphysis, the apex at the perineal body. Sometimes in brunettes the hair extends upon the anterior abdominal wall in triangular form nearly to the umbilicus, thus simulating the male type

In children and old women the labia majora are thin, from lack of subcutaneous fat, and the labia minora or the ostium vaginæ may then be exposed. In adult women the thighs may be widely abducted without separating the labia majora from one another. The inner surfaces are covered with a thin soft skin which approximates to mucous membrane in naked-eye appearances.

In structure the labia closely resemble the general integument of the body. They are provided with large numbers of compound, acinous, sebaceous glands which are abundant even on the non-hairy parts, and are often visible there to the naked eye. There are also a few sweat-glands, which, however, are poorly developed.

The **labia minora** or **nymphæ** are a pair of thin folds of soft skin which lie within the great labia, and form the lateral boundaries of the ostium vaginæ (*see* Fig. 41). They are crescentic in outline and are united posteriorly by a

transverse fold, the *fourchette*. Anteriorly each nympha splits into two folds; the anterior pair of folds fuse and pass in front of the clitoris, forming its *preputium;* the posterior pair fuse and pass behind it, forming its *frenulum*. The nymphæ are free from hair, and in brunettes they are often deeply pigmented; in children they appear relatively large and prominent owing to the undeveloped condition of the greater labia. Structurally they consist

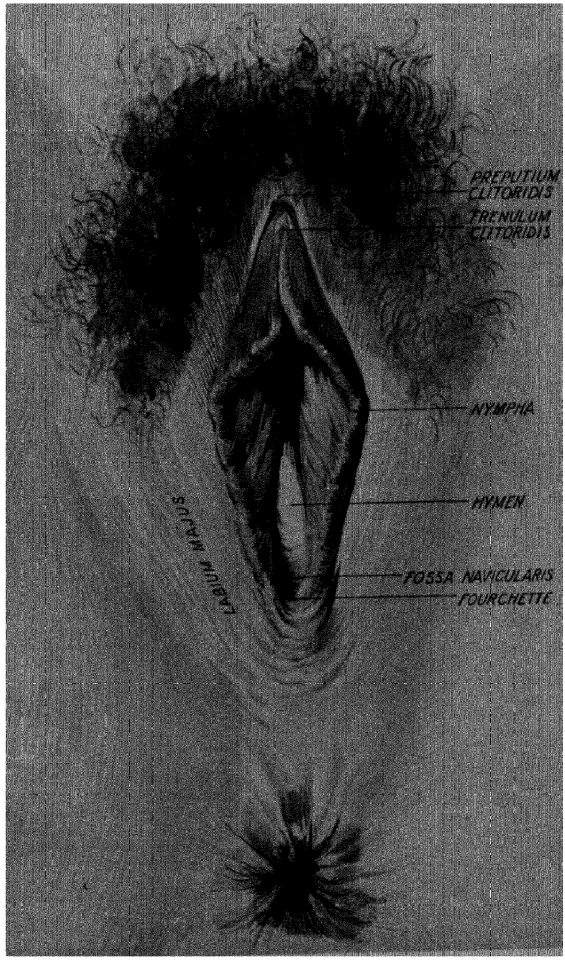


FIG. 41. THE VIRGIN VULVA. (From a photograph.)

of skin richly provided with sebaceous glands; these are often visible to the naked eye in the form of pale, slightly elevated, round areas.

The **vestibule** is the adult relic of the fœtal *urogenital sinus* (Fig. 63, p. 74). It is a triangular area, the apex, directed anteriorly, being formed by the clitoris, the sides by the nymphæ, and the base by the anterior border of the ostium vaginæ (*see* Fig. 42). The urinary meatus lies near its base in the mesial plane. The depth of the vestibule from the surface depends upon the thickness and prominence of the labia, which always conceal it. In pass-

ing the catheter this area must be exposed so as to be clearly seen, and to do this it is necessary to hold the anterior portions of the labia apart.

The **clitoris** is the rudimentary homologue of the penis. It forms a small structure consisting of a *glans* about the size of a split pea, and a small *body* of variable length attached to the pubes by a pair of *crura*. Folds from the nymphæ form a hood which covers, and sometimes entirely conceals the glans—the *preputium clitoridis*. The glans is composed of erectile tissue, abundantly supplied with sensory nerves; it receives its blood-supply

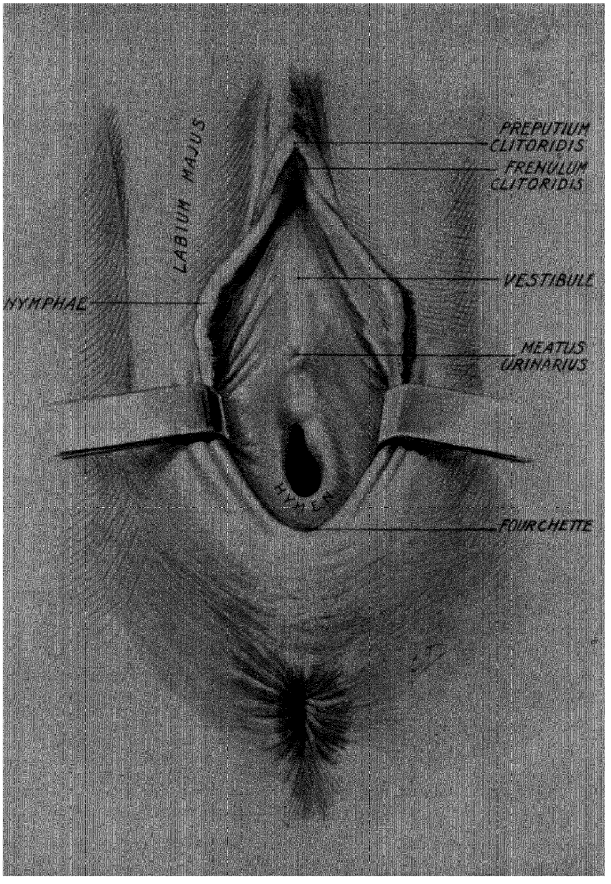


FIG. 42. THE VIRGIN VULVA AFTER SEPARATION OF THE LABIA.

through the artery to the clitoris, a special branch of the internal pudic. This vessel may be the source of serious hæmorrhage when lacerated. Secretion may collect beneath the preputium causing local irritation, and sometimes the margins of the folds adhere to one another so that the clitoris cannot be exposed.

The **ostium** or **introitus vaginæ** is the entrance to the vaginal canal; it lies at a deep but variable level from the surface of the apposed labia. In virgins the ostium is partly closed by the hymen (*see* Fig. 42); in married women the hymen is found lacerated or stretched, and the ostium is easily

dilatable; in the case of women who have sustained local injury in childbirth the ostium is enlarged and patulous (*see* Fig. 44). The *hymen*, a membrane developed from Muller's prominence (p. 68), is of average thickness of about $\frac{1}{3}$ inch, and is attached to the posterior one-half or two-thirds of the ostium vaginæ, having usually a free, crescentic, anterior border which bisects the ostium. In front of this free border lies a space giving entrance to the vaginal canal (*see* Fig. 42). Between the posterior border of the hymen and the fourchette is a small area which, when the nymphæ are separated, forms a shallow oval depression—the *fossa navicularis*. In parous women this fossa is not seen, for even slight puerperal lacerations destroy it.

Structurally the hymen is composed of well-developed but very vascular connective-tissue. On both its vaginal and vulval surfaces it is covered with stratified squamous epithelium (*see* Fig. 43).

The shape and character of the hymen are very variable. It is sometimes

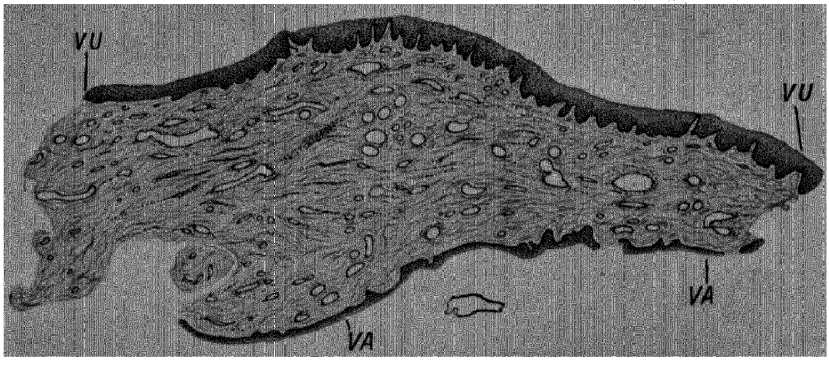


FIG. 43. SHOWING A SECTION OF THE HYMEN. On the vulval aspect there is a well-developed layer of stratified epithelium, and on the vaginal aspect a much thinner layer. Between the two epithelial surfaces there is a thick stratum of connective-tissue carrying numerous blood-vessels and nerves. The inset shows the actual thickness of the hymen. *VU*, Vulval aspect; *VA*, Vaginal aspect.

attached all round the margins of the ostium vaginæ; it may then have either a central aperture, or two lateral apertures separated by an antero-posterior fold of membrane, or a number of small openings irregularly distributed—*cribriform* hymen. Sometimes no aperture at all exists, so that the vagina is completely closed by it below—*imperforate* hymen (*see* Pl. VII., p. 151). The strength and dilatability of the hymeneal membrane are variable; it may be so elastic as to stretch without laceration during coitus; on the other hand, it may be so resistant that its removal is necessary before coitus can be completed. It follows that the presence of an entire hymen is not medico-legal evidence of virginity. In married women the hymen is, however, usually found divided by sulci into three or four portions, which have shrunk into small folds. In parous women these folds have further diminished, and appear as small sessile tubercles, several of which can be found around the ostium; they are called the *carunculae myrtiformes*.

Certain muscles in relation to the ostium vaginæ provide for it a kind of sphincter ; these are the anterior or pubic fibres of the levator ani, and the superficial perineal muscles. By voluntary action these muscles can constrict the ostium, and from reflex irritation, spasmodic contraction may occur giving rise to the condition known clinically as *vaginismus* (*see* pp. 126 and 332).

Bartholin's Glands. Bartholin's glands are a pair of small, oval, glandular structures about $\frac{1}{2}$ inch in diameter, lying at the sides of the lower end of the vagina, beneath the superficial perineal fascia at the posterior end of each vestibular bulb (*see* Fig. 45). They are the homologue of Cowper's glands in the male.

Under normal conditions the gland of Bartholin cannot be felt, but when

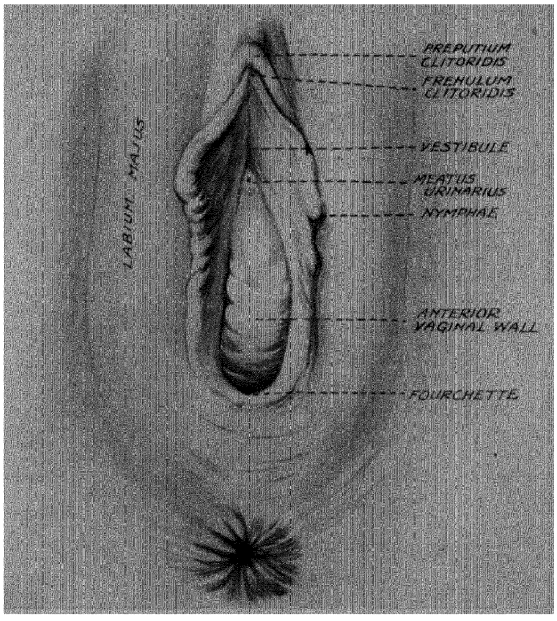


FIG. 44. THE VULVA OF A MULTIPAROUS WOMAN. (From a photograph.) The anterior vaginal wall is prolapsed (cystocele).

indurated and enlarged by chronic inflammation, as frequently occurs in gonorrhœa, it can be palpated by pinching up the tissues at the sides of the vulva between the finger passed inside and the thumb outside. The gland lies deeply, near the ascending ramus of the ischium (*see* Fig. 45), and can often be felt there as a hard, movable body, the size of a haricot bean. Each gland has a single, long narrow duct (*see* Fig. 46) which opens laterally at the base of the hymen. The mouth of the healthy duct may often be detected by the presence of a minute drop of clear secretion ; otherwise it is very inconspicuous, unless reddened by inflammation.

The gland itself is a compound racemose structure enclosed in a fibrous capsule, from which arise numerous septa composed of well-formed fibrous tissue, subdividing the gland (*see* Fig. 47). Both simple and compound tubules are present. The epithelium is columnar ; the nuclei stain well

and are situated at the base of the cells. There is a well-formed basement-membrane. In many tubules the epithelium is in more than one layer, but in the majority there is only one row of cells. The cell-protoplasm is very granular, but does not stain deeply. Many minute collecting ducts are seen among the tubules, and these are lined with several layers of epithelium of the low cubical type. In general appearance a section of Bartholin's gland is not unlike that of a salivary gland.

The main ducts have an epithelium of variable type. In the deeper parts it consists of a single row of well-formed columnar cells; in more superficial parts it is stratified, and of the transitional type which is characteristic of the epithelium of the urinary passages. Sometimes the transition from one type of epithelium to the other is quite sharp. Into the deeper parts of the duct a few compound, racemose glands rich in goblet-cells may be seen to open. They no doubt produce mucus.

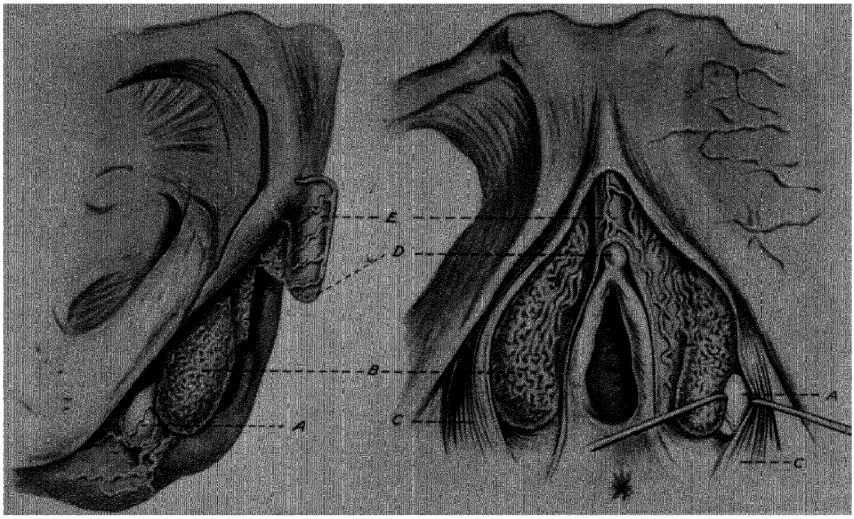


FIG. 45. LATERAL AND FRONT VIEWS OF THE GLAND OF BARTHOLIN AND OF THE ERECTILE STRUCTURES OF THE EXTERNAL ORGANS. *A*, Gland of Bartholin; *B*, Bulbus vestibuli; *C*, Sphincter vaginæ muscle; *D*, Glans clitoridis; *E*, Body of clitoris. (After Morris.)

The secretion of the Bartholin glands is a clear, thin mucus of alkaline reaction. Its function is probably merely that of a lubricant of the vulva.

The **perineal body** is the mass of tissue which separates the vulva and lower part of the vagina on the one hand, from the anal canal and rectum on the other, filling up the space left by the divergence of the lower ends of the alimentary and genital canals (*see* Figs. 1 and 2). It represents the lower part of the urorectal septum, which divides the cloaca into an anterior (genito-urinary) and a posterior (intestinal) segment (*see* Fig. 62, p. 74). It is triangular in shape, the base being formed by the cutaneous surface, the apex passing upwards to the point at which the rectal and vaginal canals come into apposition, about 1½ inches above the anus. It is composed of muscular, fibrous, and fatty tissues; its base is covered with skin; its anterior wall is formed by the vagina, its posterior wall by the rectum.

When intact the skin-surface measures about 1½ inches from the anus to the fourchette.

THE URETHRA

The urethra in the female is a short canal measuring 1½ inches in length; being slightly constricted both at the meatus and at the neck of the bladder,

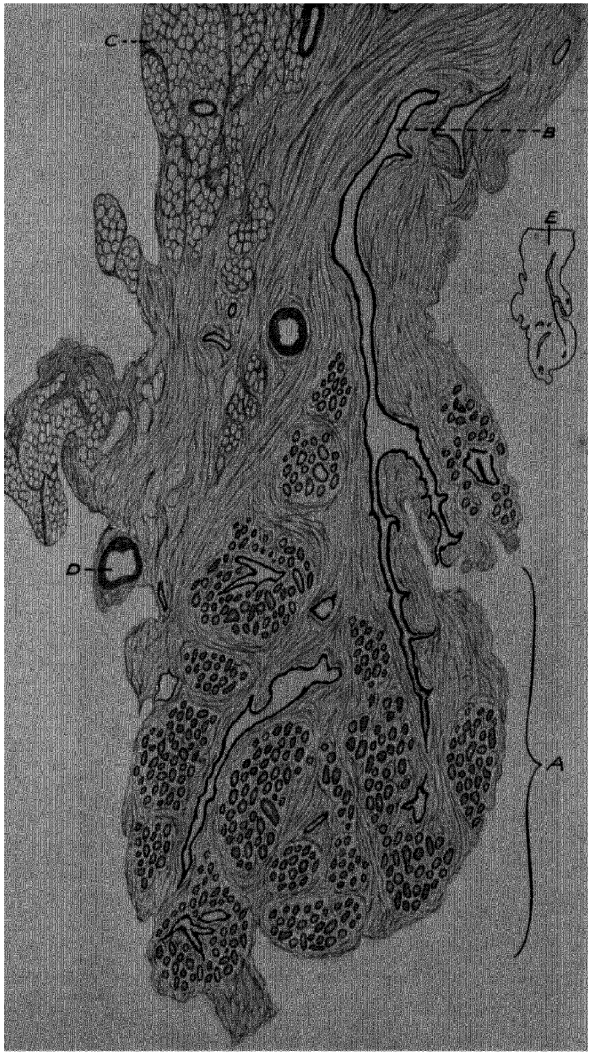


FIG. 46. A, Bartholin's gland; B, Bartholin's duct; C, fatty tissue of vulva; D, branches of internal pudic artery, which correspond to the artery to the bulb in the male; E, inset to show actual size of the microscopic slide. The portion forming the gland is about the size of a pea or small horse-bean.

it is roughly spindle-shaped (*see* Fig. 1). Its general direction is downwards and forwards, with a slight anterior curve. In its lower two-thirds it is closely related to the anterior vaginal wall, so that a single thick stratum of

tissue separates the lumen of the urethra from that of the vagina; in the upper one-third a layer of loose cellular tissue intervenes, allowing the two to be separated readily from one another by blunt dissection. Structurally the urethra consists of muscular, submucous, and mucous coats. The *muscular coat* consists of plain muscle arranged in two layers, the outer circular, the inner longitudinal; in addition, according to some anatomists, an external layer of striped muscle exists derived from the sphincter vaginæ muscles, and forms a urethral sphincter. The *submucosa* consists of highly vascular connective-tissue containing a large proportion of elastic fibres, and carrying the deep portions of the urethral glands. The *mucous membrane* is thrown into a number of longitudinal folds and consists of stratified epithelium resting directly upon the submucosa. The superficial cells are squamous near the extremities and columnar in the middle of the canal; the deeper cells throughout are cubical and are arranged at right angles to the surface. The urethra is furnished with numerous glands which have been carefully described by Williamson and Attlee. They surround the urethra (peri-urethral), and are most numerous in the neighbourhood of the meatus. They are mostly compound racemose glands opening by a single duct upon the urethral mucosa, the deeper portions being lined by columnar epithelium. Near the meatus the ducts are often dilated, forming visible crypts. A specially developed pair of these glands, which open upon the

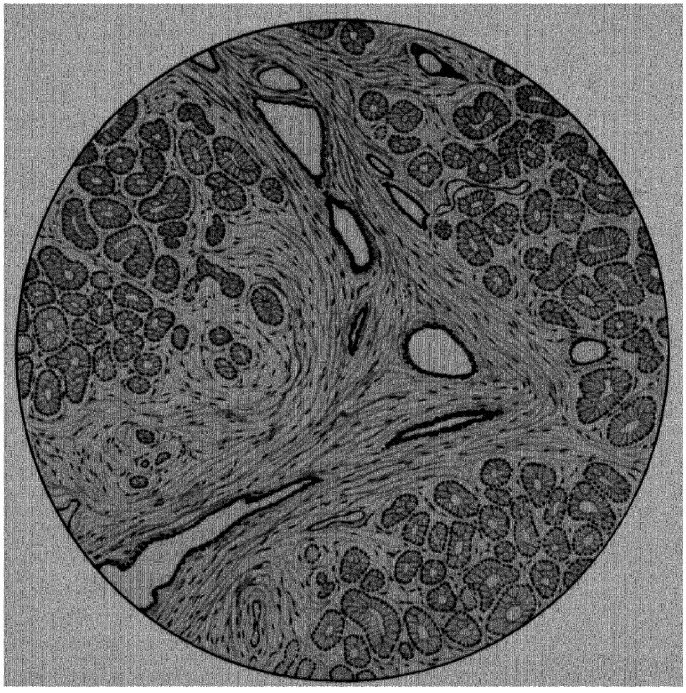


FIG. 47. TRANSVERSE SECTION THROUGH BARTHOLIN'S GLAND, showing tubules lined by columnar epithelium. The branching or racemose arrangement is shown in the section. The branches of the duct are lined by low cubical epithelium which, towards the commencement of the duct, becomes squamous.

floor of the urethra just within the meatus, are known as Skene's tubules. Morphologically the peri-urethral glands are the homologue of the prostate in the other sex.

An important characteristic of the urethra is its dilatability, which is mainly due to the large amount of elastic tissue in its walls and to the longitudinal folds of the mucosa, which during dilatation become obliterated and so enlarge the superficies of the membrane. The width to which the urethra can be dilated without laceration is variously estimated at from 13 to 30 mm. (roughly $\frac{1}{2}$ to 1 inch).

THE BLADDER

The position and relations of the bladder are subject to constant change owing to the ceaseless alternation of its systole and diastole. In the fœtus and the young infant it is entirely an abdominal organ (*see* Fig. 20) and is somewhat spindle-shaped, tapering above into the urachus, below into the urethra. In the adult it is, when empty, entirely a pelvic organ In distending within the normal limits it enlarges chiefly in the antero-posterior and transverse planes, displacing the uterus backwards, and filling the upper part of the pelvic cavity (*see* Fig 4): when over-distended it encroaches upon the abdominal cavity, and in extreme cases may form a swelling palpable *per abdomen* up to the level of the umbilicus The average fluid-capacity of the bladder, tested in twenty-five normal individuals, was found by Guy L. Hanna to be 130 c c. (about 14 ounces). The internal urethral orifice lies about $1\frac{1}{2}$ inches below the level of the pelvic brim.

The empty bladder is shown *in situ* in Fig 1. It lies between the uterus and the symphysis pubis, and is covered above by the peritoneum forming the floor of the utero-vesical pouch. The body of the uterus, when anteverted, rests upon the bladder. The bladder, commencing to distend, is shown in Fig. 2; the level of the utero-vesical pouch has risen, and even more apparent is the increase in the transverse dimension of the organ.

The only part of the bladder which has firm attachments is the base, which is supported in its entire extent by the pelvic fascia, and at the sides receives support also from the pubic portions of the levator ani muscles (*pubo-coccygeus*). The base of the bladder has no peritoneal covering, but the peritoneum completely clothes the sides and upper part of the organ when empty. The base of the bladder is related in front to the back of the pubes, below to the anterior vaginal wall, and behind to the anterior uterine wall near the junction of the cervix and the body. Planes of loose cellular tissue are found in these situations, which allow of the easy operative separation of the base of the bladder from the adjacent organs. The relations of this part of the bladder are little affected by diastole and systole. As the result of parturient injury or stretching of the pelvic floor, the bladder may become prolapsed between the fibres of the pubo-cervicalis muscle and the lateral bundles of the levator ani, pushing the anterior vaginal wall in front of it (cystocele, *see* pp. 509, 537, 736).

The relations of the top and sides of the bladder vary with the degree of distension. The lateral reflections of the peritoneum are raised considerably, so that a part of each side of the bladder is laid bare of peritoneum; behind and in front the peritoneal reflections are much firmer, so that a peritoneal pouch is maintained between the bladder and the abdominal wall in front and between the bladder and the uterus behind. Between the anterior

peritoneal reflection and the abdominal wall and symphysis, there is a space filled with loose cellular tissue continuous with that surrounding the cervix and pelvic cellular tissue generally. This space is called the *cavum Retzii*. In a case of extreme distension, the level of the anterior reflection may be raised from the abdominal wall for 2 inches, but it is not possible for the peritoneum to be stripped off the uterus to anything like this extent. In all conditions the base of the bladder can be reached through the upper one half of the anterior vaginal wall.

The wall of the bladder consists of mucous, submucous, and muscular coats, all three being readily distensible.

The mucous membrane, when the organ is empty, is thrown into numerous folds and rugæ; even when distended it appears rugose from the

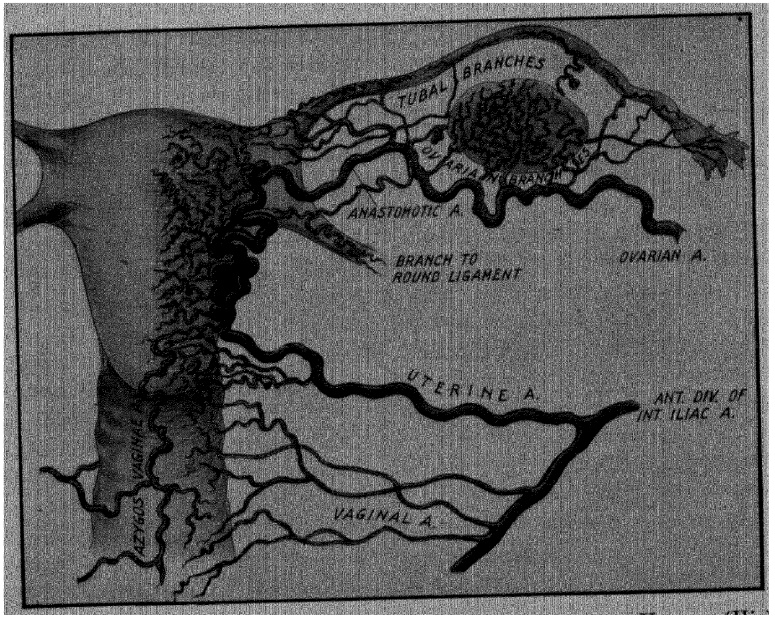


FIG. 48. THE ARTERIAL BLOOD-SUPPLY OF THE UTERUS AND VAGINA (His).

columnar arrangement of the subjacent muscular fibres. A portion of the base of the bladder is, however, smooth both in systole and diastole; this portion is triangular in shape and is outlined by the urethral aperture in front and the two ureteric apertures behind; it is called the *trigone* (*see* Fig. 5). The internal urethral opening forms a depression surrounded by a ring of mucous membrane, which is crossed by radiating folds. The ureteric apertures are narrow, oblique, valvular slits directed from behind forwards and towards the middle line. Between them runs a narrow ridge of mucous membrane called the *inter-ureteric fold*. At each side of the trigone is a shallow pouch, the *paratrigonal fossa*. The part of the base from which the urethra arises is sometimes called the *neck* of the bladder.

The epithelium of the bladder is of the transitional type, and there are no glands. The submucous connective-tissue is abundant except at the trigone, where the mucosa is firmly attached to the muscular layer. The bladder-muscle is arranged in three layers, the outer longitudinal, the inner circular, the middle reticulated.

The bladder-wall is very vascular and bleeds freely when cut or torn; it is supplied by the superior and inferior vesical arteries from the internal iliac. The venous return is collected in plexuses; the inferior vesical plexus, in relation with the base of the bladder, is very large and gives rise to free venous bleeding during operations on this part of the organ.

PELVIC BLOOD-VESSELS, LYMPHATICS, AND NERVES

Blood-vessels. The arterial supply of the genital organs is derived from the following vessels, enumerated from above downwards.

1. The ovarian artery from the abdominal aorta or the renal artery.
2. The uterine artery
3. The vaginal arteries (3 or 4) } from the anterior division of the
4. The internal pudic artery } internal iliac.

The *ovarian* artery enters the pelvis posteriorly near the sacro-iliac joint, crossing obliquely in front of the ureter to pass into the infundibulo-pelvic fold of the broad ligament (*see* Figs. 2 and 17). Between the layers of the upper portion of the broad ligament (mesosalpinx) it runs inwards to the uterine cornu, giving off many branches which supply the ovary and Fallopian tube (*see* Fig. 48). Near the uterine cornu it effects an anastomosis with the terminal branch of the uterine artery. It has two or more companion veins which freely communicate by tributaries.

The *uterine* artery enters the base of the broad ligament near the lateral pelvic wall and runs obliquely forwards and inwards through the abundant cellular tissue to reach the side of the uterus at about the level of the internal os. It crosses obliquely above the ureter just before reaching the side of the uterus (*see* Figs. 18 and 49). The main artery now turns abruptly upwards, keeping in close contact with the uterine wall. A numerous series of branches are given off at right angles to the main trunk which pass some over the anterior, some over the posterior surface of the uterus to anastomose, in the middle line, with corresponding branches from the artery of the opposite side (*see* Fig. 48). The first of these branches to be given off is of comparatively large size, and with its fellow of the opposite side forms the *circular artery of the cervix*. Near the uterine cornu the terminal portion of the uterine artery anastomoses with the ovarian by its anastomotic branch. There are numerous companion veins throughout. In the broad ligament a large venous plexus (pampiniform plexus) is formed which is drained by the ovarian veins, and communicates below with the vesical and hæmorrhoidal venous plexuses.

Both the ovarian and uterine arteries and their branches run a spiral or tortuous course which forms a strongly marked characteristic of these vessels (*see* Figs. 2 and 48). This peculiarity allows of the rapid elongation of these vessels which is required to meet the physiological enlargement of the uterus in pregnancy, and also permits of their return to the normal condition of tortuosity after the still more rapid shrinkage which succeeds delivery.

The *vaginal* arteries arise from the anterior division of the internal iliac below the uterine artery; sometimes one of them arises directly from the uterine, or from the middle hæmorrhoidal artery. They reach the sides of the vagina near its upper end, and branch irregularly, their general course

being across the vaginal canal. Another artery is sometimes present, the *azygos vaginae*, which is derived partly from the circular artery of the cervix, and partly from the upper branches of the vaginal artery ; it runs along the middle line both anteriorly and posteriorly. In addition to this anastomosis, numerous direct communications are formed with the branches of the uterine arteries in the region of the vaginal fornices. The vaginal veins communicate freely with the hæmorrhoidal and vesical plexuses.

The internal *pudic arteries* supply the parts composing the vulva and the perineal body ; the trunk-vessel lies deeply beneath the edge of the pubic arch, and sends off numerous branches. Two of these are of some import-

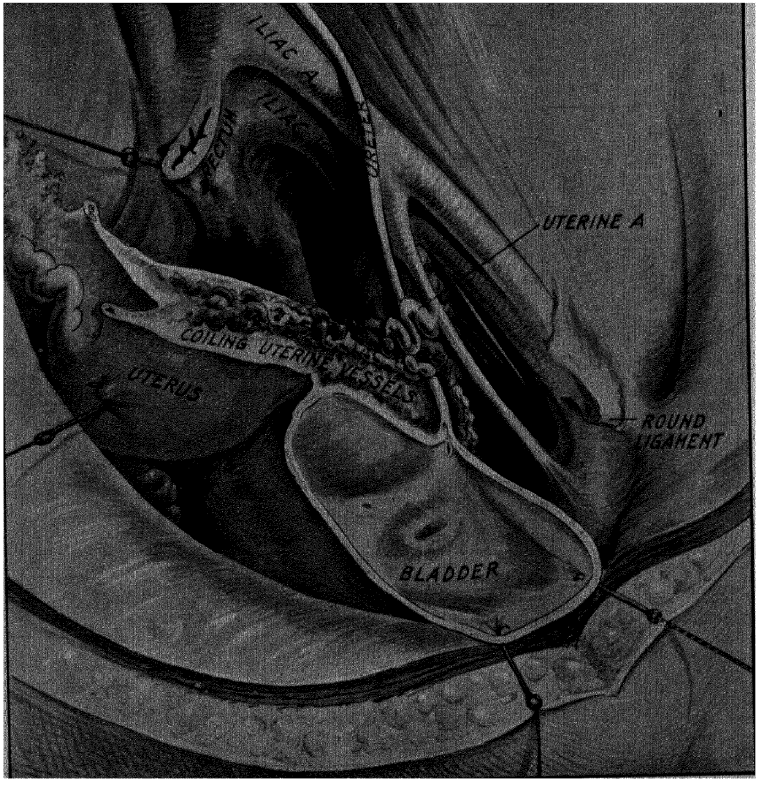


FIG. 49. DISSECTION OF THE LEFT BROAD LIGAMENT, showing the relation of the uterine artery to the ureter (Kelly).

ance : (1) a large branch which reaches the posterior part of the vulva and supplies the Bartholinian gland (*see* Fig. 46, D) ; it corresponds to the *artery to the bulb* in the male ; (2) an anterior terminal branch which supplies the clitoris and vestibule—*artery to the clitoris* (Fig. 45, E). The companion veins are numerous and pass, some into the inferior hæmorrhoidal, some into the inferior vesical plexus. The superficial labial branches frequently form varicosities of large size in pregnancy. The vulva is almost completely encircled by highly vascular erectile tissue, arranged in two crescentic lateral masses—the *vaginal bulbs* (*see* Fig. 45). The deep transverse

groups. Of the *superior* group, some join those of the cervix and pass into the superior group of the internal iliac glands; the rest pass directly to the inferior group of glands of the same chain. The *median* vaginal lymphatics also pass into the inferior group of the internal iliac glands, but one or two small trunks make their way into two glands lying upon each side of the rectum, and these are in communication with the superior hæmorrhoidal

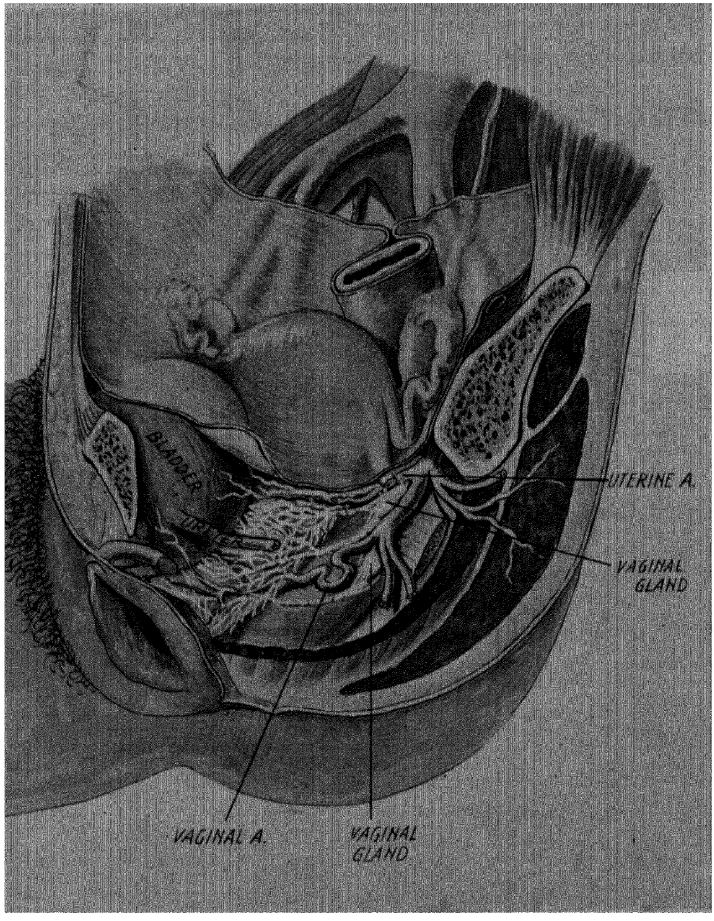


FIG. 52.—THE VAGINAL LYMPHATICS AND THE GLANDS TO WHICH THEY PASS (Poirier).

glands (Fig. 52). The *inferior* vaginal lymphatics, draining the parts down to the level of the hymen, according to Poirier, also pass into the inferior group of the internal iliac chain.

The *vulval* lymphatics, including those from the hymen, all pass into the superior group of the superficial inguinal chain. Free anastomoses exist between the lymphatics of one side and those of the other, so that both chains of glands may become infected from a unilateral or a median vulval lesion.

The latter are only found in the middle section of the genital streak ; at its head- and tail-ends the streak is not thickened, but forms a flat fold. The germ-epithelium grows rapidly into the underlying tissue in the form of *germinal cords*, which have only a slight significance in the development of the entire ovary, since, after the formation from them of the primary follicles, they largely disappear, but portions may remain and give rise to cystic neoplasms (Goodall). The head-end of the genital streak does not

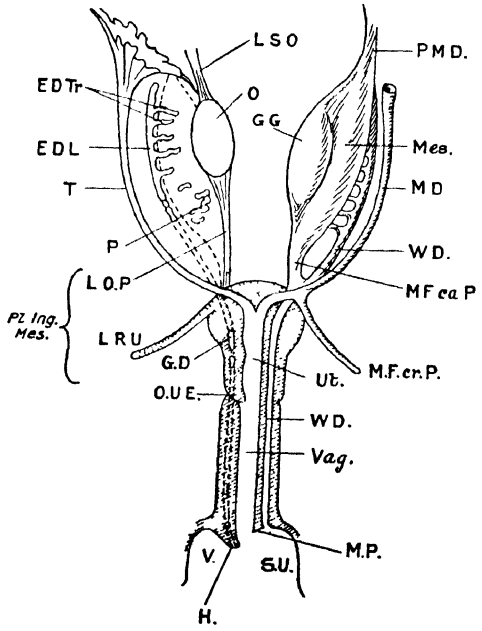


FIG. 55. SCHEME OF THE DEVELOPMENT OF THE FEMALE GENITALIA. On the left of the figure are shown the adult organs ; on the right the embryonic structures are shown for comparison (after Tandler). E.D.L., epoophoron, longitudinal duct ; E.D.Tr., epoophoron, transverse ducts ; G.D., Gartner's duct ; G.G., genital gland ; H., hymen ; L.O.P., lig. ovarii proprium ; L.R.U., lig. rotundum uteri ; L.S.O., lig. suspensorium ovarii ; Mes., mesonephros or Wolffian body, M.D., Muller's duct ; M.F.ca.P., mesonephric fold, caudal portion ; M.F.cr.P., mesonephric fold, cranial portion ; M.P., Muller's prominence ; O.U.E., external os uteri ; O., ovary ; P., paroophoron ; P.M.D., plica mesonephrica diaphragmatica ; S.U., sinus urogenitalis ; T., Fallopian tube ; Ut., uterus ; V., vestibulum vulvæ ; Vag., vagina ; W.D., Wolffian duct ; P.Ing. Mes., plica inguino-mesonephrica.

develop, but the tail-end shows proliferation of its epithelium to form the *reticular cords* which are interposed between the mesonephros and the genital gland ; from relics of these cords cystic new growths may also arise (Goodall). The genital gland is not yet differentiated as ovary or testis ; this differentiation is first seen in embryos 14 mm. long (fifth to sixth week), when a testis begins to show a tunica albuginea and a marked development of genital cords. Absence of these structures at this stage marks the gland as an ovary.[1] At this stage the ovary shows a development of connective-tissue which grows from the depths into the germinal layer and divides the germ-epithelial cells

[1] "There is nothing (no structure) in the testicle that has not had, at some time in embryonic life, its homologue in the ovary."—GOODALL.

and genital cells into groups (*egg-follicles*). In each such follicle we have a genital cell surrounded by the germ-epithelial cells. No further increase of genital (primordial egg-cells) takes place excepting for such cell-division as occurs in each individual group. Meanwhile the splitting-up of the groups by the stroma-tissue continues. This leads to the egg-cells being scattered through the entire ovary, and these, surrounded by epithelial cells, constitute the *primordial follicles.* Those follicles which lie in the centre of the ovary begin to disappear in embryonic life, and by the end of the first year of life follicles are only found in the cortex. The follicles increase in size for a few weeks after birth and then remain at rest until puberty. The reticular cords, which were interposed between mesonephros and ovary, form part of the paroöphoron which in the adult is rudimentary, but supplies one source of origin for *small hilum cysts* which are often to be seen later in life (*vide supra*). The ovary develops from the *middle third of the genital streak,* the head- and tail-ends are rudimentary or disappear. The middle part grows out more and more from the mesonephros until these structures are only connected by a fold of peritoneum. The fœtal ovary is an elongated gland (*see* Fig. 55, G.G.), with its surface moulded by surrounding structures. The rounded form of the ovary is not assumed until after birth.

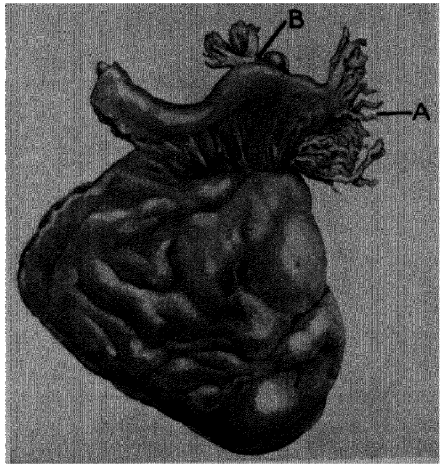


FIG. 56. FALLOPIAN TUBE SHOWING ACCESSORY ABDOMINAL OSTIUM.

A. Normal Ostium. B. Accessory Ostium.

The Oviducts (Fallopian Tubes) represent the upper non-fused portions of the Müllerian ducts; they appear relatively late in the human subject. In embryos 12 mm. long the oviducts arise on the lateral wall of the Wolffian duct as a shallow furrow in the cœlomic epithelium. This develops into a tube, the cephalic segment of which is funnel-shaped. The narrow caudal end of the funnel is at first imperfectly united with the remainder of the tube, and at this point an accessory ostium often forms (*see* Fig. 56). Keith has advanced the view that the funnel-shaped segment of the oviduct is developed not from Müller's duct, but from the *pronephros.* The imperfect union above referred to as existing between the funnel-shaped extremity and the rest of the tube seems to us a confirmation of Keith's view that the fimbriated extremity of the tube has a different origin from the remaining segment of the duct, *i.e.* that the former is pronephric whilst the latter is Müllerian in origin (*see* Hydatid of Morgagni, p. 43). The tail-part of the Müllerian duct descends alongside the Wolffian duct. These two ducts therefore lie in the same peritoneal fold (*see* Fig. 54, W.D., M.D.), which is derived from the mesonephric fold already described (*see* Fig. 54, M.F.). This is called the *urogenital fold* (*see* Fig. 54, U.G.F.); it lies on the posterior abdominal wall and on the lateral pelvic wall, whence

it turns towards the mid-line rising up more and more from the floor of the pelvis as a transverse septum. Its median part is called the *genital fold* and contains four ducts—two Müllerian and two Wolffian—whilst its lateral parts form the *ligamentum latum*. At the level of the lower pole of the mesonephros the Müllerian ducts cross in front of the Wolffian ducts to meet each other in the mid-line (*see* Fig. 55. W.D., M.D.), and from thence they descend side by side to reach the dorsal wall of the urogenital sinus (*see* Fig. 55, S.U.), where they project and form a prominence. This prominence is clearly seen in embryos 28 mm. long and is called Müller's prominence (*see* Fig. 55, M.P.) Before the Mullerian ducts open at this prominence they *fuse to form a single canal.* The point where the fusion commences corresponds later to the external os uteri (*see* Fig. 55, O.U.E.). From thence the fusion spreads upwards and downwards to form the utero-vaginal canal. This is already seen in embryos 25 mm. long (end of second month).

Development of the Tubal Mucous Membrane. In the fourth month a simple longitudinal fold appears in the lumen of the tube, this is the primary mucous fold ; secondary and tertiary folds, also longitudinal, appear about the seventh month. The fimbriæ arise as blunt projections at the end of the tube.

The Uterus and Vagina. At this time the division between uterus and Fallopian tube is marked by the attachment to the Müllerian tubes of the mesonpheric or urogenital fold (*see* Fig. 55, M.F.cr.P. and M.F.ca.P.) ; the part above this point is the Fallopian tube, that below it is the utero-vaginal canal. The differentiation between uterus and vagina is first seen in a distinction between the epithelial linings ; that lining the uterus is simply cylindrical, that in the vagina is many layered.

Muller's ducts take a course which is concave forwards from the very beginning, and in the region of the utero-vaginal canal a bend appears corresponding to the boundary between vagina and uterus. In the fifth month the *portio vaginalis cervicis* and vaginal fornices are formed ; at the same time, the lumen of the vagina is opened up, by the disappearance of the epithelial plug at its lower end. At this time also the *columnae rugarum* appear in the vagina (*see* Fig. 20, p. 26), and the *arbor vitae* in the cervix. The former appear at the vulval end of the vagina and spread upwards. In the seventh month glands form in the cervix ; at the time of birth they appear in the uterus.

All the derivatives of Müller's ducts acquire a layer of muscle about the fifth month. It is circular in the region of the tube and uterus, longitudinal in the vagina. The vaginal musculature spreads itself out on the lips of the *portio vaginalis cervicis.* In the sixth and seventh months a strong submucous muscular stratum appears *parallel* to the long axis of the Fallopian tube.

At the end of fœtal life an additional muscular layer also appears in the subserous tissue. This increases until puberty. The subserous muscular layer develops simultaneously in the uterus, round ligament, ovarian ligament, and in the utero-sacral folds.

The Development of the Sinus Urogenitalis, the Fusion of the Urinary and Genital Tracts with each other and with the Sinus Urogenitalis

As the sinus urogenitalis is derived from the cloaca, the latter must be first described.

The hind gut forms, in a 3 mm. embryo, a pouch which is flattened from side to side—the *cloaca* (*see* Fig. 57, Cl.). Into this the allantois opens at its upper and anterior aspect (*see* Figs. 57, 58, 59, All.D). The ventral wall of the cloaca lies against the ectoderm of the belly-wall extending from the navel to the prominence of the tail so that the ectoderm and entoderm are here in immediate contact. These layers form a ventral boundary and constitute the *cloacal membrane* or plate (*see* Fig. 57, Cl.M.).

Quite early in development the cœlomic cavity protrudes downwards as a hollow spur between allantois and gut (*see* Figs. 57, 62 and 63, C.). This depression carries an investment of mesoblast before it, which by dipping into the cloaca forms the *urorectal septum* (*see* Fig. 62, S.Ur.). Later, the cloacal membrane in the median plane becomes depressed so as to form the ectodermal cloacal furrow (*see* Fig. 62, Cl.M., p. 74).

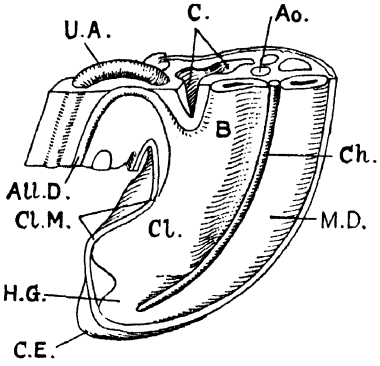


FIG. 57. MODEL OF THE CLOACAL REGION OF AN EMBRYO 3 MM. IN LENGTH (after Keibel). All.D., duct of allantois; Ao., aorta; U.A., umbilical artery; C., cœlom; Ch., cord; Cl., cloaca; Cl.M., cloacal membrane; B., bowel; C.E., caudal extremity; H.G., hind gut; M.D., spinal canal.

At this stage the Wolffian ducts reach the lateral part of the ventral walls of the cloaca, which has widened out transversely at this level (*see* Fig. 58, Wf.D.). The mesodermal depression (urorectal septum from the cœlom) is descending all the time and has now divided the cloacal space above the openings of the Wolffian ducts into two cavities. The ventral one, in direct continuation with the allantois, is the future bladder (*see* Fig. 61, B.L.), the other (dorsal) is in communication with the hind gut (*see* Fig. 61, B.O.). The openings of the Wolffian ducts in the ventral segment of the cloaca form the site of the future differentiation of bladder and ureters on the one hand, from the sinus urogenitalis on the other. The upper part of the ventral portion of the cloaca is therefore appropriated by bladder and ureters, the lower part becomes the sinus urogenitalis (*see* Fig. 63, Bl. Sin. ug.). Shortly after the Wolffian duct reaches the cloaca, there arises on its dorsal wall, directly opposite its opening, the *renal or ureteric prominence;* this is seen in embryos 6½ mm. long (third or fourth week) (*see* Fig. 59 U.B.). The significance of this will be seen later.

The Müllerian ducts reach the sinus urogenitalis at a later stage than the Wolffian ducts. In the interval, two important developmental processes take place. The first concerns the development of the bladder and the vesical trigone, the second the complete separation of bowel from the sinus

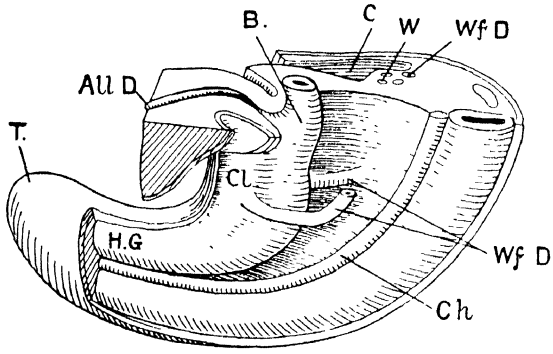


FIG. 58. CLOACAL REGION OF AN EMBRYO 4·2 MM. IN LENGTH (after Keibel). All D., allantoic duct; C., cœlom; Ch., cord; Cl., cloaca; B., bowel, T., tail; H.G., hind gut; W., Wolffian body; Wf.D., Wolffian duct.

urogenitalis. Taking the latter first, we note that the urorectal septum by its continuous downgrowth divides the ventral cloacal segment (urogenital sinus) from the dorsal cloacal segment (the rectum). Finally the urorectal septum reaches the cloacal membrane, then the separation between bowel

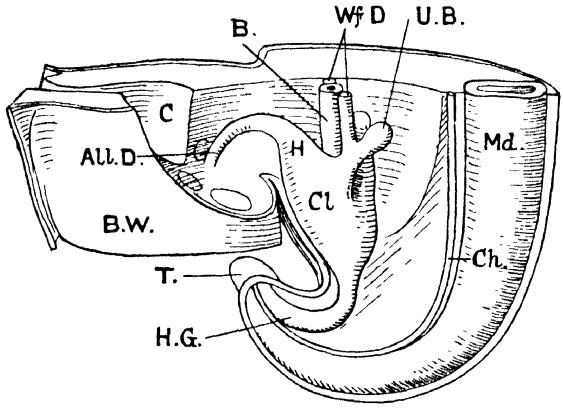


FIG. 59. MODEL OF CLOACAL REGION OF AN EMBRYO 6·5 MM IN LENGTH (after Keibel). All D., allantoic duct; B W., belly-wall; C., cœlom; Ch., notochord; Cl., cloaca; B., bowel; H., bladder; Md., spinal canal, U.B., ureter; T, tail; H.G., hind gut; Wf.D., Wolffian ducts.

and urogenital sinus is completed (*see* Fig. 62, Cl.M., S.Ur.). This will again be referred to in dealing with the development of external genitals and rectum.

As previously stated, there arises from the dorsal wall of the Wolffian duct, just before it opens into the cloaca, the renal or ureteral bud (*see* Fig. 59, U.B.); this is the foundation of the ureter. The part of the

Wolffian duct (A in Fig. 60) between its opening into the cloaca and the ureteral bud (*see also* Fig. 59) gets shorter and shorter and ultimately

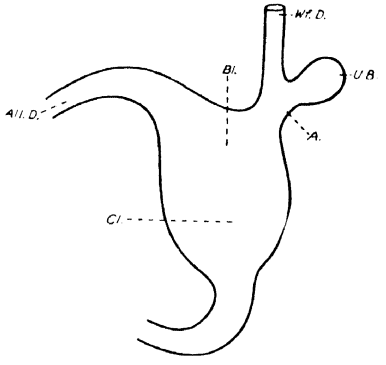


FIG. 60. Showing the portion of Wolffian duct (A) which forms part of the trigone of the bladder. All.D., allantoic duct; Bl., bladder; Cl., cloaca; U.B., ureteric bud; Wf.D. Wolffian duct.

helps to form the trigone of the bladder and a part of the urethra (*see* Fig. 63, P.R.).

Meanwhile Müller's ducts have reached the sinus urogenitalis (*see* Fig. 63, M.D.), and produced Müller's prominence on its dorsal wall; through

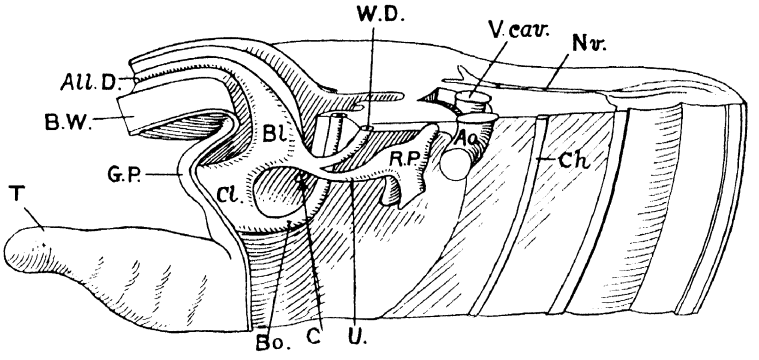


FIG. 61. MODEL OF CLOACAL REGION OF AN EMBRYO 11·5 MM. IN LENGTH (after Keibel). All.D., allantoic duct; Ao., aorta; B.W., belly-wall; C. coelom; Ch., notochord; Cl., cloaca; Bo., bowel; G.P. genital papilla; Bl., bladder; Sp.C., spinal canal; R.P., renal pelvis; Nv., nerve; T., tail; U., ureter; V.cav., vena cava; W.D., Wolffian duct.

this they open and their point of opening lies above that of the Wolffian ducts.

The bowel has now been completely separated from the urogenital system by the urorectal septum (*see* Figs. 62 and 63). The upper part of the ventral cloacal segment has become the bladder and urachus. The sinus urogenitalis is at this stage an extremely long pouch (*see* Figs. 62 and 63, Sin. Ug.).

Changes in the Cloacal Membrane. Before describing the formation of

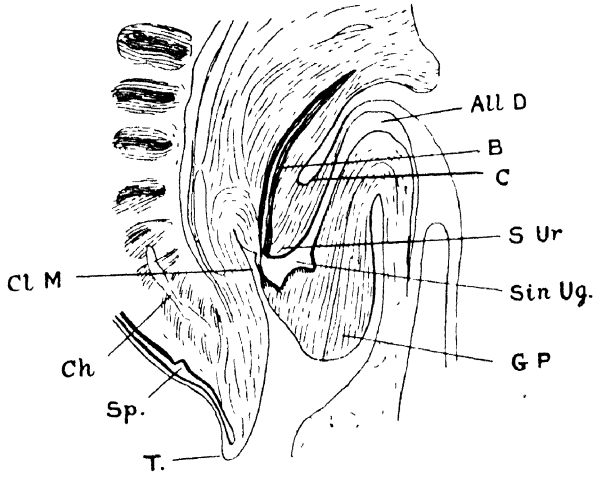


FIG. 62. SAGITTAL SECTION THROUGH THE PELVIC EXTREMITY OF AN EMBRYO 13 MM. IN LENGTH (after Keibel). All.D., allantoic duct; B., bowel; Ch., notochord; Cl.M., cloacal membrane, C., cœlom (future pouch of Douglas); G.P., genital papilla; S.Ur., urorectal septum; Sin. Ug., sinus urogenitalis; Sp., spinal cord; T., tail.

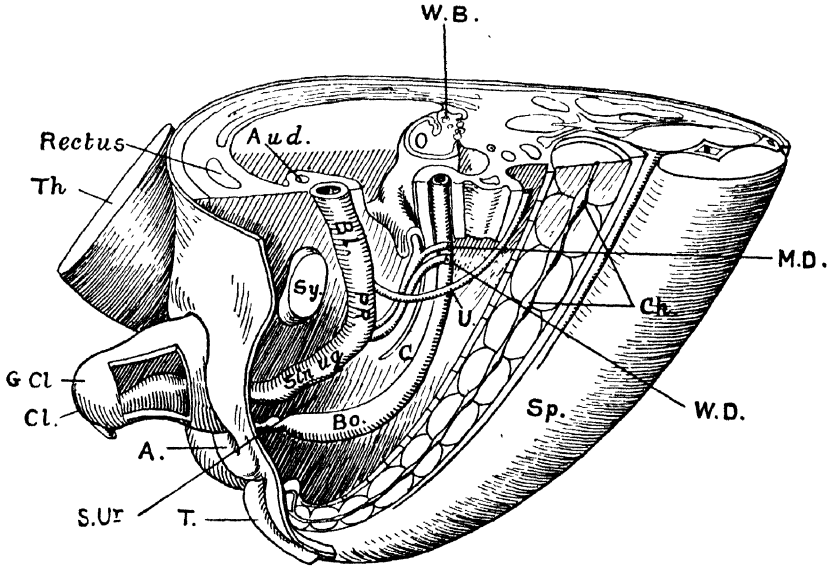


FIG. 63. MODEL OF THE PELVIC REGION OF A HUMAN EMBRYO 29 MM. IN LENGTH (after Keibel). A. Anus; A.u.d., art umbilicalis dextra; Bo., bowel; Bl., bladder, C., cœlom (pouch of Douglas); Ch., notochord; Cl., clitoris; G.Cl., glans clitoridis; M.D., Muller's duct; O., ovary; P.R., primary urethra; Sin. ug., sinus urogenitalis; Sy., symphysis; Sp., spinal cord; U., ureter; Th., thigh; T., tail; W.B., Wolffian body; W.D., Wolffian duct; S Ur., urorectal septum.

the external genitals we must consider what has been going on with regard to the cloacal membrane.

This membrane, which reached from the navel to the tail, has been pushed inwards and invested by a thick mass of tissue which forms a papilla on the ventral aspect (*see* Figs. 61 and 62, G.P.). This papilla partly covers the cloacal membrane. Partly through the growth of the genital papilla and partly through two lateral thick swellings—the *genital folds*—the cloacal membrane is pushed somewhat into the depths (backwards) (*see* Fig. 62, Cl.M.). By the union of the urorectal septum with the cloacal membrane the latter is divided into *urogenital membrane* anteriorly, and *anal membrane* posteriorly. The former is the first to dehisce, and thus the sinus urogenitalis opens externally prior to the gut. The genital papilla acquires a

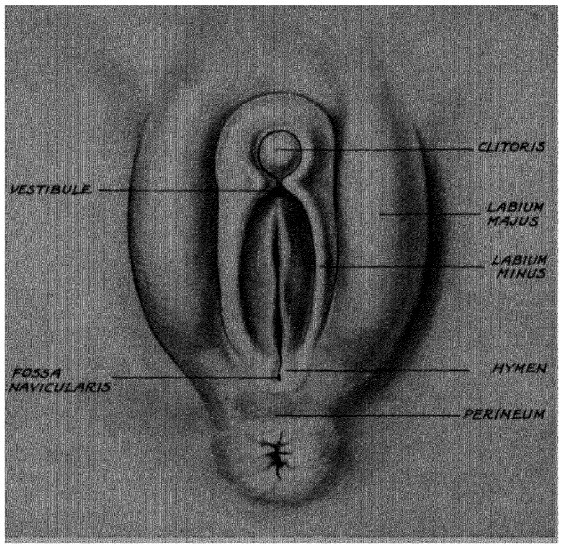


FIG. 64. DEVELOPMENT OF THE EXTERNAL GENITAL ORGANS (Kollmann). The glans clitoridis is derived from the genital papilla; the labium majus from the genital folds; the labium minus from the urethral lips; the hymen from Müller's prominence, and the perineum from the urorectal septum. The vestibule and fossa navicularis are both relics of the urogenital sinus.

blunt free end, which is the future *glans clitoridis* (*see* Fig. 63, G.Cl.). Its surface, which looks towards the sinus urogenitalis, becomes furrowed and presents two lateral borders. The groove between these borders is lined by epithelium and becomes the urethral groove; the borders themselves become the urethral lips.

From the genital folds the labia majora develop, whilst the urethral lips become the labia minora (*see* Fig. 64). The length of the urogenital sinus diminishes more and more, but the upper part, *i.e.* that between the opening of the ureter and the Müllerian prominence, stretches considerably in length (*see* Fig. 65, urethra). A circular furrow divides this section of the urogenital sinus into a proximal part, the *trigone*, and a distal part, the *urethra*. Through the reduction in length of the lower segment of the sinus urogenitalis and through the gradual increase in width of this portion of the canal,

Müller's prominence recedes more and more upwards, and comes to lie finally in the floor of a short wide pouch. From the epithelium of Müller's prominence develops the *hymen*,[1] whilst the short pouch below, which is now the sole remaining part of the original sinus urogenitalis, becomes the *vestibule* and *fossa navicularis*. The former is relatively much deeper in the newborn than in adults. The septum urorectale widens out to form the perineal body and perineum (*see* Fig. 64).

The Ligaments. At a certain stage of development we find on the posterior abdominal wall of the embryo a long Wolffian body tapering at its caudal and cranial ends (*see* Fig. 55, Mes.). Internal to this is the ovary

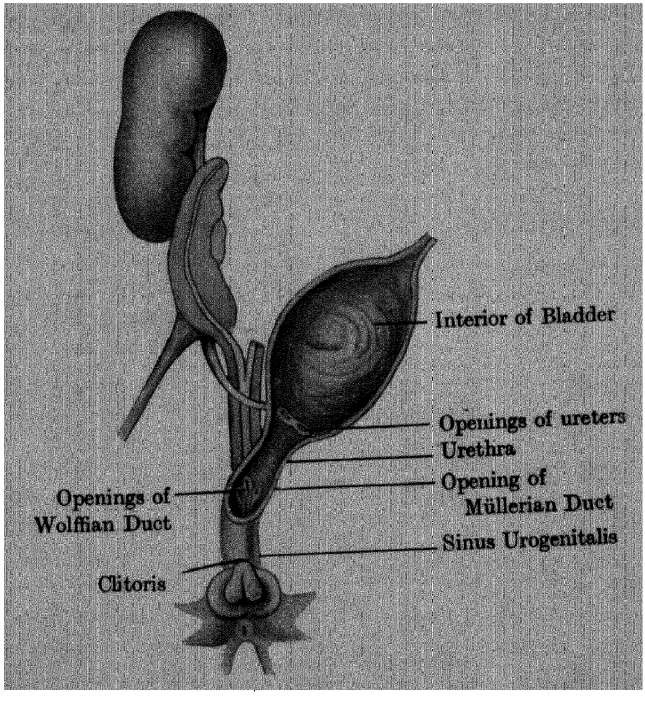


FIG. 65. (FROM MORRIS' "ANATOMY.") THE SINUS UROGENITALIS HERE SEEN ULTIMATELY BECOMES SHORTENED AND FORMS THE VESTIBULE.

(*see* Fig. 55, G.G.), lateral to it and lying in the genital fold are the Wolffian and Müllerian ducts (*see* Fig. 55, W.D., M.D.). A fold develops from both the head- and the tail-ends of the Wolffian body; the former is the *plica diaphragmatica mesonephrica* (*see* Fig. 55, P.M.D.), which becomes the suspensory ligament of the ovary or infundibulo-pelvic fold; the latter is the *plica inguino-mesonephrica*, the upper part of which becomes the *ligamentum ovarii proprium* (*see* Fig. 55, M.F.cr.P.), and the lower part becomes the *ligamentum rotundum* (*see* Fig. 55, M.F.ca.P.). The Wolffian and Müllerian ducts on each side lie in the urogenital fold (*see* Fig. 54, U.G.F.). These two folds fuse to form a transverse septum at the level of the lower pole of the Wolffian body. The *plica inguino-mesonephrica* crosses the urogenital fold

[1] Berry Hart and Keith regard the hymen as developing from the bulbous termination of the Wolffian ducts.

changes is to bring into prominence the physical and mental characteristics of sex. Before puberty these characteristics are only slightly marked: although in most children the presence of masculine or feminine traits is recognizable, they do not become pronounced until the age of puberty has been reached. Foundations of sex-characteristics are no doubt deeply laid at a very early period of intra-uterine existence. During life two powerful influences promote their further development. Firstly, the external influence of training and environment, especially association with others of the same sex; and, secondly, the inherent influence of the physiological changes which constitute puberty. The first-named influence may be very powerful, as is exemplified in the case of female pseudo-hermaphrodites (*see* p. 146), *i.e.* individuals with male gonads and female external genitalia. Such persons, brought up as girls, may display feminine qualities of mind and manner, and being married as women may fulfil the sexual *rôle* of the wife with apparent success. It must not, however, be forgotten that there are structural differences between male and female children quite apart from the genital system. The skeleton shows marked differences in the weight of the long bones, and in the shape of the pelvis, the special characters of the female pelvis being well marked in fœtal life (Arthur Thomson). Possibly there are differences also in some of the endocrine bodies, although this cannot be definitely stated at present. The changes in the sexual glands at puberty are coincident in both sexes with atrophy of the thymus.

In the female, as already stated, the essential elements of the ovary do not reach their full structural development until puberty. Gräafian follicles then begin to mature and to rupture, leading to the liberation of ova and the formation of corpora lutea. In addition, the uterus develops, passing from the infantile to the adult type; the mammæ enlarge; the nipples become more prominent, and the areolæ more marked; hair appears in the axillæ, upon the mons Veneris and over the labia majora. A considerable formation of subcutaneous fat occurs upon the mons Veneris and in the labia majora, which expand until they cover and nearly conceal the nymphæ. The latter are really the more prominent pair of labia in childhood, owing to the imperfect development of the greater labia.

MENSTRUATION

Menstruation is a periodic hæmorrhage from the corporeal endometrium which usually first appears coincident with puberty, and continues throughout the fertile period of life, *i.e.* until the climacteric has been reached. The age of commencement of menstruation in white women of the United States and Canada has been investigated by Englemann who, from the data of 20,000 cases, placed the average age at fourteen. Under the various climatic conditions found between Hudson Bay and the Gulf of Mexico, this writer found very little variation in the time of onset of menstruation. From Englemann's observations it appears that climate is of less importance than race, and the often-expressed opinion that in cold countries women begin to menstruate later than in hot countries cannot be maintained. Thus the negresses of Somaliland begin at sixteen, the women of the Arctic Indians at twelve and a half; but in India and Samoa menstruation begins early, and the first pregnancy often occurs at the age of twelve. In addition many factors of a general nature, such as nutrition, surroundings, heredity, etc.

come into operation, some retarding, others advancing the process. While the average age for European races may be regarded as fourteen, the limits of normal puberty must be placed a good deal wider than this, viz. from twelve to sixteen years. Many instances of precocious menstruation at ages of five to eight years are on record, but few of them can be accepted as true examples of the menstrual function, due care not having been taken to exclude pathological conditions. It cannot be doubted, however, that true cases of precocious menstruation sometimes occur, for a recent case has been carefully recorded by Nacke, in which regular menstruation, at intervals of four weeks, was established at the age of three and a half years, and the signs of puberty were all fully developed at the age of five years.

Each menstrual period lasts on an average four to five days, but many individual variations, both in the duration and the amount of the hæmorrhage, are met with : less than two or more than seven days' duration may be regarded as abnormal. No definite standard of amount can be applied, but for practical purposes increase or diminution from what is usual in any given individual is of more importance than the actual quantity of blood lost. An amount which is normal for one woman may be an excess for another. As a rule menstrual blood coagulates slowly, the formation of clots of large size is only seen when bleeding is excessive.

The hæmorrhage is usually scanty at first and reaches its acme on the second or third day. At first the discharge is pinkish and rather viscid consisting of a large amount of mucus from the uterus and only a small amount of blood. Later it becomes bright red, and towards the end of the process it changes again to a brownish tint. It is not infrequent for menstruation to become suspended for twenty-four hours or more, after which the flow returns and pursues its normal course.

The menstrual cycle averages about twenty-eight days, but here again variations are encountered ; in many healthy women it is twenty-one days only, in others it may be five weeks. The limits of the normal menstrual rhythm may therefore be placed at from three to five weeks. Departure from the rhythm normal to the individual in question is the more important point. From the first onset, a year or two frequently elapses before the rhythmical character of the process becomes established ; during this period the intervals are usually prolonged ; sometimes, however, the early periods come too frequently, and are profuse and very painful.

THE ANATOMY OF MENSTRUATION

The structure of the uterine mucosa varies at different phases of the menstrual cycle, therefore in dealing with the histology of menstruation it will be necessary to describe the entire cycle of changes. Hitschmann and Adler [1] first drew attention to these physiological cyclic changes ; previously, the menstruating mucosa and the non-menstruating mucosa were studied apart, the idea being that the characters of the latter were constant, except when the mucosa was the seat of a pathological process, such as inflammation. The above observers were the first to affirm that the cyclic physiological changes in the normal uterine mucosa are so definite that, from the condition of the tissues, microscopists can tell, almost to a day, the date of the nearest

[1] *Wiener med. Wochenschr.* 1907, lvii. 1297 ; *Monatschr. f. Geb. und. Gynäk.*, 27, page 1, 1908 ; *Archiv. für Gyn.* 1913, Band C., H. 2, S. 233.

period. In these cyclic changes all the elements of the endometrium take part.

The menstrual cycle may be studied in four *phases*: (1) the *premenstrual phase*; (2) the *menstrual phase*; (3) the *post-menstrual phase*, or *phase of involution and repair*: and (4) the *interval*.

(1) *The Premenstrual Phase.* Eight days before menstruation, or twenty days after the beginning of the last menstrual flow the glands are seen to

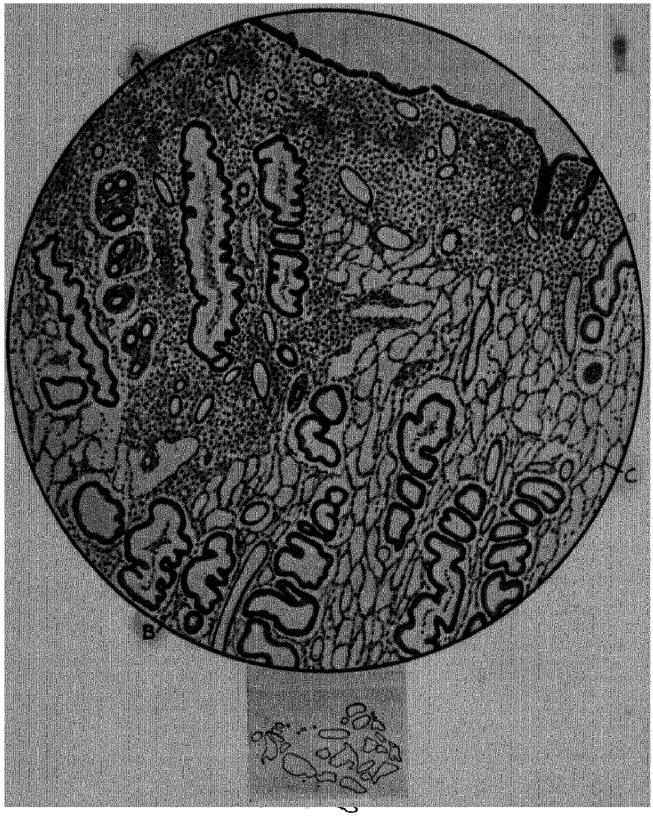
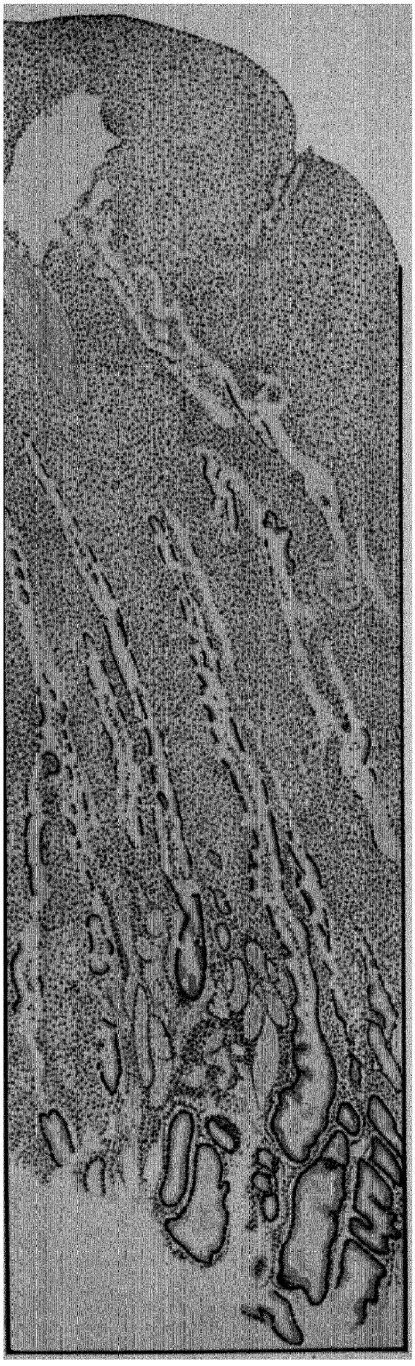


FIG. 66. SHOWING THE ENDOMETRIUM EIGHT DAYS BEFORE MENSTRUATION. A, Compact layer. B, Spongy layer of endometrium. C, Œdematous stroma. As the menstrual epoch approaches the endometrium will resemble more and more the decidua of pregnancy.

have increased in size and length and are becoming convoluted. Fern-like processes project into the lumina, dividing the latter into deep bays. The epithelial cells have become higher and wider, and are secreting actively so that the lumina of the enlarged tubules are filled with mucus. The connective-tissue stroma has become swollen and now consists of a superficial compact and a deep spongy layer. The former resembles an early stage of *decidua compacta*, the similarity being so marked in some instances that it is not always easy to exclude pregnancy. Figure 66 shows the division of the endometrium into compact and spongy layers. Plate I and Figure 62 show the so-called "tufted" gland, which was at one time regarded



PREMENSTRUAL ENDOMETRIUM (W. Shaw) SHOWING COMPACT AND SPONGY LAYERS. The epithelium of the superficial portions of the tubules is degenerating.

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as pathognomonic of pregnancy. It is, in fact, the typical histological feature of the premenstrual phase of the periodic cycle. Figure 66 shows the compact and a portion of the spongy layer of the endometrium in the premenstrual phase. In Plate VI the more superficial portions of the glands

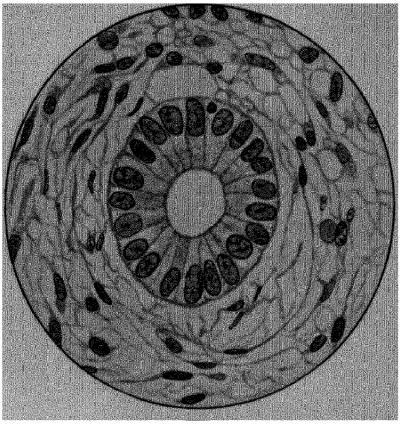


FIG. 67. UTERINE GLAND IN THE INTERVAL OF REST. Cells with basal nuclei. Note the even contour of the columnar cells towards the lumen. (W. Shaw.)

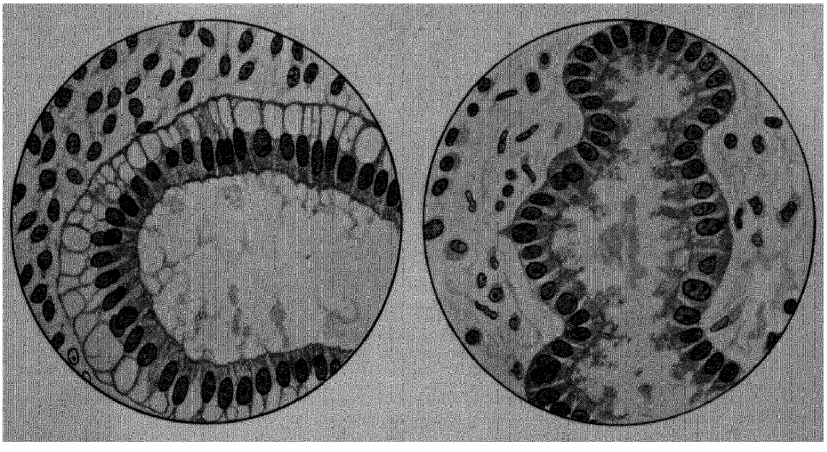


FIG. 68. THE SAME IN THE EARLY STAGE OF PREMENSTRUAL ACTIVITY. Note the clear protoplasmic zone between the nuclei and the basement membrane. (W. Shaw.)

FIG. 69. THE SAME IN THE LATE STAGE OF PREMENSTRUAL ACTIVITY. The nuclei are again basal, the cell-protoplasm is uneven towards the lumen. (W. Shaw.)

demonstrate that their epithelium is degenerating and disintegrating. Interstitial hæmorrhage, due to degeneration of the endothelium of the capillaries is also present. Both these degenerative changes are attributed, by Wilfred Shaw, to a tryptic ferment which Frankl and Aschner describe as present in menstrual fluid.

(2) *The Phase of Menstrual Haemorrhage.* During the menstrual phase

the above destructive changes bring about a shedding of the entire compact and spongy portions of the mucosa, *i.e.* of the parts shown in Figures 66 and 70, leaving therefore only the basal layer. Plate VII shows fragments of the compact and spongy layers already shed and lying in an intra-uterine blood-clot. It will be noted that the menstrual shedding of endometrium thus effected resembles what is known to occur in the separation of the mature placenta during labour at term, the basal layer of the decidua

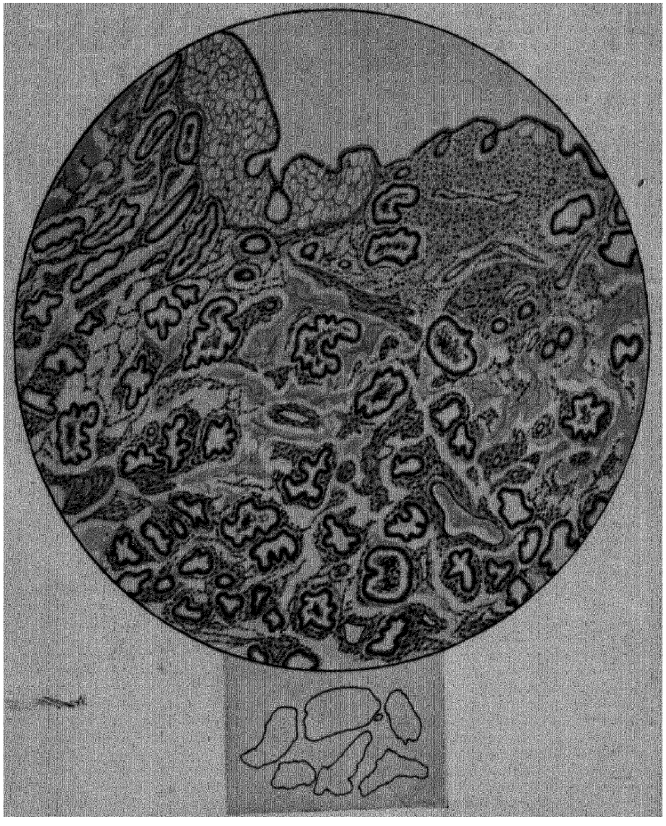
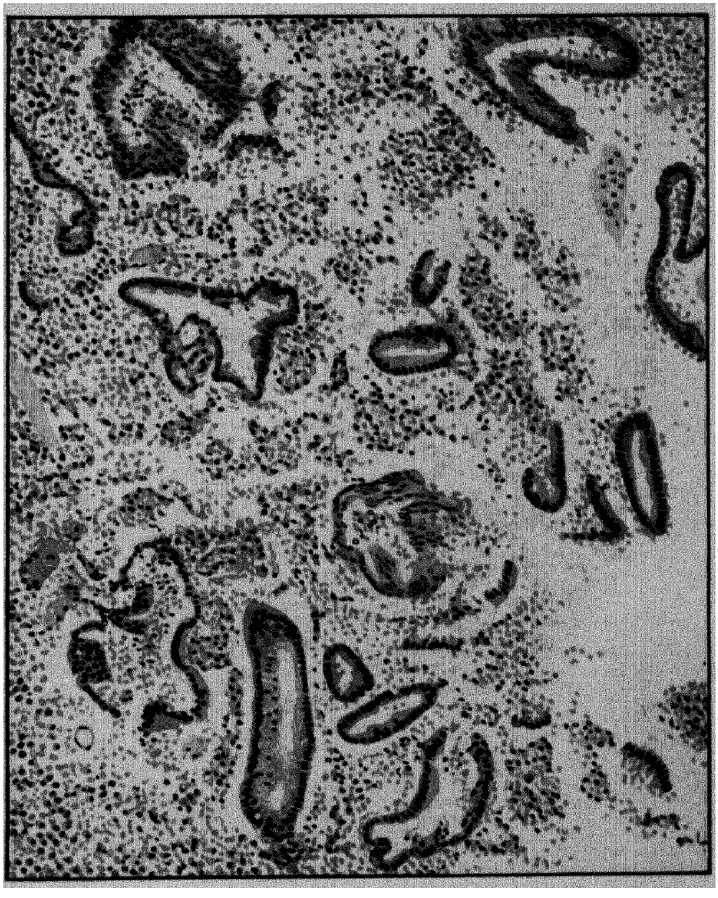


FIG. 70. SHOWING THE ENDOMETRIUM ON THE FIRST DAY OF MENSTRUATION. The decidua-like appearance of the compact layer is marked and diapedesis has led to interstitial hæmorrhage. The glands are full of mucus. × 63.

being the only part which is not shed. In other words, the line of cleavage in menstrual shedding is the same as in placental separation (*see also* p. 44).

(3) *The Post-menstrual Phase.* It follows that when menstruation ceases the mucosa is represented solely by the basal layer of the premenstrual phase. The surface will be bare until it is covered by epithelium derived from the glands. This process of epithelial covering is a rapid one. It may possibly proceed *pari passu* with the shedding. Figure 71 shows it as seen on the third day after menstruation, Figure 72 shows it completed by the sixth day. The post-menstrual phase, therefore, is concerned in the restoration of a



FRAGMENTS OF THE COMPACT AND SPONGY LAYERS OF THE ENDOMETRIUM SHED DURING MENSTRUATION, and found lying in an intrauterine blood-clot. (W. Shaw.)

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surface-covering for the residual basal mucous membrane. When this is accomplished this phase is at an end and we enter upon :

(4) *The Interval*, which is a short period of rest before the resumption of activity. The renewal of activity takes the form of nuclear mitosis, and cell-proliferation. It begins, according to Wilfred Shaw, on the fourteenth day (*i.e.* the midday in the cycle of twenty-eight days), and with its appearance the " interval " is at an end.

The premenstrual activity in its earliest stages can be studied by tracing

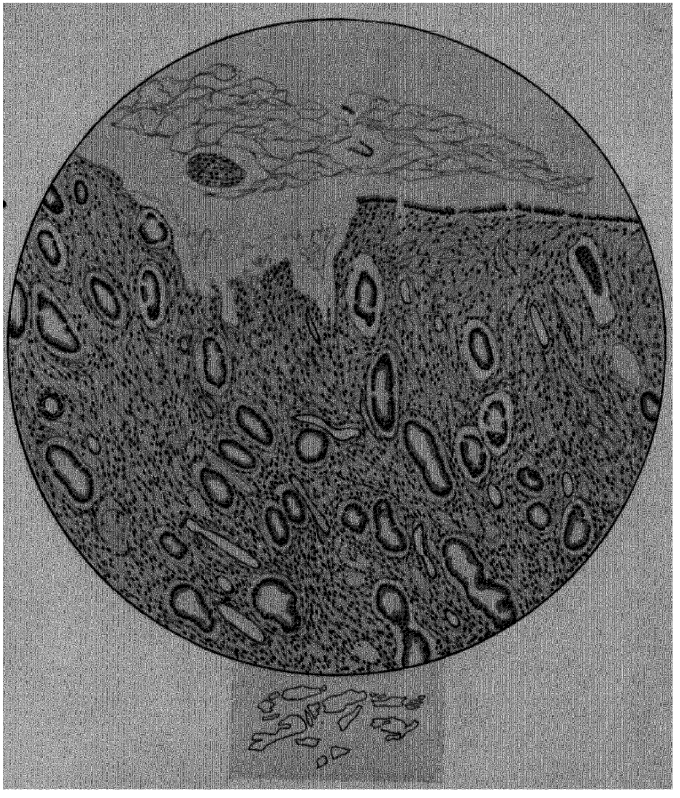


FIG. 71. SHOWING THE ENDOMETRIUM OF THE THIRD DAY AFTER MENSTRUATION. Only the basal layer is left. The surface is being covered by epithelium derived from the glands.

the behaviour of the protoplasm of the gland-cells and of their nuclei. Figure 67 shows a uterine gland in the resting stage, its cells present a level contour towards the gland-lumen and their nuclei are basal in position; this is the normal appearance of the cells during the " interval." Figure 68 represents the early stage of proliferation; it will be seen that there is a clear protoplasmic zone between the basement-membrane and the nuclei; this nuclear displacement constitutes the earliest of the premenstrual changes. Figure 69 shows a later stage, when the nuclei are again basal, but the surface-protoplasm is unevenly projecting, as if pouring itself out, into the lumen. This brings us to the point from which we started, *i.e.* eight days before the next period, and Figures 66, 70 continue the picture of the

premenstrual phase until the time of "shedding," *i.e.* up to the first day of the next cycle. If pregnancy supervenes no "shedding" will occur, the endometrium becomes the decidua of pregnancy and the ovum will embed itself in the compact layer. Plate VIII shows a recently embedded ovum; the tufted glands have continued to enlarge and the stroma-cells have laid down a true decidua.

The Composition of Menstrual Fluid. A good deal of attention has been devoted to this subject by Blair Bell and others. The former made use of the contents of a hæmatocolpos, which affords the opportunity of

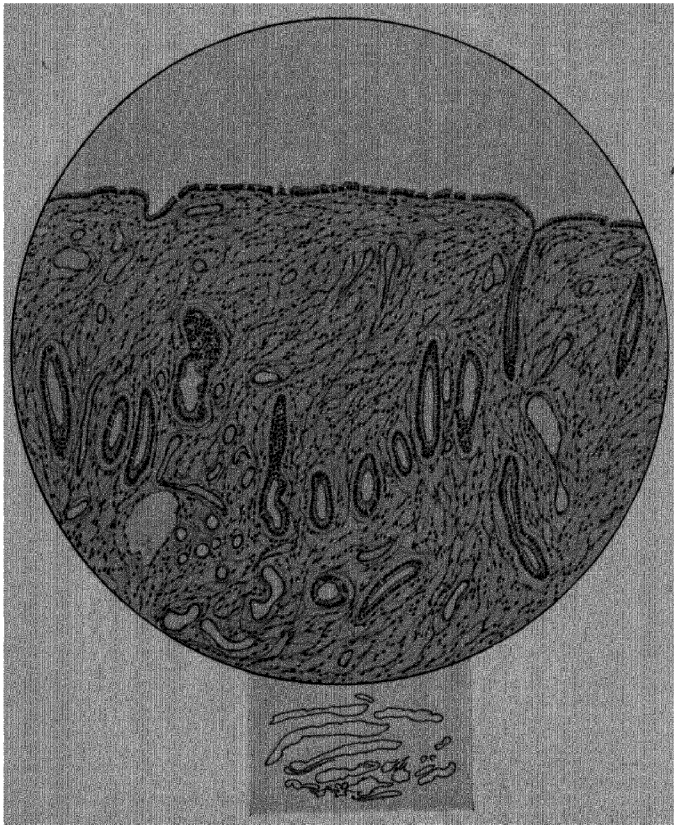


FIG. 72. SHOWING THE APPEARANCE OF THE ENDOMETRIUM SIX DAYS AFTER MENSTRUATION. The surface covering is now complete.

examining uncontaminated menstrual fluid in bulk, the chief alteration for which allowance must be made, being loss of water by absorption. Hæmatocolpos-fluid contains a very high proportion of *mucin*, estimated at 33 *per cent.*; the source of this substance is, of course, the uterine and cervical glands which are very active during menstruation. The blood is always fluid and has been shown to contain neither fibrinogen nor fibrin-ferment. Blair Bell claims to have proved by experiment that these bodies are removed from the blood by the endometrium during its passage through that membrane; they are not destroyed, as was formerly supposed, by the uterine and vaginal secretions. A considerable amount of lactic acid is



CONVERSION OF THE PREMENSTRUAL ENDOMETRIUM INTO THE EARLY DECIDUA OF PREGNANCY. The fertilised ovum is seen embedded in the compact layer of the early decidua. (C. L.) The naked-eye appearance of the ovum is seen in Plate III, facing page 32.

To face page 84.

present in hæmatocolpos-fluid, and in this connection it is important to notice that the vaginal bacillus of Döderlein has not been found in it. Lactic acid is a normal constituent of the healthy vaginal secretion (*see* p. 206), and Doderlein attributed its production to a process of fermentation set up by the vaginal bacillus. Blair Bell suggested that it must be produced by an enzyme, but it is clear that conclusions drawn from an examination of hæmatocolpos-fluid cannot be applied to normal conditions, both methods of production of lactic acid may be possible under different circumstances. Lastly, it has been shown by Blair Bell that calcium salts are present in very large amount, and this observation has been repeatedly confirmed by the examination of fresh menstrual blood. This point will be referred to again, when discussing the causation of menstruation.

Microscopical examination of the menstrual discharge shows that at first it contains a large excess of leucocytes; later it consists of almost pure blood. Occasionally shreds of tissue, visible to the naked eye, may be detected when the fluid is mixed with water. It has been shown on a previous page (*see* Plate VII) that fragments of shed endometrium of considerable size can be found in uterine clots on microscopic examination.

When menstruation is normal in amount the discharge is almost entirely fluid, and the blood does not coagulate. Small clots of the size of a pea or a haricot bean are, however, not uncommonly found, and occasionally, in profuse bleeding, clots of large size may form in the vagina. The question of the coagulability of menstrual blood has been studied by Beckwith Whitehouse.

His observations led him to the conclusion that *in the uterus* menstrual blood clots as soon as it is effused, this is in accordance with what has been observed by Heape in monkeys, for in these animals an intra-uterine menstrual clot is always formed. In the human uterus this clot is liquefied during its passage through the cervix and vagina, the effect being produced by admixture of the secretion of the uterine glands; this secretion, it is believed, is rich in a substance of the nature of an enzyme, which has the power of digesting blood-clot and which is named *thrombolysin*.

Whitehouse suggests that some cases of excessive menstrual bleeding may be due to delay in the process of coagulation, since hæmorrhage from the damaged vessels of the endometrium is arrested mainly by the formation of thrombi.

Clinical Features of Menstruation. Certain recognizable changes occur *in the uterus itself*. Immediately before menstruation begins the uterus is unusually sensitive to pressure; this is probably the result of the pre-menstrual congestion. Often the ovaries and Fallopian tubes also appear to be unduly sensitive. During the menstrual flow the cervix becomes definitely softened as in early pregnancy, and a little dilatation of the canal occurs; the uterine body is also soft, so that the local conditions simulate an early abortion. This may give rise to considerable difficulty in diagnosis in the case of menstrual irregularity, where a period occurs after an abnormally long interval. The diagnosis of abortion can then only be established by the discharge of definite embryonic structures.

Menstrual dilatation of the cervix is no doubt occasioned by uterine contractions which thus fulfil the double purpose of expelling the menstrual blood and at the same time facilitating its escape through the cervix. The

contractions probably also assist in arresting the bleeding by diminishing the calibre of the vessels in the uterine wall, and ultimately the uterus becomes firm and hard once more.

Symptoms Hæmorrhage from the uterus is not the only symptom of menstruation. For several days preceding each period certain *premonitory* symptoms are often present, such as pelvic discomfort or actual pain, backache, headache, and more or less general malaise ; in some cases excitability of temper or mental depression occurs ; in others transient skin-eruptions appear regularly during the premenstrual phase. This train of symptoms is recognized by the patient as the precursor of the period. In other persons no premonitory symptoms occur, the period coming on without any kind of warning. In the first two or three days of the period the symptoms just described persist, and irritability of the bladder and sometimes painful micturition are also not infrequently met with.

It has been shown by numerous observations that during the premenstrual phase the pulse-rate and the temperature are slightly elevated, the blood-pressure is slightly raised, and the excretion of urea is slightly increased above the normal During the menstrual period itself a fall occurs in each to slightly below the normal, and after the period is over a rapid return to the normal level sets in These are indications of vaso-motor and, perhaps, of metabolic disturbances associated with the process.

The severity of the symptoms of menstruation is very variable even in healthy women. Only a small minority appear to pass through the period without some suffering, and in many cases each menstrual period entails either a day or two of semi-invalidism, or at the least a good deal of restriction of activity

The premonitory symptoms being due to pelvic congestion, it will be obvious that when local morbid conditions are present, especially those of an inflammatory nature, the symptoms which accompany them will tend to become aggravated before each monthly period, by the general premenstrual congestion of the pelvic organs

The Causation of Menstruation. Facts which have been gradually accumulated in experimental and clinical work, during recent years, have influenced deeply the question of the causation of the menstrual process. The effect of recent work has been to indicate that the problem is even more complex than was supposed, owing to the correlation which has been shown to exist between the ovarian functions and those of the other endocrine bodies. Much of the difficulty attending investigation of the subject is due to the fact that no process strictly analogous to menstruation exists in the lower animals, with the exception of certain species of monkeys, in which a true menstruation occurs. The rut, or proœstrum, seen in many lower mammalian orders, is probably the physiological homologue of menstruation, but differs widely from it in character.

All theoretical considerations start from the well-established fact that menstruation in some way depends upon the presence of fully developed and active ovarian tissue. Complete removal of the ovaries before puberty prevents the establishment of the menstrual process, and in sexually mature women totally arrests it. Only one apparent exception to this rule is known, viz. that in female pseudo-hermaphrodites a periodic hæmorrhagic discharge may occur from the external genitalia, which are of the female type, although

the gonads are of the male type. The explanation of this exception will be mentioned later.

The presence of ovaries does not alone suffice to excite menstruation: the ovarian tissue must be *fully developed and activating*. The first appearance of menstruation coincides with certain general physiological changes which collectively constitute *puberty*. These changes affect the external genitalia, the internal genitalia, the mammary glands, and the psychical characteristics, of the individual, and reference has been made to them on page 78. In their totality they make up the female sex-characteristics and differentiate the woman from the child. The changes which take place at puberty in the ovary are that follicles begin to ripen and to discharge their ova, while for the first time lutein tissue makes its appearance in the organ. Removal of the ovaries before puberty inhibits most, if not all, of the other changes, but it is doubtful whether the ovarian changes can be regarded as the sole exciting cause of puberty, for removal of the thyroid, and partial removal of the pituitary, in animals, causes retrogressive changes in the uterus and ovaries. It is therefore possible that puberty depends upon the healthy activity and physiological co-ordination of the ovaries with other endocrine bodies. A certain amount of support for this view may be found in the fact that female children usually display marked physical and psychical characteristics widely different from those of boys; in them the ovaries are not fully developed and are inactive, so the presence of sex-characters cannot be entirely attributed to their influence. Further, female pseudo-hermaphrodites, possessing testes may yet, in external configuration and in psychical characters, present the appearance of attractive women.

Again, when the age of forty-eight to fifty is reached the menstrual process comes to an end, and coincident changes occur in the ovary, in the external and internal genitalia, in the mammary glands, in the general metabolism, and in the psychical characteristics of the individual. These will be found more fully described on page 91. All the climacteric changes are retrogressive, while those of puberty are progressive. The ovaries shrink, the Graafian follicles cease to ripen and ultimately disappear *in toto*; fresh lutein tissue therefore ceases to be produced, and the ovary in the end entirely loses all its characteristic histological elements. Changes closely resembling those of the natural climacteric can be induced in younger women by removal of the ovaries, yet the conclusion cannot be safely drawn that the loss of ovarian activity is the sole physiological cause of the cessation of menstruation, for ovarian and uterine atrophy may be induced in animals by removal of the thyroid or by partial removal of the pituitary (*vide infra*). Caution must be observed in applying experimental results to the problems of human physiology, but if due allowance be made it is fair to conclude that the ovaries exert a preponderating influence upon the menstrual process.

Assuming therefore that the ovaries initiate and maintain the functions of menstruation, it may be further stated that there is fairly conclusive evidence that each recurring menstruation is correlated with the changes which occur in the ovary as the results of ripening of the Graafian follicle and formation of the corpus luteum. This evidence has been already referred to (*see* p. 40), and it is only necessary here to repeat that menstruation appears when the corpus luteum has reached its mature stage, unless pregnancy has supervened. Discharge of the egg-cell occurs about the fourteenth day of the menstrual cycle (Shaw); the corpus luteum immediately begins

to be formed, and at the same time the premenstrual changes begin in the endometrium. It is permissible to conclude that from the corpus luteum is absorbed some body of the nature of a hormone whose function it is to initiate the menstrual changes in the endometrium. Involution of the corpus luteum is quickly followed by necrotic changes in the endometrium which result in hæmorrhage. The fact that the Gräafian follicles do not begin to ripen before puberty is in complete harmony with this view of the causation of menstruation.

An important contribution to this difficult subject has been made by Blair Bell in relation to calcium metabolism. This observer first noted that menstrual fluid contains a very high percentage of calcium salts; he also found that just before menstruation the calcium-content of systemic blood is very high, falls rapidly when the bleeding begins, and gradually rises again to its previous level as the next period is approached. In laying-hens he observed also a marked fall in the calcium-content of the blood when an egg had been laid, and sometimes a preliminary rise. From these observations he suggests that periodic alterations in calcium-metabolism may be the exciting cause of menstrual bleeding. He believes that the excessive calcium-excretion is brought about by the uterine glands, and is an active function of their epithelium, the marked leucocytic diapedesis which occurs at the onset of menstruation assisting the process. The calcium-excretory function of the uterus, he suggests, is under the control of the ovaries, probably through the internal secretion, and this view perhaps receives some support from the consideration that the ovaries do not become active until an age at which the growth of the skeleton has reached an advanced stage.

Under this theory the uterine hæmorrhage may be partly accounted for by a deficiency of calcium in the systemic blood, impairing its coagulability. But whether or not it be accepted as a theory of menstruation, the fact that an increased output of calcium occurs through the medium of the menstrual fluid may be accepted as proved. This fact seems to revive in scientific form the old view that menstruation was a form of excretion which served the purpose of carrying off various waste substances from the body. This view of menstruation is embodied in the Hebraic laws and customs, which decreed that during menstruation a woman was "unclean." In some of the earliest extant medical writings this view also found expression and was currently maintained until recent years, when the process came to be regarded as a purely local phenomenon, the effect of which was periodically to prepare the uterus for the implantation of a fertilized ovum. Now a fresh group of facts has come to light which indicate that the ovarian functions are clearly correlated with those of the other endocrine bodies, and therefore make it reasonable to suppose that menstruation is a process which influences and is influenced by the organism generally to an extent which had not hitherto been surmised.

The relations of the endocrine bodies to the ovaries and to the entire genital system have been investigated in four different directions: *first*, it has been shown that certain definite changes occur in some of the endocrine organs during pregnancy; *secondly*, that removal of the ovaries induces changes in other endocrine bodies and conversely, the removal, partially or entirely, of certain endocrine bodies leads to definite changes in the genital system; *thirdly*, pathological conditions of certain of the endocrine organs have been shown to be associated with morbid changes in the genital system;

fourthly, it has been shown that the effects of removal of the ovaries can be modified by the administration of extracts of certain endocrine bodies other than the ovary. Probably not all of these conclusions can be at present regarded as definitely established, and the experimental work upon which they are chiefly based requires confirmation. In regard to the thyroid, the pituitary and the adrenals, the evidence is fairly satisfactory: in regard to the thymus and the pineal we have little information at present.

The Thyroid. The clinical fact has been well known for many years that the thyroid often enlarges appreciably during pregnancy, the enlargement subsiding after labour. In the rabbit it has been shown that an increase of colloid occurs in the premenstrual phase and during pregnancy, and that after oophorectomy an enormous increase takes place. Further, goître is a disease which affects women much oftener than men, and a certain number of cases are on record where Graves's disease (exophthalmic goître) ensued with great rapidity after removal of the ovaries. Conversely, when the thyroid is removed in rabbits, which may survive for a considerable time, rapid atrophy of the uterus, similar to that produced by oophorectomy, is said to occur. Clinically it has been observed that cases of obesity associated with amenorrhœa can often be successfully treated by administering thyroid extract.

The Pituitary Gland. During pregnancy histological changes have been found in rabbits indicating increased cellular activity; after oophorectomy somewhat similar changes have been seen. Partial removal of the pituitary in animals causes atrophy of the uterus, and disappearance of follicles from the ovary (Cushing). In young animals which survive this operation for some time, a condition supervenes which has received the name of *dystrophia adiposo-genitalis*, characterized by stunted growth, atrophy of the genital organs, and general obesity. Blair Bell has shown that an extract of the infundibular portion of the pituitary exerts a powerful action on the muscle of the parturient uterus. This action, however, is not exerted only on the uterus, other forms of non-striped muscle are similarly affected, as is shown by an increase in intestinal peristalsis and a diminution in the calibre of small blood-vessels.

The Adrenals. In these organs also certain histological changes can be detected in pregnant animals. Removal of one does not affect the ovaries, but is said to cause a certain amount of atrophy of the uterus. Morbid conditions of the adrenals have been observed in rare instances in children, in whom also abnormal conditions of the genitalia were present. In males precocious sexual development, and in females approximation to the male type, may apparently be produced by abnormal adrenal activity.

From these considerations it is clear that the functions of the genital system are interlocked with those of the other endocrine bodies, that some of the ovarian functions are shared by the thyroid and pituitary; that the adrenals are possibly antagonistic to the ovaries; and, finally, that the causation of menstruation is to be sought not solely in the genital organs, but in the proper co-ordination of activity of widely separated and structurally diverse organs. And; further, it follows that menstruation serves more than a merely local purpose in connection with the process of reproduction; it is probably of the nature of a true excretion.

General Management of Menstruation. Menstruation, though a natural process, is one which readily passes the border line and becomes abnormal.

The due and regular occurrence of this function is undoubtedly an indication of good bodily health, while marked departures from the normal unfavourably influence the general health in most cases. At puberty care is accordingly called for until the menstrual function becomes properly established and its rhythm defined. Especially to be avoided under these circumstances are overwork in school tasks, physical fatigue, and exposure to cold or wet during a menstrual period. In later life the same precautions, though desirable, are not in all classes of society practicable. A chill caught during menstruation sometimes causes sudden arrest of the hæmorrhage and, following upon this, acute pelvic pain, probably from unrelieved congestion. Such an occurrence may perhaps become the starting-point of inflammatory changes in the pelvic organs. In women who are habitually constipated the daily use of a mild aperient is indicated during the premenstrual period. (For treatment in detail see 'Disorders of Menstruation,' p. 149)

Vicarious Menstruation (Xenomenia). Gynæcological writers of a generation or more ago universally held the opinion that normal menstruation was sometimes replaced or supplemented by hæmorrhages from organs outside the genital tract, which recurred at approximately regular monthly intervals. Writing in 1885, Routier succeeded in collecting the reports of 334 cases, most of which, however, had come from ancient literature. In the great majority of cases the hæmorrhage was described as occurring from a mucous membrane, the commonest sites being the stomach, the respiratory passages, the nose, the throat, or the intestine; sometimes the breasts and sometimes skin-surfaces were however affected. As a rule the periodic hæmorrhages were accompanied by the usual general symptoms associated with menstruation. In a large number of cases the organ from which the bleeding arose was the seat of some disease, such as gastric ulcer in cases of hæmatemesis, phthisis in cases of hæmoptysis, cancer in the breast, and ulceration in the case of skin-surfaces. Periodic bleeding from diseased surfaces in women who are at the same time menstruating naturally cannot possibly be regarded as instances of 'vicarious menstruation,' and practically the whole of such cases must be rejected.

A small number of cases remain, however, which require further consideration. These are cases of primary amenorrhœa, associated with congenital defects which rendered normal menstruation impossible, and in which periodic monthly hæmorrhages occurred from apparently normal mucous membranes, and were attended with general symptoms similar to those of normal menstruation. A typical instance of this kind was published by Lloyd Thomas in 1888. At the age of seventeen a well-developed girl, who had never menstruated, began to suffer from attacks of violent headache, followed by vomiting, and terminating in abundant epistaxis; the attacks lasted for three to four days and recurred regularly every month, but there was no uterine bleeding at any time. This continued to the age of twenty-one, when she was examined and found to have complete atresia of the vagina; a small supra-pubic incision was then made, and the pelvic organs explored, when it was found that the uterus was absent, but a small nodular body, taken to be an ovary, was found on the left side. After the operation the monthly nasal hæmorrhages continued as before.

A similar case has been since recorded by de Sinéty, in which the bleeding occurred from the anal canal, the patient up to the age of thirty-one having never menstruated normally.

Cases such as these merit the name of 'vicarious menstruation,' and suggest the possibility that when menstruation is, from congenital defects, completely inhibited, periodic hæmorrhages may occur from other organs, which serve some physiological purpose. From what has just been said of the causation of menstruation, and the widespread systemic disturbances which attend it, it is not wholly improbable that under the influence of the internal ovarian secretion or the secretion of other endocrine bodies, such hæmorrhages may occur.

THE MENOPAUSE OR CLIMACTERIC PERIOD

Menstruation generally ceases at some time between the ages of forty-five and fifty, it may, however, be delayed to the age of fifty-five or even later; occasionally it occurs early, before the age of forty. There are three modes in which the menstrual function may come to an end: (*a*) It may terminate suddenly and finally without any preceding change being observed; (*b*) the periods may occur at irregular and increasing intervals, with gradual reduction of the amount of bleeding, until it finally disappears completely; (*c*) during the period of irregularity occasional profuse or prolonged losses of blood may occur. The duration of the period of irregularity is variable, and may extend over several years.

Accompanying these alterations in the menstrual function certain general disturbances are very commonly met with. These disturbances may be divided into three groups: (*a*) psychical; (*b*) vasomotor; (*c*) metabolic.

The commonest *psychical* change is mental depression, although naturally of a cheerful disposition the woman may become morose, tearful, despondent or irritable. Exaggeration or perversion of sexual feeling sometimes occurs. The climacteric is not necessarily the precursor of senility; women often preserve the freshness of maturity for many years unless general ill-health or mental disturbances supervene. Loss of energy, of memory, of imagination and originality are sometimes found. The climacteric is a time at which there are increased risks of insanity, and this liability is more marked in the statistics of private than of rate-paid asylums (Percy Smith), indicating a greater liability on the part of women of the better class.

Another psychical disturbance often found in sterile women who are approaching the menopause is *pseudocyesis*, or *spurious pregnancy*. In this condition amenorrhœa is associated with the presence of a *phantom* abdominal tumour and many of the minor signs and symptoms of pregnancy. The tendency to the deposition of fat in the abdominal walls at this time of life helps to simulate the presence of a growing abdominal tumour. The patient is, as a rule, herself entirely deceived, and often sincerely believes herself to be pregnant, so that it may be difficult to convince her of her error. So closely is the natural condition simulated that at the appropriate time a *false labour*, attended with severe abdominal pains, may occur. In order to avoid mistakes cases such as these should be examined under anæsthesia, when the absence of pregnancy-changes in the uterus will be made out without difficulty.

The most characteristic *vasomotor* symptom consists in attacks of 'flushing.' The patient experiences the sensation of waves of heat passing over the whole body, often accompanied by visible congestion of the face and neck or other areas of the body, and followed by sweating, which in severe cases

may be profuse. Each 'flushing' may last from fifteen to thirty minutes, or, on the other hand, may be almost momentary; several may occur in a day, or they may be much more infrequent than this; they appear to be especially severe at night. The mechanism of production of this vasomotor disturbance is not known. Headaches, neuralgia, sensations of tingling or numbness in the extremities, and sensory neuroses of the throat are also common.

The chief *metabolic* change is the marked tendency to obesity; often this is local, the abdominal wall being a frequent position where large deposits occur, leading to the suspicion of an abdominal tumour.

In rare instances women pass through the climacteric without suffering from any of the above-described disturbances. In other instances they are severe and prolonged, and may persist for several years after menstruation has ceased.

The *artificial* menopause which ensues upon operative removal of both ovaries during the sexually active period of life closely resembles the natural process, but the attendant symptoms are often unusually severe. Arrest of menstruation by removal of the uterus, if one or both of the ovaries are retained, is usually almost entirely free from the attendant symptoms just described.

Sometimes a *premature* menopause occurs apart altogether from operative interference, and a case has been recorded in which menstruation ceased naturally at the age of twenty-three, having begun at the age of eleven. A severe illness or a mental shock appears in some cases to have been the exciting cause; in others it has been due to lactational atrophy of the uterus, in others no cause has been discovered.

The general phenomena of the menopause are induced partly by the loss of the internal ovarian secretion, partly by the effects of the arrest of menstruation. The fact just alluded to, that hysterectomy with preservation of the ovaries is not attended by climacteric symptoms indicates the importance of the ovarian secretion. This view is further supported by the results of ovarian grafting, with and without retention of the uterus, referred to on page 46.

Anatomical Changes. Certain well-marked changes take place in the external and internal genital organs when the climacteric has been passed; they do not, however, appear immediately, and many women retain for a long time the outward signs of sexual activity. The labia majora slowly shrink from loss of subcutaneous fat, and the labial and pubic hair becomes less abundant, gradually disappearing as old age is reached. The nymphæ then become relatively prominent, and the skin of the vulva is generally dry and somewhat polished in appearance. The stratified epithelium of the vulva and vagina atrophies, and small round patches of a dark-red colour, apparently due to exposure of the deep layers of epithelium, are often seen (*see* Pl. XV, p. 309). The vaginal portion of the cervix shrinks and becomes less prominent, or it may retreat until the lips of the external os are flush with the surface of the vaginal vault. The body of the uterus and the Fallopian tubes shrink; the endometrium in old women is found to be atrophied (*see* Fig. 212), and the greater part of the uterine muscle replaced by fibrous tissue (*see* Pl. II, Fig. *b*), but the endometrium may occasionally be found to retain approximately its normal characters for several years after the cessation of menstruation (*see* Fig. 21, p. 27). The ovaries also shrink and completely lose all

their Gräafian follicles, and then consist mainly of fibrous tissue. Gradual disappearance of the follicles can be traced long before menstruation ceases. The connective tissue beneath the pelvic peritoneum to a great extent disappears, and the various ligaments become shortened and inelastic. The upper roomy part of the vagina becomes much diminished in capacity by shrinkage; sometimes irregular or concentric bands of dense fibrous tissue form in the vaginal wall, producing a constriction of the canal, or forming pockets in the vaginal vault. The mammary glands simultaneously atrophy and lose much of their fatty envelope.

The vaginal secretion of women past the menopause has no bactericidal properties, and owing to the imperfect closure of the ostium vaginæ, foreign matter enters more readily than in the case of younger women. Infection of the mucous membranes is accordingly more prone to occur, and this change is probably the main factor in the causation of the condition described as *senile vaginitis* (*see* p. 341). The same changes may spread into the uterus, producing *senile endometritis* (*see* p. 223).

Treatment. The care of the general health in women who are passing through the change of life is of some importance. The attendant symptoms do not require treatment unless they are unusually severe or prolonged, and then it must be admitted that we do not possess any remedies which can be relied upon to relieve them. Ovarian extract, given in the form of tablets, or 'corpus luteum' tablets, or ovarian and mammary extract combined in capsules, sometimes appear to diminish the severity of the flushings, in other cases small doses of thyroid or thymus gland have proved useful. The use of sedatives, alcohol, and analgesic preparations is to be discouraged, especially in women of neurotic temperament, for drug habits are readily acquired under these conditions. The use of small doses of bromide combined with valerian or with a vegetable tonic, such as cinchona, is however often useful.

Hæmorrhage and discharges at or after the menopause must in all cases be regarded as indications of the possible occurrence of malignant disease, the most likely seat of the disease being the cervix or the body of the uterus. A careful and complete internal examination must in all cases be made without delay, for successful surgical intervention is possible only in the early stages. The necessity for submitting to such an examination must be explained to and urged upon the patient, who may, at first, be unwilling to allow it. In the great majority of cases a local cause will be found for irregular and protracted bleeding at the menopause, but sometimes, as has been already mentioned, this is not so. This matter will be again discussed in connection with the diagnosis of cancer of the uterus (p. 484).

PART I: SECTION II

METHODS OF EXAMINATION

INTERROGATORY EXAMINATION

The Patient's Previous History. In this connection there are certain points which are of especial significance in gynæcological cases. In the first place the menstrual function demands attention; the age of commencement, periodicity, degree of regularity, duration, amount, and attendant symptoms should be noted. Next the obstetric history, if any, should be taken, the chief points to be noted being the number of pregnancies, their dates, the occurrence of difficulties in delivery, and the length and character of the subsequent convalescence. The last-named point is of great practical importance, for a large number of cases of chronic pelvic inflammation arise from infection following either a confinement or miscarriage, and a prolonged or complicated lying-in period may be generally accepted as an indication of septic infection having occurred. The occurrence of a series of miscarriages is an important point in the obstetric history, for signs of systemic syphilis or local pelvic morbid conditions are not infrequently found in such cases; further, it must be remembered that a miscarriage is almost as frequently followed by septic infection as a confinement. A history of gonorrhœal infection in the patient herself, or in her husband, or in a previous husband, has important bearings upon the causation of sterility, the sequelæ of gonorrhœa may sterilize both the male and the female, the former by setting up chronic epididymitis, the latter by sealing the Fallopian tubes. Further, gonorrhœa is a frequent cause of both acute and chronic pelvic inflammation in women, and may on occasion give rise to puerperal sepsis following either miscarriage or labour. Acute attacks of appendicitis may be the starting-point of pelvic inflammation, which may persist after operative relief of the original disease. Syphilis is a very infrequent cause of pelvic inflammation, but it is regarded by some writers as the cause of one variety of subinvolution of the uterus, and in the late secondary stage a chronic form of granuloma affecting the vulva may appear.

The History of the Present Illness. Whenever it is possible to do so, a clear history of the *onset* of the illness should be elicited. In chronic cases of long standing this is seldom practicable, partly from the patient's recollection being at fault, and partly from her want of observation. In recent or acute cases the relation of the first symptoms to the last preceding menstrual period, or the last preceding pregnancy, should be established by dates. In many diseases, symptoms of considerable diagnostic importance appear at first, but being of brief duration, are often not mentioned by the patient unless particular inquiry is made for them. As an example may be noted the scalding pain on micturition which accompanies the transitory acute urethritis of gonorrhœa (*see* p. 259). In cases characterized by recurrent attacks of acute pain, particular inquiry should be made as to their relation

to a menstrual period, and as to the occurrence of such menstrual alterations as delay, or increase in the amount of the hæmorrhage. The importance of these points will be obvious in cases of pelvic inflammation and of extra-uterine gestation.

It will be found that the symptomatology of gynæcological disease is somewhat restricted. There are three important symptoms, viz. *haemorrhage, discharge*, and *pain*, which are met with either individually, or in various degrees, as a symptom-complex in a variety of different circumstances. The causation and significance of these cardinal symptoms will be considered in a later section, their incidence, their severity, their recurrence, and their special characters are subject to very numerous variations, the details of which should be noted in each individual case. Next in importance to these symptoms come disturbances of the function of menstruation, either in the form of alterations of rhythm, such as increased or diminished frequency, alterations of amount—either less or more, and alterations of duration. The effect, if any, of a menstrual period upon the symptoms complained of should also be inquired into. Many minor symptoms are also frequently met with, such as sterility, pain or difficulty in sexual intercourse (dyspareunia), and disturbances of the function of micturition, and, though of much less importance, of the function of defæcation.

The general health may be adversely influenced; thus severe hæmorrhage, sudden or prolonged, may lead to profound anæmia; malignant disease to wasting and cachexia; chronic pain to loss of sleep and appetite, to functional disturbances of the nervous system, or in some cases to aggravated forms of neurasthenia. It is to be borne always in mind that cases of the latter variety must be carefully discriminated from commencing *disseminated sclerosis*, a disease to which women are particularly prone, and which may on occasions be mistaken for hysteria, unless caution is exercised and the possibility of error recollected.

Care and judgment are required in estimating the value to be attached to the statements made by patients as to the severity of the symptoms of which they complain. This is especially the case with regard to pain, for many women unconsciously exaggerate this symptom; in others it bears the complex and variable characters which are associated with functional disturbances. In all cases less importance should be attached to the account of her sufferings given by the patient than to the results of careful physical examination.

ABDOMINAL EXAMINATION

The patient should lie upon her back with the body uncovered from the mammæ to the pubes. *Inspection* will detect the presence of enlargement of the abdomen, its distribution and extent, skin markings, of present or past pregnancy, scars of previous operations, the condition of the navel and the degree of mobility of the parietes on respiration. Enlargement may be due to obesity, to the presence of fluid, to the presence of a tumour, to flatulent distension of the intestine, or it may be of the variety known as phantom enlargement. In the case of obese patients great care is required; on the one hand a small tumour may easily be missed in such cases, while on the other the general enlargement may be wrongly attributed to a large tumour.

In some cases the presence of the signs of early pregnancy must be sought

for in the breasts; in cases of pain referred to the breast, a systematic surgical examination of both mammæ, including the axillary and supra-clavicular regions, must be made.

Palpation. A certain amount of skill is required in successfully conducting an abdominal palpation. The hands should be warm, and in using them the whole hand should first be placed flat upon the abdomen, and lightly passed over the parietes, great gentleness being employed at first, especially in the case of nervous patients. The points of the fingers should not be used, but when pressure is required this should be applied with the whole hand or with all the fingers together. The patient meanwhile should breathe lightly and easily, keeping the mouth open. From nervousness many patients contract the recti muscles upon the lightest contact of the fingers, or maintaining the diaphragm in contraction, breathe solely with the thoracic muscles. An anæsthetic may, in some cases, be required before a satisfactory palpation can be made.

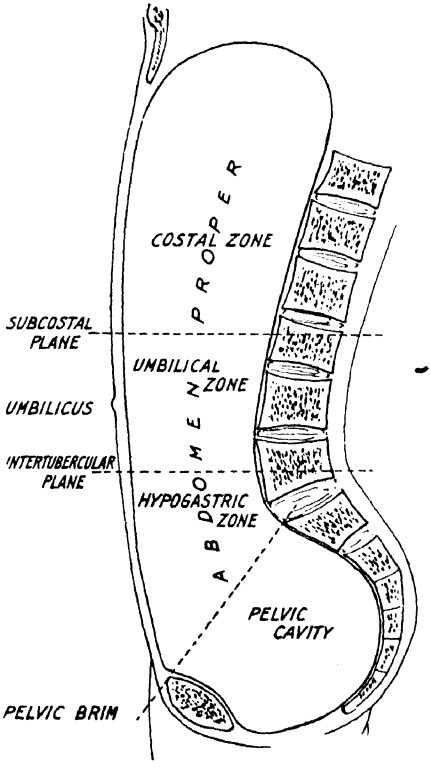


FIG. 73. THE ABDOMINO-PELVIC CAVITY (Cunningham).

When the abdomen is not enlarged and its walls are thin, it is sometimes possible to recognize the body of the normal anteverted uterus on deep pressure behind the symphysis pubis. A soft, ill-defined swelling, dull on percussion, in the hypogastric region, which prevents the hand from being pressed into the pelvic brim, suggests the full or distended bladder. The cæcum and pelvic colon, when distended, form soft tympanitic swellings in either iliac region, which should not be mistaken for any abnormal condition; when empty and contracted these portions of the gut, in thin patients, can be rolled beneath the fingers, and may feel solid and cylindrical in shape. Tenderness on deep pressure at a point about 2 inches above the middle of Poupart's ligament is so frequently met with, especially upon the left side, that it can hardly be regarded as abnormal except in a severe form; it forms one of the well-known *stigmata* of hysteria, and though often referred to as 'ovarian tenderness,' its connection with the ovary is at least doubtful. On the right side its possible relation to appendicitis must be borne in mind.

The routine examination should also include palpation of the regions of the cæcum and appendix, the transverse colon, the gall-bladder, the pelvic colon, and the renal region on both sides. Movable kidney is very common in women, and when the abdominal walls are thin, it may be readily recognized by the following manœuvre. When examining the right kidney the examiner

stands upon the patient's right side and places his left hand upon the flank with the fingers behind in the ilio-costal space, the thumb in front along the costal margin. The patient is then directed to take a deep inspiration ; when the kidney descends with the diaphragm the thumb is depressed deeply below the ribs, while the patient allows the chest to empty itself. The kidney is thus detained below the ribs and can be palpated with the right hand, and its size, contour, and sensibility determined. Afterwards the pressure of the left thumb is relaxed, when the kidney can be pushed up again into its bed. In examining the left kidney the examiner stands upon the left side and uses his right hand in the flank.

The position of swellings, or of areas of pain, increased sensibility or abnormal dulness, should be defined as accurately as possible for record, and here percussion is a useful aid. For this purpose the pelvi-abdominal cavity may be divided, as shown in Figure 73, into four horizontal *zones* named from below upwards—the pelvic cavity, the hypogastric zone, the umbilical zone and the costal zone. The hypogastric zone is limited below by the pelvic brim, and above by the inter-tubercular plane, an horizontal line drawn between the highest points of the iliac crest. The costal zone is limited below by the sub-costal plane, an horizontal line joining the tips of the *tenth* costal cartilages, and above by the dome of the diaphragm. The pelvic cavity may be further subdivided by the intersection of its anterior and posterior diameters into four sections, which are named right and left, anterior and posterior sections respectively. Each of the abdominal zones may be further subdivided into three *regions* by two vertical lines drawn one on each side from the middle of Poupart's ligament to the costal margin. Nine regions are thus marked out upon the anterior abdominal wall which are named as shown in Figure 74. In the case of abdominal swellings of considerable size, it is well to state the horizontal zones in which they lie, as well as the regions which they occupy.

When *general* enlargement of the whole abdomen is present the cause may be—(1) obesity ; (2) ascites ; (3) ' phantom ' enlargements ; (4) a tumour. *Obesity* will be suspected if the adipose tissue of the body generally is in excess , when giving rise to abdominal enlargement, the greater part of the excess of fat is in the abdominal parietes, the remainder in the omentum and mesenteries. The obese abdomen is flattened anteriorly, bulges in the flanks, and shows no increase of tension ; the umbilicus is depressed to an unusual degree. The presence of a thick layer of subcutaneous fat can be demonstrated by taking up the abdominal wall in folds between the fingers. Firm percussion is required to bring out a resonant note from the subjacent intestines. Small abdominal tumours, in such conditions, may be overlooked even when great care is exercised. When deep palpation is rendered difficult by obesity, or by rigidity of the abdominal muscles, it is convenient to employ both hands, one superimposed upon the other. The fingers of the lower hand are then used for palpating, while the upper hand presses it deeply into the abdomen so as to overcome the parietal resistance. *Ascites* causes general enlargement of the abdomen only when the amount of fluid is great. An area of resonance then persists around the umbilicus, and extends upwards through the epigastric region into the costal angle, while the flanks and lower abdomen are dull ; the area of dulness shifts on change of position, as may be demonstrated by turning the patient on her side, when the upper flank will become resonant ; a fluid thrill is readily obtained

from side to side by gently flicking the abdominal wall in the flank. Small amounts of free fluid in the abdomen may be very difficult to recognize when the patient is corpulent or when some other morbid condition is also present. *Phantom* enlargement of the abdomen occurs in women of neurotic or hysterical temperament, and is always recognizable by its complete subsidence under anæsthesia. Comparatively few *tumours* attain a size large enough to cause *general* enlargement of the abdomen at all similar to the conditions just mentioned; that most commonly met with is an ovarian cyst, more rarely a fibro-cystic tumour of the uterus; hydatid cysts, and malignant growths in their advanced stages, may also be mentioned.

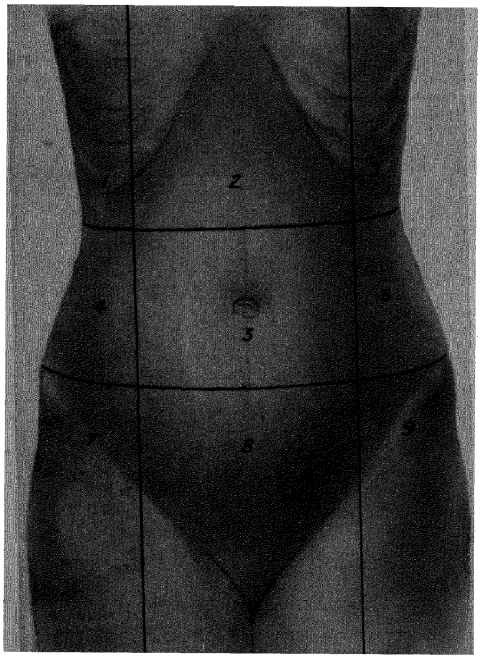


FIG. 74. THE REGIONS OF THE ABDOMEN (Cunningham). 1, Right hypochondriac region; 2, epigastric region; 3, left hypochondriac region; 4, right lumbar region; 5, umbilical region; 6, left lumbar region; 7, right iliac region; 8, hypogastric region; 9, left iliac region.

When *localized* enlargement of the abdomen is met with, the possible causes are much more numerous and include morbid conditions of all the abdominal and pelvic viscera. Only those of pelvic origin can be referred to here. In the case of a tumour of *pelvic* origin rising into the abdominal cavity it is usually impossible to define its lower borders by abdominal examination; *i.e.* the fingers cannot be pressed down below it through the abdominal walls. Exceptions to this rule will be found in a pelvic tumour with a long pedicle which allows it to ride above the pelvic brim; such are either ovarian tumours, parovarian cysts, or subserous uterine fibroids. Pelvic abdominal swellings, as thus defined, may be fluid or solid, or in parts fluid, in other parts solid; the consistence of a soft solid tumour is not readily distinguishable from a cyst with thick walls or very viscid contents. Swellings of these characters may be due to over-distension of the bladder, to pregnancy, to new growths of the uterus, or ovaries, to distension of the Fallopian tubes or uterus, to fluid or solid effusions in the pelvic cellular tissue, or to encysted collections of fluid in the peritoneum. It must never be forgotten that the commonest abdominal swelling in women is the gravid uterus, and unless the possibility is excluded by age or by the physical characters of the swelling, it should always be first considered. The over-distended bladder has also been the cause of innumerable diagnostic mistakes; the catheter offers an easy means of recognizing it. The bladder being excluded, pelvi-abdominal tumours which yield a fluid thrill are in almost all cases

ovarian or parovarian cysts ; occasionally fibro-cystic tumours of the uterus or hydatid cysts will be found to yield this sign. It is not in all cases, however, that fluid tumours yield a fluid thrill (*see* p. 642). As a rule the consistence of the gravid uterus is that of a soft solid ; occasionally, however, a fluid thrill may be detected (hydramnios).

Nearly all pelvi-abdominal tumours are dull to percussion. Exceptions will be found in cases of hæmatocele, and of encysted peritonitis, often tuberculous, in which conditions coils of intestine always become incorporated by adhesions in the walls, giving a subresonant note over the greater part of its extent. In some instances also retroperitoneal tumours displace the large gut forwards, giving a subresonant note over the position of the gut. Putrefaction, with production of gases, may occur in extra-uterine gestation, thus giving rise to a greater or less degree of resonance in such tumours.

All tumours of pelvic origin are dumb on auscultation, except the gravid uterus, an extra-uterine gestation, and certain uterine-fibroids which may yield a souffle similar to the uterine souffle of pregnancy.

VAGINAL EXAMINATION

A complete vaginal examination of the pelvic organs is conducted by inspection and palpation, and also requires the use of certain instruments. Parts of the examination are not in all cases necessary, but it will be convenient to describe the methods here in full. For general use as a lubricant there are various forms of liquid soap and glycerine jelly which can be readily procured. In cases of venereal or septic infection boiled rubber gloves *must* be worn, both to protect the fingers from contamination and to avoid the risk of carrying infective material to others. Under other conditions their use is a matter of choice, but there are many sound reasons for recommending their routine employment. It is not possible in all cases to exclude sepsis and gonorrhœa except by local examination, and contamination of the fingers may occur before the danger is recognized. To all who are frequently operating the preservation of the hands from contamination is a matter of the greatest importance, and equally to the practitioner engaged in midwifery. In hospital work, where a gynæcologist may examine a number of women in quick succession, there is a further danger, viz. the possibility of carrying infection from one patient to another through inadequate disinfection of the hands after each examination.

The position in which vaginal examination is usually made in this country is with the patient lying on her left side (*see* Fig. 81, p. 106), with the thighs flexed on the abdomen. A high couch and a good light are useful aids. In cases of prolapse it is sometimes desirable to examine in the standing position ; in rare instances such postures as the genu-pectoral may be adopted, but these are employed for treatment rather than for diagnostic examination. The examination can also be made with the patient lying on her back, with the thighs flexed, the feet supported on rests at the end of the couch, and the knees separated (*see* Fig. 75). In either position *inspection* of the vulva can be conveniently made, and this is the first part to which attention is directed. The points which should be noted are the condition of the labia majora, labia minora, and clitoris ; then separating the labia with the fingers, the hymen, carunculæ myrtiformes, vestibule, meatus urinarius and fossa navicularis

should be examined in turn; then, with the tip of the index finger introduced through the ostium vaginæ, pressure should be made upon the floor of the urethra towards the meatus, so as to reveal the presence, if any, of urethral discharge; finally, the openings of the Bartholinian ducts may be inspected, and when enlarged the glands may be palpated by taking the tissues at the base of each labium majus between the finger in the vagina and the thumb externally. The normal gland cannot be defined by palpation. Generally the mucous surfaces of the vulva are moist, but there is no visible discharge; sometimes white curdy secretion or a thin opalescent fluid is present; neither is abnormal.

The next step is the digital examination of the vagina, which is usually made with the index finger, or in a parous woman the index and middle fingers, of the right hand. It is a great convenience to learn to use either hand with equal facility for the internal examination. In introducing the fingers it will be remembered that the vulva presents an antero-posterior slit, while the lumen of the vagina is transverse; the hand will therefore be rotated through a right angle as the fingers pass upwards towards the cervix.

The condition of the *vaginal walls* is the first point to be observed; the transverse rugæ (*see* p. 49) can usually be felt on the lower one-third of the anterior wall, but in women who have borne several children, or in cases of prolapse, they are often absent. The educated finger will at once detect such conditions as abnormal laxity of the walls (in prolapse), constrictions, cicatrices, warty excrescences, and bulging swellings, either cystic or solid. The *vaginal portion of the cervix* must next be defined. It lies usually about the centre of the pelvic cavity, the external os corresponding to the level of the ischial spine; departure from this position is, however, by no means uncommon, and too much importance must not be attached to the slight displacements in one or another direction which may be met with, for the healthy uterus does not invariably lie in the middle line, nor at the same horizontal level. In nulliparous women the os forms either a small round aperture, or a narrow transverse slit; in women who have borne children it is invariably either transverse, if no laceration has occurred, or irregular if the cervix has been torn in delivery. Another condition which is not abnormal must also be borne in mind, viz. the presence of several low, smooth, round, firm elevations upon the surface; these are caused by retention cysts formed in the fibro-muscular wall of the cervix by closure and dilatation of the deep portions of the cervical glands—the so-called *ovula Nabothi* (Fig. 15, p. 19). The educated finger will detect such abnormal conditions of the cervix as dilatation of the canal, hypertrophic elongation and ectropion, protruding polypi—either cervical or uterine—and ulcerations due to malignant growths or to other causes.

Bimanual Examination. The next step is the *bimanual examination*, and this is the most important from every point of view. Considerable experience of this method is necessary to acquire confidence and skill; under favourable conditions it is easy and permits of a detailed examination of all the pelvic organs; under unfavourable conditions, such as obesity, nervousness, loading of the rectum, etc., it may be necessary to suspend judgment until an examination under anæsthesia has been made, and even this in some instances may leave many points undetermined.

For a successful bimanual examination it is essential that the bladder

should not be full nor the rectum loaded ; a mild aperient should therefore be taken in preparation for the examination.

The only position in which the bimanual examination can be properly made is with the patient lying on her back, and the knees bent to an acute angle. When a special gynæcological couch, or operating table, is used the examiner stands between the patient's knees as in Figure 75 ; it is equally convenient, however, for the examiner to stand at the side of the couch, passing his right hand beneath the bent right knee of the patient (*see* Fig. 76), and for this method no special couch is required. The right hand

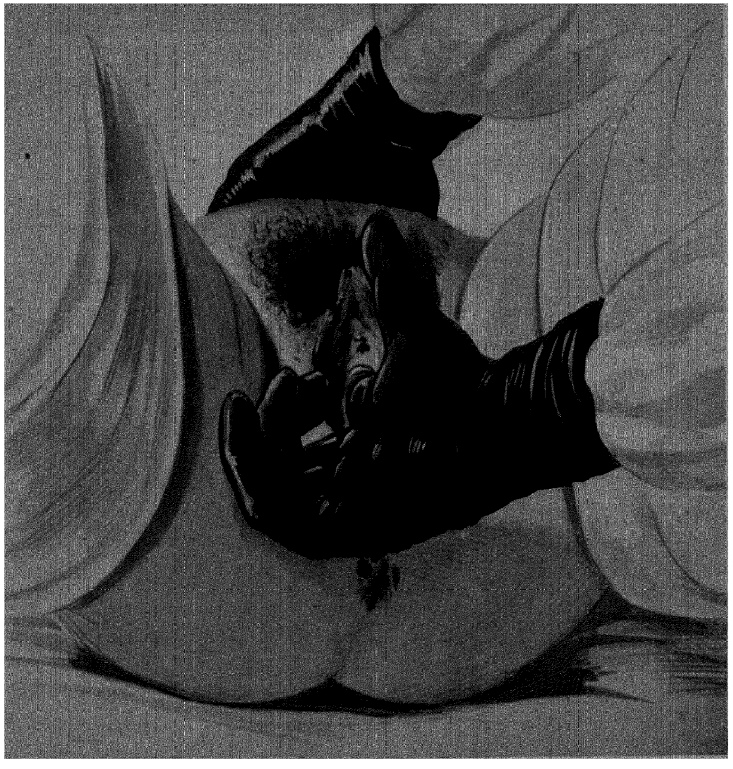


FIG. 75. METHOD OF MAKING THE BIMANUAL EXAMINATION, the examiner standing at the end of the couch. (From a photograph.)

is usually employed for the internal examination, the left is placed upon the hypogastrium, and with the fingers of the two hands working in conjunction the pelvic organs can be palpated simultaneously from above and from below. It is advisable to become familiar with the use of either hand internally, for the right side of the pelvis can be explored more thoroughly with the right hand, the left side with the left hand. The examination should also be learned in both positions shown in Figures 75 and 76, for the use of a couch or operating table is not always practicable, and in the case of patients confined to bed the position shown in Figure 76 is more convenient and occasions less distress than the other.

The *body of the uterus* is first sought in its normal position of anteversion.

The uterus usually lies roughly in the obstetric axis of the pelvic cavity. In thin subjects it will be readily felt in this position ; if not found at once, the vaginal finger should be used to push up the uterus towards the abdominal wall ; this is much more effectual than attempting forcibly to overcome the resistance of the powerful abdominal muscles, by pressure from above. The external hand should be placed about half-way between the pubes and the umbilicus. When the body of the uterus is thus held between the fingers of the two hands, it is possible to determine its position, size, shape, consistence, and mobility ; minor points also to be noted are sensitiveness to pressure, and pain provoked by movement. It is by no means easy to make a satisfactory bimanual examination of a retroverted uterus without first pushing it up to the level of the pelvic brim, and this can sometimes be done more effectually *per rectum* than *per vaginam*.

The *uterine appendages* should be identified next, and these are found

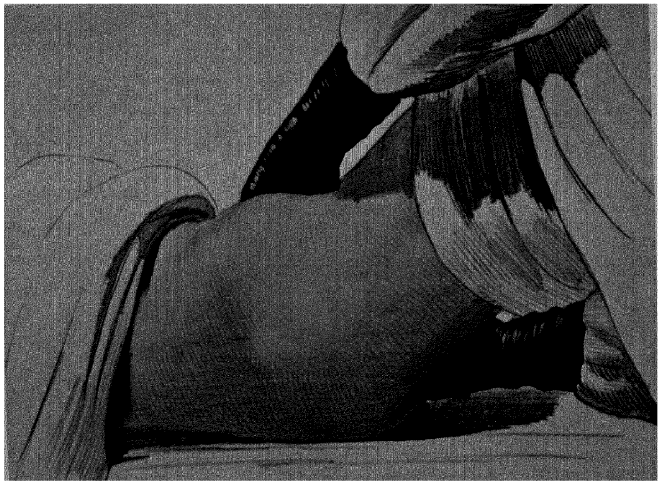


FIG. 76. METHOD OF MAKING THE BIMANUAL EXAMINATION, the examiner standing at the side of the couch. (From a photograph.)

by bimanual examination of the *lateral fornices*. Exceptionally when the abdominal walls are thin and long, three structures may be made out. Anteriorly a thin cord which can be rolled between the fingers represents the round ligament ; behind this is a softer, cylindrical structure—the Fallopian tube ; tracing the latter outwards, the ovary may be felt in its usual position, *i.e.* close to the lateral pelvic wall : it will be recognized by its round or oval shape, soft consistence, sensitiveness, and ready mobility, slipping easily between the fingers of the two hands. If the ovary cannot be felt in its normal position, it may be found prolapsed into the pouch of Douglas. The most difficult of all to recognize is the normal Fallopian tube ; it is softer in consistence than the round ligament and more difficult to distinguish unless thickened or distorted by pathological changes. In cases of obesity, or rigidity of the abdominal walls, the unenlarged appendages may not be felt at all ; when felt under such circumstances, they are probably of abnormally large size.

The *bladder* cannot be outlined by palpation when empty; the full bladder forms a soft fluctuating sac felt in the anterior fornix, which displaces the uterus backwards so that only its fundus can be felt. The termination of the pelvic portions of the *ureters* can in some cases be identified in the lateral vaginal fornices, a little to the outer side of the cervix. When thickened from tuberculous disease, or when a calculus is present, their detection is easier.

Many abnormal structures may be detected in the *lateral fornices;* a soft, cystic, movable swelling is generally an ovarian or a parovarian cyst; a hard, solid, movable swelling is generally a subperitoneal fibroid, but may be a solid tumour of the ovary; a firm or hard, fixed, tender swelling is generally inflammatory, and in the great majority of cases includes, as its nucleus, an inflamed tube or ovary, or both (salpingitis: oophoritis); less commonly this kind of swelling is due to an inflammatory effusion into the broad ligament (cellulitis). Visceral ptosis is very common in women, and a loop of the pelvic colon on the left side, or a portion of the cæcum on the right, or a loop of ileum in the middle, may often be palpated, and may sometimes be felt to gurgle under the pressure of the fingers. These parts of the intestine are sometimes mistaken for pathological conditions such as cysts, but they are always ill-defined in outline, and give an obscure sense of resistance rather than the impression of a definite mass. A second examination after proper evacuation of the bowels may show that the swelling has disappeared.

Lastly, the *posterior fornix* is explored in the same manner. By pressing the internal finger upwards behind the cervix, a small portion of the posterior uterine wall in its lower part may be felt (*see* Fig. 2); the anterior rectal wall and the utero-sacral ligaments can also be felt, but the latter are not recognizable unless unusually well developed, or thickened by inflammatory or other changes. In all cases they can be examined much more effectually *per rectum* than *per vaginam*. Of all the structures which may, under abnormal conditions, be felt through the posterior fornix, the commonest is the body of the uterus in backward displacement, and next to this the ovary when prolapsed; other structures which may be encountered include such varied conditions as uterine fibroids, ovarian tumours (cystic or solid), inflamed or dilated tubes, intraperitoneal collections of blood or inflammatory fluids, displaced abdominal viscera such as the spleen or the kidney, secondary growths of abdominal origin such as carcinoma of the omentum or peritoneum, hydatid cysts of the pelvic cellular tissue, fæcal accumulations, and new growths or foreign bodies in the rectum.

In many cases great assistance will be obtained from making the bimanual examination both in the dorsal and in the lateral positions. The change of posture brings with it a change in the position of the principal pelvic organs, especially the uterus; in the Sims's position this organ tends to fall forwards, and thus to allow a more complete examination of the region of the pouch of Douglas from below.

Rectal, Recto-abdominal, and Recto-vagino-abdominal Examination. Rectal examination is made with the index finger of the right hand, gloved and freely lubricated. It is essential that the rectum should be empty. In a *virgo intacta* it is desirable to avoid vaginal examination if possible, and the recto-abdominal method then permits of approximately accurate results

being obtained, especially as regards the size and position of the uterus and the condition of the cervix. A history of hæmorrhage or pain accompanying defæcation necessitates a careful inspection of the anus before the finger is introduced, for a digital examination may be extremely painful when a fissure is present. Rectal examination allows of a more complete examination of the contents of the pouch of Douglas than does vaginal examination; the finger in the rectum passes far up the posterior wall of the pouch, while only its floor is accessible from the vagina (*see* Fig. 4). The nature of a retro-uterine swelling can often be elucidated in this way. Further, the utero-sacral ligaments are readily felt, and early infiltration, as in cancer of the cervix, may be detected, although not apparent from the vagina. Again, cellulitic effusions often track round the rectum, surrounding it more or less completely with a firm fixed ring of induration. Lastly, conditions such as rectal stricture or polypi, hæmorrhoids, fæcal accumulations, and foreign bodies will also be detected. It is sometimes useful to carry out a bimanual examination with the index finger in the vagina, the second finger in the rectum (recto-vagino-abdominal). Slight degrees of impaired mobility may be thus detected, and the relation of a pelvic swelling to the uterus may be defined.

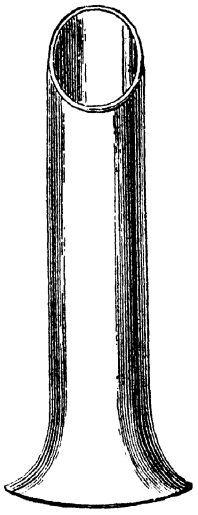


Fig. 77. Ferguson's Vaginal Speculum.

Visual Examination of the Vaginal Walls and Cervix. With the aid of a vaginal speculum and a good light the vaginal canal and cervix can be conveniently inspected. There are many types of vaginal specula, but only two need be described: the most useful is the *tubular* or Ferguson's speculum; next may be mentioned the *duck-bill* or Sims's speculum.

Ferguson's speculum is a tube of glass, porcelain or metal about 6 inches long, cut obliquely at its upper end, and furnished below with a shallow flange (*see* Fig. 77). It is made in different sizes; the smallest, suitable for a nullipara, having a diameter of about 1 inch. In introducing the instrument—boiled and smeared with a sterile or antiseptic lubricant—the fingers of the left hand are used to separate the labia minora until the ostium vaginæ can be seen (*see* Fig. 78). The upper, oblique end is then applied to the vulva, the longer side being posterior, and with the edge the posterior vaginal wall is gently pressed backwards; the lower end at the same time is so held that the instrument lies in the obstetric axis of the pelvic outlet. In this way the ostium vaginæ is stretched until the short anterior side of the speculum will slip easily over the vestibule. The instrument is then pushed gently inwards, the long side being directed behind the cervix into the posterior fornix; the cervix then lies exposed in the upper end of the speculum, and the vaginal walls are not seen. In introducing or withdrawing the speculum portions of the vaginal walls beyond it can be seen in contact with one another.

This speculum can conveniently be used in either the dorsal or lateral position and suffices for most of the purposes for which a speculum is required in clinical examination, or in the application of certain forms of treatment.

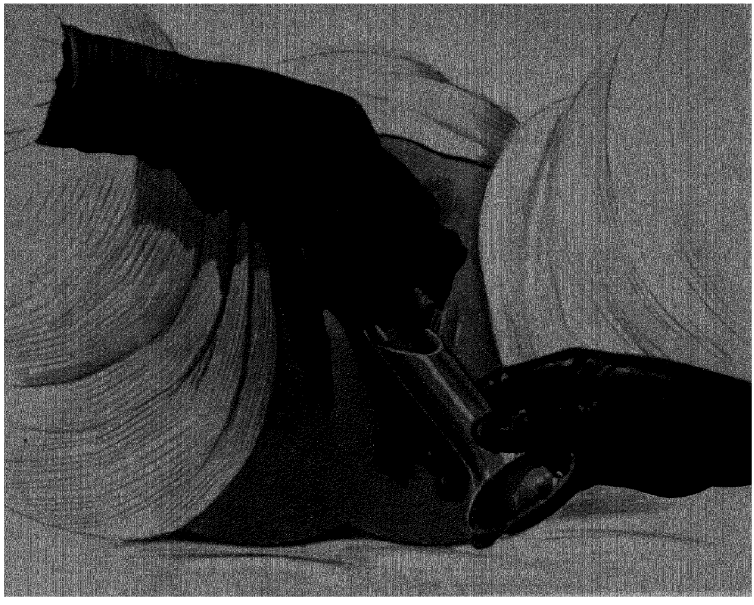


FIG. 78. METHOD OF INTRODUCING FERGUSON'S SPECULUM. (From a photograph.)

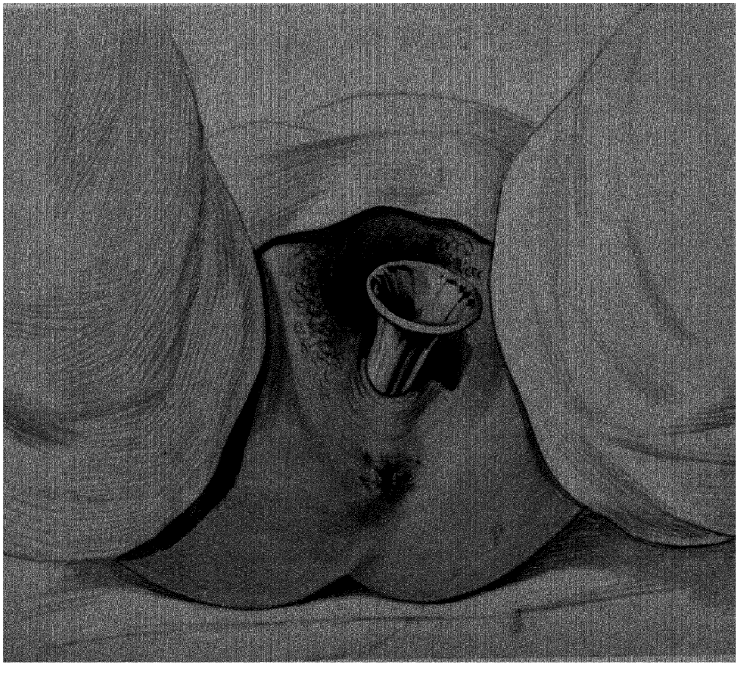


FIG. 79. FERGUSON'S SPECULUM AFTER INTRODUCTION. (From a photograph.)

Sims's speculum is shown in Figure 80; it is a double instrument, being held in the middle, and furnished with spoon-shaped ends of different sizes set transversely to the handle. According to the intention of its designer (Marion Sims), the instrument should be used in the *semi-prone*, or *Sims's* position, *i.e.* the patient lying on her left side, with the left arm carried behind her back and both thighs flexed, the right more acutely than the left (Fig. 81).

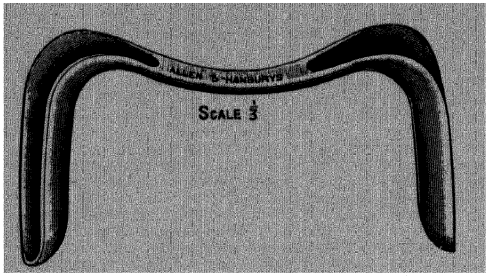


FIG. 80. SIMS'S VAGINAL SPECULUM.

If, in this position, the ostium vaginæ is opened, air enters the vagina and distends it, while the uterus falls forwards and downwards, *i.e.* towards the anterior abdominal wall. The spoon-shaped end of the speculum is then introduced along the posterior vaginal wall, and being gently pulled backwards, the whole of the anterior vaginal wall and the cervix become exposed and can be inspected. When the vaginal walls are lax, as in cases of prolapse,

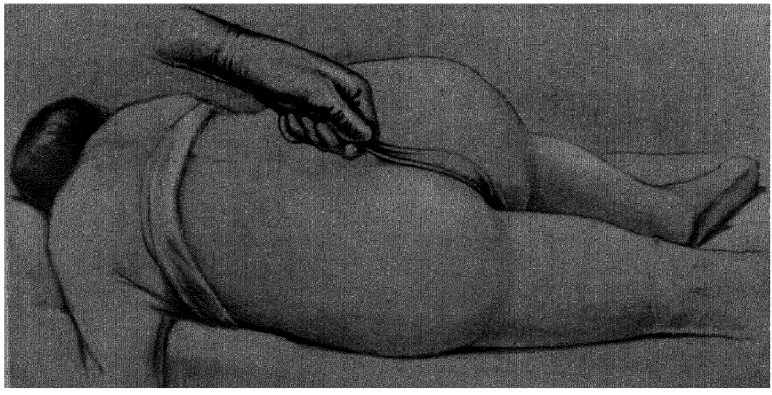


FIG. 81. SIMS'S POSITION, WITH THE SPECULUM INTRODUCED.

the anterior wall falls into the instrument and obscures the cervix until pressed back with forceps. This speculum is less convenient for general use than the tubular one, because it necessitates the presence of an assistant to hold it in place. For vaginal operations it is in common use, being then employed in the modified lithotomy position. This speculum can be readily sterilized by dipping it in methylated spirit, and then igniting that which adheres to the instrument.

For operative purposes other forms of vaginal speculum which are self-

retaining are useful, viz. Jayle's vaginal retractor and Auvard's weighted speculum; they are, however, unsuitable for purposes of ordinary clinical examination (*see* Fig. 82).

The Uterine Sound. This instrument is a probe specially designed for introduction into the cavity of the uterus (*see* Fig. 83). It is made of pliable metal so that it may be curved to suit abnormal conditions. At a point

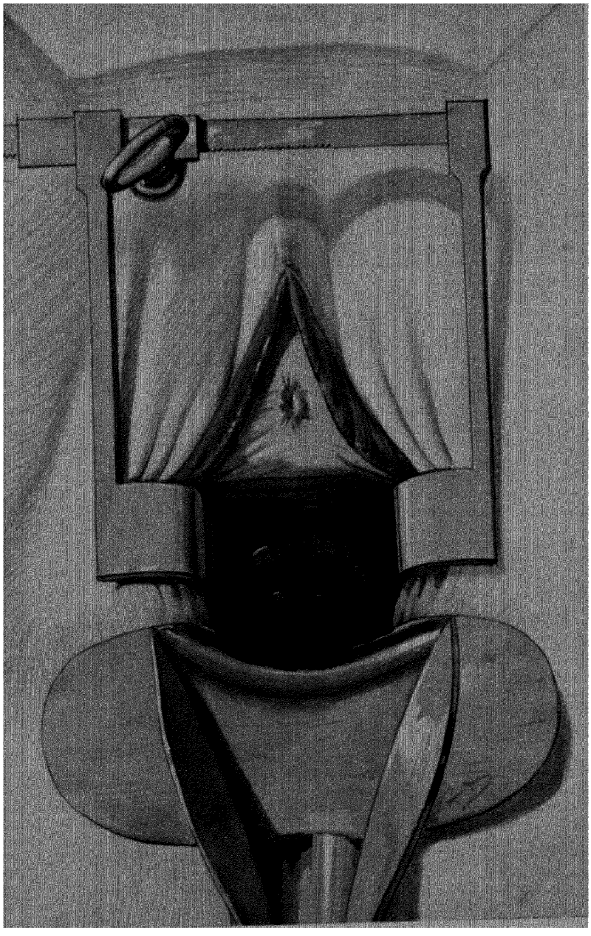


FIG. 82. SHOWING THE CERVIX EXPOSED BY THE USE OF JAYLE'S AND AUVARD'S SPECULA.

2½ inches from the tip is a small knob, marking off the normal length of the uterine cavity; beyond the knob the sound is notched at intervals of 1 inch. Before being introduced into the uterus it must be surgically clean; this can be ensured by boiling it, or by dipping it in methylated spirit and then igniting the spirit which adheres.

Information can be obtained by the use of the sound with regard to: (1) The length and direction of the uterine cavity; (2) the presence of dilatation (as distinct from elongation) of the cavity, by gently rotating the handle

of the sound when introduced, so moving the point through the arc of a circle; (3) the presence of roughness or inequalities upon the uterine walls; (4) the approximate width of the corporeo-cervical angle; (5) the relation of the uterus to a pelvic tumour, when the position of the former cannot be made out by digital examination alone. The presence of a streak of blood upon the sound on withdrawal does not indicate anything abnormal, but considerable hæmorrhage is a sign of disease.

The passage of the instrument through the cervical canal is generally painless, but a painful sensation is often produced by contact of the tip with the mucosa at the fundus.

Certain dangers attend the use of the sound which must be borne in mind. Primarily there is the risk of infection, either through a septic instrument, or through septic matter being picked up and carried from the vagina or the cervix into the uterine cavity. The sound should therefore never be used without previous careful inspection of the vaginal walls and cervix; all purulent or offensive discharges from the cervix contra-indicate its use. If a menstrual period is overdue, suggesting the possibility of early pregnancy, the use of the sound should be avoided. In certain conditions, such as malignant tumours of the body of the uterus, the friable walls are easily perforated, and perforation with the sound then entails grave risks of septic

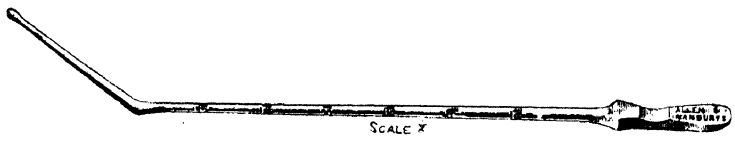


FIG. 83. THE UTERINE SOUND.

peritonitis. Accidental perforation of the healthy uterus by a sterile sound has been known to occur without any harm resulting.

In consequence of the above-mentioned risks the sound is an instrument the use of which calls for strict antiseptic precautions which cannot well be carried out except in operative work or in examinations under anæsthesia. The sterilized sound must be manipulated so that it comes in contact with no part of the genital tract below the level of the cervix. The cervix should be first exposed with a speculum, and its surface cleansed with swabs; if purulent cervical discharges are seen the instrument should not be used at all; even if the secretion appear healthy the *cervical canal* should be swabbed with iodine; the healthy sound may then be carefully introduced into the os and carried up to the fundus. The position of the uterine body should, if possible, be ascertained by previous bimanual examination; in some cases, however, this cannot be done, and one of the reasons for using the sound is to define the direction of the uterine body.

The sound is an instrument which should be seldom employed; most of the information obtained by its use can also be gathered from a bimanual examination, and the more expert the practitioner becomes in the latter method the less frequently will he resort to the use of the sound.

The volsella is a pair of long-handled, sharp-toothed forceps with which the cervix may be seized and drawn down towards the vulva to test its mobility or to facilitate the introduction of the sound in difficult cases.

In a healthy parous woman the cervix can be drawn down till the os externum lies at the level of the *introitus vaginae* without causing the patient much pain. Greatly increased mobility is present in prolapse; deficient mobility, up to complete fixation, may be met with in inflammatory conditions, in malignant infiltration of the broad ligaments, or in the presence of uterine tumours.

Methods of Testing the Patency of the Fallopian Tubes. When pneumoperitoneum was first introduced as a method of assisting the radiography of intra-abdominal disease, one method by which gas was introduced into the peritoneal sac was by driving it through the uterus and the Fallopian tubes under pressure. It was at once obvious that the same method could be

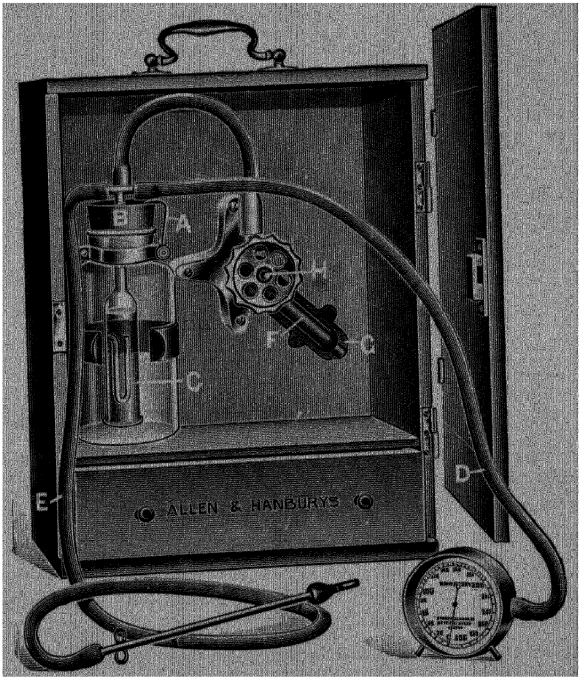


FIG. 84. APPARATUS FOR TUBAL INSUFFLATION. PROVIS'S MODIFICATION OF CURRIER'S MODEL. A. Spring Clamp. B. Stopper. C. Volumeter. D. Rubber Tubing leading to Manometer. E. Rubber Tubing leading to Uterine Catheter. F. Sparklet in G. holder for same. H. Stopcock.

employed to demonstrate the patency or, on the other hand, the occlusion of the Fallopian tubes. A considerable amount of work has now been done with this method, and the technique can be definitely and simply described.

Experimental work has also been done in other directions; *e.g.* an opaque material has been used for per-uterine insufflation, and by subsequent X-ray examination it has been shown whether the material has been held up in the uterus or in one or both of the tubes, indicating occlusion of the abdominal ostium, or whether it has passed freely through the tube to become diffused in the pelvis or to sink to the floor of the pouch of Douglas. It is claimed by the workers with the latter method that when the technique has been perfected

not only can the presence of an obstruction be shown, but also the exact spot at which it is situated. With the method of gas insufflation the only information which can be obtained is that the tubes are normally patent or that they are not.

The radiological methods have not yet reached the stage at which their use can be recommended for general purposes; the insufflation method is, however, sufficiently simple and reliable to be allotted a place among recognized methods of diagnosis.

The best apparatus for tubal insufflation is that of Currier as modified in this country by Lionel Provis (*see* Fig. 84). The essential parts are: (1) The cylinder of gas; (2) a mercurial manometer; (3) a water-valve jar; (4) an intra-cervical delivery cannula (*see* Fig. 85). The gas-cylinder used is that commercially known as a "sparklet," containing CO_2 under high pressure. The sparklet is fixed to a metal tube, through which the gas is conveyed to the jar, to which again the mercurial manometer is attached. From the jar the gas passes through the delivery tube into the uterus. The gas is liberated from the cylinder by turning a wheel, which is finely graduated so that the rate of escape is under complete control. It has been found that a pressure in the jar of 50–80 mm. is as a rule sufficient to drive the gas through the patent Fallopian tubes; after reaching this point the mercury will not rise further



FIG. 85. MODIFIED INTRA-CERVICAL CANNULA FOR TUBAL INSUFFLATION APPARATUS.

if the rate of supply of gas to the jar is not excessive. If the pressure reaches 180 mm. both tubes are occluded.

The obstruction may prove to be due not to an organic closure of the abdominal ostium, but to the ostium being buried in adhesions, or in some cases to a stricture or kink in the isthmial portion of the tube, or possibly to muscular spasm. Therefore a negative result should not be accepted for a single test; a second attempt should be made upon another occasion. It is also important that the test should be made during the seven days immediately following menstruation, *i.e.* in the stage of endometrial involution. Strict antiseptic precautions are required for this procedure, and the presence of purulent discharges in the vagina or cervix contra-indicates its use. It should be employed in all cases where it is proposed to dilate the cervix for the relief of sterility (*see also* pp. 129, 696).

It is believed that during the stage of premenstrual activity, the endometrium may become thickened to an extent which occludes the openings of the interstitial portion of the tube, and so prevents the gas from entering them. A test done during this phase might therefore give a misleading result.

It is also claimed that even if a negative result is first obtained, the effect of the attempt to pass gas through the tubes may be to dislodge a plug of mucus in the isthmial portion, and so restore the patency of the canal. A positive result would then be obtained at the second attempt. Should this claim be substantiated tubal insufflation may become a valuable therapeutic agent in the treatment of sterility.

EXAMINATION OF DISCHARGES, TISSUES, ETC.

It is obvious that the complete clinical examination of a gynæcological case may entail the microscopic and bacteriological examination of discharges or of pieces of tissue removed for histological diagnosis. This work is best entrusted to a clinical laboratory, but the methods of obtaining the material must be referred to.

Discharges for bacteriological examination should be taken with careful technique. The source of the discharge having been determined, it is exposed with a sterile speculum when necessary, and a flamed platinum wire used to take up a portion of the discharge. Two culture tubes, one of agar-agar and one of beef-tea, are then immediately inoculated, and a further portion of the discharge taken to make a smear preparation on a glass slide for staining purposes. The whole may then be sent to the laboratory for preparation and report. It is essential that culture-tubes be prepared immediately, as organisms of low virulence speedily die when taken from the body unless they are provided with a suitable culture-medium.

Pieces of tissue, such as curettings, should be placed immediately in methylated spirit. In this solution they may remain without harm for two or three days. In the case of curetting *the whole* of the fragments removed should be sent to the laboratory.

Examination of the Blood. In infective and inflammatory conditions a complete differential blood-count is often of great value for diagnostic purposes (p. 566). In septicæmia the infective organism may be recovered from the blood, and recent improvements in culture methods permit the hope that positive results will now be obtained with greater regularity than in the past. Further, specific blood-reactions, such as the Wassermann test for syphilis or the precipitation test for hydatid disease, may be indicated under special conditions.

EXAMINATION OF THE URINARY SYSTEM

Such conditions as functional disturbances of micturition, cystitis pyelitis, foreign bodies in the bladder, prolapse of the bladder, vesical fistula and movable kidney, come frequently under the notice of the gynæcologist and are often associated with lesions of the genital canal itself. Such clinical methods of investigation as cystoscopy and catheterization of the ureters may then be required, but for a detailed description of these matters other works should be consulted.

Bacteriological examination of the urine is frequently required to determine the presence or absence of infective conditions of the upper urinary tract such as pyelitis. The specimen for examination must, then, be taken with special precaution. A bottle and cork, and a catheter, should be boiled for ten minutes to sterilize them completely. Then, with clean hands, the labia are separated, and the vestibule and introitus vaginæ carefully swabbed with an antiseptic solution such as 1—4000 biniodide of mercury. A swab soaked in this solution is then passed just within the vaginal canal. The catheter is then directed into the meatus and the urine received directly into the sterilized bottle, which is at once closed with the sterilized cork. This is finally secured and the whole sent to the laboratory.

PART I: SECTION III

PROMINENT GYNÆCOLOGICAL SYMPTOMS

CERTAIN symptoms which are of frequent occurrence under varied conditions may be conveniently considered individually as regards their clinical significance and treatment. Reference to them in connection with particular diseases can then be simplified and shortened. They are:

(1) Hæmorrhage.
(2) Discharges.
(3) Pain.
(4) Disturbances of micturition.
(5) Dyspareunia.
(6) Sterility.

HÆMORRHAGE

Hæmorrhage is a symptom frequently encountered in diseases of the female pelvic organs. In a preponderating majority of cases its source is the uterus; it may, however, arise from disease of the vaginal walls, or the vulva. Severe bleeding is nearly always uterine in origin; vaginal and vulval bleeding, except when due to traumatism, is always slight. Bleeding from the rectum is very seldom due to disease of the genital organs. Occasionally an adherent retroflexed uterus becomes adherent to the rectum, and a local proctitis results from which pain and bleeding on defæcation will occur. A pelvic abscess which bursts into the rectum (*see* p. 234) may cause slight initial bleeding, but the principal feature is, of course, the discharge of pus.

In hæmorrhage from the *body of the uterus* the actual source of the bleeding is usually the endometrium; when it comes from the *cervix*, either the cervical endometrium or the stratified epithelial surface may be the actual source. Often polypi growing from the cervix cause bleeding, and sometimes growths which have come down from the uterine body and protrude through the cervix cause severe bleeding. In rare instances, blood escaping from the uterus may actually come from the Fallopian tubes, as in tubal cancer (p. 575). Hæmorrhage from the endometrium may occur either as an excess of the regular menstrual loss, or as an irregular bleeding in the intervals. Thus has arisen the time-honoured distinction between *menorrhagia* (the former) and *metrorrhagia* (the latter). This distinction is, however, of little practical importance, for one variety passes insensibly into the other and some conditions, such as fibroids may give rise to either, or to both. Before puberty and after the menopause all bleeding from the uterus is spoken of as metrorrhagia. Bleeding from the cervix is characteristically intermenstrual, for the cervix takes no part in menstruation;

but excessive menstrual loss may also be met with in such cases, owing to the presence of associated lesions in the uterine body. Hæmorrhage following coitus, except a first coitus, is usually cervical, and in the majority of cases is due to carcinoma. The slight bleeding which usually attends a first coitus is due to laceration of the hymen; sometimes serious bleeding from laceration of the vaginal wall occurs at coitus, and fatal results have from time to time been recorded.

Haemorrhage from the uterus may be due to general or to local causes; when severe it almost always has a local, not a general, cause.

General Causes. In all varieties of *anaemia* menstruation may be excessive; in chlorosis this is exceptional, in pernicious anæmia it is said to be comparatively common. In *acute infectious diseases* excessive menstrual periods, or irregular hæmorrhages, often occur. *Nervous shock, fatigue*, and *occasional alcoholic excess* may all cause uterine hæmorrhage when the occurrence coincides with a menstrual period. Occasionally cases are met with in which slight bleeding from such causes occurs in the menstrual intervals.

It is often stated that *cardiac valvular disease* causes uterine hæmorrhage, but a systematic examination of a series of heart-cases by Gow did not support this view. *Haemophilia*, a disease very rare in women, may occasionally be the cause of uterine hæmorrhage. Severe menorrhagia is sometimes seen in women suffering from *myxœdema*, without a recognizable local cause. It is possible that thyroid deficiency may explain it. Contradictory observations have, however, been recorded, in which amenorrhœa has been attributed to myxœdema. In the present state of our knowledge therefore the relation of thyroid activity to uterine hæmorrhage cannot be defined. *Puberty* and the *menopause* are often accompanied by profuse and irregular menstrual loss, and this without any discoverable sign of local lesions. After marriage an increase in the amount of menstrual loss is not uncommon, sometimes it becomes for a time profuse; it is no doubt attributable to the effects of *sexual excitement* upon the pelvic circulation. Often the change from a temperate to a hot climate causes profuse menstruation, and is seen for example in Englishwomen who go to reside in India.

Cases are not uncommonly met with in which both local and general causes are absent, and consequently the suspicion has been aroused that the hæmorrhage may be due to some disturbance of the general endocrine balance. Menorrhagia when not associated with anæmia may be attributed to such a cause as this. There is no doubt that a certain proportion of such cases can be relieved by the use of polyglandular extracts, and this circumstance may be held to support the view that faulty endocrine function is the causal condition.

Local Causes. The subjoined list of morbid conditions, giving rise to hæmorrhage, is here given without detailed comment, as each will be considered in its place in a later section.

I. *Uterine bleeding:*

(A) *Body* (exclusive of uterine pregnancy)—

Extra-uterine pregnancy.
Chronic endometritis and allied conditions.
Acute (infective) endometritis.
Chronic metritis.

I. *Uterine bleeding* (continued):
  (A) *Body*—
    Mucous (adenomatous) and fibroid polypi.
    Submucous and interstitial fibroid tumours.
    Adenomyoma.
    Chronic inversion.
    Carcinoma, sarcoma, chorionic carcinoma.
    Acute or chronic pelvic infection, *e.g.* salpingitis, peritonitis.
    Increased intra-abdominal pressure, *e.g.* very large ovarian tumours.
  (B) *Cervix*—
    Mucous (adenomatous) polypi.
    Fibroid tumours.
    Carcinoma, sarcoma, chorionic carcinoma.
    Traumatic ulceration, as from a neglected pessary.
    Tuberculous and syphilitic ulcerations.
    'Erosion' (rarely).

II. *Tubal bleeding* (in rare cases): Interstitial tubal pregnancy; tubal cancer.

III. *Vaginal bleeding*: Lacerations; carcinoma; traumatic ulceration.

IV. *Vulval bleeding*: Lacerations; ulcerations; rupture of varicose veins; carcinoma; urethral caruncle, urethral cancer.

In addition, it has already been pointed out that a certain amount of evidence has recently been adduced which appears to indicate that bleeding from the endometrium may occur as a result of some perversion or morbid alteration of the internal ovarian secretion, an excessive production, for example, of the ovarian hormone which induces menstrual changes in the endometrium. Such a condition may be evidenced anatomically by the presence of an excess of lutein tissue in the ovary. The influence of the normal internal ovarian secretion in inducing the recurrent bleeding of menstruation has been already mentioned; there is no great difficulty in supposing that abnormal bleeding may in the same way be set up by an abnormal or excessive ovarian secretion.

The clinical significance of hæmorrhage varies greatly at *different periods of life*, and it will be convenient to indicate the morbid conditions which are most likely to be met with in the various phases of the development and decline of reproductive activity.

In *infancy* slight bleeding is not very uncommon in the first few weeks of life. Sometimes it is associated with mammary activity, the infant's breasts becoming tender, swollen, and full of secretion, or there may be a definite mastitis. It appears to be uterine in origin; it is not of serious clinical import, and does not call for treatment.

In *childhood* hæmorrhage may indicate the precocious onset of menstruation (*see* p. 79); in other cases it may be due to malignant disease, the commonest forms at this period of life being sarcoma of the cervix and malignant growths of the ovary. It must also be recollected that pregnancy may occur before the establishment of menstruation, and may give rise to hæmorrhage.

In *adolescence* profuse hæmorrhage occasionally occurs at the onset of puberty, recurring with every period for several months. A more common

disturbance is prolonged slight hæmorrhage, lasting for two or three weeks or even longer. Usually there is no local cause of bleeding in such cases, and medicinal measures alone are indicated. Eventually the periods become more normal in amount, although in such cases menstruation, when regularly established, is often attended with more than the average loss It is probably correct to attribute it to excessive ovarian activity (internal secretion). Sarcoma of the uterus and malignant ovarian growths may occur, and it must not be forgotten that hæmorrhage due to disturbances of pregnancy may be met with at an unexpectedly early age.

In the period of *reproductive activity* (fifteenth to forty-fifth year) the commonest cause of hæmorrhage is some disturbance of pregnancy; the possibility of this occurrence should never be overlooked, even when personal considerations would appear to warrant its exclusion. Next to pregnancy the commonest causes encountered are fibroid tumours (including polypi), malignant growths of the uterus, and pelvic inflammatory lesions. Any of the other local and general conditions mentioned in the preceding list may also be met with. It must be recollected that in pregnancy, traumatic laceration of the vulva or vagina produce much more severe bleeding than in the non-pregnant state.

At the *menopause* profuse and irregular periods occasionally occur without any present indication or later development of local disease (*see* p. 91). The liability at this time of life to the growth of cancer in the body or cervix of the uterus is, however, so clearly established that the most careful measures to exclude these conditions must in all cases be taken. Fibroid tumours sometimes occasion profuse climacteric hæmorrhages, owing to some degenerative change occurring in them. Chronic metritis is often met with at this period of life.

After the menopause, in the *post-climacteric period*, the reappearance of hæmorrhage generally indicates carcinoma or sarcoma of the uterus; more rarely the growth will be found in the vagina or vulva Occasionally senile endometritis, or a degenerative change in an old fibroid tumour, is the cause. In elderly women an occasional slight uterine hæmorrhage may occur in connection with cardiac disease or arterio-sclerosis; the amount is generally not more than a *show*. Mucous (adenomatous) polypi may first attract attention after the menopause, giving rise to a sanguineous discharge. It is improbable that they develop at this period; more probably they have been in existence for some time but give rise to no bleeding until some secondary change occurs in them, such as loss of their epithelial covering, to which the hæmorrhage is directly due. Such polypi should always be removed and submitted to microscopic examination, as a certain number of them will show malignant characters. Mucous polypi of the cervix may exist along with cancer of the body of the uterus: the uterine cavity should therefore always be explored with the curette at the time the polypus is removed. Malignant disease, quite unsuspected, may then be discovered.

A certain amount of difficulty often arises in determining the *degree of severity* of the hæmorrhage, unless the patient is under observation at the time the bleeding occurs. Rapid recovery may apparently be made from the effects of recurrent, profuse monthly losses, but unless a blood-count is made considerable degrees of anæmia may be overlooked; for the colour of the patient is but a fallacious guide in this respect. We should not wait until the patient is blanched before deciding that she is suffering from the

constitutional effects of hæmorrhage, for chronic anæmia of moderate extent is often the starting-point of prolonged ill-health.

Generally speaking, *severe bleeding indicates the presence of a local cause, and calls for a local examination.* Slight and continuous, or irregular, bleeding is frequently due to a general cause; after the climacteric all hæmorrhages must be regarded as of grave significance, for they may be the earliest indication of the presence of a malignant growth. A glance over the conditions named above as local causes of hæmorrhage will show that bleeding, as a rule, must be accepted as indicating the necessity for a careful pelvic examination. It is better to examine and find no local disease than to delay while local disease is present and advancing.

Local examination will be directed to the exclusion (*a*) of pregnancy, (*b*) of new growths of the uterus, cervix or vagina, (*c*) of inflammatory lesions, (*d*) of uterine displacements, (*e*) of slight degrees of enlargement of the uterus, indicative of chronic metritis, subinvolution, or an intra-uterine polypus. The exclusion of pregnancy is the first and essential step. After this, difficulty in diagnosis is usually restricted to cases in which, while there is slight enlargement of the uterus, nothing else abnormal is found. In such cases exploration of the uterine cavity (*see* p. 723) is often required to clear the matter up. In rare cases profuse, or even dangerous, bleeding may occur from the uterus although no abnormality can be detected either on bimanual examination or exploration of the cavity. These cases will be again referred to in connection with chronic metritis (*see* p. 378).

Treatment. The *arrest* of bleeding from the uterus is a problem which is frequently encountered by the medical practitioner. If the uterus is gravid, the treatment is that of threatened or inevitable abortion, as the case may be, and this subject is dealt with in text-books of midwifery. In all other circumstances the immediate treatment is governed more by the severity of the bleeding than by the local morbid conditions which may be present.

In all cases of *severe* bleeding from the uterus, rest in bed and free evacuation of the lower bowel are important, as by these means the pelvic circulation is to some extent relieved. Contraction of the uterine muscle is the principal factor in the natural mechanism for the arrest of bleeding from the uterine body, but it must be recollected that bleeding due to morbid conditions of the cervix cannot be checked in this way. Another possible factor, referred to on page 85, is the influence of the uterine secretion in promoting coagulation, or in breaking up thrombi when formed. We know of no therapeutic means of influencing this function.

There are five chief methods of treating bleeding from the uterus; (1) drugs, (2) hot douches, (3) the vaginal or intra-uterine tampon, (4) radiotherapeutics, (5) operative measures.

Drugs. Two classes of remedies are employed in arresting uterine hæmorrhage: (*a*) general hæmostatics, which tend to control bleeding from any part of the body; (*b*) uterine hæmostatics, which exert a special influence in controlling bleeding from the uterus.

(*a*) Among the former may be mentioned *salts of calcium* and preparations of the *adrenal glands*. It has been already stated that menstrual blood contains a high percentage of calcium salts; therefore when menstruation is profuse and prolonged, the calcium-reserves of the body tend to become depleted. Upon the presence of calcium in the blood the property

of coagulability in part depends, and when this constituent has fallen to below the normal the coagulability of the blood has probably been reduced. It can be shown clinically that the administration of calcium-salts increases coagulability, and such an increase will probably influence the amount of hæmorrhage by allowing thrombosis to occur with greater freedom. The action of calcium is therefore prophylactic, when taken in such manner as to cause an increase in the total calcium-content of the blood. To produce this effect calcium lactate may be given in doses of fifteen grains three times a day throughout the menstrual interval, or at least for ten days preceding each period. The most convenient form of administration is in solution, *e.g.* the Liq. Calcii Lactatis B.P.C. containing 30 grains to the ounce ; it must be freshly made. This treatment should be continued for several months, and the effect will only be obtained so long as the excess of lime salts is maintained in the blood.

Salts of potassium are deserving of a trial in difficult cases. Lawson Tait had a high opinion of their value and believed that they exerted a specific action in depressing the pelvic circulation. Five grains of chlorate of potassium, given three times a day and taken continuously in the same way as calcium lactate, is the best form of administration, and is specially suitable for the menorrhagia of young girls.

Adrenalin, or other extracts of the adrenals, when taken internally, accelerate the heart and produce a rise of blood-pressure due to a vaso-constrictor action upon small arteries ; when applied locally they also produce a vaso-constrictor action which, while it lasts, diminishes or arrests local bleeding. It may thus be given hypodermically in doses of 5 minims of a 1–1000 solution every four hours. It is, however, much more effective when applied directly to the endometrium or other bleeding surface (*see below*).

(*b*) The uterine hæmostatics which have been essayed in cases of hæmorrhage are very numerous.

It has been shown by Blair Bell that an *extract of the pituitary body* has a powerful although evanescent effect on uterine muscle ; in labour it greatly increases the length and strength of the contractions, and has also a general vaso-constrictor action similar to that of adrenalin. As in the case of the latter, its effect is much less marked upon the non-gravid uterus than the gravid uterus, but it may be usefully given in uterine hæmorrhage. The dose for hypodermic injection is 1 c.c. of a 20 *per cent.* solution. As it temporarily raises blood-pressure very considerably its action must be carefully watched in the case of patients with an enfeebled or damaged heart or with degenerated arteries. As a prophylactic pituitary gland may be given in the same manner as calcium lactate, *i.e.* in regular doses continued for several weeks at a time. It appears in some cases to do good.

Ergot has been in common use for many years, and is the best known of all. Its influence upon the non-gravid uterus is, however, much less pronounced than that which is so readily produced by the obstetrician, and it must be admitted that only slight cases of bleeding can be controlled by its use. Even in many slight cases, it appears to produce no decided effect, and must therefore be regarded as somewhat unreliable. Its effect is mainly due to the influence it exerts in causing contraction of the uterine muscle, but it is also to a certain extent a general vaso-constrictor. When given by the mouth large doses should be administered, *e.g.* 30 to 60 minims of the liquid extract three times a day, or 1 to 3 grains of ergotin in pill.

It may be usefully combined with strychnine or with a dilute acid. Given by deep intra-muscular injection into the buttock or thigh, its effect will be more quickly and certainly obtained. Many special preparations, or derivatives of ergot, are obtainable under various trade names. *Stypticine* (cotarnin hydrochloride) may also be favourably mentioned; it is given hypodermically in doses of 1 to 2 minims of a 10 *per cent.* solution. *Hydrastis* may be given by the mouth as liquid extract (dose 30 to 60 minims), or in pill as 2 grains of the dry extract. *Hydrastis* and *ergot* may usefully be given in combination, either in mixture or pill, their administration being begun a day or two before the expected hæmorrhage. *Styptol* (cotarnin phthalate) and *Lodal*, another derivative of cotarnin, are given in doses of 1 to 1½ grains several times a day. In addition to hæmostatic action the two latter produce a slight sedative effect.

Besides their specific action on the uterus, these drugs are all vaso-constrictors, and produce some narrowing of the small arterial vessels of the body generally.

Hot Douching. Douching the vagina with hot water at a temperature of 115° to 120° F. is very commonly practised as a means of reducing hæmorrhage. It is doubtful if a hot douche is of much value as a uterine hæmostatic except in the case of the hypertrophied uterus of pregnancy, unless applied to the interior of the uterus, when its effect becomes at once evident. This method can, however, seldom be used in gynæcological work, except after operative procedures or when the cervix is dilated. The vaginal douche is useful as a means of cleansing, and if not markedly successful as a hæmostatic, it does no harm. Normal saline solution, or dilute solutions of antiseptics, or astringents may be used.

Plugging. Plugging the vaginal canal when properly applied is the most efficient means we possess of immediately controlling bleeding from the uterus. In nulliparous women an anæsthetic is essential, and in all cases it is desirable. Unless the plugging is accurately and thoroughly applied it will not arrest the bleeding, and unless the most stringent antiseptic precautions are taken, infection may follow. The vulva should be shaved, the vaginal canal douched and then carefully dried with sterile swabs, and finally vulva, vagina, and cervix should all be thoroughly swabbed with tincture of iodine. The plugging must be carefully introduced, and not allowed to come into contact with unsterilized objects. The instruments used should be carefully sterilized, and rubber gloves worn. Sterilized gauze, either plain or impregnated with subgallate of bismuth, in a single long strip, is the best material for the purpose, and it should be passed with the aid of Sims's speculum, by which the perineum is pulled back and the vulva opened. The strip is first pushed up along the posterior vaginal wall into the posterior fornix, which is tightly filled, and then the lateral and anterior fornices are filled in the same way; the lower part of the vagina is only loosely filled. The plug should not be allowed to remain for more than twenty-four hours, but it can be renewed under the same precautions if necessary.

Plugging the *uterine cavity* may be practicable when the cervical canal is dilated. After swabbing the canal with iodine a strip of gauze can be pushed up to the fundus, and in such cases it is useful to soak the gauze previously in a 1 in 1000 sterile solution of adrenalin. The local hæmostatic action of this substance is then added to the excitant effect of the plug.

Radiation. Within recent years much attention has been paid to the possibility of arresting uterine hæmorrhage by means of Radium and X-rays. It has now become well established that by the prolonged application of X-rays, of the hard or penetrating variety, menstruation can be completely and permanently arrested. This effect is produced chiefly by the action of the rays upon the ovaries, the Graafian follicles being completely destroyed and the subject rendered sterile, in part also by a direct effect upon the uterus, causing it to undergo atrophy. It is, therefore, unsuitable for women under forty years of age. These effects can be produced when fibroid tumours are present or when the uterus is enlarged from causes other than tumour-formation. The technique is complicated and the treatment should be applied under the direction of a skilled radiologist. The matter will be referred to again in connection with the treatment of fibroid tumours (*see* p. 425).

Radium may be employed for the same purpose, and under suitable conditions it is more rapidly effective than X-rays. The best method is to introduce a tube of 100 mgr. of radium into the uterine cavity, previously dilating the cervix, to retain it in position by careful aseptic plugging, and to remove it in twenty-four hours. The procedure may be repeated in six weeks if necessary. The radium acts directly upon the endometrium, and when used in large doses it may cause the uterine surfaces to adhere to one another, thus obliterating the uterine cavity and rendering further hæmorrhage impossible. It is therefore clear that radium will find its chief field of application in cases of climacteric hæmorrhage in which permanent arrest of menstruation is desired. Considerable advances have, however, been made in the search for a dosage which would produce temporary amenorrhœa without permanently arresting the function of menstruation, and could therefore be employed at all ages. The technique of the intra-uterine application of radium will come up for consideration later on in connection with the treatment of fibroids (p. 425).

In cases where there is any suspicion of malignancy, radiation should not be employed without preliminary curettage of the uterus. Generally speaking it is only suitable for benign conditions; malignant conditions should be treated by radical operation whenever this is possible, yet in inoperable cases radiation is a useful palliative.

Operative treatment. Curetting is a favourite remedy for all varieties of uterine hæmorrhage, but applied without discrimination it often fails, and may actually aggravate the bleeding. The indications for this operation are referred to in detail in another place (p. 721). Excision of a portion of the body of the uterus (utriculoplasty) has been practised but with disappointing results. If cases due to excessive ovarian activity could be clinically recognized they might be treated with success by partial resection of one ovary or of both. But the fact that the ovaries are found on clinical examination to be enlarged is not to be accepted as evidence of over-action, for the enlargement may be due to disease or to degenerative changes. It is obvious that ovarian resection, if used at all, must be applied with great caution.

DISCHARGES

A discharge from the vagina is common, and is not in all cases a sign of disease. In some cases it is an important indication, and it will, therefore,

be useful to consider the various kinds which may be met with in relation to their origin and their significance.

The characters of the *natural secretions* must first be borne in mind. The Bartholinian glands secrete a clear, colourless, slightly acid fluid, which in some cases can be observed welling up from the openings of the ducts on examination of the vulva. The vaginal walls produce a secretion which, even in healthy conditions, is variable in character. In nulliparous and virgin women it usually consists of a white semi-solid material of the consistence of smegma, flaky in appearance and acid in reaction. In parous women it is usually more fluid in consistence, opalescent, and neutral or alkaline in reaction. The cervical secretion is fairly abundant, and of the appearance and tenacious consistence of albumen; it is definitely alkaline in reaction. The natural secretion from the endometrium and the tubal mucosa is scanty.

Types. Four types of discharge may be described.

(1) An *excess of the natural secretions*. This may take the form of a thick, milky discharge, or of strings or pellets of thick, sticky, cervical mucus, generally described by the patient as being like "white of egg." It is usually more abundant immediately after menstruation than at other times. To these discharges the name of *leucorrhœa* (literally *a white flux*) may with accuracy be applied; this name is often, however, somewhat loosely used to indicate discharges different in nature from these. Excess of secretion may be the result of slight catarrhal inflammation, but frequently no definite sign of disease is present and the condition is of no clinical importance. It is frequently met with in anæmia and other conditions of ill-health.

(2) *Purulent* and *muco-purulent* discharges usually result from true inflammatory changes in the vulva, vagina or uterus; occasionally some neighbouring organ is its source; thus collections of pus from a pelvic abscess may be evacuated into the uterus or vagina. In the acute stages of gonorrhœal infection a discharge of yellowish-green, highly irritating pus occurs; in the later, or chronic, stages the discharge is paler and muco-purulent. Other forms of vaginitis and endometritis, or ulcerative changes in the vagina or cervix, also set up discharges containing pus.

It is sometimes difficult to decide whether a small amount of a purulent discharge comes from the vaginal walls or from within the uterus. The *tampon test* may then be employed. It consists in placing a clean cotton-wool plug in contact with the external os, and leaving it in position for some hours; if a yellow discharge has come through the cervix, the plug will be stained where it lay in contact with the os, and not in other parts.

(3) *Thin serous, coloured* discharges are comparatively rare. They occur in the early stages of malignant disease of the cervix or uterine body; in the later stages of these diseases, hæmorrhage and necrotic changes in the tumour-tissues alter the characters of the discharge. Serous discharges are but rarely met with in any other conditions except pregnancy. The condition known as *intermitting hydrosalpinx* is said to give rise to this sign, but considerable uncertainty exists upon this point, which is referred to again on page 552. In tubal papilloma and tubal cancer, a yellowish thin fluid often passes into the uterus and escapes as a vaginal discharge, but these diseases are very rare.

It must be borne in mind that attacks of urinary incontinence are sometimes mistaken by patients for a discharge. Whenever the local conditions

fail to explain such a discharge, great care should be exercised, and if possible a small amount of the discharge obtained, which can be tested for urea; the presence of this substance can be detected in very small quantities, and may clear up a diagnostic difficulty. Urinary fistulæ must not be forgotten in this connection, although their nature is usually self-evident.

(4) *Offensive Discharges.*—Discharges may become offensive from dirty personal habits, from the presence of foreign bodies in the vagina, from ulcerative changes in tumour-tissues or sloughing in the walls of the genital canal; the pus from a pelvic abscess is often offensive from the time of its first appearance. The discharge from an advanced case of cancer of the cervix is often extremely foul; the penetrating odour may be almost sickening to others though hardly noticed by the patient herself. It results from putrescent changes set up in the necrotic cancer-tissues by bacterial invasion. It is often profuse in quantity and causes considerable irritation of the skin of the vulva and perineum, which cannot be kept clean. Cancer in the body of the uterus is not so liable to undergo putrefactive changes as that in the cervix (*see* p. 491), owing to the better protection afforded against bacterial infection from without. The morbid conditions most commonly associated with an offensive discharge are: (1) cancer of the cervix or more rarely of the body of the uterus; (2) sloughing fibroids; (3) retained and neglected pessaries; (4) rupture of a pelvic abscess; (5) urinary and fæcal fistulæ; (6) in the puerperium, infection of the uterine cavity, with retention of products of conception.

Diagnosis. When a discharge is complained of, its nature should be determined by direct observation, if there is any doubt as to which of the four types it belongs to. Those of the first class do not form indications for local examination, and they require no treatment. Those of the other classes all necessitate an examination in order to discover (*a*) their source and (*b*) the nature of the lesion to which they are due.

Indiscriminate treatment of discharges without exact diagnosis should be deprecated. Discharges either require no treatment at all or they call for careful preliminary investigation. In some instances the source and nature of a discharge are evident from its physical characters, the best instances being the viscid colourless discharge which is met with in cervical catarrh and "erosion." All purulent, or offensive discharges, require careful discrimination, and a routine investigation should be made in all cases.

First the vulva should be examined by inspection, and the condition of the urethra and Bartholinian glands noted. Next the vaginal walls should be inspected through a speculum, and then the cervix. Discharges tend to accumulate in the vaginal fornices, and before the condition of the cervix can be seen they must be cleared away with swabs. If the discharge comes from the cervix or body of the uterus, the secretion seen in the cervical canal will be of the same nature as the discharge; if the discharge arises from below the uterus the cervical canal will show only the normal viscid secretion, which is nearly colourless, and nearly transparent. Sinuses or fistulæ opening into the vaginal wall will be found with the speculum in the same way. If the discharge comes from the uterine body it is of much thinner consistence than the cervical discharge; exact diagnosis is, however, impracticable without preliminary dilatation of the cervix.

In the case of a purulent discharge, it is often necessary to look for the organism to which it is due. This may involve both microscopic examina-

tion, and cultures of the organisms. The gonococcus may be detected by its staining reaction, as described on page 259. Other organisms usually require cultural methods for their detection.

PAIN

Pain arising from diseases of the internal sexual organs is not characteristic either in its distribution or general features; it may be closely imitated in hysteria and neurasthenia even when, as far as can be ascertained, the pelvic organs are normal. Consequently pain is not, as a rule, a symptom of any great diagnostic significance in gynæcology.

The parts in which pain is most commonly felt are the hypogastric zone of the abdomen, the spine from the lumbar region to the coccyx, and the front and inner aspects of the thighs. The iliac regions, more frequently the left, are common positions to which pain is referred, and often it is called on account of its position 'ovarian pain.' Its connection with the ovary is, however, very doubtful in the majority of cases; it may often be elicited or intensified by light pressure, and its seat is more probably in the nerves of the abdominal parietes. Left-side pain is attributable in some cases, according to Fothergill, to varicocele of the left broad ligament. Miles, again, has pointed out how often in such cases adhesion may be found between the colon and the anterior surface of the left broad ligament, the uterus being retroverted. It is obvious that the so-called 'ovarian pain' may be caused by a number of conditions quite unconnected with the ovary.

Epigastric pain, infra-mammary pain (especially frequent on the left side), and headaches are often regarded as referred or reflex pains of genital origin; the evidences in favour of this view are, however, not always convincing. Regions in which pain is felt are also often unduly sensitive or actually painful to pressure. Pain of an aching character in the lower half of the trunk commonly attends the menstrual process; when occurring in the menstrual intervals its significance is greater than when occurring during menstruation.

The severity of the pain in any given case depends in great part upon the ability of the nervous system to resist painful impressions. Some women are so intolerant of pain that they unconsciously exaggerate, describing as 'agonizing' a degree of pain which another would support with but little effort. Great care must accordingly be exercised in dealing with this symptom.

Certain characteristics of pain deserve notice. Thus uterine displacements, especially prolapse, give rise to a dragging, 'bearing down' pain which is relieved by rest in the recumbent position. Pain due to inflammatory lesions is also relieved by rest and aggravated by exertion; another characteristic is its liability to exacerbations which frequently coincide with the menstrual periods.

The growth of tumours, whether innocent or malignant, is usually not attended by pain until, in the former case, the bulk of the tumour causes discomfort, or, in the latter, such complications occur as ulceration of the growth, invasion of adjacent organs, or metastases in parts bones; visceral metastases are often not attended with pain. Pain associated with malignant growths is not relieved by rest; it is, indeed, almost always worse at night than in the day, and, therefore, commonly induces insomnia. Attacks of

colicky pains are associated with miscarriage, with tubal pregnancy in the early stages, and sometimes with intra-uterine polypi. Acute pain of sudden onset attends pelvic peritonitis from infection, as in a case of suppurative salpingitis, and hæmorrhage from rupture or leaking of a gravid Fallopian tube (*see* p. 195). The causes of pain located on the right side of the abdomen are very complex, for the organ at fault may be the Fallopian tube or the ovary, the vermiform appendix or the cæcum, the kidney, or the gall-bladder. Pain of neuralgic or neurasthenic origin is felt more often on the left side of the abdomen than the right, a clinical fact which it is difficult to explain satisfactorily.

It must not be overlooked that small hernial protrusions are often the cause of considerable pain. The femoral and inguinal rings should therefore be carefully examined, and in cases of doubt it is useful to make the examination with the patient standing up.

A movable kidney often gives rise to pain of an aching or dragging character, more often affecting the right side than the left; it is usually relieved by the recumbent position, and is sometimes associated with intermittent attacks of intense nauseating pain which are attributed to kinking of the ureter causing transient hydronephrosis; they are known as Dietl's crises. Pain referred to the lower part of the back is very common in women, and is often difficult to account for. Pain over the sacrum is often due simply to fatigue, and is almost invariably met with in neurasthenia and in convalescence after abdominal operation; displacements—backward and downward—of the uterus, 'erosion' of the cervix, inflammatory pelvic lesions, a tumour occupying the pouch of Douglas, and carcinoma of the cervix in its advanced stages, all cause pain in the same region. Pain localised to the region of the *coccyx* and felt chiefly when sitting, or in the act of rising from the sitting position, is sometimes met with (coccygodynia). Pain excited by movement at the sacro-coccygeal joint, or tenderness of the coccygeal ligaments, may at the same time be present. Coccygodynia occurs almost exclusively in women, and some cases follow on obstetric injuries, a few may be due to direct traumatism, others are of rheumatic origin.

Women who complain of pelvic pain not associated with any gross pelvic lesion, also usually complain of great sensitiveness of the organs on examination. This is sometimes so great as to prohibit satisfactory palpation of the uterus or adnexa. The condition is commonly attributed to 'congestion,' but no direct evidence of any circulatory disturbance has ever been advanced, and the cause of the tenderness is in point of fact unknown. It is especially marked in women of neurotic temperament.

Pain attending the menstrual process will be separately considered in the section dealing with *dysmenorrhœa* (p. 157).

DISTURBANCES OF MICTURITION

The act of micturition may become abnormally frequent, or painful; sudden or gradual retention may occur; or urine may be passed involuntarily (incontinence), either continuously or occasionally, *e.g.* during coughing or sneezing. These symptoms, although usually due to disease in some part of the urinary tract or in the kidneys, are also frequently the result of injury or disease in some part of the genital canal.

Pain and Frequency. The number of times *per diem* the bladder is evacuated is to a great extent a matter of habit; women of nervous temperament frequently present slight degrees of frequency in the day, but only rarely during the night; indeed, persons who suffer from distressing frequency during the day, often sleep all night without interruption. Nocturnal frequency is therefore always of more serious import than daytime frequency. When associated with pain during, or during and after the act, the significance of frequency is increased.

Mental influences are notoriously powerful agents in disturbing the functions of the bladder, and may produce either frequency, incontinence or retention. Further, the renal function is also influenced in the same manner, and in some persons polyuria is one of the commonest signs of nervousness.

The first step in the investigation of such cases is an examination of the urine, which must always include the microscopic examination of the centrifugalized deposit. Uric acid, or urates, may be found in the deposit, indicating disturbance of the functions of the liver, or albumen and casts may be found, indicating chronic *renal* changes, or sugar suggesting *diabetes*, or oxalates pointing to disturbance of *digestion*. The presence of pus may be due to urethritis, cystitis or pyelitis, or if the urine were passed naturally, to contamination by discharges from the vagina. Bacteriological examination and culture may be further necessitated in such cases.

Chronic bacterial infection is sometimes present without any clinical evidence of cystitis or pyelitis being found; consequently, if no other cause can be discovered, a specimen of urine should be taken with due antiseptic precautions against contamination, a sterile catheter being used, and a sterile tube into which the urine may be run. Bacteriological examination may then show that *bacillus coli* infection is present, and this condition, when chronic, may give rise occasionally to frequent and painful micturition. It must be recollected that it is extremely rare to find the urine absolutely free from bacteria even when withdrawn by catheter. Bacteria are always present in the urethral mucosa, and may be carried into the bladder in the act of introducing the catheter. The numbers of such organisms are, however, small. It is only the detection of a definitely pathogenic organism in pure culture, or practically pure culture, that can be regarded as evidence of urinary infection. In nearly all cases pus and desquamated epithelium in abnormally large quantities are also found. The urine is acid in most forms of infection except that due to chronic cystitis. After a urinary infection has been clinically 'cured' small numbers of the organisms frequently persist in the urine, *i.e.* the patient remains a 'carrier.'

It must be recollected that a movable kidney or a renal calculus, or certain diseases of the central nervous system, may also produce these symptoms in an aggravated form.

If nothing is found in the urine pointing to the presence of disease in the kidneys or any other part of the urinary tract, a local pelvic examination should be made, including a careful inspection of the vulva and urinary meatus and, if necessary, a cystoscopic examination of the bladder. The *local conditions* which may be present include the following: chronic urethritis (usually gonorrhœal), chronic cystitis, a calculus in kidney, ureter, or bladder; urethral caruncle, or prolapse of the urethral mucous membrane;

cystocele, or prolapse of the uterus; pregnancy; a pelvic or abdominal tumour; or a pelvic inflammatory lesion. These conditions will all be described in later sections.

Severe pain on micturition is usually due either to acute cystitis or urethritis, to the passage of calculi, or to the presence of a vesical neoplasm; sometimes to the presence of cracks or fissures near the neck of the bladder.

The *treatment* of pain and frequency must obviously depend upon the causal conditions which are present; it is undesirable to endeavour to relieve these symptoms by sedative drugs until a thorough examination has been made to discover the cause.

Retention. Retention of urine may be due to the presence of some obstruction—usually outside the urinary tract altogether, to reflex spasm of the sphincter, to paralysis of the bladder, *e g.* from over-distension, or to hysteria.

Obstruction causing retention of urine is seldom urethral, for stricture is very rare in the female. More often it is due to a pelvic tumour, the commonest conditions causing it being a retroverted gravid uterus, an impacted fibroid tumour, a pelvic hæmatocele, or a hæmatocolpos. These conditions will be considered in later sections. *Reflex spasm* of the sphincter may be met with after the desire to evacuate the bladder has been too long resisted, after abdominal or vaginal operations, after child-birth; or from a very sensitive urethral caruncle which gives rise to severe pain during micturition. Post-operative retention is often complex in its nature, being partly nervous and partly reflex; it is certainly more often met with in women of pronounced nervous type, than in others; in such subjects the retention sometimes persists until the patient leaves her bed. As soon as the patient can be allowed to get up, the bladder usually acts normally. The prolonged use of the catheter, which is necessary under such circumstances, is attended by definite risks of cystitis, even when the attendant nurse, to whom the duty usually falls, is careful and conscientious. It is quite possible that bacteria may be carried into the bladder from the urethra which are capable of setting up a mild form of cystitis. Prophylactic treatment should be instituted early in such cases by the regular administration of some urinary antiseptic (*see* p. 242).

Hysterical retention, which is rare, is of sudden onset, and is recognised by the complete absence of any local cause. It should be relieved if possible by such measures as hot hip-baths, vaginal douches, and hot fomentations to the vulva; the catheter being only used as the last resort.

Incontinence of Urine. This may be absolute in cases of paraplegia or of vesical fistula; more often it is partial only, as in cases of unilateral ureteral fistula, or of weakening of the sphincter of the bladder. Sometimes women with a vesico-vaginal fistula develop remarkable sphincteric action of the muscles at the entrance of the vagina, so that they can hold urine for a short time when lying down, the urine being retained in the vagina. Incontinence due to fistulæ will be referred to in connection with the latter subject; that which depends upon abnormal conditions affecting the neck of the bladder may be due to a variety of different causes. In children, a form of incontinence occurring only during sleep, known as *nocturnal enuresis*, is met with, which will be separately considered. Involuntary evacuation of the bladder commonly occurs during epileptic fits.

In *adult women* the commonest cause of partial incontinence is child-

bearing, and often, but not always, a more or less marked degree of prolapse is present. The nature of these parturient injuries will be understood when the subject of prolapse has been considered (p. 531). This form of incontinence is present only when the patient is up, and is induced by any rise of intra-abdominal pressure, as from coughing, sneezing, straining, running, or walking. When she is resting the bladder is usually competent, and although there may be nocturnal frequency there is no nocturnal incontinence. This symptom is naturally aggravated by the supervention of pregnancy, or the presence of an abdominal tumour, etc. In marked cases it is very distressing, and is exaggerated by the morbid dread of its occurrence.

When definite signs of prolapse are present, treatment of this condition may be expected to cure the incontinence. When there is no local lesion to be discovered, treatment is much more difficult. Drugs are of little benefit, but the operation of urethroplasty, described on page 767, is usually successful in giving at least a considerable degree of relief. The use of a portable rubber urinal is the last resort in cases of incurable incontinence.

Nocturnal enuresis in little girls may be due to some cause of local irritation, such as uncleanliness, thread-worms, skin-eruptions or vulvitis; hyperacidity of the urine and bladder-calculus may be found. The first consideration in such cases is to make a careful search for these conditions. Often, however, no local cause can be discovered, and the fault is to be referred to the innervation of the bladder. Usually it can be cured by carefully educating the child, if this is begun before the condition has been long in existence. It must be recollected that the bladder-centre always requires education in children, which is not equally successful in every case, the age at which a child acquires control of the bladder being variable. In some cases the removal of adenoids has cured nocturnal incontinence. Punishment of the child must always be avoided, for there is no doubt that the evacuation of the bladder is quite involuntary. Nothing to drink should be allowed at night and the child should sleep lightly covered; arrangements must be made for waking her at regular intervals so that she may be got out of bed for the purpose of emptying the bladder. The administration of belladonna is of great service in many cases, and the drug must be pushed to its physiological limits. Children bear belladonna remarkably well, and a child of three or four years may be given 10 minims three times a day, and the dose gradually raised as far as 40 minims three times a day, without any of the ocular symptoms appearing which are so marked in adults. The use of the drug must be prolonged for a considerable time *after the incontinence has been relieved*. No operative treatment is possible.

DYSPAREUNIA (PAINFUL OR DIFFICULT COITUS)

A variety of different conditions may render coitus painful and difficult to the female, and cases in which this symptom is present require careful investigation. The pain is seldom acute; usually it is described as of a dull aching character, and it may last for some hours after coitus has taken place. Dyspareunia is frequently associated with indifference or actual repugnance to sexual congress, to such an extent that in some cases nausea or even vomiting may be produced. Cases in which the dyspareunia commences at the beginning of married life have a different explanation from those in which this symptom supervenes after a period of normal married life. In

the former case it is on account of the dyspareunia alone that the patient seeks advice; in the latter case other symptoms are commonly associated with it. Certain congenital abnormalities, such as an imperforate or abnormally resistant hymen, an imperforate vagina, or stenosis of the lower part of the canal, may render coitus impossible. A mechanical obstacle of a different kind is often met with, viz. muscular spasm affecting the sphincter vaginæ and probably the other superficial perineal muscles also. This condition is known as *vaginismus* and is usually set up originally as a protection against the pain caused by a local lesion. Often, however, it is well marked where no local cause can be detected. In women of neurotic temperament dyspareunia may occur without any local morbid condition being discovered to which it can be attributed. It is then probably psychical in origin, and is scarcely amenable to medicinal or surgical treatment. Such cases can sometimes be successfully dealt with by the method of psycho-analysis or by hypnotic suggestion.

In many cases, however, a *local cause* can be found for this troublesome symptom. The local causes of dyspareunia may be stated as follows:

External causes:

Acute and chronic vulvitis or vaginitis; kraurosis.
Inflammation of the Bartholinian glands.
Fissures and ulcers of the hymen and other parts comprising the ostium vaginæ.
Chronic inflammation of the caruncule myrtiformes.
Spasm—*vaginismus.*

Internal Causes:

Inflammatory changes, acute or subacute, in the uterine appendages, the peritoneum or the cellular tissue.
Backward displacement of the uterus, when complicated by adhesions, etc.
Prolapse of the ovary.

When no local cause can be found the possibility of a serious disproportion in size between the male organ and the ostium vaginæ should be recollected. In all cases of dyspareunia an interview should be sought with the husband from whom more detailed information can usually be obtained than from the wife.

Cases of dyspareunia require a careful local examination, including inspection of the vulva; fissures in the region of the fossa navicularis are easily overlooked unless a very careful inspection is made with good illumination; they are commonly associated with severe muscular spasm (*vaginismus*), which renders their detection still more difficult, unless an anæsthetic is administered.

Vaginismus, although developed by attempts at coitus, may be absent when a gentle digital examination is made. If, however, backward pressure is exerted with the finger upon the lower part of the posterior vaginal wall the spasm can often be clearly observed. If no external cause is discovered a careful bimanual examination should be made to exclude inflammatory conditions and prolapse of the ovaries.

The *treatment* of dyspareunia consists in the first place in the removal or relief of any local cause which may be present. An unruptured or imper-

forate hymen can be clipped away under anæsthesia, and the ostium vaginæ dilated. Fissures or tender *carunculae myrtiformes* can be excised. The treatment of vaginismus is dealt with in a later section (*see* p. 773). Internal causes require the treatment appropriate to the condition. When no local cause can be discovered a period of abstinence should be advised, and when marital intercourse is renewed the application to the vulva of a 10 *per cent.* cocaine ointment a quarter of an hour beforehand may enable the difficulty to be overcome.

STERILITY

Reproduction depends as much upon the normal sexual activity of the male as of the female; sterility is therefore not due in all cases to the woman, although conditions which tend to produce it are much more common in the female than the male. Instances have occurred in which the marriage of perfectly healthy individuals has been unfruitful, yet in such cases the re-marriage of each has resulted in reproduction. Members of families with an average, or more than an average degree of fertility, are themselves more likely to have children than those characterized by a lesser or a declining degree of fertility. Certain families, like certain races, tend to die out, this process being due to a progressive failure of reproductive activity (in some cases, to hereditary disease in others).

Sterility is usually described as of two kinds, *absolute* and *relative:* the former indicates persistent failure to conceive; the latter, failure to carry pregnancy to a successful termination. Relative sterility is therefore an obstetric question and will not be further referred to here. The rule formulated by Matthews Duncan that the marriage of young persons between the ages of twenty and thirty cannot be regarded as sterile until four years have elapsed, should be generally observed. In the case of women over thirty years of age, delay in bearing the first child is of greater importance than in younger women; it is therefore advisable to undertake a full investigation of both parties after an interval of, say, two years. Instances have, however, occurred in which a child has been born after as much as fifteen years of sterile married life.

Absolute sterility is the consequence of a failure affecting the earliest stages of the reproductive process; either fertilization does not occur, or the fertilized ovum fails to make good its implantation and perishes at once. Non-fertilization probably implies that spermatozoa and oöcytes are not brought into contact with one another. This may be due (1) to inactivity of the sperm-cells preventing them from accomplishing their transit to the Fallopian tubes, where fertilization normally occurs; (2) to absence of spermatozoa from the semen (azoöspermia), or to destruction of the sperm-cells by abnormal discharges in the genital canal; (3) to mechanical obstacles in the canal which impede their progress, such as stenosis of the cervix, which may prevent the entrance of the spermatozoa into the uterus, or occlusion of the Fallopian tubes which prevents the ovum from entering the abdominal ostia; (4) failure of the normal process of ovulation, *e.g.* the egg-cell may not be properly liberated from the ovary owing to surrounding adhesions or to abnormal thickness of the tunica albuginea. Failure of the fertilized ovum to become successfully embedded may be due to an unhealthy or abnormal endometrium, *e.g.* septic uterine infections, and exfolia-

tive dysmenorrhœa. Absence or serious mal-development of any part of the genital canal may be a cause of absolute sterility.

Some of these conditions constitute local causes capable of clinical detection. But sterility is not uncommon in persons in whom no local cause whatever can be discovered. It is, therefore, necessary to recognize also the *general conditions* which, on the one hand favour, or on the other impede the occurrence of conception. Of these age is one of the most important, and the age of the wife is of more weight than that of the husband. Women who marry between the ages of 20 and 30 show the highest degree of fertility; in those who marry after 40 Matthews Duncan found 85 *per cent* were sterile.

Men of delicate health and sedentary occupation are usually less likely to procreate than robust men who lead an outdoor life; the influence of the general health in women is less important than in men. It is generally accepted that women who suffer from dysmenorrhœa are less fertile than those who menstruate without excessive pain, a view which rests upon the careful statistical observations of Matthews Duncan, Vedeler and others. Menstrual irregularities and even marked degrees of amenorrhœa are not incompatible with an average fertility.

After passing these questions in review a *local cause* of the sterility should be sought for.

The local conditions previously mentioned as causes of dyspareunia tend to prevent conception by interfering with the natural course of sexual congress. Certain congenital abnormalities absolutely prevent conception, such as imperforate vagina (*see* p. 142), infantile uterus, hypospadias and hermaphroditism (p. 147); others are believed to hinder but do not absolutely prevent conception, such as conical cervix and hypertrophic elongation of the cervix (p. 539). Small size of the os externum (so-called pin-hole os) may perhaps also unfavourably affect the prospects of conception. Uncomplicated displacements of the uterus do not form a serious hindrance to child-bearing, and numerous instances occur in which a retroverted uterus becomes gravid; at the same time, the correction of a backward displacement in a childless woman has been frequently observed to be followed by conception. Chronic endometritis, and fibroid tumours of the uterus, stand in the same category as displacements, although their influence is much more unfavourable. The infective forms of endometritis, whether corporeal or cervical, form an almost absolute hindrance to conception. Occlusion of both Fallopian tubes renders conception impossible; peritonitic adhesions involving the tube and ovary may cause sterility, but it is probable that sometimes more or less complete recovery from these conditions may occur, and it is therefore necessary to give a cautious prognosis when old adhesions have been detected at operation. We now have a reliable clinical means of determining the patency of the Fallopian tubes by the method of tubal inflation, described on page 109. The application of this test should be employed as a routine procedure in cases of sterility, for, according to Giles, 33 *per cent.* are due to tubal occlusion.

Bilateral ovarian tumours, when solid or malignant, may destroy all the ovarian cortical substance and render conception impossible by arresting ovulation.

When no local abnormality can be detected in the wife, it is quite possible that the fault is with the husband. In all such cases it is desirable to see

the husband and determine the absence of sexual weakness or incompetence; an examination of the semen should also be made, for sexual activity may co-exist with deficient vitality or absence of spermatozoa. Chronic orchitis of gonorrhœal origin, or following an attack of mumps, is not infrequently a cause of sterility in the male when both testicles have been affected. Spermatozoa are then present in only small numbers in the testicular secretion, or they may be absent altogether.

Treatment. It must be understood that in all cases the condition of the husband requires attention as much as that of the wife. Improvement of the physical condition of the husband often puts an end to a long period of sterility. Only when no fault can be found in the male partner is it right to submit the wife to operative procedures for the cure of sterility. In the female all local conditions which are, or which may possibly be, causes of sterility deserve careful treatment. Conditions which give rise to dyspareunia and so interfere with complete congress must be dealt with. Purulent or muco-purulent discharges, backward displacements, abnormal conditions of the cervix, such as 'pin-hole' os, 'conical' cervix and hypertrophic elongation, should be dealt with by the operative methods which will be found described in another place. Inflammatory conditions affecting the tubes and ovaries are frequent causes, and are very difficult to deal with. If the tubal inflation test has shown that one at any rate of the tubes is patent, prolonged treatment by palliative methods (*vide* p. 235) should always be carried out before resort to operation is advised. Inflammatory occlusion of the abdominal ostium of the Fallopian tube when bilateral is, of course, an absolute bar to conception; in such cases the tubes may be reopened and an artificial ostium made, but this operation cannot be undertaken until all clinical indications of activity in the inflammatory process have disappeared. If the walls of the tube are definitely thickened, or if semi-purulent fluid is found on opening the tube, it is very unlikely that the artificial ostium will remain open, and a sharp attack of pelvic peritonitis may follow the operation, which will invariably result in resealing of the opened tubes. It is therefore clear that salpingostomy has but a limited field of usefulness, and cases require very careful selection.

Certain general regulations are important in the treatment of sterility. Frequent sexual congress should be discouraged. It should further be pointed out that the ten days immediately following a menstrual period is the most favourable time for the occurrence of conception. In support of this statement sound anatomical reasons can be advanced. It is estimated that a period of eight to ten days (von Franqué) must elapse between the act of insemination and the arrival of the *fertilized ovum* in the uterus. If the act of insemination occurs a week after the cessation of menstruation, and conception follows, the fertilized ovum is due to arrive upon the endometrium when this membrane has entered the premenstrual phase. It is in this phase that the endometrium most closely resembles the decidua of pregnancy and has been called the *menstrual decidua* (*see* p. 80); it is reasonable to suppose that it is then best prepared for the embedding of the ovum. Very little change is required to convert the menstrual decidua into the true decidua of pregnancy.

A period of several weeks' separation of husband and wife is indicated if there has been excess, or if any sign of failure of sexual activity in the husband is detected. Abstinence from alcohol and tobacco should be prescribed,

whenever there has been excessive indulgence in either. Apart from these general measures two other procedures deserve consideration, viz. dilatation of the cervix and artificial insemination of the uterus.

Dilatation of the cervix is useful not only in widening the canal but possibly also in stimulating the function of uterine polarity. Its effect is temporary, and it should accordingly be performed at the most favourable moment: further it should be so carried out as to avoid injury to the uterine tissues, such as laceration by the use of unnecessarily large dilators. The cervical tissues may be softened and dilatation thus rendered easier by preliminary hot douching. This should be carried out three times a day for a week, a tampon of cotton wool soaked in glycerine being placed in the upper part of the vagina after the douche. In cases of 'pin-hole' os the preliminary use of a tent (*see* p. 723) is desirable. Dilatation should be performed at the close of a normal menstrual period; it is then practically certain that the patient is not at the moment pregnant, and it is agreed that the part of the menstrual cycle most favourable for the occurrence of conception is the week which immediately succeeds the period. The operation should be carried out with the most careful antiseptic precautions, and the dilatation should not be carried further than number 10 (Hegar) (*see* p. 722). An anæsthetic is necessary, but the patient can return to her husband after forty-eight hours.

Artificial insemination consists in the introduction of the semen into the uterus with a syringe. An old device of veterinary surgeons, it was first applied to women by Marion Sims (1860), but the results were unsatisfactory and the method fell into disrepute. Recently, with improved technique, occasional successes have been reported. Stringent precautions are required to preserve the vitality of the spermatozoa. The best plan probably is to take the semen up into a syringe immediately after its deposition in the vagina and to introduce it at once into the uterus. A syringe with a special nozzle designed to pass through the internal os is required. There are few women who are willing to submit to this procedure, and the results are so uncertain that it cannot be urged with any degree of confidence.

In describing the apparatus for tubal insufflation (p. 109) it was mentioned that occasional instances of cure of sterility from the use of this apparatus have been reported, the result being attributed to dislodgment of a plug of mucus from the narrow segment of the Fallopian tube.

PART I: SECTION IV

DISORDERS OF DEVELOPMENT AND FUNCTION

(1) MALFORMATIONS.
(2) DISORDERS OF MENSTRUATION.
(3) ECTOPIC PREGNANCY.

MALFORMATIONS

Etiology. The greater number of the malformations of the female generative organs are of congenital, *i.e.* pre-natal, origin. Some are to be referred to the earlier months of gestation, such as pseudohermaphroditism and duplication of the uterus and vagina : others probably occur much later, for example the various kinds of occlusion of the vulva. Other malformations again are of post-natal origin, and are due to failure of the normal developmental changes which occur during childhood or at puberty ; examples of these are seen in the *uterus infantilis* and *uterus pubescens* in which the transition from fœtal to adult characteristics is only imperfectly accomplished. Defects of development are not infrequently multiple and may affect different systems as well as different parts of the same system.

The etiological factors concerned in the production of malformations are quite unknown. Recent experimental work has shown that nutritional disturbances and slight traumatic influences can profoundly disturb the course of development of the ovum *in vitro*. Direct evidence of the operation of such conditions in the course of natural development is, of course, most difficult, if not impossible, to obtain. Clinical observation shows that heredity, and possibly parental syphilis, are the only conditions to which an unfavourable influence upon development can reasonably be attributed The well-known influence of the latter condition in causing pre-natal death is the chief reason for regarding it as a possible cause of deflection of development from its normal course.

MALFORMATIONS OF THE OVARIES

These are uncommon and of minor clinical importance.

Supernumerary and Accessory Ovaries. A *supernumerary* ovary is one which is independent of, and of equal size with, the normal ovaries. The only satisfactorily demonstrated case is that of von Winckel in which the supernumerary ovary lay in front of the broad ligament and was attached to the uterine cornu by a definite ligamentous band. An *accessory* ovary is a piece of ovarian tissue of small size, present in addition to two normal ovaries ; usually it is attached by a band to some portion of the normal ovary, and its formation is then attributed to the effects of constriction by peritonitic bands

in early embryonic life. Sometimes it is found in an aberrant situation, but this is always upon the line of the normal descent of the ovary from the lumbar region to the pelvis (p. 68). Care is required in the diagnosis of an accessory ovary; unless the tissue under examination contains the characteristic histological elements, *i.e.* Graafian follicles or lutein-cells, it cannot be regarded as ovarian. Many recorded cases have failed to comply with this test, and it is probable that the condition is rarer than would appear from the literature. It is, however, possible that in some of the recorded cases of persistence of menstruation after double oöphorectomy, accessory ovarian tissue may have been present. Sometimes, again, accessory ovaries may become the seat of new growths, such as fibromata, or cysts, developing in unexpected situations. Except in these relations, however, supernumerary and accessory ovaries have no clinical importance.

Absence and Rudimentary Development. Complete absence of both ovaries only occurs in connection with such gross fœtal monstrosities as the acardiac and sympodial fœtuses, which are incapable of independent existence. Absence of the gonads in individuals of the other sex is excessively rare, if indeed it ever occurs; confusion of sex may occur (hermaphroditism), but in such individuals sexual glands are always present, though they may be of aberrant type. Complete absence of the ovaries can only be certainly recognized by post-mortem examination, operative records of the condition cannot be trusted, for it is easy for an ovary in an aberrant position to escape detection by an operator. By a 'rudimentary' ovary is meant an ovary which contains no Graafian follicles, and properly recorded cases of this condition are almost as rare as those of absence of the glands. Owing to this uncertainty we are unable to say what would be the clinical effects of congenital absence of the ovaries upon an adult individual.

Abnormal Situation: Ectopia Ovarii. A number of cases have been recorded in which an ovary has been arrested in the abdomen at some point along the line of its normal descent. Further, in a few instances it has also been found in the sac of a congenital hernia (*see* legend of Fig. 86). It will be recollected that hernia of the ovary is not uncommon in the acquired variety also. An abdominal ovary gives rise to no clinical results; congenital ovarian hernia only becomes troublesome after puberty, when it gives rise to pain and tenderness which are aggravated with the menstrual periods.

MALFORMATIONS OF THE FALLOPIAN TUBES

Supernumerary Tubes and Accessory Abdominal Ostia. A true *supernumerary* tube is an extremely rare occurrence, and it is doubtful if a satisfactory case is on record. Accessory ostia on the other hand are comparatively common, and occur, according to post-mortem records, in from 4 to 10 *per cent.* of cases. The number of such accessory ostia varies up to six, although more than one is uncommon. They are usually situated on the dorsal surface (*see* Fig. 56, p. 69); the fringe of fimbriæ is always present, although variable in character; in many instances there is no communication with the tube-lumen. An accessory ostium may become occluded, and dilatation may then occur giving rise to one variety of tubal cyst (*see* p. 547). Apart from pathological changes, accessory ostia have no clinical significance.

Defects of the Fallopian Tube. Complete absence of both tubes is very

rare, but two cases have been recorded by W. G. Spencer in which the tubes were represented only by a pea-like body upon each uterine cornu; the ovaries and the uterus were normal. Both these patients suffered from severe dysmenorrhœa, which was relieved by an operation which established a communication between the uterine cavity and the peritoneum.

Rudimentary tubes are not nearly so uncommon as the latter condition, and a number of cases are on record. In some the inner (uterine) portion has been deficient, and in a case recorded by one of us (C. L.) the abdominal ostium and infundibulum were the only portions represented (*see* Fig. 86). In others the inner half alone was present, the tube ending abruptly about 2 inches from the uterine cornu. In *uterus bicornis unicollis*, the tube corresponding to the undeveloped horn is also often in a rudimentary condition (*vide infra*).

Diverticula of the Tube. In the latter half of fœtal life the tube is normally tortuous, but it straightens out as the pelvis increases in size during childhood. As a fœtal maldevelopment, a spiral tube is sometimes found associated with gross malformations of the genitalia, and in cases of arrested development. A persistence of the fœtal tortuosity must not be confused with the convoluted state of the tube which is secondary to salpingitis, to which we shall have occasion later to refer.

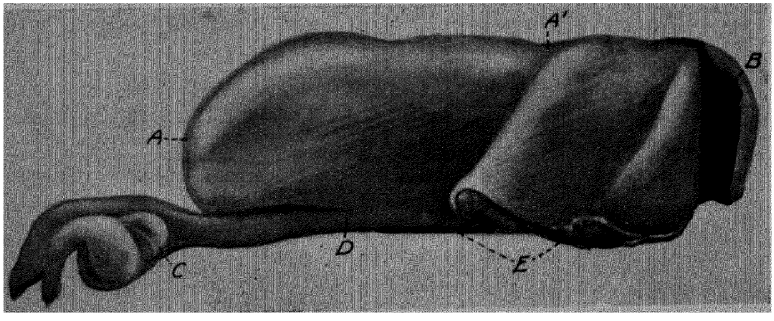


FIG. 86. ABSENCE OF THE INNER TWO-THIRDS OF THE FALLOPIAN TUBE. A, A', Ovary. B, Uterine horn. C, Ampullary portion of tube. D Marks the site where the tube terminated. E, Round ligament spread out. The above formed the contents of a right inguinal hernial sac.

Congenital diverticula include the entire wall of the tube and are not merely diverticula of the lumen into the tube wall. When the mucous membrane is found to trespass into the muscularis of the tube it is a manifestation of chronic salpingitis and not a congenital abnormality.

Slighter developmental defects occasionally met with are persistence of the spiral convolutions which are normal in the fœtus (*hypoplasia tubae, see* Fig. 87), non-ciliation of the tubal epithelium, and very occasionally non-canalization of the tube, which remains as a solid cord.

Displacements of the tube sometimes occur; the greater number of examples are cases of hernia; one instance in which the tube with its companion ovary was situated in the right lumbar region has, however, been recorded (C. L.). In this case the right half of the uterus was undeveloped, the organ being unicornute.

MALFORMATIONS OF THE UTERUS, VAGINA, AND VULVA

The uterus is developed from the middle portions of the two Müllerian ducts which fuse to form a single tube; the vagina is similarly developed from the lower or caudal portions of the same ducts. The greater number of malformations occur from arrest of the normal process of fusion at some stage or other, so that an intermediate arrangement becomes permanent. Such arrest may affect the whole of the uterine and vaginal sections of Müller's ducts, or may be limited to a portion of them. Further, unequal development of the two sides may occur, one being arrested, the other pursuing its normal course, as far as may be, without the full participation of its fellow. One of the commonest examples is the failure of one important factor only in development, viz. the fusion of the two ducts, the result being *duplication* of the whole or of certain parts of the uterus and vagina.

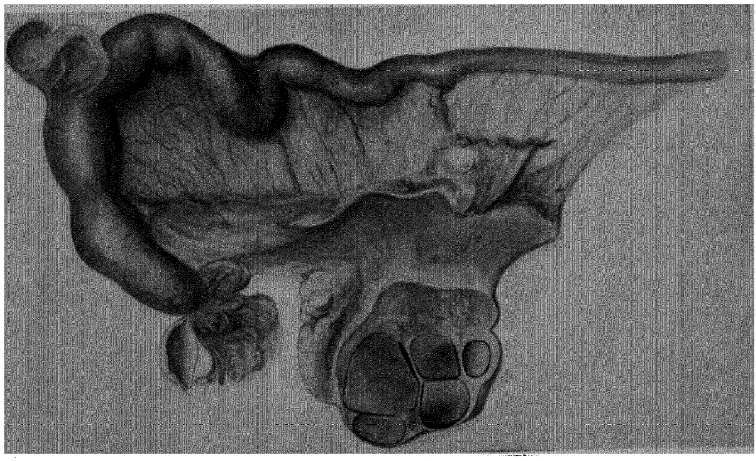


FIG. 87. HYPOPLASIA OF TUBE. The tortuosity is normal in the fœtus, abnormal in adults. The walls are abnormally thin. There is a small cyst of the hydatid of Morgagni close to the fimbriæ, also a small peritoneal cyst attached to the ampulla.

Accessory Uterus. This rare defect consists in the presence of a second uterus (corpus only) which is not furnished with adnexa or vagina; in this it is distinguished from the various forms of double uterus described below.

Absence and Rudimentary Condition of the Uterus. Complete absence of the uterus, if it ever occurs, is extremely rare, most of the cases recorded as such have probably been instances of pseudohermaphroditism (*vide infra*). The most marked defect of development is that known as the *uterus rudimentarius*, in which the organ is represented by a solid or very imperfectly canalized body composed of muscular and fibrous tissue. Sometimes the uterus permanently retains the characters which are normal at birth, *i.e.* development does not progress during infancy—*uterus fœtalis* or *infantilis*. In this form the cervix is longer and thicker than the corpus and somewhat conical in shape; the total length of the organ is 1 to $1\frac{1}{2}$ inches; the mucous membrane of both body and cervix is folded transversely. The Fallopian tubes and the vagina are also usually defective in development. Sometimes development is arrested before the changes normal

at puberty have occurred ; this gives rise to the *uterus pubescens*. Here body and cervix are of about equal length, and the whole organ is undersized ; the tubes and the vagina usually participate in the defect.

The preceding defects of development of the uterus give rise to more or less complete loss of the function of menstruation, and to complete loss of the function of reproduction. With the *uterus pubescens* a scanty and irregular menstrual function may be developed. The two more serious varieties of defect are attended with absolute amenorrhœa. In other respects the subjects of these defects may be normal and they often marry. Diagnosis can be made by careful examination under anæsthesia, when the small size of the uterus can be shown by bimanual examination and the use of the sound. It must be recollected that the cervix in these cases may appear to be full-sized ; it is to the condition of the uterine body that attention must be chiefly directed.

Duplication of the Uterus. Six types of double uterus are known, which

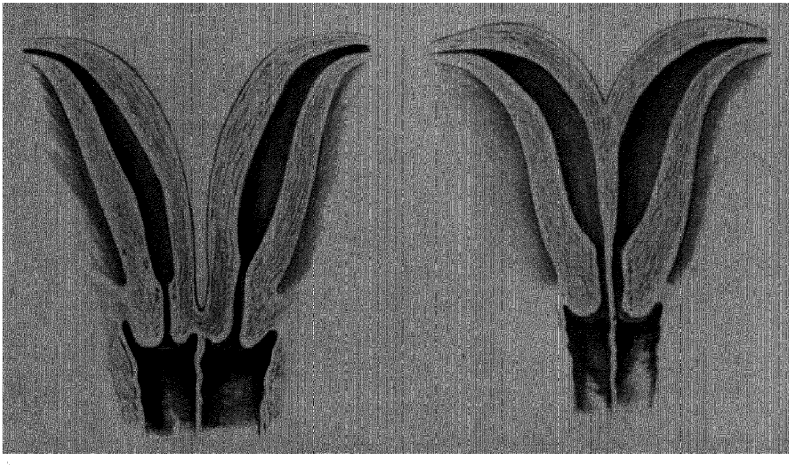


FIG. 88. UTERUS DIDELPHYS. Two uteri are formed, separated from one another by a deep sulcus which passes down to the cervico-vaginal insertion. Two distinct vaginal canals are present, in each of which lies a complete cervix.

FIG. 89. UTERUS BICORNIS BICOLLIS. Fusion has occurred in the cervix and lower part of the uterine body, but it is incomplete, for the lumina are distinct. The vagina is divided by a median septum which is prolonged up into the cervix.

are diagrammatically represented in Figures 88 to 93. Each Müllerian duct may develop independently, and remain distinct from its fellow, fusion being completely absent ; two uteri, independent of one another except at the cervico-vaginal insertion, result from this abnormality, the condition being called *uterus didelphys* (*see* Fig. 88). The vagina in such cases also consists of two distinct canals separated by a median septum, a normal cervix and external os being found in each. The vulva is single, and, as a rule, there is only one hymen. Through the deep cleft which persists between the two uteri, a fold of peritoneum often passes, the *vesico-rectal ligament*. A case of uterus didelphys has been recorded in which each uterus had entered the sac of a bilateral inguinal hernia. Atresia is not uncommonly

found in some part of the cervix or vagina of one or other side. Each half is roughly cylindrical, the characteristic pear-shape of the properly developed organ being the result of fusion of the two ducts.

In other cases the upper parts of the uterine portions of the Müllerian ducts remain distinct, while the lower parts undergo imperfect fusion, so that the apposed walls unite while the lumina remain distinct. The cervix is single but divided by a median septum, and the vagina is usually duplicated also. This form is called the *uterus bicornis bicollis* (*see* Fig. 89), and differs in general outline from the uterus didelphys mainly in the lesser depth of the cleft between the two halves. Sometimes the process of fusion in the lower parts of the Müllerian ducts is carried a step further, an undivided cervix and vagina being formed, while from the level of the internal os upwards the uterine body is duplicated. On vaginal examination in such

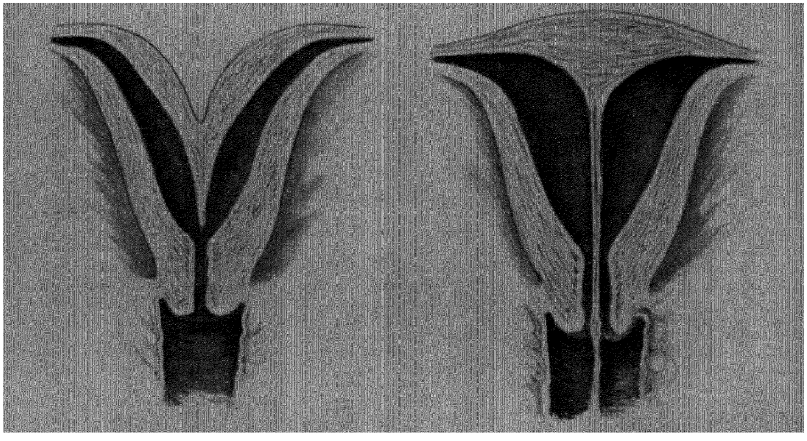


FIG. 90. UTERUS BICORNIS UNICOLLIS. The cavity of the uterine body is double; that of the cervix and vagina is single. Complete fusion has occurred in the lower half of the uterus.

FIG. 91. UTERUS SEPTUS. Incomplete fusion has occurred throughout, but the outward configuration of the uterus is normal. The cavity is divided by a median septum which extends into the vagina.

a case the cervix and vagina appear normal; the cleft between the uterine bodies is seldom so pronounced as to attract attention on bimanual examination; the presence of two divergent cavities may, however, sometimes be detected by the use of the sound. This form is the *uterus bicornis unicollis* (*see* Fig. 90).

In two other forms fusion has been carried to a point at which a single organ, having the characteristic pear-shape of the uterus, is formed, but the lumina remain wholly or partially separated from one another by a median septum; these are the *uterus septus* and the *uterus subseptus* (*see* Figs. 91 and 92). In the former the septum extends from the fundus to the os externum, and may also be continued into the vagina; in the latter the septum ends at, or about, the level of the os internum, the cervix and the vagina being single. There is nothing in the shape of the uterine body in these cases to draw attention to the abnormality.

Lastly, one Müllerian duct may be entirely undeveloped, when a tubular

uterus having a strong lateral inclination is formed, *uterus unicornis*. More often, in such cases, however, a rudimentary condition of the opposite duct is found in the shape of a fibrous cord or band (blind rudimentary cornu), usually only imperfectly canalized, which is attached to the side of the unicorn uterus (*see* Fig. 93). Sometimes in such cases the Fallopian tube itself on the side of the imperfection may be well developed; but the undeveloped horn rarely communicates with the uterine cavity. Such an imperfectly developed horn may become the seat of an ectopic pregnancy, the spermatozoa reaching it by migration from the opposite tube across the pouch of Douglas (external wandering). The mucous membrane of an undeveloped horn penetrates deeply into the muscular stroma (*see* Fig. 95).

These six recognized types of double uterus are clearly produced by arrest at some stage or other of the normal process of fusion of the apposed

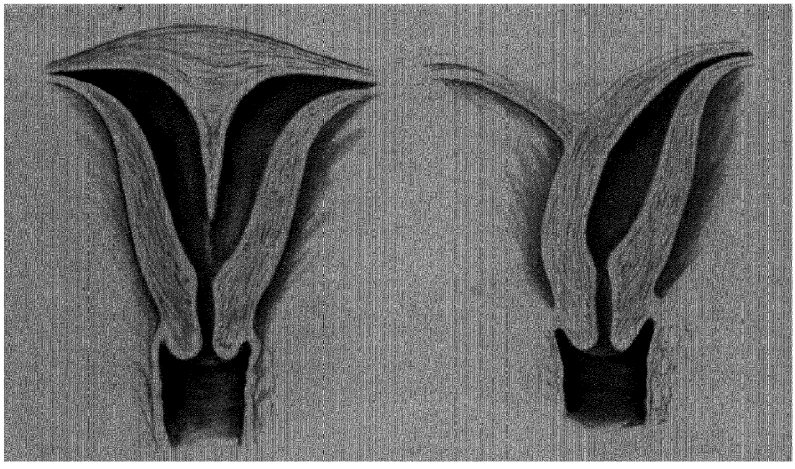


FIG. 92. UTERUS SUBSEPTUS. This differs from Figure 91 only in respect of the septum, which ceases above the level of the internal os; the cervix and vagina are single.

FIG. 93. UTERUS UNICORNIS, WITH AN IMPERFECTLY DEVELOPED SECOND CORNU.

portions of the Müllerian ducts. Another type of duplication exists of which there is only one recorded instance (Gemmell and Paterson)[1]; it is the most complete of all and arises at an earlier stage of development than any of the before-mentioned. In this the sole recorded instance the following developmental abnormalities were present: (*a*) partial bifurcation of the lower part of the vertebral column; (*b*) a very large and wide bony pelvis; (*c*) two uteri widely separated from one another by lateral inclination; (*d*) two vaginæ and two vulvæ; (*e*) two urethræ and two bladders. This woman had given birth to a child from each of her distinct genital canals. These deformities were probably produced by partial dichotomy of the tail end of the early embryo (*see* Fig. 94, p. 139).

Duplication of the Vagina. The two vaginal canals when present almost always lie side by side, not in an antero-posterior relation; a few exceptions have been recorded. The septum is composed of muscular tissue covered on

[1] *Journ. Obst. and Gyn. Brit. Emp.*, xxiii., 25, 1913.

each aspect with stratified squamous epithelium. It is often incomplete, and the deficiency may be in the upper or lower half, or in the middle. Occasionally complete or partial duplication of the vagina occurs with a single uterus, but in most cases the uterus is double also. The *uterus unicornis* usually goes with a single vagina which has a marked lateral inclination, and is abnormally small.

Clinical Features of Duplication of the Uterus. Double uteri, though of great morphological interest, are of small clinical importance. They are functionally entire organs, and menstruation and conception may proceed normally so as to arouse no suspicion of the imperfection. Menstruation occurs from both halves of the uterus; if pregnancy occurs in one half, menstruation is, as a rule, suppressed from both; exceptions have, however, been recorded. Twin pregnancy may occur from simultaneous lodgment of an ovum in each half, and this condition offers a possible explanation of the occurrence of superfœtation. The Fallopian tubes and ovaries are usually normally developed. The condition is often first revealed by the accidental discovery during clinical examination of a double vagina. In married women one half of the vagina is usually found dilated, the other in its virginal condition; but sometimes both sides have been found dilated. The *septate uterus* is especially difficult to recognize clinically on account of its normal external configuration. The sound may indicate two cavities, but in applying this test it is better to use two sounds so that there may be no doubt of the presence of two cavities separated by a septum.

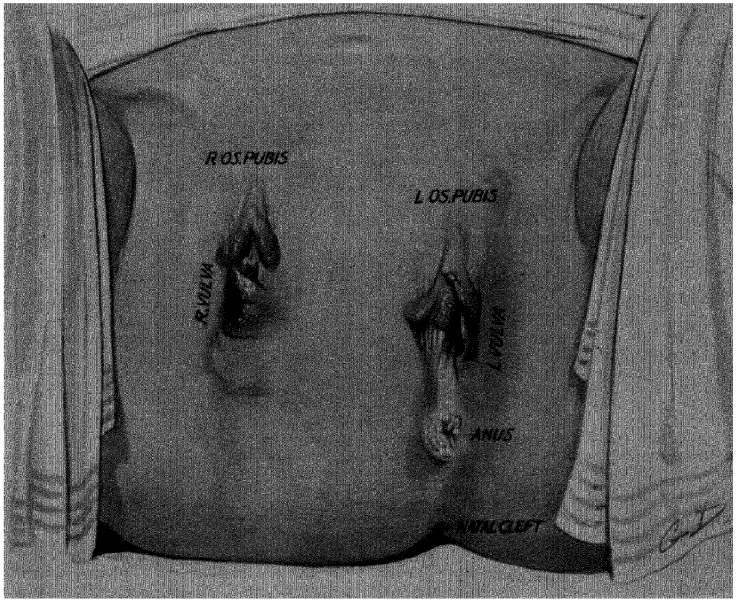


FIG. 94. DUPLICATION OF GENITALIA. (Gemmell and Paterson.)

Double uteri are prone to the formation of fibroid tumours, just as are normal uteri, and many unsuspected instances have been discovered in uteri removed for these growths. Sometimes duplication of the uterus is not the

only developmental fault present: stenosis may also be found affecting either the cervix or some other part of the vagina upon one side but not upon the other. Accumulation of menstrual fluid will then occur above the obstruction (cryptomenorrhœa), and *lateral* hæmatocolpos or hæmatometra will then be formed. The clinical diagnosis of these conditions naturally presents great difficulty as there are no external signs of maldevelopment, and menstruation may be normal from the other side. Usually the dilated

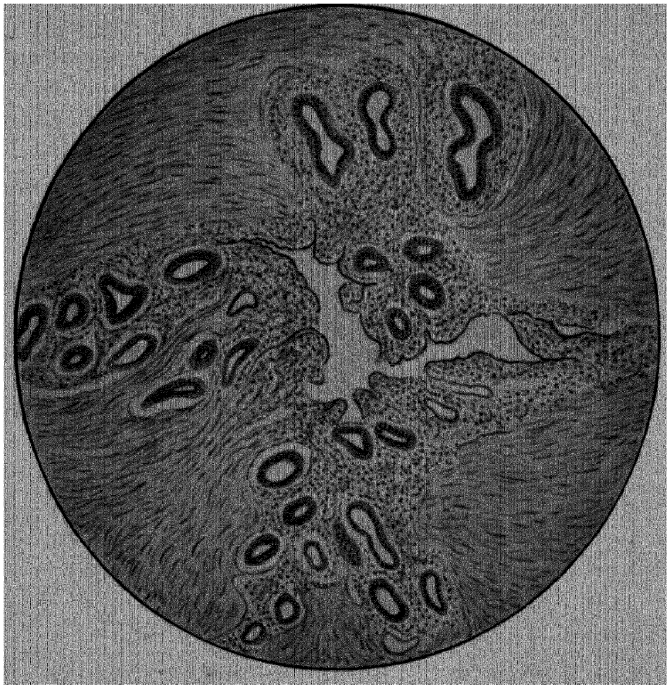


FIG. 95. TRANSVERSE SECTION THROUGH THE WALL OF A UTERUS UNICORNIS, showing a thick layer of uterine muscle into which the mucosa penetrates deeply. In this case only one Müllerian duct had developed; there was no accessory cornu as shown in Figure 93.

portion has been mistaken for a neoplasm, and its true nature has only become apparent when exposed by operation.

ATRESIC CONDITIONS OF THE GENITAL CANAL

These may affect the cervix, the vagina, or the vulva.

Atresia of the Cervix. This may take the form of complete failure of canalization, the cervix being represented by a solid block of fibrous and muscular tissue. More common are partial forms in which the canal is blocked only at one point, the commonest position for such a deformity being the region of the isthmus; sometimes in partial atresia a canal exists large enough to admit a fine probe.

These conditions are important clinically, inasmuch as they give rise to *haematometra and haematosalpinx*. Attempts must therefore be made to correct the deformity. The procedure of choice is an abdominal operation exposing the isthmus by free separation of the bladder; then the uterine cavity is opened above, and the vagina below the obstruction; the inter-

vening tissue is then excised, and the mucous membrane of the uterus united to that of the vagina. The alternative to this operation is removal of the uterus with conservation of the ovaries.

A minor form of cervical atresia is that known as the *pin-hole os, with conical cervix*. In these cases the vaginal portion of the cervix instead of being cylindrical is smaller than normal, and shaped like an inverted cone, the os externum being upon the apex. This condition of the cervix is often

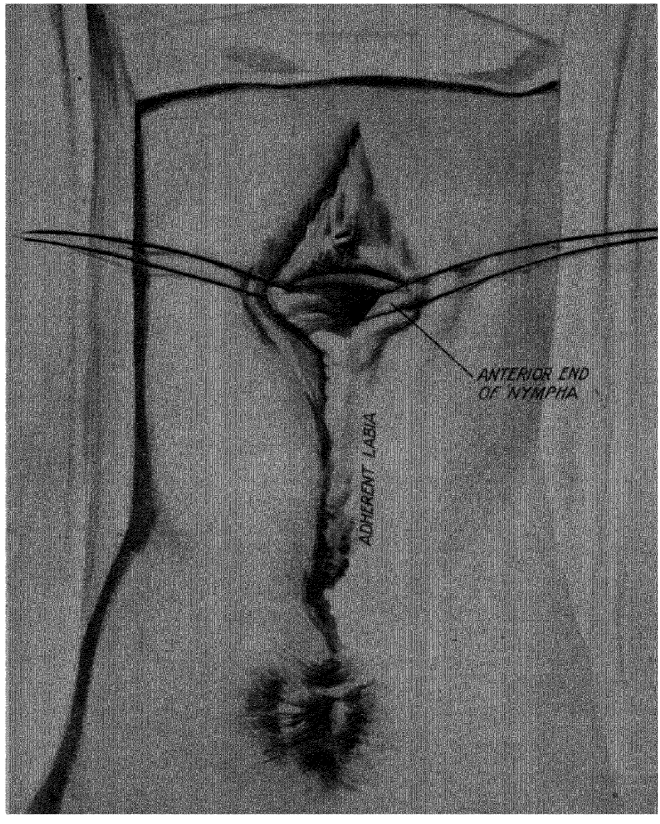


FIG. 96. SUPERFICIAL ATRESIA OF THE VULVA IN AN ADULT. The anterior extremities of the nymphæ have been drawn apart by ligatures, showing the narrow aperture leading to the vagina. The clitoris is seen to be unaffected. (*See also* Fig. 546, p. 766.)

associated with an anteflexed and undersized uterine body; clinically, dysmenorrhœa and sterility are usually present in such cases. The abnormal shape and size of the cervix are of little direct importance, but they point to the co-existence of a general condition of imperfect uterine development.

The os externum is, as a rule, abnormally small in these cases, and also in some instances where the vaginal portion of the cervix is otherwise normal. The abnormally small os is circular, and is often spoken of as the 'pin-hole' os; although its size exceeds that of a pin-prick, it is too small to admit the point of the uterine sound. Occasionally the internal os is also found

to be abnormally small; as a rule, the point of the uterine sound will readily pass through it, but sometimes considerable difficulty is found, and the sound is tightly gripped in passing through the os. The operative treatment of this condition will be described in connection with other plastic operations (p. 732).

Atresia of the Vagina and Vulva. Three forms or degrees of *vaginal* atresia may be met with. In the first and most extreme form the organ is represented only by a fibrous band of variable dimensions. In the second degree a part only of the canal is imperforate, the remainder being normal; in the third degree a transverse septum, which may be complete or perforated, obstructs some part of the canal. The vulva below, and the uterus and adnexa above, may in all these cases be normally developed, the vaginal

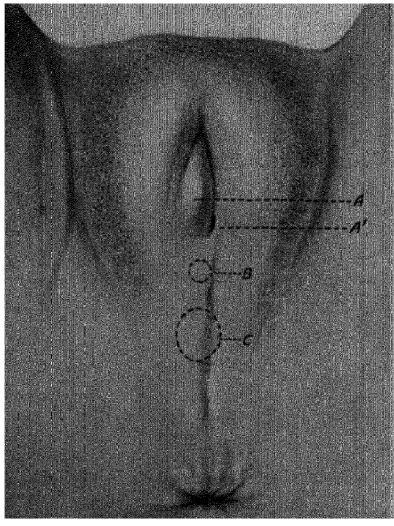


FIG. 97. SUPERFICIAL CLOSURE OF VULVA. A, clitoris. A', sinus, through which menses and urine escaped. B and C indicate sites of urethral and vaginal orifices.

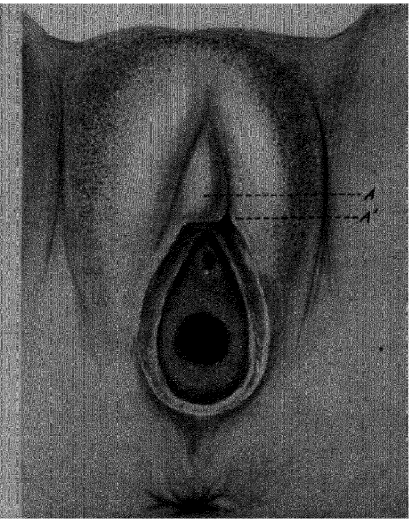


FIG. 98. The same as Figure 97, with the obstructing membrane cut away.

defect being the only one present. On the other hand the uterus may be duplicated or rudimentary.

Complete vaginal atresia in any form, if the uterus and ovaries are normal, will lead to the phenomena of cryptomenorrhœa (*see* p. 150). Recognition is easy as the affected organ is well within reach, but the important point in diagnosis in such cases is to determine whether the uterus and ovaries are normally developed or not. If they are normal, complete restoration of the integrity of the genital canal can be effected by operation. If they are not normal, it is questionable whether operative treatment of the vaginal obstruction is advisable. Operative reconstruction of the vagina has been undertaken in a few such cases, in order to render the woman marriageable, although the functions of menstruation and reproduction are irretrievably lost. A certain number of such cases have been dealt with by utilizing a loop of small intestine for the construction of a new vaginal tube; this operation is briefly described on page 775.

Lesser degrees of atresia may be dealt with upon the same principle as that applied in cervical atresia, *i.e.* union of the normal mucous membranes situated above and below the defect.

Vulval Atresia is, in comparison with the above, extremely rare. Complete absence (*defectus vulvae*) is only met with in fœtal monstrosities, which are incapable of independent existence.

Superficial atresia of the vulva is more often met with ; it may consist in closure of the vulva by adhesion of the nymphæ and posterior parts of the labia majora to one another, or the adhesion may be of the nymphæ only, the labia majora taking no part in the occlusion (*see* Fig. 97). In either case the condition is caused by an inflammatory process which has occurred before birth or during infancy. Figure 97 demonstrates a case which has recently been treated by one of us (C. L.). The obstructing membrane passed from the clitoris to the fourchette, thus hiding from view the vestibule, the meatus urinarius, the hymen, introitus vaginæ and the fossa navicularis (*see* Fig. 97 and Figs. 98, 99). The clitoris can be seen anteriorly

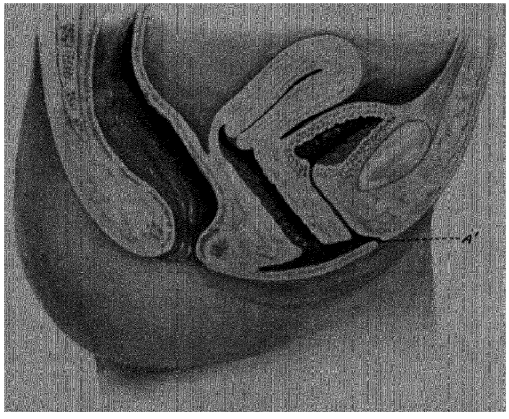


FIG. 99. Sagittal section of obstructing membrane seen in Figure 97. A′ indicates the position of a sinus through which menses and urine escaped.

(A), and a narrow channel (A′) existed immediately behind the clitoris. Through this small channel the menstrual secretion and urine escaped, and, in consequence, the deformity remained unrecognized until adult life [1] was reached. Occasionally the occlusion of the vulva in such cases is complete, and retention of menstrual fluid occurs.

The occluded portion of the vulva may be obviously cicatrized, as shown by the wrinkled and uneven condition of the surface, similar to that seen in Figure 96. The treatment consists in dividing the bridge of cicatricial tissue in the middle line from one end to the other. After removing any redundant tissue the raw edges are united by catgut. Microscopic section of the obstructing membrane (Fig. 100) shows the structure characteristic of the nymphæ, *i.e.* squamous epithelium on both surfaces and a few sebaceous glands in the vascular stroma. Superficial vulval atresia has been known to

[1] The patient in this case was aged 22 years. Menstruation caused no trouble; treatment was sought for difficulty in micturition.

lead to the deposit of triple phosphates from residual urine, and to the formation of a vaginal calculus (*see* p. 347).

Atresia involving the ostium vaginæ may also be due to defects of development of the *hymen* or of the *lower end of the vaginal canal.* This subject will be dealt with, and the variations in structure of the obstructing membrane described in connection with cryptomenorrhœa (*see* Pl. VII, p. 151). In some cases the conditions are slightly different, for a distinct interval may occur between the imperforate hymen below and the lower end of the vaginal canal above; the intermediate area then represents the site of a vaginal atresia. In such cases the physical signs are modified for the marked bulging of the hymen, and the impulse on coughing may be absent; the dilated condition of the vagina above will, however, be made out on rectal examination. The *treatment* consists in opening and draining the hæmatocolpos, and

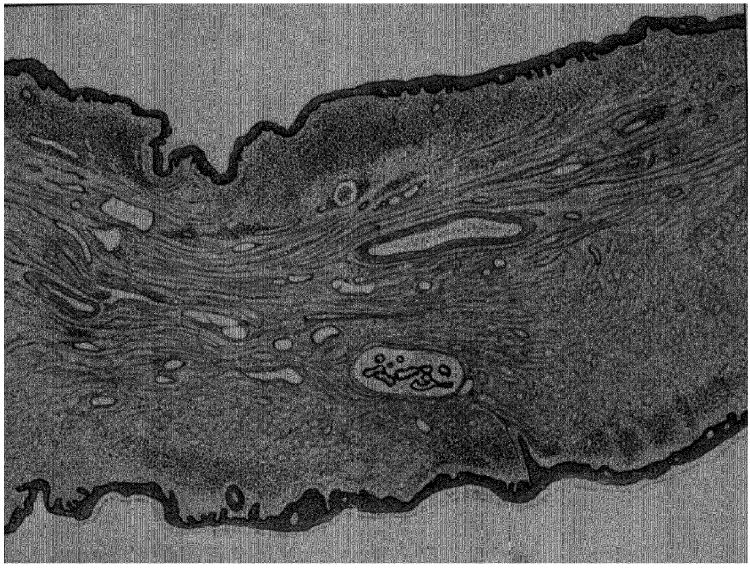


FIG. 100. MICROSCOPIC SECTION OF OBSTRUCTING VULVAL MEMBRANE, seen in Figures 97 and 99. The structure is similar to that of the labia minora.

restoring the integrity of the vaginal canal. If the interval between the vagina and the vulva is considerable, a somewhat deep dissection may be required to reach the accumulation of blood. It is essential that the mucous membranes of the two segments should be united, for constriction or complete closure will gradually ensue if this is not accomplished. The vaginal wall must be freed from its connective-tissue sheath for a sufficient distance so that it may be drawn down to the vulva and held there by stitches without tension. A wide glass or rubber tube is then introduced and held in position by dressing until union has taken place.

HYPOSPADIAS : EPISPADIAS

Hypospadias. This anomaly is produced by a defect of the *posterior* wall or floor of the urethra. In some cases the entire urethra is absent and the bladder then appears to open directly into the vagina. In the female it is

a very rare malformation, and, as it is sometimes associated with an enlarged clitoris, the subject may be mistaken for a male. Hypospadias in the male is more common, and when complete the subject may be mistaken for a female (*see* p. 148). According to Ballantyne, hypospadias in woman is the result of a persistence of the urogenital sinus (*see* Fig. 62, p. 74).

Epispadias. Epispadias is a defect of the *anterior* wall or roof of the urethra. The anterior wall may be entirely absent. As in the case of hypospadias, epispadias is more common in the male than in the female. In woman, anomalies in the development of the anterior urethral wall vary much in extent. In the mildest type the urethral passage forms an open channel in the mid-vestibular region, whence it runs beneath the symphysis pubis towards the neck of the bladder. Before reaching the bladder the proximal or vesicular end of the urethra may be found to be complete, the defect existing only in the vestibular portion of the duct. In some cases the channel remains exposed in its whole course, the anterior wall being entirely absent.

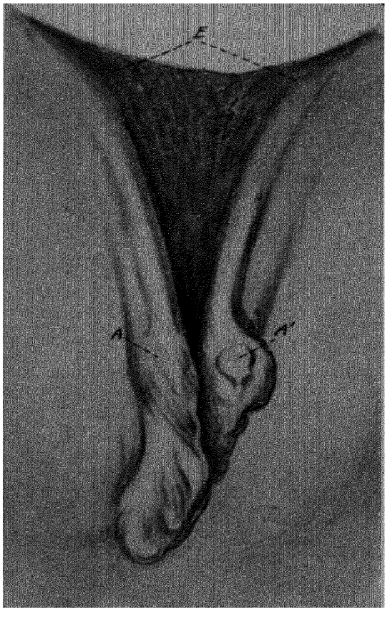


FIG. 101. EPISPADIAS. A-A', Hypertrophied nymphæ (*see* p. 312). E, Ununited pubic bones.

Whatever the degree of this lesion, it is usual to find that median fusion of the corpora clitoridis has not taken place, so that this organ is represented by two halves which lie on the respective sides of the open urethral groove (*see* Fig. 101). Separation of the two halves of the symphysis pubis may be present even in the milder forms of epispadias (*see* Figs. 101, E, and 102, E). When it occurs the chief feature of the lesion is the wide separation of the two halves of the clitoris and the labia. Figures 101, E, and 102, E, demonstrate the fact that in female epispadias nonunion of the symphysis may be present with a completely formed bladder and with the upper segment of the urethra intact. These illustrations show the wide separation of the external parts which results from the failure of the pubic bones to unite in the symphysis. This is a very rare form of epispadias. More commonly, separation of the symphysis pubis and absence of the urethral roof are associated with absence of the anterior wall of the bladder. The entire lesion is then spoken of as *ectopia vesicae*.

The clinical feature of even such a mild case of epispadias as that seen in Figure 101 is a very distressing form of incontinence of urine. The pubic hair and the labia become encrusted with phosphates. The surface of the vestibule is excoriated and the odour of stagnant urine is an offence to the patient and to her associates.

Before operating for epispadias it is necessary to keep the patient in bed, to remove the pubic hair and phosphatic deposits, and to bathe the

external genitals with a mild antiseptic lotion until the skin is restored to a healthy condition. Then a plastic operation such as that described on page 769 should be devised.

Ectopia Vesicæ. This is a very extensive developmental lesion due, according to Berry Hart, to a subsidence of the cloacal membrane, which is a plate formed by fusion of the ventral wall of the cloaca and of the ectoderm of the belly-wall, and which extends from the navel downwards. Reference to Figure 62, Cl.M. (p. 74), will show the extent of, and position of, this membrane.

The structures which are absent are (1) the anterior wall of the bladder and of a corresponding part of the anterior abdominal wall, (2) the symphysial junction, (3) the anterior wall of the urethra. The parts exposed

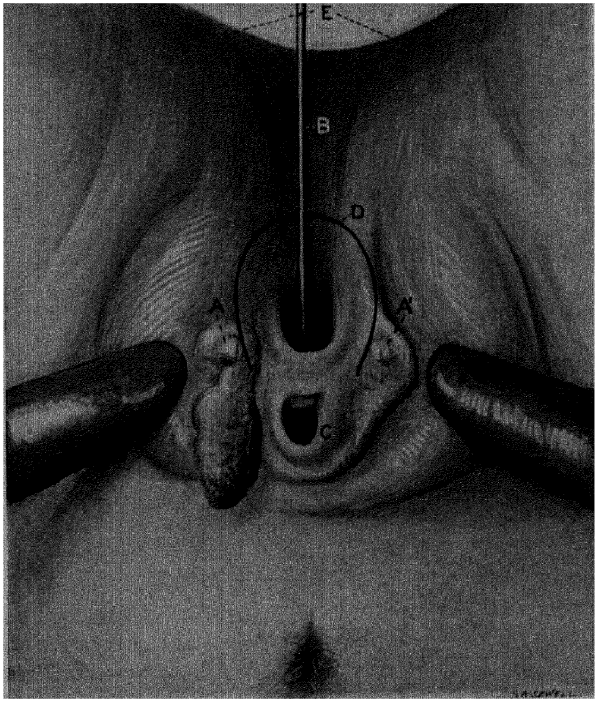


FIG. 102. EPISPADIAS. Same case as shown in Figure 101. Nymphæ (A-A') held apart to show absence of roof of urethra. B, Sound in urethra. C, Hymen. D, Horseshoe incision (*see* Operations, p. 69). E. Ununited symphysis.

are (1) the mucous membrane of the posterior wall of the bladder, (2) the orifices of the two ureters, (3) the floor of the urethra. The vulval aperture is thus continuous with the entire urinary mucous membrane of bladder and urethra.

Various repair-operations have been suggested for this extensive defect and the ureters have been transplanted into the rectum. The operative treatment of the condition usually falls to the general surgeon, and a text-book of general surgery should be consulted for details of the operation.

HERMAPHRODITISM AND PSEUDOHERMAPHRODITISM

A *hermaphrodite* is an individual in whom the sexual glands or gonads characteristic of both sexes (ovary and testis) are represented. The essential characteristic of true hermaphroditism is the presence of both ovary and testis, either separate or in the form of a combined gland, and although there have been a number of reputed instances recorded in children and adults, in the great majority it remains open to doubt whether they can actually be accepted as such owing to the inconclusive nature of the evidence offered. An instance has been recorded by Blacker and Lawrence in a fœtus of eight and a half months' development; a complete autopsy revealed on one side a uterus unicornis with an ovary and a Fallopian tube, and on the other a

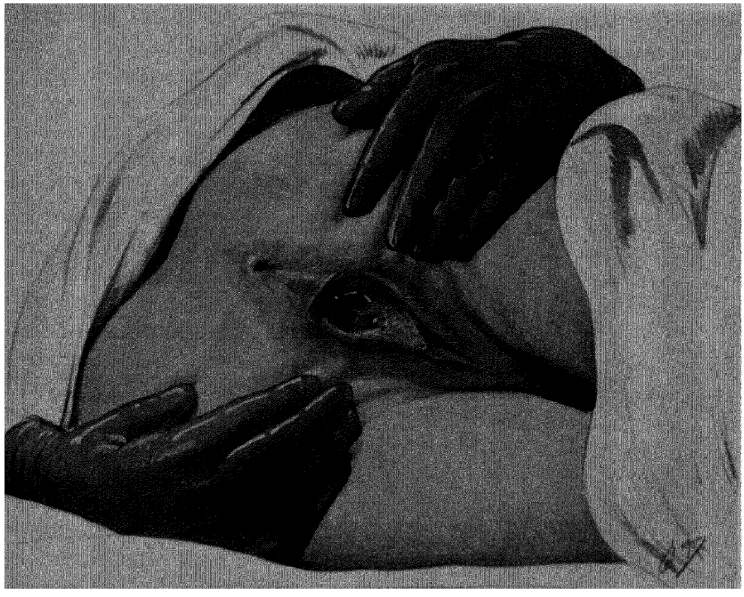


FIG. 103. A CASE OF MALE PSEUDOHERMAPHRODITISM, SHOWING THE EXTERNAL GENITALIA OF THE FEMALE TYPE. (Christopher Martin.)

combined gland (ovo-testis) with an enlarged Wolffian duct, representing the epididymis and vas deferens, and a malformed Fallopian tube (Müller's duct).

A *pseudohermaphrodite* is an individual with gonads characteristic of one sex, associated with external genitalia and secondary sexual characters resembling those of the opposite sex. This condition is not uncommon, and many undoubted examples have been recorded. Physiologically the sex of an individual is determined by the character of the gonads: strictly speaking, therefore, the condition under consideration is not hermaphroditism at all; indeed there can be no such state as 'false hermaphroditism.' While the name is inexact, the convenience of retaining it in use must in the meantime outweigh the desire for terminological exactitude.

It will be recollected that in a normally developed man the essential female sex-organs, with the exception of the gonads, persist in the form

of vestigial structures; thus the hydatid testis represents the remains of the Müllerian duct, and the prostatic utricle, the uterus. Again, in the normally developed female are to be found the epoöphoron and paroöphoritic tubules representing epididymis and paradidymis, the clitoris representing the phallus, and the clitoridian folds representing the foreskin. The sex having been determined by the formation of an ovary or testis in very early embryonic life, it is obvious that an aberrant course of later development might furnish the individual with some or all of the minor sexual organs of the opposite sex.

The arrangement may be still further complicated by the well-known tendency of malformations to be multiple; combined malformations of the external and internal genitals are quite exceptionally frequent. The effect of certain of these malformations is to cause the external genitalia to assume the outward appearance of those of the opposite sex. Thus *hypospadias* in the male is brought about by non-union of the lateral halves of the penile urethra and of the scrotum; the result is that the separated halves of the scrotum resemble the labia majora, and leave between them a space, upon the floor of which opens the urethra. The penis is imperfectly developed and of small size. If normally descended testes were present there would be little difficulty in recognizing the malformation, for the glands would be felt in the apparent labia. Frequently, however, non-descent of the testes is associated with hypospadias, and this greatly increases the difficulty of diagnosis. Thus an undoubted male may come to be regarded as a female, since in infancy sex is necessarily determined by examination of the external genitalia alone. Again, in a female, adhesion of the nymphæ may occur resulting in the forward prolongation of the urethra to the clitoris, the so-called 'clitoridian urethra'; this may be associated with hypertrophy of the clitoris, and double or single, labial ovarian hernia, when the *tout ensemble* will closely resemble the male genitalia.

In cases of malformation of the external genitalia, the major genital organs, in addition to the gonads, may be normally developed, *e g.* the uterus and tubes in the female, and the epididymis and vas deferens in the male. Pseudohermaphrodites with gonads of the male, and external genitalia of the female type, are known as *male pseudohermaphrodites* (*see* Fig. 103), those with gonads of the female and external genitalia of the male type, as *female pseudohermaphrodites*. The former are much commoner than the latter.

A further complication is introduced in cases of pseudohermaphroditism by the development of *secondary sex characters* at puberty. Thus in male pseudohermaphrodites (hypospadiac male) development of the mammæ may occur, the development of hair may be of the female type, psychosexual feeling may be for the male; and the individual may take the place of a woman in society and may even marry. In a few instances a scanty periodic hæmorrhage from the genitalia has also been observed. Yet the individual is an undoubted male. In the same way a female pseudohermaphrodite (female with hypertrophy of the clitoris) may develop male characteristics and play the part of a man even to the extent of marrying. The process of development of the secondary sex-characters is probably very complex and the facts suggest that the environment and training in childhood may have more to do with the matter than has been suspected.

When mistakes in sex have been made in infancy and are not discovered

until adult age has been reached, attempts to rectify the mistake are, generally speaking, inadvisable. The subjects of these malformations are necessarily sterile, and, of course, they should not marry. No operative treatment is practicable.

DISORDERS OF MENSTRUATION

In this section will be considered the following conditions :

(1) Amenorrhœa.
(2) Menorrhagia
(3) Dysmenorrhœa.
(4) Menstrual exfoliation.
(5) Intermenstrual pain.

AMENORRHŒA

Absence of the menstrual function is a natural condition before puberty, after the menopause, during pregnancy, and also, frequently, during lactation. This amenorrhœa of childhood, of age, and of reproduction, may be called *physiological* amenorrhœa. Another variety must also be specially distinguished, viz. that in which, owing to developmental faults, the menstrual discharge, although produced in normal amounts, is unable to find exit from the genital canal ; this variety is known as *cryptomenorrhœa* (concealed menstruation). It is obvious that this condition differs widely from true amenorrhœa, in which there is an absence of menstrual bleeding, *i.e.* the essential menstrual changes in the uterus do not occur. It is convenient to divide cases of true *pathological* amenorrhœa into two classes, viz. primary and secondary ; the former class consists of cases in which the menstrual function has never been established, the latter includes all cases in which it is suppressed under abnormal conditions. Cryptomenorrhœa will be most conveniently considered as a variety of primary amenorrhœa due to developmental defects.

PRIMARY AMENORRHŒA

This condition may be due to certain congenital defects, some of which are incurable, or to certain general disorders which, within limits, are capable of being cured.

I. **Developmental Causes**

(*a*) *Ovaries.* Absence or imperfect formation of the ovaries.
(*b*) *Uterus.* Under-development, *e.g.* the conditions *u. rudimentarius* and *u. infantilis* (p. 135).
(*c*) *Cervix and vagina.* Atresic conditions leading to cryptomenorrhœa.
(*d*) Deficiency or unstable equilibrium of endocrine secretions.

II. **Other Causes**

(*a*) *Delayed Puberty.*
(*b*) *Anaemia.*
(*c*) *Tuberculosis*, either general or affecting the uterus and ovaries.

I. **Developmental Causes.** These form an important and an interesting group of cases. Defects of the *ovaries* are very rare ; absence of one ovary does not necessarily affect the process of menstruation at all ; absence of

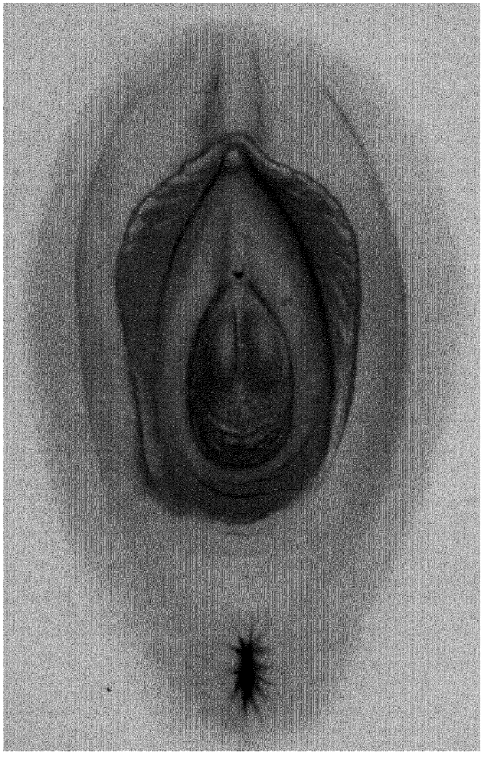
both ovaries is extremely rare except in certain forms of fœtal monstrosity incompatible with extra-uterine existence. Only by careful post-mortem examination can a diagnosis of this defect be established, for the ovaries may be misplaced and so remain unobserved during a clinical examination, or even a surgical exploration of the pelvis. A rudimentary condition of the ovaries in which no Gräafian follicles are present occurs, though rarely; it may be congenital, or may be the result of disease during infancy, and in either case it is, of course, incurable. Another condition, the existence of which is at present theoretical, may also possibly occur, viz. defect or deficiency of the internal ovarian secretion. To this condition the name of *hypo-oöphorism* has been applied.

In the *rudimentary uterus* the organ is represented by a small fibrous body which is usually solid, but may contain a rudimentary cavity. In the *infantile uterus* the organ retains its fœtal characters, viz. relatively small size of the body and large size of the cervix (*see* Fig. 20, p. 26), but a cavity lined with a mucous membrane is always present. The former causes complete and incurable amenorrhœa; in the latter, development sometimes progresses to a certain extent leading to an imperfect menstrual function. It is possible that if a case of infantile uterus were recognised at or soon after puberty, the regular and prolonged administration of pituitary, mammary, and thyroid gland preparations might be serviceable in promoting the secon dary development of the uterus; they should certainly be given a full trial, each being administered separately or in combination with the others. As a rule these cases do not come under observation until long past the age of puberty, when the favourable opportunity for treatment has passed.

Another possible developmental cause of primary amenorrhœa must be mentioned, viz. defects of other endocrine bodies. The only defect of this kind which has received much clinical attention is *cretinism*, resulting from imperfect development of the thyroid gland. This condition is commoner in girls than in boys, and leads to marked deficiency in mental and bodily growth. Amenorrhœa is a frequent, but not by any means an invariable symptom, and when present it may be attributed, like the other features of the condition, to absence of the thyroid secretion. Cases of partial, primary amenorrhœa in which menstruation is scanty and occurs only at rare intervals are seen sometimes in girls who present certain indications of hypothyroidism. They are fat, lethargic, and coarse-featured, although in other respects well developed. The dependence of such a condition upon thyroid defect is highly probable.

Cryptomenorrhœa. For the production of this condition it is necessary that the essential organs of menstruation, viz. uterus and ovaries, should be well developed, and that some cause of obstruction should be present in the lower part of the genital canal which prevents the escape of the menstrual discharge. The obstruction may be found in any part of the canal below the internal os, the commonest situation being the *ostium vaginae*. The pent-up menstrual discharge will distend the canal above the site of the obstruction; thus, in obstruction at the vulva, the vagina may become enormously distended; and in the presence of very large quantities of fluid the uterus also may fill up, and overflow may occur into the Fallopian tubes. Blood in the tubes leaks at first into the peritoneal cavity, but later the abdominal ostia become occluded, and accumulation also takes place in the tubes, which may become more or less markedly dilated.

PLATE IX



IMPERFORATE HYMEN: HÆMATOCOLPOS. The obstructing membrane is pinkish in colour and presents a low median raphé.

To face page 151.

The commonest site of obstruction is the ostium vaginæ; the middle third of the vagina and the cervix are occasional sites, but in comparison with the first-named they are very rare. At the ostium vaginæ the lesion usually takes the form of an obstructing diaphragm, to which the name of *imperforate hymen* is applied. Under this designation are probably included two different conditions; both are characterized by the presence of a membranous diaphragm in the position of the hymen, closing the lower end of the vagina; in other respects the vagina and vulva are normally developed Thus the obstructing diaphragm may be formed, either by a septum representing the lower end of the imperforate Müllerian duct, or by non-perforation of the hymen, which then forms a complete transverse septum. It will be recollected that the hymen is developed from the Müllerian bulbs [1] which lie at the sides of the lower end of the Mullerian duct. In the first-named form of occlusion a normal hymen may be found lying behind and beneath, *i.e.* external to, the obstructing membrane; in the second variety no trace of the hymen can be found apart from the obstructing membrane. The membrane can be readily seen on separating the labia. It is pinkish in colour, like the adjacent mucous surfaces, and often presents a low median *raphe* (*see* Pl. IX). Its thickness is variable, and the thinner varieties being semi-translucent, allow the dark colour of the blood filling the vagina to show through. Usually the membrane bulges slightly, and there is a distinct impulse on coughing. The structure of the membrane can be determined by taking a portion for microscopic examination and cutting sections at right angles to its surface. The nature of the epithelial covering is the point to which attention should be directed. The external surface is in all cases covered with stratified squamous cells of the same type as those of the vagina, the internal surface may show traces of columnar epithelium; and, according to Blair Bell, it does so in over 50 *per cent.* of cases. In some instances this epithelium forms a well-developed layer with small glands. Such cells indicate that the membrane has been formed from the Mullerian duct, at any rate in part, for the hymen itself never possesses columnar cells. If the membrane is covered with squamous cells on both surfaces it is a true imperforate hymen; if columnar cells are found on the inner surface, the Müllerian duct has not been canalized at its lower extremity.

Occasionally occlusion of the ostium vaginæ results from vaginitis in infancy, leading to adhesion of the apposed surfaces; this form of occlusion is usually incomplete and does not lead to concealment of menstruation (*see* Fig. 96). Sometimes occlusion of the vagina or cervix may be acquired in adult life as the result of sloughing and subsequent cicatricial contraction; but this again seldom leads to the occurrence of cryptomenorrhœa.

The accumulated menstrual blood distends the whole vagina (hæmatocolpos), which may become gradually dilated until it contains from two to three pints of fluid. A large hæmatocolpos forms a dome-shaped swelling, palpable *per abdomen*, which may reach as high as the umbilicus, may fill the entire pelvic cavity compressing the rectum, and may even produce a certain amount of dilatation of the anal canal. The uterus, and with it the tubes and ovaries, become elevated, and can often be felt on external examination riding upon the summit of the abdominal swelling (*see* Fig. 104). As the anterior vaginal wall stretches, the urethra becomes elongated, while the bladder is carried upwards until it becomes wholly an abdominal organ.

[1] See footnote on page 76.

The lower part of the cervical canal is not uncommonly found dilated, but accumulation of menstrual blood in the uterus or the Fallopian tubes is only rarely met with. The possibility of this occurrence must, however, be borne in mind, for its clinical importance is considerable.

Clinical Features. The condition here described occurs in girls of about fifteen to eighteen years of age. The rate of accumulation of the fluid varies according to the amount of the menstrual flow. When the retained fluid accumulates slowly, no symptoms beyond the non-appearance of menstruation may be present, and the age of seventeen or eighteen may be attained before attention is directed to the state of affairs. When rapid accumulation occurs, periodic attacks of abdominal pain are generally met with, and such cases come under observation at an earlier age. The attacks of pain appear to correspond with the menstrual epochs, and are no doubt due to fresh hæmorrhage producing a rapid increase in tension in the already distended vagina. They do not, however, necessarily occur every month, but at more or less prolonged and irregular intervals. Coincident rise of temperature is sometimes observed. Gradual enlargement of the abdomen is noticed in the chronic cases, and sometimes, though this is rare, there may be occasional attacks of retention of urine, which are explained by the changes in the bladder and urethra already mentioned.

On abdominal examination a dome-shaped, elastic, fixed swelling may be felt in the hypogastric region, on the convex summit of which is a solid movable body which represents the uterus. The bladder, if distended, covers its anterior aspect; when this organ is empty the swelling is subresonant on percussion, owing to the presence of coils of intestine between it and the abdominal wall. On vaginal examination the labia will be found normal, and the characters of the obstructing membrane are easily seen. The perineal body may bulge, and in cases of extreme distension of the vagina the anus may become slightly relaxed. On rectal examination the finger will detect a tense swelling more or less completely filling the pelvic cavity, and perhaps compressing this part of the bowel.

Congenital vaginal atresia resulting in retention of menstrual fluid is much less common than occlusion at the vulva. Vaginal atresia is more often associated with other defects, incompatible with the establishment of the menstrual function, than is imperforate hymen, and accordingly these cases do not present the same clinical features. Atresia of the lower third of the vagina may, however, result in the formation of a hæmatocolpos, the lower end of which is separated from the vulval *cul-de-sac* by a septum of fibrous tissue of variable depth. Atresia of the upper part of the vagina will only result in retention of blood in the uterine cavity, if the development of the uterus and ovaries is normal.

Congenital atresia of the cervix is a rare condition; it is sometimes met with in cases of duplication of the uterus (*see* p. 140), when the exit from one division of the uterine cavity may be obstructed, leading to the formation of a hæmatometra which exists side by side with a normal uterus. Unless the duplication of the organ has been detected, this form of hæmatometra is very difficult to recognize clinically, for menstruation may proceed normally from the other half of the uterus. *Acquired cervical atresia* is even rarer than this, and is seldom seen except as the result of a plastic operation on the cervix such as amputation.

Treatment of imperforate hymen consists in incising the obstructing

membrane under anæsthesia with strict antiseptic precautions, the incision being made with either knife or thermo-cautery. The retained fluid is dark red or reddish-brown in colour, and viscid in consistence ; it flows slowly away, and owing to its viscidity it is difficult, even with the aid of the douche, to remove it completely. The remains of the hymen are then clipped away with scissors and the edges sewn over with catgut. As soon as the vagina is empty a careful bimanual examination should be made, and the degree of patency of the cervix, the size of the uterus, and the condition of the Fallopian tubes made out. If no accumulation in the uterus or tubes has occurred, the vaginal canal should be cleansed as thoroughly as possible with the douche, a sterile, alkaline solution being the most useful in removing the sticky fluid from the vaginal walls. During the next week great care is

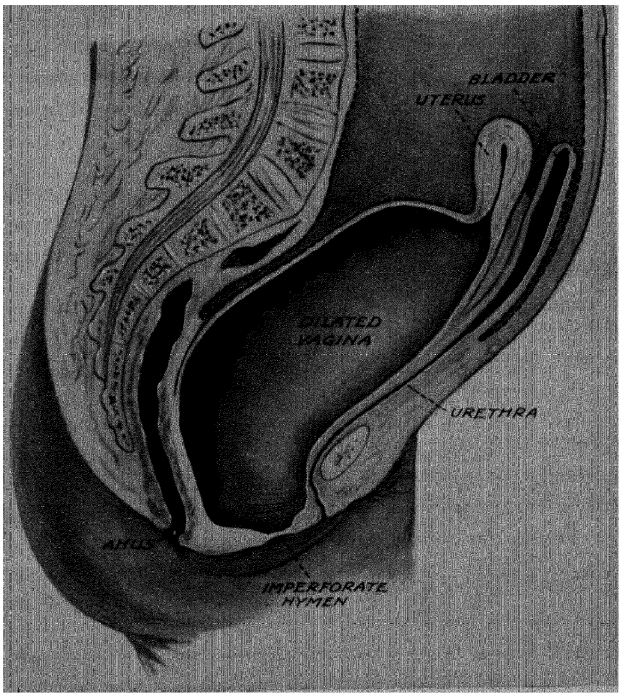


FIG. 104. HÆMATOCOLPOS (shown diagrammatically), after Cullingworth. The cervical canal is also dilated up to the level of the internal os. Note the elongation of the urethra and the elevation of uterus and bladder.

called for in keeping the vulva surgically clean, and in receiving the discharge into pads of antiseptic wool.

If accumulation of menstrual fluid in the *uterus* has occurred it will flow away spontaneously in time ; the uterine cavity should not be douched, owing to the risk of passage of the douche-fluid into the tubes if these have become at all patulous. The risks of sepsis are much increased when there is hæmatometra, for it is impracticable to keep the vaginal canal sterile for long, and if pathogenic organisms obtain entrance, the conditions are peculiarly favourable for the development of an ascending infection.

If the *tubes* are found to be dilated, abdominal section should be immediately performed, and the condition of the tubes carefully examined. The ideal procedure is to open the sealed tubes, emptying them of blood, and construct an artificial abdominal ostium (*see* p. 696). It may, however, be necessary to remove the tubes. The ovaries should be left, as they are in practically all cases healthy.

II. **General Causes of Primary Amenorrhœa.**

(*a*) *Delayed Puberty.* In this condition absence of the onset of menstruation is associated with absence, or imperfect completion, of the changes which are normally found at the epoch of puberty (*vide* p. 77). Thus the mammæ remain rudimentary, the pubic hair and the supra-pubic pad of fat (*mons Veneris*) do not appear, the labia majora do not become hirsute, and remain thin and slightly gaping in the middle line, allowing the nymphæ to appear. The age of twenty to twenty-five years may be attained before sexual maturity is reached, but unless some gross developmental defect is present the ultimate development of the individual will be normal.

Overwork, both mental and physical, is said to delay the onset of puberty, but nothing definite is known at present upon these points. Gross developmental defects, such as cretinism, in their lesser degrees, may delay, without altogether inhibiting, the occurrence of puberty.

(*b*) *Anaemia* in severe forms may inhibit the onset of menstruation which, however, will appear when the condition is cured.

(*c*) *Tuberculosis* of the lungs in its advanced forms, and in many cases abdominal tuberculosis also, are associated with delay at the onset of menstruation. In the latter case the explanation may lie in destruction of Graafian follicles by the disease or in advanced changes in the endometrium.

Treatment of Primary Amenorrhœa. When the average age of onset of menstruation has been exceeded by two or three years, a careful investigation of the case is called for. The condition of the general health, the presence of the changes characteristic of puberty, and the general development, are the first points to consider. If this part of the examination is negative a local examination is required, and this should be conducted under anæsthesia if inspection shows that the vulva and ostium vaginæ are normal. The defects which have just been considered should be looked for one by one, and the prognosis depends entirely upon the nature and degree of the defect which may be present.

Anæmia and tuberculosis call for the treatment appropriate to these conditions; deficiency of thyroid activity may be treated by the administration of full physiological doses of thyroid gland, the effects of which must be carefully watched. There are no *specific* remedies for primary amenorrhœa.

SECONDARY AMENORRHŒA

Causes.

I. General debility from:
   - (*a*) Acute illness.
   - (*b*) During convalescence from illness or operation.
   - (*c*) Late stages of chronic disease, such as chronic nephritis, diabetes, tuberculosis, malaria, cancer.

II. Severe form of anæmia.

III. Some form of chronic poisoning, *e.g.* alcohol, lead, morphia: other forms of the drug-habit.

IV. Disorders of the nervous system · nervous shock, overwork, hysteria, insanity.
V. General conditions, such as change of climate, imprisonment, etc.
VI. Obesity, when rapidly advancing.
VII. Chill.
VIII. Disorders of certain endocrine bodies, *e.g.* thyroid.
IX. Local conditions :
(*a*) Obliteration of the uterine cavity—as from sloughing.
(*b*) Uterine atrophy, *e.g.* lactational atrophy.
(*c*) Bilateral solid ovarian tumours.
(*d*) Surgical removal of the uterus or both ovaries.

Any well-marked loss of vitality, either from acute illness or from chronic wasting disease, is usually accompanied by a temporary suspension of the menstrual function. The list given above is capable of considerable expansion, the instances mentioned being cited as examples only. There is probably no specific influence exerted on menstruation by extra-pelvic disease ; it appears rather that the menstrual function is one which may be readily arrested by marked depression of the level of the general health. It follows that no *specific* treatment is required, for restoration of health invariably results in the reappearance of menstruation.

Although all severe anæmias are usually accompanied by amenorrhœa, *chlorosis* is particularly liable to produce this effect. This condition was formerly one of the commonest causes of amenorrhœa in girls of sixteen to twenty-five years of age. It appears, however, that in recent years this condition has become much rarer, and according to Clifford Allbutt it has practically disappeared, probably as the result of the better hygienic conditions under which children and adolescents now live. Owing to the exaggerated importance attached to cessation of the menses, these cases frequently come first under the notice of the gynæcologist, but specific treatment of the amenorrhœa is unnecessary, for when the anæmia is cured the menstrual function will spontaneously reappear. The treatment consists, therefore, in attention to the teeth and the condition of the digestive organs, the correction of constipation, and the administration of iron and arsenic internally ; fresh air, good food, and cessation from work are most useful adjuncts.

Advanced stages of chronic poisoning by alcohol and lead, or of morphinism, characterized by profound disturbance of nutrition, are usually attended by amenorrhœa. Occasional alcoholic outbreaks often lead to menorrhagia, but habitual and long-continued tippling produces amenorrhœa.

Obesity is a fairly common accompaniment of amenorrhœa, but we have no knowledge of their inter-relationship. Such nervous disturbances as severe fright and hysteria may lead to prolonged periods of suspension of menstruation ; as also may changes of environment, such as imprisonment or extreme changes of climate.

The local pelvic conditions mentioned in the list will not be here described, as they will come up for consideration in later sections.

It must be added that a certain number of cases of secondary amenorrhœa occur for which no explanation can be discovered. Sometimes such cases eventually declare themselves as instances of a premature menopause (p. 91) ; in others, after much apparently fruitless treatment, the menstrual

function reappears and thenceforth pursues a normal course. In other cases, although menstruation recurs at prolonged intervals, it never regains the normal monthly periodicity. In the latter cases the general health may continue satisfactory, and one or two children may be borne, although these women seldom show a high degree of fertility.

In a certain number of cases of amenorrhœa, some of the attendant symptoms of menstruation may appear at the time corresponding to the menstrual epochs; these symptoms are then described as the *menstrual moliminia* (*molimen* = effort). Thus headache, pelvic pain, backache, and nausea, lasting for a day or two, may be complained of, and, perhaps,

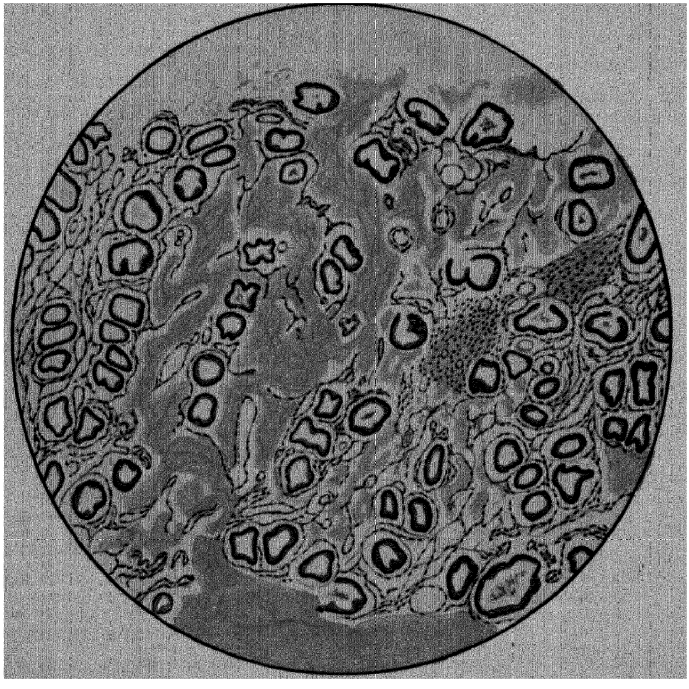


FIG. 105. CORPOREAL ENDOMETRIUM FROM A CASE OF FIBROMYOMA UTERI WITH MENORRHAGIA. Showing the formation of large blood-lacunæ which extended through the whole thickness of the mucosa down to the muscle.

recognized by the patient as being similar to the troubles she experienced previously in connection with menstruation.

Treatment of Secondary Amenorrhœa. Amenorrhœa must, as a rule, be regarded as a *symptom*, not as a disease; treatment should, therefore, be directed to the underlying morbid condition, the successful management of which has the indirect effect of restoring the menstrual function. The class of drugs known as *emmenagogues*, to which is attributed a specific influence in exciting menstruation, are disappointing in their effects, and indeed generally prove useless; none of them can with any confidence be recommended, but the following are harmless, and have sometimes, in the opinion of certain observers, proved useful. Apiol (essential oil of parsley; dose, 2–5 minims), either alone or in conjunction with ergot as *ergo-apiol;* manganese in the form of permanganate of potash (dose, ½–2 grains); aloes in

mild laxative doses; corpus lutuem or thyroid may also be given, in the form of tabloids, on the supposition that the amenorrhœa may be due to deficiency of the thyroid or ovarian secretions. The drug that will be found most serviceable is iron, either alone or in combination with arsenic; even when there is no apparent anæmia, this combination will often prove successful after regular use for several weeks. The advantages, in difficult cases, of giving these drugs by deep intra-muscular injection must not be overlooked. In some cases the use of ferruginous natural waters may succeed where direct medicinal treatment has failed. Constipation must in all cases be carefully controlled. In cases where molimina are present, hot hip-baths, taken when these symptoms appear, may be tried. The internal use of electricity is not to be generally recommended; exceptional conditions in which it may be employed are cases of lactational atrophy or of infantile uterus.

MENORRHAGIA: PROFUSE MENSTRUATION

This condition has already been dealt with in connection with the symptom of hæmorrhage from the genital canal (p. 112). No further general discussion is therefore required.

It is impossible to fix an arbitrary standard of the amount of bleeding which constitutes normal menstruation, and, consequently, profuse menstruation is difficult to define. It must be considered mainly in relation to two points, viz. the general effects, if any, produced by the monthly losses of blood, and the amount of increase above what is the average for the individual in question. These are the true criteria of excessive loss.

It must, however, be borne in mind that profuse menstruation may take the form of abnormal *frequency* instead of abnormal *amount*. Thus, a woman who usually menstruates five days every four weeks ($\frac{5}{28}$), may menstruate for the same number of days every three weeks ($\frac{5}{21}$). The name of *epimenorrhœa* has been suggested for this condition by Blair Bell. In many marked cases of profuse menstruation there is an increase both in amount and in frequency.

In cases of profuse menstruation some modification often occurs in the endometrial changes, as will be seen by comparing Figure 105 with Figure 70, page 82, which represents normal menstruation. These changes consist in the formation of large blood-lacunæ which may extend through the thickness of the mucous membrane down to the muscle.

DYSMENORRHŒA: PAINFUL MENSTRUATION

A certain amount of pain usually accompanies menstruation even in women of normal health; only a very small proportion of the women of civilized races menstruate absolutely painlessly. A degree of pain which incapacitates the patient for a shorter or longer time from following her usual avocations is definitely abnormal and may be designated *dysmenorrhœa*. Excessive pain in menstruation may be due to some disturbance of the menstrual process itself, or to some disease of the uterus or other pelvic organs, which is a source of pain independent of menstruation, and incidentally makes the menstrual process abnormally painful also. In the latter case dysmenorrhœa is *secondary*, and should be regarded as a symptom of the morbid condition to which it is due. In the former case the dysmenorrhœa is *primary* or *intrinsic*, and in the menstrual intervals the patient is free from all symp-

toms; it is clearly of much greater clinical importance than the secondary form.

Sources of Pain in Menstruation. We must first consider with regard to the primary form what are the factors in the menstrual process which may possibly become sources of pain, and with regard to the secondary form what morbid conditions of the pelvic organs are likely to make menstruation abnormally painful.

(*a*) *Uterine Contractions.* The part played by contractions of the uterine muscle in menstruation has been already explained (p. 86); efficient contraction is necessary to dilate the cervix, to expel the menstrual fluid into the vagina, and finally to assist in arresting the bleeding. Under normal conditions these contractions are probably rhythmical and not extremely painful. In some cases they may become spasmodic or tetanic, and, as is the case with cramp in voluntary muscles, severe pain will be produced.

Spasmodic contractions may result either from faulty innervation, from inadequacy of the uterine musculature, or from the presence of some obstruction to the outflow of blood through the cervix.

Of the existence of faults in the *innervation of the uterus* nothing is definitely known. *Inadequacy* of the uterine muscle has been shown to exist in congenital under-development of the uterus, not only in the extreme form known as the infantile uterus, but in much less marked cases of abnormally small uteri. The proportion of muscle to fibrous tissue is low, and perhaps the arrangement of the fibres is also abnormal. To fulfil its menstrual function an abnormal effort will be required from such a uterus, and the contractions will become tetanic and extremely painful.

The existence of a *partial obstruction* would also induce an abnormal uterine effort. Such partial obstructions undoubtedly exist in the form of an abnormally acute bend at the isthmus of the uterus, an abnormally small external os uteri (*pin-hole os*), or a fibroid polypus blocking the cervical canal. Yet clinical evidence clearly shows that all these conditions do not of themselves cause dysmenorrhœa, but when associated with inadequacy of the uterine muscle they are undoubtedly important. The obstacle they offer to the dilatation of the cervix and the expulsion of the menstrual blood can be overcome by a uterus of normal strength, but seriously embarrasses a congenitally weak organ. In the older nomenclature such cases were called *obstructive dysmenorrhœa*, but the true view is that the obstruction is too slight of itself to influence appreciably the menstrual process; it is of importance only when associated with muscular deficiency. Clinical experience shows that the most severe cases of primary dysmenorrhœa are those in which an abnormally small uterus is also acutely *flexed* or has an abnormally small os externum.

(*b*) *Intra-uterine* Clotting. Under normal conditions the probability is that menstrual blood does not coagulate in the uterus. The reasons for this have been already referred to (*see* p. 84). Women who menstruate freely, however, usually notice that clots are passed in the menstrual discharge, and these may be of large size when bleeding is excessive. They are formed in the vagina in almost all cases, and their expulsion is not necessarily attended by unusual pain. If, under abnormal conditions, large clots should be formed in the uterus, their expulsion through the cervix would undoubtedly cause great pain. In the severest known cases of dysmenorrhœa it is unusual for such clots to be passed, and there is no clinical evidence that they are an

important cause of menstrual pain. At the same time some women assert that bouts of severe pain in menstruation are often greatly relieved after clots have been passed, and it is, therefore, possible that intra-uterine clotting may be an occasional cause of dysmenorrhœa, but it must be regarded as of secondary importance in the production of pain.

(*c*) *Vaso-motor Disturbances.* General pelvic congestion forms an integral part of the menstrual process ; under normal conditions it is not of sufficient intensity to cause much pain, but the slight symptoms of the pre-menstrual phase may be due to it. An extreme degree of congestion would necessarily cause great pain, and might possibly be induced either by abnormal activity of the menstrual hormone, or by local pathological conditions. Of the former there is no direct evidence ; of the latter there are numerous clinical examples. Inflammatory conditions, uterine displacements and uterine tumours all cause circulatory disturbances which take the form of local or general pelvic congestion. When the vaso-dilator action of the menstrual hormone is exerted upon the pelvic circulation in pathological conditions, the resultant effect may be an extreme degree of congestion sufficient to produce severe pain which can only be relieved by the local depletion produced by the menstrual hæmorrhage, together with the cessation of the action of the menstrual hormone. These are the cases which were formerly described under the name of *congestive dysmenorrhœa :* the dysmenorrhœa is, however, as already pointed out, not a primary disorder but a symptom of another morbid condition.

Clinical Types of Dysmenorrhœa. There is no agreed classification of dysmenorrhœa, and it is almost beyond the wit of man to devise one which is not open to the most destructive criticism. We may, however, proceed by defining three common types.

I. In this type dysmenorrhœa is only a symptom of definite pelvic disease. This form has been variously called *secondary* or *acquired, congestive,* and *extrinsic* dysmenorrhœa , it does not really matter what we call it, for the dysmenorrhœa is only an incident in the course of certain morbid processes in the pelvic organs.

This type of case is very familiar. After menstruating normally and without undue pain for perhaps many years, the patient begins to suffer severe pain, usually accompanied by increased loss and by other symptoms of pelvic disorder which are present in the menstrual intervals. The advent of dysmenorrhœa is due to the formation of a pelvic lesion, the commonest examples being (*a*) inflammatory affections of the tubes and ovaries often associated with retroversion, (*b*) hæmorrhagic cysts of the ovary (endometrioma) which usually become densely adherent, (*c*) an interstitial or submucous fibroid tumour. These conditions may of course all occur in married or unmarried women alike, and those who are either childless or mothers. The presence of these lesions influences the menstrual process mainly by exaggerating the pelvic congestion which always precedes and accompanies menstruation. In the case of the fibroid the muscular contractions of the uterus may become spasmodic from attempts to expel the foreign body.

Although other pelvic symptoms are usually present, it is for the menstrual pain that the patient seeks advice. Clearly all such cases require a detailed pelvic examination, and it is not wise to undertake their management until this has been done.

This form of dysmenorrhœa is satisfactorily explained by the presence of the extrinsic lesion; the pain is seldom really acute, and it cannot be successfully treated otherwise than by removal of the causal conditions. Measures necessary for the actual relief of pain will be referred to later on and are the same for all forms of dysmenorrhœa.

II. In this type the patient has had dysmenorrhœa from the onset of puberty or from the early years of womanhood, and in the menstrual intervals she is entirely free from pelvic symptoms. This variety is variously called *primary* or *idiopathic*, *spasmodic*, and *intrinsic* dysmenorrhœa; it comprises practically all the really severe cases of dysmenorrhœa that we meet with. In this class we can distinguish two varieties.

The *first variety* is represented by women who are anæmic, constipated, badly fed, and take little or no exercise. They have a few days of discomfort in the week before the period, followed by one to three days of severe suffering, in which it is difficult or impossible to continue at work; the amount of loss is usually moderate or scanty, and they recover quickly from their indisposition. It is quite exceptional to find any pelvic cause for this type of dysmenorrhœa, which appears to be mainly due to general ill-health. When a case first comes under observation, it is not necessary for a pelvic examination to be made, for experience shows that treatment directed to improvement of the general health will in nearly all cases also result in a great degree of relief to the menstrual suffering. In addition to the treatment of anæmia and constipation, we must not overlook the value in these cases of physical exercise; it is difficult to get girls to do dumb-bell exercises or use light Indian clubs, but dancing is universally popular and is within the reach nowadays of most classes of patients. There is no better indoor exercise, but outdoor games, or walking, should always be preferred if possible.

The *second variety* is often represented by women of artistic or literary tastes, sedentary in habits, and often introspective or self-centred in their psychological outlook. These patients are often well cared for and in good average health, but they pass through a period of the most intense suffering every month. Subconscious exaggeration no doubt plays a part, and when they begin to anticipate the return of the attack of pain, anxiety and dread step in to complete the picture of mental and physical distress.

This distinguishing feature has led some psychiatricians to declare that dysmenorrhœa is nothing but an " anxiety neurosis " and should be treated as such. Without subscribing to this view, it is clear that there is no class of case which calls for more careful and sympathetic handling.

In these cases a fairly clear syndrome of symptoms can usually be recognised. In addition to pain in the lower abdomen and back, general malaise is very marked during the pre-menstrual phase; a few hours after the period has started comes headache, often hemicranial in character, accompanied by nausea or vomiting, or often both, and frequently by more or less open manifestations of hysteria. Paroxysms of acute spasmodic abdominal pain supervene, and twenty-four hours or more of this kind of suffering leads to complete exhaustion. Sometimes rectal or vesical spasm also occurs, leading to tenesmus of a very severe character. In this complex picture it is often difficult to distinguish between that which is the outcome of disorder of function and that which is the result of the uncontrolled reaction of a highly sensitive nervous system.

In cases of this type it is by no means uncommon to find a local pelvic condition which is either the sole cause, or at least, a contributing cause, of the dysmenorrhœa. The commonest pelvic condition is a moderate degree of hypoplasia of the middle portion of the genital tract, *i.e.* the uterine body, the cervix, and the upper parts of the vagina. The whole uterus may be small and acutely flexed—usually anteflexed, but occasionally retroflexed. This is commonly called the *cochleate uterus*, but would perhaps be better named the "small flexed uterus." The cervix is undersized, sharply curved, and often more or less pointed or conical instead of being nearly cylindrical in contour, and naturally the external os is also smaller than normal. Our predecessors called it the("conical" cervix with "pin-hole" os externum, and the dysmenorrhœa was attributed to the mechanical hindrance to outflow caused by the sharp uterine bend and the narrow cervical canal. It is necessary, however, to take a broader view of the matter than this. There is good reason, as we have seen, to believe that the hypoplasic uterus is abnormal in structure as well as in form. It is a feeble uterus, and the expulsion of the menstrual blood calls for an excessive effort which takes the form of acutely painful spasmodic contractions to which the paroxysms of abdominal pain are mainly due. The uterine bend and the small calibre of the cervical canal naturally add to the difficulties of the feeble uterus.

A minor form of uterine hypoplasia must be recognized in which the uterus is small but not flexed; often it is retroverted, the *portio* is short but otherwise of normal characters, and the vaginal fornices are cramped instead of being relatively spacious or roomy. Suffering may be almost as severe with this uterus as with the other form.

Sometimes women of robust health, and given to athletic pursuits, suffer severely from slight developmental errors leading to this form of dysmenorrhœa, but such cases are rare.

III. A third type must be recognized, viz. that in which the general health is good and the pelvic organs are normally developed; some other factor in the menstrual process being at fault. Thus some women pass membrane at their periods, which is the result of massive exfoliation of the endometrium, the discharged pieces varying from small, narrow, rolled slips, to large pieces representing one half or even the whole of the uterine wall. Still others pass complete casts of the uterine cavity consisting solely of blood-clot. There is no satisfactory explanation of the occurrence of these abnormal features of menstruation. It must be borne in mind, however, that small pieces of membrane are occasionally passed without much menstrual pain; it is, therefore, possible that when exfoliation does accompany dysmenorrhœa, it is not the essential cause of the condition.

Apart from the formation of blood-casts, intra-uterine clotting does sometimes occur, and is a contributory factor of some importance. The greater number of clots passed during menstruation are formed in the vagina, and are discharged without pain. Sometimes the severe pain continues until after a clot has been discharged, when it is at once greatly relieved. Clotting in the uterus is probably to be explained by the hypothesis that the blood is effused too rapidly to be maintained in its liquid state by admixture with the mucous secretion of the glands. The expulsion of an intra-uterine clot through the cervix provokes excessively painful contractions which are relieved by its discharge.

In another variety of this type it is possible that the internal secretions

are at fault. Modern views of the nature of menstruation regard it as a very complex process in which, in addition to the ovarian and uterine periodic changes, other factors are probably concerned. The endocrine system generally is believed to play a part in the regulation of the menstrual process, and at present we can only guess at the part which is taken, or may be taken, by individual endocrine bodies. Clearly an internal ovarian secretion, abnormal in quantity or in quality, may result in painful menstruation. Further, it is quite possible that a general disturbance of endocrine function, or of the balance of endocrine function, may influence menstruation in the direction of making it an unduly painful process. Nothing further can be said than that this is a plausible hypothesis to account for cases of dysmenorrhœa for which no other explanation can be found.

Treatment of Dysmenorrhœa. *Preparatory* measures will often succeed in relieving the severity of the pain during the period, especially in the case of women who are in indifferent general health, are constipated, over-worked, or over-excited. A mild aperient taken daily for a week before menstruation is useful in all cases, and enemata are indicated in difficult cases of constipation. A hot mustard bath before going to bed each night in the same week is another very useful measure for reducing pre-menstrual pelvic congestion. A late night or the more strenuous forms of exercise, on the day before menstruation begins, will often result in an attack of exceptional severity.

Generally speaking, severe cases of dysmenorrhœa are confined to bed or bedroom (for some insist that they suffer more when lying down than sitting up), for one to three days. Every patient discovers for herself that a hot-water bottle will give her a certain relief from the abdominal pain, but there is no doubt that hot fomentations frequently renewed are much more effectual than dry heat. The application of radiant heat to the whole of the trunk may be useful.

Those who suffer from the hemicranial syndrome should be kept perfectly still in bed in a darkened, and if possible, a quiet room, so as to cut off external stimuli as much as possible. It would be better to withhold food entirely during the acute stage, even if this be prolonged to forty-eight hours, for it is practically certain that the digestive processes will be in abeyance during the period of acute suffering. Water or barley-water can be given freely, and its diuretic effect will be valuable. When the environment is a favourable one, we can administer analgesic remedies with some hope of success; but it is of little use to give such drugs unless the patient can rest quietly while its effect is developing. Each member of the class of synthetic analgesic remedies is at times successful when others fail, and it may be necessary to give a trial to more than one before discovering what is best suited for an individual case. Antipyrin, phenacetin, pyramidon, or ammonal are the most useful, and they act better when given with a draught of hot water or a little sal volatile. A newer preparation than those just mentioned, viz. benzoate of benzyl, is well spoken of by American writers; it is given in 20 m. doses of a 20 *per cent.* alcoholic solution, repeated as may be required.

Occasional cases are encountered so severe that this class of remedy fails entirely: further, these drugs tend to lose their effect under repeated usage. Resort must then be had to opium in some form, for it is still the most reliable drug we possess for the relief of pain. It is better to avoid its administration by the mouth, and if possible by the hypodermic needle also.

Women of the mental type usually associated with severe dysmenorrhœa are precisely those who need to be most carefully guarded against opportunities of acquiring the drug habit. We can give morphia in the form of rectal suppository very conveniently in these cases ; it acts well, and although its effect is much more slowly produced than when given hypodermically, it is not a method of drug taking which ever becomes a " habit."

The use of atropin in dysmenorrhœa has now been tried sufficiently to ensure it a useful place in our therapeutics. It is begun on the day before menstruation, given orally in small doses of $\frac{1}{100}$ gr. twice a day, and pushed until the early symptoms of belladonna poisoning, such as dryness of the mouth, dilatation of the pupils, and some feebleness of accommodation have appeared. Its action on plain muscle is to reduce its activity and eventually to paralyse it ; its effect on the uterus is therefore the converse of that produced by calcium salts. It also relieves pain. In cases of dysmenorrhœa which are free from the associated hemicranial symptoms, atropin appears to be most useful, and although no remedy will succeed in all instances, it well deserves a trial. It can be employed where pain is not so severe as to necessitate confinement to bed or couch, and can be conveniently administered in tablet form

Operative Treatment. Many cases will prove refractory to medicinal and hygienic treatment, and we are then driven to attempt to cure them by surgical measures. It is difficult to speak concisely of the surgical treatment of dysmenorrhœa, because the subject is still somewhat confused. Defects of development, such as the small ante flexed uterus, the conical cervix and small external os, are not, strictly speaking, amenable to surgical treatment at all. The uterine axis can be straightened, and the external os enlarged, but the fundamental unfitness of the organ for its physiological *rôle* is not thereby removed, and it is not astonishing that even the most successful exponents of these operations do not claim more than 40 to 50 *per cent.* of cures. It would be a very interesting point for investigation whether, in these cases, it is possible to stimulate the developmental process anew and carry it forward from the point of arrest by other than surgical means. The difficulty in the investigation is that diagnosis is seldom made at a sufficiently early age. Secondary sexual development, though usually completed at puberty, may be delayed, and often is. It is probable, therefore, that the uterus would be sensitive to forces which influence its development, could such be discovered, for several years after the establishment of menstruation. Electrical stimulation has been tried with no very encouraging results, but it is possible that an endocrine combination may yet be discovered which will prove effective if applied at the right time. The physiological stimulus of pregnancy resulting in marked hyperplasia of the uterus, almost invariably cures the dysmenorrhœa permanently.

The surgical correction of defects is of undoubted advantage, for it removes the mechanical factor in the causation of pain, and this is sufficient to afford great relief in a considerable proportion of cases. It is therefore a valuable method when applied judiciously. As regards the cases in which no such defects are present, surgical treatment is practically limited to dilatation of the cervix, with or without curetting, according to the local condition found.

The *rationale* of dilatation must be sought in the function of uterine polarity. Regular intermittent uterine contractions act upon the cervix,

softening its tissues and dilating its canal, while tetanic contractions have no such effect. Conversely, artificial dilatation of the cervix acts upon the uterine body, producing contractions. These phenomena may be observed both in the gravid and the non-gravid uterus. It appears that forcible dilatation, in cases of spasmodic dysmenorrhœa, exerts a more or less profound influence upon the mechanism of polarity, by which the contractions of menstruation are so regulated that they lose their tetanic or spasmodic character. Any severe case of dysmenorrhœa may be benefited by dilatation.

There are several different ways of carrying it out. In the first place, the degree to which the dilatation is carried varies very much. One method is to stop short of a point at which laceration of cervical tissues would be likely to occur. This point is not the same in all cases, but the mean is about No. 10 Hegar; in the younger patients laceration will occur sooner than in the older ones. Other gynæcologists take an entirely opposite view and deliberately push dilatation to a point at which laceration of tissues will be inevitable, in the belief that permanent widening of the cervical canal will be the result. Again, it is the practice of many gynæcologists to keep the canal dilated for one to three days by introducing a glass stem through the dilated cervix; others allow the canal to close down again at once after dilatation. Still others introduce a canalised metal stem into the uterus, fix this with a stitch to the lip of the external os, and leave it there for several months. This practice is common in the United States, but is seldom employed in this country. Still others introduce a laminaria tent into the cervix the day before undertaking dilatation under anæsthesia: this undoubtedly makes the dilatation easier, but in childless women it usually requires an anæsthetic, which is a great disadvantage.

The prospects of success are the best in cases where no hypoplastic defects are present; about 50 *per cent.* of such cases are cured either directly by dilatation, or by the subsequent occurrence of pregnancy, to which, perhaps, the dilatation has contributed. After carefully examining the pelvic organs under anæsthesia, including inspection of the cervix, the curette is indicated if the uterine cavity is elongated and if the cervix is 'eroded,' these conditions being regarded as indications of an abnormal endometrium. If there are no such indications, and if the tubes and ovaries are apparently normal, dilatation is carried to No. 10, a glass stem introduced through the cervix and left there for forty-eight hours. This simple procedure should be carried out with the most careful aseptic technique. Calamitous results may follow from sepsis when the operative technique is at fault. No harm can be done by introducing a sterile stem into the cervix after dilatation for forty-eight hours, and it must be beneficial to maintain the patency of the internal os for that period.

Very occasionally a case is encountered which resists all the measures we have hitherto considered; such cases belong to Type 2 of the intrinsic class of dysmenorrhœa. The only remedy which remains is to suppress menstruation completely, and if this is decided upon it can be carried out with the least risk of remote ill-effects by the removal of the uterus, the ovaries being conserved. The alternative procedure is a large dose of radium introduced into the uterine cavity and repeated if the first dose does not completely suppress menstruation. This procedure is resorted to with the greatest reluctance, and only in view of the necessity of procuring relief from intolerable suffering.

MENSTRUAL EXFOLIATION

Under the designation '*membranous dysmenorrhœa*' a condition has been long recognized in which pieces of membrane, so-called 'casts,' are expelled from the uterus. Experience has, however, shown that such casts may be passed without an abnormal amount of menstrual pain. The name, membranous dysmenorrhœa, is therefore inappropriate. The outstanding feature of the condition is the detachment and expulsion of portions of the superficial compact layer of the mucous membrane during menstruation. By some writers the name *exfoliative endometritis* has been used, but we are convinced that no histological evidences of inflammation can be found, and therefore this name is also inappropriate. We propose to use the term *massive menstrual exfoliation*, which expresses all that is certainly known of the process.

The pieces of discharged membrane usually occur in the form of narrow strips, or, more rarely, of pieces of large size representing the whole area of

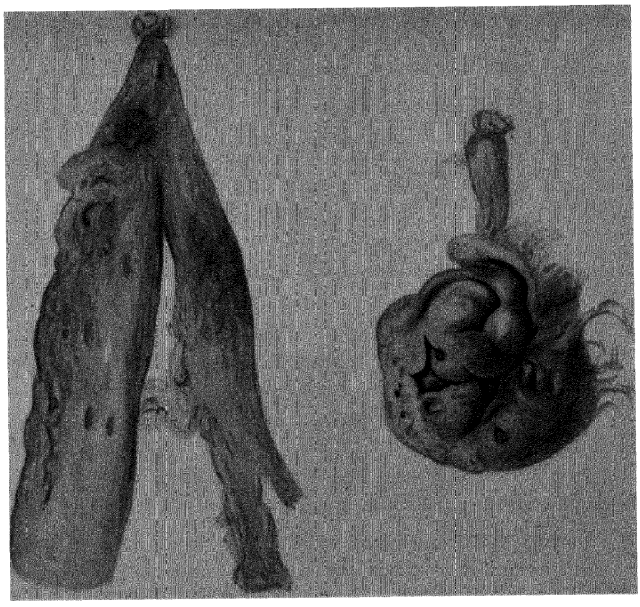


FIG. 106. MEMBRANE THROWN OFF IN TWO PIECES DURING MENSTRUATION BY A VIRGIN AGED 19 YEARS.

the anterior or posterior wall. Complete casts are never met with in this condition, although they do occur from other causes (p. 174). The free surface is smooth, and the attached surface shaggy (*see* Fig. 106). Structurally, the membrane appears to consist of degenerated endometrium : the stroma-cells are shrunken and the interstitial tissue is infiltrated with blood, giving the appearance of degenerated fibrin. The glands are few, shrunken and very small ; their cells, at the best, are cubical not columnar (*see* Fig. 107). In some instances the membrane is much thickened from hæmorrhagic infiltration, and then cells resembling decidual cells may be found in the stroma. There are no inflammatory changes in the membrane at all, nor is

there any clinical evidence of its being due to infection. After the uterus has been curetted, portions of the same kind of membrane may be discharged at the next period.

Its causation is quite unknown; its occurrence is rare, and it is found chiefly in virgins and in sterile women; sterility appears to be generally associated with it, but we have known the condition to arise in a patient who had already had three children. In rare instances menstruation is not unduly painful, but usually extreme pain is present. It is well known that in normal menstruation fragments of endometrium are often cast off large enough to be visible to the naked eye. The condition here described is, however, the extensive exfoliation of an abnormal mucous membrane, and that it is a pathological condition there can be no doubt.

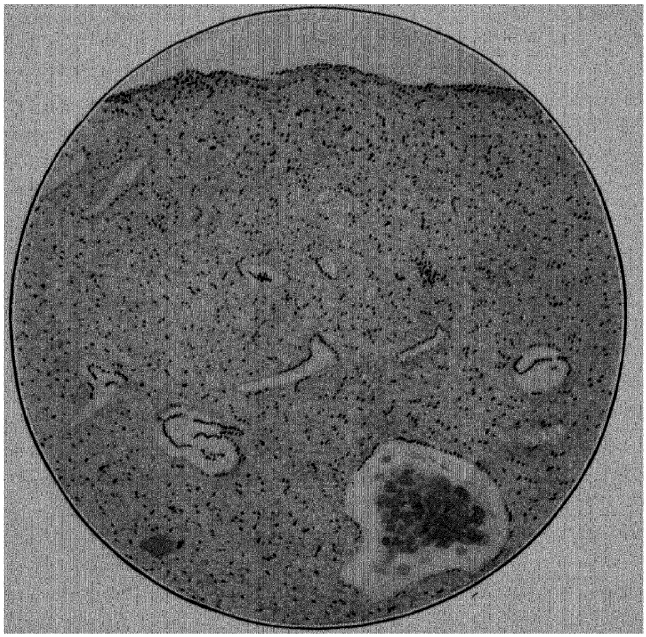


FIG. 107. VERTICAL SECTION THROUGH MEMBRANE SHOWN IN FIGURE 106. Several imperfect glands are seen in the section.

The menstrual disorder seldom begins at puberty. The period tends to be profuse in amount, and in most cases pain is a marked feature; it comes in attacks with remissions, and is relieved by the passage of the membrane, which usually occurs about the second or third day.

In order to recognize the condition the membrane must be sought for in the menstrual discharge. The narrow strips may escape notice unless carefully looked for, as they are often rolled up into small bulk and concealed by blood-clot. All the diapers used by the patient must therefore be examined, and all clots and pieces of tissue carefully inspected in water; the strips of membrane can then be unrolled and floated out. As a rule they are thin and semi-translucent in appearance, pale in colour and with one surface smooth, the other rough. In some instances a thick membrane, resembling decidua, is passed (*see* Fig. 106). The strips are about

1–2 inches in length, and quite narrow: often much smaller fragments are found.

Treatment by curetting and drugs is useless, and if pain and menorrhagia are very severe the only means of relief is by hysterectomy.

INTERMENSTRUAL PAIN

Although the causal relation of this affection to the menstrual process is not established, it is most convenient to consider it here. It consists of attacks of abdominal pain in the intermenstrual periods which recur at regular intervals; as a rule the attacks occur about midway between two menstrual periods, but in other cases they may come on either earlier or later than this. In some cases they preserve a rhythm almost as regular as that of menstruation. The disease affects women during the time of full sexual development, and has not been observed at puberty. Subjects of this affection are nearly always sterile during its continuance, although a considerable proportion have been previously pregnant; in some instances the disease has ensued upon a confinement or a miscarriage. The menstrual function itself is not in all cases abnormal, but a considerable proportion of patients suffer from dysmenorrhœa, and some from menorrhagia. In a few instances a watery or blood-stained discharge is regularly present during the attack of intermenstrual pain. The pain is not acute, seldom indeed severe, but is usually described as aching or bearing-down in character. It bears no comparison with the pain of a severe case of spasmodic dysmenorrhœa.

A local lesion, recognizable by ordinary clinical examination, is present in the majority of cases. The lesion most frequently met with is inflammation, indicated by matting and enlargement of the tubes and ovaries upon one or both sides; in other cases chronic endometritis, a small fibroid tumour, or a backward displacement may be found. It cannot in all cases be assumed that the morbid condition discovered in the pelvis is the cause of the pain.

The *causation* of intermenstrual pain is by no means clear. The theory that it is due to some abnormality of the function of ovulation offers the best explanation of the clinical facts. Thus it accounts for its periodic rhythm, for its varying relation to the menstrual period, and for the frequency with which it is associated with inflammatory lesions of the tubes and ovaries. It is possible that in inflamed or adherent ovaries the process of maturation of the Graafian follicle is interfered with, and rendered more difficult, and consequently painful. Clearly this may be induced by general thickening of the tunica albuginea, or by previously existing adhesions of that part of the ovarian surface upon which the ripening follicle presents. The view advanced by certain writers that it is due to intermittent hydrosalpinx (*see* p. 552), while it may account for the occasional accompaniment of a watery discharge, does not explain the principal feature of the affection, *i.e.* its regular periodicity.

The *treatment* consists essentially in dealing with the local lesion which may be present. The attacks of pain may be relieved by the same remedies as those employed in cases of dysmenorrhœa. The prospect of permanent cure is not hopeful.

EXTRA-UTERINE (ECTOPIC) GESTATION

It is well established that a fertilized ovum may become implanted not only in the uterus, but in the Fallopian tube, or in the ovary; in the two last-named positions the pregnancy is called extra-uterine or ectopic.

The possibility of the implantation of a fertilized ovum upon the peritoneum—*primary peritoneal pregnancy*—has been much discussed, but until recent years it cannot be said to have been satisfactorily demonstrated. It has been stated that it may occur in rodents, and its occurrence in the human species cannot be regarded as impossible. Further, a case has been recorded by Gröné (Sweden), which he asserts to be one of primary peritoneal pregnancy, the ovum having been implanted upon the peritoneum

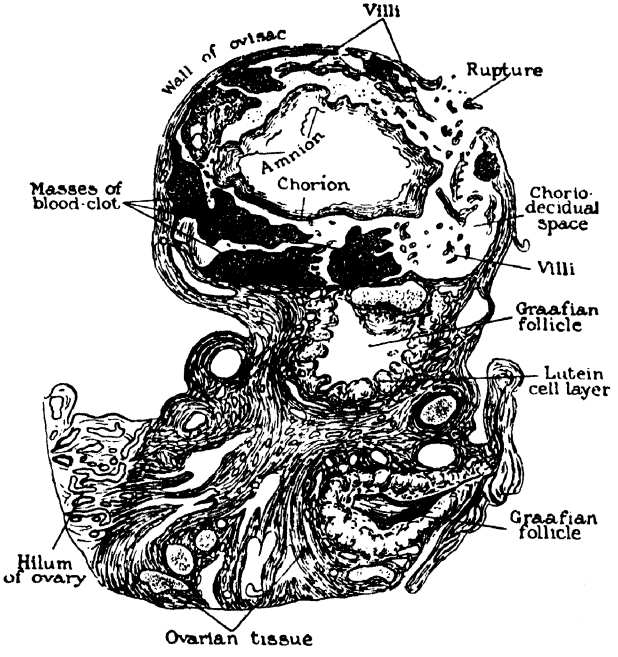


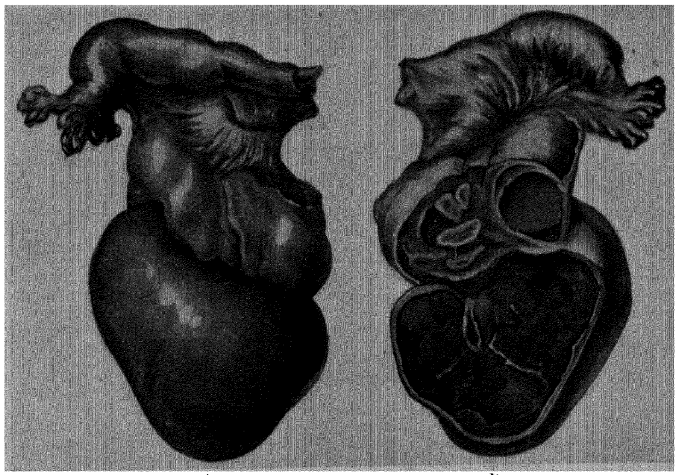
FIG. 108. OVARIAN PREGNANCY (Van Tussenbroeck). The ovum has developed in a Gräafian follicle; rupture has occurred on the free surface of the gestation-sac.

immediately behind the right round ligament. The case was submitted to operation, and as the patient recovered a detailed histological examination of the uterus and Fallopian tubes was not made. While there can be no inherent possibility about the occurrence of primary peritoneal pregnancy, its actual demonstration is beset with great difficulties; and there can be no question that if it occurs at all in women it is very much rarer than the other two varieties of ectopic pregnancy.

OVARIAN PREGNANCY

The first case of ovarian pregnancy to be satisfactorily proved was published by Catherine van Tussenbroeck in 1899 (*see* Fig. 108). Between the years 1899 and 1909 Norris collected nineteen authentic cases; and during the period 1910–1917 twenty-two genuine cases were collected by one of us (C. L.). Thus there were known to be at least forty-one authentic

cases published in the literature up to March, 1917, and since that date another case has come under our personal observation. It is clear, therefore, that ovarian gestation is a comparatively rare occurrence, although not the rarest variety of extra-uterine pregnancy, as will be stated later (*see* p. 190).[1] In most cases of ovarian pregnancy the site of implantation appears to have been a Gräafian follicle (*see* Fig. 108), which may be entered by spermatozoa through the site of rupture or possibly by direct penetration of the wall. It is, however, possible that the egg-cell may be impregnated when lying upon the surface of the ovary after its discharge from the follicle and may afterwards excavate a bed for itself in the ovarian tissues by its remarkable powers of erosion. Generally, however, the spermatozoa enter a Gräafian follicle and fertilize an egg-cell therein, which has not been discharged along with the fluid-contents of the follicle. In the cells which line the



A B

FIG. 109. OVARIAN PREGNANCY. A, External appearance of gestation sac. B, Gestation sac seen in section.

follicle the fertilized ovum finds its nidus, and the early stages of development pursue the usual course. Figure 108 shows the formation of the *gestation-sac* or maternal covering of the ovum ; this consists simply of the layers of tissue which normally compose the wall of the Gräafian follicle (tunica interna and tunica externa), and it will be seen that the greater part of the ovum is unsupported except by this delicate follicular wall. The features essential to the diagnosis of an ovarian pregnancy are shown in Figure 109. It will be seen that the ovary contains a large blood-clot A and B, in which were found amniotic membrane and chorionic villi. The clot and the products of gestation are enclosed in a complete *capsule* composed of ovarian tissue ; the ovary maintains its normal relations to the unaltered meso-salpinx and to the corresponding Fallopian tube.

A true decidua compacta is not formed in the ovary, but patches of decidual cells may be found both in the stroma of the medulla and in that of the cortex (*see* Figs. 110 and 111). In most of the authentic cases preg-

[1] For more recent literature see Hochne: *Zeuli für Gynäk*, 1923, No. 1 ; also *Monatschr. f. Geb.*, 1921, Bd. liv. S. 102–108.

nancy terminated at an early period by rupture (*see* Fig. 108), but in the case described by Giles and Lockyer,[1] and in two other cases published by Lockyer,[2] a mole was formed and the ovarian capsule was never ruptured (*see* Fig. 109). The differential diagnosis by clinical methods from tubal pregnancy is impracticable in the present state of our knowledge, but the naked-eye appearances of an ovarian molar pregnancy are characteristic owing to the following features:

(*a*) Normal Fallopian tube; (*b*) normal mesosalpinx; (*c*) a cap of ovarian tissue of variable size overlying (*d*) the mole—a dark plum-coloured cyst with smooth walls; (*e*) a sulcus, or sharp line of demarcation, between

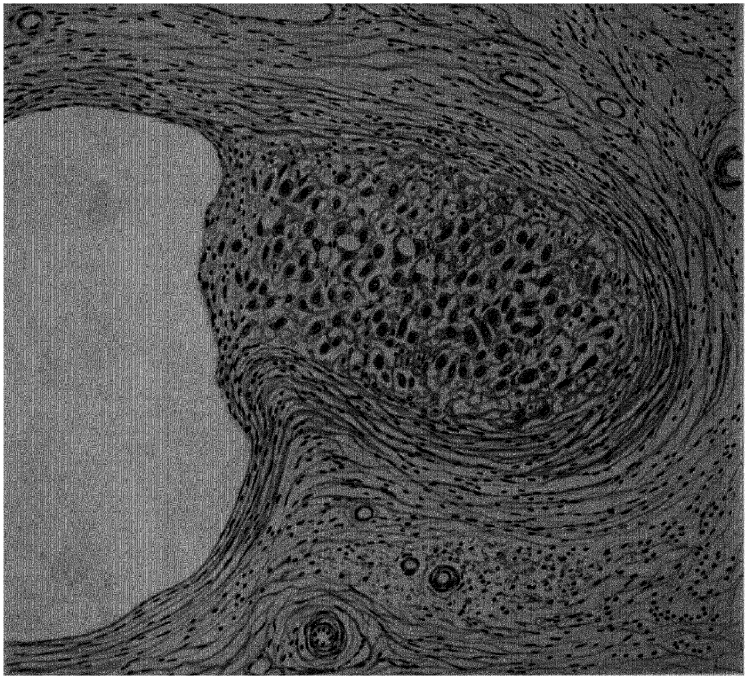


FIG. 110. Showing decidual reaction in the connective-tissue cells of the medulla of the ovary. From a case of ovarian gestation. (Giles and Lockyer.)

(*c*) and (*d*). The presence of this sulcus serves to distinguish an ovarian pregnancy from a hæmorrhagic ovarian cyst.

We regard these features as sufficiently distinctive for the diagnosis of ovarian molar pregnancy to be made during operation, but the supposition must always be confirmed by histological proof of the presence of chorionic villi, and this final proof is the only way in which a ruptured ovarian gestation can be verified.

TUBAL PREGNANCY

Etiology. The lodgment of a fertilized ovum in the Fallopian tube is not uncommon. The occurrence is of the nature of an accident; the predis-

[1] 'Case of Ovarian Pregnancy' (Arthur E. Giles, M.D., and Cuthbert Lockyer, M.D.), *Proc. Roy. Soc. Med.* (Obst. Sect.), vol. viii, pp. 2–10, 1915.

[2] 'Two Cases of Primary Ovarian Pregnancy' (with a review of the literature 1910–1917) (by Cuthbert Lockyer, M.D.), *Proc. Roy. Soc. Med.* (Obst. Sect.), vol. x, pp. 160–182, 1917.

posing factors comprise many mechanical conditions relating to the tubes, and some authorities include anomalies of the fertilized ovum in the etiology of tubal pregnancy. With regard to the ovum it has been suggested that the preservation of the zona radiata (pellucida) during the time a fertilized ovum is in the tube prevents its implantation in this situation, and that premature disappearance of the zona radiata will favour immediate embedding. Normally the egg-cell is fertilized in the tube during its passage from the ruptured Gräafian follicle to the uterus. By the time it has reached the uterus the zona pellucida has disappeared owing to the histolytic (destructive) faculty of the ectoderm, and the ovum, by means of its developing trophoblast, commences to burrow into the maternal tissues. If, owing to some

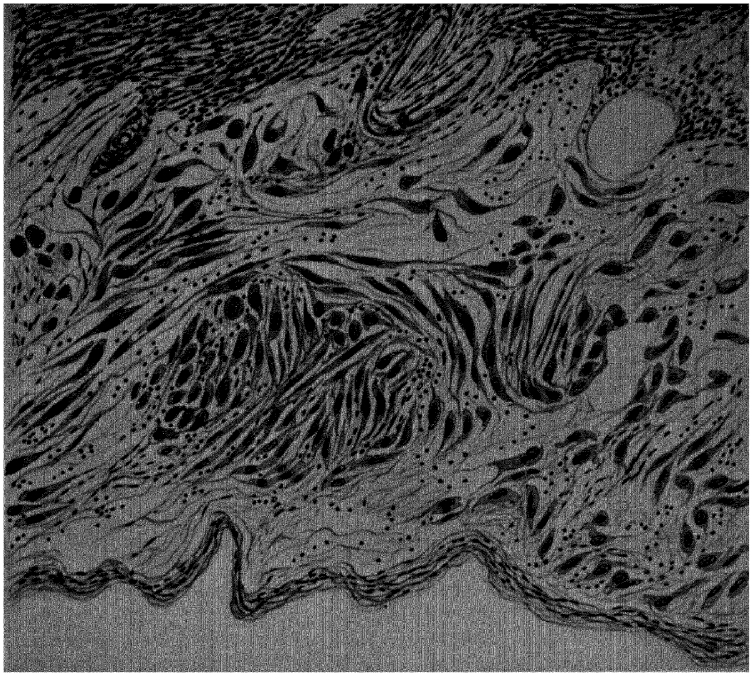


FIG. 111. Showing decidual reaction of the connective-tissue cells of the cortex of the ovary. From a case of ovarian gestation. (Giles and Lockyer.)

delay, the zona pellucida has disappeared before the ovum has entered the uterus, ectopic implantation is liable to occur. Delay in reaching the uterus may be brought about (1) by *external wandering:* (2) by elongation of the tube itself; (3) by the presence of some obstacle in the lumen of the tube.

Foremost among the conditions which may *delay the passage* of a fertilized ovum through the tube is a preceding inflammation, which is very frequently of gonorrhœal origin. In the section dealing with salpingitis it will be explained that there is a loss of cilia and of epithelium, with swelling of the mucosa and fusion of plicæ; thus the lumen is narrowed and rendered very complicated by the presence of polypoidal masses of adherent plicæ and pseudo-follicles. Later epithelial crypts and diverticula form in the muscu-

laris, and kinking may produce septa in the lumen which add to the obstruction. It is thus clear that inflammation is capable of impairing the normal function of the tube, which is the transmission of the ovum into the uterine cavity, (1) by destruction of cilia, and (2) by the formation of mechanical barriers such as kinks, crypts, and diverticula. Rabinovitz, from an examination of 147 cases, came to the conclusion that gonorrhœal salpingitis is the most common cause of *repeated* tubal pregnancy. He lays stress on the view that mucosal changes may be present in tubes which appear normal to the naked eye, so that when a normal-looking tube on the opposite side is left *in situ* after the removal of a tubal gestation, it may, by reason of progressive inflammatory changes in its mucous membrane, become the seat of a second tubal gestation. The same author draws attention to the fact that in cases of tubal pregnancy, not infrequently the opposite tube is found to be the seat of hydrosalpinx, pyosalpinx, or hæmatosalpinx. Dührssen, in twenty-four out of thirty-five cases, found evidence of pre-existing

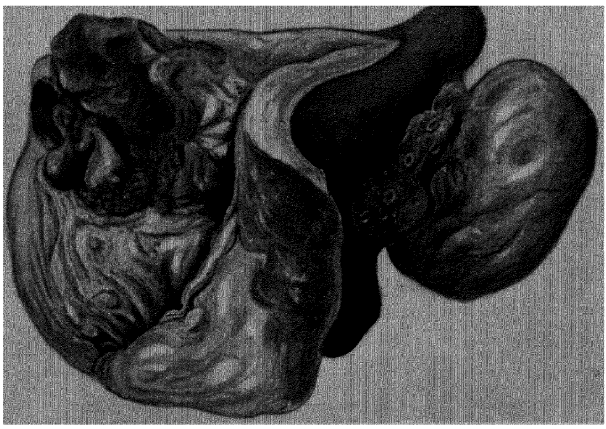


FIG. 112. TUBAL MOLE IN THE WALL OF A TUBE WHICH WAS THE SEAT OF CHRONIC SALPINGITIS PREVIOUS TO BECOMING GRAVID.

disease in the tubes, and considered that in most of the cases this was due to gonorrhœa. In one of our own cases there was a mole in the wall of a pyosalpinx (*see* Fig. 112) which showed old interstitial thickening of the tube-wall in keeping with a history of chronic salpingitis. Prusmann found in twenty out of twenty-eight pregnant tubes, adhesions between the folds of the mucosa in portions of the tube remote from the implantation of the ovum.

Old pelvic peritonitis may kink the tube and interfere with its muscular contractions and so lead to the retention of a fertilized ovum. The preponderance of inflammatory changes in the etiology is practically illustrated by the rare occurrence of tubal pregnancy in nulliparæ and by the circumstance that it happens very frequently after a long period of sterility, and after the occurrence of an adnexal infection has been demonstrated clinically.

Nevertheless it is quite certain that there are other causes of delay of the fertilized ovum in the lumen of the tube besides those of an inflammatory origin, *e.g.* developmental errors. An ovum may find its way into a blind accessory tube and there become embedded. Congenital hypoplasia of the

tubes, a condition in which the walls are thin and the tube tortuous, is said to favour tubal gestation. The thin walls are thought to be lacking in the contractile power which is probably necessary for the propulsion of the ovum towards the uterus. The accompanying tortuosity is thought to offer an actual obstruction sufficient at any rate to delay the ovum until its trophoblast has had time to develop. Examples of hypoplasia are seen in Figures 87 (p. 135) and 113. There is no fusion of plicæ in a tube which retains its infantile tortuosity, but when convolutions are produced by inflammation the plicæ will be found adherent also.

Pregnancy in Anomalous Situations. Pregnancy has occurred in the stump of a tube which has been removed, or in a tube left behind and ligatured after supravaginal amputation of the uterus, and in the stump of the tube which had been tied into the angle of the vaginal scar.

Summary. A tubal pregnancy is obviously due to more than one factor. It is always of the nature of an accident. The most probable *predisposing factor* would seem to be one of the mechanical conditions already described as interfering with the passage of the ovum along the tube, but it must be

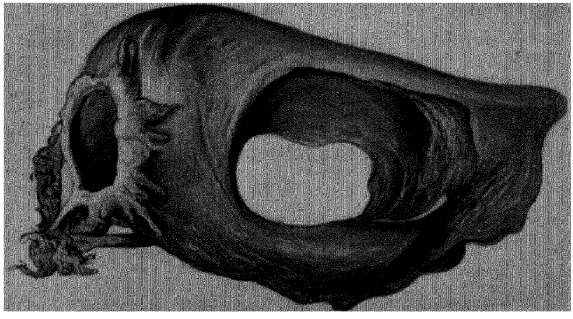


FIG. 113. GRAVID TUBE. Showing the dilated ostium through which the ovum escaped. The walls, which are ruptured, were so thin as to be nearly transparent, a condition due to congenital hypoplasia.

remembered that chronic salpingitis is certainly not present in many cases of tubal gestation. When it is present, however, it forms the most likely explanation of the accident. In 133 cases investigated by Finsterer, the course of childbed had previously been normal, and from this he concluded that the important factor in the causation must be, not inflammatory changes but anomalies in the fertilized ovum. The average interval between the last normal pregnancy and tubal gestation was in this series seven years, so that it would seem quite impossible to exclude an intervening salpingitis.

ANATOMY OF TUBAL PREGNANCY

Tubal pregnancy gives rise to a series of well-marked changes in the uterus, and in the affected Fallopian tube; the former are uniform and constant, the latter vary with the position of the ovum. The *uterus* always shows a certain amount of enlargement, accompanied with softening of its walls and softening of the cervix; both are recognizable clinically, although the softening of the lips of the external os is not so well marked as in uterine pregnancy. The endometrium is completely converted into a decidual membrane, indistinguishable from the decidua vera of normal uterine pregnancy—

(*see* Fig. 114). This change has been spoken of by Webster as the " decidual reaction " of the uterus. In the affected *tube* the changes are mainly confined to the neighbourhood of the ovum, distant parts showing practically no changes recognizable with the naked eye. The portion of the tube which encloses the ovum is usually called the *gestation-sac.*

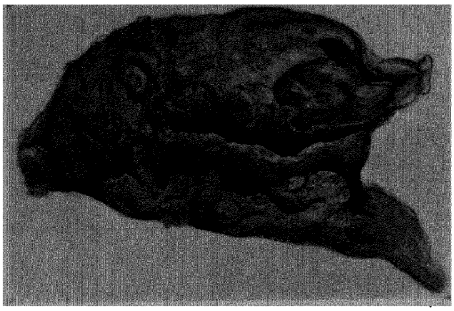


FIG. 114. DECIDUAL CAST FROM A CASE OF TUBAL PREGNANCY.

The fertilized ovum lodges most frequently in the *ampulla* of the tube (*see* Figs. 115 and 118, and Plate X), more rarely in the *isthmus* (*see* Fig. 119), and least frequently of all in the *interstitial* portion. Reference to Figure 116 clearly shows that when lodged in the tube the fertilized ovum buries itself in the maternal tissues very much in the same manner as in uterine pregnancy. The depth to which penetration occurs varies; thus, the embedding may take place immediately beneath the mucosa, *i.e.* between the latter and the muscularis, or, more commonly, the ovum burrows into the muscular wall (*see* Fig. 117). In either case the ovum develops external to the lumen, *i.e.* in the wall of the tube, and the tissues of the tube-wall form for it a *gestation-sac.*

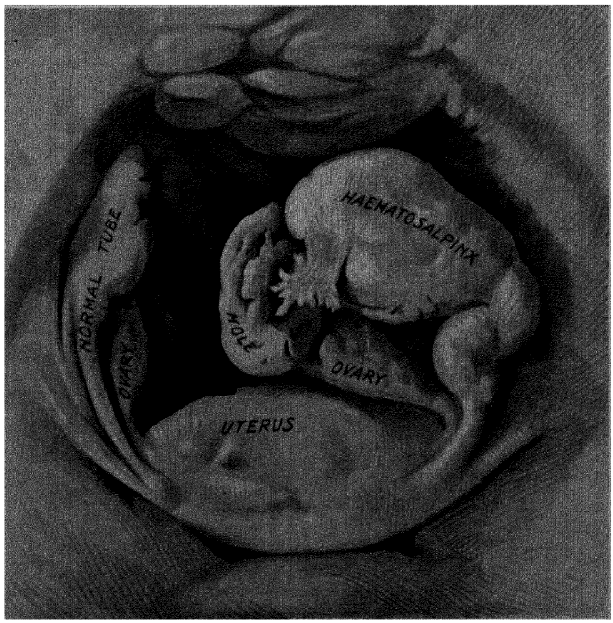
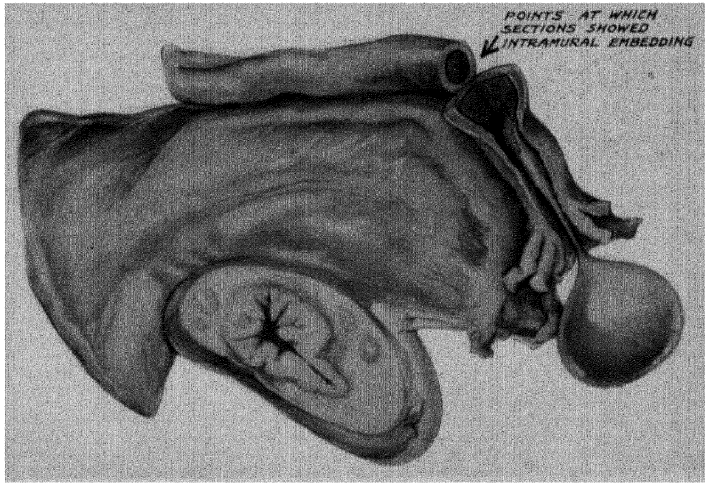


FIG. 115. TUBAL ABORTION WITH HÆMATOSALPINX (Bumm). The ovum, converted into a mole, has been expelled from the tube, the ampulla of which remains distended with blood. The gravid tube occupies the left posterior quarter of the pelvis, and is connected by a pedicle with the uterine cornu.



INCOMPLETE TUBAL ABORTION. The ampullary portion of the tube has been laid open to show the placental site, to which is attached the umbilical cord. The latter connects the extruded amniotic sac with the placenta. The arrow indicates the site from which the section was taken, which is shown in Figure 116.

To face page 174.

In intra-uterine pregnancy the embedding is not deep; penetration never extends beyond the mucous membrane into the muscle; indeed, it does not reach very deeply into the mucosa (*see* Plate VIII, p. 84), so that the growing embryo forms, almost from the first, a vesicular projection towards the uterine cavity. The more superficial the embedding in the tube, the more striking is the analogy of tubal pregnancy to uterine gestation. Figure 116 shows the ovum surrounded towards the tube-lumen by mucosa only, the latter corresponding to the decidua capsularis of uterine pregnancy. The site of the embedding in the specimen is in the *floor* of the tube, corresponding to the attachment of the mesosalpinx; this corresponds to what in uterine gestation would be called the *decidua basalis*. It must be pointed out, however, that no true *decidua compacta* is formed in the tube, although a

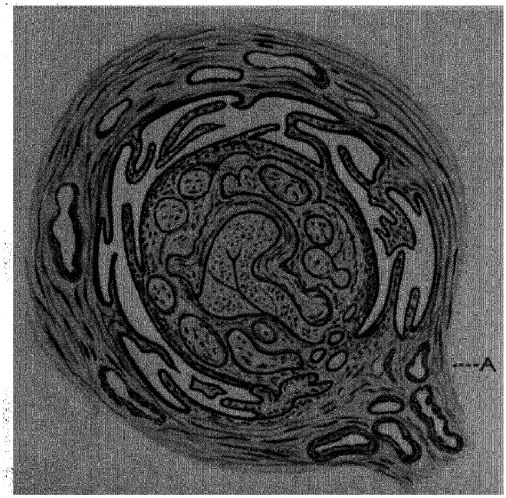


FIG. 116. Showing superficial embedding of the ovum, *i.e.* beneath the mucosa of the tube. The lumen of the tube surrounds the greater part of the ovum. The gestation-sac, or capsule, is in this case composed solely of mucous membrane. No muscle could be demonstrated in the sac, except at its narrow pedicle-like attachment to the tube-wall opposite the mesosalpinx (A). This mode of embedding in the tube-wall more closely resembles the normal implantation in the uterus.

certain amount of ' decidual reaction ' of the stroma-cells has been observed. The absence of a true decidua is due to a deficiency of stroma-cells in the tubal mucosa, the latter being, as compared with the corporeal endometrium, a much thinner lining membrane. When penetration by the fertilized ovum extends into the muscle-tissue of the tube (*see* Fig. 117), the gestation-sac is represented in its whole circumference by the muscle-wall, and the strict analogy to uterine gestation breaks down.

As the embryo grows, the eroding trophoblast destroys the maternal tissues and eats its way into maternal blood-vessels. Hæmorrhage thus occurs within the gestation-sac and the latter ruptures in consequence at its weakest spot. In the majority of cases the gestation-sac is thinnest towards the lumen and hence hæmorrhage into the lumen is a common event; this accident is spoken of as *internal tubal haemorrhage*. Less frequently the

gestation-sac gives way externally, *i.e.* through the peritoneum or into the layers of the broad ligament, and to this the term *external tubal haemorrhage* is applied. The results of each type of hæmorrhage will be considered later on.

When the ovum lodges in the ampullary portion, the abdominal ostium almost invariably becomes occluded before the end of the second month (eighth week); when the ovum lies in the isthmus or the interstitial portion, the abdominal ostium does not close (*see* Figs. 118 and 119). The condition of the ostium, as will appear later, has an important clinical bearing.

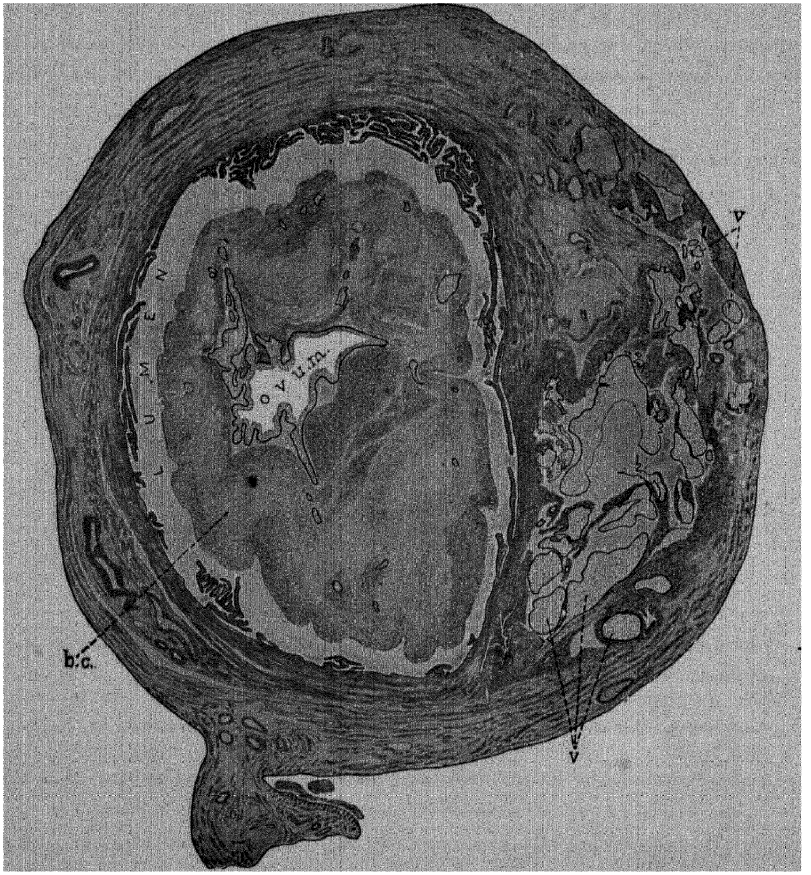


FIG. 117. SECTION THROUGH A GRAVID FALLOPIAN TUBE, ILLUSTRATING THE RESULTS OF INTERNAL CAPSULAR HÆMORRHAGE (Whitridge Williams). The ovum has escaped into the lumen of the tube; the site of the embedding in the tube-wall is shown to the right of the figure. *V*, Villi which have penetrated deeply into the wall of the tube; *b.c.*, Blood clot containing chorionic villi seen in section; in the centre of the mass is an irregular space representing the amniotic sac.

The ability of the Fallopian tube to continue to accommodate the growing ovum is by no means certain; as a matter of fact it fails to do so except in extremely rare instances. It is, however, believed that genuine cases are on record of gestation continuing to term, or nearly to term, in an unruptured Fallopian tube. Failing this event, either the ovum is destroyed, or it

escapes from its cramped surroundings and pursues its development under more favourable conditions.

It is thus clear that, speaking generally, a tubal gestation terminates in one of two ways, viz. by—

I. Internal Tubal Hæmorrhage.

II. External Tubal Hæmorrhage.

These lesions in their turn lead finally to others still to be described, which may be summarised thus :—

I. Internal Tubal Hæmorrhage may terminate in the formation of—

(*a*) Tubal Mole.

(*b*) Tubal Abortion.

(*c*) Peritubal Hæmatocele.

(*d*) Retro-uterine or Pelvic Hæmatocele.

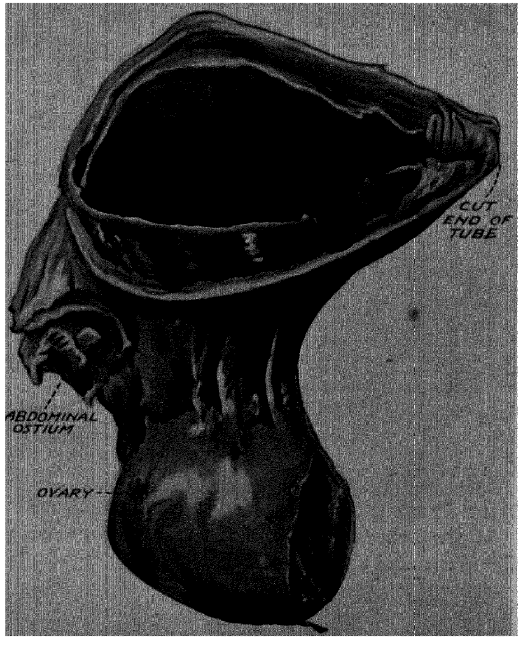


FIG. 118. TUBAL MOLE *in situ*, LAID OPEN BY LONGITUDINAL INCISION OF THE TUBE (Charing Cross Hospital Museum). The mole occupies the inner half of the ampullary portion of the tube. The abdominal ostium is patent.

II. External Tubal Hæmorrhage may terminate in the formation of—

(*a*) Paratubal Hæmatocele.

(*b*) Spontaneous Tubal Rupture, which may take the form of—

(i) Intra-peritoneal rupture, with hæmorrhage into the abdominal cavity. This may result in death from hæmorrhage or in the formation of—

(*a*) Retro-uterine or pelvic hæmatocele with death of fœtus.

(*b*) Secondary tubo-abdominal pregnancy.

(*c*) Secondary abdominal pregnancy.

(ii) Extra-peritoneal rupture—

(*a*) With death of the fœtus and broad-ligament hæmatoma.

(*b*) With survival of the fœtus (intra-ligamentary pregnancy), of which there are two clinical varieties:

(1) Anterior.

(2) Posterior.

I. **Internal Tubal Hæmorrhage.** As a result of internal tubal hæmorrhage tubal pregnancy is terminated, as previously stated, in one of the following ways: (1) The formation of a tubal mole; (2) tubal abortion; (3) the formation of a peritubal hæmatocele; (4) the formation of a retro-uterine or pelvic hæmatocele.

(1) *The Tubal Mole.* This termination to a tubal pregnancy is brought

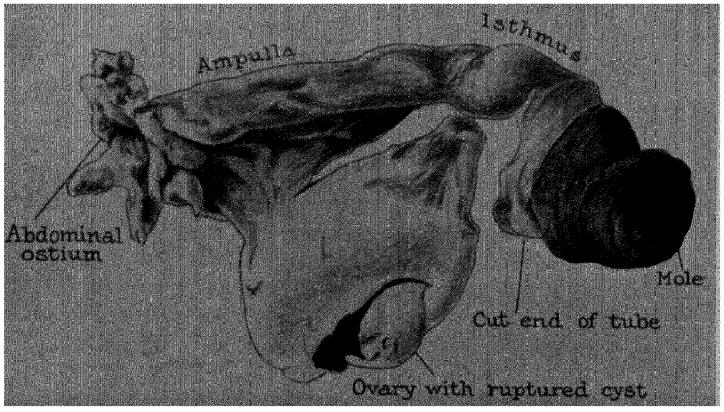


FIG. 119. TUBAL PREGNANCY OF FOUR TO FIVE WEEKS' DURATION. Rupture has occurred in the isthmic portion of the tube and a small mole has been extruded. The abdominal ostium is patent, and the ampullary portion shows little alteration.

about by the rupture of maternal blood-vessels caused by the eroding action of the proliferating trophoblastic investment of the chorionic villi. Blood is then poured into the ovum which, becoming over-distended, bursts through the gestation-sac. Maternal and fœtal blood, and finally the ovum itself, escape into the lumen of the tube. The result is a mole consisting of blood-clot, remains of the embryo, and fragments of chorionic villi, all of which form a solid mass which lies in, and distends the lumen of the tube. The original site of implantation is marked by the presence of villi in the musculature of the tube-wall. The mode of formation of a tubal mole is well shown in Figures 116 and 117, both of which represent a transverse section through a gravid Fallopian tube at the site of implantation of the ovum. In Figure 117 the lumen of the tube is occupied by an oval mass of blood clot detached completely from the wall; a cavity of irregular shape, representing the amniotic sac, is seen, placed somewhat eccentrically in the midst of the blood-clot. The effect of the hæmorrhage has clearly been to break up the chorion, which at this early period is covered in all parts with villi; many

detached villi are seen in section in the blood-clot surrounding the ovum; a few are seen still retaining their attachment to the ovum; others are seen to be buried in the tube wall and to be broken off entirely from the ovum. There is no appreciable thinning of the wall of the tube except at the right of the figure, where chorionic villi can be seen to have penetrated nearly as far as the peritoneal investment, thus breaking up the muscular wall of the tube. This area represents the position of the pit in which the ovum was originally imbedded. Remains of the branching plicæ of the tubal mucosa are also seen flattened out against the tube-wall, which indicate that the ovum has lodged in the ampullary portion of the tube. In Figure 118 are seen the naked-eye appearances of a tubal mole *in situ* laid open by longitudinal section; the

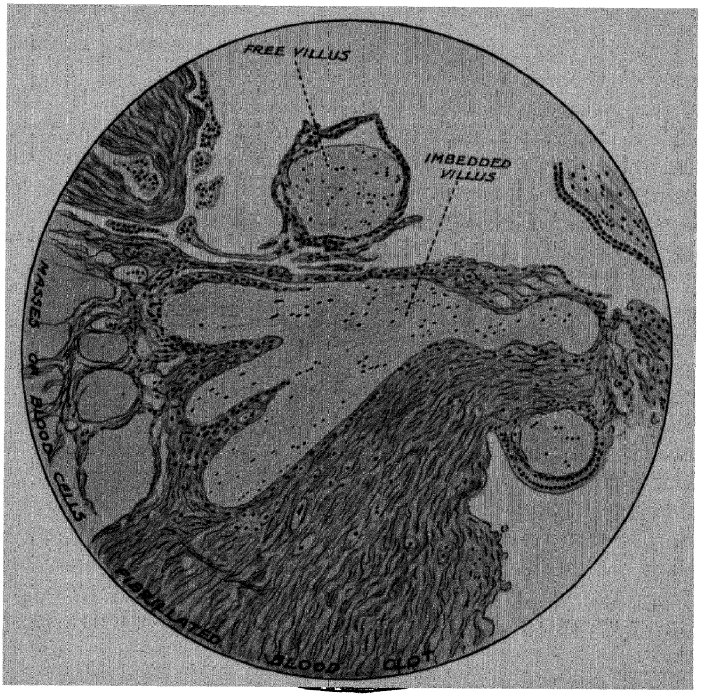


FIG. 120. CHORIONIC VILLI FROM A TUBAL MOLE. The large imbedded villus is seen to have lost its epithelial covering; its stroma contains very few nuclei. The free villi have preserved their epithelium, which consists of a double row of cells. Syncytial buds in section are seen on the left side in the upper part of the figure.

tube was removed on account of hæmorrhage through the unsealed abdominal-ostium. In Figure 116 the mole will be seen to be attached to the wall of the tube over a relatively small area of its floor. Another very common arrangement is that shown in Figure 117, in which many of the chorionic villi have penetrated deeply into the wall of the tube.

In tubal pregnancy the frequency with which moles occur is far greater than in the case of uterine pregnancy, probably on account of the greater insecurity of the ovuline attachments in the former. The formation of a mole is usually accompanied by more or less hæmorrhage through the

unsealed abdominal ostium. The ovum is, of course, destroyed by this process; small moles may perhaps be retained in the tube and gradually disposed of by absorption; larger moles are usually expelled by tubal rupture or abortion. Suppuration of a mole retained in the tube probably only occurs as the result of some form of infection, such as sepsis, gonorrhœa, or bowel-infection.

In operating on cases of tubal gestation, a mole is frequently found among the blood effused into the peritoneal cavity by rupture or abortion; it exactly resembles a lump or blood-clot, and may remain unnoticed unless carefully looked for. Small moles are nearly globular (*see* Pl. XI, p. 182, and Fig. 116); larger ones are oval in shape, heavier, and firmer than simple clotted blood (*see* Fig. 118); they often show remains of the amniotic sac on section, and on miscroscopic examination, after suitable hardening, are found to contain chorionic villi imbedded in clotted blood. The embryo is very rarely discovered.

The recognition of chorionic villi under these conditions is a matter of some clinical importance. As shown in Figure 120, some are free, others imbedded in the blood-clot. The former are covered by epithelium, definitely recognizable as that of the chorion, since it is composed of two layers– the outer layer consisting of regularly nucleated plasmodium (the syncytium), the inner layer consisting of a single row of low columnar cells (Langhans' layer). The latter have almost completely lost their epithelium, while the stroma of all the villi has undergone considerable degeneration and appears structureless. After the destruction of the ovum the epithelium retains its vitality for a longer period than the stroma; this difference is due to the fact that the former is normally nourished directly by the maternal blood, with which it is always in contact, while the latter is normally nourished by the blood in the fœtal capillaries. The epithelium can therefore draw nourishment from the effused blood in a mole, and thus survive, while the stroma, being suddenly cut off from its source of nutrition, perishes with the embryo. Owing to survival of the epithelium, villi can be recognised in a mole many weeks after its formation. Around the villi is seen blood-clot, in varying degrees of contraction, *i.e.* with a variable amount of fibrinous network. Sometimes quite fresh-looking villi may be found in a recent tubal mole.

(2) *Tubal abortion* occurs frequently in ampullary pregnancy, while the abdominal ostium remains patent, *i.e.* during the first two months of gestation; it is believed that it occurs almost as commonly as rupture in this variety of tubal pregnancy. In the isthmic and interstitial varieties, however, rupture is much more frequent than abortion; in the latter variety tubal abortion consists in the discharge of the ovum through the uterine ostium into the *uterine* cavity. An aborted tubal ovum, as a rule, has been previously converted into a mole, but this is not always the case. The process of abortion is seen in Figure 121, which shows that the mole has been partly expelled through the dilated abdominal ostium. The main factor in its production is undoubtedly muscular contraction of the unaffected portions of the tube; the process constitutes a miniature labour, consisting of a stage of dilatation followed by a stage of expulsion, which again is succeeded by a stage of retraction. The developmental unity of the uterus and Fallopian tubes no doubt accounts for this physiological analogy. The contractions are perhaps reflexly excited by hæmorrhage into the ovum, causing

sudden distension of the tube. The expulsion of the ovum may be *complete or incomplete;* in the latter the ovum is detained in the insufficiently dilated abdominal ostium, or a portion of it may remain attached to the original implantation-site of the ovum, the bulk of which has been expelled. Here again the analogy with uterine abortion will be obvious. Tubal abortion may be attended by severe internal bleeding, equal in severity to that caused by rupture; when complete its result, as regards the ovum is invariably to destroy it. After the expulsion of the ovum the tube usually remains considerably distended with blood (Fig. 121), but it is believed that it may rapidly retract and resume its normal shape and calibre, leaving no trace to the naked eye of having been recently gravid. It is impossible to distinguish tubal abortion from tubal rupture by clinical diagnosis.

(3) *Peritubal Haematocele.* The abortion of the ovum seldom occurs with the first hæmorrhage, the whole process may take days or even weeks.

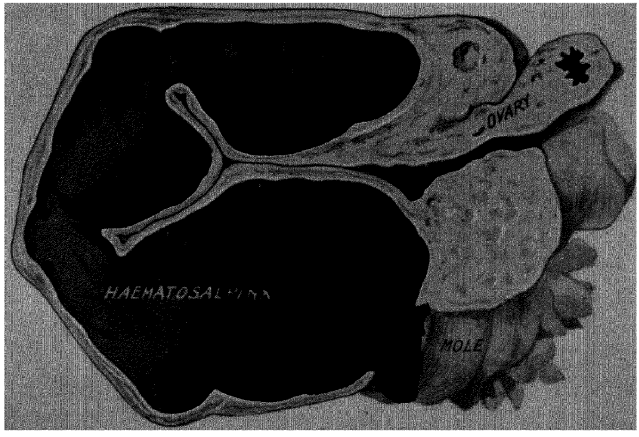


FIG. 121. TUBAL PREGNANCY, TERMINATING IN ABORTION. The tubal mole is seen partly extruded through the abdominal ostium. The tube is convoluted and its walls thickened from chronic salpingitis; its lumen is dilated and full of blood.

The blood may at first escape from the ostium in small quantities, and mixed as it is with fragments of necrotic tissue, it may clot around the ostium and not be absorbed. The outer layers of the coagulum become organized into fibrous tissue. Thus an encapsulated clot is formed around the patent, fimbriated end of the tube, which increases in size by what Handley describes as the hæmodynamic pressure produced by recurring hæmorrhage within the tube. The term *peritubal haematocele* has been applied to the mass which is produced in this way. Figure 122 shows a good example of the peritubal variety of discrete hæmatocele. The tube has been partially dissected from the false capsule which embraced its fimbriated extremity, in order to demonstrate the patent ostium into which a bristle has been passed. The ampullary segment of the tube, which was the seat of the gestation, is seen to be distended, while the isthmic portion is normal.

Peritubal hæmatoceles form hard discrete tumours which are prone to acquire adhesions to the surrounding structures. When the clinical history is

indefinite, they may be diagnosed as uterine myomata or solid tumours of the ovary, or more frequently as tubo-ovarian masses of inflammatory origin.

(4) *Retro-uterine or Pelvic Haematocele.* (*See* Pl. XI, B.) A far more frequent occurrence than the formation of a peritubal hæmatocele is that of a diffuse pelvic or retro-uterine hæmatocele. The escape of blood is too extensive to allow of clotting and the formation of a capsule around the ostium of the tube, the blood is therefore poured into, and fills, the pouch of Douglas. The clot thus formed is bounded below by the floor of Douglas' pouch, in front by the uterus and broad ligaments, whilst above it becomes shut off by a false membrane, adherent coils of intestine and omentum. The adhesions in these cases may be so dense as to resemble the capsule of a cyst. In such an encapsulated mass of blood lies the ovum in the form

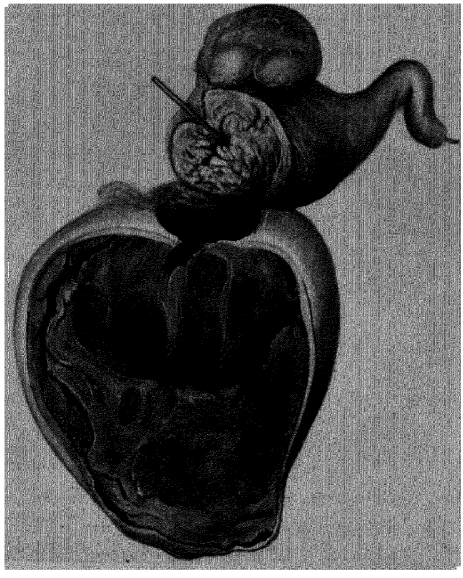


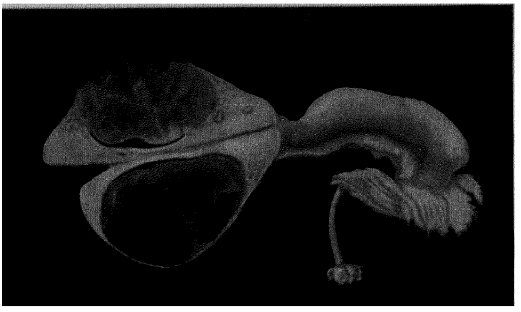
FIG. 122. PERITUBAL HÆMATOCELE. The ostium of the tube has been dissected off the hæmatocele and a rod has been inserted into the patent fimbriated end of the tube.

of a mole, or the latter may be found still detained at the site of expulsion (*see* Fig. 121).

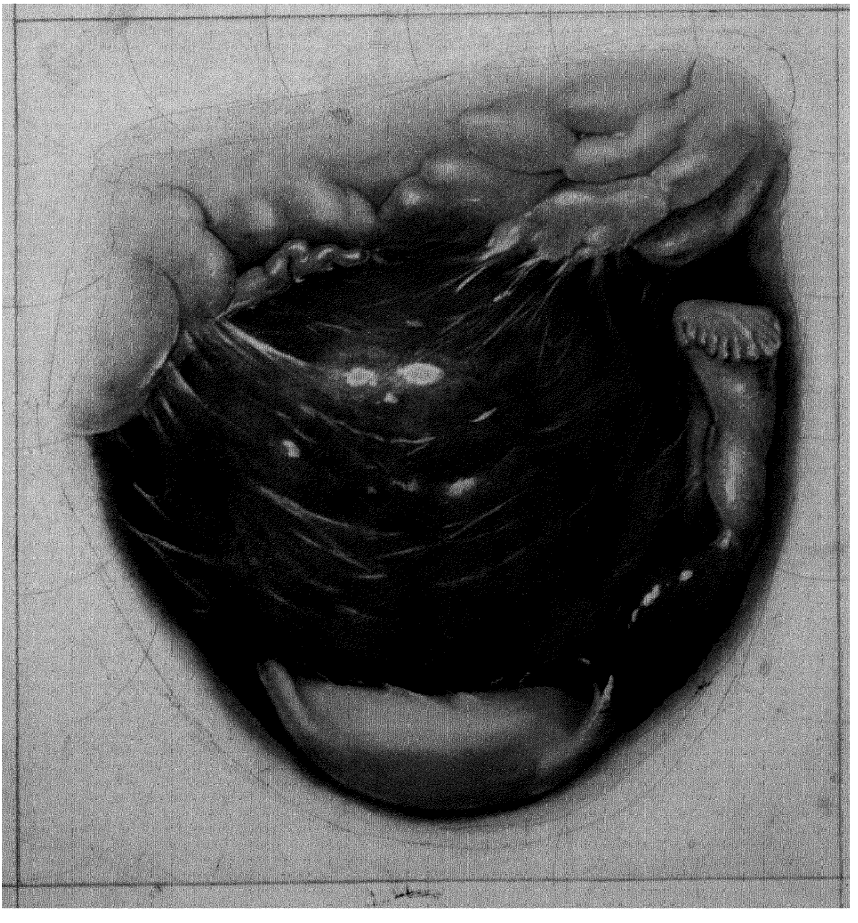
II. External Tubal Hæmorrhage. The second possible ending to a tubal pregnancy is for the *gestation-sac* to rupture, not into, but outside, the tube. In these cases the muscle-wall forming the gestation-sac becomes so thinned by the eroding action of the trophoblast that it ruptures (*a*) through the peritoneal coat of the tube into the abdominal cavity, or (*b*) through the uncovered floor of the tube into the broad ligament. In the case of both (*a*) and (*b*) *external tubal haemorrhage* is said to have occurred, and the condition in (*a*) is described as *intra-peritoneal* rupture, whilst in (*b*) it is spoken of as *intra-ligamentary rupture.*

In the case of intraperitoneal rupture a time comes when both muscle

PLATE IX



(A.) An unruptured tubal pregnancy showing intramural implantation of the ovum, which has been converted into a mole. U.C.H., Med. Sch. Museum. No. 690.
(After G. BLACKER. By permission of Messrs. MACMILLAN & Co.)



(B.) A Pelvic Hæmatocele secondary to rupture of a tubal pregnancy in the isthmic portion of the left Fallopian tube.
(After G. BLACKER. By permission of Messrs. MACMILLAN & Co.)

To face page 220.

and peritoneum have been eroded and the external boundary of the ovum is composed only of trophoblast and fibrinous tissue. A sudden rent may then occur externally and violent hæmorrhage result. Thus we have the condition known as *spontaneous tubal rupture*. More rarely, villi are seen to project here and there covered only with blood-clot, which overlies and encloses miniature leakages. This is spoken of as a *latent rupture*, and leads to the formation of a *paratubal haematocele*.

(*a*) *Paratubal Haematocele*. Leakages may occur at various points around the ovum, and by the resulting clot increasing in size a discrete or solitary hæmatocele is produced in the same way as was seen to happen in the case of tubal abortion. In this case a false capsule is formed which embraces the part of the tube in which the leaking point or points occur. As

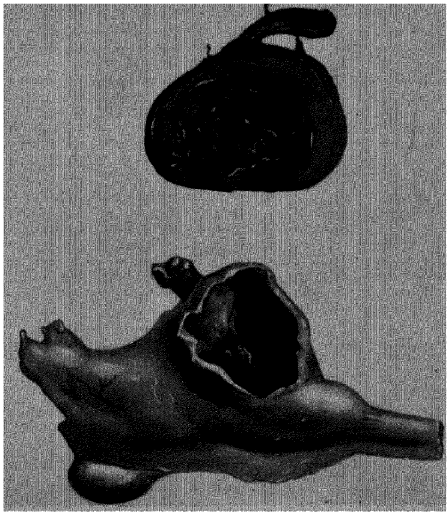


FIG. 123. PARATUBAL HÆMATOCELE. A false capsule has formed, around a leak, at the junction of the isthmic and ampullary portions of the tube. The upper drawing shows the blood-clot which lay within the false capsule before its rupture.

only a part of the circumference of the tube is enveloped by the encysted clot, the term *paratubal* is applied to this variety of hæmatocele. Figure 123 shows this condition. The false capsule has ruptured, and its contents are seen in the upper drawing: the rupture occurred in the narrow portion of the tube internal to the ampulla.

(*b*) *Spontaneous Tubal Rupture*. In whatever part of the Fallopian tube the fertilized ovum may be lodged, there is a liability to the occurrence of *spontaneous rupture*. In the isthmic and interstitial parts of the tube rupture is apt to occur earlier than in the ampullary portion, owing to the fact that the lumen of the tube is larger and more distensible at the ampulla than it is in the interstitial and isthmic segments. The commonest time for rupture to occur is between the eighth and tenth weeks, but it may be earlier or later than this. The conditions which *predispose* to rupture have been men-

tioned, viz. thinning of the tube-wall by distension, and the eroding action of the villi. In addition, there is probably a *determining* cause in most instances, such as a sudden increase in size of the ovum from hæmorrhage, or slight increase in vascular tension from some muscular effort on the part of the patient. Occasionally the eroding action of the villi alone will determine spontaneous perforation of the wall of the tube. Occlusion of the abdominal ostium is not an essential factor in the causation of rupture, for this accident frequently occurs without it (*see* Fig. 113, p. 173), even in the ampullary variety. Any part of the wall of the distended portion of the tube may burst.

The results of rupture, in so far as the life of the ovum is concerned, depend to a great extent upon the position of the rent. If occurring upon the roof or sides of the tube the rupture will involve the peritoneal covering,



FIG. 124. INTRA-PERITONEAL RUPTURE OF THE TUBE (diagrammatic; after Giles). The chorion has been torn, but the amnion remains intact, the fœtus contained within it; the placental portion of the chorion is uninjured. The fœtus may survive.

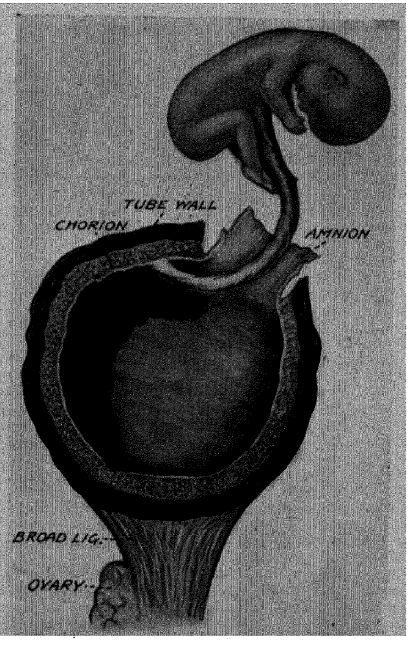


FIG. 125. INTRA-PERITONEAL RUPTURE OF THE TUBE (diagrammatic; after Giles). The chorion and amnion have both been torn, and the fœtus has escaped from the gestation-sac; the placental portion of the chorion is injured. The fœtus will perish.

and the blood effused will therefore be poured out into the general peritoneal cavity, while the ovum may be completely expelled through the rent (*see* Figs. 124 and 125). If, on the other hand, the tear takes place in the floor of the tube, the peritoneal coat may escape, while the effused blood and the discharged ovum will make their way between the layers of the broad ligament, gradually separating these peritoneal folds and burrowing in the connective-tissue which this ligament contains (*see* Figs. 126 and 127).

This form of rupture is very uncommon and occurs mainly in cases of isthmic pregnancy, since the lower wall of this portion of the tube is less completely invested by peritoneum than the ampulla. The former, as previously stated, is known as *intra-peritoneal* rupture, the latter as *intra-ligamentary* or *extra-peritoneal* rupture. In both varieties the ovum is, as a rule, destroyed by previous hæmorrhage and converted into a mole. Apart from hæmorrhage, death of the ovum also inevitably follows (*a*) if the amnion is ruptured, or (*b*) if the placental portion of the chorion is lacerated or detached by the rupture (*see* Figs. 125 and 127). Occasionally, however, the ovum may continue its development, and in such cases it is observed that the amnion has remained intact, and that the placental chorion was so situated as to-

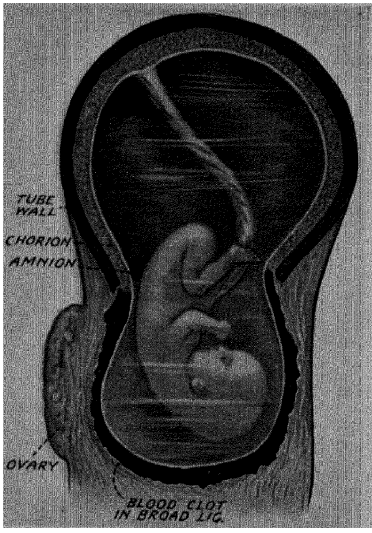


FIG. 126. INTRA - LIGAMENTARY RUPTURE OF THE TUBE (diagrammatic; after Giles). The amnion and the placental portion of the chorion are uninjured. The fœtus may survive.

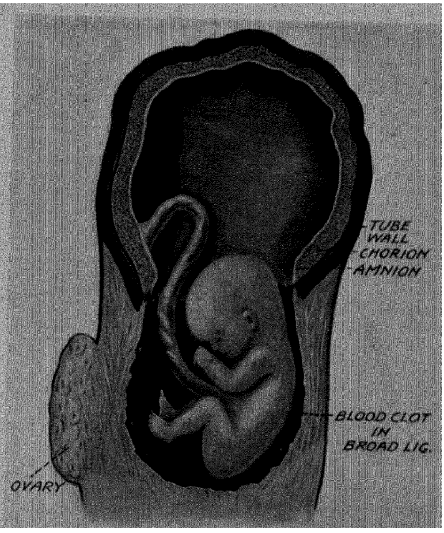


FIG. 127. INTRA-LIGAMENTARY RUPTURE OF THE TUBE (diagrammatic; after Giles). The chorion and amnion have both been torn, and the placental portion of the chorion is injured. Bleeding is intra-ligamentary. The fœtus will perish.

escape injury from the rupture (Figs. 124 and 126). In intraperitoneal rupture the placenta then grows out of the rent in the tube and becomes attached to the neighbouring peritoneal surfaces, while layers of lymph are deposited upon the exposed amnion from the surrounding peritoneum, forming a false membrane which constitutes a secondary gestation-sac (*tubo-abdominal gestation; see* Fig. 131, p. 189). This secondary sac becomes further strengthened by adhesion to the neighbouring peritoneal surfaces, including omentum (*see* Figs. 128 and 129), coils of intestine, and the abdominal parietes. The ovum is now known as a *secondary abdominal* (*intra-peritoneal*) *pregnancy*. Precisely similar results may follow extra-peritoneal-rupture, and for the same reasons; the condition is then described as *secondary abdominal* (*intra-ligamentary*) *pregnancy* (*see* Figs. 126 and 130). Intra-ligamentary pregnancy may undergo *secondary rupture* into the peri-

toneal cavity (Fig. 130); even then the ovum is not in all cases destroyed, but may continue to survive, as also happens in the case of an intra-peritoneal pregnancy (*see* Figs. 128 and 131).

Both intra-peritoneal and intra-ligamentary pregnancy may continue till term; the patient then usually passes through a 'false-labour' and the fœtus perishes. The occurrence of this false labour is a physiological point of great interest and importance, but we have no information as to its causation, or the mode in which it leads to the death of the fœtus. False labour is attended with severe abdominal pain, which is mistaken by the patient for

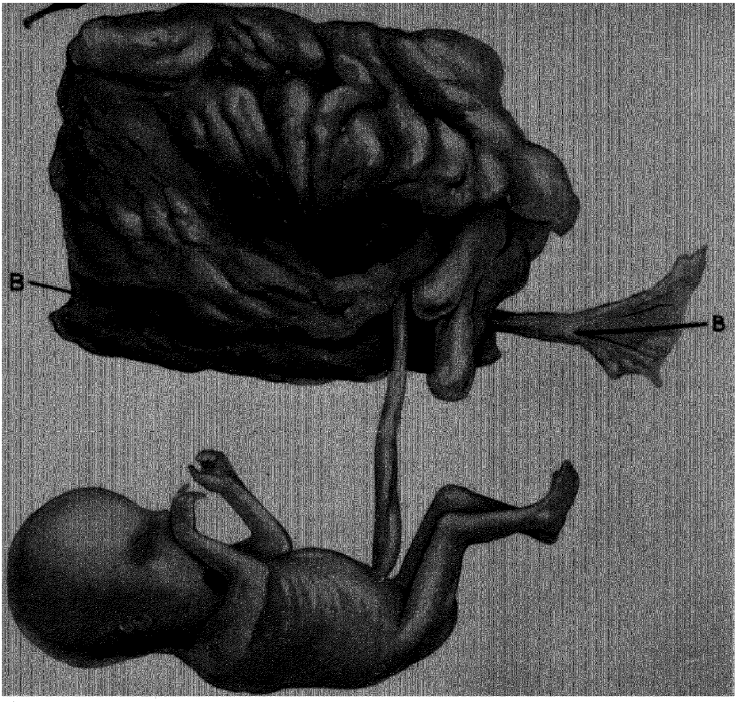


FIG. 128. MASS OF OMENTUM COILED AROUND A SECONDARY GESTATION-SAC ABOVE A RUPTURED FALLOPIAN TUBE. A bristle (B-B) has been passed along the tube. The fœtus continued to develop for sixteen weeks after the primary rupture (Routh and Lockyer).

labour, but there is no clinical evidence that uterine contractions play any part in its production.

In the intra-peritoneal form of secondary abdominal pregnancy the gestation-sac consists of a membrane which is largely inflammatory in origin, and is composed of layers of lymph deposited upon the amnion, in which organisation has proceeded to a variable extent. The membrane becomes closely adherent internally to the amnion, externally to the abdominal walls, and to the viscera, which structures support it and add to its strength. A great deal of the placental blood-supply is obtained from adherent omentum and mesentery. In this form of pregnancy the placenta generally lies below the fœtus.

In the intra-ligamentary form the gestation-sac consists of the tissues

composing the broad ligament, which are progressively expanded as the fœtus grows. This process involves great changes in the anatomical relations of the parts. Thus the peritoneum is raised from the pelvis, and stripped off the anterior abdominal wall, so that the reflection which corresponds to the floor of the utero-vesical pouch may exceed the height of the umbilicus. To this condition the term *anterior extraperitoneal pregnancy* is given. When situated posteriorly to the uterus the fœtus may be accommodated in a sac formed by the elevation of the peritoneum of the posterior layer of the broad ligament, and then that of the pouch of Douglas and that of the posterior



FIG. 129. The same specimen as shown in Figure 128 (Routh and Lockyer). The omentum has been folded back to expose a secondary gestation-sac lying within it and above the Fallopian tube. The latter is seen to have ruptured through its isthmic portion.

pelvic wall. Finally, the mesocæcum or mesosigmoid may be opened up by this, the so-called *posterior extraperitoneal* pregnancy. An incidental result of these changes is that in the *anterior* cases the sac may be opened by an abdominal incision without traversing the peritoneal cavity at all, whilst in *posterior* cases the fœtus may lie in a peritoneal sac which, on opening the abdomen, may be eventrated almost as freely as is possible with the gravid uterus.

In cases of intra-ligamentary gestation the relation of the placenta to the fœtus is of importance. It was seen that in the secondary abdominal (intra-peritoneal) pregnancy the fœtus generally lies *above* the placenta. In the intra-ligamentary variety the fœtus lies generally *below* the placenta (*see*

Fig. 130). By the growth of the fœtus the placenta becomes displaced progressively upwards, which causes its detachment from its original connections with consequent death of the fœtus. A point of importance in posterior extraperitoneal gestation is the close relationship of the sac to the rectum, which frequently leads to infection. Hence it is that in this

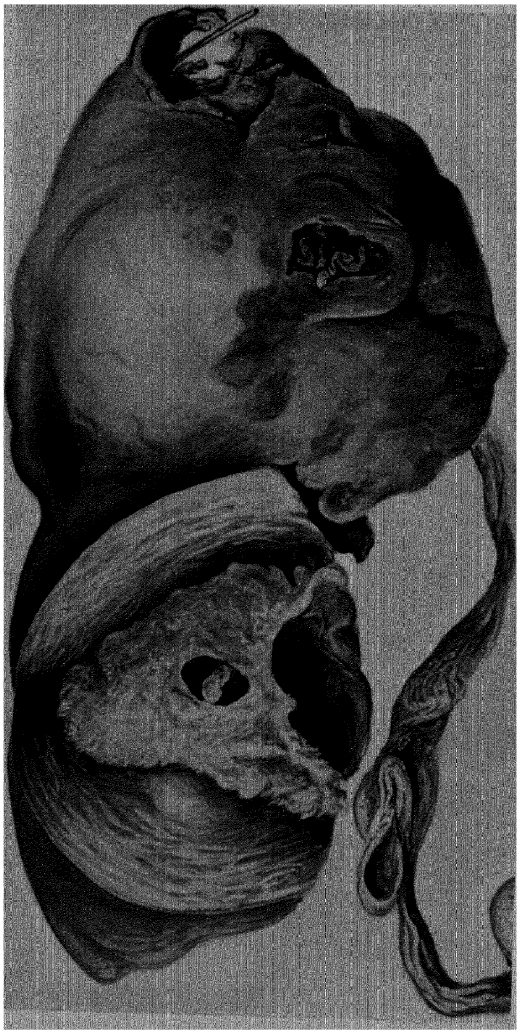


FIG. 130. INTRA-LIGAMENTARY PREGNANCY OF THE RIGHT SIDE. The uterus has been opened up from behind; it shows the decidua of pregnancy *in situ*. The fœtus lay below the placenta and had escaped into the peritoneal cavity by *secondary rupture* of the gestation-sac. The umbilical cord is seen issuing from the bottom of the broad ligament. A bristle lies in the Fallopian tube at the top of the expanded broad ligament.

variety suppuration and the discharge of fœtal bones *per rectum* are known to occur.

In a true broad-ligament gestation the ovary and its ligament will lie outside the sac, stretched out either on its posterior surface or on the summit, or even on its anterior wall. The localization of the ovary is a matter of importance because a condition known as *pseudoligamentary* gestation is apt to be confused with and spoken of as gestation between the layers of the broad ligament. In the false variety the fœtus is contained within the ampullary portion of the tube, which becomes adherent to the posterior

surface of the broad ligament, the latter being stretched over the sac like a cap. In these cases the ovary lies in front of the gestation-sac, between it and the posterior surface of the broad ligament.

Many cases are on record, both in ancient and in modern times, in which an extra-uterine fœtus has been retained within the abdominal cavity for many years after its death. In some of these cases the gestation-sac

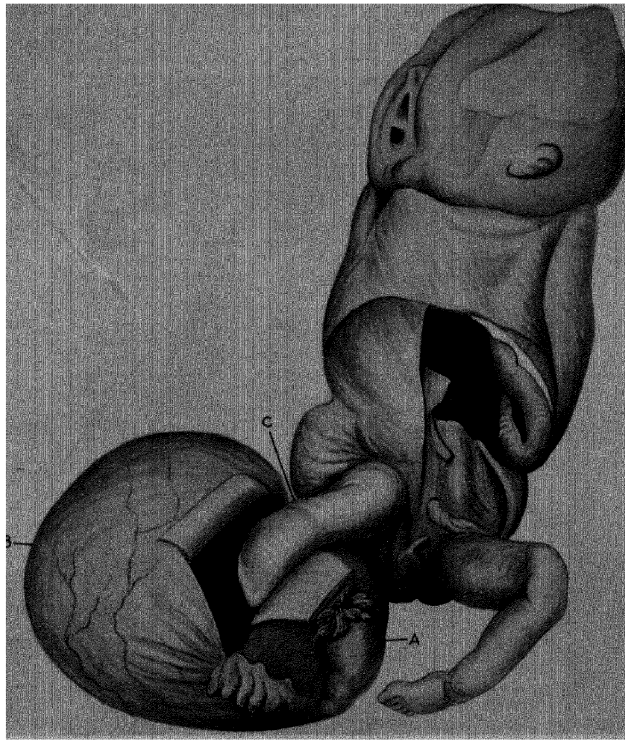


FIG. 131. TUBO-ABDOMINAL PREGNANCY, from a sketch by one of the authors of a specimen shown by Dr. J. B. Hellier. A, Ampulla of tube; B, Primary tubal gestation-sac; C, Foot of fœtus within gestation-sac. The rest of the fœtus had escaped into the peritoneal cavity.

has become infected from the bowel or the uterus, and suppuration has occurred, resulting in the formation of fistulous communications with the exterior, or with the neighbouring hollow viscera—large intestine, bladder, and vagina. Through these fistulæ, fœtal bones are from time to time discharged. When, however, the sac remains free from infection, the body of the fœtus shrinks by absorption of its fluid constituents, and upon the dried tissues limesalts become freely deposited, converting it into a *lithopædion*. In this condition it may be retained for many years with little disturbance to the patient.

MULTIPLE PREGNANCY AND ECTOPIC GESTATION

With intra-uterine gestation multiple pregnancy, occurring as it does in about one in eighty cases, is a fairly common incident. On the other hand, with extra-uterine gestation multiple pregnancy is a rare event.

Reported cases fall into three categories.

I. Coincident intra- and extra-uterine pregnancy.

II. Multiple pregnancy in a single Fallopian tube.

III. Coincident pregnancy in each tube; (*a*) cases of consecutive gestation; (*b*) cases of simultaneous binovular gestation.

Class I includes the greatest number of cases, whilst Class III (*b*) contains the fewest, *i.e.* simultaneous binovular gestation is the rarest form of ectopic gestation.

It has already been stated (*see* p. 169) that at least forty-two authentic cases of ovarian pregnancy have been collected up to 1927, whereas we can only find twenty-eight cases in which *simultaneous* pregnancies in both tubes have been proved, figures which show this to be the rarest gestation-type of all. The question of abdominal pregnancy for the genus *homo* being unsettled, cases reported as such are not here considered.

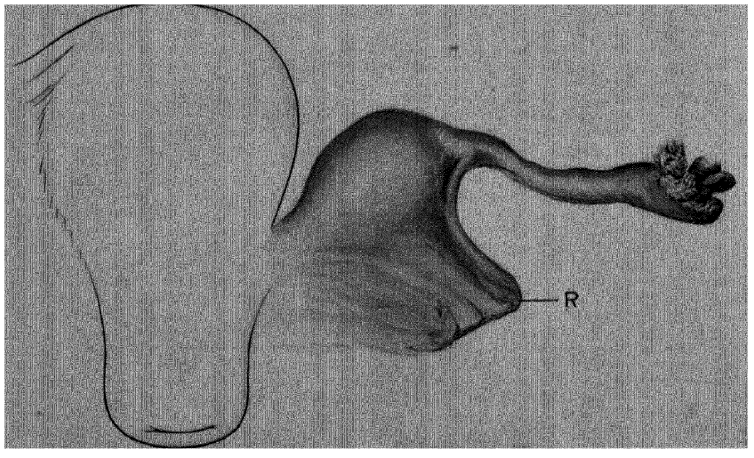


FIG. 132. ACCESSORY HORN ATTACHED TO THE LEFT SIDE OF A WELL-FORMED UTERUS. (Diagrammatic, the uterus was not removed.) The round ligament (R) is seen coming off from the outer side of the horn. There was no communication between the accessory horn and the normal uterine cavity.

The most remarkable case of multiple pregnancy in a single Fallopian tube is that of Treub of Amsterdam: the gestation-sac contained quintuplets. In McCann's case there were uni-ovular twins with a single implantation.

Diagnosis of Bilateral Tubal Pregnancy. It is practically impossible to make a *clinical* diagnosis of simultaneous pregnancy in both tubes; but in the case of consecutive pregnancies, *i.e.* where one tube becomes gravid some considerable time before the other, a diagnosis *may* be possible. Definite attacks of pain, starting on the one side and then on the other, have been noted, but hitherto no correct diagnosis has ever been made before operation. With the abdomen opened it may be easy to observe a tubal lesion on both sides; nevertheless the bilateral nature of the lesion has been missed, and this has necessitated a second operation. When operating for extra-uterine gestation it is, therefore, essential to *examine the appendages on both sides.*

Even when the opposite tube is not the site of a gestation-sac it is no

infrequent occurrence to find it presents a hæmatosalpinx (Doran). In such cases the differential diagnosis can only be settled by microscopic examination. The most difficult diagnostic problem in connection with bilateral tubal pregnancy concerns the question of simultaneity, but this is an academic point into which it is not necessary to enter in a text-book.[1]

Treatment. The possibility of a bilateral tubal pregnancy is an argument in favour of early surgical intervention during an acute abdominal attack. Several cases are recorded in which only one tube was ruptured, but there may be an equally serious lesion on the opposite side in the shape of abortion. In fact, the patient incurs a double risk from the double lesion.

In removing both tubes every effort should be made to save as much ovarian tissue as possible. The uterus should not be extirpated unless the exigencies of a particular case call for its removal.

Pregnancy in the Accessory Horn of a Uterus Bicornis. This interesting

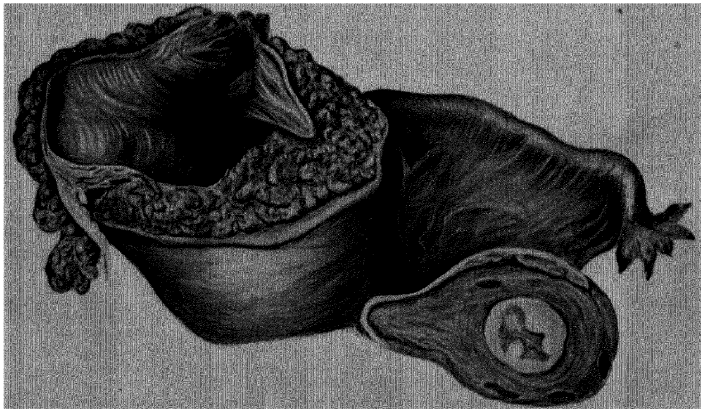


FIG. 133. PREGNANCY IN ACCESSORY HORN OF A BICORNUTE UTERUS SEEN FROM BEHIND. Rupture has occurred through the upper pole of the sac. The ovary contained a corpus luteum of pregnancy (Doran and Lockyer).

phenomenon has been repeatedly mistaken for tubal pregnancy, from which it is distinguished by the different relationship borne by the round ligament in the two conditions (*see* Fig. 132). In the case of tubal pregnancy the round ligament is attached to the inner side of the gestation-sac, whilst in cornual pregnancy it comes off the outer side of the sac.

In the majority of cases the band of union connecting the rudimentary or accessory horn to the uterus is solid, so that spermatozoa cannot enter this horn direct. In such cases external migration of the *spermatozöon* across the peritoneal cavity must take place if pregnancy occurs. The corpus luteum is then found in the ovary of *the same side* as the gravid horn, as shown in Figure 133. In other instances, where the corpus luteum is in *the opposite ovary*, external migration of the *ovum* must have occurred, either before or after fertilisation. In Figure 133 the accessory horn shows a broad pedicle which was found on microscopic section to be impervious. In the majority of cases the pedicle is narrow and long, allowing a considerable amount of mobility to the horn.

[1] 'Simultaneous Bilateral Tubal Pregnancy' (Cuthbert Lockyer, M.D.), *Proc. Roy. Soc. Med.*, vol. x, No. 7, pp. 88–102, 1917.

Rupture of a gravid horn generally occurs through its upper and inner wall, and is preceded by a gradual process of thinning (*see* Fig. 133). There is no decidual formation in an imperfectly developed horn (*see* Fig. 134), so that the eroding power of the trophoblast acts directly on the muscle-fibres in a way similar to that seen in tubal pregnancy, where it is also unchecked by a decidua. Contributing factors in the causation of rupture are found in the cornual contractions and in the increased tension due to the growth of the ovum within the sac. Some accessory horns are sufficiently well developed to allow pregnancy to continue to term. More often

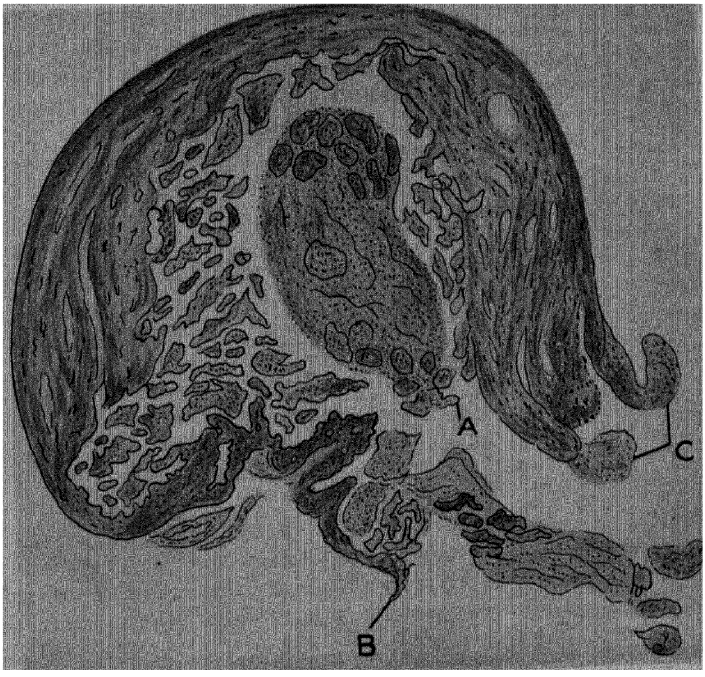


FIG. 134. TRANSVERSE SECTION THROUGH THE SITE OF RUPTURE OF CORNUAL PREGNANCY. Erosion of the muscular layers of the horn is well shown. A, Portion of placenta in lumen of horn; B, Muscle laminæ thinned out and plicated; C, Thick muscle-laminæ which have retracted after rupture, and expulsion of fœtus.

the musculature is feebly developed, and then rupture generally occurs at or before the sixteenth week of pregnancy. If pregnancy goes to term a false labour occurs, the fœtus dies and is retained, when it may become macerated, only the bones remaining, or it may be converted into a litho-pædion.

CLINICAL FEATURES OF TUBAL PREGNANCY

This subject will be considered in relation to three stages: I. Before the occurrence of internal hæmorrhage; II. After that occurrence; III. In secondary abdominal pregnancy.

I. Before the Occurrence of Internal Hæmorrhage. At this time tubal pregnancy gives rise to little more local or general disturbance than does an

early pregnancy in the uterus. When a healthy adult woman, who is usually regular, goes for two or three weeks over the expected date of her period, there is a strong presumption of pregnancy, but at this time there may be nothing to indicate whether pregnancy is uterine or extra-uterine. The general signs and symptoms of pregnancy, such as amenorrhœa, morning sickness, and slight mammary changes, are often met with ; but in something like 30 *per cent.* of cases there is no definite interruption of the periods, as irregular bleeding makes its appearance at or before the time when the first period following conception becomes due. The occurrence of uterine bleeding probably indicates that hæmorrhage has occurred either into the gestation-sac or into the tube-lumen. In the remainder, amenorrhœa may persist for a period of two or three, or exceptionally, four to five months. During this time the only symptom likely to be met with apart from those of pregnancy is recurrent attacks of spasmodic abdominal pain, which is often referred to the affected side (Blacker). This is probably due to distension of the tube, for it is certain that hyperplasia does not occur in the gravid tube comparable to that seen in the gravid uterus ; dilatation in the gravid tube is therefore *passive*, not *active*. The occurrence of attacks of abdominal pain in early pregnancy should always arouse the suspicion of an ectopic gestation, and must be regarded as indications for an internal examination.

Physical Signs. The presence of signs of mammary activity are of importance only in a woman who has never before been pregnant ; the most important point is hypertrophy of some of the lobules of the gland, often those in the upper and outer quadrant. On vaginal examination softening of the lips of the external os may be detected, and this forms one of the most reliable signs of early pregnancy. The body of the uterus may be found to be somewhat enlarged and of softish consistence.

The *unruptured gravid tube* (Pl. XIA) forms an elastic swelling lying as a rule posteriorly or postero-laterally to the uterus (Fig. 115) ; it may in rare cases be found in the utero-vesical pouch. Pulsating vessels are often to be felt beneath it. Its physical characters do not distinguish it from tubal enlargements due to other causes, and its nature can only be inferred from the accompanying symptoms.

Care is required in distinguishing tubal pregnancy from a *tubo-ovarian swelling associated with early uterine pregnancy.* Before the eighth week the uterine changes characteristic of normal pregnancy cannot be definitely recognized even under anæsthesia, and herein lies the chief difficulty of the differential diagnosis. Cervical softening will be present in both cases. If there is slight uterine hæmorrhage, this in no way assists the diagnosis, for it often occurs from the gravid uterus. The character and position of the swelling are not essentially different in the two cases, but the presence of definitely pulsating vessels *on the affected side only* is favourable to a diagnosis of tubal pregnancy. Rapid increase in size of the swelling, as determined by repeated examination, is the surest differential point, but when in doubt it is always better to operate at once.

It appears certain, from clinical observation, that symptoms other than those just described do not occur until hæmorrhage has taken place – either into the tube itself, into the peritoneal cavity, or into the broad ligament. In the majority of cases the first sign of disturbance is the occurrence of a little external bleeding from the uterus, which may precede, by a few days, any of the more serious symptoms which inevitably follow. These symptoms,

which will be described below, are commonly regarded as the symptoms of extra-uterine gestation, but they are in reality *secondary* symptoms, inasmuch as they result not directly from the gestation, but from certain disturbances which either destroy the ovum or greatly modify the course of its development. Naturally the secondary symptoms are not uniform, for they depend upon the nature and extent of the damage which has been sustained by the ovum and the tube. In any case a marked and rapid transformation of the clinical features takes place as soon as the normal course of gestation in the tube is disturbed.

II. **After the Occurrence of Internal Hæmorrhage.** The uterine hæmorrhage continues and is usually steady, not irregular, moderate in amount,

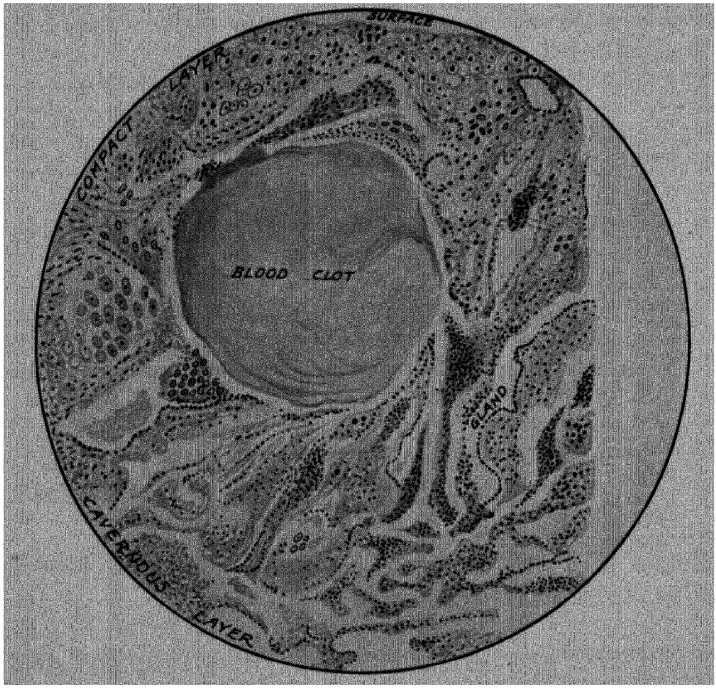


FIG. 135. DECIDUAL CAST FROM A CASE OF EXTRA-UTERINE GESTATION. A large interstitial hæmorrhage is seen in the centre of the membrane; to the left are seen clusters of decidual cells.

and dark in colour. Separation and discharge of the decidua may also occur, sometimes in the form of a complete cast of the uterus (*see* Fig. 114), more often in fragments; in some cases the discharge of the decidua is not recognized at all, and it is possible that it may be cast off gradually in the form of *débris*. The characters of the decidua are definite and uniform, and their recognition may be of considerable help in diagnosis.

The decidual membrane is smooth upon its inner and rough upon its outer surface, which is also often beset with small papillary elevations. Microscopically, it is seen to consist of a superficial compact layer, and a deep, reticulated or cavernous layer (*see* Fig. 135). The surface-epithelium is almost entirely lost, and very few glands are to be found in the compact layer, which consists of closely packed masses of oval, round, or polygonal

cells with large globular nuclei—the *decidual cells*. Many large venous sinuses and numerous interstitial hæmorrhages, sometimes of large size, are commonly found in this part of the membrane after it has been shed. The deep layer contains many irregularly dilated glands, in most of which the epithelium is fairly well preserved. The presence of decidual cells in small numbers, in tissue discharged from the uterus, is not of much diagnostic importance, but a membrane possessing the characters above described is distinctive of pregnancy. In cases of uterine pregnancy (abortion) traces of chorionic villi, or of chorionic epithelium, will usually be found attached to the decidual membrane, but naturally this will not be found in extra-uterine pregnancy.

The clinical results of internal bleeding in tubal pregnancy are variable and mainly depend upon two factors, viz. the *amount* and the *rapidity* of the bleeding; three clinical types may be defined.

(*a*) If the hæmorrhage is rapid and the amount of blood lost is great, the effused blood becomes distributed over the general peritoneal cavity, and tends to accumulate in the most dependent parts, viz. the pouch of Douglas and the renal pouches; this is the *diffuse* type sometimes spoken of as 'intraperitoneal flooding.'

(*b*) If the hæmorrhage is less severe, and occurs gradually instead of rapidly, a variable amount of blood will accumulate in the pelvis, mainly in the pouch of Douglas and around the gravid tube. This is the stage in which the greater number of cases of tubal pregnancy come to operation, and such cases usually show the condition already described as "tubal abortion," the tubal mole being either retained in the tube or discharged, partially or completely, through the abdominal ostium.

(*c*) Should such a case as this be allowed to continue, the effused blood will, in the course of a few days, become encysted by the formation around it of a limiting membrane composed of lymph, to which surrounding organs become attached by adhesion. An encysted collection of blood in the pelvic peritoneal cavity is called a *pelvic haematocele*.

A. Diffuse Type of Intra-peritoneal Bleeding. Occasionally a single hæmorrhage occurs so rapid and profuse as to cause death before surgical aid can be obtained. Blacker has recorded a case which ended fatally in twenty minutes, and a specimen in our collection was obtained from a case which ended fatally in a few hours. It may ensue with this appalling suddenness when there has been no previous warning of anything abnormal except perhaps the occurrence of attacks of spasmodic pain referred to above. In such a case the hæmorrhage is always intra-peritoneal, and may be due either to tubal rupture or to tubal abortion. More frequently a diffuse hæmorrhage is less severe than this, ceases spontaneously after a time, and, while imperilling the patient's life, is not necessarily fatal. It may, however, recur after an interval and ultimately prove fatal. The initial attack of bleeding may occur without any exciting cause, when the patient is at rest in bed, or even when asleep; more often it appears to have been induced by some slight muscular effort, such as that entailed by ordinary domestic work or by the act of defæcation.

Severe abdominal pain, sudden in onset, situated in one or both iliac regions, is usually the first symptom. It is often quickly followed by vomiting and occasionally by diarrhœa. Quite commonly it leads to faintness or, less often, to actual loss of consciousness from syncope. Upon these

symptoms supervene, in cases of profuse bleeding, the signs and symptoms of concealed hæmorrhage—pallor, rapid and feeble pulse, deep, laboured breathing (air-hunger), restlessness, coldness of the extremities or of the whole skin-surface of the body, sweating, depression of temperature. Slight hæmorrhage from the uterus will also usually occur. It must be recollected that it is only when a *very large amount of blood is rapidly lost* that the classical signs of internal hæmorrhage are met with. An equal amount of blood effused in stages, spread over two or three days, instead of at a single loss, does not occasion symptoms nearly so severe. Pallor and quickening of the pulse-rate may then be the only general signs observable.

The presence of a large amount of free blood in the peritoneal cavity can usually be detected by percussion ; when the patient is lying down it gravitates into the flanks, which accordingly become dull, and the area of dulness shifts slowly when the position of the patient has been altered.

When a diffuse tubal hæmorrhage, though severe, is not large enough immediately to imperil life, the symptoms resemble those of the condition often called " peritonism," and are common, with variations, to many circumstances in which fluid suddenly escapes into the peritoneal cavity. These symptoms are : Acute abdominal pain, at first located to one iliac region, but soon becoming general, with more or less profound shock , the symptoms of shock differ from those of profuse bleeding chiefly *in the absence of restlessness and air-hunger*. The pain may last for many hours, and may be accompanied by abdominal distension and by vomiting, but the latter is not persistent. Gradual improvement supervenes, and in two or three days the symptoms generally subside. There is, however, great risk under these circumstances of renewal of the bleeding, which will manifest itself by recurrence of more or less acute attacks of pain and of some of the symptoms of shock. Even while the patient is confined to bed, recurrences of bleeding may be met with ; a risk which is sufficiently explained by the anatomical points already referred to.

The *diagnosis* of tubal pregnancy under these conditions is sometimes fairly simple. When there has been a profuse loss of blood the fact that internal bleeding has occurred will be obvious from the signs already described , a history of a recent short period of amenorrhœa giving place to slight uterine bleeding will suggest the possibility of ectopic pregnancy. Pelvic examination may show softening of the cervix and a soft swelling in the pouch of Douglas, caused by the accumulation there of fluid or clotted blood. In some instances a lateral swelling representing the gravid tube may be found (Fig. 115). These findings together make up a strong presumptive case for the diagnosis of tubal pregnancy with internal bleeding.

More often there is no history of amenorrhœa, and all that can be made out on vaginal examination is the presence of blood in the pouch of Douglas, and particular attention should be directed to this point. Owing to the distension and tenderness, detailed abdominal examination may be impossible without anæsthesia, but the pouch of Douglas can always be examined, for it is easily accessible both *per vaginam* and *per rectum*. The space behind the cervix feels full, and the consistence of the swelling is characteristic ; there is no definite outline, it is soft and doughy when upward pressure is made with the finger, and, felt from the rectum, the swelling may be found to bulge towards the anterior rectal wall. The swelling is not a cyst, for its outline is impalpable , it is not inflammatory fluid, for there is a complete

absence of tension; it can only be blood. Judged in association with the general clinical features, this point is conclusive of the diagnosis of free internal hæmorrhage, the outstanding cause of which is ectopic pregnancy.

When the loss of blood has been less severe than this, the symptoms are less characteristic, and there may be some doubt whether perforation of a hollow viscus, or an acute inflammation, has occurred. The history may be misleading, inasmuch as early uterine pregnancy may be associated with any of these surgical disasters in women in the fertile period of life. If the condition of the patient is not too serious to allow of a few hours' delay, the further course of the case will often clear up the diagnosis, for after internal hæmorrhage has ceased the general condition rapidly improves, while with such lesions as acute peritonitis the general condition as rapidly deteriorates, and characteristic localizing symptoms may appear.

Differential Diagnosis of Diffuse Haemorrhage.

(*a*) *Acute Appendicitis.* Rare cases of so-called *fulminating appendicitis* occur in which the symptoms are mainly those of acute toxæmia, and there is little by which the lesion may be localized. The symptoms more closely resemble those of shock than those of hæmorrhage. In the case of an *appendix-abscess*, however, it is not uncommon to find a pelvic swelling (abscess) either on the right side or in the pouch of Douglas, and this is a source of difficulty in the diagnosis. It cannot be too strongly emphasized that indications of *concealed bleeding* are the most important signs of tubal pregnancy in the stage under consideration. Further, *uterine bleeding* is not met with in association with appendicitis, and due weight should be given to this sign, which is practically invariably seen in extra-uterine pregnancy. The more common type of *acute appendix* in which definite local muscular rigidity and tenderness are often associated with a swelling in the appendix region, need not be confused with tubal pregnancy. Yet even with careful consideration mistakes are not altogether avoidable, and it is the duty of the gynæcologist to fit himself to deal efficiently with cases of acute appendicitis which he may meet with when operating.

(*b*) *Perforation or Rupture of a Viscus.* In these conditions the predominant features in the early stages are those of shock, followed after some hours by the signs of an 'acute abdomen,' and later by those of general peritonitis. Here also the general indications of pregnancy, and the occurrence of uterine bleeding, will not be met with unless indeed the accident should occur in the early weeks of normal pregnancy and differential diagnosis is then almost impossible. In any case, the indication for an exploratory operation is urgent, and the operator must be prepared to deal with whatever condition he may find.

B. The Tubal Mole. The formation of the tubal mole usually takes place in the second month, and, except in rare instances, it is accompanied by hæmorrhage through the patent abdominal ostium. Occasionally the ostium is closed, when there will be no extra-tubal hæmorrhage. The bleeding is almost always of moderate degree, although occasionally a complete tubal abortion leads to 'intraperitoneal flooding.' In typical examples of this class the classical symptoms of amenorrhœa, uterine bleeding, and recurrent attacks of pain are encountered, and on vaginal examination the physical signs are those of a diffuse pelvic swelling the consistence of which is not uniform, and which can usually be recognized as involving one or

other lateral half of the pelvic cavity. Some degree of irregular fever is often present, possibly some degree of anæmia, depending naturally upon the amount of internal hæmorrhage.

The *diagnosis* in such a case as that just described is fairly clear. When the classical symptoms are modified, as they often are, the differential diagnosis from an inflammatory condition such as salpingitis must be considered, and the decision is often difficult. In the case under consideration there is no danger in keeping the patient under observation, and in bed, for a few days; rapid improvement in the symptoms and physical signs favours the diagnosis of an inflammatory condition. If the condition is stationary or deteriorating, operation must not be further delayed.

C. Encysted Type of Internal Bleeding. In this form bleeding is more gradual than in the diffuse type, and the signs of internal hæmorrhage are usually inconspicuous. Nevertheless a certain amount of pallor and quickening of the pulse are present from the first, and may become more pronounced as the case proceeds. The prominent symptoms constantly encountered are *pain, fever,* and *uterine haemorrhage;* as a rule attacks of pain precede the occurrence of bleeding, increasing in intensity as they recur.

The *pain* which is met with is almost always sudden in onset, and usually spontaneous, although muscular effort may appear to excite it; it is always severe, and may be intense; beginning in one or other iliac region, it soon affects the whole abdomen, but later on may again become localized; it may at first be attended with vomiting and other signs of shock, sometimes with faintness or actual syncope; after lasting acutely for several hours it subsides, and thereafter may recur at varying intervals of a few days or a week, until several attacks have been sustained; sometimes continuous pain without exacerbations follows the first attack.

The *uterine haemorrhage* rarely begins before the first attack of pain; it shows the characters already mentioned, and may be accompanied by discharge of a decidual cast, either complete or in fragments.

After pain and bleeding have lasted for a few days *an irregular elevation of the temperature* occurs as a rule, which is due in part to the peritonitic reaction which occurs around the effused blood and results in its isolation, and in part to the absorption of fibrin-ferment or other products from the dead blood. The temperature seldom exceeds 100°–102° F. unless infection of the hæmatocele occurs; yet occasionally a sharp rise to 104° or 105° has been observed from an uninfected hæmatocele.

The blood which is slowly poured from the gravid tube tends to accumulate in the most dependent part of the peritoneal cavity—the pouch of Douglas. In some cases, probably when the bleeding is very slow, the effused blood does not reach the pouch of Douglas at all; it becomes rapidly encysted by adhesive peritonitis and is detained in contact with the bleeding part, usually the abdominal ostium, at times a rent in some other part of the tube. An encysted collection of blood in the pelvic peritoneal cavity is called a *pelvic haematocele;* when formed around the abdominal ostium it is distinguished as *peritubal* (*see* Fig. 122), when formed upon the proximal part of the tube it is called *paratubal* (Handley) (*see* Fig. 123). Around these encysted collections of blood *a false capsule* is rapidly formed by the deposition of layers of lymph, and beneath this by organization of the superficial layers of the blood-clot. In this way a membrane $\frac{1}{16}$ to $\frac{1}{4}$ inch in thickness may be formed. In those rare instances where intra-ligamentary rupture

occurs, the blood is slowly poured out between the layers of the broad ligament, and this condition is distinguished as a *pelvic haematoma.*

Physical Signs. From the symptoms which have been already described, a presumptive diagnosis of tubal pregnancy with internal bleeding can generally be made. The physical signs met with are mainly those of a pelvic effusion, the nature of the effusion being inferred from the history and the symptoms.

A large pelvic *haematocele* forms a swelling extending upwards above the pubes (*see* Fig. 136). The hypogastric region is prominent, and pressure causes considerable pain. On palpation a dome-shaped swelling, ill-defined

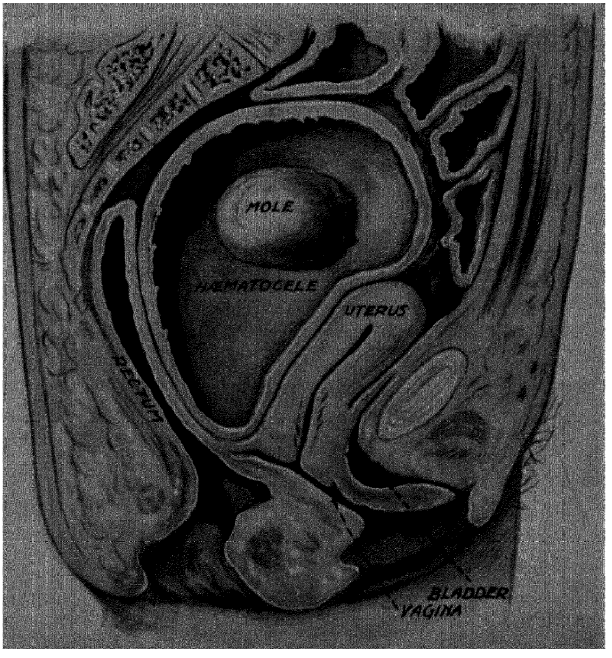


FIG. 136. PELVIC HÆMATOCELE SHOWN IN MESIAL SAGITTAL SECTION (Bumm.) The section shows the hæmatocele distending the pouch of Douglas and pushing the uterus forwards. Attached to the left wall of the hæmatocele is a tubal mole.

in outline and elastic in consistence, can be made out. Its position is usually, but not always, mesial. On percussion the note is subresonant. The surface of the swelling felt in the hypogastrium corresponds to the roof of the hæmatocele, which is formed by omentum and coils of intestine adherent to one another and to the mass of effused blood beneath them.

On vaginal examination, it will be found that the whole uterus, including the cervix, is displaced forwards and pressed close up to the back of the symphysis pubis; usually the level of the uterus is lower than normal, and occasionally it may be displaced a little to one side or the other. Softening of the lips of the os externum may be recognizable and the uterine body is somewhat enlarged. The rest of the pelvis is occupied by the effusion, which has crowded the uterus out of its normal position; sometimes it depresses the floor of the pouch of Douglas and causes bulging of the posterior

fornix. The consistence of the swelling is generally elastic ; it may be almost doughy in parts or, on the other hand, areas which feel firm and solid may be encountered. These variations are probably due to incomplete or irregular coagulation of blood. The pelvic mass is continuous with that felt above the pubes. On rectal examination it may be found to fill the sacral hollow (Fig. 136) and compress the bowel ; thickening of the uterosacral folds is also commonly felt and probably results from coagulation taking place upon their surfaces.

Differential Diagnosis of Pelvic Hæmatocele. In considering this point it must be recollected that, although the great majority of pelvic hæmatoceles are due to ectopic pregnancy, this is not invariably the case. Thus Jayle has collected seventeen cases due to rupture of a small blood cyst in the ovary, and others have been recorded from rupture of a tubo-ovarian varicocele, and from a large vein on the surface of a fibroid tumour.

Four conditions may give rise to difficulty in diagnosis, viz. (1) a retroverted gravid uterus ; (2) an inflammatory effusion ; (3) an ovarian tumour incarcerated in the pelvis , (4) an incomplete uterine abortion.

(1) The differential diagnosis is not always easy from *retroversion* of the *gravid uterus*. It is, however, of practical importance, for if the treatment of a retroverted gravid uterus was applied to a case of pelvic hæmatocele, disaster might follow from rupture of the hæmatocele.

The history usually presents well-defined differences. Thus retention and incontinence of urine, common in retroversion when the uterus has grown large enough to fill the pelvis, are exceptional with hæmatocele, although they sometimes occur. Bleeding from the uterus may occur with either, but the discharge of decidual tissue, apart from abortion, is only met with in extra-uterine cases Attacks of abdominal pain strongly favour the diagnosis of hæmatocele.

On bimanual examination the gravid uterus is of more uniform consistence than the hæmatocele, and may sometimes be felt to undergo intermittent contractions. The point of chief diagnostic importance, however, is that with a hæmatocele the body of the uterus will be found to lie *in front of the swelling which fills the pouch of Douglas.* If the fundus cannot be felt in front, or to one or other side, it may be concluded that the swelling felt posteriorly is the enlarged uterine body. Owing to the softening of the tissues in pregnancy the cervix of the retroverted uterus may appear under anæsthesia to be movable independently of the retroverted body, and the observer must not be misled by this point. Unless the uterine body can be definitely recognized in front of the swelling it is not a hæmatocele.

(2) An *ovarian cyst* which has become incarcerated by adhesions in the pouch of Douglas, and is sufficiently large to occupy the whole pelvic cavity, gives rise to the same displacement of the uterus as a hæmatocele. The consistence of the swelling is, however, uniform, and more tense or resistant than the hæmatocele, and its general outline is better defined. Menstruation may be unaffected ; the commonest disturbance, if any, being in the direction of menorrhagia. There is no softening of the cervix and no irregular uterine bleeding.

(3) *Inflammatory* (peritonitic) effusions in the pouch of Douglas and inflammatory enlargements of the Fallopian tubes can often be distinguished by a careful consideration of the history (*see* p. 230), and in this connection it should be borne in mind that while fever is the initial symptom in pelvic

peritonitis, which is sometimes ushered in with a rigor, it is a comparatively late and mild one in hæmatocele. In inflammatory cases the general condition of the patient does not suggest hæmorrhage ; there is no pallor, and the pulse, though quick, is of high tension. There are none of the general symptoms of pregnancy. The pelvic signs of the two conditions may be very similar, but the local tenderness in the case of the inflammatory effusion is much greater than in the case of the hæmatocele, and there is more abdominal distension.

(4) *Incomplete Abortion.* This diagnostic error usually consists in regarding a case of hæmatocele as an abortion , in many instances the uterus has been explored and curetted before the true nature of the condition has been recognized. The mistake may be followed by serious consequences if the hæmatocele is ruptured, or if septic infection should occur.

Both conditions are attended by the general signs of pregnancy, the occurrence of abdominal pain, uterine bleeding, and the discharge of membrane from the uterus ; the cervix is found to be softened, and on perfunctory examination a peritubal hæmatocele may be mistaken for the body of the gravid uterus. Fever also may occur with either. No rules for the avoidance of this error need be laid down , care in consideration of symptoms and in pelvic examination is undoubtedly called for, and due attention should be paid (*a*) to the position of the swelling ; (*b*) to its correspondence in size to the presumptive period of pregnancy ; (*c*) to the severity of the external bleeding, which is hardly ever profuse with hæmatocele, but frequently so with an abortion ; (*d*) to the nature of the discharged membrane, chorionic tissue being readily recognizable even to the naked eye.

Peritubal and paratubal hæmatoceles cannot be clinically distinguished from a sactosalpinx. Effusions of blood into the broad ligament (hæmatoma) closely resemble inflammatory effusions in the same position (cellulitis), and are best distinguished by the clinical history.

III. **Secondary Abdominal Pregnancy.** The clinical diagnosis of this condition presents considerable difficulties, and in the great majority of the recorded cases diagnosis has not been made until, following upon the death of the fœtus, the gestation-sac has become altered by infection or by shrinkage. The history of the pregnancy presents abnormal features, such as attacks of abdominal pain in the early months, usually accompanied by hæmorrhage ; but when the ovum survives a tubal rupture, the amount of internal bleeding appears to be inconsiderable, and the accompanying symptoms are less urgent than those described above. In advanced pregnancy the local conditions on abdominal examination may closely resemble those of normal gestation, the position of the body of the fœtus, and of the presenting part, showing little abnormality. The most striking difference is the condition of the cervix : in an advanced normal pregnancy the degree of softening of the whole of the cervix is extreme and quite characteristic : in the extra-uterine case softening, if apparent at all, is only slight. Careful examination under anæsthesia would, however, show that the uterus was small and was displaced to some extent by the gestation-sac, while the use of the sound would indicate that the uterine cavity was only slightly enlarged and empty. The differential diagnosis of the intra-ligamentary from the intra-peritoneal variety presents even greater difficulties ; in the latter the fœtus usually lies above the pelvic brim and is more freely movable ; while

in the former the head may lie unusually low in the pelvis to one or other side, and the mobility of the fœtus may be unusually limited. But absolute reliance cannot be placed upon these points.

The fœtus often perishes before full time is reached; it may, however, survive until term has been exceeded. A definite attack of pain, such as could be called a 'false labour,' does not in all cases occur, but when met with it is usually synchronous with the death of the fœtus. After this occurrence the abdominal enlargement may gradually decrease from absorption of fluid; on the other hand, it may rapidly increase in size, either from hæmorrhage into the gestation-sac, or from infection reaching it from the bowel. Infection is usually distinguishable from hæmorrhage by being accompanied by fever.

Old cases of secondary abdominal pregnancy, in which the fœtus has been retained for prolonged periods after its death, are almost incapable of being clinically diagnosed. It is curious to note the extraordinary resistance to infection from adherent intestine which this condition exemplifies. Notwithstanding the large masses of dead matter which the gestation-sac contains, and its contiguity to sources of infection, the processes of dry gangrene (mummification) and subsequent encrustation with lime-salts may proceed without apparent interruption, and the presence of the large foreign body may be tolerated for many years with little apparent inconvenience. Many instances are on record of a lithopædion being found in the body of a woman who died of some independent malady at an advanced age. Thus Kuchenmeister has recorded the case of a woman who died at the age of eighty-seven, and in whose body a lithopædion was found which, it was estimated, had been retained for a period of fifty-seven years. In some cases, however, a lithopædion has proved to be the direct cause of death from intestinal obstruction.

TREATMENT OF EXTRA-UTERINE PREGNANCY

This subject must be considered in relation to the various clinical phases just described.

I. **Unruptured Extra-Uterine Gestation.** In this case the gravid tube or ovary should be removed without delay by abdominal section. The great probability that internal hæmorrhage will occur, with its serious risks to life, necessitates this preventive operation being performed in all cases. The operation required is that afterwards described on p. 695; in the case of tubal pregnancy the corresponding ovary is as a rule healthy and should not be removed. The gravid tube can be excised by securing the mesosalpinx with two or three ligatures and dividing the tube close to its uterine attachment (salpingectomy). The procedure is simple and the prognosis correspondingly favourable.

II. **Diffuse Hæmorrhage.** In this case operation is again invariably necessary. The conditions may be very unfavourable for surgical interference, as when the patient has been brought nearly to death by a profuse intra-peritoneal flooding. No unnecessary delay is admissible, but time for efficient preparation is usually available as the hæmorrhage ceases spontaneously after a rapid profuse loss, and gradual improvement in the general condition of the patient at once sets in. If the condition of the patient is, however, deteriorating instead of improving, even a short delay may be fatal; the abdomen must be immediately opened and the bleeding vessel

secured. Saline transfusion into the median basilic vein should be practised during the operation, and is of the greatest assistance to success. Rapid work is necessary when the patient is under the anæsthetic; the pedicle should therefore be secured in the simplest and most expeditious manner possible. As much of the effused blood as possible should be cleared away, but time must not be consumed in making a complete peritoneal toilet. One or two pints of warm, sterile, saline solution may be poured into the peritoneal cavity and left to be absorbed, before the wound is closed. If necessary, a transfusion of a pint of blood may be given as soon as practicable after the operation is over. Auto-infusion of blood taken from the patient's abdomen citrated and injected into a vein, together with normal saline solution, has given good results.[1]

III. **Encysted Hæmorrhage.** There is not the same necessity for immediate operation as in the diffuse type of hæmorrhage, but all cases should be operated upon. The possibility of further hæmorrhage cannot be excluded, and the risks of leaving a large collection of blood in the pelvis are probably greater than the risks of surgical interference.

A pelvic hæmatocele may be attacked from the abdomen, or from the vagina by posterior colpotomy. The advantage of the former is that the damaged tube is completely exposed and can be removed; the pelvic peritoneal cavity can be properly cleared out, and the wound closed without drainage. When the vaginal operation is adopted, the hæmatocele is simply evacuated and drained (*see* p. 668); evacuation is necessarily incomplete and, as coagulated blood does not come away freely by drainage, several weeks may elapse before the cavity has completely closed up. Preliminary vaginal drainage may be resorted to in an infected hæmatocele, to be followed by abdominal operation when the infection has subsided.

IV. **Secondary Abdominal Pregnancy.** Whether intra-ligamentary or intra-peritoneal, this condition can be dealt with only by operative measures. The difficulty of distinguishing the two varieties has been already referred to; it practically precludes any attempt to apply different methods of treatment to them. Operation may be undertaken (*a*) when the *fœtus is alive and viable*, and (*b*) when the *fœtus has been for some time dead*.

It is but seldom that cases come under observation while the child is alive, and the number of recorded cases operated upon is relatively small. The proper procedure in such cases is to operate at once with the view of securing the survival of the child as well as the mother. The only objection to this procedure is the formidable technical difficulty which may be encountered during the operation, owing to the presence of a quick placenta with its active maternal circulation. Hæmorrhage of the most severe kind may occur when the placenta is separated, and may be very difficult to control. Occasionally, however, surprisingly little difficulty is met with, and the anatomical dispositions in different cases explain it. Sometimes, as in tubo-abdominal cases, the placenta is mainly attached to the broad ligament and the uterus. The vessels which supply it are accordingly, in the main, the uterine and ovarian arteries. An attempt should therefore be made to secure these vessels before the separation of the placenta is begun. The ovarian artery may be secured on the pelvic brim, where it crosses the ureter, or in cases of difficulty the cæcum or colon may be reflected and the

[1] Hendy, *Amer. Jour. Obst. and Gyn.*, Vol. X, 'A Clinical Analysis of Ectopic Gestation,' 1925.

vessels secured even higher up. The principal blood supply is through the ovarian vessels. In cases of difficulty the uterus may be removed in order to obtain access to the uterine artery of the affected side, the procedure adopted being the transverse method of hysterectomy, commencing on the sound side (*see* p. 679). With these vessels under control the placenta may be peeled off without much danger. If possible the whole of the sac should be removed along with the placenta. Drainage is usually required, and these cases are specially suitable for the vaginal route.

In other cases the placental attachments are widespread, involving coils of intestine and areas of mesentery. Control by ligature of the feeding arteries is then impossible. The placenta must be rapidly peeled off; such bleeding-points as can be isolated picked up with forceps, and for the remainder, plugging with gauze must be relied upon for controlling the bleeding. It may even be necessary to clamp bleeding areas with forceps and leave them in position for twenty-four hours. The best material for plugging is bismuth gauze, which is valuable both as a hæmostatic and antiseptic agent. The immediate after-treatment of such cases is always an anxious matter. Nothing should be touched for twenty-four hours, when the outer part of the gauze plugging should be loosened, and the forceps gently opened and then withdrawn with care. Day by day a portion of the gauze should be removed, until the whole has been got rid of by the fifth day. The plugs should be thoroughly soaked with sterile saline solution to facilitate withdrawal, but the process is necessarily very painful and an anæsthetic may be required.

In opening the gestation-sac it may be practicable, in either variety, to make the incision through a part which is closely incorporated with the abdominal parietes, when the operation may be conducted extra-peritoneally throughout. With this object the incision may be made in the linea semilunaris instead of the linea alba. After extracting the child and dividing the cord the membranes should be peeled off the wall of the sac and the limits of the placenta thus defined.

The difficulties of dealing with the quick placenta induced many operators in the past to delay operation until after the death of the fœtus had occurred in the natural course of events: methods of destroying its life were even advocated instead of awaiting the natural termination. This was based upon the view that death of the child would be quickly followed by thrombosis of the placental sinuses, which would allow of the placenta being removed without any alarming amount of hæmorrhage. Experience has shown, however, that the time required for thrombosis to occur is variable and uncertain; cases have been recorded in which profuse bleeding occurred from separation of the placenta at operations undertaken several months after the presumptive death of the fœtus. Waiting is also attended by the additional risk that spontaneous rupture of the sac may occur from hæmorrhage, or that it may become infected by organisms from the bowel, this being more likely to occur with a dead than with a living fœtus. From every point of view it is better to operate *at once*, whether the child is dead or alive.

It has been advised that when bleeding is difficult to control, the placenta should be left *in situ*, and the sac marsupialized by stitching the edges to the skin of the abdominal wound. It may then be removed piecemeal with forceps and scissors after a few days' delay, in which thrombosis may occur.

Infection of the placenta is, of course, unavoidable, and there are grave risks of secondary hæmorrhage from sepsis, which seriously discount the immediate advantages of this method. When marsupialization is carried out the cavity would probably be best treated by the Carrol-Dakin method of continuous irrigation which has been so extensively employed in war Surgery.

Still another method of dealing with the placenta has been recommended, viz. to leave it untouched, ligature and remove the umbilical cord flush with the placenta, stitch the sac closely over it, and close the abdomen without drainage, leaving the placenta to be absorbed. That the placenta can be thus absorbed is shown by its total disappearance in cases of lithopædion. If this method is adopted it is essential that no preliminary attempt to detach the placenta should be made, but it should be left with its attachments entirely undisturbed. The risks of infection by organisms which may enter it from the bowel are unavoidable, but a small number of cases have been treated with success in this way.

The operator's chief concern is the safety of the mother. The extra-uterine fœtus, even if it survives the risks inseparable from the conditions under which it is developing and reaches term, is seldom normal in development and vitality. Malformations are remarkably frequent, and in a recent series of 100 cases collected by Gordon Ley, roughly 50 *per cent.* showed malformations, many, however, being of only minor importance. Among those born alive the early mortality is extraordinarily high. In 122 instances collected by Sittner 59 died in the first four weeks, and 14 others before the end of the first year, giving a mortality for the first year of life of about 60 *per cent.*

PART I: SECTION V

INFECTIONS OF THE FEMALE PELVIC ORGANS

INCLUDING

(*a*) MICRO-ORGANISMS OF THE GENITO-URINARY TRACT.
(*b*) SEPTIC INFECTIONS.
(*c*) SPECIFIC INFECTIONS.

MICRO-ORGANISMS OF THE FEMALE GENITO-URINARY TRACT

A LARGE variety of organisms are found in the female genital tract and a lesser number in the urinary organs; many organisms which occur in the genitalia are not found in the urinary tract.

Vaginal Flora in the Newborn Child. For the first twenty-four hours of life the vagina is said to be sterile, but by the third day it always contains micro-organisms. The latter include *staphylococcus pyogenes albus* and *aureus*, and *streptococci*. Maxwell has shown that before bacterial contamination occurs the vaginal secretion of infants is acid. From the second day of infant-life organisms in the vagina increase in numbers, and in addition to those above mentioned Schmidgall found the *bacillus coli communis* and the vaginal bacillus (*see* Fig. 137) during the first year of life. This authority considers that the character of the vaginal secretion of the infant may be influenced by the vaginal flora of the mother, the explanation being that the genitalia of a female fœtus may become infected during birth in the case of breech presentations. In older children bowel-bacteria form about half the germs present in the vaginal secretion. The finding of organisms so constantly in the vaginæ of young children negatives the existence of a natural vaginal antiseptic function at this age.

Flora of the Adult Vagina. In 1892 Döderlein published the results obtained from the examination of the vaginal secretion of 195 pregnant women. The secretions were divided according to macroscopic evidence into (*a*) normal, (*b*) pathological or abnormal. Bacteriological examination showed that the flora were quite different in the two conditions.

(*a*) *The normal secretion* presented a whitish appearance and semi-solid consistence; there was no mucus present and the reaction was intensely acid. Microscopically it contained recent and macerated epithelial squames. From this normal secretion a distinctive bacillus was cultivated.[1] It appears as a long thick bacillus, non-motile, anaerobic, and it produces lactic acid. In 36 *per cent.* of cases this organism (Döderlein's bacillus) was accompanied

[1] Western states that Doderlein's bacillus does not grow on artificial media. See p. 134 of "Common Infections of the Female Urethra and Cervix." Kidd and Simpson, 1924.

by a yeast fungus.[1] Döderlein's bacillus was found to possess the power of destroying staphylococci within certain limits. When the latter were introduced into virgin vaginæ they disappeared in four days. This germicidal action was attributed by Döderlein to the presence of lactic acid produced by the bacillus which bears his name, and he advanced the following facts in support of this view :

(1) All pathological vaginal secretions, containing saprophytes and many pathogenic germs, are only faintly acid or may be even alkaline in reaction.

(2) In puerperæ the vaginal bacillus disappears and its place is taken by many kinds of saprophytes ; the lochial discharge is alkaline.

(3) When the lochia cease, the saprophytes disappear, the vaginal bacillus reappears, and the vaginal secretion becomes intensely acid.

(*b*) *The abnormal secretions* were yellowish or greenish in colour, of the consistency of thick fluid, mixed with mucus, and often contained bubbles of

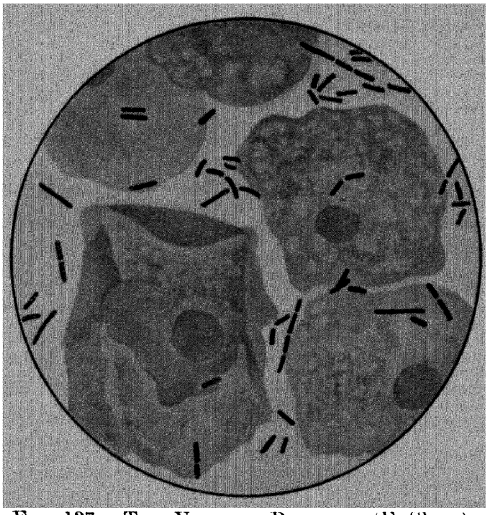


FIG. 137. THE VAGINAL BACILLUS (E. Shaw).

gas ; their reaction was feebly acid or alkaline and the quantity usually abundant. Bacteriologically they contained cocci and bacilli in great variety. Of the 195 cases examined by Döderlein only eight showed streptococci, and of these virulency was established in only five cases.

An estimation by Lockhart [2] as to the frequency with which streptococci occurred in the vagina in 100 consecutive cases of normal pregnancy showed that these organisms were present in 46·9 *per cent.* of primigravidæ and 52·6 *per cent.* of multiparæ. Before labour the streptococci were found to be hæmolytic in one instance only. Subsequent to labour the latter variety was discovered on five occasions in the above series. Of those in whom streptococci were found 15 *per cent.* of the primiparæ and 30 *per cent.* of multiparæ subsequently developed puerperal pyrexia. In *non-pregnant* women streptococci are found but very seldom in the vaginal secretions.

[1] Recent investigation by Houlton confirms these results. See 'Investigation of the Bacteria of the Vagina in Pregnancy,' Charlotte L. Houlton, *Jour. Obst. and Gyn. Brit. Emp.*, 1924, xxxi, 258.

[2] 'Bacteriological Examination of Cervix and Vagina during Pregnancy,' etc. Leonard P. Lockhart, *Jour. Obst. and Gyn. Brit. Emp.*, 1925, xxxii, No. 1, 49.

The germicidal power of the vaginal secretions has been proved by many other investigators, including Krönig, Menge, Walthard, and Stroganoff. Krönig inoculated the vagina with pure cultures of *streptococci*, *staphylococci*, and *bacillus pyocyaneus*, and found that these germs were destroyed after eleven to twenty hours. Menge summarized the causes of the destruction of pathogenic germs in the vagina as follows: (1) The antagonism of the normal flora of the vagina; (2) the products of the life-activity of the vaginal bacillus; (3) acidity of the secretions; (4) the germicidal power of the anatomical elements of the vagina; (5) the leucocytosis produced either by the vaginal discharge or by the infecting organism; (6) the phagocytosis following the leucocytosis and the absence of free oxygen in the vagina.

Distribution of Organisms in the Genital Tract. The genital canal is divided practically into two parts, the one *infected*, the other *sterile* (*see* p. 49). According to Walthard, however, there are three divisions of the genital

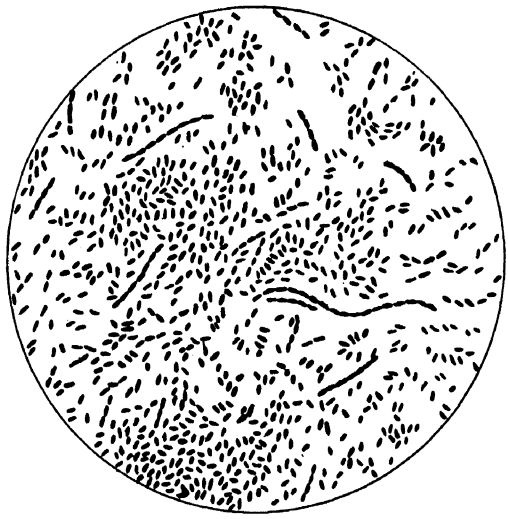


FIG. 138. BACILLUS COLI (E. Shaw). Film made from a culture of *B. coli communis*. The bacilli vary in size, and some are in chains.

canal: (1) the vagina, containing leucocytes and bacteria; (2) the cervix, containing only leucocytes; (3) the uterus body, containing neither leucocytes nor bacteria. According to Stroganoff no part of the cervical canal contains organisms in the majority of cases.

In the region of the vestibule the *smegma bacillus* is found. It is an organism resembling the bacillus of tuberculosis both in its morphology and in its staining reactions, which fact has an important bearing in the diagnosis of tuberculous disease of the urinary tract (*see* p. 270).

Summary. (1) In normal vaginal secretions the vaginal bacillus is the most plentiful of all organisms.

(2) None of the organisms composing the normal vaginal flora are pathogenic. Even streptococci when present behave as saprophytes in the normal mucous membrane.

(3) Streptococci can become infective and hæmolytic, and if the tissues are injured in any way the potential virulence of the streptococcus may be demonstrated. It may be taken for granted that their presence in the

vagina of a pregnant woman increases the risk of her developing puerperal fever.

(4) The lactic acid found in normal vaginal secretions has been proved by conclusive experiments (carried out by Schlutter) to be the product of the bacillus of Döderlein.

Micro-organisms of the Urinary Tract. Infection of this tract is very common, but the variety of organisms found therein is small. The modes of entry of organisms to the urinary tract will be considered under Cystitis and Pyelitis (*see* pp. 237 and 243). As regards the urethra, Savor found no bacteria in this passage in 36·5 *per cent.* of the normal cases examined. Kelly and Burnam express the view that more than half of normal individuals show bacteria in the urethra. Hofmeister pointed out that there are fewer bacteria in the deeper parts of the urethra than are found in the more exposed parts near the meatus. The organisms found in the urethra in apparently normal cases include staphylococci, colon bacilli, and, less frequently, streptococci. In the majority of cases of primary infection the bacteria present belong to the *B. coli* group. Bacteriological experience has shown that the *B. coli communis* is the most common organism met with in pyuria, and that in the majority of cases it occurs alone. In a certain percentage of cases *streptococcus brevis* is present as a secondary infection, and the same may be said of *staphylococcus albus, staphylococcus aureus, bacillus pyocyaneus,* and also the *bacillus proteus.*

Next to the *B. coli* as a primary infective agent may be placed the *B. tuberculosus.* This organism is nearly always accompanied by *staphylococcus albus* and sometimes by one or other of the organisms named above. To prove the presence of *B. tuberculosus* in urine the possibility of contamination with the smegma bacillus must be excluded, as these two organisms cannot with certainty be differentiated by their morphology and staining properties (*see* p. 270), therefore, when testing for tubercle, a catheter-specimen should always be used.

The Infective processes which may, directly or indirectly, affect the genito-urinary tract may be classified as follows :

I. **Septic infections (non-specific).**

A. Genital.

(1) Uterine sepsis.

(*a*) Sapræmia :
Puerperal.
Non-puerperal.

(*b*) Pyometra.

(*c*) Septicæmia.

(*d*) Retained products and subinvolution.

(*e*) Senile endometritis.

(2) Pelvic cellulitis.

(3) Pelvic peritonitis.

(4) Pyæmia.

B. Urinary.

(*a*) Cystitis.

(*b*) Pyelitis.

C. Alimentary.

(1) Appendicitis.

(2) Diverticulitis.

II. Specific infections.

(*a*) Gonorrhœal.
(*b*) Tuberculous.
(*c*) Syphilitic.
(*d*) Parasitic.

SEPTIC GENITAL INFECTIONS

Under the above heading will be included only those conditions which are due to infection by common pyogenic organisms, infections by certain specific germs being described under their respective headings. We have here to deal with two groups of bacteria: (1) Saprophytic (anaerobic, putrefactive, *non-pathogenic*), which give rise to putrefactive processes and which thrive in dead or passive tissues, and (2) pyogenic (*pathogenic*), which subsist on living tissues. Whilst the above division is admissible it must be borne in mind that non-pathogenic organisms have the faculty of becoming pathogenic and *vice versâ*. The germs which are found in putrefactive processes are very variable, some are bacilli, some are cocci. The best known variety is the *bacillus proteus vulgaris*. Saprophytes flourish in the secretions of wounds, decidual *débris*, placental fragments, retained lochia, necrotic myomata, and in carcinomata. By their growth they destroy the material on which they feed and produce soluble chemical bodies which act as toxins. When such substances are retained in the body under pressure, *e.g.* in a closed sac or cavity, they become absorbed to an extent which causes a general febrile reaction, which subsides directly an outlet is provided for the putrefactive secretions. To the clinical conditions set up by saprophytes the terms *sapræmia*, *toxæmia*, or *putrid intoxication*, are applied.

There are two specific organisms which resemble saprophytes in their mode of action, viz., the bacilli of diphtheria and tetanus; these organisms do not penetrate deeply into the tissues, but produce their effects through the absorption of their toxins. Diphtheria of the genitalia is very rare, and tetanus extremely so, therefore these diseases will not receive further mention.

Pyogenic bacteria also act by the liberation of toxins, but the latter are produced in the living tissues of the body on which the germs thrive; the diseases occasioned in this way are much more severe and more dangerous than those produced by the putrefactive (saprophytic) class. Pyogenic bacteria produce a true *infection* (in contradistinction to mere *intoxication*), which in its most virulent form is described as general sepsis, bacteræmia, or septicæmia.

The varieties of bacteria which produce a true infection are very few; the commonest and the most dangerous of this class are the streptococci hæmolytic or non-hæmolytic. In the majority of cases streptococci alone are found; less frequently the infection is a mixed one, consisting of a streptococcus with other bacteria. The streptococcus which is usually found in septic infections of the genitalia is the *streptococcus haemolyticus* or *pyogenes*. In 1921 Gordon [1] found that 100 *per cent.* of streptococci obtained by him from puerperal cases were of the *pyogenes* type. This organism varies in its morphology; it may be present as short or as long chains or as a diplo-

[1] Gordon. "A Serological Study of Hæmolytic Streptococci," *Brit. Med. Jour.*, 1921, April 30, p. 632.

coccus; its virulence is in great measure dependent upon its hæmolytic properties. Some streptococci are truly *non*-hæmolytic, whilst others are hæmolytic by mutation, *i.e.* they appear to be able to display the capacity for hæmolysis and then to withhold it and pose as non-hæmolytic cocci; moreover, their hæmolytic faculty is quite independent of their morphological variability. "There is no doubt that hæmolytic streptococci are found more frequently in connection with the severe type of puerperal fever than with the milder forms" (Lockhart). Although the *Streptococcus pyogenes* is not a *specific* organism, local environment seems to alter its antigenic properties so as to produce a differentiation (obtainable by absorption of agglutinin) between various strains such as *puerperal*, *scarlatinal*, *erysipelatous* (Eagles). In comparison with the streptococcus other germs play a subordinate part in the causation of puerperal sepsis. Those found in addition are *staphylococcus aureus* [1] and *albus*, *bacillus coli communis* (mostly in company with streptococci), the *bacillus acrogenes capsulatus*, the *streptococcus faecalis* (10 *per cent.* Gordon), and some anaerobic germs.

As stated above, it is quite impossible to prove that any bacterium is capable of producing *only* infection or *only* intoxication. The gravity of any given case is decided by the virulence of the strain of the bacteria which are present and by the resisting powers of the tissues. In this sense the streptococcus is proved to possess the most exalted virulence, but it is also certain that the *bacillus coli* produces both intoxication and infection.

For the growth of non-specific pathogenic germs such as streptococci the presence of a wound, or of dead tissue or secretion, is generally essential. On the other hand the specific germs of such diseases as diphtheria, noma, tubercle, gonorrhœa, and syphilis seem to be able to colonize in the absence of any local lesion.

Non-specific pyogenic organisms gain access to the genital tract through wounds or abrasions occasioned, in the majority of cases, during labour or abortion. The manifestations of septic infection therefore appear most commonly during the early days of the puerperium. Septic infection may also occur after manipulations and operations upon the uterus, such as curetting and the passage of the uterine sound, it is also seen in cases of cancer and necrotic myomata. The condition therefore admits of classification into (1) puerperal septic infection and (2) non-puerperal septic infection, and as this classification is clinically convenient it is often followed.

The consideration of puerperal septic infection is included in obstetric text-books, but as a matter of practice its treatment often comes under the purview of the gynæcologist, and it will therefore be included here along with the infections which are non-puerperal, and therefore of a purely gynæcological nature.

INTOXICATION OR SAPRÆMIA

(Synonym—Absorption Fever)

Puerperal Sapræmia. This condition is frequent in the puerperium and after abortion. Retention in the uterus of placental tissue, or of membranes, or of lochial discharge provides a most suitable nidus for the growth of anaerobic putrefactive saprophytes. The symptoms produced by a putrefactive process will be proportional in severity to the degree of absorption,

[1] In a most virulent case of puerperal septicæmia which recently came under the care of one of us (C. L.), the blood yielded pure cultures of *staphylococcus aureus*.

and this will vary inversely with the efficiency of drainage: thus putrid tissues in the uterus will result in a higher degree of intoxication than when decomposing material lies in the vagina, since the discharges from the latter escape more freely. The effect on the puerperal uterus of a putrefactive process within it is that involution is delayed, the organ remains bulky and flabby; being soft, it is easily lacerated during intra-uterine manipulations —a point to which particular attention must be drawn. The endometrium is thickened, sloughy, and covered with a foul-smelling discharge. Adherent blood-clot, membranes, or fragments of placenta, in a state of decomposition, may be present. To this condition the term of *putrid puerperal endometritis* has been given. Microscopically are seen, from the cavity outwards, (1) a thick layer of necrotic tissue composed of fibrinous material overlying remains of necrotic endometrium, and containing organisms (generally bacilli); (2) a *wide* zone of leucocytic infiltration; (3) œdematous muscle devoid of infiltration and free from organisms. To the wide protective barrier of leucocytes is due the fact that the effects of puerperal sapræmia are frequently transient. Its influence is shown clinically in that after uterine exploration and indiscreet curettage, intensification of the toxæmia is wont to follow, resulting in a rigor; in some cases the character of the disease is altered and true infection (septicæmia) is set up. Such clinical evidence teaches the lesson that to make a sharp distinction between saprophytic and pyogenic bacteria is dangerous, and that in every case of intra-uterine sepsis the possibility of a blood-infection must not be overlooked. It must be admitted that there is often great difficulty in coming to a decision whether a given case is one merely of intoxication or of blood-infection.

Treatment. When it is established that the uterus is empty, intra-uterine treatment, even douching, is unnecessary, as long as the discharges are escaping freely. Slight cases of sapræmia seldom call for intra-uterine exploration. The further treatment of sapræmia will be considered with the treatment of uterine-sepsis in general (*see* pp. 218–221).

Non-puerperal Sapræmia. Whilst sapræmia, in the majority of cases, is due to puerperal processes, it is liable to be met with in certain gynæcological conditions. *Submucous myomata* readily become infected. They are frequently necrotic from impairment of their blood-supply, and after menstruation the local conditions are especially favourable to bacterial invasion of the uterine cavity. These tumours themselves are prone to open up the communication between the *cavum uteri* and the vagina, and during extrusion of the growth the lower pole may become strangulated and may slough. Whether a submucous myoma sloughs or not, depends largely upon the integrity of its capsule. The passage of the uterine sound, or curettage, in such cases may, by causing capsular abrasions, expose a necrotic myoma to the risk of infection. With sloughing uterine growths the degree of intoxication depends upon the drainage, upon the size of the growth, and the extent to which it has sloughed. Enucleation *per vaginam* is the treatment for such cases.

In cases of *carcinoma of the cervix* the canal may be so completely closed by the growth that the intra-uterine secretion cannot escape; this leads to hydrometra, which is speedily infected by the germs which are always found in a necrosing cancerous growth. The result is that a pyometra and signs of septic absorption (sapræmia) follow.

At the risk of repetition it must be stated that the *passage of the uterine sound* has repeatedly led to intoxication by setting up a septic endometritis. Caustics, such as chloride of zinc, fuming nitric acid, and strong antiseptics, when applied to the cavity of the uterus may produce necrosis, which will lead to septic absorption, and in former days the same condition was wont to follow atmocausis by superheated steam.

Finally, intoxication may occur from *collections of blood* in the vagina, uterus, Fallopian tube, and pouch of Douglas becoming infected. As a rule such blood-collections as occur in the genital tract are not exposed to infec-

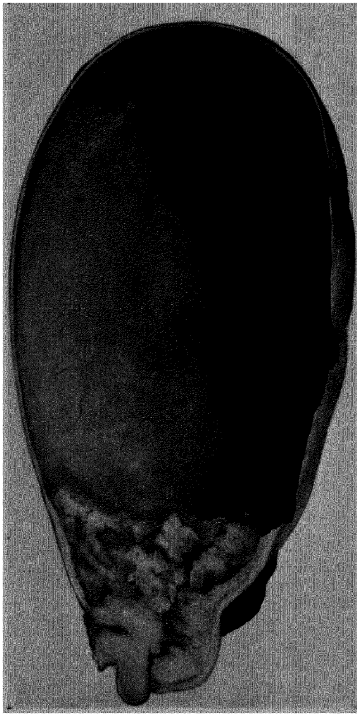


FIG. 139. LARGE PYOMETRA WITH VERY THIN WALLS, in a case of carcinoma of the cervix.

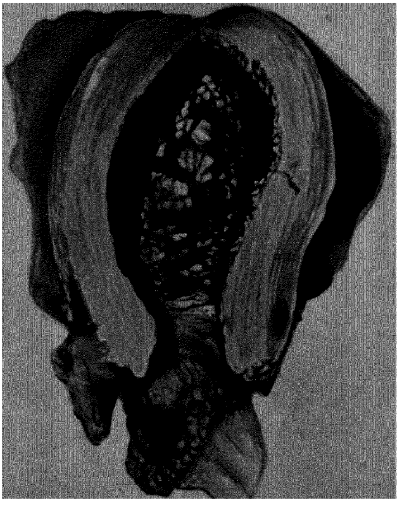


FIG. 140. SENILE ENDOMETRITIS AND PYOMETRA. Uterus removed by vaginal hysterectomy. Multipara, aged 63. The endometrium is replaced by granulation tissue.

tion from without, but if a hæmatocolpos is treated by an inadequate opening, the latter may close and lead to a putrid pyocolpos.

Intoxication due to suppuration in a cellulitic exudate will be dealt with under the heading of pelvic cellulitis (*see* p. 224).

Treatment. It will be seen that the treatment of non-puerperal sapræmia is mainly surgical and consists in dealing with the cause, for example, removal of a necrotic myoma, etc.

Pyometra. Pyometra may occur as an *acute* condition, but in the majority of instances it is chronic. The acute form may be met with in the puerperium due to infection of retained lochia. We have known of two cases in which nearly a pint of purulent fluid had collected in post-partum uteri which were retroflexed. The symptoms were those of sapræmia, and

they cleared up after evacuation of the pus and irrigation of the uterus with a weak antiseptic. In non-puerperal cases pyometra is a *chronic* condition, produced by infection of retained uterine secretion. It is usually due to blocking of the cervical canal and may be found in association with senile and tuberculous endometritis, with carcinoma situated low down in the body of the uterus, cicatricial contraction of the cervical canal, or cancer of the cervix. In some cases, on the other hand, the cervical canal is patent, the retention of fluid being due to loss of contractile power in the uterine wall. This is sometimes associated with retroflexion, when uterine drainage is still further impeded. On rare occasions pyometra may result from infection of a hæmatometra. Suppurating submucous fibroids may also be accom-

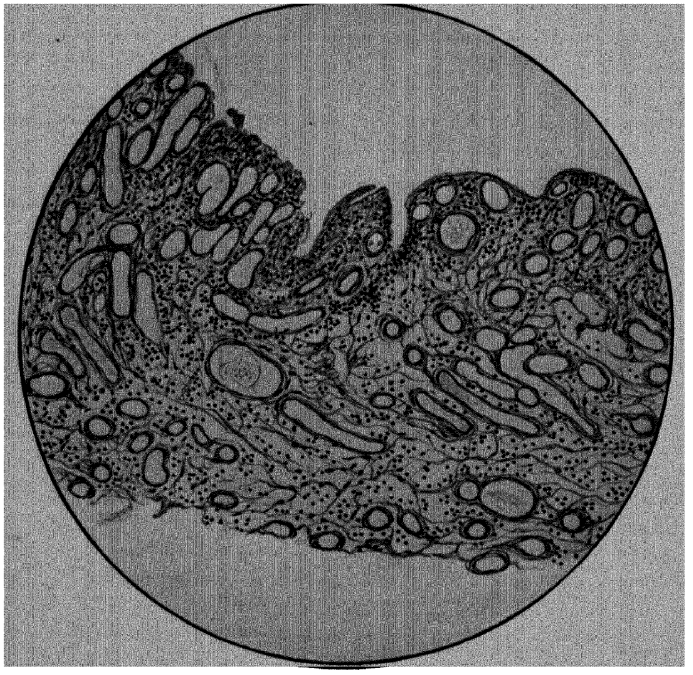


FIG. 141. MICROSCOPIC SECTION OF THE LINING OF THE UTERUS IN A CASE OF PYOMETRA. It consists of very vascular granulation tissue, the mucosa having been destroyed.

panied by a certain amount of pus retained in the uterus. In *pyometra*, especially the acute form, there is a danger of infection spreading along the tubes to the peritoneum producing pyosalpinx and peritonitis. In one of our cases a peritonitic abscess had to be opened subsequent to the drainage of the pyometra.

Pathology. The fluid is usually thin, offensive, brown or chocolate coloured pus, from which various organisms (including the *bacillus coli*) have been cultivated, but which may prove to be sterile. The condition of the uterine wall varies with the amount of the distension, *i.e.* with the quantity of retained pus; it is often thin and soft, but the muscle may be little reduced in thickness. A case has been recorded by one of us in which the uterine wall was reduced to the thickness of parchment (Fig. 139). The

cavity, as a general rule, possesses a smooth surface, but when pyometra has been of long standing the cavity is lined by a rough pyogenic membrane macroscopically resembling diffuse carcinoma, but consisting entirely of granulations, as seen in Figures 140 and 141. In cases of diffuse tuberculous endometritis, which have gone on to suppuration and pyometra, the cavity will be lined by the caseous masses characteristic of chronic tubercle.

Clinical Features and Treatment. Cases associated with malignant growths are frequently overlooked. When present it is usually found associated with advanced cervical cancer, but we have known a pyometra result from a small corporeal carcinoma situated low down in the uterine body and overlying the internal os. In such cases there may be intermittent discharges of pus into the vagina even whilst residual pus is gradually accumulating in the uterine cavity. Pyometra may cause pain, fever, and rigors, or sweating, but these symptoms may be absent. When in cases of *carcinoma cervicis* the uterine body is felt to be soft and enlarged, the cavity should be explored before hysterectomy is undertaken, as the escape, during operation, of pus from an unsuspected pyometra has led to fatal peritoneal infection.

In cases of *pyometra* due to senile endometritis, the cervix should be dilated, the uterus cleared out and curetted, and then swabbed with pure carbolic acid, and drained with a strip of gauze passed through the cervix and changed daily, vaginal hysterectomy is indicated in cases which resist this treatment. When associated with a malignant growth or tubercle, the treatment is determined solely by the extent and operability of the disease.

INFECTION OR SEPTICÆMIA

From what has already been stated it will be understood that a sharp clinical distinction between intoxication and blood-infection is often impossible; indeed it would seem that the question is one of a quantitative rather than a qualitative difference, and it is quite certain that a putrefactive process may become a true septicæmia. It is nevertheless certain that the morbid process may be a true blood-infection from the start. Such a condition is nearly always puerperal in origin, but as in sapræmia so in septicæmia, the organisms may gain entrance through abrasions caused by the passage of the sound or through operation-wounds. The gross local lesions which are associated with puerperal infection are here given in anatomical order.

Vulva. In severe cases of puerperal infection ulcers are formed on the vulva; they present a dirty greyish-green surface and are bathed in foul purulent discharge. They are surrounded by a zone of redness, and there is often marked œdema, especially of the labium minus. The most common situation for such septic ulcers is the posterior part of the *introitus vaginæ*. Such ulcers cause local pain and tenderness, and a 'burning' on passing urine.

Vagina. Wounds extending to the vagina from a torn cervix or from perineal lacerations may become septic. Bruising due to prolonged labour may cause necrotic areas on the anterior vaginal wall, leading to sloughing and fistula-formation. Extensive vaginal lacreations extending into the ischio-rectal fossa may sometimes be discovered in cases of puerperal infection. Such lesions require thorough drainage and frequent cleansing. In the case of a perineal laceration which has become septic, the stitches must

be removed, the wound laid freely open, and painted with 2 *per cent.* iodine-solution and drained with gauze.

Cervix Uteri. Lacerations of the cervix may become infected and form sloughing ulcers; such a condition is nearly always an indication that a similar state of sepsis exists in the uterine cavity.

The Uterus. This is usually the primary seat of infection. The organ will correspond in size with the date of the puerperium, that is to say it will not remain bulky as is the case in putrid intoxication. Its walls are soft and flabby, its cavity may present nothing unusual to the naked eye, *i.e.* there is no foul clot or placental tissue present, and no sloughing is to be seen on the surface.

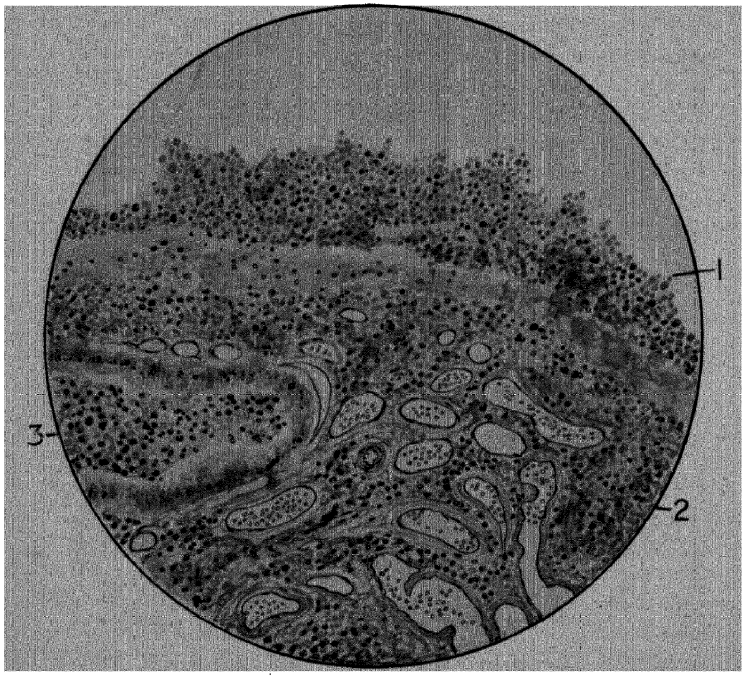


FIG. 142. ENDOMETRIUM IN A CASE OF PUERPERAL SEPTICÆMIA WHICH ENDED FATALLY. It shows (1) a surface of irregular granulation tissue; (2) a *leucocytic zone* containing dilated capillaries; (3) a uterine gland with its epithelium partially destroyed.

Microscopically, the changes in the wall of the uterus contrast with those seen in cases of sapræmia, and the condition is called *infective endometritis*. The leucocytic zone which in the *putrid* endometritis of sapræmia is well formed and thick, in the case of the infective endometritis of septicæmia is badly formed and thin, too thin in fact to limit effectually the invading organisms. Consequently the latter are not only found in the endometrium, but by suitable staining they can be demonstrated in the œdematous musculature of the uterus (*see* Fig. 143), where they are generally accompanied by a track of leucocytes which leads back to a weak spot in the leucocytic zone, thus indicating the path of invasion. In many cases there is no naked-eye evidence of the muscular invasion, but occasionally single or multiple abscesses may form in the myometrium. In rare instances whole areas of

muscle may become gangrenous and be thrown off in small fragments or large pieces. To this condition the name of *metritis desiccans* has been given.

The blood-vessels of the area corresponding to the point of invasion are found to be thrombosed. This applies to the venous sinuses at the placental site and also to the vessels around a tear in the cervix when such exists. The infection of these thrombi explains the frequency of a spreading septic thrombo-phlebitis in the ovarian, uterine and femoral veins.

From the uterus, infection may extend to the pelvic cellular tissue, to the peritoneum, to the Fallopian tubes, and to the ovaries.

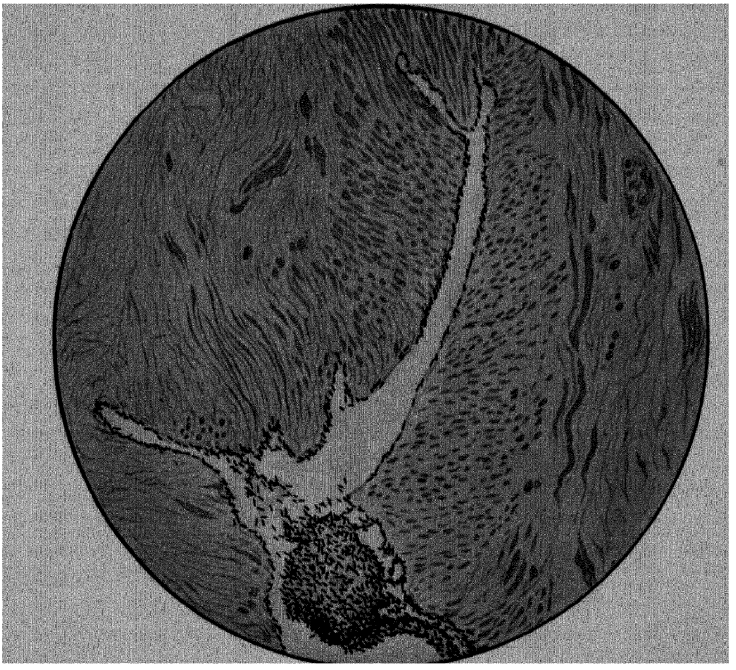


FIG. 143. SECTION THROUGH THE MUSCULAR WALL OF THE SAME UTERUS AS THE PRECEDING FIGURE, showing a dilated lymphatic containing colonies of the *Bacillus perfringens*, a non-motile, Gram-positive, anaerobe, first discovered in 1898 by Veillon and Zuber in conditions of gangrene.

SYMPTOMS OF INFECTION OF THE UTERUS

Under this heading will be included the signs and symptoms of the two pathological conditions to which attention has already been drawn, viz. the *putrid* endometritis of sapræmia and the septic or *infective* endometritis of septicæmia. From the clinical aspect it is customary to speak of both conditions as uterine *infection*, and as experience shows that sapræmic and septicæmic processes are often combined, there is justification for including both in the common term *infection* provided the fact that there are two varieties is not overlooked.

The onset of uterine infection generally occurs during the first four or five days following labour; cases beginning later than this are probably due to infection subsequent to labour.

In *mild* cases the first symptom is a rise of temperature to 101°–102° F.; this is accompanied by a corresponding rapidity of the pulse-rate, frontal headache, and malaise. In *severe* cases the fever starts earlier and is quickly followed by a rigor and an exaggerated pulse-frequency, whilst other symptoms, such as vomiting and diarrhœa, may supervene. A mild type of onset is more frequently associated with sapræmia, but it does not exclude septicæmia.

The uterus may be abnormally large, and tender to touch, the lochia may be profuse, offensive, and dirty in colour; such signs are characteristic of the *putrid endometritis of sapraemia*. On the other hand, the involution of the uterus may be normal, the organ may not be tender, the lochia may be non-offensive and not profuse, it may even be reduced in amount or absent. All such signs point to a blood-infection, *i.e.* to *septicaemia*, whilst it is common experience to find cases of mixed infection in which the symptoms are so anomalous that a differential diagnosis cannot be made by unaided clinical means. It will be useful here to describe the general features of simple sapræmia and of simple septicæmia.

Symptoms of Sapræmia. The main clinical manifestations are *fever*, *putrefactive discharge*, and *sub-involution*. Following infection during labour the temperature will rise on the third or fourth day to 100°–102° F. There is a sense of chill, but as a rule no actual rigor. The pulse-rate is accelerated in proportion to the rise of temperature. The patient does not appear to be seriously ill. The uterus is larger than it should be and may be tender. The lochia are foul and profuse, the vulval pad is widely stained by the blood-pigments which have escaped into the serum from the broken-down red discs. The illness soon subsides after the employment of suitable treatment, but if untreated generalized infection may result.

Symptoms of Septicæmia. The onset is generally acute and occurs during the first three days of the puerperium. An initial rigor is the rule with the temperature rising higher day by day. During a rigor the temperature may mount to 105° 106°–107° F. In general the temperature is remittent in type, it does not drop to normal, but suffers remissions of two or three degrees daily. The pulse-rate is invariably rapid, the rapidity being *disproportionate to the temperature;* the volume is small, and the tension is lowered in severe cases. A persistent pulse-rate of over 120 is of grave import. The uterus is neither unduly large nor tender. The lochia are scanty or absent, the milk is suppressed. Puerperal ulcers may be found on the vulva. Cutaneous rashes may appear, and the skin assume a lemon-yellow colour. Later the tongue is furred and sordes appear on the lips. Diarrhœa may supervene as a late symptom. Sleeplessness may be marked; synovial effusions may appear in various joints. There is a marked leucocytosis, and an increase in the polymorphonuclear leucocytes with a diminution of eosinophile corpuscles.

The *positive* diagnosis of septicæmia consists in finding the organisms in the blood, but a negative result is not conclusive since the germs in circulation may be few and their presence intermittent. The most likely time to demonstrate their existence in the blood is just after a rigor.

TREATMENT OF UTERINE INFECTION

The consideration of this subject involves details of *prophylaxis* for which a manual of obstetrics must be consulted. After the diagnosis of

uterine infection has been made by the exclusion of all other causes of pyrexia, treatment must be begun without waiting to differentiate between sapræmia and septicæmia. The means adopted will vary with the severity of the symptoms.

If the symptoms are mild, vaginal douching and the administration of ergot and aperients is all that is necessary, the patient being put in the Fowler's position (*see* p. 779) as an aid to drainage. If the symptoms do not subside in a day or two, disinfection of the uterine cavity must be undertaken. This, if done thoroughly, involves an exploration under an anæsthetic and must be carried out with rigid aseptic precautions. A swab of the intra-uterine secretion for bacteriological examination should first be taken in the manner described below.

When the infective process is of high virulence, as indicated by the height of the fever or the occurrence of rigors, the detachment of adherent pieces of infected placenta or membrane is not unattended with danger; fresh blood- and lymph-channels outside the protective zone of leucocytic infiltration may be laid open, and through them a large dose of toxic material may be rapidly absorbed; or actively growing bacteria may make their way into the circulation, resulting in generalization of a hitherto localized infection. This danger, however, is one which must be faced, due care being taken by suitable technique to limit the risk as far as may be possible.

The operation of clearing out the uterus when it contains the infected placental remains is, therefore, one which calls for special care and some skill; unless the circumstances allow of its being carried out thoroughly, and with adequate surgical precautions, it should not be undertaken at all; for an incomplete attempt is certain to aggravate the condition and may convert a mild case into one of great severity.

The patient should be anæsthetized, the vulva shaved and disinfected, and the vagina cleansed as far as may be. Before anything is passed into the cavity of the uterus, a specimen of the uterine secretion should be obtained for bacteriological examination, partly for diagnostic purposes, and partly to allow a vaccine to be prepared later if called for. Great care should be exercised in getting the uterine secretion free from vaginal or cervical contamination. To effect this a small sterile glass-tube should be passed through the cervix, and along this the swab may be pushed up to the fundus, and secretion thus got from the upper part of the uterus. Little or no artificial dilatation of the cervix is required as a rule, for during the first week of the puerperium the index finger can be introduced through the internal os with care. Laceration of the cervical tissues should be carefully avoided. The entire cavity should then be explored with the finger; adherent pieces of tissue are, as a rule, readily recognizable and are most commonly met with at the part which corresponds with the placental implantation-site. This part of the uterine wall always feels rough and irregular to the finger, even when there is nothing retained, and the student must not be deceived by this, the remainder of the uterine wall should feel smooth and uniform to the touch, if free from retained tissues.

An attempt should then be made to detach the retained piece of tissue with the finger; the gloved finger forms a very blunt instrument, and will only detach the tissue in the plane of natural separation. If it is morbidly adherent, the finger will not suffice, and it should then be seized with a pair of ovum-forceps and gently twisted off. The so-called 'blunt' curette will

not suffice to do more than the gloved finger can do. The remainder of the uterine wall should not be scraped; and the operation is completed by thoroughly douching the uterus with a mild antiseptic, such as Tr. iodi. 1 drachm to water 1 pint, or by douching with hypertonic saline solution (salt 4 drachms to water 1 pint). Finally, 1 c.c. of pituitrin is injected and the uterus grasped bimanually between the fingers of the two hands and massaged until it responds by contracting; this will squeeze out blood and arrest the oozing, which is always free; the uterine walls may then be swabbed with pure tincture of iodine.

If no retained tissues are found in the uterus, the walls should simply be swabbed with tincture of iodine and nothing further done.

Curetting in uterine sepsis is definitely to be condemned. The tissues of the uterine wall are so softened in septic inflammation, that the curette may detach strips of a much greater thickness than when the tissues are not inflamed; therefore the protective zone of leucocytes may be actually removed and a fresh raw surface laid bare through which infective material will rapidly be absorbed. Further, there is nothing to be gained by scraping where foreign tissues are not encountered; the superficial necrotic changes which always attend a septic endometritis are not the chief source of danger, for the open cervix allows of the ready escape of the discharges which these changes produce.

A rigor may occur at any time within twelve hours after intra-uterine manipulation. This occurrence does not necessarily indicate generalization of the infection, it may be due to the rapid absorption of a large dose of toxins at the operation-site. These toxins will, however, be quickly excreted if their production in the uterus has been arrested, and the recovery of the patient will not be retarded by the rigor.

The injection of glycerine into the uterine cavity has of late been advocated. It is thought that the hygroscopic action of the glycerine produces a flow of germ-laden lymph towards the uterine cavity and so aids drainage from the infected uterine walls. The patient is kept propped up in the sitting position also to promote drainage, and hot vaginal douches are serviceable in exciting uterine contractions.

In cases where there is 'potential' infection, *i.e.* where instrumental manipulative interference has been employed in effecting delivery, a prophylactic dose of 20 c.c. of antistreptococcic serum may be given. Serum is now to be regarded as a preventive, but not as a cure, for sepsis. The details of general treatment include the employment of subcutaneous infusion of saline solution, which promotes leucocytosis and stimulates the skin and kidneys, thereby aiding the elimination of toxins. Efforts have been made in cases with a positive blood-culture, to sterilize the blood by intravenous injection of mercurochrome, perchloride of mercury, acriflavin, eusol, and other antiseptics. Dudgeon, who has injected perchloride of mercury in 330 cases and mercurochrome in 150 cases of acute bacterial infections, advocates the use of these antiseptics in the early stages of the infective process. He gives 5 c.c. of a 1–1250 solution of perchloride of mercury (1–16 gr.) in saline and repeats the injection in twelve to twenty-four hours if necessary, and he says that if four injections given over a period of three days fails to produce improvement it is useless to continue this treatment. He also uses mercurochrome in saline solution in strengths of 1–200, 500 and 750. Ten c.cm. of 1–200 mercurochrome should be the maximum initial dose. If

used stronger than this, blood, albumen and casts appear in the urine. It is too early to judge of the results of these heroic measures.

Direct blood-transfusion has been employed fairly extensively in America. Polak reports that the beneficial effects last for three or four days only, so that it is necessary to repeat the transfusion on the fourth day. The amount of blood he found to be most effective was from 250–300 c.c. and the transfusion is carried out under the influence of scopolamin and morphia. In the transfusion of citrated blood severe pyrexial reaction may occur. This has led to the use of defibrinated blood, a simple method for the employment of which has been devised by Platt,[1] who uses 500 c.c. of blood, which is defibrinated by placing a bent glass rod in the receiver and rotating the latter during collection. Colebrook and Storer [2] speak favourably of immune transfusion, the donor's blood being immunised before collection.

It has been claimed that in the presence of hæmolytic streptococci the bactericidal power of the leucocytes and of the blood as a whole can be increased by intravenous injections of novarsenobillon (0·6 gramme in 10 c.c. of sterilized distilled water). This solution should be used quite fresh, and it can be repeated in two or three days if necessary. Luker advocates the use of bichloride of quinine for the purpose of raising the bactericidal power of the blood.

For fuller details of puerperal uterine infection the student should consult a text-book on obstetrics.

RETAINED PRODUCTS AND SUB-INVOLUTION

(Sub-acute Endometritis)

This condition is a sequel of a confinement or of an abortion, in which infection plays an undoubted part. The clinical features are largely modified by the presence or absence of retained tissues in the uterus. It is certain that pieces of the ovum may remain in the uterus for weeks without becoming putrid ; and if infection is present it may be of so mild a type that its presence is clinically overlooked. The main symptom then is hæmorrhage of irregular type, usually more or less continuous but varying in quantity. The patient soon becomes anæmic, and even when obviously ill, her condition may be attributed to loss of blood alone. A little fever is usually found, however, and there is little doubt that infection of a low degree of virulence forms an important element in the case. Such cases are easily cured by removing the retained piece of tissue with the precautions set forth in the preceding section.

In many cases of this variety, however, nothing has been retained in the uterus, and hæmorrhage is not then a prominent symptom. Such patients complain of the persistence of a blood-stained discharge since the miscarriage, of internal pain and backache aggravated by exertion, and of a more or less general feeling of illness. Women of the hospital-class usually do not consider themselves sufficiently ill to lie up, but come to the out-patient department for relief.

On examination it will be found that the cervix is closed, the uterine body definitely, although not greatly, enlarged ; in a considerable propor-

[1] Robert Platt, *Lancet*, January 23rd, 1926.

[2] Colebrook, L., Storer, E. J., *Lancet*, 1923, ii., 1341, also *Brit. Jl. Exp. Path.*, 1924, v., 47.

tion of cases the adnexa on one side or on both will be found thickened, tender, and sometimes prolapsed into the pouch of Douglas. Often the uterus is retroverted, but by no means invariably. Speculum-examination shows a muco-purulent discharge issuing from the cervix, which may be covered with an unusually bright red erosion; the vaginal walls are also often deeply reddened, although seldom tender. During the first few weeks after the miscarriage careful observation of such cases will often show a slight, irregular pyrexia.

Such cases as these were formerly designated 'sub-involution,' and it is possible that an arrest of the normal process of puerperal involution is a factor in causing the uterine enlargement in some cases (*vide infra*). A certain number of cases of this type probably pass gradually into the state

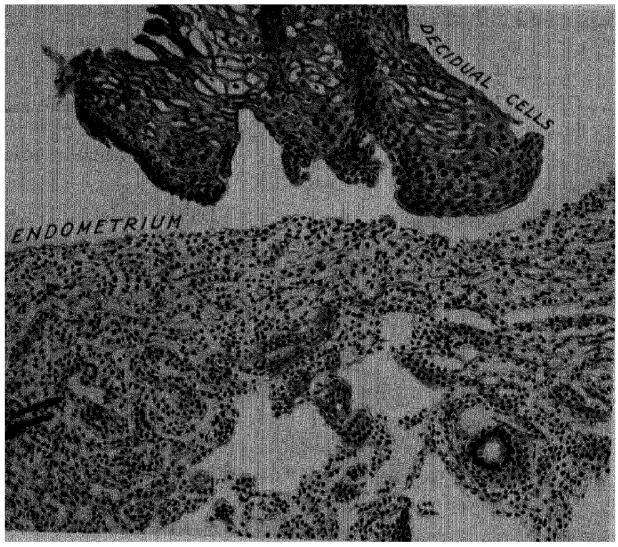


FIG. 144. SCRAPING FROM THE UTERUS IN A CASE OF SUB-INVOLUTION. A fragment of decidual tissue is seen upon the surface of the endometrium.

known as 'chronic metritis,' which is described on page 373. In others, the tubal and ovarian infection progresses, and its importance from a clinical point of view comes to overshadow completely the uterine infection from which it originally arose. In considering chronic tubal infection the probability that a chronic septic endometritis accompanies it must not be overlooked.

The *treatment* consists in curetting the uterus, and this operation may have to be repeated before a satisfactory result is obtained. The presence of a certain amount of thickening and tenderness of the adnexa does not contra-indicate this operation. A mild tubal infection may subside after the infective focus in the uterus from which it arose has been destroyed. If the adnexal inflammation is advanced, and there is suspicion of the presence of pus, curetting is contra-indicated.

Sub-involution. Following upon a confinement or a miscarriage an enlarged condition of the uterus is often met with, to which the name of *sub-involution* is usually applied. This name connotes the view that the enlargement is due to an arrest of the normal process of puerperal involution

before the uterus has been reduced to approximately its proper size. To such a change the name of *sub-involution* is, of course, strictly applicable. The enlargement thus produced may become permanent, and may be associated with severe bleeding and other symptoms. At this stage the condition is classed for clinical purposes as one of the varieties of *chronic metritis*, and its causation and histology will be fully discussed in connection with that condition (*see* p. 373).

We are dealing here, however, with *recent cases of sub-involution*, which present quite a different clinical picture. Certain conditions must be recognized as predisposing causes of arrested involution, *e.g.* age and fertility.

Age. It has been already pointed out that the relative proportion of muscle and fibrous tissue to the uterus varies with the age of the subject Before puberty the proportion is muscle 2, fibrous tissue 3 , after puberty it becomes muscle 3, fibrous tissue 2 ; after the menopause the proportion again becomes muscle 2, fibrous tissue 3, or the amount of muscle may be even less than that. The greater the proportion of fibrous tissue in the uterus the more does the process of involution tend to become incomplete.

Fertility. Each succeeding pregnancy results in the deposition of an excess of elastic tissue in the uterus, with a loss in the relative proportion of muscle (*see* p 377). Accordingly a slight and permanent enlargement of the uterus occurs in all women who have had several children.

In the great majority of cases of sub-involution which come under observation, arrest of the process of involution is not the only pathological factor. It is probable that infection and retained tissues are the commonest causes of arrested involution. Another frequent concomitant condition is retroversion, which is directly attributable, partly to the undue size and weight of the uterus, partly to the general relaxation of the uterine supports which results from pregnancy.

The *symptoms* of sub-involution bear a general resemblance to those of subacute endometritis The more pronounced is the element of infection the more severe are the symptoms, and when a piece of infected tissue remains in the uterus, irregular fever and severe hæmorrhage may occur, as described in connection with septic endometritis. In cases accompanied by only a mild infection the main symptoms are menorrhagia and leucorrhœa, with pain especially marked when the uterus is also retroverted.

The *diagnosis* is usually simple, for bimanual examination is easy in women recently confined and the enlargement of the uterus can be readily detected, and its position, forward or backward, readily made out. It may be very tender to palpation if a definite uterine infection is present. It is by no means always easy to determine whether any retained tissue is present without exploring the uterine cavity ; if the internal os remains patulous, the presence of a piece of tissue of considerable size may be foretold. A small fragment does not interfere with the closure of the internal os.

The treatment consists in the first place in exploring and curetting the uterus. If no retained tissues are found and the condition is of long standing, this operation may fail, and the case then becomes clinically identical with the group of chronic metritis.

SENILE ENDOMETRITIS

This is a form of true endometritis which occurs in elderly women who have passed the menopause, and it is not usually met with until several

years after this event. By this time the changes in the endometrium associated with post-climacteric atrophy (*see* p. 360) are pronounced, and they, no doubt, form a predisposing cause of infection. The special liability of the vagina to infection at this time is marked, and it is highly probable that the vagina is frequently the primary source of the infection which ultimately leads to senile endometritis. The two conditions *senile vaginitis* and *senile endometritis* are accordingly usually associated. The *symptoms* met with are *haemorrhage*, which is never severe, and *discharge*, which is purulent and sometimes offensive. The endometrium shows true inflammatory changes, *i.e.* foci of suppuration are present and plasma-cells are found in abundance in the altered stroma, whilst such gland-tubules as remain show cystic change and desquamation of their epithelium. The surface-epithelium is likewise destroyed. The uterus is usually small and its walls are thin and atrophied. From suppuration and destruction of the mucosa two results may ensue: (1) stenosis of the cervix; (2) pyometra.

Stenosis results from fusion of the partly denuded lips of the os or walls of the cervix; it leads to the retention of secretion which, in the presence of infection, becomes purulent and often highly offensive (pyometra). As a sequela of senile endometritis *pyometra* is rare, but it occurs in some instances independently of stenosis of the cervix (*see* Fig. 140, p. 213).

The *differential diagnosis* of senile endometritis from carcinoma of the uterine body, a disease prone to occur about the same period of life, is discussed on page 493.

The *treatment* consists, in the first place, in curetting and thorough disinfection of the uterine cavity with peroxide of hydrogen (4 vols.); after the operation has been recovered from, application of a strong antiseptic fluid such as pure carbolic acid or iodized phenol should be made to the walls of the uterus once or twice a week, or relapse will probably occur. If a cure cannot be effected by these means, the uterus should be removed by the vaginal route (vaginal hysterectomy, *see* Figs. 480–488, pp. 708–714).

PELVIC CELLULITIS

(*Synonyms—Parametritis, Peri-uterine Phlegmon, Lymphangitis*)

This condition is one of the most important local lesions resulting from puerperal infection. As a complication of the puerperium it is an acute infective disease resulting from lacerations of the cervix, lower uterine segment, or vagina. If such lesions become infected a primary lymphangitis is set up in the adjacent cellular tissues, and to this the name of 'parametritis' was applied by Virchow, Matthews Duncan, and others.

Primary acute cellulitis also occurs in the pelvis apart from obstetric injuries. Surgical operations on the cervix, with faulty antiseptic technique, or those undertaken for the removal of infected necrotic fibroids, may lead to cellulitis. Occasionally it may be set up by a spread of lymphangitis from a rectal ulcer, which produces a phlegmon in the perirectal connective tissue, and it is not an uncommon accompaniment of extensive cancer of the cervix.

It is to this *primary* form of pelvic cellulitis that this section chiefly applies, but it must be borne in mind that pelvic cellulitis may also occur in varying degrees of intensity as a sequence of pelvic peritonitis, and as an accompaniment to salpingo-oöphoritis; in such cases the cellulitis is a

secondary condition, and, clinically speaking, it is also of secondary importance, the disease which has caused the cellulitis being the predominant and primary factor.

Anatomy. For a description of the distribution of the cellular tissue and lymphatics of the pelvis, reference should be made to pages 8 and 63. Without a clear understanding of the anatomical distribution of the cellular tissue it is impossible to obtain an intelligent appreciation of this disease.

The following anatomical points will bear repetition :

(1) The cellular-tissue not only surrounds the blood-vessels, but it forms their sheaths, hence cellulitis starting in the pelvis may spread *viâ* the perivascular lymphatics to those regions outside the pelvis whence the large blood-vessels arise.

(2) The cellular tissue of the pelvis is continuous with that of the rest of the body, therefore a cellulitis of pelvic origin may spread by lymphatic-continuity into other areas adjacent to the pelvis.

(3) The cellular tissue lies immediately underneath the peritoneum, therefore an acute primary cellulitis necessarily sets up a secondary peritonitis, and a primary peritonitis will secondarily implicate the subjacent cellular tissue.

(4) The cellular tissue is related to the ureter in the same way as it is to the blood-vessels, hence cellulitis may track up along this duct to the kidney-region, just as it may course along the large vessels to reach the front of the thigh and the buttock.

(5) The cellular-tissue completely invests the supra-vaginal cervix whilst it is practically non-existent where the peritoneum covers the body of the uterus, therefore primary cellulitis is liable to occur when a cervical injury becomes infected, but it is unlikely to be caused by primary direct infection from lesions confined to the *corpus uteri*.

(6) The cellular tissue, which lies between the vaginal roof and the peritoneum, ordinarily measures one-third of an inch in thickness. In pregnancy, this is enormously increased ; for instance at full term the broad ligaments lie above the pelvic brim, and the peritoneum does not dip into the lateral parts of the pelvis at all. This increase in the size of the pelvic cellular space during pregnancy can be realized when it is remembered that it will accommodate a placenta which escapes into it through a rupture in the lower uterine segment, and also that it is possible to perform Cæsarean section through this interval without opening up the peritoneal cavity. This extensive increase of connective-tissue in the pregnant state is of the greatest clinical importance.

Etiology. The commonest infecting agent is the *streptococcus pyogenes*, which may be associated with staphylococci, with gonococci, or with the colon bacillus, or it may be obtained in pure culture. Gonococci alone do not produce acute primary cellulitis.

A *predisposing cause* is to be found in a lessened resistance of the tissues due to bruising during delivery or operation. The commonest point of entry of organisms is through lacerations of the cervix and upper part of the vagina, produced, as a rule, by instrumental delivery or by version, but occasionally also during spontaneous labour. When infection follows abortion, primary acute cellulitis is not likely to occur, because there is less risk of cervical and vaginal laceration, and because the amount of cellular tissue is far less than that present at term. Abdominal operations which involve

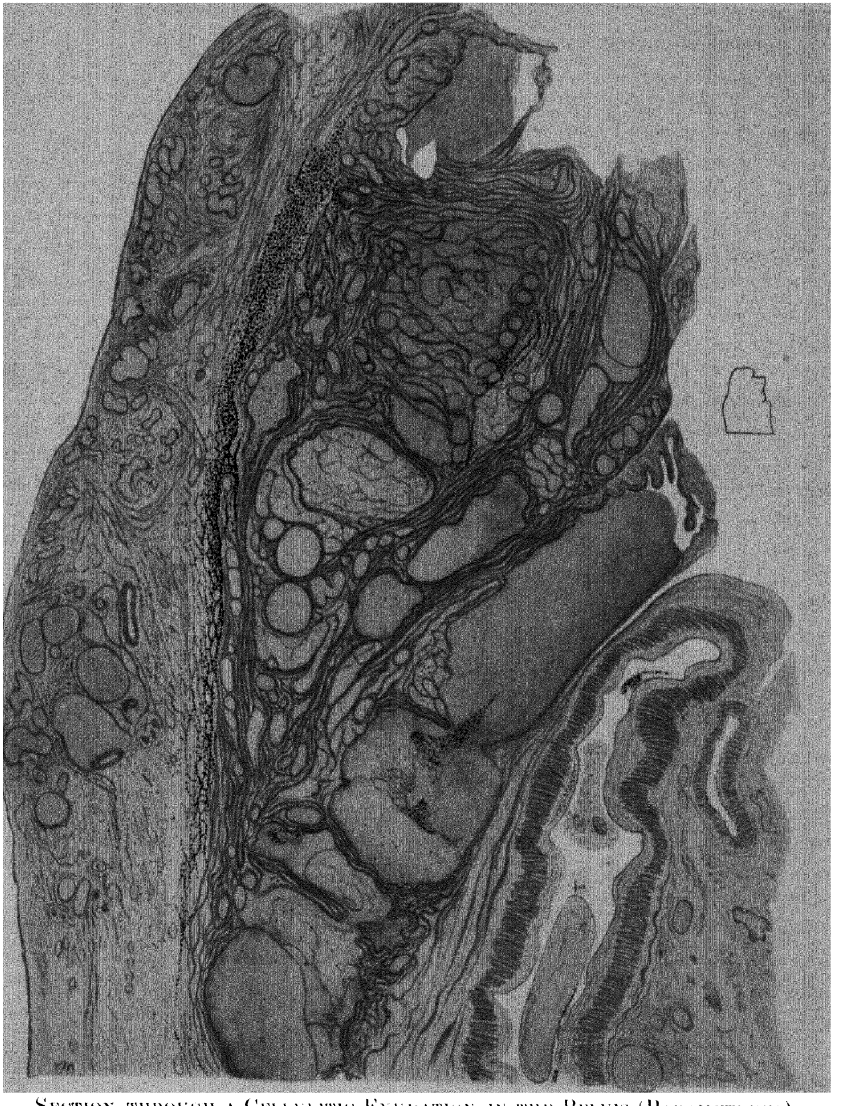
extensive dissection deep in the pelvis, especially when performed for carcinoma, are liable to set up acute cellulitis, and, as already mentioned, vaginal operations necessitating dilatation of the cervix for septic intra-uterine growths may likewise be followed by the same form of local pelvic inflammation.

In comparison with pelvic *peritonitis* primary pelvic *cellulitis* is a very rare affection.

Pathology. Following the entrance of organisms into the lymphatic vessels, the tissues become hyperæmic and infiltrated with *blood* (*see* Pl. XII) and leucocytes. This stage is rapidly succeeded by the outpouring of a sero-fibrinous exudation, and by œdema of the infected area. The swelling thus formed is at first soft, but it very soon becomes stiff and indurated, due to clotting of *blood* in the tissues, to thrombosis in the veins, and to coagulation of lymph. Later on it acquires a hardness which is almost equal to that of cartilage. The fibrinous exudation is first felt in the base of the broad ligament adjacent to a septic cervical or vaginal laceration, where it may form a very extensive unilateral mass. When extension occurs, the exudate usually spreads towards the antero-lateral pelvic walls, and can be felt as an indurated mass anteriorly above Poupart's ligament, and laterally in the iliac fossa. Backward extension along the utero-sacral fold to the pararectal connective-tissue also occurs, and, as already stated, it may follow the track of the ureter to the loin (*see* Fig 145), and the course of the blood-vessels through the great sacrosciatic notch, through the crural canal, and through the obturator foramen. Finally the exudation may spread from the *cavum Retzii* upwards along the course of the obliterated hypogastric vessels and the urachus towards the umbilicus. An extra-pelvic extension of this character is known as *remote parametritis*. Not infrequently suppuration occurs in these extensions (*see* Fig. 146).

The inflammatory exudation may undergo complete absorption and eventually disappear altogether, leaving no evidence of damage to the tissues In the most severe cases suppuration occurs, resulting in a pelvic abscess. Usually there is a single abscess-cavity, but there may be multiple foci of suppuration (*see* Pelvic Abscess, p. 233). In the acute form of primary pelvic cellulitis, thrombo-phlebitis may occur in the veins of the thigh leading to *phlegmasia alba dolens*.

Chronic pelvic cellulitis is never a sequel of the acute primary disease which has just been considered It is found as a complication of peritonitis and salpingo-oophoritis, and it sometimes happens that an infected tube and ovary may be so surrounded by cellulitic exudation that the primary lesion cannot clinically be made out until the induration in the connective-tissue subsides. Opinions differ as to whether this secondary cellulitis persists; some authorities say that it does do so, and that fibrous tissue is formed which produces puckering and contraction of the overlying peritoneum; others deny the existence of chronic pelvic cellulitis altogether. Some writers draw attention to a chronic form of pelvic cellulitis which is found beneath the pouch of Douglas and which is thought to arise from an infection through the rectal wall. It seldom produces a large exudation, but small hard masses, accompanied by thickening of the folds of Douglas's pouch, it leads to much scarring and contraction of the pouch of Douglas, and is spoken of as *parametritis chronica atrophicans* and also as *parametritis nodosa posterior*. According to Robert Meyer, processes of epithelium sometimes grow



SECTION THROUGH A CELLULITIC EXUDATION IN THE PELVIS (PARAMETRITIS). (Seven weeks after parturition.) Note the marked engorgement of the vessels and also the free hæmorrhage into the cellular tissues. The large artery (A) contains a thrombus (T). The inset shows an outline of the microscopic section.

To face page 226.

down into the indurated cellular tissue and form pseudo-gland tubules, thus giving rise to an adeno-myoma of the recto-genital space (*see* p. 442). This type of cellulitis rarely leads to suppuration.[1]

Symptoms. Towards the end of the second week of the puerperium the patient has a rigor with a rise of temperature and acceleration of pulse. Pain is not a characteristic symptom; when present it is an indication that the peritoneum is also involved. The skin becomes harsh, dry, and desquamating. When suppuration occurs there is progressive emaciation, and the skin takes on a characteristic earthy sallowness. Anorexia, constipation, dysuria, mental depression, and irritability of temperament are symptoms which may be expected. When extension occurs along the cellular tissues overlying the ilio-psoas muscle, the patient lies with the leg of the affected side drawn up in order to relax this muscle. If allowed to get up before resolution has occurred, she will limp, and attempts at walking will cause pain. This may lead to the discovery of an exudation which had not been suspected, in a case in which the general symptoms were those of a mild form of infection.

Physical Signs. When an examination is made, the vagina will be found to be hot and tender, with distinct pulsation of the large vessels in the lateral fornices. A tear may be discovered in the vaginal wall or, more often, in the cervix. In the early stages of acute pelvic cellulitis, when the exudate is serous and the tissues are œdematous, a slight feeling of resistance on the affected side is all that can be felt. After a lapse of several days the exudation becomes fibrinous and is then palpable as a hard, unyielding, tender mass around the cervix and upper part of the vagina. The mass spreads out into the base of the broad ligament and causes fixation of the cervix and depression of the lateral fornix. The mass may be large enough slightly to displace the uterus laterally, but Cullingworth has stated that "an exaggerated importance has been attached to lateral displacement of the uterus as a distinctive sign of pelvic cellulitis; it occurs but rarely, and is of little diagnostic value." A point of importance is, that whilst the exudate spreads all around the cervix in the form of a thick, tender, indurated collar, it does not, as a rule, extend far into the opposite broad ligament, hence a pelvic cellulitic swelling is mainly *unilateral*.

A very extensive exudation will vary in its physical signs according to the course taken in its unilateral extension. Most frequent of all is to find (1) that it takes the form of a broad, hard band which runs above the inner portion of Poupart's ligament, (2) more rarely the hardness is felt above the pubes, whence it ascends upwards in the midline towards the umbilicus; (3) sometimes the exudate occupies the iliac fossa and can be felt at the level of the anterior iliac spine, and above that point it appears again in the loin, where, when suppuration occurs, a swelling of considerable size may be found (*see* Figs. 145 and 146); (4) in some cases the exudation may be felt in the utero-sacral fold and around the rectum, where on rectal examination it appears as a hard, indurated, semicircular or horseshoe-shaped mass investing the front and lateral aspects of the bowel. Under such conditions the pouch of Douglas is empty unless peritonitis is also present. The iliac fossæ and the renal region should be carefully examined, as extensions to these parts may occur (remote parametritis, *see* Fig. 145).

[1] It is quite possible, too, that this form of cellulitis may be set up by the burrowing of endometrial grafts through the peritoneum.

When suppuration does not occur the exudation gradually becomes absorbed until no trace of it can be found.

Cellulitic Pelvic Abscess. Suppuration is not uncommon in acute pelvic cellulitis. The presence of pus is indicated by œdema and pitting of the skin, by finding a soft spot in the area of induration, and later by definite fluctuation. As, in the majority of cases, the exudation occupies the cellular space of the anterior part of the pelvis, the abscess formed will point externally, and generally over the inner half of Poupart's ligament, more rarely over the outer half. As previously stated, a perinephric abscess may be formed which will point in the loin. Exceptionally, an abscess will point in Scarpa's space or in the gluteal region. A point of importance for the student to note is that only very exceptionally does a cellulitic abscess burst into the bladder, vagina, or rectum. The usual time for an abscess to point is from the seventh to the twelfth week after delivery (Cullingworth).

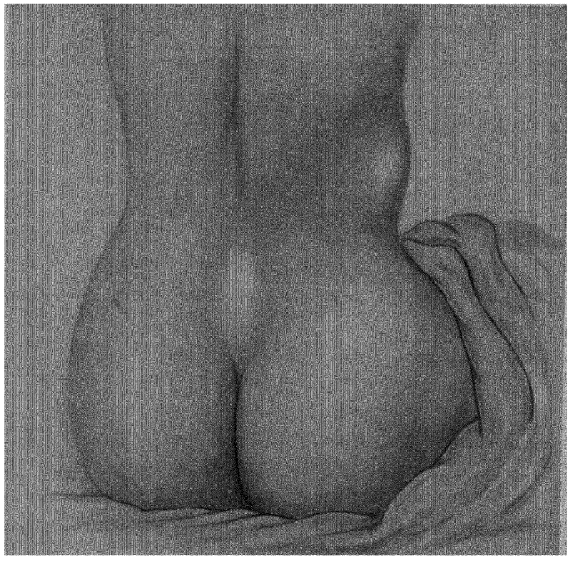


FIG. 145. SWELLING IN RIGHT LOIN CAUSED BY REMOTE PARAMETRITIS. The abscess in the loin appeared ten months after confinement. The cervix had been badly torn and had sloughed off completely.

Diagnosis. One of the earliest signs of cellulitis is fixity of the cervix, accompanied by a tender unilateral swelling. Later on the swelling spreads laterally and becomes harder; it may obliterate the vaginal fornix, and eventually become evident above Poupart's ligament. If the exudate widely opens up the folds of the broad ligament, the whole uterus will be fixed, and in this case, pushed somewhat towards the opposite side (*see* Fig. 147). When the cellulitis has taken a backward direction, its presence is best made out by rectal examination, when the horseshoe-band of induration investing the bowel, and continuous with an induration in the utero-sacral ligament, will be easily felt.

There are two conditions which simulate the rarer form of cellulitis which fills up the whole of the mesometrium. (1) Hæmatoma, produced by

intraligamentary rupture of an ectopic gestation, or by a ruptured varicose vein; (2) a broad ligament fibroid. The confusion is chiefly one of physical signs; the clinical history, if carefully gone into, will greatly assist the diagnosis. In the case of pelvic cellulitis there will be a history of puerperal pyrexia or of post-operative fever; with a hæmatoma the history will be that of a sudden pain, faintness, and an attack of vomiting; pyrexia will have been slight and transient, unless the blood-effusion had suppurated. As regards a fibroid, Figure 147 shows how, during resolution of a cellulitis, a lump may be felt resembling an intra-ligamentary uterine growth; but again there will be the history of recent delivery to aid the diagnosis of

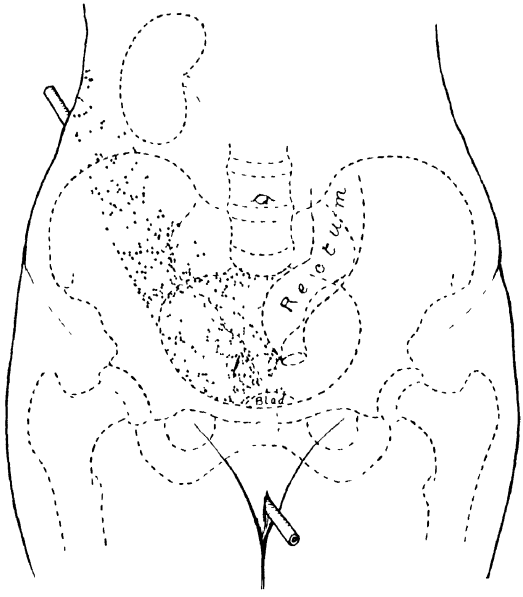


FIG. 146. REMOTE PARAMETRITIS. Scheme of case seen in Figure 145, showing a drainage tube which was passed through the whole length of the suppurating tract.

cellulitis, whilst in the case of a tumour, no such history is obtainable unless it became infected.

Differentiation between pelvic peritonitis and pelvic cellulitis will be deferred until the latter condition is described (pp. 230, 236).

Prognosis. Under favourable conditions the exudation completely subsides, recovery is complete, and the attack of cellulitis leaves no barrier to future pregnancy. When suppuration occurs, if the pus pointing externally is evacuated, recovery is rapid. When the pus extends to parts distant from the uterus, or burrows posteriorly, recovery may be prolonged for several months. In the case illustrated in Figure 146 the illness had lasted for ten months before the abscess appeared in the loin. After the whole track had been drained the sinus quickly closed and the patient soon recovered.

Treatment. Rigid asepsis in midwifery and in surgical manipulations would prevent the occurrence of acute primary pelvic cellulitis. When the disease is established, treatment consists of prolonged rest in bed, the giving of saline aperients, the application of fomentations to the lower abdomen,

the use of hot vaginal douches and electric-light baths. Injection of warm unboiled milk into the muscles below the iliac crest has been employed by Schmitt and Gellhorn with the object of increasing the number of leucocytes and causing absorption of the exudation. It is said that the best results are obtained in mixed infections following gonorrhœa.

Polak recommends that diathermy and the ultra-violet rays be employed in addition to intra-muscular injections of 5 c.c. of milk every other day. The value of glycerine tampons as an aid to absorption is a matter of doubt. Septic wounds of the vaginal vault and of the cervix must receive suitable treatment. When pus forms, the abscess must be opened without delay, and a drainage-tube inserted. In cases where prolonged flexion of the thigh has resulted from an exudation under the ilio-psoas muscle care must be taken to avoid contracture of the knee-joint, by placing the limb on a double-

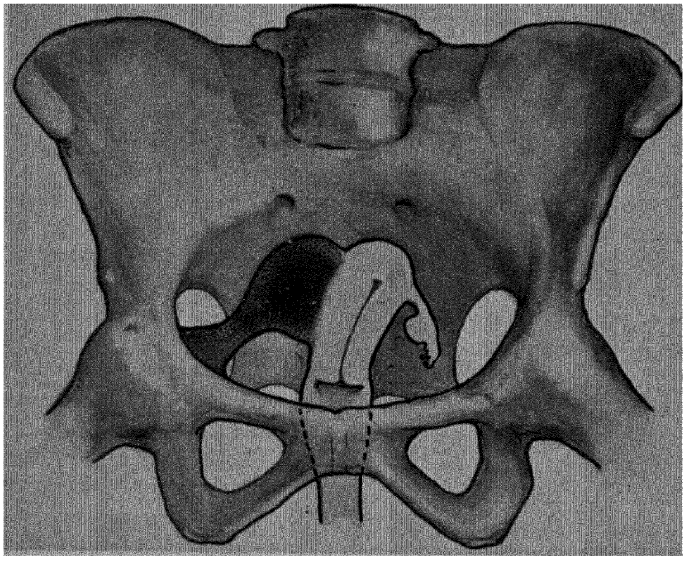


FIG. 147. A PARAMETRIC EXUDATION IN THE RIGHT BROAD LIGAMENT, yielding clinical signs similar to a fibroid of the uterus (after Winter and Ruge).

inclined splint, which should be taken down daily for passive movements and massage.

PELVIC PERITONITIS

(*Perimetritis*)

Although pelvic peritonitis is an infective process, its function is protective and life-saving, but when the excitant is too virulent the resultant peritonitis may be destructive to tissues and dangerous to life.

Etiology. Pelvic peritonitis is the result of some pre-existing intra-pelvic disease; the symptoms it produces are often the first indication of the presence of such disease, hence arose the idea that pelvic peritonitis was a primary idiopathic inflammation. This view is now known to be erroneous.

The commonest cause of pelvic peritonitis is an ascending infection of the genital tract which has reached the Fallopian tube (*see* Pl. XI, p. 258). The commonest sources of infection are therefore puerperal sepsis and

gonorrhœa, whilst tubercle comes third in etiological importance. The morbid anatomy of inflammatory affections of the Fallopian tubes and of the ovaries will be described in detail in a later section (*see* p. 548), but certain points must here be referred to in order to render an account of pelvic peritonitis intelligible.

Salpingitis. Pelvic peritonitis in the female usually arises as a complication of salpingitis. By means of the Fallopian tube the peritoneum is placed in direct continuity with the mucous lining of the uterus and of the vagina; thus extension of an infective process in the uterus to the peritoneum is what must be regarded as likely, if not inevitable. Once a tube is infected, the lumen, at its uterine end, is speedily closed by turgescence of the mucous membrane, and infective secretions find their way through the more patent abdominal ostium as their only mode of egress. Hence pelvic peritonitis is a constant sequel to salpingitis. When the abdominal ostium is closed the infected secretion, which becomes pent up, causes an extension of the inflammatory process through the walls of the tube to its peritoneal coat, thus giving rise to *perisalpingitis* and adhesions. With retention of pus in the tube the tendency is to repeated fresh attacks of peritonitis, the spread of inflammation extending over the neighbouring peritoneum on each occasion. The pus may also find its way through the tube, and produce a peritubal abscess in the way explained on page 554. From close proximity with the ovary, the abdominal ostium frequently adheres closely to the surface of this gland, but, apart from this change, patent tubes may cause *peri-oophoritis* and, in many cases, also infection of the Graafian follicles, leading to ovarian abscess (*see* Fig. 377, p. 584). In such cases the ovary provides a fresh source of infection for the peritoneum, and it may happen that the original tubal infection may clear up when the ovarian abscess will appear to be the original source of the peritonitis.

New Growths. Experience shows that a cystoma of the ovary is much more likely to become the seat of abscess-formation than is the non-cystic ovary, since suppurating ovarian cysts are much more frequently encountered than is the true ovarian abscess. The infection in the case of suppurating cystomata is, however, not necessarily of tubal origin. An ovarian cyst may come in contact with, and press on, the bowel, and becoming infected from the latter may lead to pelvic peritonitis. Ovarian cysts may also lead to inflammation of the serosa by becoming infected after suffering injury, from twisting of their pedicle, or from bruising during labour. Some types of tumour, viz. the papillary cyst and teratoma, are rarely found without evidence of more or less extensive peritonitis, and the same applies to every type of malignant ovarian or tubal growth, and also to lutein and endometrial hæmatomata. Fibroids do not, as a rule, cause peritonitis, but they are very prone to undergo necrosis, and when associated with salpingitis, a necrotic fibroid may, like an ovary, become infected and form an independent source of peritonitis.

Acute Uterine Infections. As already mentioned, when a septic infection follows abortion, labour at term, or surgical procedures on the genital tract, it may be followed by a general pelvic peritonitis. In some of these cases the peritonitis may remain localized with the formation of an encysted abscess in the pouch of Douglas. More often diffuse pelvic suppuration of a very virulent type, and involving both the peritoneum and the connective tissue, ensues. This is rapidly fatal.

Pelvic Cellulitis. We have stated that a pelvic cellulitis may be secondary to pelvic peritonitis; the converse holds equally good, especially when the former has gone on to suppuration and abscess-formation.

Tubercle. In relative importance tubercle may be regarded as the third bacterial source of infection of the pelvic peritoneum, the other sources of *paramount* importance being sepsis and gonorrhœa. For an account of the relationship between tubercle and pelvic peritonitis the student is referred to the section on tuberculosis of the female genitalia (p. 270).

Pelvic Haematocele. Peritubal and paratubal hæmatoceles are examples of what peritonitis can accomplish as a protective agent. The false capsule which limits the amount of hæmorrhage, and which shuts off the blood from the general peritoneal cavity, is produced by adhesive peritonitis. In diffuse hæmatocele there is also an associated peritonitis which tends to limit the extravasation of blood by the formation of adhesions between omentum and coils of intestine at the pelvic brim.

Ovarian Haematoma. Reference will be made in a further section (*see* Ovary, p. 592) to the fact that endometrial cells may regurgitate along the Fallopian tubes during menstruation in a backwardly placed uterus and become engrafted in ovarian substance. This may result in an ovarian hæmatoma. In such cases the ovary is found to be enveloped in adhesions, thus affording another instance of the protective character of plastic pelvic peritonitis.

Appendicitis. The vermiform appendix in woman frequently lies in the pelvis and is intimately concerned with gynæcological affections (*see* p. 245). It is, therefore, necessary, when investigating a case of right-sided pelvic peritonitis, to bear in mind the possibility of a diseased appendix; indeed this organ may not infrequently be found adherent to the right Fallopian tube or to the ovary, and is one of the common causes of right-sided salpingo-oöphoritis (*see* Fig. 349, p. 549). It has also been found adherent to the pregnant uterus, when the risk of uterine infection is very great.

Pathology. When inflamed, the peritoneum becomes dull, dry, and slightly roughened; masses of lymph adhere to its surface and lead to the formation of adhesions. After repeated attacks, adhesions showing a varying degree of organization into fibrous tissue are to be seen. Serous effusion is another feature of peritonitis. The serum collects in the pouch of Douglas, where it becomes shut off by adhesions; it is also found between adhesions, forming swellings resembling true cysts. The name of *encysted serous perimetritis* has been given to the latter condition. In the serous effusion it is common to find floating flakes of lymph. Serous effusion is present in every case of *acute* pelvic peritonitis, but where the inflammation passes to a chronic stage the fluid may be absorbed; collections encysted between adhesions may, however, remain and form pseudo-cysts varying in size from that of a pea to that of a large orange. To such serous pseudo-cysts of inflammatory origin Targett gave the somewhat incorrect name of *perimetric cystomata*. In some cases these pseudo-cysts are subdivided into loculi by membranous septa.

Inasmuch as pelvic peritonitis usually originates in salpingitis, the densest adhesions are generally met with at the abdominal end of the tube, but in appendical cases, the adhesions are most dense wherever the vermiform appendix happens to be situated.

When the infection is more virulent the secondary peritonitis leads to

the formation of intra-peritoneal abscess or, in rarer instances, such as virulent puerperal sepsis, to general suppurative peritonitis. *Intra-peritoneal abscesses* may be single or multiple. As the tubes, in cases of *salpingitis purulenta*, generally lie with their ostia low in the pouch of Douglas, that cavity becomes the receptacle for pus, and it is here that an intra-peritoneal abscess most commonly forms. Sometimes a collection of pus forms around the abdominal ostium of the tube; this is spoken of as a peritubal pyocele, and is comparable to a peritubal hæmatocele. From ulceration of a tubal pus-sac an intra-peritoneal abscess may be formed in whatever position the tube may happen to have leaked. Sometimes the ulceration occurs into a loculus of an ovarian cyst, and a tubo-ovarian instead of an intra-peritoneal abscess is then formed.

Small intra-peritoneal abscesses may dry up and disappear; larger abscesses will either run an acute course, or remain latent and cause but few symptoms. In the latter, however, there is a tendency for ulceration of the abscess-wall to occur, and for the contents to escape into the pelvic colon. Less frequently, the pus escapes into the bladder or vagina. In rare instances it will rupture into the peritoneal cavity, or through the abdominal wall

Symptoms. Pelvic peritonitis is ushered in by sudden acute local pain accompanied with fever, rapid pulse, and often vomiting. This is followed by abdominal distension, either general or local. The acute pain may last for a few hours, and on subsiding it leaves a tenderness over the affected parts. The patient during an acute attack lies on her back with her knees drawn up; the lower abdomen is rigid and tender and may be tympanitic from flatus in the distended intestines. Except in cases of diffuse septic peritonitis rigors are not frequent; a rigor may indicate the rupture of a pyosalpinx or of an ovarian abscess. Constipation dyschezia and dysuria may be met with. In chronic cases dysmenorrhœa, menorrhagia, sacralgia, and inability to work are the prominent symptoms. *There is always a liability to recurrent subacute or even acute attacks* which form a good indication of the presence of some focus of suppuration of which in the intervals the temperature may give no sign The grade of severity in the symptoms of pelvic peritonitis varies between those which cause a patient to be bed-ridden and emaciated, to those where the woman suffers only from occasional attacks of pelvic pain.

On vaginal examination, if the parts are not too tender, the posterior vaginal fornix may be felt to be depressed by a median retro-uterine swelling, which pushes the uterus forwards. Lateral swellings cannot usually be detected in the acute stage, but when this has subsided elongated swellings, leading to the uterine cornua, may be made out under anæsthesia. Such lateral swellings represent the fused tubes and ovaries. These tubo-ovarian masses are of various shapes and sizes; they may be large enough to depress the lateral fornices or they may rise above the pelvis and, in the case of large pus-sacs, ascend as high as the umbilicus. When examination is made soon after an acute attack the consistence of the adnexal structures is found to be hard and dense owing to a cellulitic exudation around them, and also to the œdematous thickening of the tube-walls. This hardness subsides in time and the true outlines of the appendages become more easily felt. It may then be possible to obtain distinct fluctuation in a pus-sac. Fuller clinical details will be given in dealing with tubo-ovarian inflammation (*see* p. 565).

Diagnosis. The two conditions which are most likely to be mistaken for pelvic peritonitis are pelvic cellulitis and pelvic hæmatocele.

Pelvic Cellulitis. There are many points of strong contrast in the etiology, signs, and symptoms of pelvic peritonitis and cellulitis, the most important are summarized in tabular form below:

	Pelvic Cellulitis	Pelvic Peritonitis
Frequency	Rare	Common
Cause . .	Sepsis.	Sepsis, gonorrhœa, tubercle.
Associated lesion	Laceration of cervix and vagina.	Salpingitis.
Symptoms	Pain, none or slight, unless peritoneum is involved.	Pain severe, the initial symptom.
Signs . .	Unilateral, hard, smooth swelling	Bilateral irregular swellings of unequal consistence.
Commonest position of swelling	Above Poupart's ligament continuous with induration in lateral fornix (pathognomonic).	Behind the cervix.
Cervix . .	Surrounded and fixed by a hard thick collar	No indurated girdle, therefore usually some mobility of cervix
Rectum .	Surrounded by a belt of induration, narrowing calibre of bowel.	Walls not indurated, not encroached on laterally.
Broad ligament	When infiltrated, forms hard, smooth flattened tumour continuous with uterus, can be moved slightly from front to back.	When tumour caused by inflamed tube and ovary, the mass is irregular, and lies on a plane below and behind the uterus, and is quite fixed.
Course . .	Tends to disappear entirely.	Tends to persist and permanently to impair the mobility of the uterus, and even to cause its displacement.
Abscess .	Tends to point externally and to open above Poupart's ligament.	Usual outlet is the bowel, bladder, vagina, or other internal part.
Sinuses .	Never persist.	Often persist and cause much trouble, especially in tuberculous cases.
Prognosis .	Good. No impairment of prospects of maternity.	Less favourable. Mortality higher, tends to chronic invalidism and to sterility.

Pelvic Haematocele. Of the three types (peritubal, paratubal, and diffuse retro-uterine), the diffuse retro-uterine hæmatocele, with the pouch of Douglas full of blood, has to be distinguished from effusion of serum and

pus due to pelvic peritonitis. The clinical history of ectopic pregnancy and the transient febrile attack will point the way to the diagnosis of hæmatocele, but it must be remembered that when, as may happen, the latter suppurates, the signs and symptoms will resemble those of an intra-peritoneal abscess. Peri- and para-tubal hæmatoceles forming definite tubal swellings can only be diagnosed from true inflammatory tubal conditions by a careful study of the clinical history.

Prognosis. After an acute attack has passed off there is a liability to recurrence of peritonitis due to the fact that a focus of pus may remain in the tube, or ovary, or amongst peritoneal adhesions. Thus pelvic peritonitis must be regarded as a serious disease which seldom completely clears up, but tends to produce a state of chronic ill-health and incapacity for physical exertion. Interference with the normal action of the bowel is a frequent result, and adhesions which have formed may be dense enough to produce acute intestinal obstruction. Only in rare instances does pelvic peritonitis clear up completely.

Treatment. *Preventive.* One of the commonest causes of pelvic peritonitis is gonorrhœa, therefore prophylaxis implies the early recognition and vigorous treatment of this disease (*see* p. 256). Prophylaxis in the non-gonorrhœal cases consists in carrying out strict asepsis in midwifery and in surgery. When the disease has once been established, patients must be cautioned against the risk of a relapse through exposure to cold, over-fatigue, and constipation, especially during menstruation. Attention to the bowels is of the greatest importance for obvious reasons.

Medical. During an acute attack rest in bed is essential; the initial pain will require anodyne treatment. One-sixth of a grain of heroin may be given, abdominal fomentations applied, and the distension relieved by an enema; 1 oz. of castor-oil may be given if the enema does not act efficiently. Alcohol may be indicated by a weak, intermittent pulse.

Surgical. Except in the case of acute appendicitis, it is generally wiser to postpone operative interference until an acute attack of pelvic peritonitis has passed off, but this will not apply to serious septic conditions, where "opportunity is fleeting" and where desperate risks must be taken. When a tense cystic swelling forms in the pouch of Douglas it should be at once evacuated by posterior colpotomy (*see* p. 704). The same applies to a rapidly increasing swelling in the lower abdomen, for this may prove to be a suppurating ovarian cyst or an intra-peritoneal abscess. Less acute and chronic cases must be considered individually; many such are best treated by rest and medical aid—that is to say, convalescence may be expected without operation.

If, after the first acute attack, nothing be felt except a swelling indicative of chronic salpingo-oophoritis with no evidence of the presence of pus, operation is not indicated. Recurrent attacks may be regarded differently, and removal of an inflamed tubo-ovarian mass may be necessary for restoration of health, but every endeavour should be made by rest in bed, douches, aperients, enemata and hot-air baths to reduce the size of the swelling before its removal is considered imperative. Such a conclusion may be necessary if the inflammatory mass is not reduced in size by palliative means. In hospital practice the surgeon's hand is often forced by the necessity of restoring the patient to health as soon as possible, because she happens to be a bread-winner. In private practice it is possible to be much more

conservative in the treatment of adnexal inflammation For further details *see* pages 571, 572.

It may be necessary in a certain number of cases to operate for symptoms produced by extensive adhesions, *e g.* for a fixed retroposed uterus. In such circumstances attempted reposition *per vaginam*, with a view to maintaining the normal position of the uterus by the use of a pessary, is a distinctly dangerous procedure ; whereas if the uterus is freed from adhesions and kept in position by ventri-suspension, the relief of symptoms may be expected, and even sterility may be cured by these operative means, if the tubes remain patent.

PYÆMIA

We have seen that following a local infection of the genital tract a general or systemic infection may ensue. This may occur in two ways. (1) The organisms may pass directly into the circulation *viâ* the lymphatics and blood-vessels, and then multiply in the blood-stream without causing any local lesion. To such a spread of infection the name of *septicæmia* or *bacteræmia* is applied ; (2) the bacteria may pass from the uterine wall into the veins, setting up septic thrombo-phlebitis. Some of the infected thrombi then break down, particles are carried off as septic emboli and become lodged in various situations throughout the body, notably in the lungs. At the point of lodgment these emboli form foci of infection, resulting in the formation of serous effusions or abscesses. Thus is set up the condition known as *pyæmia*.

All cases of pyæmia are of grave import. Arnold Lea states that this form is responsible for from 30 to 50 *per cent.* of all deaths from puerperal infection. The prognosis varies with the organism present. Streptococcal pyæmia is usually fatal, but with other organisms there is a better chance of recovery. Pyæmia may result from non-puerperal as well as from puerperal infection. The thrombo-phlebitis, by which it is preceded, may follow directly upon a uterine infection, or be secondary to a local infection, such as primary cellulitis. The primary source of infection is usually the uterus, and by far the commonest cause is abortion induced without proper surgical precautions and which is usually criminal in intent. Apart from this it may be met with in obstetric practice, where there is a history of intra-uterine manipulations, such as manual delivery of the placenta, or where a sharp curette has been used to remove fragments of infected placenta during the puerperium. The condition indicates a relatively less degree of virulence in the bacteria than that which produces septicæmia. This is indicated by the following facts : (1) bacterial dissemination is for a time confined to the pelvic veins ; (2) clinically the disease is later in onset than septicæmia ; (3) the organisms can only be found in the blood just before and during a rigor ; (4) the disease is not so fatal.

The *symptoms* commence with an initial rigor, and the temperature rises to 104° or 105° F. It then rapidly falls to or below normal, the patient meanwhile sweating profusely. The pulse at first is proportionately less rapid than in septicæmia ; it is only in the later stages of pyæmia that the pulse-frequency is increased to the extent seen in the latter condition. The course of pyæmia is characterized by repeated rigors, whilst in the intervals the temperature may remain normal or subnormal. In this way the disease may continue for weeks. In the

worst examples death usually occurs in the third week, but we have known a fatal issue postponed until the fifty-second day. A case has been recorded in which a pyæmic patient recovered after seventy rigors and an illness lasting five months The issue depends on the distribution of the emboli, multiple emboli in the lungs, endocardium, and brain being necessarily fatal.

Autopsies on pyæmic cases have revealed extensive thrombosis in the femoral, ovarian, uterine, iliac, and renal veins, and in the vena cava. Also multiple abscesses in the lungs, with areas of pulmonary gangrene, pneumonia and empyema. Metastatic abscesses have also been found in the brain, the eye, the liver, the kidney, in joints, bones, skin, and muscle. Ulcerative endocarditis is seen to be present in half the fatal cases. The peritoneum generally escapes, excepting for slight local peritonitis around the broken-down thrombi in the local veins.

The *treatment* of pyæmia is the same as that already mentioned for septicæmia, and from what has already been stated it will be gathered that there will be no place for serum-therapy in pyæmia when the organisms have already established a foothold in the blood-stream. The injection of the chemicals already mentioned, or of collargol (10 c. c. of a 1 *per cent* solution), may be given into a vein once daily, or nucleinic acid in doses of 1–2 drachms of a 2 *per cent.* solution may be given twice daily under the skin. For remarks on blood-transfusion *see* page 221. Tying the ovarian veins on the proximal side of the thrombosed area has not yielded encouraging results.

SEPTIC URINARY INFECTIONS

CYSTITIS

Etiology. The causes of cystitis are (*A*) predisposing, (*B*) active. The bladder is more easily infected in women than in men.

(*A*) The *predisposing* causes are chill, foreign bodies in the bladder (*e.g.* stone, hairpins, etc.), introduction of instruments (catheter), vesical new growths, retention of urine due to paralysis or to obstruction caused by a retroverted gravid uterus or a tumour in the pelvis, and, lastly, traumatism, *e.g.* injury during operation, or fracture of the pelvis.

(*B*) The *active* causes are *bacteria*, which may reach the bladder by way of (1) the urethra; (2) neighbouring organs, (3) the blood-stream. Examples of urethral or *ascending* infection are (*a*) bacteria carried from the anal region to the urethral orifice (B. coli); (*b*) direct infection of the urethra in gonorrhœa, (*c*) direct infection during catheterization. The most frequent avenue of infection of the bladder is the urethra. Examples of infection from neighbouring organs are (*a*) fistulous openings from rectum or colon, uterus, vagina, and perforating endometrial ovarian cysts [1]; (*b*) lymphatic spread from the rectum or pelvic cellular tissue (parametritis); (*c*) direct infection from the peritoneum (pelvic peritonitis); (*d*) direct infection from ureter and kidney; the latter is known as *descending* infection.

The kind of organism causing the infection has a marked influence in determining the avenue of infection. Staphylococci infect the bladder by ascent from the urethra. Most tuberculous infections of the bladder in women are from urine coming down from a kidney which has become tuberculous through the blood-stream. The colon bacillus may cause both

[1] Keene: *Amer. Journ. Obst. and Gyn.*, vol. x., 1925, p. 619.

bladder- and kidney-infection by ascent through the urethra, or it may first infect the kidney through the blood, cause a pyelitis, and then descend to the bladder. The same applies to the pyogenic cocci and to the *proteus* group. The relative frequency of the two main routes of infection, the ascending and the descending, cannot be stated, but in hospital practice there is no doubt that the ascending infection is the more frequent, for it is common observation that nearly all cases of cystitis in the wards are post-operative and largely due to repeated catheterization.

The most important organisms which cause infection of the urinary passages are: the colon bacillus, the typhoid bacillus, the *staphylococcus aureus*, the *staphylococcus albus*, the streptococcus, the gonococcus, the proteus bacillus, the tubercle bacillus, the *bacillus pyocyaneus*, and bilharzia. The commonest of all is the *bacillus coli communis*, the next most frequent is the tubercle bacillus (E. Shaw) Very common combinations forming mixed infections are (*a*) B. coli and staphylococci, (*b*) B coli and streptococci, (*c*) B. coli, staphylococci, and streptococci Another common combination is *bacillus tuberculosus* and staphylococci Mixed infections usually mean that the secondary organism has been conveyed by instruments.

The identification of gonococci and of tubercle bacilli is made by staining films prepared from the centrifugalized deposit. With other organisms cultural methods are employed. The pathogenicity of the organisms is sometimes determined by animal inoculations, *e g* in tuberculosis.

It is generally agreed that two factors must be present in the causation of cystitis one the *infecting organism*, the other *injury*, either in the nature of actual trauma or a condition of lowered resistance. Micro-organisms alone will not set up cystitis: this has been proved by injecting large quantities of bacteria into the bladder without any detriment to that organ, and again, cystitis is by no means an invariable accompaniment of renal infection. Similarly, traumatism produced during parturition or by surgical instruments will never alone cause cystitis, but if traumatism is severe or repeated, sooner or later micro-organisms from the bowel, or from the urethra, or even from the circulation, will find a nidus, and start an infection. Hence it is that repeated catheterization is so frequently followed by cystitis. The influence of trauma as a predisposing cause of cystitis is brought to the attention of the surgeon in performing hysterectomy, notably for cancer. In cases where there has been much difficulty in dissecting the bladder from a cancerous cervix, the base of the organ will be contused and indurated by effusion of blood, and it is frequently found that a severe cystitis follows after the catheter has been passed only a few times. Of all the paths of entry for organisms, it must be borne in mind that the *ascending* route is by far the most important.

A thorough bacteriological examination should be made in all cases of cystitis, especially if the infection does not respond promptly to treatment, since, by a recognition of the organism responsible for the infection, it is advisable to employ autogenous vaccine therapy.

Pathology. The appearances of *acute cystitis* have been studied by cystoscopy. The mucosa is universally reddened and swollen; dilated branching vessels are prominent; ecchymoses may be seen. The lesion starts in the epithelium and reaches to the submucosa, but there is no involvement of the muscle and perivesical tissues. Microscopically, there

is dilatation of blood-vessels and the tissues of the mucosa are infiltrated with polymorphonuclear leucocytes, and perhaps with plasma-cells. Later on, the blood-vessels are seen to proliferate and the leucocytes aggregate, forming foci which lead to tiny abscesses. In spite of these changes the mucosa is hardly ever adherent to the submucosa. In acute cystitis there is very little loss of epithelium, and practically never any muscular hypertrophy.

Chronic cystitis presents a remarkable variety of lesions. Superadded to the ordinary changes incidental to chronic inflammation of the mucosa, there is a great thickening of the muscular coats and marked trabeculation. In tabetic cystitis the bladder is distended, but in an uncomplicated case of chronic cystitis the capacity of the bladder is diminished. The entire wall is thickened, the mucosa is slate-coloured, showing red spots here and there. Instead of a smooth, velvety aspect the surface becomes leathery and granular. It is thrown into coarse folds, and presents ulcers and bosses of granulation tissue. Leucoplakic patches may be present, and actual cysts may form between trabeculæ.

Microscopically the surface-epithelium is in part absent, polymorphonuclear leucocytes and plasma-cells abound. The muscle is largely replaced by fibrous tissue, and the perivesical tissues undergo a fibro-lipomatous change which adds greatly to the thickness of the organ. A leucoplakic area presents many layers of horny epithelium overlying scar-tissue. The behaviour of the epithelium in chronic cystitis is very striking. It dips down into the submucosa as solid buds of transitional epithelium; these buds break down in the centre and form small cysts, which vary in size from a pin's head to a pea. By the breaking down of these cysts small pockets are formed in which phosphatic deposits collect. This may go on to extensive ulceration with further incrustation, resulting in the so-called stalagmite-bladder. An even more striking pathological feature, demonstrated by the mucosal epithelium, is the formation in chronic cystitis of pseudo-glands, resembling Lieberkuhn's follicles in the intestine. The process of branching gland-formation is similar to that seen in the muscular wall of the Fallopian tube in chronic salpingitis, especially in tuberculous cases (*see* Fig. 161, p. 279). It is also seen in the formation of acquired *erosion* following on cervicitis (*see* p. 368). The significance of such gland-formation in the walls of the bladder is that these pseudo-follicles are liable to become the site of the development of carcinoma, and their presence affords a rational explanation of the occurrence of adeno-carcinoma of the bladder.

Symptoms. The characteristic symptoms of cystitis are increased frequency of micturition, pain, dysuria, local tenderness, a sense of pressure or bearing down in the lower abdomen, and turbidity of the urine.

The onset of *acute cystitis* is ushered in with a severe febrile attack. In the most severe cases there may be a rigor. The temperature may rise to 101°, 102°, or 103° F., and the patient feels very ill, complaining of a severe forcing pain in the hypogastrium which radiates round to the back. The pain is accompanied by tenderness in the hypogastric area. Irritability of the bladder soon becomes very distressing; small quantities of urine are passed with intense pain of a spasmodic character (*strangury*). This goes on day and night, robbing the patient of sleep; the pulse rapidly rises, and the temperature keeps up continuously. Under suitable treatment the severe symptoms gradually subside, but frequent and painful micturition

may remain long after the fever has subsided. The urine, during the acute stage of cystitis; is rendered turbid by the presence of pus-cells, epithelial cells, and blood-corpuscles. The latter may be present in sufficient numbers to render the urine smoky, or to be thrown down as a red ring in the deposit which forms when a specimen is allowed to stand in a conical glass. In the majority of cases of cystitis in women, the urine is acid or neutral in reaction ; alkaline ammoniacal cystitis is only seen in the female, when, from any cause, there is sloughing of the mucosa. The amount of albumen will vary with the quantity of pus and blood which is present. If a large trace persists after the acute symptoms have subsided, it points to involvement of the kidney. The blood-count is normal in acute cystitis, *i.e.* there is no leucocytosis.

An acute cystitis may clear up completely, or it may lapse into the chronic form. The gravity of acute cystitis is due (*a*) to the difficulty of complete cure ; (*b*) to the danger that ascending infection along the ureters to the kidney may occur, but this is, fortunately, a very exceptional complication of acute cystitis (*see* p. 243).

When cystitis lapses into the *chronic stage*, all symptoms subside except the increased frequency of micturition, and even that may be absent ; but long after the symptoms have subsided, there may be organisms abounding in the urine. In a recent case which was under our care in hospital for twelve weeks, an extensive growth of the *bacillus coli communis* was obtained from the urine two months after the patient had felt quite well, and in spite of the fact that she had been systematically treated by hexamine, irrigations, and autogenous vaccines.

In *subacute* cystitis, as a rule, the frequency of micturition is lessened but still marked ; indeed in some instances it may be so troublesome at night as to exhaust the patient from want of sleep. In the most severe cases, a constant spasmodic condition of the bladder occurs, leading to a dribbling of urine indistinguishable at first from the simpler forms of incontinence. The amount of pus may be small at first, so small in fact that it is only to be found in a centrifugalized deposit of a twenty-four hours specimen. With the continuance of the disease the pus increases until there is a heavy deposit of pus, mucus, and epithelial *débris*.

Diagnosis. Cases of *acute cystitis* occur during pregnancy, in the puerperium, after operations, and in the subjects of an acute gonorrhœal infection. In the worst cases the question of the kidney being also implicated will arise (pyelonephritis). When acute symptoms supervene after the passage of a catheter in the puerperium, or after an operation, the diagnosis of an inflamed bladder is not difficult. The local pain and tenderness, the frequent and painful micturition, and the altered character of the urine, are clear indications of cystitis. In a gonorrhœal infection, the swollen meatus, and a purulent urethral discharge, together with the discovery of the gonococcus, will suffice for diagnosis. In acute cystitis it is not advisable to employ cystoscopic examination, as additional trauma may result therefrom. We must, therefore, be content with such evidence as can be obtained clinically, short of actual inspection of the interior of the organ, and this, when combined with a cytological and bacteriological examination of the urine, suffices for all practical purposes.

In *chronic cystitis* a cystoscopic examination is often essential ; it may be made with, or without, the aid of an anæsthetic. The first investigation

is best made under anæsthesia ; for a description of the technique the student should consult a text-book on the surgery of the urinary tract. Cystoscopic examination has revealed the fact that inflammation of the bladder is not uniformly distributed over the mucous surface, but exists in localized foci or ulcers. Irregular red areas, rounded or crenated in shape, are seen, or sometimes the infection causes petechiæ containing little spots of ulceration. Such lesions may give rise to very troublesome hæmorrhage and they heal very slowly. When an ulcerated area heals, it contracts and leaves a linear or radiating scar The line of an old ulcer stands up as a falciform ridge, dividing the bladder into deep loculi, and expansion of the organ is thereby seriously curtailed. When healed, a linear ulcer appears as a yellowish white streak in the centre of a red zone.

Differential Diagnosis. It is important to differentiate between cystitis and the condition known as *irritable bladder*, in which there is increased frequency in voiding urine, and tenderness at the base of the bladder. These symptoms are found to be associated with hyperæmia of the trigone. There is no inflammatory area to be seen on cystoscopic examination, and there is no pus in the urine. Similarly in *bacilluria* there is no local lesion, for, as was previously stated, micro-organisms are found to abound in the urine long after the symptoms of cystitis have cleared up. *If a bladder is cystoscopically examined in a persistent case of simple bacilluria there will be none of the signs of inflammation mentioned above.* In every case of increased frequency of micturition from whatever cause, *e.g.* when it appears in the early and late months of pregnancy, or when it is caused by the pressure of pelvic tumours, a thorough examination of the urine should be made, in order to exclude the possibility of cystitis.

Finally, the diagnosis of cystitis must not be considered complete until the infecting organism has been isolated , a practical guide in this respect may here be mentioned, viz *that a persistent acid pyuria with a small quantity of pus, and accompanied by slight fever, is liable to be a tuberculous affection.*

Treatment of Acute Cystitis. The patient must remain in bed until the acute stage is over. At the onset it may be necessary to give heroin hypodermically to allay the pain. Copious drinks of *alkaline* mineral water should be given, which has a sedative effect. Balsam of copaiba (given in capsules) and sandal-wood oil (capsules of arheol) are said to be of use in gonorrhœal cystitis.

The administration of hexamine followed ten minutes later by a mixture containing acid phosphate of soda or sodium benzoate will help to cut short the disease. If the bladder is not too tender it may be irrigated with warm boric acid solution or with boroglyceride solution twice a day, and at the end of the irrigation a teaspoonful of protargen (albuminate of silver), in solution varying from 1 to 10 *per cent.* (according to tolerance) should be injected. If the cystitis does not clear up, vaccine-therapy should be employed. In a few cases it is necessary to drain the bladder through a vaginal incision.

Treatment of Chronic Cystitis. Before beginning the treatment of chronic cystitis, the possibility of a renal source of infection should be thought of, and settled by cystoscopic examination. If a descending infection can be excluded, the treatment of the bladder is proceeded with on (*a*) general, (*b*) local lines.

Internal medication is employed (*a*) for the relief of pain and (*b*) to destroy the invading bacteria. The preparations of opium (morphia, codein, and

heroin) must not be used ; the best sedative consists of a mixture containing 20 grs. of citrate of potassium, and ½ drachm of the tincture of hyoscyamus in combination with infusion of buchu. To destroy the organisms present there is no drug so efficient as hexamine. Its efficiency depends upon the liberation of formaldehyde in the urine ; the reaction being manifested only in acid urine, acid sodium phosphate should also be given as already directed. These two drugs are combined together in tablets, and sold under various fancy names by druggists, but we prefer to prescribe them separately, giving for a dose 10 grs. of hexamine to be followed twenty minutes later by a mixture containing 20 grs. of acid sodium phosphate combined with tincture of hyoscyamus and infusion of buchu. The determination of the infecting organism is of assistance ; *e.g.* where tubercle bacilli are found, the initial lesion will be found in the kidney, and will call for surgical treatment. Gonococci will indicate the employment of copaiba and sandal wood, and the administration of large doses of alkalies. The coliform group of bacilli will indicate the need for large doses of hexamine, *i.e.* 10, 15, 20 grs. thrice daily, followed by acid sodium phosphate as above stated. The diphtheria bacillus, if present, would indicate the use of antitoxin. The *proteus* group of bacilli in alkaline urine necessitates rendering the urine acid by giving benzoic acid in doses of 10–15 grs., and then following this up with hexamine when the urine has been rendered acid. Staphylococcic and streptococcic cystitis also indicate the use of the latter drug.

Local treatment includes (*a*) irrigation ; (*b*) instillation ; (*c*) topical applications ; and (*d*) drainage.

(*a*) If the urine is acid, the bladder should be washed out with a borax solution, in the strength of one teaspoonful to a pint of warm water at 105° F. In the case of alkaline urine, warm boric acid solution should be used. Care must be taken to admit no air into the bladder, as it causes distress. After the first rinsing, the same solution may be run in and out two or three times by alternately elevating and lowering the funnel. Irrigation should be used twice daily. In very chronic cases the bladder will not hold many ounces of fluid, but with patience the organ can be gradually *distended* to hold ten times as much as it does at first. In order to assist the tolerance of the bladder, a 1 *per cent.* solution of cocaine may be injected five minutes before irrigation is begun.

(*b*) Instillation consists in the injection of a fluid and leaving it in the bladder. It should be used immediately after irrigation. The best preparations for this purpose are solutions of silver nitrate 1-1000, and protargen in 2–10 *per cent.* solution. One or two teaspoonfuls are injected by means of a glass-catheter, to which is attached a rubber-bulb containing the fluid to be injected. Many cases of chronic cystitis are cured by combined irrigation, distension, and instillation.

(*c*) Topical treatment consists in the direct application of a drug to the diseased area after such has been well defined (and found to be strictly localized) by means of cystoscopy. It is suitable for small areas of ulceration above the trigone on the posterior wall of the bladder (Kelly and Burnam).

(*d*) *Drainage.* The bladder may be kept at rest for a week or longer by drainage *per urethram*, by means of a self-retaining catheter. The viscus must be irrigated once or twice daily during the retention of the catheter.

Vesico-Vaginal Drainage is a valuable method of treatment for bad cases.

It is indicated when the patient is utterly intolerant of any local form of treatment. Its effect is to put the bladder completely at rest by keeping it empty. The opening is made through the anterior vaginal wall, and must be large enough to allow of a free escape of urine.

Urethritis. This condition is discussed in the section dealing with gonorrhœa (*see* p. 259).

PYELITIS: PYELONEPHRITIS

It is considered doubtful whether a renal infection is ever strictly localized to the mucous membrane of the pelvis and calices of the kidney, but the term 'pyelitis' is used clinically in describing the milder and non-surgical forms of pyelonephritis, and is in such general use that we shall retain it.

Pyelitis may be caused by chemical irritants or by infective organisms. Only the latter will be considered. Organisms may enter the kidney through the blood-stream, through the lymphatics, or by the ureters in an ascending infection. In cases of *chronic* pyelitis the bacillus coli is usually found in pure culture. The manner in which the bacillus coli obtains access is at present unsettled. There are three possible routes to be considered. The *first* is an ascending infection *per urethram;* as Williamson has pointed out, this may occur either by direct infection of stagnant urine above a ureteral block, or by the peri-ureteral lymphatics. By this route the bladder would first be involved, but clinically the special symptoms of cystitis are seldom observed in the early stages. The *second* route is by the circulation, the organisms passing through the kidney and attacking the mucous membrane of the renal pelvis (*descending infection*). The *third* is a direct infection from the bowel, the organisms passing from the colon through the peri-ureteral cellular tissue to gain access to the ureter, or possibly to the kidney. In *acute* pyelitis staphylococci and streptococci, and the proteus bacillus are more frequent. More rarely the gonococcus, pneumococcus, and the bacillus of influenza are found (Kelly and Burnam). Among the conditions which predispose to the occurrence of pyelitis are (*a*) hydronephrosis; (*b*) pressure on the ureter (*e.g.* from the gravid uterus); (*c*) retention of urine with cystitis; (*d*) infection in other parts of the body.

Pathology. There is a great variety in the form and extent of the lesions found in the kidney. In *obstructive* cases, *i.e.* where the flow of urine through the ureter has been interfered with on one side by a pelvic tumour, or by the pregnant uterus, or by cancer of the cervix involving the ureter, the corresponding kidney is liable to become infected through the blood-stream. At autopsy the kidney may look fairly normal, but there will be obvious pathological changes in the pelvis and ureter (*vide infra*). Histologically, the renal substance will be found to show various grades of nephritis, enough seriously to impair its secretory power.

In cases where there has been no ureteral obstruction, but where there is a severe infection of the kidney, the parenchyma contains multiple small or single abscesses in the acute form, whilst in a chronic form the kidney-substance is reduced, being largely converted into fibrous tissue. In such cases the ureter and pelvis may appear normal. The above constitute two types of pyelonephritis, and there is every grade of transition between them.

Symptoms. In the *acute* form, the patient is suddenly seized with acute abdominal pain, sometimes attended with shivering, and leading, after a few hours, to abdominal distension and sometimes to vomiting. The pain,

diffused at first, usually settles down to the right side, but in a small proportion of cases the left is the affected side. The bowels are usually constipated and the tongue furred. The kidney, when palpable, is tender and may be felt to be enlarged; often there is well-marked rigidity of the rectus muscle over it, and so much tenderness that detailed palpation is impracticable. Sometimes the pain on pressure is felt chiefly in the costo-vertebral angle. In cases occurring in pregnancy, the gravid uterus shows no abnormality, but tenderness of the terminal portion of the ureter (usually the right) may be detected *per vaginam* on deep palpation at the sides of the cervix anteriorly. The temperature may be raised to 103°-104° F., and the fever continues irregularly for some days unless controlled by treatment. Sometimes rigors occur, and the general condition of the patient is so much affected as to give rise to anxiety. When occurring in the puerperium, it may be mistaken for septic uterine infection.

On examination of a catheter-specimen of the urine, it will usually be found distinctly acid, less often it has been observed to be neutral or alkaline. It is turbid and contains flocculent *débris*. In the great majority of cases culture-methods yield a pure *bacillus coli;* sometimes other pyogenic organisms are also present. There are no renal casts, but the deposit may contain a little blood, and there is always a good deal of pus, shed epithelial cells and epithelial *débris* from the urinary passages. The quantity of urine is usually small, and there is no offensive odour. A trace of albumen can usually be found. In many cases the onset is less acute than this, but fever and severe pain in the abdomen or flank are invariably met with.

In the *chronic* form the symptoms are, of course, less characteristic. There is often slight irregular fever, but this is not invariable, and the patient complains of backache and sometimes of persistent irritability of the bladder. Large quantities of urine may be passed a fact which is said to explain partly the increased frequency of micturition. The development of cystitis is the rule, and in some cases the bladder-symptoms are liable to mask the primary pyelitis. Dysuria may be taken as a sign that the bladder has become secondarily infected. As a rule the kidneys are not enlarged, nor are they tender on palpation, but pressure on the ureter *per vaginam* may elicit pain and a desire to micturate (Kelly and Burnam).

Diagnosis. This rests on a careful examination of the urine, and in localizing the lesion, to one or other side, or both, by cystoscopy. In acute pyelitis the urine contains a quantity of serum-albumen, some red discs, pus-cells, and the invading micro-organisms.

Cystoscopic examination reveals a reddened, pouting, or retracted ureteral orifice on the affected side. Turbid urine may be seen issuing from the corresponding ureter, and clear urine from the other.

In gonorrhœal cases there will be collateral evidence of the disease in the cervix, urethra, and perhaps in the Fallopian tubes. Other primary sources of infection should be sought for.

Acute pyelonephritis is frequently confused with malaria, tuberculosis, appendicitis, cholecystitis, or typhoid fever.

Prognosis. Acute cases usually respond readily to appropriate treatment. Chronic cases are very intractable and often resist treatment.

Pyelitis of Pregnancy and the Puerperium. This condition seldom occurs earlier in pregnancy than the fourth month. It may assume either an acute or a chronic form, and as a rule there have been no symptoms of cystitis or

of renal disease previous to the pregnancy. Occasionally an acute attack of great severity occurs in the puerperium, when care will be required to distinguish it from acute septicæmia.

The right kidney shows a definite predisposition to this disease, but not to the extent that was at one time believed. Out of 129 cases collated by Albeck and Lenharz, in 67 the right kidney alone was affected, in 26 the left kidney alone, and in 36 both right and left were affected. It has been shown further by autopsy, and by direct observation upon cases submitted to operation, that the ureter may become dilated, at any rate in its abdominal part, upon the affected side. It is generally agreed that this dilatation does not affect the lower portion of the ureter, *i.e.* that it is only found in the part which lies above the pelvic brim. It will be recollected that ureteral dilatation similar to this has been observed in autopsies on cases of eclampsia, and is frequently found in normal pregnancy also.

Treatment of Pyelonephritis. In an acute case the patient should be kept in bed, the diet restricted to fluids, chiefly milk, and large doses of an alkaline diuretic, such as citrate or acetate of potash, administered with the object of increasing the amount, and reducing the acidity of the urine. As already stated, an acid urine forms a better culture-medium for the *bacillus coli* than an alkaline urine. The acute symptoms usually subside in a few days if a free flow of urine can be maintained, and it is probable that much of the initial severity of the attack results from dilatation of the renal pelvis and upper part of the ureter. The bowels must be freely moved every day. The urinary infection can be directly attacked in two other ways, viz. by urinary antiseptics and by autogenous vaccines (*see* Cystitis, p. 241). It has been found best to withhold urinary antiseptics until the acute symptoms have subsided. The results obtained with vaccines are unreliable, but this treatment is worthy of trial. Medicinal measures usually suffice to relieve the symptoms, but the specific organism often persists in the urine after the symptoms have all disappeared. Catheterization of the ureter, either alone, or with irrigation of the renal pelvis, is sometimes practised.

APPENDICITIS

No excuse is needed for including an account of this condition in a text-book of Gynæcology. It has been already pointed out that both in its anatomical and pathological bearings the vermiform appendix is closely related to the special pelvic organs of the female. Thus the appendix, in a considerable proportion of normal cases, is found to overhang the pelvic brim and to lie in contact, or in close relation, with the right tube and ovary. Again it has been pointed out that inflammation of the tube and ovary is not infrequently due to infection from an appendix which, itself diseased, has become adherent to one or other of those organs (*see* Fig. 349, p. 549). From this close relationship it naturally follows that there is sometimes difficulty in distinguishing clinically between morbid conditions of the appendix, and of the right tube and ovary. Errors in diagnosis are accordingly not uncommon, and the gynæcologist, when operating, is frequently called upon to deal with this organ, either because it is found to be the primary seat of disease, or because it is involved in disease which has spread to it from the tube or ovary. Many gynæcologists, and as we think with justice, make a routine practice of examining the appendix when performing an abdomino-pelvic operation, and of removing it whenever it shows signs

of disease either active or latent. From all this it follows that appendicitis is a subject with which the gynæcologist must be familiar, and the technique of the removal of this organ is a part of the training and experience which he must acquire.

Anatomy and Topography of the Appendix. The vermiform appendix springs from the inner aspect of the cæcum, about 1 inch below the ileo-cæcal valve. The anterior longitudinal band of the ascending colon, if followed into the cæcum, will be found to terminate at the base of the appendix, which is a cylindrical structure of an average length of 3½ inches, and provided with its own mesentery, in the free border of which runs the appendicular branch of the posterior ileo-cæcal artery. Usually the appendix is straight, but not infrequently it may be found curved, or acutely bent, when inflammatory changes have occurred. The direction of the appendix from its base is very variable; it may hang down into the true pelvis, or it may run upwards along the inner aspect, behind, or even on the outer side, of the cæcum and ascending colon. When inflamed it may be found adherent in any one of the three shallow peritoneal fossæ which are found in the ileo-cæcal region. It may, on occasion, much exceed its normal length, and a specimen measuring 10 inches in length has been removed by Paterson. It has not infrequently been found, when elongated, running upwards to the liver, the tip of the appendix being adherent to the under-surface of this organ.

In structure, the appendix resembles the rest of the intestinal tract in consisting of *peritoneal*, *muscular*, *submucous*, and *mucous* coats. The mucosa has a covering of columnar epithelium, with a fair number of tubular glands similar to Lieberkuhn's glands. In addition, there is an abundance of lymphoid tissue, collected in the form of numerous *follicles*, which project on the surface and also extend into the submucous layer. They are most numerous in the distal parts of the organ.

Of the *function* of the appendix nothing is definitely known, and by many writers it is regarded as a vestigial structure. The well-developed glands which it possesses, and the fact that it has been proved to increase in length during childhood and early adult life, suggest that it is a functional and not an effete organ (Arthur Keith).

Etiology of Appendicitis. In infancy and old age the disease is rare; in young and middle-aged adults it is most common. Of the exciting causes of appendicitis nothing is definitely known, and it is unnecessary in this chapter to examine the many interesting speculations which have been put forward by different writers. The organisms and parasites (oxyuris vermicularis) which are found are those frequently inhabiting the intestinal tract.

Morbid Anatomy. The inflammatory process begins in the mucosa and thence spreads outwards, involving the peritoneal coat last of all. The initial stage is a *catarrhal inflammation* of the mucous membrane, and specimens examined at this stage usually show small petechial spots, and sometimes minute ulcers. When the infection is acute the catarrhal stage passes into one of extensive, or even general *ulceration* of the mucous membrane, as a result of which perforation of the coats may occur at some point. Occasionally, the infection is so acute that massive *gangrene* affecting all the coats, or even the entire organ occurs. The gangrenous wall soon gives way, allowing the contents to escape. When the infection is less virulent than this, the stage of catarrhal inflammation passes into one of subacute or

chronic inflammation affecting all the coats of the organ, and by extension affecting its own mesentery, and the peritoneal surfaces of adjacent organs. In such cases the inflammatory process progresses, not uniformly, but by exacerbations with more or less prolonged intervals, and clinically these cases are characterized by repeated recurrences.

An inflamed appendix tends to form adhesions rapidly with surrounding organs. These are protective, and serve to isolate the diseased organ from the general peritoneal cavity. Occasional exceptions are met with in the case of an acutely inflamed or gangrenous appendix, in which diffuse general peritonitis ensues, and yet the diseased organ may be found entirely free from adhesions. This is to be explained by the sudden flooding of the peritoneal cavity with organisms of great virulence, which being rapidly absorbed produce an acute toxæmia, in the presence of which the protective peritonitic reaction is not developed. That perforation does not invariably result in general peritonitis is explained by the fact that there is usually time for limiting adhesions to be produced.

As a result of the adhesions, localised abscess-formation is frequently seen in cases of appendicitis. This may occur either with an acute initial attack, or with a chronic case which has undergone exacerbations. There are four principal situations in which an appendix-abscess may develop: (*a*) on the inner aspect of the cæcum, the pus-cavity being limited by adherent coils of small intestine; (*b*) on the outer part of the cæcum between it and the anterior abdominal wall; (*c*) in the pelvic cavity, either in the pouch of Douglas, or in the cellular-tissue planes on the right pelvic wall; (*d*) behind the cæcum, tracking upwards towards the kidney, or into the connective-tissue lying upon the iliacus muscle (*retro-cæcal abscess*). These abscesses very rarely rupture into the peritoneal cavity; occasionally they become spontaneously evacuated into the intestine, or through the abdominal wall. Sometimes they remain encapsuled and gradually become sterile. Occasionally secondary abscesses may form in such remote situations as the left iliac region and the subdiaphragmatic space.

CLINICAL FEATURES OF AN ACUTE ATTACK

The symptoms of an *acute* attack will be first described, and then those of a *chronic* case with exacerbations.

Symptoms. The onset is almost invariably sudden and may occur in an individual who has previously shown no sign of ill-health. The symptoms are, generally speaking, those of the 'acute abdomen,' and do not call for description here, but infrequently, however, there is little in the symptoms to call attention to the abdomen and the patient's condition is that of a severe febrile toxæmia. Even in such atypical cases there are usually certain localising signs which can be recognised on careful examination of the abdomen.

Abdominal Signs. In the initial stages there is general tenderness on pressure, even of the gentlest; this is soon succeeded by general abdominal swelling, and impaired movement on respiration, localized tenderness, rigidity of the right rectus muscle, affecting usually the lower half of the muscle, and in some cases the formation of a swelling in the right iliac region.

The degree of *general enlargement* is not great unless general peritonitis supervenes. When *localized tenderness* appears the general tenderness usually subsides, although the localization may take the form of an exag-

gerated tenderness at some part. The point of greatest tenderness is usually in the area corresponding to the position of the base of the appendix (*vide supra*), but this is by no means invariable. McBurney's point (obtained by bisecting a line joining the umbilicus with the right anterior superior iliac spine), although the commonest point of great tenderness, has not the diagnostic importance which was at one time attributed to it. Not infrequently the most tender spot will be found beneath the right costal arch over the gall-bladder, or in the right renal region. Sometimes the umbilical region, or the left iliac region is the seat of greatest tenderness In retro-cæcal cases, the tender spot is often to be found posteriorly in the costo-iliac space; unless this is remembered an important diagnostic sign may be overlooked.

Muscular rigidity is a very important sign, and great attention should be paid to it. It is a reflex spasm which is protective in function, the muscle being 'on guard' over the subjacent diseased area In its lightest form it can best be detected by very gently palpating the two recti muscles simultaneously with the two hands, when the delicate difference can be detected. Later on, the increased tension and resistance of the muscle can be more readily recognized. This sign is an early one and is therefore of importance, for it may be found at a time when the abdominal respiratory movements are apparently unchecked.

A *swelling* in the right iliac region is formed in most cases where protective adhesions have had time to develop, *i e* in all but the most severe cases of perforation, gangrene, or general peritonitis. In the early stages this swelling is obscured by the protective muscular spasm beneath which it is being formed. In character it is ill-defined, subresonant, of variable size, and of variable tenderness and consistence. It consists mostly of adherent coils of intestine, among which may be found a variable amount of pus. In some cases the swelling may be formed in the pelvis, and may then be detected by vaginal or rectal examination, even if nothing can be felt in the appendix-region. It is therefore important to remember the assistance which may be obtained in a difficult case from internal examination.

The majority of cases of acute appendicitis tend to subside spontaneously, *recurrence is then almost invariable*, although the subsequent attacks are usually less severe. When the original infection is intense, the case goes from bad to worse, and if unrelieved by operation, death ensues from acute toxæmia or from general peritonitis.

Differential Diagnosis. We are here only concerned with the diagnosis of certain gynæcological conditions: there are a number of other conditions, common to both sexes, the exclusion of which is of equal importance, but for this the reader must be referred to text-books of general surgery.

Ectopic Pregnancy. In the early stages the symptoms of profuse internal bleeding from tubal rupture, or tubal abortion, may closely resemble the initial symptoms of acute appendicitis (*see* p. 197). In both, an acute attack of abdominal pain, attended with nausea or vomiting, may occur with entire suddenness. Some general abdominal enlargement and tenderness are seen, and in an ectopic case, the pain and tenderness may become localized to one or other iliac fossa. And further, in both conditions a swelling may be detected in the pouch of Douglas, and although in the one instance it is blood, and in the other inflammatory fluid or pus, the differentiation of these two is not easy. A history of amenorrhœa may be misleading, for appendicitis may occur in early uterine pregnancy.

Three points may be relied upon to distinguish a case of ectopic pregnancy. (1) There may be definite signs of internal bleeding, such as pallor, coldness of the extremities, a subnormal temperature (in the initial stages), and in extreme cases restlessness and air-hunger. (2) Slight hæmorrhage from the uterus practically always occurs, and will usually be found to have preceded the acute onset. (3) On vaginal examination, cervical softening, and some enlargement of the body of the uterus may be detected. If these three points can all be made out the diagnosis is certain. Errors in diagnosis of this condition are not attended by serious consequences, if the rule laid down for the treatment of both is followed, viz. *operate immediately.*

Acute Salpingitis. The commonest cause of this condition is an ascending infection, consequently it is most likely to be met with in the course of an attack of gonorrhœa or in connection with miscarriage and childbirth. In virgins tubercle is the commonest cause, and, although usually chronic, tuberculous salpingitis sometimes undergoes acute exacerbations. The history of the case is consequently an important point in the differential diagnosis. An attack of acute salpingitis frequently coincides with a menstrual period.

The initial symptoms may closely resemble those of acute appendicitis; when localizing abdominal signs appear, they will be found to affect the lower abdominal zone generally, although tenderness and pain may be much more marked upon one side than the other. This is due to the fact that acute salpingitis is essentially a bilateral condition. In this region a swelling soon develops, which has the characters already described as those of pelvic peritonitis (p. 234), for except in the most acute cases, a protective roof of adherent coils of intestine is formed above the inflamed tubes.

On pelvic examination the findings are usually definite and clear. Acutely inflamed appendages are recognizable as postero-lateral swellings of characteristic shape, and accompanied by general thickening and extreme tenderness of the region of the pouch of Douglas. Rectal examination will often give better access to the swelling than examination *per vaginam.*

Acute Axial Rotation of an Ovarian Cyst or a Dilated Tube. The clinical results of acute twisting of the pedicle will be described on page 636, to which the reader is referred; it will be seen that they also resemble the initial symptoms of acute appendicitis. The recognition of this condition depends solely upon the discovery of the tumour (cyst or tube) which has become twisted. In the case of an ovarian cyst of moderate size, this presents little or no difficulty, except perhaps in the case of very corpulent women. A dilated tube seldom attains sufficient size to be recognized by abdominal examination alone; but bimanual examination will certainly reveal its presence. It is only in the early stages that diagnostic difficulties will arise; when the abdominal swelling and tenderness subside, a complete examination of the abdomen becomes practicable, and the tumour will then be discovered.

Ovarian Hæmatoma. Occasionally an acute effusion of blood occurs into the stroma of an ovary (*see* p. 594), causing intense pain and many of the signs of peritoneal irritation—such as abdominal enlargement and tenderness. When the right ovary is affected, the localizing signs make the case practically indistinguishable from one of acute appendicitis. The affected ovary may, however, be found, on pelvic examination, to be enlarged and extremely tender. If the case is kept for a time under observation, the ovary may be found to increase rapidly in size.

Acute Pyelitis. In this condition a sudden onset attended with acute abdominal pain in the right side and tenderness on pressure, and sometimes with vomiting, may occur. A catheter specimen of urine will show the characteristic charges associated with pyelitis (*see* p. 244), enabling the condition to be recognized.

The differential diagnosis of the above-mentioned conditions from acute appendicitis is not of mere academic interest, but has its practical importance. In the cases of ectopic pregnancy and axial rotation, immediate operation is indicated, so that the treatment does not differ from that of acute appendicitis. In the cases of acute salpingitis and ovarian hæmatoma the interests of the patient require delay for reasons which are set out in the section dealing with tubo-ovarian inflammation (*see* pp. 570, 571).

Treatment of Acute Appendicitis. The treatment is to operate as soon as the diagnosis is made; when in doubt as to the diagnosis, it is better to operate than to wait. The justification for formulating such a rule is, that cases of acute appendicitis practically always recover when operated on in the early stages, while the risk to life increases with every hour's delay. When perforation, or gangrene, or diffuse peritonitis has occurred, it is not too much to say that every moment's delay imperils the patient's chances of recovery. Yet there is no clinical method of recognizing the exact condition of the appendix; the true nature and gravity of the case can only be revealed by operation. If the diagnosis is proved to be wrong, a simple exploration of the abdomen, when properly carried out, is practically devoid of risk, and it is better to operate and be wrong, than from indecision to allow the favourable moment to pass.

The Operation. The technique of removal of the appendix is considered in a later section (*see* p. 696). It is, however, important to bear in mind that in dealing with all acute abdominal conditions, the aim of the surgeon should be strictly to limit his interference to what is absolutely necessary. Prolonged manipulations, forcible handling, and hæmorrhage should be most carefully avoided. If an abscess is present, the collection of pus should be evacuated and drained; if the appendix lies within the abscess-cavity it can be dealt with, if not, the abscess-wall should not be broken through in order to search for it. It is better to perform a second operation and remove it at a later date. Again, if the appendix is located, but cannot be raised to the surface on account of adhesions, it is better to amputate it and cauterize the base without attempting to bury the stump. The bowel-wall may easily be torn, as acute inflammation renders it extremely friable, and to close the rent may prove impossible for want of free access. *It is generally advisable to drain cases of acute appendicitis;* when collections of pus have been met with it is essential.

A case of acute appendicitis with severe toxæmia is not out of danger when the operation has been successfully concluded. Vigorous treatment on the general lines laid down for cases of septicæmia (*see* p. 220) must be begun immediately after the operation, and among the measures advised none is more important than continuous, rectal, saline transfusion.

CHRONIC APPENDICITIS

After an attack of acute appendicitis has subsided, if an operation is not performed, recurrences are practically certain to occur. These recurrences vary much in severity, and are often subacute or even trivial in character.

Sometimes cases of chronic appendicitis are met with in which there has been no acute attack at all.

Morbid Anatomy. The conditions met with at operation are chiefly peritonitic adhesions, with thickening and induration of the walls of the appendix. As a result of narrowing of the lumen in places, local dilatations may form, the distal end being specially liable to undergo this change. Often the appendix is bent or twisted, and its mesentery thickened. In the earliest stages the vessels on the surface of the appendix are injected, and the whole organ feels abnormally rigid. On opening a 'chronic appendix' fæcal matter or fæcal concretions are almost invariably found within it. Cases such as these are true instances of primary appendicitis even when the appendix is found, as frequently happens, adherent to the tube, the ovary, or the uterus; the latter organs then show no other abnormality than the adhesions.

Frequently, however, the appendix becomes involved in the spread of an infective inflammation from the tube, and it is then difficult to know whether it was primarily diseased or not. Thus it may be found densely adherent to the wall of a pyosalpinx, or an infected ovarian cyst. When such a condition has been of long standing, a fistulous communication may be established by ulceration between the lumen of the appendix and the abscess-cavity, as in a case recorded by Bland-Sutton. This occurrence is, however, very rare. In cases where the appendix and the right tube are involved, while the left tube and ovary are healthy, the presumption is that the appendix is the organ primarily at fault. Unilateral salpingitis from gonorrhœa or sepsis is almost unknown, but it may occur from tubercle, and when the right tube and appendix are the only organs involved, the possibility of tubercle should always be borne in mind.

Clinical Features. The symptoms of chronic appendicitis are abdominal pain, not necessarily referred to the site of the appendix at all, and frequently felt in the epigastric or umbilical regions. The most characteristic feature is its marked tendency to recurrence in definite attacks, which may last for a few days, or only for a few hours. As a rule, no exciting cause of the attacks can be recognised. In addition to the attacks of pain, there is often more or less constant abdominal discomfort or actual pain, which may be aggravated by such conditions as menstruation, fatigue, jolting from a railway journey, etc. In addition there are often marked dyspeptic symptoms, especially of the variety known as 'hyperchlorhydria,' and attributed to an excess of acid in the gastric secretions. It has been shown that gastric and duodenal ulcers frequently occur in company with chronic appendicitis, and the clinical picture is then necessarily complex in its details.

When chronic or acute inflammatory pelvic conditions exist in company with chronic appendicitis, the clinical features are modified in a different direction. The tendency to recurrent attacks of abdominal pain is a feature of both conditions, and menorrhagia, dysmenorrhœa discharges, and sterility are usually present as well. When the symptoms appear more severe than should be expected from the amount of damage sustained by the pelvic organs proper, it is reasonable to suspect that the appendix is also involved.

The *physical signs* met with in chronic appendicitis are few and ill-defined. Tenderness in the 'appendix region' is often met with in cases of pelvic inflammation as well as appendicitis. Sometimes definite thickening

can be felt on deep palpation, sufficiently localized to warrant its being attributed to the appendix. If the stomach or duodenum is also involved, the tenderness and thickening may be found in the upper abdomen. If pelvic examination shows definite inflammatory enlargement of the tubes and ovaries, the relation of the appendix to the swelling can only be made out by exploratory operation.

Treatment. Cases of chronic appendicitis usually resist all medical treatment and come in the end to operation. When removing an appendix of this character the general surgeon must recollect how frequently the tubes and ovaries are also involved, and must carefully examine them. And in the

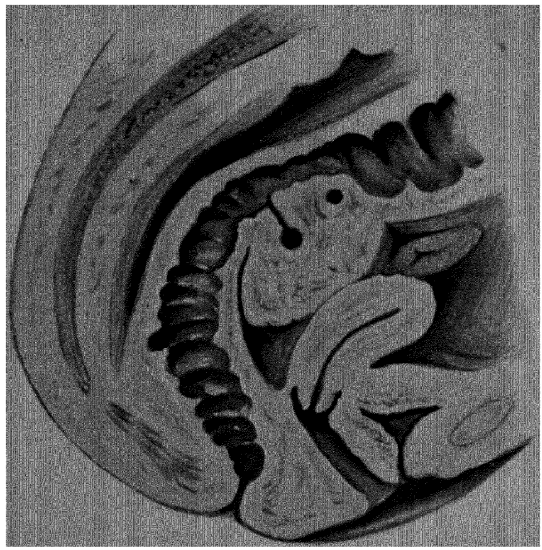


FIG. 148. DIAGRAM OF A VERTICAL SECTION OF THE PELVIS IN A CASE OF PERFORATING DIVERTICULITIS. The bowel-wall is seen to be stenosed for some distance and a narrow channel leads from the lumen of this portion into a mass of inflamed tissue placed between the intestine and the uterus. The round black mark on the right of this channel is the cross-section of a second diverticulum. Infection of the cellular tissue had taken place from the larger diverticulum, and, spreading in all directions, had led to the formation of the dense mass indicated in the drawing. The posterior cul-de-sac is occupied by fluid—inflammatory exudate. (Maxwell-Telling.)

same manner the gynæcologist, when dealing with chronically inflamed adnexa, must never omit to explore the appendix and remove it whenever it shows any abnormality.

DIVERTICULITIS : SIGMOIDITIS

The name ' diverticulitis ' is made to include the inflammatory changes, incidental or secondary, to diverticulosis, a condition in which hernial pouches exist in the walls of the large bowel. These pouches or diverticula are protusions of mucous membrane through the muscular coat of the bowel and their site of election is the upper part of the pelvic colon ; the disease has therefore been studied more closely in connection with the sigmoid portion of the colon than with any other part of the alimentary system, so that the

terms 'diverticulitis' and 'sigmoiditis' are almost interchangeable. Just as the old term 'typhlitis' has been replaced by 'appendicitis,' so it has come about that the term 'diverticulitis' has replaced 'sigmoiditis.'

Strictly speaking, the expression 'diverticulitis' should be confined to inflammation of diverticular origin—since hyperplastic inflammation of the bowel can be present in the absence of diverticula, *i.e.* non-diverticular sigmoiditis is known to occur. It is highly probable that the type of sigmoiditis which leads to the formation of an inflammatory mass is nearly always due to diverticula, and as this intrinsic mass-forming type of sigmoiditis (*see* Fig. 148) is the one which is most likely to be encountered by the gynæcologist we shall consider the term 'diverticulitis' to be the most appropriate for our use.

Diverticulitis is commoner in men than in women (25 men to 16 women (Lockhart-Mummery), 71 men to 29 women (Spriggs)), yet the fact that in a clinical record of 92 cases compiled by Maxwell-Telling, 74 of these apply to the female sex is sufficient reason to indicate the necessity of mentioning this lesion in a text-book of Gynæcology. Telling remarks: "There is no doubt of the pathological relationship of the sigmoid flexure to the pelvic viscera, and further research will help to determine with what frequency the diverticula play a part in pelvic lesions."

Prominence was first given to this condition as far as the sigmoid is concerned by Fraser in 1898. Moynihan published the first case in this country in 1907 [1]; he spoke of "the mimicry of Malignant Disease in the Large Intestine," and at the suggestion of this surgeon Maxwell-Telling has compiled the most complete account of the condition which has ever been published.[2]

To the above we are indebted for the present short abstract. Diverticula of the mucous membrane of the sigmoid occur most frequently near the convexity of the bowel; they tend to be multiple and to run in two rows. They often form hernial protrusions of the mucosa into appendices epiploicæ. Externally they present as flask-shaped bodies with narrow necks. The communication with the bowel-lumen is quite small and may be hidden under one of the mucous folds of a bowel which shows (1) an abnormal rugosity, (2) an abnormal amount of fat, (3) tonic contraction of the longitudinal bands. These diverticula may only be microscopic in size, they are never very large, they usually contain fæces in varying degrees of inspissation. They may become separated from the bowel at their narrow neck and lie as loose foreign bodies on the floor of the pelvis.

Etiology. The cause of these mucous protrusions is thought to be increased pressure within the bowel produced by the accumulation of fæces or the pressure of gas. Fæcal stagnation being greatest in the sigmoid will account for this portion of the bowel being most commonly affected. Spriggs cites the habitual use of aperients as a cause. Anything which hampers or weakens the musculature of the bowel is a contributary factor—*e.g.* ptosis of the viscera is said to lead to general weakening and relaxation of the alimentary musculature. Obesity is another cause of such weakness, and it is proved that diverticula are much commoner in fat-laden bowels than in those with a thin mesentery. Senility favours the condition, the frequency of diverticulitis in advanced age is such as to render the association helpful

[1] *Brit Med. Jour*, 1907, ii, 138; *Edin. Med. Jour.*, 1907.

[2] "Acquired Diverticula," etc. Telling and Gruner, *Brit. Jour. of Surg.*, iv., 1916–17.

in differential diagnosis; according to Telling its presence would not seriously be considered under the age of 35, most of the cases occurring between the ages of 40–65. In Lockhart-Mummery's 41 cases the average age was 60 and the youngest 42.

As gynæcologists we are more concerned with the secondary pathological processes which occur with sigmoid diverticula than with the primary lesion; the fact that a mass of considerable size may be formed must be realized, and we must study the symptoms due to the inflammatory changes which follow diverticulum-formation. It is a well-known fact that chronic peritonitis in the sigmoid region is extremely common. Byrom Robinson, quoted by Telling, found it in 85 *per cent.* of females in 800 autopsies. How

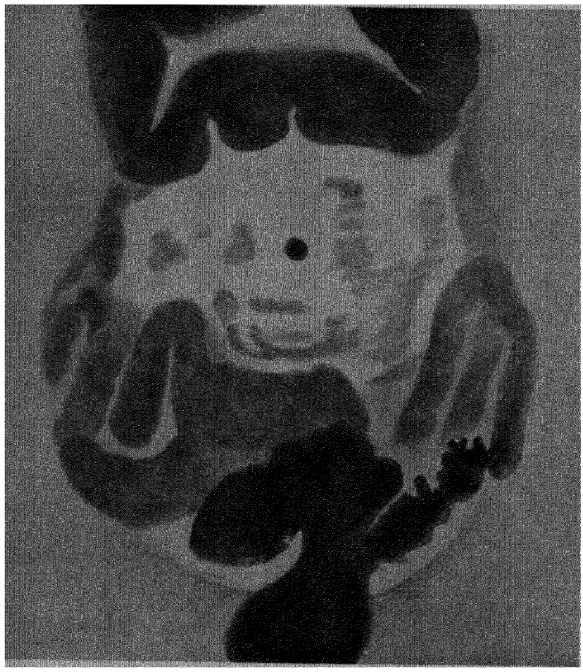


FIG. 149. X-RAY PHOTOGRAPH TO SHOW SEVERAL SHADOWS THROWN BY DIVERTICULA OF THE SIGMOID AFTER BARIUM INJECTION. (Maxwell-Telling).

far this fact is associated with diverticula of the sigmoid has not been ascertained because so many diverticula are not to be discovered by the naked eye; a thickening, however, of an adherent sigmoid is quite a common observation, and this thickening may result in the formation of a fusiform mass of consi lerable size.

The point for the gynæcologist to grasp is that a chronically inflamed sigmoid is bound to force its existence upon his notice sooner or later, and that in a large proportion of cases the cause of the inflammation is a pre-existing diverticulosis or acquired hernial protrusion of the mucosa through the muscular coat of the bowel.

Clinical Features. The clinical features of inflammation of the sigmoid flexure are :—

(1) *Pain.* A long history of pain of a colicky recurrent character referred to the left iliac fossa. The pain is not, as a rule, accompanied by vomiting.

(2) *Tenderness.* This is felt over the sigmoid and is accompanied by more or less rigidity of the abdominal muscles on the left side.

(3) '*Tumour.*' A sausage-shaped lump lying above and parallel to Poupart's ligament, varying greatly in size, and which may be mistaken for an ovarian or a uterine new growth. This mass is usually tender and fixed; it may be observed to vary in size and even to disappear for a time. This variability in its physical manifestations is of great diagnostic value. The 'disappearance' may be due to suppuration and bursting into the bladder. Abscess-formation and rupture leads to the supervention of acute symptoms which may be preceded by a history of slight trauma, such as straining at stool, jolting in an automobile, lifting heavy weights, etc. The clinical aspects of the case then resemble appendicitis. In 324 cases collated by Telling and Maxwell general peritonitis occurred in 18 *per cent.* Fistulous communication with the bladder occurs in over 10·7 *per cent.* of these cases.

Pelvic Symptoms. The relationship between sigmoidal inflammation and diseases of the female genitalia is deserving of careful study. Poulain draws attention to the coincidence of salpingitis and sigmoiditis with the one lesion augmenting the other; sigmoiditis has been found associated with phlebitis and inflammation of the left broad ligament. The symptoms will correspond with the associated adnexal or uterine lesion. As the figure (Fig. 148, p. 252) shows, there may be a definite tumour without any notable constriction of the lumen of the gut, and this mass will have to be differentiated from ovarian and uterine conditions. Many cases are recorded of pelvic swelling of sigmoid origin without bowel-symptoms. Telling considers that diverticulitis should be taken into account in the differential diagnosis of all pelvic inflammations and tumours situated in the left lower quadrant of the pelvis.

Diagnosis. The use of the sigmoidoscope has proved disappointing; orifices of diverticula are difficult to find, being overlaid by semilunar folds of mucous membrane. X-ray examination, after a barium-enema or bismuth-meal, may help to reveal such diverticula as are not already filled with inspissated fæces (*see* Fig. 149). In differential diagnosis the following points of contrast between diverticulitis and carcinoma may be noted: –

In diverticulitis there is (*a*) a long history of left-sided abdominal pain yet no loss of nutrition; (*b*) the appearance and disappearance of a swelling; (*c*) X-ray demonstration of diverticula in some cases; (*d*) pyrexial attacks.

In carcinoma of the sigmoid, (*a*) loss of flesh may be evident early; (*b*) pain and tenderness occur quite late; (*c*) there is no temporary subsidence of the swelling; (*d*) suppuration and abscess are formation most unlikely. In certain of our own cases the secondary inflammation following on diverticulosis was so diffuse as to present features similar to a retro-peritoneal sarcoma; and in others it resembled diffuse adenomyoma of the base of the left broad ligament. The formative, or hyperplastic, type of tuberculous peritonitis is another condition which may resemble the late results of diverticulitis. The finding of giant-cells in the inflammatory tissue has led to an erroneous diagnosis of tubercle in some cases of diverticulitis.

Treatment. If recognised early enough any segment of the colon containing diverticula should be resected. A time comes later on when it is

impossible to remove the bowel on account of fixation by secondary inflammation. At this stage nothing but a colotomy is of any assistance.

For further information on diagnosis and treatment see "Diverticulitis and its Surgical Treatment," J. P. Lockhart-Mummery, *Lancet*, February 27th, 1926. E. I. Spriggs and O. A Marxer, "Intestinal Diverticula," *Quarterly Journal of Medicine*, 1925, xix, 73.

SPECIFIC INFECTIONS

GONORRHŒA IN WOMEN

Historical. The word gonorrhœa, from ῥεῖν (seed), and γονή (flow), dates from A.D. 160, and was given by Galen to the flow of pus which escapes from the male urethra in the condition which we now know to be a contagious venereal disease. Galen believed gonorrhœa to be an involuntary flow of semen; etymologically, therefore, the term 'gonorrhœa' is inaccurate. In the Book of Leviticus (chap. xv) Moses laid down rules relative to prophylaxis, and in Deuteronomy we find that a man was entitled to a divorce if his wife was found to have gonorrhœa. Thus biblical history takes us back to about B.C. 1471. The disease was also known to the early Japanese, Egyptians, Romans, and Greeks. The early writers gave little attention to gonorrhœa in the female, and intraperitoneal complications were not recognized. About the end of the fourteenth century the infectious and contagious nature of gonorrhœa began to be recognised, and medical supervision of brothels was inaugurated. Towards the end of the fifteenth century the first great epidemic of syphilis swept over Europe. It was a comparatively new disease, and subsequently much confusion arose between syphilis and gonorrhœa. The latter was regarded as a complication of syphilis, and was vigorously treated by mercury and sarsaparilla. John Hunter, wishing to settle the relationship of gonorrhœa to syphilis, inoculated himself in May, 1767 by making two punctures in his penis with a lancet dipped in venereal matter taken from a supposed case of gonorrhœa. He developed syphilis, and consequently drew the conclusion that syphilis developed from gonorrhœa. The true explanation of the nature of gonorrhœa thus received a setback, which was not made good for over sixty years. Phillippe Ricord (1831–1837) made 667 inoculations of gonorrhœal pus and in no case did syphilis result, thus clearly establishing the non-identity of gonorrhœa and syphilis. Ricord did not believe that gonorrhœa was a specific disease, but regarded it as a 'simple' catarrh produced by the action of various irritants on the mucous membrane. Among these irritants he mentioned uterine catarrhal, lochial and menstrual discharges as peculiarly likely to set up urethritis. In 1868 Salisbury found spores in twos and fours in pus-cells, and in 1872 Hallier found a micrococcus in gonorrhœal pus.

In 1879 Neisser described these micrococci and their method of division and gave them the name of *gonococci*. Watson Cheyne discovered the gonococci in the same year as Neisser, but did not publish his discovery until 1880. In 1872 Emil Noeggerath, of New York, drew attention to "latent gonorrhœa of the female sex." Previous to this, gonorrhœa in the female was regarded as a vaginitis. Noeggerath was the first to insist that inflammation of the uterus, appendages, and peritoneum was the direct result of gonorrhœa. He showed that the disease may remain latent for long periods, and drew attention to the sterilizing effects of gonorrhœa.

Summary. *Ricord* definitely established the identity of gonorrhœa,

Noeggerath proved it to be an *ascending* infection capable of producing sterility and puerperal infection, and, what is very important, he pointed out the long continued contagiousness of the disease. *Neisser* in 1879 demonstrated the specific diplococcus with which his name has ever since been associated. In 1885 the gonococcus was first grown on an artificial medium by Bumm. In 1886 Roux, of Paris, published the method by which gonococci can be differentiated by the Gram method of staining.

Bacteriology. The gonococcus is most frequently found in pairs, but is not uncommonly seen in tetrads, and occasionally groups of eight cocci exist. In shape they are somewhat reniform, and have been likened to coffee beans; they are arranged with their concave surfaces in close apposition (*see* Fig. 150). In size a gonococcus measures from ·8μ to 1·6μ in its long diameter and ·6μ to ·8μ in its short axis. It is non-fertile. The typical shape and arrangement are best seen in smear-preparations made from pus. When prepared from growths on culture-media, gonococci vary considerably in size and are rounded in shape. A film made from pus shows the organisms *within the pus-cells*—an important feature for purposes of identification. Gonococci are Gram-negative, they are difficult to grow on ordinary culture-media, the best medium being agar covered with a thin film of sterile human blood. There are two other organisms which, like the gonococcus, are left unstained by Gram's method, viz. the meningococcus (*diplococcus intracellularis meningitidis*) and a staphylococcus known as *micrococcus catarrhalis*. The former not only resembles the gonococcus in its characters and staining reaction, but it is likewise to be found in pus-cells. Cultural differences must be relied upon in making a differential diagnosis between these two organisms, and this is provided for by the fact that the meningococcus grows more readily on artificial media. If Gram-negative diplococci are found in cerebro-spinal fluid it may reasonably be assumed that they are meningococci, and if Gram-negative diplococci are found in the secretion of the genitalia the inference is that they are gonococci; but the meningococcus has occasionally been found in the urethra and in the female genital organs, so that cultures must be made in order to arrive at a correct diagnosis. The *micrococcus catarrhalis* has been found in the urethra. It grows freely on media in common use such as agar, broth and gelatin; it is more oval in form, and is slightly larger than the gonococcus.

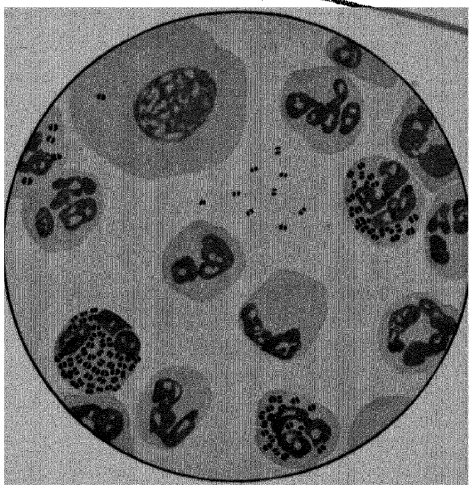


FIG. 150. Gonococci discovered by Neisser and by Watson Cheyne in 1879. The film was prepared from vaginal discharge and stained with Löffler's methylene-blue. The gonococci are seen lying free and also within pus-cells (E. Shaw).

Gonococci may be grown on blood-agar and on hydrocele-fluid agar

(Western, Mallory). The cultures soon die, so that to keep the growth alive, sub-cultures must be made every other day, and even then they lose their power of reproduction (E. Shaw). The organism requires moisture, it dies in a dry atmosphere, and it is killed by a low heat (*e.g* 41–43° C. for ten minutes). Both these facts have been turned to account in the treatment of gonorrhœa. In addition to the peculiarities above mentioned, it is to be noted that the gonococcus shows a selective parasitic adaptability for the human race. Even the highest apes cannot be infected.

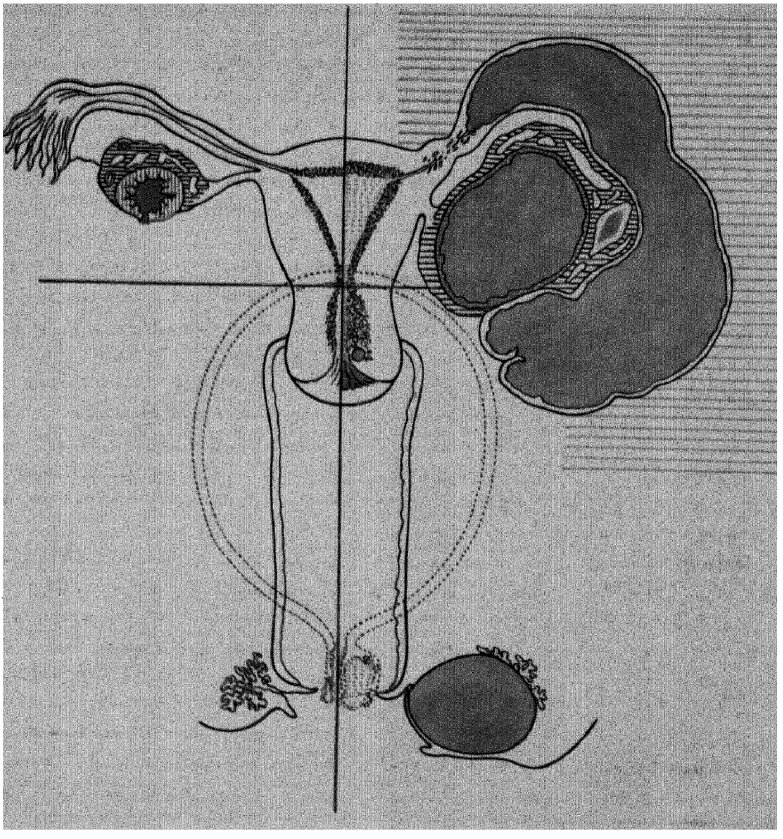
Pathology. *Toxin and Injury.* The gonococcus produces an endotoxin which sets up an active inflammatory reaction. This toxin is said to be set free from the body of the organism at its death. The inflammation spreads along epithelial-lined surfaces without, as a rule, producing necrosis of the epithelium, but this may occur, and then infection quickly extends to the underlying tissue, when necrosis and abscess-formation may follow. The inflammatory exudation consists of serum and polymorphonuclear leucocytes; little or no fibrin is formed. The leucocytes take up the fat and collect in the subepithelial tissues, where they appear to the naked eye as a narrow, opaque, yellowish zone. In the more chronic lesions, lymphocytes often infiltrate the submucous tissues in large numbers, plasma-cells abound and eosinophiles may be fairly numerous.

The gonococcus, although normally an organism which lives on mucous membranes, is able to penetrate into the tissues and into the blood. Thus a *gonococcal septicaemia* may arise, with metastatic infection of joints, heart, serous membranes, and meninges (*see* p. 266). In women the seriousness of gonorrhœa is enhanced by the far-reaching local lesions it produces, and by its persistence in spite of treatment.

Being acute to start with, it tends to become less active and to persist in a chronic form for years. It commonly causes a spread of inflammation through the whole generative tract, as well as along the urethra, and bladder; and sometimes it ascends to the ureters and to the kidneys. The effect of the toxin on fibroblasts is to cause them to throw out an abundance of collagen which produces scar-tissue and contraction. The toxin is also said to account for the buboes which are seen in acute cases of gonorrhœa.

Clinical Data. *The Collection of Material for Investigation.* This requires a knowledge of the lurking-places of the gonococcus, which, stated briefly, are all the anatomical orifices and crypts appertaining to the external genitalia, and also the cervical canal (*see* Pl. XIII). These comprise the urethra with the openings of the paraurethral glands in its floor; the openings of Skene's tubules (*see* p. 59), the orifices of Bartholin's ducts; and, finally, the cervical endometrium and Nabothian follicles. From these situations secretion may be obtained. In obtaining a specimen from the cervix, a Ferguson's speculum is passed and the external os exposed: excess of mucus or muco-pus is removed by a saturated solution of sodium bicarbonate, and a wire, with sterile wool wound around it, is passed up the cervical canal and the mucous membrane well rubbed; this will bring away some surface-epithelium with its secretion and a little blood. The swab is then returned to its tube and sent to the laboratory. When the organism cannot be detected in the cervical secretion, it may still be possible to find it in the deeper portion of the glands, if a piece of tissue is excised for microscopic examination.

Urethral secretions are obtained by running the finger along the anterior vaginal wall from within outwards, so as to express the fluid from the meatus.



Scheme of Gonorrhœal Infection of the Female Genital Tract (after J. A. Amann). Abscess of the duct of Bartholin (yellow). Gonorrhœal urethritis and paraurethral abscess (dotted yellow); gonorrhœal cervicitis (yellow); erosion (red); endometritis (dotted yellow); pyosalpinx (yellow) with indrawn fimbriæ; lutein abscess (yellow with red wall); perisalpingitis perioöphoritis, pelvic peritonitis (yellow lines).

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By means of expression, pus may also be made to issue from the ducts of Bartholin. A fine platinum loop may be passed into the more patent of the paraurethral crypts and a suppurating Nabothian follicle may be punctured by a sterile scalpel through a speculum. Care must be taken to avoid contamination with vulval or vaginal secretions. If pus from more than one source is examined the tubes must be numbered. The methods of preparing and staining films are described below.[1]

The clinical importance of what has already been stated must be emphasized, viz. that the danger of gonorrhœa is very largely due to the power possessed by gonococci of penetrating uninjured epithelial tissues. Once underneath the surface, these tissues afford them nutrition and protection, whence the chronicity of the disease and its frequently latent characters.

There is no immunity against gonorrhœa. The wife to whom a husband has given the disease may re-infect her husband. Chronic cases are as dangerous as they are common, owing to the fact that gonorrhœa may be present in chronic form without subjective signs to warn the infected person of its presence. Gonorrhœa can be very obstinate, but it can be cured. Many bacteriological investigations are necessary, however, before we are in a position to pronounce upon a cure.

The average incubation-period in conveyance of the organism *per coitus* is about *three days*. Accurate determination of the site of infection in women is a matter of prime importance for the gynæcologist. This will depend, to some extent, upon the anatomical peculiarities of the genitalia. A highly situated meatus is more likely to escape initial infection than one which opens lower down ; a low cervix with a gaping vagina may lead to the former being the first site of inoculation, but a very common occurrence is to get both urethra and cervix infected at the same time.

Gonorrhœal Urethritis. This is extremely frequent, and is generally present in fresh infections. In three days the discharge is purulent, the swollen lips of the meatus present as prominent red flaps owing to the ectropion of the mucous membrane, and between these a drop of greenish-yellow pus exudes. The canal is tender up to the neck of the bladder ; on endoscopic examination the swollen mucous membrane is seen to be covered by pus and a croupous exudate, and on removal of the latter a slightly hæmorrhagic red surface is disclosed. The patient's general condition is not much interfered with ; subjectively there is tickling or burning after micturition. Then follows a dull, continuous, pressure-sensation above the symphysis, or cramp-like pain during micturition may be complained of. These subjective symptoms soon lessen, in three or four weeks the urethra has its normal appearance, and in from six to twenty weeks it heals. If the general state of the patient is good it may heal spontaneously. In the chronic stage gonorrhœal urethritis is difficult to detect ; if the patient has

[1] Method of Staining for Gonococci From a swab taken in the way indicated, the secretion must be spread upon a clean glass-slide free from grease. It should then be fixed by passing it three times through a Bunsen flame, and stained by Jensen's method. Examination is then made under a $\frac{1}{12}$ inch oil-immersion lens.

(1) Stain for half a minute in 0 5 *per cent.* aqueous solution of methyl-violet (6B).

(2) Pour off the methyl-violet and pour on iodine solution (iodine 1 part, potassium iodide 2 parts, distilled water 100 parts) for one minute.

(3) Wash off iodine with absolute alcohol until decolorised.

(4) Counter-stain with neutral red 0 1 per cent.

(5) Wash in water, dry and mount.

voided urine within an hour of examination, pus may be absent. In this way a woman, who may be regarded as clean by her doctor, may infect her husband. An important point to know is that even when pus is absent from the urethra, the swollen meatal lips present for some time as red or grey jelly-like elevations, very sensitive to the touch, and they bleed on palpation. Later on, the whole tube feels thick and hard, and internally the mucosa looks granular or jelly-like, and upon its surface plaques of grey or glassy appearance may be seen. Chronic gonorrhœal urethritis may, at any time, again become subacute or even acute. It should be borne in mind that unsuspected gonorrhœal inflammation of the urethra in the wife is one of the commonest causes of supposed relapses in the husband.

In the lower part of the urethra and near its mouth are found tiny glands,

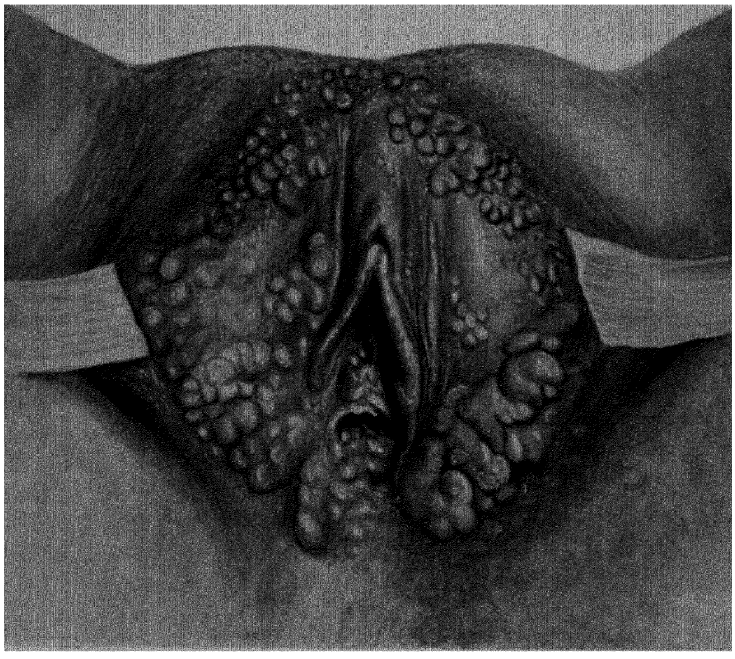


FIG. 151. CONDYLOMATA ACUMINATA VULVÆ. Naked-eye appearance.

the homologues of the prostate. Their orifices soon become infected in the acute stage of gonorrhœa, and if their ducts get blocked, small miliary abscesses form at the sides of the meatus. It is important to remember these glands in the treatment of gonorrhœa in women.

Gonorrhœal Inflammation of Bartholin's Glands. This is often double in acute stages of the disease, and generally so in the chronic form. The rule is for one gland to become infected before the other; it does not always result in abscess-formation, and before it does so the appearances are not very striking. Infection is detected by the everted swollen mouth of the duct, from which pus can be squeezed; and a spindle-shaped hardness indicates *adenitis*. Sometimes the duct becomes blocked with a cast swarming with cocci. It is well to give here a word of caution about an over-readiness to diagnose gonorrhœa from undue redness of the orifice of

Bartholin's duct. This feature may be due to innocent (non-specific) causes, and although it was designated the *macula gonorrhœica* by Sänger, it is by no means pathognomonic of this disease.

Specific Bartholinitis may last for many months, undergoing exacerbations especially after coitus; it gives rise to a dull pain on walking or sitting, but subjective signs are not prominent. In chronic cases the duct may be blocked partially or completely, the secretion becomes pent up in either case, but if the block is only partial the secretion escapes, and fills up again, giving what Martineau called *abscés à répétition*. If the block is complete and the secretion great, a large abscess the size of a pigeon's egg forms. This is situated at the hinder part of the labium majus and pushes forward as far as the vestibule (*see* Fig. 45, p. 56); it is fluctuant, and the skin over it is red, stretched, and shiny. It ruptures in from one to two weeks, generally on the inner side, seldom above or below; a suppurating fistula is formed which gradually closes up.

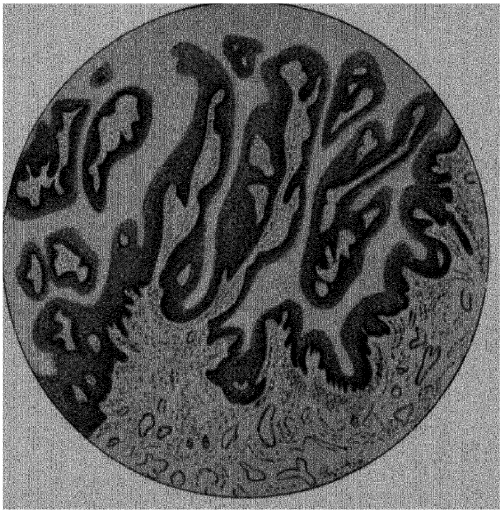


FIG. 152. CONDYLOMATA ACUMINATA, × 16. (Jolly.) Microscopic appearance.

Condylomata Acuminata, or venereal warts, are the result of irritation produced by gonorrhœal discharges. They are compound papillomata which may occur on any part of the vulva and surrounding skin of the thighs and natal cleft, and may even extend up the whole length of the vagina. They consist of a central branching stalk of connective-tissue, which is covered by layers of squamous epithelium. In size they vary from that of a pin's head to masses as big as a chestnut or Tangierine orange, and may be so numerous as to cover the vulva and completely to obscure its anatomy (*see* Figs. 151 and 153). Rarely, they extend up the vagina, and may be found upon the vaginal cervix. If the discharge subsides these warts may disappear spontaneously, but in neglected cases they persist and undergo necrosis. They are diagnosed from *condylomata lata* of syphilis by being more pointed, and more inclined to become pedunculated. Moreover, the *spironema pallidum* is to be found in the serum of the latter, and the Wassermann test will be positive.

Gonorrhœa of the Vagina. The vagina was formerly regarded as the commonest seat of this disease, but this is only true in children. The thick keratoid vaginal epithelium of the adult offers considerable resistance to the entry of penetrating diplococci, whereas the latter find it a comparatively easy task to enter through the epithelium of the urethra and of the cervical canal. In children, the vaginal epithelium is thin and soft, and hence more easily penetrated by the cocci (*see* Vulvo-vaginitis, p. 273).

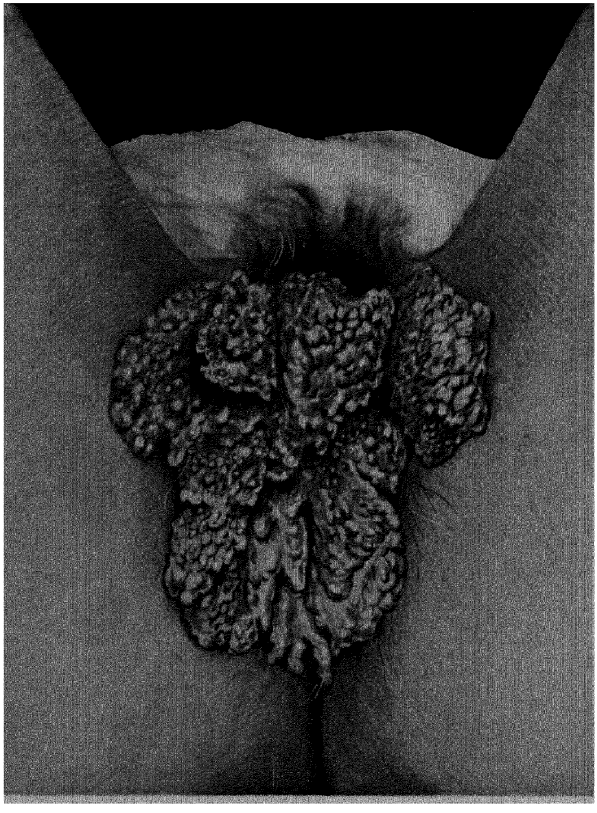


FIG. 153. CONDYLOMATA ACUMINATA VULVÆ. Naked-eye appearance.

Acute primary gonorrhœal vaginitis in adults is a most exceptional occurrence. It presents very striking features. There is such an abundance of pus that the outer genitalia are matted by dried secretion; the small labia are red, œdematous, and project beyond the labia majora, and they are eroded on the vaginal surface. The hymen is likewise swollen, tender, and eroded; patches of adherent lymph are seen here and there, whilst every furrow is filled with pus; the whole mucous membrane easily bleeds on touch, and is so exquisitely tender that examination has to be conducted under a general anæsthetic. The symptoms are marked pain, heat, burning, and swelling of the outer parts, tenderness of the whole lower abdomen, inability to walk, even sneezing, coughing, and loud speaking being painful. There is fever with a few rigors. The symptoms subside in about three

weeks, if no menstrual period intervene; it may leave behind a chronic cervicitis, but it never leaves a chronic gonorrhœal vaginitis.

Too great stress cannot be laid upon the fact that in chronic gonorrhœa there is nothing in the appearance of the vagina at all suggestive of its presence, simply because the disease is usually not in the vagina, but in the *cervix uteri* and urethra; no importance is to be attached to the appearances of the vaginal walls in the diagnosis of *chronic* gonorrhœa. In young people and nulliparæ, redness and swelling of the vaginal mucous membrane are met with often enough in the *early stages* of infection. This is generally due to secondary invasion by pus from the cervix. In children, vaginitis is the usual result of gonorrhœal infection.

Gonorrhœa of the Cervix. Next to the urethra, the cervix is the most common seat of infection, cervicitis being present in 80 *per cent.* of the acute, and in 95 *per cent.* of the chronic cases. In the majority of cases the infection originates as an *endocervicitis*, *i.e.* as an inflammation of the cervical endometrium which swells up and projects beyond the external os. The thinned-out squamous epithelium in the region of the external os is thrown off by a hæmorrhagic exudation, presenting a raw, red zone over which the columnar epithelium ultimately grows to form a definite catarrhal or pseudo-adenomatous patch (*erosion*). The gonococcus penetrates as far as the deep epithelium of the compound cervical glands, and the fibromuscular stroma in which the latter are set becomes infiltrated with polymorphonuclear leucocytes and serum. The exudation produces an œdematous state of the cervix, which is appreciated clinically as softening, and by a livid congested appearance in the acute stages. At first, therefore, in a recent acute infection the cervix is swollen, the external mucous membrane is stretched, shiny and red. Later on a mucopurulent discharge is seen issuing from the cervical canal, and suppurating points of infected Nabothian follicles give the vaginal surface of the cervix an acneiform appearance (*see* Pl. XVII, p. 366). Pain is not a pronounced symptom; movements of the uterus cause a slight tenderness; the patient complains chiefly of the discharge, but in some instances there is pain in the sacral region and over the pubes.

Gonorrhœa of the Body of the Uterus. Gonorrhœa of the *corporeal* endometrium and of the submucous and muscular strata, when it occurs, is always a sequel of gonorrhœal endocervicitis. It is, fortunately, not an invariable accompaniment of infection of the cervical endometrium, although its occurrence is favoured by the patency of the cervical canal at a menstrual period, or after the emptying of a pregnant uterus. Whilst gonorrhœal cervicitis is essentially chronic, gonorrhœal endometritis is much more transient, and it is difficult to demonstrate the gononoccus in the endometrium of the body. We have repeatedly found a true endometritis, as evidenced by the presence of plasma-cells and interstitial thickening of the stroma, in cases of gonorrhœal salpingitis, and explain the persistence of the endometritis by repeated infection from the Fallopian tubes. The endometrium in such cases corresponds to the hyperplastic type of endometritis (*see* p. 356), and shows the following evidences of a chronic inflammatory process: (1) proliferation and metaplasia of the surface-epithelium, columnar, giving place to squamous cells; (2) goblet-cells appear in the glandular epithelium in all stages of the menstrual cycle; (3) the gland-lumina at all stages of the cycle may be distended with mucus or serum

containing leucocytes, blood, and epithelial *débris ;* (4) the stroma contains plasma-cells (Pl. XVI, p. 352). As a rule, no gonococci are found, and the above-mentioned changes are not peculiar to gonorrhœal infection. For other data the student is referred to the chapter dealing with chronic endometritis (p. 351).

Metritis. In severe cases of gonorrhœal *corporeal* endometritis the underlying myometrium is involved. In the acute stage the whole muscular wall is softened and boggy, and gives the impression of a subinvoluted organ, even in a nullipara. The most marked cases of gonorrhœal metritis are usually associated with adnexal infection and pelvic peritonitis.

Clinical Features. In the *acute* form the symptoms are those of acute metritis. In the early stages the cervix cannot be drawn down without pain. Under an anæsthetic, the body is found to be only slightly movable on the cervix ; it is stiffly anteflexed or retroflexed.

Subjectively there is a sense of fulness and stretching with a boring or pulsating pain in the pelvis, leading to a cramp-like ' bearing down.' Bodily movements are impossible, and the patient feels very ill. Fever is always present.

Young women, whose first attack reaches the cavity of the uterus, always suffer most, that is, more than those who have suffered from pre-existing chronic cervicitis. It is a notable fact that the severe symptoms rapidly subside. In a week, or sometimes a couple of days, the tenderness is less and the cramps are gone, the patient gets about again, and attaches but little importance to her few days' illness. We do not, as a rule, meet with acute uterine gonorrhœa in gynæcological practice. These cases come to us after the acute attack is over, when there is nothing pathognomonic in the symptoms ; the secretion is often so slight as to be easily overlooked ; this applies especially to chronic infection limited to the cervical canal, the only symptom of which is discharge, which may be quite clear whilst still containing cocci. Pseudo-adenomatous areas (*erosion*) on the cervix may be present, but more suggestive than *erosion* is a bright red inflammatory border to the orifice, with some ectropion. With such local signs exacerbation of symptoms, especially after sexual excess, or menstruation, is liable to occur, the flow again becoming purulent, and the pelvic pain may return.

Chronic gonorrhœa of the cavity of the uterus, which has not extended to the tube, shows no special symptom of its own, and is only to be diagnosed by finding gonococci in the discharge, taken from the body of the uterus, with special precaution against cervical contamination. In some, especially the more chronic cases, there arise signs of chronic metritis.

Gonorrhœa of the Fallopian Tubes and Ovaries. The pathological changes in the tubes and ovaries are not specific to gonorrhœa, and are fully described in the sections on tubal and ovarian inflammation (*see* pp. 548–564). There are two mechanical barriers to the ascent of gonorrhœa, the internal os and the uterine end of the Fallopian tubes. The cocci have no power of movement in themselves, their spread is by passive deportation or continuous surface-growth ; the small size of the external os, and the minute calibre of the interstitial part of the tube, are not sufficient to obstruct so small a body as a coccus, but are yet small enough to obstruct mechanical deportation. Conditions which favour the spread of the disease are (1) menstruation, (2) labour and the puerperium, (3) coitus, (4) instrumentation.

The onset may be sudden and acute. There is an initial rigor followed by pyrexia, which is often maintained for a fortnight. Pain of a continuous and boring character may be complained of. As the condition is often bilateral, tenderness in both groins over the eleventh dorsal segment is generally present. Menstruation is rendered painful, more frequent, more profuse, and it lasts longer. In *acute* salpingitis the abdominal walls are too rigid to make out more than a tenderness on one or both sides, but with the aid of an anæsthetic the tubes feel like stiff cords running outward and backward from the uterine cornua; an increase in their size is not at first noticeable. Healing can now set in, and the possibility of a future pregnancy is not yet excluded. If complete healing fails, the tenderness on pressure persists, menstruation continues to be painful, the woman is sterile and liable to periods of relapse. With the climacteric the pain subsides. The usual results of gonorrhœal salpingitis are therefore *sterility and pelvic pain*. But this is not all, for a large pus-sac may develop with involvement of peritoneum, ovaries, and surrounding viscera; this is indicated by a corresponding increase in severity of the general and the local symptoms. It is not usual for a tubal abscess to arise directly on infection; there is generally a history of frequent attacks with improvement in between. In these cases a tumour of variable size is found lying in the pouch of Douglas; it may be slightly mobile, but often quite fixed and tender on pressure: this tumour consists of the enlarged tube, and inflammatory exudation uniting it to omentum, adnexa, and small bowel.

When once a pus-sac has become thoroughly encapsulated in dense adhesions the acute attacks of pain and fever are less frequent, and if the patient will not submit to operation, she may drag out a weary life of ill-health for many years.

Gonnorrhœa of the Peritoneum. In acute ascending gonorrhœa, even when there is no escape of cocci from the abdominal ostium of the tube, there occurs a fibrinous exudation of the tubal and uterine peritoneal coats. The thin wall of the tube allows the spread of inflammation by continuity of tissue to its own serosa. This kind of inflammation may entirely subside. Of more importance are those cases of peritonitis due to the escape of pus from the tube. A gonorrhœal pus-tube which leaks freely during removal has been known to cause fatal general peritonitis. This is probably due to a mixed infection with staphylococci and streptococci, since gonococci alone do not live very long on the peritoneum. Gonococci may exist, however, long enough to cause a fibro-purulent exudation on the surface, the final results of which are dense mattings of the neighbouring organs—tubes, ovaries, omentum, rectum, and parietal peritoneum.

The onset of peritonitis is clinically indicated by a rise of temperature and by increased pain; some patients are extremely ill as soon as the peritoneum is involved. The severe pain at the onset and in all future attacks is explained by *peritonitis*.

Gonorrhœa of the Anus and Rectum. These are rare conditions. We may find gonorrhœal pus around the anus without the canal being infected. Direct contact of pus with the deeper parts of the anal canal is necessary to cause the disease. It may be set up by coitus *per anum*, unclean instruments, or digital examination; a perineal tear during labour may lead to this condition. The symptoms are heat and burning after stool, with the formation of erosions, ulcers, and fistulæ at the anal orifice. The

discharge may be mixed with blood; œdematous folds of mucous membrane hang dependent at the anal ring, these are very tender to touch. When the disease has become chronic the swelling subsides, but the mucosa is still red, and on dilatation, *erosions* can be found above the anal orifice and even above the internal sphincter. It is difficult to destroy the cocci in the mucous folds, and hence rectal gonorrhœa is prone to become chronic, and is capable of leading to granulation and stricture. In women, stricture is usually situated below the internal sphincter when due to gonorrhœa. Periproctal abscess and rectal fistulæ may result from rectal gonorrhœa.

The Course of Gonorrhœa in Women. The disease may be slight or severe; its intensity depends largely upon the site of the disease. It is slight so long as it is confined to the urethra and cervix, once beyond the internal os, the disease becomes severe. Many women date the onset of their illness from this moment. The condition which is most often overlooked is chronic urethritis, with or without cervicitis; the acute stage is soon over and the pain forgotten; a slight discharge is left, which is ignored, the woman becomes tolerant and does not consult a doctor.

Disturbances of Function. These vary with the localization. Gonorrhœal disease of childhood does not disturb later functions as the uterus and tubes usually escape; any after-history relates to vulval conditions, the symptoms being itching and burning. The course of gonorrhœa in an otherwise healthy child is favourable; the disease is curable in four to six weeks.

Functional disturbances in adults relate to menstruation and ovulation. Gonorrhœal endometritis and salpingitis disturb menstruation, the interval is reduced, the duration of the flow is prolonged, and the amount is increased, dysmenorrhœa of extrinsic (secondary) type is produced, pain may commence a week before the flow and last as long afterward. Salpingitis and peritonitis cause exacerbations of menstrual pain. Ovulation is not interfered with until the ovary becomes encapsulated by adhesions, or suppurates, or is in a state of fibroid induration throughout, when there is a tendency to amenorrhœa.

Relation of Gonorrhœa to Fertility. Gonorrhœa by no means always leads to sterility. It does not do so in the majority of cases. The frequency of *ophthalmia neonatorum* proves this, since in most cases the disease was present in the mother at the time of conception (Bumm). Conception can never occur after bilateral salpingitic closure of the tubes. Many women are rendered sterile, either completely or after the birth of one child. The relation of gonorrhœa to abortion is not definitely settled. Sanger held that gonorrhœa of the endometrium produced abortion about the fourth or fifth month, from inflammation of the decidua, and gonococci have been found in the decidual fragments which formed part of an abortion. After the ovum has completely filled the uterine cavity, gonorrhœa will not produce abortion, there will be no symptoms as far as the uterus is concerned, but there will be a very profuse discharge both from the cervix and from the urethra.

Gonococcal Septicæmia. Under conditions not thoroughly understood, gonococci may enter the blood-stream, and cause a general blood-infection indistinguishable, clinically, from septicæmia due to streptococci or other organisms. Systemic infection by the gonococcus is rare; it is more prone

to occur after the local lesion has become chronic than during the acute stage, but it has been known to supervene within seven days of the initial attack. It occurs more frequently in males than in females, and is more often seen in children, and in gravid than in non-gravid subjects. In women, general gonorrhœal infection usually originates from an intrapelvic lesion, *e.g.* salpingitis, at a time when all the evidences of gonorrhœa may have disappeared from the external genitalia.

The gonococcus has been grown from the blood in pure culture in gonococcal septicæmia, but the infection is frequently a mixed one, the associated organisms most commonly being the colon bacillus, streptococci, and staphylococci.

The prognosis is always serious, but particularly so when gonococci and streptococci are associated. Gonococcal septicæmia may be fatal in itself, but death is more often due to metastases; the most important of these are endocarditis, pericarditis, arthritis, periostitis, pleurisy, pneumonia, and pyelonephritis. From this it will be seen that the serous and synovial membranes form the sites of election of the infective emboli; but metastatic lesions have also been noted, though less frequently, in tendon-sheaths, periosteum, nerves, muscles, the parotid gland, and the skin. The commonest local manifestation of general gonococcal infection is *arthritis*. The gonococcus has been found in the joint-effusion and in granulations on the synovial membranes. When the infection is a mixed one the effusion becomes purulent. The disease is more frequently polyarticular than monarticular. The commonest joint to be affected is the knee; the wrist is attacked more frequently in women than in men. In children and in infants gonorrhœal arthritis may follow vulvo-vaginitis and ophthalmia. Holt states that a pyæmic arthritis in a young infant is more frequently due to the gonococcus than to any other micro-organism. The prognosis as regards life is good. Recurrences are frequent; partial ankylosis is common, but is less likely to occur in children than in adults.

For the symptoms, diagnosis, and treatment of gonorrhœal arthritis, a work on general surgery should be consulted.

Diagnosis. This is much more difficult in women than in men, vaginal discharge being a symptom of a whole series of pathological conditions which are not infective. If on vaginal examination we see pus on squeezing the urethra, and if at the same time there is redness and ectropion of the urethra and cervical mucous membrane (*see* p. 259), it is safe to diagnose gonorrhœa. In the chronic stages there may be no pus in the urethra until some hours after micturition. Pus or muco-pus from Bartholin's duct points to gonorrhœa, but the redness of the orifice of the duct, which Sänger called the *macula gonorrhœica*, is of no great diagnostic value. Suppuration in Bartholin's gland generally means gonorrhœa, but not always, since it may occur in puerperal women and even in virgins from sepsis.

Gonorrhœa of the vulva, vagina, cervix, body of uterus, and tubes, cannot be diagnosed with certainty without bacteriological examination. In adults a purulent discharge coming from the vaginal walls or from the vulva is generally not gonorrhœal. Granular vaginitis is not generally gonorrhœal; the same applies to pseudo-adenomatous patches (*erosions*) and various inflammations of the cervical mucosa. Even the 'gonorrhœal warts' are not always pathognomonic. All the changes that can arise in the uterus, tubes, and peritoneum from gonorrhœal infection can also arise from

sepsis, especially in the puerperal state; therefore we must take full account of all associated conditions, and gauge the history carefully, in order to diagnose gonorrhœa with safety. In cases of young women who are unmarried, tubercle must be considered in the differential diagnosis of tubal swellings.

Scalding micturition with a vaginal discharge, arising soon after marriage, is probably due to gonorrhœa. Threads in the urine are suggestive, but not pathognomonic.

In all cases of suspected gonorrhœa, the discharge from the cervix, or urethra, or from the duct of Bartholin's gland, should be collected on a sterile swab for microscopic and cultural investigation. It should here be stated that the gonococcus is very seldom found in film-preparations made from vaginal discharges in cases of *chronic* gonorrhœa, but cultural methods give a positive result where films have failed. The extreme difficulty in diagnosing gonorrhœa microscopically has led to the employment of chemical and physiological tests. Nitrate of silver has been injected to provoke irritation of the mucosa and so to determine the flow of bacterial lymph to the surface. In the same way a provocative gonococcal vaccine is said to wake up latent foci. Müller, quoted by David Thomson,[1] says: "An increase or recrudescence of a urethral discharge after a provocative dose of vaccine is evidence that the disease is not yet cured." The complement-fixation test is of great diagnostic value according to Thomson.

Prophylaxis and Treatment. The public must be taught to regard gonorrhœa as a serious disease and not as a trifling accident or a slight misfortune. Doctors must warn their male patients of the serious results of this disease in married life. Marriage during the existence of chronic gonorrhœa should be forbidden. Patients should be warned of the infectiveness of the discharge, sponges should never be used for its removal, cleansing of the genitals must be done with wool, which can immediately be burned.

In the *acute* stages the patient should rest in bed, take a sitz bath, and wash the external genitals with a mild antiseptic such as boric acid lotion. Employ no other local treatment in the acute stage. Smear the external genitals with lanoline to prevent excoriation by discharge. In cervical gonorrhœa, in the acute stages, do not paint the cervix, but keep the vagina clean with douches and baths. After the fourth week, when the condition will have become *subacute*, paint the endocervix with a Playfair's probe dipped in 10 *per cent.* protargen or a freshly prepared 10 *per cent.* solution of colloidal silver iodide. In America *subacute endocervicitis* is being treated with 2 *per cent.* solution of mercurochrome. Wool saturated in this solution is wrapped around wooden tents and these tents are inserted into the cervical canal. The tents swell up and express the infective secretion from the cervical glands, whilst the mercurochrome solution penetrates into and disinfects the tissues. These cervical pessaries are inserted every second or third day.

Aspiration with a suction pump after multiple puncture has been used to produce a passive hyperæmia and to empty the cervical glands of their secretion; after this has been accomplished the cervix is swabbed twice weekly with a 2 *per cent.* solution of mercurochrome.

Subacute urethritis may be treated with daily applications of 1 *per cent.* colloidal silver iodide injected into the canal under low pressure.

For gonorrhœal *vaginitis* what is called the 'dry treatment' is adopted in America. The patient is placed in the Sims' posture and the perineum is

[1] "Gonorrhœa," David Thomson. Frowde, Hodder & Stoughton, 1923.

retracted by a Sims' speculum. The vagina is then dried with sterile wool and exposed to hot air from an electric drier. When the canal is quite dry its surface is covered with subcarbonate of bismuth blown on by an insufflator.

Corporeal endometritis of gonorrhœal origin must be treated with great caution. The curette must not be used. Apply 15 *per cent.* solution of collosol silver iodide on a Playfair's probe ; leave it *in utero* for a few minutes, then continue the treatment of douching the uterine cavity with a 5 *per cent.* solution of the same silver salt, using a two-way glass catheter, the patient of course being kept in bed. If these mild solutions fail, paint the endometrium with strong iodine solution. In any case, if fever follows from intrauterine treatment the latter should be discontinued.

Chronic endocervicitis, *chronic* urethritis, *chronic* vulval infections, and also gonorrhœal salpingo-oöphoritis have been extensively treated of late by diathermy, and as this new therapeutic measure has met with promising results we shall briefly describe its action.

Diathermy is the employment of an alternating electric current of very high frequency. The alternations are sustained and no electrolytic action takes place in the tissues by the use of this current. On the other hand, *heat* can be developed in the tissues to any depth provided they lie between the two electrodes. The amount of heat-production depends on (1) the number of milliampères, (2) the relative size of the electrodes, (3) the resistance of the tissues, (4) the length of time the current is flowing.

Medical diathermy is the employment of heat generated in the tissues by the passage of the current and varying from 37·5° to 52° C. Above 52° C. the therapeutic value is lost and the temperature causes electro-coagulation or tissue-destruction, so that between 52°–60° C. diathermy becomes a *surgical* procedure.

The therapeutic value of diathermy in gonoccal infection is based upon the fact that the gonococcus is destroyed at a comparatively low temperature. Cherry [1] states that a temperature of from 41° to 43° C. maintained for ten minutes is enough to kill a growing culture, and that 43° to 47° C. suffices to kill the gonococcus in the vagina. A point of practical importance is that in *chronic* gonorrhœa the infection is very mixed, strepto- and staphylococci may be present, and as the former requires a temperature of 54° to 60° C. and the latter a temperature of 56° to 58° C. to cause their destruction, these pyogenic germs escape altogether and may keep up a purulent discharge. In such cases Cumberbatch and Robinson [2] supplement the diathermic current with zinc and copper ionisation. The value of diathermy is not entirely dependent on its bactericidal effect on the gonococcus. In ascending gonorrhœa, where the tubes and ovaries are affected and inflammatory tubo-ovarian masses exist, the hyperæmia induced by the heating of the tissues relieves the vascular stasis, favours transudation, removes pressure from the nerve fibres, thus assuaging pain and favouring absorption of inflammatory exudation. It is, therefore, claimed that the bactericidal powers of the tissues themselves are raised by their being heated *en masse* by the diathermic current.

For *chronic* endocervicitis Cherry[3] recommends placing the large electrode

[1] Cherry, Thos. H. "Diathermy in Pelvic Infections." *Med. Journ. and Record*, July 15th, 1925.

[2] Cumberbatch and Robinson. "Treatment of Gonococcal Infection by Diathermy. W. Heinemann, 1925.

[3] "Gonorrhœa," Selected Abstracts, *Amer. Jl. Obst. and Gyn.*, x, 1925, 304–311.

on the abdomen and the small one (thermophore) in the cervical canal. He employs 500–800 milliampères for fifteen to thirty minutes and keeps the temperature in the cervical canal at 43°–47° C.

Cumberbatch and Robinson use a higher temperature for a shorter time, *i.e.* about 50° C. for ten minutes.

For *chronic* urethritis the same technique is employed. This canal being sensitive, pain will be felt when the heat becomes excessive.

Cumberbatch and Robinson made the interesting observation that in cases of gonorrhœal arthritis treatment applied to the cervix and urethra caused the pain and swelling in the joints to subside.

Cumberbatch speaks in favour of using diathermy for vulvovaginitis of children and virgins, the active electrode being placed in the rectum. Ultra-violet rays have a powerful germicidal effect on superficial lesions of the vulva, but they do not penetrate far below the surface.

If pus-sacs develop, they should be removed as soon as the initial febrile attack has subsided: the uterus should also be taken away at the same time, for, if it is left, the cornual stumps are a source of infection.

In gonorrhœa coitus should of course be prohibited.

During the puerperium prolonged rest is essential. The patient should be kept in bed four or five weeks, even if there has been no fever. the time of greatest danger for puerperal women who are the subjects of gonorrhœa is when they first get out of bed and move about.

TUBERCULOSIS OF THE GENERATIVE ORGANS

General Pathology. The organism responsible for tuberculosis was discovered by Koch in 1882. It is a delicate bacillus 3μ in length It can be grown slowly on blood-serum and more rapidly on certain special media.

The diagnosis is made by finding the bacillus in a film made from the pus (*see* Fig. 154). After fixation of the pus on a slide or cover-slip, hot carbol-fuchsin is poured on the film and left for five minutes. The cover-slip is then immersed in 25 *per cent.* sulphuric acid until the colour disappears; it is next washed in tap-water, the film is counter-stained with Löffler's methylene-blue for one minute, then washed and dried. Tubercle bacilli are stained bright red; the other structures in the film appear blue.

The smegma bacillus stains in the same way, but it is more easily decolorized by alcohol, so that in examining for tubercle of the *external genitalia* it is better to employ a 3 *per cent.* solution of hydrochloric acid in absolute alcohol instead of the 25 *per cent.* mixture of sulphuric acid and water. By this means the smegma bacillus becomes decolorized and only the tubercle bacilli will remain red (*see* p. 209).

The lesion produced by the tubercle bacillus is first manifested by a proliferation of the endothelial cells of the lymphatic channels. The cells thus produced are called *epithelioid* from their resemblance to epithelial cells. By nuclear division in an epithelioid cell a giant-cell with peripheral nuclei is formed. Around this multinuclear cell other epithelioid cells arrange themselves concentrically to form a *giant-cell system*, which is completed by a widely extending zone of lymphocytes. Such a system is invisible to the naked eye, but when many such fuse together they appear as yellow or grey nodules and are known as *tubercles*. A *tuberculous giant-cell system* is an avascular granuloma which tends to undergo necrosis and to become the site of a secondary infection by true pyogenic cocci. In the human subject a

tuberculous lesion shows only a scanty number of bacilli ; those which exist are mostly extra-cellular, but occasionally they may be found inside a giant-cell or in an epithelioid cell. An emulsion made by pounding tuberculous tissue in normal saline solution, when injected into the knee-joint of a guinea-pig, causes an ascending infection of the lymphatic glands, which is followed in the course of a few weeks by general tuberculosis. This *physiological* test is slow, but it is the most reliable from the point of view of diagnosis. For diagnostic purposes use is made of the fact that tissues invaded by the tubercle bacillus are hypersensitive to tuberculin. Koch's 'old tuberculin,' the cutaneous inoculation of von Pirquet, and the conjunctival inoculation of Calmette are employed as tests. If a subcutaneous injection of tuberculin is followed by bearing-down pain, tenderness in the vaginal fornices, or metrorrhagia, the coincidence is regarded as suggestive of pelvic tuberculosis. The diagnostic tests for tubercle are therefore (1) microscopic, (2) therapeutic, (3) physiological. The microscopic discovery of the specific bacillus is conclusive ; the tuberculin (therapeutic) test is not always reliable, because a reaction may be obtained after the tuberculous lesion has healed. The physiological test (inoculation into guinea-pigs) is absolutely positive.

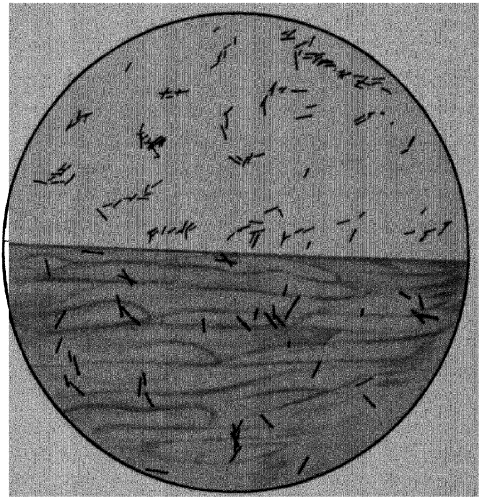


FIG. 154. TUBERCLE BACILLUS (E. Shaw). This organism was discovered by Köch in 1882. In the upper half of the field are seen large numbers of tubercle bacilli obtained by culture. In the lower half of the field are seen tubercle bacilli on a film prepared from sputum.

Frequency. André Rives has published statistics which show that the frequency of genital tuberculosis found at the autopsies of women dying of general diseases is 1 *per cent.* In women dying of phthisis and other forms of tuberculosis, pelvic tuberculosis exists in 5 *per cent.* It has been stated that 10 *per cent.* of all cases of salpingitis are tuberculous. Genital tuberculosis frequently causes no characteristic symptoms, so that during laparotomy unsuspected tuberculosis is not infrequently discovered.

Etiology. Genital tuberculosis is uncommon before puberty and rare after the menopause ; the majority of cases occur between the fifteenth and thirty-fifth years. Hypoplasia, or defective development of the genitalia, would seem to predispose to an infection by tubercle. The co-existence of tubercle with other types of infection suggests that a pre-existing inflammation may determine the site of a tuberculous deposit. New growths in like manner are said to favour a tuberculous infection. It has been claimed that adenomyomata of the tube predispose that structure to tuberculous infection, but this is reversing the order of facts. It is the tuberculous lesion that produces a condition which has been confused with adenomyoma (*see* Fig. 161, p. 279).

Methods of Infection. Three paths of infection of the pelvic organs are recognized—the ascending path, the descending path, and the blood- and lymph-streams.

Ascending Infection viâ the Mucous Surfaces. Tuberculosis of the vagina, uterus, and Fallopian tubes occurs more commonly in virgins than in married women, which is opposed to the theory held by some, that an ascending infection by spermatic fluid is a common explanation of genital tuberculosis in the female. Gorovitz obtained positive results by injecting tuberculous material into the uterus of guinea-pigs, but when the infective organisms were only introduced into the vagina the results were negative. It is possible that in rare instances tuberculous discharges from the bladder or bowel have caused direct inoculation of the genital tract from below, but speaking generally an ascending tuberculous infection, although possible, must be extremely rare in its occurrence.

Descending Infection. Experiments on animals have proved that foreign particles can pass from the peritoneal cavity to the vagina. In like manner, tubercle bacilli may be washed into the Fallopian tubes in cases of tuberculosis of the peritoneum or of the mesenteric glands, but it has been observed that the latter are rarely involved in genital tuberculosis. In cases where the general peritoneum and the pelvic viscera are involved at the same time, it is difficult to decide which is the primary focus, but the possibility that tuberculous peritonitis may produce a descending infection along the mucosa of the tubes must be admitted.

Infection through the Blood- and Lymph-streams. Most authorities now regard the *blood-stream as the most important route of infection.* This mode of infection can never be excluded in any case, and is the only satisfactory explanation in those cases of pelvic tuberculosis where there is an isolated lesion with no evidence of tubercle elsewhere. Moreover, such isolated lesions may be interstitial in situation with no evidence of invasion of the mucous membrane. It is, however, difficult to exclude an older *primary* focus in other parts of the body, so that perhaps it is wise to regard primary tuberculosis of the genitalia as a rare occurrence.

Distribution. The order of frequency in which the pelvic viscera are affected is: Fallopian tubes, body of uterus, ovaries, cervix, vagina, and vulva.

Prognosis. The coincidence of tuberculosis in other viscera, *e.g.* pulmonary, alimentary, or urinary tuberculosis, increases the gravity of the prognosis. Sterility is the rule, but when pregnancy does occur the maternal prognosis is grave. Acute miliary tuberculosis has been known to occur after labour or abortion. If fistulæ form, they are most intractable. Tuberculosis of the female genitalia usually runs a chronic course, and on the whole the prognosis is serious.

Tuberculosis of the Vulva. Clifford White states that about one-quarter of all cases occur in children. In adults it is usually secondary to some other lesion. There are two main types—the *ulcerative* and the *proliferative* (*non-ulcerative*). The former is the commoner. Tuberculous ulcers occur on either labium majus or minus—they are multiple, with yellowish bases, and with œdematous, purple edges. By the confluence of several ulcers a serpiginous sore is produced, which shows signs of healing in one part while extension is occurring elsewhere. The epithelium at the edges is sodden and raised. The lesion is tender on contact. From a vulval ulcer, sinuses may be found

running into the adjacent connective-tissues, which are always œdematous. The inguinal glands are only affected late in the disease. Tuberculous ulceration of the vulva is sometimes associated with hypertrophy of the labia, which may be so extreme as to simulate elephantiasis. The *proliferative* or *non-ulcerative* type has been described by Bender; it is rare, both labia are generally involved, and the vulva becomes regularly hypertrophic as seen in elephantiasis (*see* Fig. 155). It mostly affects adults, and often recurs after operation. Microscopically there is œdema of the sub-epithelial tissues, and round-celled infiltration. Owing to the bulk of tissue present, giant-cell systems are infrequent and therefore difficult to find.

Symptoms. Swelling of the vulva, painful micturition, and in some cases

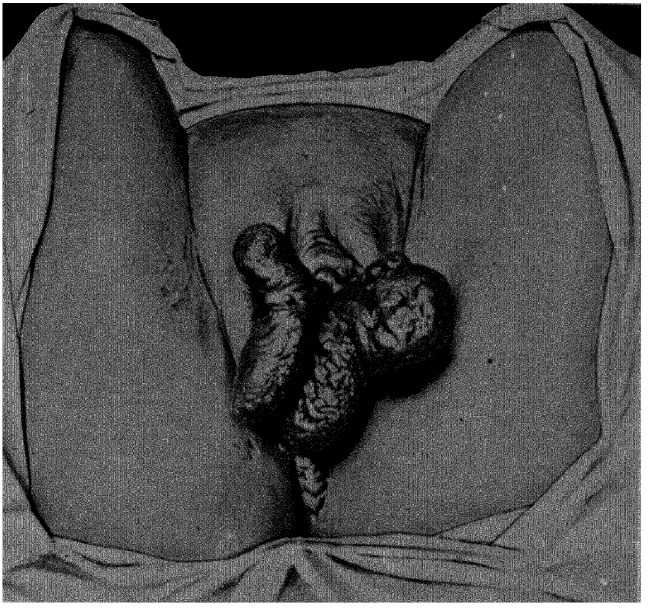


FIG. 155. SHOWING THE PROLIFERATIVE (NON-ULCERATIVE) TYPE OF TUBERCULOSIS OF THE VULVA (Bender). The labia are hypertrophic, the condition simulating elephantiasis.

pruritus, are the chief symptoms. In an ulcerative lesion there will be some discharge, and cicatrization may lead to urethral stenosis.

Diagnosis. A tuberculous ulcer in childhood has to be distinguished from noma and from diphtheritic vulvitis (*see* p. 303). Tuberculous ulcers of the vulva in adults must be distinguished from *ulcus molle*, chancres, herpes, epithelioma, and (if accompanied by hypertrophy) from esthiomène and from sarcoma (*see* pp. 312 and 322). Differential diagnosis in the early stages is not difficult, but late in the disease, when the vulva has become altered by hypertrophy, œdema, and ulceration, diagnosis may be impossible by clinical means, so that the specific tests described above will be required.

The proliferative or non-ulcerative form to which Bender has drawn attention resembles chronic lymphangitis, and the diagnosis depends upon finding tuberculous systems in the tissues by microscopic examination.

Prognosis. In children the disease progresses rapidly and dissemination

of tubercle occurs early. In adults progress is slow, but if phthisis is present the outlook is grave. Prognosis is more favourable in the proliferative than in the ulcerative cases.

Treatment. If the patient's general condition will admit of a general anæsthetic being given, free excision is indicated. Otherwise X-rays may be employed and ulcers painted with lactic acid; sinuses should be irrigated with peroxide of hydrogen (5 vols.).

Tuberculosis of the Vagina. Tuberculosis of the vagina is infrequent; it is rarely a primary lesion and is usually seen in association with tuberculous cervicitis. Two forms are described—the *miliary* and *ulcerative*. The commonest sites for ulcers are the posterior fornix and the *introitus vaginae*, near the urinary meatus in front, or near the perineum behind.

Symptoms. Leucorrhœa, blood-stained discharge, dysuria, pruritus, and vulvitis are the symptoms which accompany tuberculous vaginitis.

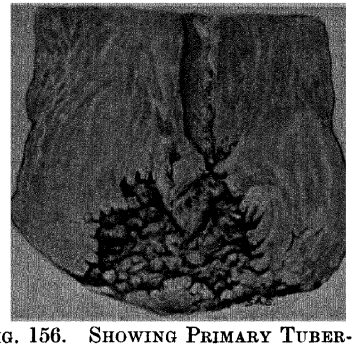


FIG. 156. SHOWING PRIMARY TUBERCULOUS ULCERATION OF THE CERVICAL CANAL. (Clifford White.) The cervix shown in Figure 157 bisected.

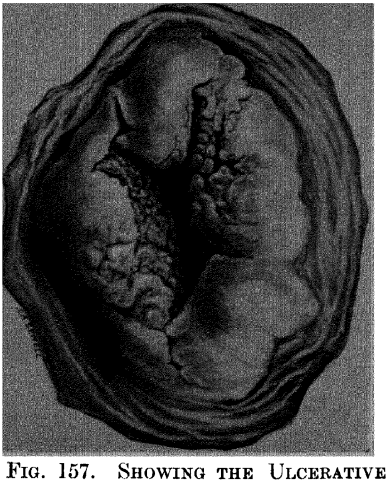


FIG. 157. SHOWING THE ULCERATIVE FORM OF PRIMARY TUBERCULOUS CERVICITIS. (Clifford White.)

Diagnosis and Treatment. The lesion must be distinguished from a septic ulcer due to a neglected pessary, from epithelioma, and from venereal lesions. The purple œdematous granulations seen at the edges of the ulcers, and evidence of co-existing tuberculosis in other parts, may be relied on as helping to make a correct diagnosis. The treatment consists of excision where possible, but if the patient is too ill to tolerate radical measures, douching and radio-therapy may be employed.

Tuberculosis of the Cervix. According to Clifford White, the cervix is affected in about 8 *per cent.* of cases of tuberculosis of the female generative organs. An isolated lesion involving only the cervix is rare, the cervix being usually secondarily implicated by a descending infection from the tubes or uterine body. Clinically two varieties are recognized, the *ulcerative* and *proliferative* forms; of these the former is the more frequent. The disease may be confined to the portio vaginalis or to the canal, but usually both are affected simultaneously (*see* Figs. 156 and 157). The ulcers occur

in the neighbourhood of the external os, and may be single or multiple ; they are serpiginous in outline, with sharp edges and a yellowish base. The proliferative variety appears as fine and coarse papillary processes around the external os and over the adjacent part of the portio vaginalis, to which they give a dark, livid, red appearance, resembling the rare condition of simple adenoma of the cervix (*see* p. 450). These outgrowths may block the cervical canal and give rise to *pyometra*. This form of tuberculosis is also accompanied by ulceration due to the breaking down of tuberculous foci. The cervical glands become hypertrophied and their lumina are filled with serous exudation and round cells. Metaplasia of the epithelium of the glands is often marked, giving a resemblance to squamous-celled epithelioma, which

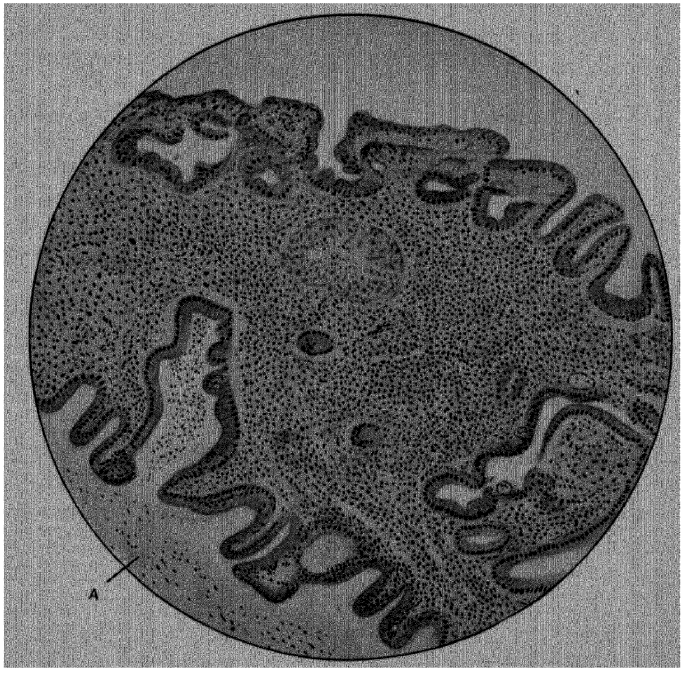


FIG. 158. TUBERCULOSIS OF THE CERVIX UTERI. Showing giant-celled systems. *A*. Gland filled with serous exudation and round cells. A gland at the top of the Figure showed metaplasia of its epithelium.

in some cases has actually been associated with tuberculosis of the cervix. Giant-celled systems exist in the infiltrated muscle-tissue surrounding the glands (*see* Fig. 158).

Signs and Symptoms. *The ulcerative type* is often mistaken clinically for carcinoma, and the latter can be satisfactorily excluded only by microscopic examination. A blood-stained leucorrhœal discharge, which may be offensive, is present. There is little or no pain, menorrhagia may be noted, there is no fever, and the patient's general condition remains good unless there is tubercle elsewhere. *The proliferative type* resembles in appearance a pseudo-adenoma (*erosion*) (*see* Pl. XV, p. 366), but it is soft, friable, and very vascular ; there is no surrounding infiltration. The tuberculous cervix has been described as " looking like a carcinoma and feeling like a cervicitis."

It is difficult clinically to diagnose a tuberculous ulcer of the cervix from a venereal ulcer; resort must be had to microscopic examination and to Wassermann's test. The prognosis in an isolated cervical lesion is good, but the outlook is often vitiated by the presence of tuberculosis in other parts of the body.

The *treatment* consists of high amputation of the cervix, but if there is also advanced phthisis no operative treatment is indicated.

Tuberculosis of the Body of the Uterus. Tuberculosis of the body of the uterus is generally secondary to tuberculous salpingitis, but cases of primary uterine infection have been recorded. It occurs at all ages from infancy to the climacteric. It may be associated with tubercle of the cervix. Of all cases of uterine tuberculosis the cervix *alone* is involved in 2 *per cent.* and the body of the uterus *alone* in 85 *per cent.* (C. White); in the remainder both are affected together. The commonest site for the disease is near the cornua; during pregnancy it attacks especially the placental site.

Varieties. (1) A miliary form without ulceration; (2) a chronic diffuse or caseous type; (3) a chronic fibroid variety. The second type is the one usually met with clinically, acute miliary tuberculosis of the uterine body is only met with in dying women, whilst the third, or fibroid form, is very rare. The chronic diffuse type is what is generally known as *tuberculous endometritis*, but the invasion is not confined to the mucosa; it spreads into the subjacent muscular tissue. The first macroscopic evidence is the presence of small yellowish areas in the mucosa near one or other cornu, *i.e.* near the entrance of the Fallopian tubes (Cullen). At first, the surface-epithelium is intact, the glands become enlarged, and their epithelium proliferates whilst the interglandular tissue becomes infiltrated with small round cells in which giant-cell systems make their appearance. Later the epithelium on the surface gives way, its place is taken by granulations which break down and caseate, so that on section we see a surface-layer of caseous material, then a layer containing polynuclear cells and giant-cells, with here and there the fragment of an endometrial gland remaining, followed deeper down by a zone of round-celled infiltration and hæmorrhage. It is not uncommon for the caseous granulations to obstruct the cervical canal and for pyometra to form (*see* p. 213). We have traced a tuberculous infection from the Fallopian tubes into the musculature of the uterus without the endometrium becoming infected, the infection having travelled along the perivascular lymphatics just as it does in carcinoma; such an observation explains the occurrence of interstitial tuberculous abscesses in the uterine body.

In tuberculous endometritis the muscularis is generally implicated to some extent, being thickened and fibrotic. Tubercle and carcinoma of the endometrium may co-exist, and it is thought that the marked epithelial metaplasia which is found in the glands of a mucous membrane infected by tubercle may, in many instances, be the starting point of a malignant process.

Symptoms. These are not characteristic. Leucorrhœa and menorrhagia may be present, followed by amenorrhœa on the destruction of the endometrium, or on the formation of a pyometra. Pain, when present, is due to a complication, such as salpingitis or pyometra. Sterility is the rule.

Diagnosis and Treatment. Whilst there are no characteristic symptoms, physical examination shows an enlarged uterus which is usually accompanied by a tubal swelling or swellings. Examination of curettings may

reveal the presence of giant-cell systems. In advanced cases caseous material may be extruded.

The *treatment* is either simple curettage or laparotomy. If there is no other evidence of tubercle than that discovered by curettage, nothing further

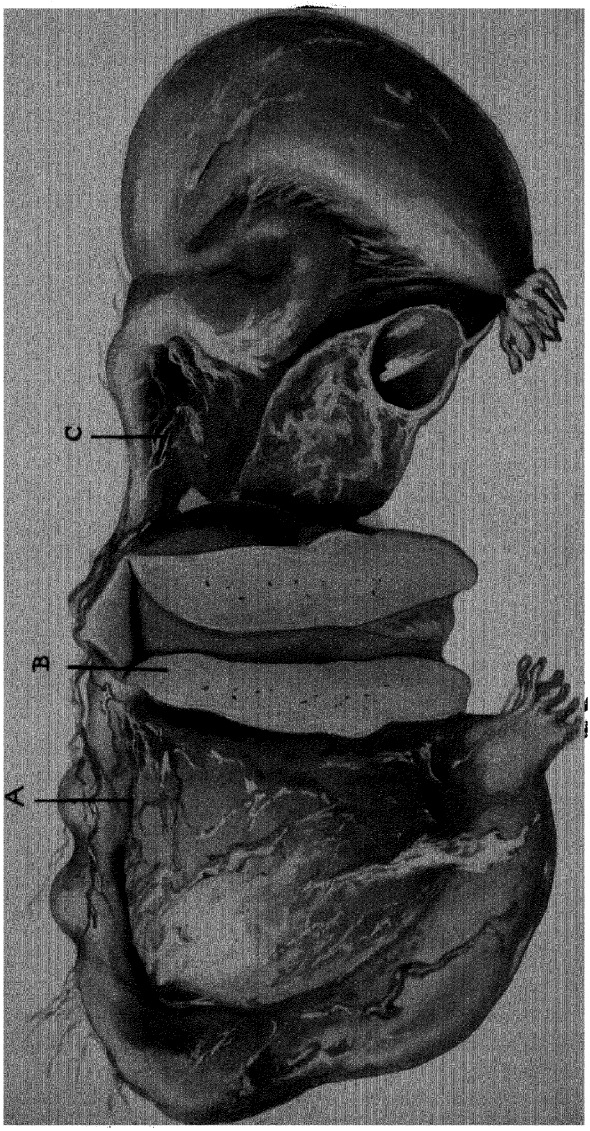


FIG. 159. DOUBLE TUBERCULOUS PYOSALPINX. Note (1) the presence of Nodular Salpingitis; (2) the Fimbriæ are not indrawn.

A and C show the points at which sections were taken to prove the presence of tuberculous foci in both tubes. At B a section showed foci of tubercle spreading from the interstitial part of the tube into the uterine muscle.

for the moment should be done by way of operative treatment, but the patient should be carefully watched. When there is evidence of other pelvic lesions there can be no alternative but to open the abdomen and remove the infected tissues.

Tuberculous Disease of the Ovaries. The ovaries may be secondarily

infected from the Fallopian tubes or from the peritoneum. In either of these conditions peri-oöphoritis is common, but owing perhaps to the density of the cortex, infection of the ovarian stroma is comparatively rare. It is very doubtful whether interstitial tuberculous oöphoritis ever occurs primarily, but von Franqué has traced the source of an ovarian infection to an abrasion in the vaginal vault. Schöttlander states that miliary tubercles may exist in apparently healthy ovaries, and Sitzenfrey claims to have demonstrated the presence of tubercle bacilli in the ova of the human ovary in the case of a woman with pulmonary and pelvic tuberculosis.

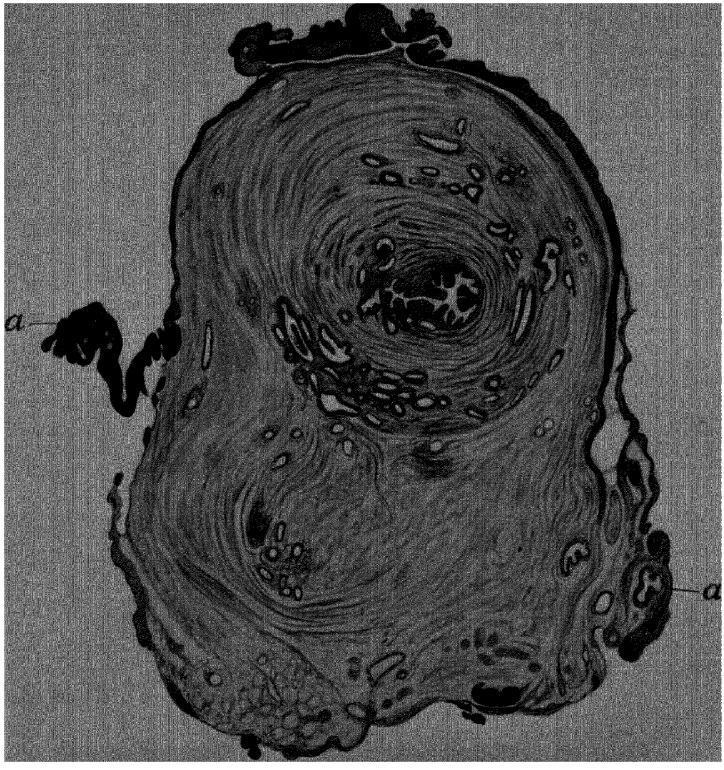


FIG. 160. NODULAR SALPINGITIS (SALPINGITIS ISTHMICA NODOSA (von Franqué). *a–a'*, extent of peritoneal coat of tube.

Apart from a few isolated examples of infection *viâ* lymphatics, it may be stated that, clinically, tuberculous oöphoritis is associated with infection of the peritoneum and of the Fallopian tubes, both ovaries being commonly affected.

In the early stage of the disease miliary tubercles are found in the connective tissue of the cortex, whilst the Gräafian follicles may be quite normal in appearance, even when surrounded by the inflammatory exudation. Later caseation sets in, the glandular tissue is destroyed, and the ovary enlarges, and ultimately becomes an abscess-sac. Tuberculous oöphoritis may subside, leaving the ovary in a state of fibrosis. The symptoms and physical signs are similar to those of tuberculous salpingitis.

Tuberculosis of the Fallopian Tubes. This is the most frequent of all tuberculous lesions in the female genitalia. The reason for this is that the Fallopian tubes are so constructed and placed as to favour the stagnation of any infective matter (*see* Salpingitis, p. 549). Tuberculous salpingitis therefore is present in 85 *per cent.* of all cases of tuberculosis of the generative organs in women.

Frequency. According to Clifford White adequate investigation by careful observers has shown that about 10 *per cent.* of all tubes removed for

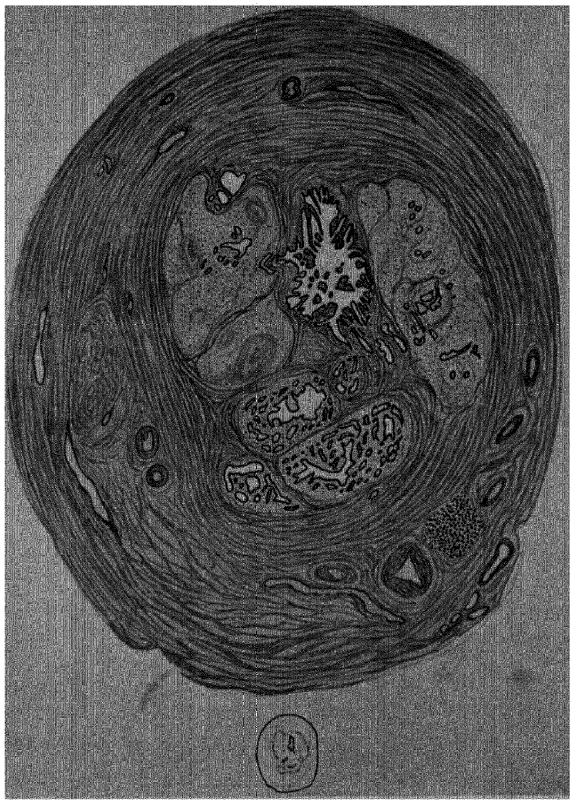


FIG. 161. MICROSCOPIC SECTION OF NODULAR SALPINGITIS (SALPINGITIS ISTHMICA NODOSA). Showing gland-follicles in the muscularis (*salpingitis follicularis*). The inset shows the actual size of the tube. Tuberculous systems were seen in this section under a higher power (*see* Fig. 363, p. 561).

inflammatory disease show old or recent tuberculous lesions. The majority of cases occur between the ages of fifteen and thirty-five years.

Pathological Anatomy. The tubes are generally enlarged and bent; there may be nodular thickenings, more especially near the isthmus. The fimbriated extremity may be patent and even patulous; when closed the fimbriæ are not, as a rule, indrawn, but remain visible (Fig. 159). Three types of tuberculous salpingitis are met with: (*a*) perisalpingitis, (*b*) endosalpingitis, (*c*) interstitial salpingitis, but all three forms often occur together. In (*a*) the peritoneum covering the tube is studded with tubercles. In (*b*) the plicæ are swollen and infiltrated; their tips become denuded of epithe-

lium and stick together, thus forming pseudo-cysts (*salpingitis pseudo-follicularis*). The epithelium may also undergo metaplasia and keratinization, and instead of a single layer of columnar cells, irregularly shaped cells in many layers, are formed by proliferation. In some cases these changes are so marked as to resemble malignancy. In other cases the epithelium is totally destroyed and the tube lumen filled by caseous *débris*. A variety of endosalpingitis is the so-called *nodular* salpingitis, in which the epithelium penetrates quite deeply into the muscularis, where it proliferates in an adenomatous manner, whilst both the muscle and connective tissue undergo hyperplasia, so that histological resemblance to an adenomyoma is produced

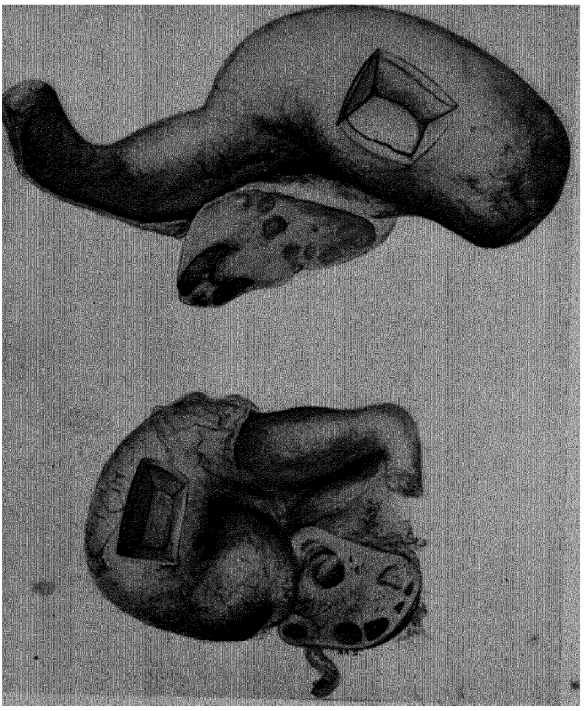


FIG. 162. DOUBLE TUBERCULOUS PYOSALPINX. The upper sac resembles somewhat a banana in shape. It was non-adherent. The lower specimen shows the tube bent upon itself and adherent to the ovary. It was also adherent to other adjacent structures. Apertures made in the tubes after hardening show the inspissated caseous contents.

(*see* Fig. 161). This trespassing of epithelium, known as *epithelial heterotopy* or epithelial displacement, is not peculiar to tuberculous lesions, but also occurs, though in a less marked degree, in chronic gonorrhœal and septic infections of the tubes. In nodular tuberculous salpingitis the nodules may undergo calcification. In (*c*) giant-cell systems or caseous foci are found in the muscle-wall; this *interstitial* type is due to a blood- or lymph-infection.

It is impossible in the early stages to tell by macroscopic examination that a case of salpingitis is tuberculous, *but if a tube is thickened at its isthmic portion whilst the abdominal ostium remains patent it suggests the presence of*

tubercle. In cases due to peritoneal infection, miliary tubercles may be seen on the serous surface, and can often be traced to the subserous coat. The stress of the infection usually falls on the two ends of the tube, the ampullary and the uterine. When the fimbriæ adhere together a pyo-salpinx forms in the ampullary portion; this is said to happen in one-third of all cases. The contents consist of sterile, liquefied caseous material; only in cases of secondary infection will true pus be found. A *cold abscess* of the tube is the name given to a large tuberculous pyosalpinx with thin walls, the result of a mild infection. Such an abscess may closely resemble an ovarian cyst, the investing peritoneum being generally of normal appearance. In other cases the tubes filled with tuberculous material may form cylindrical swellings (*see* Fig. 162). In advanced cases of tuberculous salpingitis dense adhesions unite the tube to adjacent structures; fistulous tracts may penetrate the ovary, the bowel, or the bladder. Occasionally the mesenteric glands are found enlarged.

Clinical Features. Symptoms referable to the tubes may be absent altogether; especially is this the case in the miliary form of the disease. On the other hand, if secondary infection of a tuberculous abscess supervenes, the symptoms may be very severe. It is a common experience for an operator to be surprised to find that a tubo-ovarian mass is tuberculous, and Whitridge Williams' expression, "unsuspected tuberculosis," covers a large number of cases. There may be a failure in general health with loss of weight. There may be iliac and lumbar pain, aching in character, with exacerbations due to tubal contractions or to perisalpingitis. Dysmenorrhœa of extrinsic (secondary) type may be present. Partial amenorrhœa may be noted; other symptoms referable to endometritis, such as leucorrhœa, may be present, and lastly ascites may cause abdominal enlargement. The onset is usually insidious, and the progress of the disease is slow.

Physical Signs. Ascites may or may not be present; a nodular bead-like thickening of the isthmic portion of the tube suggests tubercle; in the absence of these features there are no characteristic signs to point to a salpingitis being tuberculous.

Diagnosis. If bilateral salpingitis be present in a virgin who gives no history of appendicitis, tubercle may be regarded as the most likely cause of the trouble. Nocturnal pyrexia, or definite signs of phthisis, will strengthen the suspicion. A ruptured ovarian cyst with ascites will produce physical signs akin to those of tuberculous salpingitis with ascites.

Treatment. In cases in which the tubal or tubo-ovarian lesion constitutes the main focus of the disease, laparotomy followed by removal of the affected organs should be carried out. In advanced cases it is surgically sound to remove the uterus as well as the suppurating tubes (*see* Fig. 159). Wherever possible, the whole, or a portion, of one ovary should be left, as most cases which come to operation occur in women under thirty-five years of age. A tuberculous abscess should never be drained *per vaginam, as an intractable fistula always results.*

Tuberculosis of the Peritoneum. Tuberculosis of the peritoneum is commoner in women than men. The peritoneum of the pelvis is the part frequently affected most, a fact which has been attributed to the gravitation of tubercle bacilli to the bottom of the peritoneal cavity. Williams attributes peritoneal infection to a pelvic source in from 40 to 50 *per cent.* of cases. Abbé considers that 66 *per cent.* of the cases are infected from the

thoracic glands, and 16 *per cent.* through the mesenteric glands. The intestine and the blood-stream are other sources of infection.

Varieties. There are three types to be distinguished: (1) the miliary, (2) the caseous, (3) the fibroplastic.

(1) *The Miliary Form.* This form may exist for a long time without causing symptoms. The peritoneum is covered with minute tubercles (*see* Fig. 163). There may or may not be adhesions present. In the acute form the peritoneum is thickened and lustreless, and flakes of lymph, like opaque curds, adhere to the surface. There is a variable amount of ascites; the fluid is yellow or blood-stained, and may contain masses of floating lymph. In this type adhesions are frail and easily bleed.

(2) *The caseous form* is much more severe: caseous masses and abscesses exist; the intestines and omentum may form an adherent mass which feels like a neoplasm on physical examination. Between coils of adherent bowel encysted collections of yellow, caseous, or purulent fluid may be found. Such a condition may be localized to the pelvis or to the omentum or elsewhere, or a general ascites may exist. There is a danger in the caseous form of *fistulae* forming and opening into bowel or bladder, or at the umbilicus. When

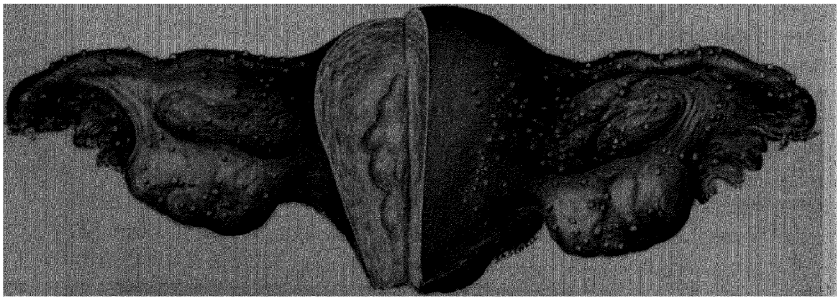


FIG. 163. SHOWING MILIARY TUBERCULOSIS OF THE PELVIC PERITONEUM (Clifford White.)

localized to the pelvis, tuberculous peritonitis is practically always associated with tuberculosis of the Fallopian tubes, the diseased tissues forming a cystic mass which resembles an adherent ovarian cyst.

(3) *The fibroplastic form* is the outcome of the two other varieties, especially of the first. It is characterized by the disappearance of the tubercles, and by the formation of bands uniting intestinal coils to each other and to the parietes. The adhesions may be so dense as to make it difficult to find the true peritoneal cavity. Encysted collections of clear yellow fluid exist. The omentum and mesentery retract, and may thereby produce kinks and narrowing of the bowel. Bands passing from one point to another endanger the bowel by causing risk of strangulation.

Clinically, all three types of tuberculous peritonitis may be found in combination.

Symptoms and Signs. Symptoms may be entirely absent or they may be those of extensive peritonitis associated with intestinal obstruction. The onset may be so acute as to suggest the presence of a twisted ovarian cyst —a condition which the physical signs may also resemble. Certain prodromata may be noted in many cases; they are, anorexia and loss of weight,

dyspepsia, and rise of temperature, especially towards evening. In acute cases the temperature may run up to 103° F., and there is acute abdominal pain and a certain amount of tenderness. In the more chronic forms there is often bearing-down pain in the pelvis and tenderness in the lower abdomen. Kelly has drawn attention to dysuria as a frequent symptom. The abdomen is at first tympanitic, but later, signs of ascites are present. A *variable percussion-note* is obtained, according to whether a distended coil or an encysted collection of fluid is encountered. In the most chronic ascitic form the phenomenon of shifting dulness is easily obtained, because the fluid is not encysted by adhesions. Sometimes an apparently solid tumour will be found which gives a resonant note, and the relations of the tumour may change between two examinations; such puzzling anomalies are always suggestive of tuberculous peritonitis.

Diagnosis. The diagnosis may be very difficult. The acute cases have to be differentiated from typhoid fever, and from other forms of acute peritonitis; the *chronic* cases from malignant neoplasms and ovarian cysts, whereas some cases are not even suspected, much less diagnosed. The family history, and the presence of tubercle elsewhere, are of the greatest help in forming an opinion. Cases with free fluid and no pelvic mass resemble cirrhosis of the liver; cases with a pelvic mass and free fluid simulate ovarian carcinoma. Encysted tuberculous fluid in the pelvis may resemble an ovarian cystoma. Other alternative cystic conditions higher up in the abdomen are hydronephrosis, cystic sarcoma, hydatids, and appendix-abscess. When the parietal peritoneum is thickened it gives a characteristic doughy feel to the abdominal wall. With a slowly enlarging abdomen presenting anomalous and variable physical signs, the probability of tuberculous peritonitis should always be borne in mind.

Prognosis. The chronic miliary or ascitic form gives the best chance of recovery. The prognosis in the caseous form, with multiple breaking-down foci, is unfavourable. The prognosis is better in adolescence than in young children and elderly subjects. Associated phthisis or intestinal tuberculosis renders the prognosis grave. High temperature, blood and mucus in the stools, diarrhœa, frequent vomiting, and emaciation are very unfavourable symptoms, as they indicate that the mucosa of the bowel is involved.

Treatment. If recognized in the early stages, sanatorium treatment, combined with X-rays and tuberculin injections, should be tried. Palliative treatment should also be given a full trial in the caseating and adhesive types. In cases of free fluid, where the latter is increasing, the abdomen should be opened, the fluid evacuated, and the Fallopian tubes and appendix removed if they are implicated.

Great care is necessary in dealing with adhesions, because intestinal fistulæ are easily formed but never heal; the same applies to an external fistula, so that great care chould be expended upon the closure of the abdominal wall. Treatment at a sanatorium should follow convalescence from operation.

SYPHILIS IN WOMEN

It is not intended in this section to give a general description of syphilis. In many respects, however, the disease as it occurs in women shows well-marked differences from that seen in men, and it is with these points that we are here chiefly concerned.

The specific organism, *treponema* or *spironema pallidum* (*spirocheta pallida* of Schaudinn), is a small spiral filament with pointed ends (*see* Fig. 164); it is actively mobile, being furnished with a flagellum at each end. It is present in primary, secondary, and tertiary lesions. Successful inoculation-experiments upon monkeys have been carried out, so that no doubt remains as to its causal relation to the disease.

It is believed that women may become infected in two different ways: (*a*) by sexual congress with a man in whom the disease is recent and active; (*b*) through becoming impregnated by a man in whom the disease has reached the tertiary stage and there are no open lesions. Such men do not infect their wives by sexual intercourse only, but should the wife become pregnant the child is syphilitic and the mother becomes infected through it. The treponema is present in the semen and is carried into the uterus by the spermatozoa; here it infects the growing ovum, and

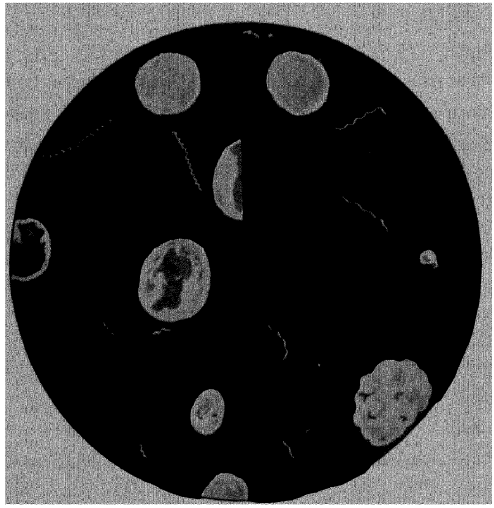


FIG. 164. TREPONEMA PALLIDUM. (E. Shaw.) Films made from the discharge obtained from specific ulcers, prepared by the Indian-ink method. To the left of the figure is seen the *Treponema pallidum*, it has the form of a closely folded white spiral. To the right of the Figure is shown the *spirocheta refringens*, which presents wide spirals. The latter organism is thicker than is the *treponema pallidum*; it is *non-specific*, but it is shown by way of contrast with the true specific organism.

through it obtains entrance to the mother's blood. If pregnancy does not occur the treponemata perish, as they do not possess the power, shown by the gonococcus, of penetrating healthy epithelium and multiplying within the cells. The maternal infection is of a particularly mild type throughout, and definite manifestations may be delayed in appearance for many years after the original infection. The former differs little from the disease as seen in men, the chief differences being found in the characters of the initial lesion. The latter is distinguished as *conceptional syphilis;* it is acquired indirectly, *i.e.* through fertilization, and it differs from the ordinary form in the following respects: (*a*) there is no primary stage; (*b*) the early secondary stage is often absent, and when observed is very mild; (*c*) the first manifes-

tations of the late secondaries may not make their appearance until many years have elapsed and the child-bearing period is over.

The apparent freedom, in many cases, of the mother of obviously syphilitic children, from all manifestations of the disease, led to the view that she was in some way protected from infection through her child. This view received support from the well-established fact that a woman could suckle a syphilitic child which she had borne herself, and remain free from all signs of the disease, while another woman, not the mother of the child, would become infected by suckling it. These observations formed the basis of "Colles's Law of Immunity." Extended clinical observation and the use of the Wassermann test have, however, put the matter in its true light. The disease is present in the mother, but in a very mild form; the Wassermann reaction often fails to yield positive evidence of the existence of syphilis until *after the age of child-bearing has been passed.* The developing ovum probably offers the organism a better environment than the mother's tissues, for the children of such parents usually show severe manifestations of the disease.

The Initial Lesion. A typical Hunterian chancre is seldom seen in women. It will be recollected that this lesion is a subcuticular granuloma, which shows a marked tendency to superficial erosion or ulceration. The resulting ulcer has a dirty greyish indurated base and a raised edge. In men, the exposed position of the lesion favours the ulcerative process, and as a sequel of secondary infection by cutaneous organisms, a stratum of inflammatory induration is formed at the base, to which the characteristic features of the *hard sore* are due. In women the primary lesion is less exposed to external sources of injury and infection, and consequently less regularly develops the characteristic induration of the base. It is probable that the original papule is often absorbed completely without ulceration having occurred, and consequently without scarring.

Site. The following are the commonest positions in order of frequency:—the labia, the cervix, the vagina, and extra-genitally, the anus and the inner aspects of the thighs. When affecting the vaginal walls or the cervix, the patient will be necessarily unconscious of the presence of a sore. In many cases the labial sore also passes unnoticed, for it is painless and gives rise to no noticeable discharge. When observed, a *labial* chancre appears either as a flat papule, or a shallow ulcer with a greyish unhealthy floor; if the base is picked up between the fingers induration is barely noticeable. The *cervical* chancre similarly is non-indurated, and may present either in a papular or an ulcerative form. The stage in which the typical ulcer is seen may be brief, and may pass unnoticed, leaving a clean reddish papular area not unlike a cervical *erosion.* Vaginal chancres are rare: the extra-genital chancres resemble the typical *hard sore* more closely than any of the others.

Labial chancres are often multiple, attacking apposed surfaces; the inguinal glands will show the typical enlargement and induration. In cervical chancres the external glands may escape altogether as the lymphatics drain into the deep iliac glands; occasionally, however, owing to free lymphatic anastomoses, the inguinal glands may be involved as well.

Septic infection, leading to phagædena, is seldom seen in women, as free surface-drainage is permitted from the sore in all positions in which it occurs; the typical situation for a phagædenic sore is beneath the prepuce, where drainage is imperfect.

It must be recollected that mixed infection with the virus of gonorrhœa and syphilis is not uncommon from impure coitus, and the symptoms referable to the former, inasmuch as they appear earlier, and are more obtrusive, may entirely obscure the existence of the more serious infection.

The Secondary Stage. In women two lesions belonging to this phase of the disease often make an unusually early appearance, viz. condylomata of the vulva and papilloma of the tongue. Condylomata, or mucous patches, form flat, broad, warty elevations, greyish in colour, moist in appearance, always multiple; they are often very extensive in distribution, affecting not only the labia, but the perineal body, the anus, the folds of the nates, and the inner surfaces of the thighs. They are infective like the primary sore. The *papilloma* of the tongue will be found at the apex of the circumvallate papillæ, *i.e.* on the posterior part of the tongue; it forms a flat, red elevation with an irregular surface. Its presence, even in the absence of a local lesion, is powerful confirmatory evidence of syphilis; hence examination of the tongue should be part of the routine followed in cases of suspected syphilis.

Examination of the chains of *lymphatic glands* which are accessible to palpation will generally show the characteristic induration and enlargement without peri-glandular thickening; this is well marked in the superficial and deep cervical glands, and in those of the axilla and the elbow. The treponema may be demonstrated in the fluid drawn from an enlarged gland by puncture.

The late secondary stage presents no distinctive features in women except as regards the reproductive functions. Here the disturbances met with in conceptional syphilis, and described below, occur to an even more severe degree than in that condition.

Diagnosis. It is clear from what has been said that when a woman has been exposed to the contagion of syphilis the greatest care is called for in clinical investigation. Careful inspection of the vulva may reveal traces of a disappearing lesion, which would be overlooked were the observer not aware of its inconspicuous characters. The fact that such a lesion, when found, does not present the characters typical of a syphilitic chancre must be allowed very little weight in diagnosis; and even if it heals rapidly under simple local treatment caution is still called for. In the absence of an external lesion the cervix and vaginal walls should in all cases be *carefully inspected in a good light:* an ordinary digital examination is of course quite useless for the purpose.

Owing to the atypical character of the initial lesion in women diagnosis by detection of the infecting organism is necessary. The treponema may usually be detected in an initial sore or papule or in a condyloma by the following method. First wash the surface of the sore with saline: then squeeze it, or lightly scrape the surface with a knife without causing bleeding; with a platinum loop take up a drop of the serum expressed and place it on a glass slide: side by side with this place a drop of water and a drop of an emulsion of Indian ink; mix the three drops and prepare cover slips from the resulting large drop. Examined with an oil-immersion lens the treponema will stand out unstained from the general background (*see* Fig. 164).

Staining methods have been largely replaced by the method of dark-ground illumination by which the organism can be detected in the serum without staining. A special condenser and a strong source of illumination

are required. If the staining method is negative the other method should be used before forming a conclusion.

If the organism cannot be detected on the first occasion, the examination should be repeated. The introduction of a positive test for generalized syphilitic infection has, however, rendered diagnosis much more certain, and except in the early stages the Wassermann reaction test should be applied in all cases. A negative result must not be absolutely accepted; the test should be repeated after an interval of a few days, treatment being in the meantime withheld, or a provocative dose of N.A.B. previously administered. Until the secondary stage has been entered upon, about the fourth week, and there are signs of glandular enlargement, dissemination of the disease has not occurred, and the test is of no value. It cannot, therefore, be usefully applied at the first appearance of the initial lesion. In this stage the detection of the treponema suffices for diagnosis, and treatment may be at once entered upon.

Syphilis and Child-bearing. Some of the most striking results of syphilis will be found in the obstetric history. The women are often highly fertile, *i.e.* conception occurs with relative frequency. Eardley Holland has shown that the old view that maternal syphilis is a frequent cause of abortion is probably erroneous; it is exceptional to find definite evidence of syphilis in the early fœtus or its membranes. When syphilitic women abort, this event is not the direct result of fœtal disease, but must be attributed either to the general or local conditions which lead to abortion in non-syphilitic women. Maternal syphilis, however, is by far the commonest cause of death of the fœtus after it has become viable, and Holland found that in 33 *per cent.* of still-born premature births definite evidence of syphilis could be found. Occasionally a child is carried to term and born alive, and may then show definite signs of the disease at birth; or it may be apparently healthy when born, but sooner or later will develop more or less severe manifestations of the disease. According to the observations of Hochsinger, not more than 9 to 10 *per cent.* of the children borne by syphilitic mothers are free from signs of the disease at birth, and of these a considerable number develop signs of syphilis during the first six months of life. Unless appropriately treated, the effect of the specific virus upon reproduction shows little or no tendency to die out, and premature births, or fœtal deaths *in utero*, or living syphilitic infants may be spread out over a long series of several years. Examination of the fœtal membranes and placenta, or of the fœtal viscera, *e.g.* the liver, shows that the treponema is usually present. The organism is therefore probably transmitted in the paternal semen, and develops mainly in the tissues of the ovum.

Treatment of Syphilis. The discovery of the Ehrlich series of organic arsenical compounds and their destructive action on the treponema when administered by intravenous injection forms the basis of the present methods of treating syphilis. For the technique of this treatment the reader must be referred to a monograph on Syphilis, but there are certain general considerations which cannot be too often emphasized.

The arsenic treatment must be begun at an early stage of the disease, and prolonged over a period of two or more years if the best results are to be obtained. There is no single sign by which the definite extermination of the organism from the tissues can be determined. "When the serum reaction first becomes negative the patient is far from being cured" (Harri-

son), and experience has shown that if treatment is then suspended relapses frequently occur. When the reaction becomes negative the male may be no longer infective to ordinary contact, but exception must be made, as has been already pointed out, of sexual intercourse.

There are certain cases in which the arsenic compounds cannot be given without undue risk, such as renal and hepatic disease, and arteriosclerosis. Reliance is then placed upon the mercury compounds, which now hold the second place in the treatment of syphilis. Recently it has been found experimentally that bismuth salts are destructive to spirochetes in hens, and trial is therefore being made of these compounds in cases of syphilis, but this work is still in the experimental stage.

It is generally agreed that arsenic treatment alone is not sufficient to ensure a cure, and it is customary to supplement it with the periodic administration of mercury or potassium iodide. Harrison favours the latter, and advises its administration for a period of three weeks after each series of arsenic injections. Blood-tests are made every three months during the first year, every six months during the second year.

In some cases, especially those with late manifestations, iodides in full doses may judiciously be combined with mercury.

Syphilis and Marriage. The question when it is safe for a man who has had syphilis to marry has always been very difficult to answer satisfactorily; nor has the difficulty been entirely removed by the introduction of Wassermann's test, for a negative result cannot be entirely relied upon. Approximate certainty can be obtained only by a thorough course of treatment, comprising, if possible, at least one preliminary administration of salvarsan and two years' treatment with mercury, the first year continuously, the second year intermittently. Should manifestations of the disease appear in spite of treatment, a further six months' continuous course of mercury is advisable. Wassermann's test should be repeated at the end of the allotted course of treatment before marriage is sanctioned. *A man who has contracted syphilis should not marry until he has been under observation and treatment for four years.*

PARASITIC AFFECTIONS OF THE GENITALIA

The following varieties of parasites may be met with in the genital tract under rare conditions:

(1) Protozoa.
  (*a*) Trichomonas vaginalis.
  (*b*) Amœba urogenitalis.
(2) Trematode worms.
  (*a*) Distoma hæmatobium.
(3) Nematode worms.
  (*a*) Oxyuris vermicularis.
  (*b*) Ascaris lumbricoides.

More common and of greater clinical significance are:

(4) Cestodes.
  (*a*) Tænia echinococcus.

And for the sake of convenience may be added an example of the higher class of bacteria:

(5) Streptothrices.
  (*a*) Actinomycosis.

(1) **Trichomonas Vaginalis.** This is a flagellated protozoon (*see* Fig. 65) measuring 0·015–0·025 mm. in length and 0·007–0·012 mm. in breadth. It thrives in the acid vaginal secretion. It occurs at every age of life, but how it finds its way into the vagina is unknown. It cannot live in an alkaline medium, so that menstrual discharges and alkaline douches are inimical to its existence. In the vagina this parasite is harmless, but it may invade the urethra and bladder and set up chronic cystitis.

Another protozoon, the *amœba urogenitalis*, has been recorded in Japan. It wanders from the vagina into the bladder and sets up tenesmus and hæmaturia.

(2) **Distoma hæmatobium** (*Bilharzia haematobia*) occurs less frequently in women than in men. In a few cases it has caused lesions of the labia major resembling gonorrhœal warts (*condylomata acuminata*). In these cases the ova of this round worm are found in the submucosa of the vagina. The distoma has also been known to produce a papillary condition of the cervix uteri resembling epithelioma.

(3) **Oxyuris vermicularis,** a form of thread-worm frequently found in the large bowel of children, has been discovered in the vulva and vagina, where it produces a vulvitis and colpitis resembling a gonorrhœal infection. This worm has been known to enter the uterus and Fallopian tubes, setting up serious inflammation in the higher genital tract.

Ascaris lumbricoides. This is the common round worm of the intestine, it has been found in the vagina in cases of rectovaginal fistulæ.

(4) **Echinococcus.** Cysts due to the *taenia echinococcus* will be described in the next section.

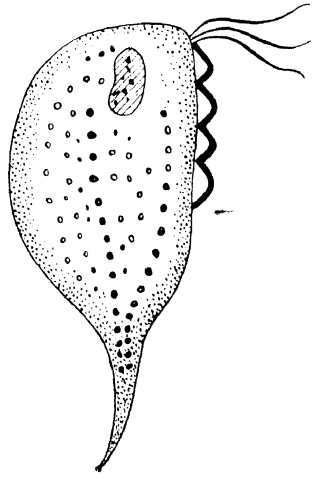


FIG. 165. TRICHOMONAS VAGINALIS HIGHLY MAGNIFIED (H. Füth).

(5) **Actinomycosis** of the genitalia is described later (*see* p. 294).

It is very difficult to prove the parasitic nature of vulvitis and colpitis in children, but in cases where the gonococcus cannot be demonstrated, careful search for the oxyuris should be made, and the bowel washed out with infusion of quassia. The vaginitis should at the same time be treated by syringing with a weak antiseptic, such as 1–2 *per cent.* lysol-solution. Cystitis should be treated by washing out the bladder with 1 *per cent.* protargen-solution and by giving hexamine *per os.* Papillary growths of parasitic origin should be removed.

HYDATID DISEASE OF THE PELVIS AND PELVIC VISCERA

Hydatid disease is due to a cestode or tapeworm known as the *Taenia echinococcus.* Like other members of the class *cestodes,* this worm passes through two phases of development. The mature sexual form (*enteral phase*) is only found in the intestinal tract of certain canines, *e.g.* the dog, wolf, etc. The immature *encysted* form (*somatic phase*) is passed in the visceral connec-

tive tissues, or serous membranes of various other mammals, notably in the sheep and occasionally in man. For full details of the life-history of the parasite the student is referred to a text-book of Medicine.

Each embryo-worm possesses three pairs of hooklets, and is enclosed in a chitinous shell. It is called an *oncosphere*. The disease in man begins with the ingestion of such oncospheres as have been discharged from the bowel of the dog and have found their way into drinking water or on to vegetables, or which, after becoming desiccated, have been inspired in dust by the host (air-borne). In the stomach the chitinous shells are softened and the spicated embryo liberated. The hooklets bore a track for the embryo through the alimentary walls. In 60 *per cent.* of cases (Thomas) it finds its way to the liver probably by the portal system, and in 12 *per cent.* the embryo-worm reaches the lungs. Taylor Young points out that as the embryos are only

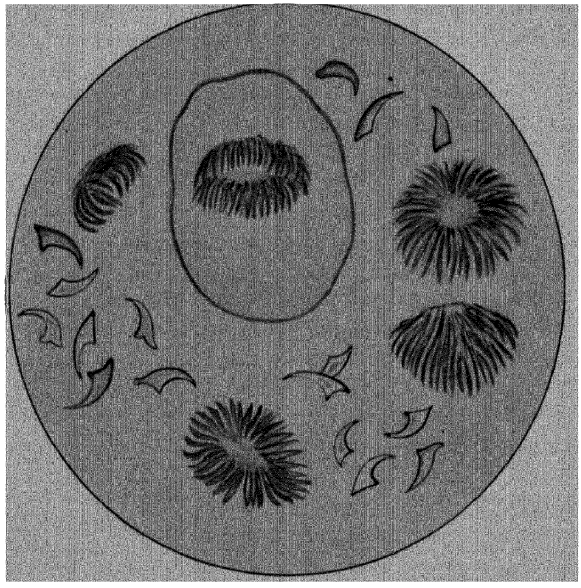


FIG. 166. SCOLICES OF TÆNIA ECHINOCOCCUS (Taylor Young and Welsh).

thrice the size of a red blood-disc and are actively motile, it is possible for them completely to penetrate through the walls of stomach or bowel and migrate into the peritoneal sac and along connective-tissue planes, and he concludes either that it has a selective affinity for certain tissues, or else that some tissues enjoy a greater immunity than others from echinococcal invasion.

A *hydatid cyst* is a monocyst derived from one embryo ; it is surrounded by a *pericyst* or adventitious capsule provided by the host and produced by inflammatory reaction. The parasitic part of the cyst is composed of two layers, *ectocyst* and *endocyst*. It contains an abundance of watery fluid. In size it varies from less than an inch to more than a foot. The ectocyst is the cuticular outer layer ; it is translucent, like hard-boiled white of egg, and shows a fine lamination which is so characteristic that a small fragment is enough for identification. The endocyst or germinal layer represents the vital tissue of the parasite ; from it a multitude of heads or *scolices*, bearing

hooklets (*see* Fig. 166), may develop from numerous small projections known as *brood-capsules*. When the parasite is healthy the cyst-walls are tense and the fluid contents clear. When the parasite dies the cyst-walls collapse and leucocytes may enter in abundance, producing what is called a *suppurating hydatid*, although no bacteria are present. A hydatid cyst may dry up, degenerate, necrose, or calcify.

Secondary, or daughter cysts arise by endogenous or exogenous formation, but there is no further advance in the life-cycle of the worm within the intermediate host.

Endemic Areas. The parasite is endemic to Australasia, the Argentine, Iceland, and to portions of the European Continent. In Iceland women are more often affected than men and, according to Taylor Young, this proportion is reversed in Australia. The incidence in man is dependent solely on the opportunity of infection.

Interaction between the Parasite and its Host. There is evidence of the

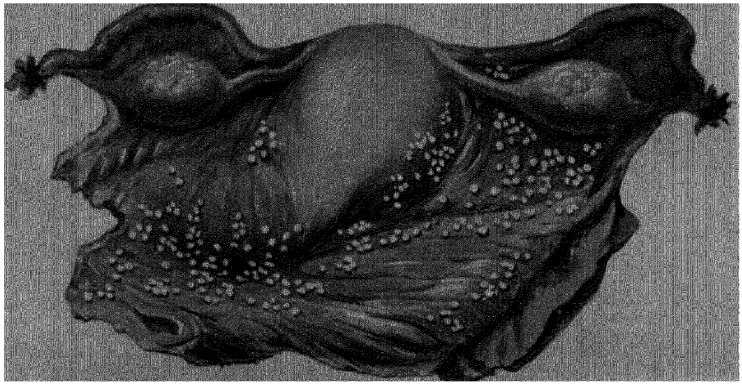


FIG. 167. SECONDARY IMPLANTATION OF SCOLICES ON THE PERITONEUM FOLLOWING RUPTURE OF A HYDATID CYST (Taylor Young and Welsh).

passage outwards from the encysted parasite of substances which stimulate a series of reactions on the part of the host, including (1) *immunity reactions* and the appearance of anti-bodies in the blood; (2) *leucoblastic reactions* of a selective type; (3) *toxic reactions*. All these reactions reach their maximum when the cyst is ruptured. The *immunity* (precipitin) reaction provides a scientific test for the diagnosis of hydatid disease within certain limits (Fleig and Lisbonne). The *leucoblastic* reaction is shown by a selective increase of eosinophil-leucocytes in the blood. The *toxic* reactions are insignificant except after rupture of the cyst, when they may include (*a*) such symptoms as syncope or urticaria; (*b*) local inflammatory processes from direct contact with hydatid-fluid (peritonitis); (*c*) chronic toxic effects, *e.g.* wasting and anæmia. Hydatid cysts are therefore not inert foreign bodies, but must be regarded as living structures which are capable of causing a continuous reaction within the tissues of the host.

Topical Distribution of the Pelvis. *Secondary implantation* of scolices (heads) on the peritoneum of the pelvis is a frequent occurrence after rupture into the peritoneal cavity (*see* Fig. 167) of a primary cyst situated higher up.

Primary pelvic hydatids generally take origin in the connective tissues immediately beneath the peritoneum of the pouch of Douglas, whence they spread and come into connection with the uterus, ovaries, Fallopian tubes, bladder, and rectum. The parenchyma of the pelvic viscera is only very rarely the seat of primary development of the echinococcus. Nearly all cases described as growing from the ovary or from the Fallopian tube are really invasions of the loose connective tissue of the broad ligament (Taylor Young and Welsh). Subserous invasions of the hollow pelvic viscera may ultimately lead to perforation into the lumina of these structures, and the latter may then become filled with daughter-cysts (lumen of tubes, cavity of uterus).

Primary hydatids of the *uterus* (*see* Fig. 168) have been observed by

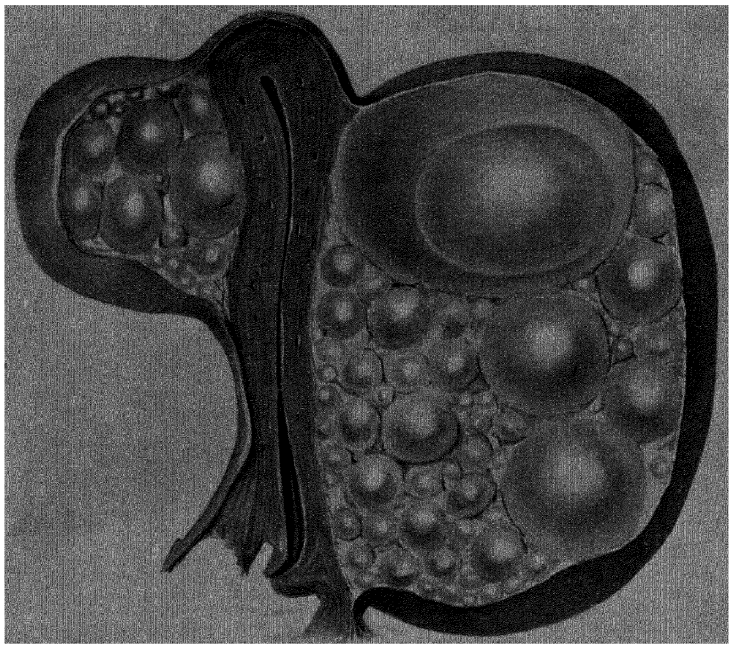


FIG. 168. ECHINOCOCCAL CYST IN UTERINE MUSCLE (Taylor Young and Welsh).

Giles and Moloney ; of the *Fallopian tubes* by Doléris and Eden (*see* Fig. 169) ; of the *ovary* by Péan, Taylor Young and Welsh. Hydatids have also been found primarily to invade the pelvic bones, and when situated in extraperitoneal situations they have been known to obstruct labour.

Diagnosis. A positive result with the specific immunity-reactions, properly controlled, or the microscopical discovery of hooklets, makes the diagnosis of echinococcal invasion certain. A well-developed cosinophilia is strong presumptive evidence of hydatid invasion in cases where the physical signs are confirmatory but indecisive (Taylor Young and Welsh).

The characters which hydatid cysts of the pelvis present on examination are very variable. A large thin-walled cyst may be indistinguishable from any of the commoner cysts which arise in the pelvis. A thick-walled hydatid cyst may simulate a single myoma or a teratoma, and multiple cysts may

give the impression of multiple subserous myomata (*see* Fig. 168). The site of invasion is difficult to locate clinically, the part of the pelvis in which the mass lies being often the only point which can be determined with certainty. The presence of a mass in the liver, or the history of a previous operation for hydatids of the liver, would afford presumptive evidence of a pelvic swelling being echinococcal in origin. After rupture of the cyst there will be a history of sudden disappearance of the swelling, with possibly symptoms

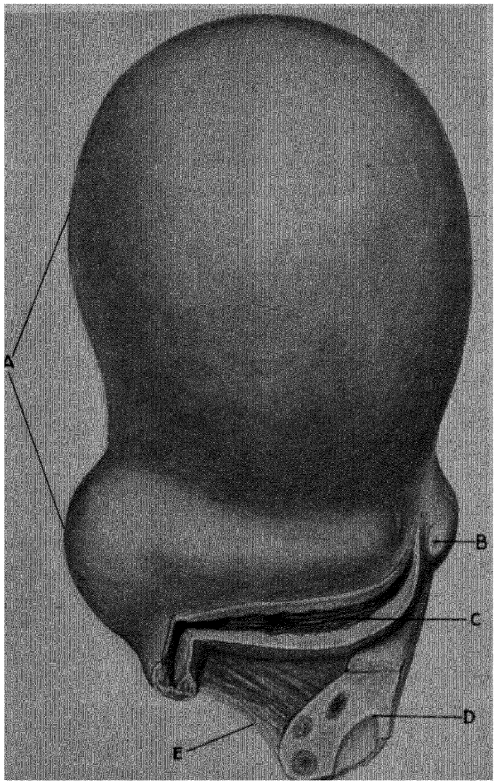


FIG. 169. HYDATID (ECHINOCOCCAL) CYST OF THE FALLOPIAN TUBE. *a*, Cyst. *b*, Closed abdominal ostium. *c*, Lumen of tube laid open. *d*, Ovary. *e*, Mesosalpinx. The cyst has formed in the subperitoneal cellular tissue of the upper wall of the tube.

of serous peritonitis, marked eosinophilia, and transient urticaria (Barling and Welsh).

Treatment. As the pelvic condition is often not the only manifestation of hydatid disease, the surgeon must be prepared to deal with abdominal lesions as well; *e.g.* in the experience of one of us (C. L.) the cysts had burrowed behind the diaphragm and extended as high as the left axilla, whilst below it depressed the pelvic floor and bulged into the vagina.

The treatment of hydatids consists in the removal of the cyst or cysts. The removal should be *complete* whenever possible. In a certain number of cases only *partial* removal can be carried out, the adventitious pericyst having to be left behind.

(1) *Complete Removal of the Cyst.* Hydatids of the uterus, ovaries, tubes, and broad ligaments are best treated by this method. Simple cysts should be aspirated before incising the pericyst.

(2) *Partial Removal of the Cyst.* This consists in opening the pericyst and scraping away the entire endo- and ecto-cyst in order to destroy the parasite. The operation is concluded in one of two ways: (*a*) By stitching the cut edges of the pericyst to the parietes and inserting a drain (*marsupialization*) or (*b*) by inverting the cut edges of the pericyst and uniting them by sutures, thus closing the cavity.

Sometimes the pericyst may be calcified, or too thick and tough to collapse when empty; it then becomes necessary to drain. In pelvic cases drainage should be carried out *per vaginam*.

In operating for the removal of hydatids the risk of operative implantation must be borne in mind. The edges of the wound should be protected by rubber-sheeting, and the various intra-abdominal structures guarded by gauze-pads.

STREPTOTHRIX INFECTIONS, INCLUDING ACTINOMYCOSIS

The generic term streptothrix embraces certain *higher* forms of bacteria which are pathogenic in man and other mammals. In certain cases the organisms have a radial grouping which is characteristic in the ray-fungus or *actinomyces*. The lesions produced by streptothrices, in common with those of tubercle, leprosy, and syphilis, belong to the *chronic infective granulomata*.

This group of lesions is characterized by nodules of granulation-tissue around foci invaded by the organisms. The endotoxins of the latter modify the inflammatory reaction in such a way as to produce peculiar cell-formation in the granulations. This gives rise to the development of endothelioid and giant-cells. The latter, which are abundant in tubercle, are, however, less numerous and less definite in streptothrix-infections. The granulomata produced by streptothrices invariably lead to chronic local suppuration.

The Organisms. The streptothriceæ differ from the *lower* forms of bacteria in consisting of a filament which shows true branching and the development of gonidia or spores. The latter arise from specialized hyphæ; thus, both in the tissues and in cultures, the parasite appears as an interlacing network of branching filaments which soon form a densely matted compact mycelium (*see* Fig. 170). The following changes occur in the latter: (*a*) The formation of swellings at the ends of the filaments; (*b*) necrotic changes in the centre of the mycelial mass; (*c*) fragmentation of the mycelial threads.

Of the terminal swellings two distinct forms appear: (1) small bulbous expansions of the filaments themselves; (2) larger hyaline swellings of the investing sheaths forming the so-called *clubs*. The latter assume a radial arrangement, and from this fact the name *ray-fungus* or *actinomyces* is derived. *Clubs* are best seen in bovine lesions, in human infections they are very fragile and therefore hard to demonstrate. They occur in a late stage of the growth when the colonies in the tissues are extensive and have begun to show central necrosis.

To demonstrate a streptothrix-infection, the tissues must be stained by Gram's method, the filaments of mycelium and the spores are gram-positive (Fig. 170), the hyaline clubs and necrotic areas are gram-negative.

Distribution. Some American and Norwegian authorities regard the

streptothriceæ as essentially pathogenic parasites, which cannot continue to subsist outside the animal body. There is, however, evidence to show that the pathogenic streptothriceæ are capable of a non-pathogenic (saprophytic) existence, *e.g.* that they may be found on straw, grain, and grass, and that they gain access to the body through abrasions made by infected material. A common point of entrance is the mouth and pharynx, but infection may also occur through the alimentary and respiratory tracts, and through the skin. The occurrence of actinomycosis of the tubes and ovaries in a woman who had worn a " womb-protector " of the wishing-bone type has suggested the possibility that the vagina may have been the channel of entrance.[1]

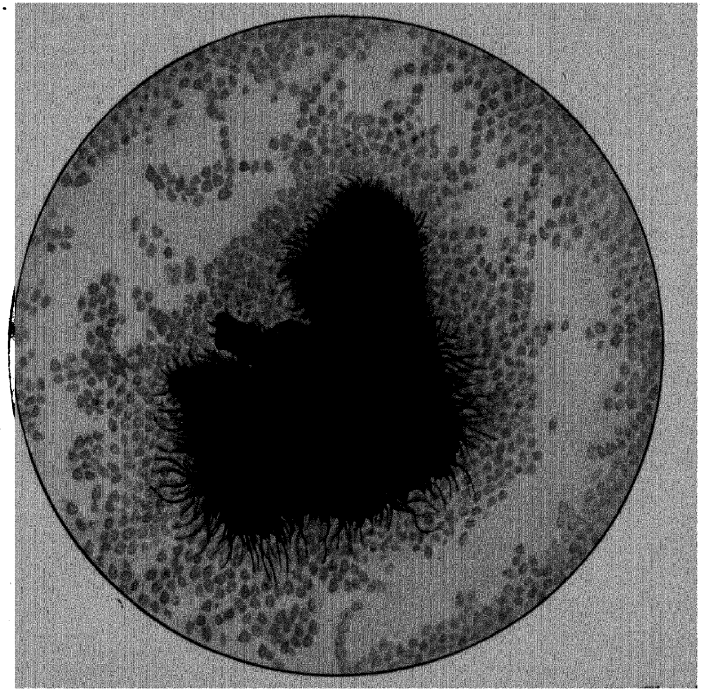


FIG. 170. ACTINOMYCOSIS OF HUMAN OVARY (F. Taylor and Fisher). Showing a densely matted compact mycelium. × 450.

The above drawing was made from a section supplied by Dr. Frank Taylor. It was prepared from a case of primary actinomycosis of the right ovary in a woman æt. 34 years. There was no other lesion. Recovery followed the removal of the appendages.[2]

Morbid Anatomy. The lesion is characterized by its progressive extension. By direct local spread, large areas of tissue may become infected, and there may also be secondary dissemination to distant parts. Each colony becomes the centre of an infective focus, and each focus ultimately forms a small abscess surrounded by indurated and œdematous tissue (*see* Fig. 171). In this way an infected organ may be riddled with multiple foci of suppuration, or may become the seat of an enormous abscess. The pus is character-

[1] " Actinomycosis of Tubes and Ovaries." Draper and Studdiford. *Amer. Jl. Obst. Gynaec.*, vol. xi, No. 5, May, 1926.

[2] Taylor and Fisher, *Lancet*, 1909, vol. i, p. 758; and *Brit. Med. Journ.*, 1909, vol. i, p. 844.

istic, in that it contains whitish or sulphur-yellow granules, visible to the naked eye ; these represent the actual parasitic colonies.

Clinical Features. General intoxication may be severe, causing fever, sweating, and wasting, but this is not usually the case until late in the disease, and even with extensive chronic infections there may be but little constitutional disturbance. It may be said that the general intoxication is similar to, but less severe than, that due to tuberculosis. In abdomino-pelvic lesions three stages have been pointed out by Grill : (1) A stage of invasion



FIG. 171. ACTINOMYCOSIS OF THE EXTERNAL GENITALIA, Chenhall's Case I. (Taylor Young and Welsh).

with vague symptoms suggesting appendicitis ; (2) a stage of tumour-formation in the viscera or in the abdominal walls, usually in the ileo-cæcal region, and seldom painful ; (3) a stage of suppuration with the formation of deep sinuses and intractable fistulæ.

Pelvic Infection. Pelvic infection is rare ; it most often occurs *viâ* the appendix, but it may happen through the blood-stream, the organism entering the system through the tonsil.

Actinomycosis of one or both ovaries has several times been recorded (Fig. 170). The organs were reduced to fibrous tissue enclosing small abscesses, or were found to be nothing more than a thin abscess-sac.

Actinomycosis of the Fallopian tube has been found to be generally on the right side, suggesting infection from the appendix.

Treatment. Free removal of infected tissues and swabbing the raw surfaces with tincture of iodine is recommended. Large doses of potassium iodide (90 grains thrice daily) should be given for a few days and then withdrawn for a week, then given again for a few days and afterwards repeated once a month (Taylor Young). This authority also favours the administration of nascent iodine by giving 30 grains of potassium iodide every morning, to be followed after four hours by 1 oz. of chlorine-water, repeated at intervals of two hours until 3 ozs. have been taken. This, he says, should be continued for many months. Taylor Young also speaks highly of the value of autogenous vaccination.

PART II

REGIONAL GYNÆCOLOGY

PART II: SECTION I

DISEASES OF THE VULVA[1] AND URETHRA

ACUTE INFLAMMATORY CONDITIONS

Compared with the frequency of inflammatory processes in the upper part of the genital tract, acute and chronic inflammations of the vulva are met with relatively seldom. Inflammation of the vulva is nearly always associated with that of the vagina and of the endometrium. In many of these cases it is produced by infected secretions escaping from above, which, by causing the vulval epithelium to become sodden, allows of its penetration by septic or other infective germs. Thus necrotic uterine tumours may produce successively septic endometritis, colpitis, and vulvitis. Urinary fistulæ are a source of septic discharges, which exert a very excoriating effect upon the vulva. Suppurative urethritis acts in the same way.

Diabetes may be a cause of vulvitis. The sugar-containing urine may be infected with the fungi of thrush (oidium), or the Monilia Persoon, or the Vibriothrix (Castellani)[2] and several other varieties, any of which may cause vulvitis. Fæcal fistulæ, a complete perineal tear, and hæmorrhoids, may also be indirect causes of acute vulvitis.

As the vulval skin is provided with a thick protective epithelium, it is necessary for the surface-continuity to be destroyed before acute vulvitis can supervene. Irritating discharges will do this, as just stated, but there may be evidence of trauma, *e.g.* masturbation or rape. In the case of children, acute vulvitis is more readily caused by gonorrhœa, since the epithelium, being thin and delicate, is less impervious to organisms than that of adults.

Gonorrhœal Vulvitis. The gonococcus is the most frequent cause of *acute vulvitis*, accounting for more than 75 *per cent.* of cases (Jaschke). It is more frequent in young subjects for the reason given above.

Clinically, acute gonorrhœal vulvitis is associated with urethritis and inflammation of the para-urethral glands and not infrequently with Bartholinitis as well. The secretion in the acute stage is copious, purulent, and of a yellowish-green colour. From the irritating effect of the pus, 'warts' (*condylomata acuminata*) are formed on the external genitals (*see* Figs. 151 and 153 on p. 262). In acute cases it is generally easy to find the gonococcus in films prepared from the pus.

Acute vulvitis is seen in its most extreme form in the vulvo-vaginitis of children. The labia, both small and large, are intensely red, swollen (*see* Fig. 172), œdematous, and sore, and may become adherent. A false membrane may form on the labia minora In acute vulvitis the vagina, urethra, and Bartholin's glands may be simultaneously infected; it causes swelling

[1] For structural abnormalities, both developmental and acquired, *see* pages 75 and 140.

[2] Castellani and Taylor, "Vaginal Monilias," *Jl Obst. and Gyn. Brit. Emp.*, Vol. 31, No. 1, 1925.

of the inguinal glands and is accompanied with malaise and pyrexia. In cases of assault, gross traumatic lesions may be present, but in young children vulvitis may occur in the absence of a definite lesion, the gonococcus being conveyed to the genitals on a towel or by the fingers. At times gonorrhœal infection appears in epidemic form. An instance of this is cited by Skutsch, in which 236 girls were infected in a public bath.[1] The bacillus coli and parasites (ascaris and oxyuris) may also set up vulvo-vaginitis.

Treatment. In the early stages vaginal douches should not be employed, but the patient should be made to sit in a bath two or three times a day for

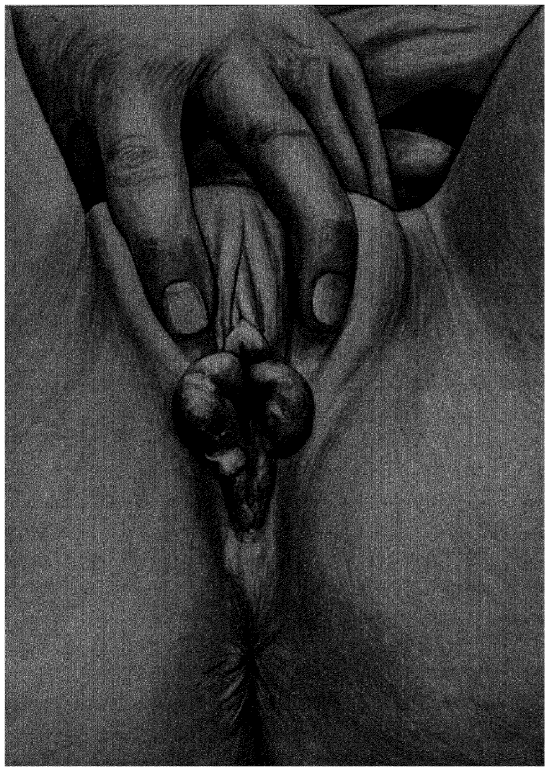


FIG. 172. VULVO-VAGINITIS IN A GIRL OF 14, showing inflammatory œdema of the nymphæ.

half an hour, and during the intervals boric lint, wrung out in hot sterile water, should be applied between the labia and over the vulva. When the acute attack has subsided, the vulva and vagina should be irrigated with hypertonic saline solution followed by the application of 10 *per cent.* solution of collosol silver iodide on a probe. Sixty-four children under ten years of age died of gonorrhœal infection in America in 1914, and most of these were infected *per vaginam.*[2]

[1] Stein, "A Clinical Investigation of Vulvo-vaginitis," *Surgery, Gyn. and Obstet.*, 1923, vol. xxxvi; also "Gonorrhœa," *Am. Jl. Obst. Gyn.*, x, 1925.

[2] La Fétra, "Vulvo-vaginitis in Children," *Trans. Amer. Peiiatric Soc.*, 28th Session, Washington, 1916; see also B. K. Rachford in same *Transactions.*

Syphilitic vulvitis is a rare accompaniment of specific ulcers and condylomata (*see* Syphilis, p. 284).

Ulcus molle is very frequently a cause of acute vulvitis. The labia are swollen and bathed in a copious secretion, and the glands in the groin soon become acutely inflamed and painful.

Rarer Forms of Vulvitis. Under this heading may be classed vulvitis seen in acute miliary tuberculosis (*see* Infections, p. 273), gangrenous vulvitis, membranous vulvitis, erysipelatous vulvitis, and thrush.

Gangrenous Vulvitis. This is a very rare disease, but it may occur from infection of a vulval wound during the course of puerperal fever. It may also supervene in erysipelas, diphtheria, venereal infection, smallpox, and typhus. There is intense local pain, accompanied by general profound toxæmia.

Noma is a form of gangrenous vulvitis which occurs in rare instances during, or after, an attack of measles or one of the specific diseases in childhood. The disease is generally unilateral. The labium of one side swells, a dark spot appears over an area of induration, followed by the formation of vesicles, bullæ, ulceration, and gangrene.

The *local treatment* consists in free removal of the gangrenous area and in painting the parts with sulphurous acid. This should be followed by hot antiseptic fomentations changed every four hours. The *general treatment* consists in the use of autogenous vaccines and in maintaining the patient's strength.

Membranous Vulvitis. This is generally due to an infection by the Klebs-Loffler bacillus; it may also be caused by streptococcal infection. The labia are inflamed and swollen, patches of greyish-green membrane appear here and there, and may ultimately cover the whole or a large part of the vulva. The true diphtheritic membrane is thrown off in small pieces, but in streptococcal vulvitis large yellow sloughs are separated. Unless the condition passes into that of gangrenous vulvitis the membrane is formed only of the superficial layers of the integument, whilst in the latter the fibro-fatty tissues are deeply implicated. Membranous vulvitis may lead to superficial atresia of the vulva (p. 141).

Treatment. The organism must be isolated, and in the case of infection by the Klebs-Löffler bacillus, antidiphtheritic serum must be injected. Locally, the parts should be treated with strong solutions of phenol or biniodide of mercury.

Erysipelatous vulvitis occurs as a rare but deadly affection. It takes the form of a spreading phlegmon in the cellulo-cutaneous tissues and leads to diffuse suppurative cellulitis or to the formation of an extensive abscess. The treatment consists in maintaining the patient's strength with stimulants, and in the administration of iron tonics. The spreading edge of the infected area should be painted with a solution of nitrate of silver or picric acid.

Aphthous vulvitis is sometimes seen in badly nourished children, and in adults during pregnancy, and towards the end of a long and fatal illness. Small white adherent patches, surrounded by a zone of redness, and accompanied by a certain amount of œdema of the vulva, are the signs by which it is recognized. The white patches sometimes consist of a surface-growth of the mycelium of *oïdium albicans*. According to Castellani and Frank Taylor[1] many other fungi play the same *rôle*, notably those belonging to the genus monilia.

[1] *Journ. Obst. and Gyn. Brit. Emp.*, 1925, xxxi.

Treatment. The local condition responds to mild antiseptic measures, such as the application of lint soaked in perchloride of mercury solution (1–3000). Attention to the general health is important.

Skin Diseases in the Vulval Region. *Intertrigo* is the most common skin-lesion in this region. It is seen in fat and dirty subjects as a superficial redness of the labium majus and of the *sulcus genito-femoralis*. It is commonest during the hot season, and causes itching and soreness. Intertrigo indicates the taking of a daily bath, and the parts should be bathed with ½ *per cent.* spirituous resorcin-lotion, then dusted with equal parts of oxide of zinc and boric acid.

Furunculosis occurs on the labia majora from infection of hair follicles, scratches, and acne-spots. It is sometimes an indication of ill-health. Small pustules should be painted with 2 *per cent.* spirituous solution of iodine; boils should be opened and treated with an antiseptic dressing.

Rarer skin-affections are herpes, psoriasis, and molluscum contagiosum.

Herpetic Vulvitis. Groups of vesicles appear on one or other labium majus; they may coalesce to form bullæ. Eventually they become pustular, then rupture and dry up. Before vesicles form, the labium is very painful; in the eruptive stage there is intense itching and irritation. An ointment composed of bismuth carbonate (1 dr.) and lanoline (1 oz.) spread on lint should be applied to the affected parts.

CHRONIC INFLAMMATORY CONDITIONS

Chronic inflammation of the vulva is found as a sequel to the acute processes already described, more especially in gonorrhœa, in which constant vulval irritation may result from infective discharge from the cervix. Under the above heading are included certain well-marked clinical conditions, viz. eczema, leucoplakia, and kraurosis, also esthiomène and the specific ulcers. As chronic vulvitis is invariably accompanied by irritation in a more or less severe degree, we shall first consider this symptom.

Pruritus Vulvæ. Irritation (itching and burning) at the vulva is, of course, a symptom, not a disease; further, it may be occasioned by a variety of morbid conditions, and may be accompanied by other symptoms besides the above. It is classed as a distinct disease by Sanger under the name of *vulvitis pruriginosa*, and Veit described a definite pathological condition, *parakeratosis*, as characteristic of pruritus vulvæ. In parakeratosis, processes of keratinized epithelium dip down into the corium, where they are surrounded by a zone of leucocytic infiltration (*see* Fig. 173). This form of dermatitis is probably not a precursor of pruritus, but is to be regarded as the result of rubbing and scratching.

Sometimes in cases of intense itching no local morbid condition can be discovered. In most instances the irritation leads to friction and scratching of the affected parts, resulting in changes in the local appearances which may obscure the original affection. The areas most frequently involved correspond to the clitoris and nymphæ; in severe cases the greater labia, the whole of the ostium vaginæ, the perineal body, the anus, and the post-anal region all may be affected. It may be met with in children, adults, or old women. In cases of slight severity, the irritation is felt chiefly or solely at night after retiring to bed; all gradations of severity may, however, occur, and in the severest cases there is constant and intolerable itching both day and night, the patient becoming haggard and emaciated from loss

of sleep and ceaseless annoyance. Such cases have been known to terminate in insanity or suicide.

Causes. A great variety of morbid conditions may give rise to pruritus, but they may all be classified in three groups: (1) Chronic discharges which irritate the vulval mucous membrane. (2) Diseases primarily affecting the vulva. (3) Toxic conditions and neuroses.

(1) Discharges coming from the uterus or the vaginal walls do not, as a rule, occasion pruritus, but chronic gonorrhœal discharges, and the septic discharges set up by a neglected pessary, frequently do so; the constant slight dribble of urine from a small vesico-vaginal fistula may set up intolerable pruritus, and much the same result may follow from incontinence of the bladder-sphincter. In adults of unclean habits pediculi or accumulations of

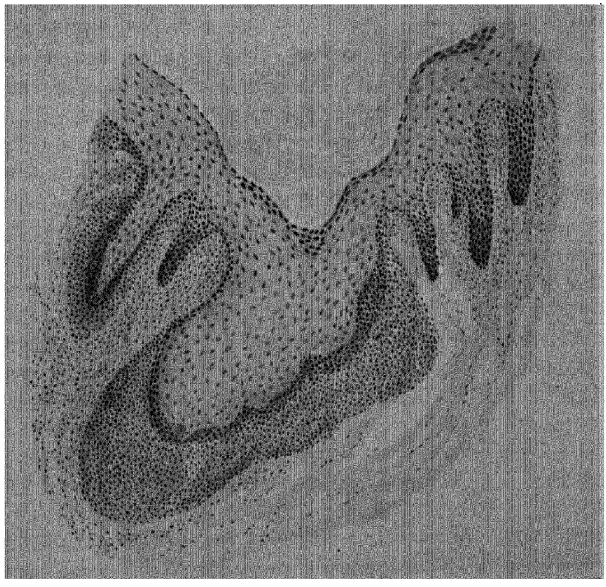


FIG. 173. PARAKERATOSIS OF THE VULVA.
From a case of pruritus.

dirt, and in children threadworms which migrate to the vulva from the anal canal, produce much the same results as vaginal discharges. Masturbation, as an occasional cause of pruritus, also belongs to this class.

(2) Chronic forms of ulceration, *e.g.* those due to tubercle or secondary syphilis, cause itching, but these conditions are rare. There are two skin diseases, which, however, are fairly common and usually set up this disorder in a severe form, viz. *eczema* and *leucoplakia;* whilst an uncommon local disease, known as *kraurosis*, also causes pruritus. The last three conditions will be described (*see* pp. 307 and 309) after the treatment of pruritus in general has been considered.

(3) *Toxic Conditions and Neuroses.* Cases in which pruritus vulvæ is not accompanied by recognizable alterations in the appearance of the affected parts, except those due to scratching, are usually attributable to a neurosis. The subjects of this form of pruritus are usually women of neurotic

or hysterical temperament. A common exception is the pruritus of pregnancy, which in its usual form is only a mild affection, but sometimes becomes intolerably severe, expanding into general irritation of the skin of the whole body. This affection is now more properly regarded as due to a form of gravidic toxæmia, although the nature of the toxæmia is unknown. Pruritus vulvæ may also be an accompaniment of glycosuria and diabetes, but whether this is due to the irritant qualities of sugar-laden urine, or to nerve-lesions produced by toxæmia resulting from the disease, is unsettled. In every case of pruritus the urine should be examined for sugar.

Treatment of Pruritus. The possibility of an exciting cause, such as glycosuria or leucorrhœa, being present, must first be considered; if such conditions as these are overlooked, treatment will necessarily be unsuccessful. The next point to consider is the nature of the local changes in the skin, if such are present; when none are found it is always very difficult to relieve the irritation locally, but these cases may derive help from the internal administration of calcium lactate and alkaline sedatives. Cases of chronic eczema, and early cases of leucoplakia, can, as a rule, be greatly relieved, and in many cases entirely cured, by appropriate local treatment.

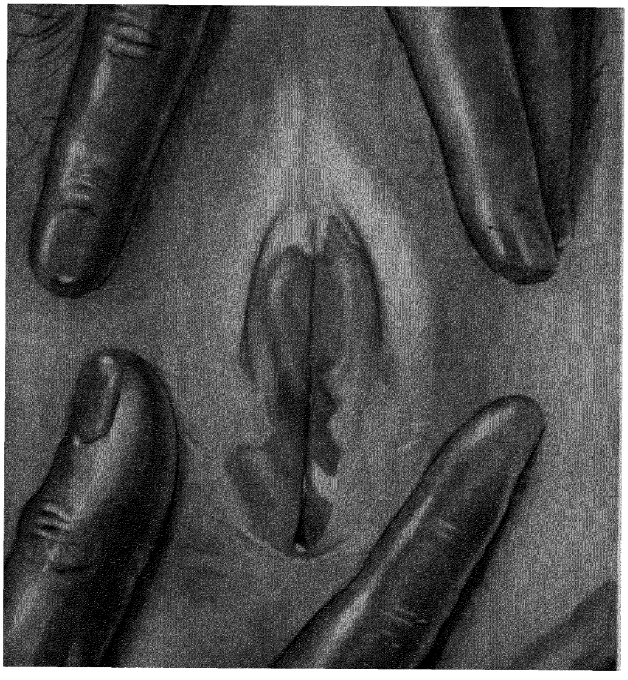
In regard to *local treatment* two preliminary points are of great importance, viz. that strict local cleanliness should be observed, and that scratching and rubbing should be avoided as far as possible. In a severe case, the patient often scratches herself unconsciously when asleep, and at other times the irritation is so intense that the impulse to rub or scratch is almost irresistible. A hot alkaline hip-bath (p. 307), taken before retiring to bed, often brings temporary relief, and as a means of local cleansing is a useful preliminary to the application of local remedies.

Of the numerous local remedies which have been made use of none can be recommended with confidence, for what succeeds in one case may fail in the next. In mild or early cases, or when no local changes are found, sedatives such as a 5 *per cent.* thymol or menthol ointment or lotion, or 1 *per cent.* chloretone lotion, may succeed; or, failing these, a 5 *per cent.* to 10 *per cent.* cocaine ointment. Hot compresses wrung out of lead and opium lotion, or sprinkled with *linimentum belladonnae,* may also prove useful. In other cases strong antiseptic solutions are more successful, such as 1 1000 *biniodide* of mercury, which penetrates skin more readily than the perchloride; or 5 *per cent.* carbolic lotion freely applied exerts both an antiseptic and a local anæsthetic action. When the local changes are advanced, caustics strong enough to cause a certain amount of desquamation are often useful, such as pure liquefied carbolic acid painted freely over the affected parts under anæsthesia; a milder remedy of this class is a solution of nitrate of silver of 40 grains to the oz., the application of which causes very little pain. In some instances the prolonged and careful use of a dilute mercurial ointment, one half of the official strength, or the *unguentum metallorum* [1] of hospital pharmacopœias, may be found of great service. Intractable cases may sometimes be relieved by the use of X-rays.

The treatment of cases in which there are well-marked local changes, and which cannot be relieved by the above measures, will be described when dealing with the respective causal conditions.

Eczema vulvæ begins as a papular eruption, usually upon the inner

[1] Ung. Metallorum = Ung. Plumbi Acet.: Ung. Hydrarg. Nit dil: Ung. Zinci āā partes æquales.



LEUCOPLAKIA: SECOND STAGE: ASSOCIATED WITH SENILE VAGINITIS. The labia minora are shrunken from retraction of tissues. (See text.)

To face page 307.

surfaces of the greater labia, but may also be found upon the lesser labia, and upon the parts of the vulva covered with hair. The papules become vesicular and desquamate, leaving a moist surface, around which an area of redness is quickly formed. In acute cases this erythematous zone may spread widely to the perineum and the inner aspects of the thighs. In old-standing cases the affected areas become dry and scaly. The acute stages are attended with pain, the chronic stages with itching and burning (pruritus). Impelled by the necessity of obtaining relief from the itching, the affected parts are scratched and rubbed, giving rise to abrasions which in time may become infected. Thus the original morbid appearances may be hidden beneath the secondary lesions due to scratching.

Treatment. The cause of the eczema, *e.g.* vaginal discharge, should be sought for and treated by suitable means. During the acute stage rest in bed is necessary. The patient should be given a bath at a temperature of 95° F., to which is added bicarbonate of soda and potash, of each 1 oz. This allays the itching. Afterwards soothing applications are applied to the sore parts by a nurse. Lint soaked in Liq. plumbi subacetatis (1 dr.), Acidi salicytici (5 gr.), dissolved in 1 oz. of milk, is recommended. Or the lint may be smeared with an ointment containing 20 gr. of salicylic acid and 3 dr. of oxide of zinc or of bismuth, to 1 oz. of lanoline.

Leucoplakia Vulvæ. Berkeley and Bonney have defined this lesion as "a chronic inflammatory condition characterized in its early stages by marked hyperæmia and cellular activity, and in its later phases by marked epithelial hypertrophy, and a thickened, sclerosed and retracted condition of the subepithelial tissue."

In a well-marked case the whole of the vulva, *with the exception of the vestibule and orifice of the urethra*, may be implicated, and the disease may even spread laterally to the folds of the thighs, and over the perineum to encircle the anus (*see* Figs. 179, 180). The cause of the disease is unknown. The authors quoted above have been unable to obtain any evidence of syphilis, either clinically or histologically, in the series of twenty-four cases examined by them. They state that in a series of nineteen cases the average age was fifty-one years.

Signs. Leucoplakia of the vulva has been divided into four clinical stages. In the *first* stage the parts affected are reddened, swollen and excoriated; the surface is dry. In the *second* stage the labia decrease in size, from retraction of the tissues by subepithelial thickening. The surface has now changed in colour from red to opaque white (*see* Pl. XIV). This occurs in patches which fuse until the whole area becomes opaque—hence the term leucoplakia. In the *third* stage cracks and ulcers appear, yielding a scanty discharge and sometimes slight hæmorrhage on contact. At this stage malignant epithelial changes may occur in an ulcer or in a fissure (*see* Figs. 179 and 180, p. 317). If carcinomatous changes do not supervene, the leucoplakic condition passes into its *fourth* or final stage, in which the involved area becomes smooth, shiny, and white, the labia minora and clitoris practically disappear, and the disease becomes quiescent.

Pathology. The histological appearances are best described by considering the morbid changes in the early, intermediate, and late stages.

In the *early stage* there is thickening of the epithelium and round-celled infiltration of the subepithelial connective tissue. This stage corresponds to that shown in Figure 173 as *parakeratosis*. Reference to this Figure will show

that the horny layers are thickened by keratoid degeneration, whilst there is epithelial hyperplasia of the basal layer with the formation of deep processes of epithelial cells between the papillæ of the corium. It is around these deep epithelial processes that the round-celled infiltration is most pronounced.

In the *intermediate stage* the keratinized epithelium begins to desquamate, the round-celled infiltration gives place to an exudation of plasma-cells, and hyaline degeneration of the connective tissue in the superficial layers of the corium makes its appearance.

In the *late stage* the horny layer becomes thinned by desquamation, the

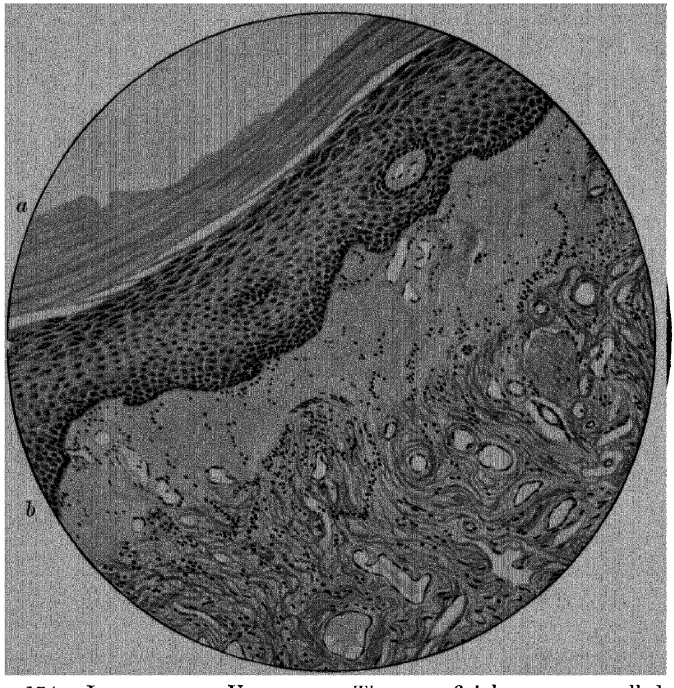
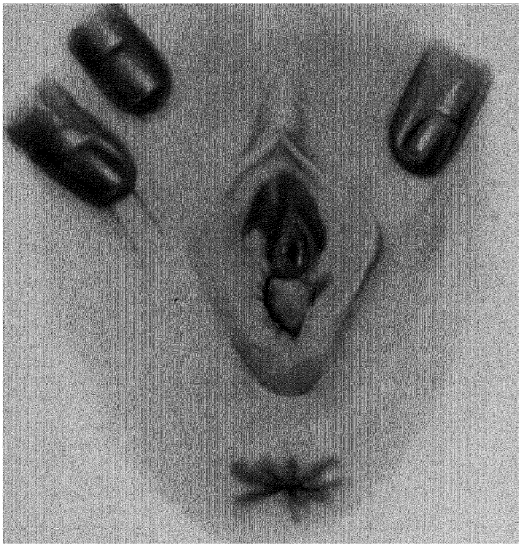


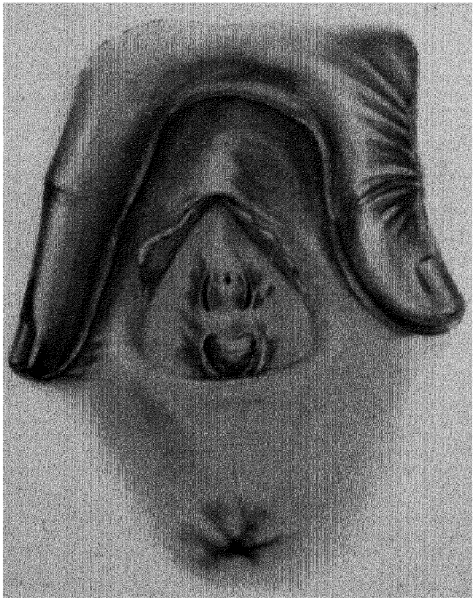
FIG. 174. LEUCOPLAKIA VULVÆ. *a*, The superficial squamous-celled layer shows excessive horny degeneration and desquamation; *b*, the connective tissue of the corium immediately beneath the epidermis shows a wide zone of hyaline degeneration, and appears practically structureless.

down-growing epithelial processes disappear, hyaline degeneration of the corium leads to the disappearance of elastic fibres and of healthy connective tissue; thus a wide zone of hyaline material may be seen immediately beneath the epithelium (*see* Fig. 174). It is in this stage—in which a desquamating epithelium lies upon a degenerated corium—that cracks and fissures occur and malignancy may supervene. The final condition in the *late stage* is that of fibrosis. Fresh fibrous tissue takes the place of the hyaline material, leaving the corium permanently thickened; by this time the surface-epithelium, devoid of downgrowths, is reduced to a thin, flat layer covering the sclerosed tissues.

Symptoms. Often the only symptom is pruritus, which is very severe in the first and second stages. The third stage is characterized by pain and



EARLY STAGE OF KRAUROSIS. The diseased area comprises the vestibule, which is of a deep red colour. The mucosa of the urethra is prolapsed.



A LATER STAGE OF KRAUROSIS. The red change is giving place to the yellow colouration referred to in the text.

To face page 309.

acute soreness due to exposure of nerve-endings in the floor of ulcers or fissures. In the fourth stage symptoms disappear.

Diagnosis. Leucoplakic vulvitis must be diagnosed from kraurosis. For the points of contrast between these two conditions the student is referred to page 310. Whether an ulcer or fissure associated with the third stage of leucoplakia is malignant or not must be settled by microscopic examination.

Prognosis. A certain percentage of cases pass into the fourth stage, in which the disease becomes quiescent; the remainder may develop carcinoma. The percentage of malignancy following leucoplakia has not been ascertained.

Treatment. In the first and second stages the treatment is that for pruritus (p. 306). Failing relief, or if the third stage be reached, the treatment is that of free excision (*see* Operations, p. 721).

Relationship of Leucoplakic Vulvitis to Carcinoma of the Vulva. We regard leucoplakia as a precancerous condition, *i.e.* as an antecedent and cause of carcinoma of the vulva. Histologically, it is found that the malignant change begins as an increasing hypertrophy of the interpapillary epithelial processes, whereby they penetrate more and more deeply into the connective tissue. This epithelial activity reaches its maximum in the second stage of leucoplakia. The next stage towards carcinoma is seen in branching of the enlarged interpapillary downgrowths. Bonney lays stress upon the relation between malignant epithelial growth and the altered state of the subepithelial connective tissues in leucoplakia. In the earliest stages of the disease, the subepithelial tissues take on "an accession of cellular energy which anticipates the occurrence of epithelial hypertrophy" (Bonney). In a later stage, *i.e.* that which is accompanied by *hyaline* change (*see* Fig. 174) and the disappearance of elastic tissue, active epithelial growth is favoured by absence of the latter. In the final stage of leucoplakia, which is characterized by dense sclerosis, the white fibrous elements probably check epithelial ingrowth, and hence the diminished tendency to malignancy in this stage of leucoplakia.

Kraurosis Vulvæ. In 1885 Breisky drew attention to a disease of the vulva, to which he gave the name kraurosis. Until that date the condition had escaped recognition, and since then it has been commonly confused with leucoplakia. Berkeley and Bonney describe kraurosis as "an atrophic condition of the vulva associated clinically with stenosis of the vaginal orifice, and pathologically with certain changes in the dermis."

Distribution. The labia minora, the vestibule, the orifice of the urethra, and that of the vagina are always, and the hood of the clitoris is sometimes, affected. The skin of the outer surface of the labia majora, the folds of the nates, the perineum, and the post-anal region are never affected.

Signs. There are two stages. In the *first* the mucocutaneous surface is red, glistening, and shiny, whilst here and there are tiny discrete patches of a bright red or purple colour (Pl. XV). A caruncular condition of the urethral orifice is often present. In the *second* stage the surface becomes pale yellow (Pl. XV), glistening, and smooth, all ridges having been obliterated. The vaginal orifice is contracted, making digital examination difficult, the labia minora and clitoris disappear, the mons Veneris atrophies, and the pubic hair becomes brittle, and breaks off or falls out.

Symptoms. The patient complains of soreness, pain, dysuria, and

dyspareunia; pruritus is not a marked symptom and may be absent; the chief trouble is dyspareunia. Thibierge states that "the functional symptoms of kraurosis vulvæ are of an exclusively mechanical order." In the first stage dysuria is very pronounced and coitus is painful, in the second stage, owing to contraction of the vaginal orifice, coitus is impossible.

Pathology. The epithelium is thinner than usual and the papillæ have mostly disappeared. The subepithelial tissues show patches of inflammatory cells. Under a red surface-area, aggregations of plasma-cells are seen immediately adjacent to the thinned and flattened epithelial layer, and mixed with the plasma-cells are seen polymorphonuclear leucocytes and lymphocytes. The former push their way outwards between the surface-epithelial cells. Elastic tissue is seen everywhere, excepting where accumulations of plasma-cells abound. Whilst the changes are in a large measure inflammatory, it would appear that a deficiency, or absence, of ovarian secretion plays a large part in the causation of the disease.

Diagnosis. As this condition is liable to be confused with leucoplakia, the distinctive differential points are summarized in the table given below.

Treatment. The palliative treatment mentioned under pruritus (*see* p. 306) should be tried. Red patches may be cauterized or excised, whilst for stenosis of the introitus vaginæ the plastic operation described on page 766 may be carried out.

Differential Diagnosis of Leucoplakia and Kraurosis

Leucoplakia.	*Kraurosis.*
(A) A chronic inflammatory condition, cause unknown: Average age about 50.	(A) An atrophic condition, with patches of dermatitis, found in young sterile subjects; at the menopause; and after double oophorectomy.
(B) Vestibule and orifice of urethra never affected, may spread over remainder of vulva, around the anus and on to genito-femoral sulcus.	(B) Located to labia minora, vestibule, orifices of urethra and vagina. Rest of vulva and adjacent areas (thighs and perineum) free.
(C) Three stages are to be distinguished	(C) Three stages to be made out.
(1) Parts red, *swollen*, excoriated, dry.	(1) Diseased area red, with small purplish-red patches seen on remains of hymen, on vestibule, and around urethra.
(2) Tissues *retracted and thickened.* Colour changes from red to semi-opaque white.	(2) Tissues retracted and *thinned.* Colour changes to that of yellow elastic cartilage, surface glistening and perfectly smooth.
(3) Cracks, ulcers, discharge, bleeding on contact. Carcinoma may appear in a crack or ulcer.	(3) Labia minora and clitoris disappear. Mons Veneris atrophies, pubic hairs disappear. Vaginal orifice contracts.
(D) A precancerous condition.	(D) No tendency to malignancy.

ULCERATION OF THE VULVA

All septic or infective processes occurring in the vulva may lead to ulceration; also every malignant new growth will ultimately lead to ulceration; and even growths of benign origin may, by becoming infected, cause ulceration of the external genitalia. Hence it follows that all or most of the lesions to be mentioned under the above heading will be more fully described elsewhere; thus tuberculous ulcers, chancre, *ulcus molle*, the tertiary syphilitic ulcer, rodent ulcer, squamous-celled carcinoma, ulceration due to leucoplakia and *esthiomène* will all appear under their respective headings.

Septic Ulcers. These may arise on the vulva during the course of puerperal fever. *Small* septic ulcers may appear in the fossa navicularis or on the hymen following laceration at the first coitus. They should be treated by an antiseptic douche and cocaine ointment (2 *per cent.*), and if they show signs of delay in healing, the cautery should be applied or the ulcer excised. *Larger* septic ulcers may occur on the labia as the result of infection of a severe wound inflicted by accident, or from a ruptured varicose vein, a hæmatoma, or a puerperal laceration. They require rest in bed and an antiseptic dressing.

Fissures. These occur chiefly in the vestibule and in the fossa navicularis; they are shallow linear ulcers, extremely sensitive and consequently causing great pain on coitus. They are readily curable by division of the base of the ulcer or one or two applications of solid silver nitrate, or liquefied carbolic acid, the vulva at the same time being kept scrupulously clean.

Follicular Ulcers These may follow on follicular vulvitis, and occur in the hair-bearing skin of the labia majora and sometimes in other parts; they are multiple and occur in crops. They may form part of a general furunculosis, or may occur independently in the vulva. A papule first forms, which becomes vesicular, then pustular, and lastly forms a small round ulcer which may be of considerable depth. Sometimes the pustules dry up, and the scab does not separate until the underlying surface has healed. Considerable induration may form round the affected spots, giving rise to pain and tenderness. Dry boracic dressings externally, and iron internally, will usually arrest their formation.

Tuberculous Ulcers. These are rare in the vulva and occur chiefly in children affected by advanced tuberculous disease of the genito-urinary tract. They are indolent in type and show the characters associated with tuberculous ulceration in other parts. Microscopic examination will establish the diagnosis. Local treatment is seldom curative owing to the presence of advanced tuberculous disease elsewhere. For further mention, *see* page 272.

Syphilis. For an account of the ulcerative lesion of this disease *see* page 285.

Esthiomène or Genito-Anal Scleroma. This is a chronic hypertrophic condition associated with secondary ulceration: it is described on page 312.

Leucoplakic Ulcers. These have already been mentioned (*see* p. 307).

Actinomycosis. Ulceration due to this rare vulval lesion has been referred to on page 296.

Rodent Ulcer, Carcinoma, and Sarcoma. Ulceration due to these conditions will be referred to under their respective headings.

HYPERTROPHIC AND HYPERPLASTIC CONDITIONS OF THE VULVA

Under this heading we include certain conditions which are usually *acquired*, and are produced by some form of chronic irritation. *Congenital* hypertrophy is rare, and when present it is confined to single parts of the pudenda, *e.g.* to the labia minora and to the clitoris.

(1) **Hypertrophy of the Clitoris.** This condition is generally congenital. It occurs, however, in a minor degree as the result of chronic irritation such as that due to chronic vulvitis ; it is usually unconnected with masturbation, although masturbation has been known to produce a certain amount of enlargement of the organ. Marked cases of hyperplasia are always congenital, and are sometimes associated with hypospadias (*see* p. 144).

Treatment. Congenital hypertrophy requires no treatment as a rule, but certain cases occur, with a patent vagina, in which the enlarged clitoris causes either obstruction or dyspareunia ; in such as these the organ may be removed wholly or in part. For minor enlargement due to irritation by infective processes or by masturbation, clitoridectomy should not be performed.

(2) **Hypertrophy of the Nymphæ.** The labia minora may be elongated to form long pendulous flaps. This condition may be congenital and associated with other malformations such as epispadias (*see* p. 145), or it may be produced by masturbation or, finally, by manipulation carried out with the intent to produce enlargement. The last cause is exemplified by the practices of the South African Hottentots and of some Circassian races, who, by certain methods practised on their female children, produce that enormous hypertrophy of the nymphæ described as the 'Hottentot apron.' Hypertrophic nymphæ may form an impediment in coitus, or may become irritated from the contact of clothes in walking. If, in a virgin, both clitoris and nymphæ are enlarged, so as to project visibly between the labia majora without separation of the thighs, masturbation in childhood may be suspected. The inference is stronger if the right nympha is specially elongated. Masturbation does not, however, necessarily produce any physical change whatever. If they appear to be a source of irritation, the hypertrophied nymphæ may be partially or wholly removed (*see* Fig. 549, p. 769).

(3) **Condylomata.** These structures, whether produced in the course of gonorrhœa or in the secondary stage of syphilis, must be regarded as examples of a local hypertrophy secondary to an inflammatory process. They have already been described (*see* pp. 260, 262).

(4) **Esthiomène.** The name of esthiomène (ἐσθειν, to eat away) was first applied by Huguier in 1849 to a form of chronic nodular hypertrophy, associated with secondary ulceration, which he had observed in the vulva ; he regarded it as probably tuberculous in origin. Some later writers regard it as *syphilitic* (Kurz),[1] others as a form of lupus, others as elephantiasis. It appears probable that under this designation have been grouped cases of varied kinds, some tuberculous, some syphilitic, others of chronic infective origin.

This disease finds its chief incidence in prostitutes of the lowest class, and is associated with uncleanliness, insobriety, and constant local irritation.

[1] Lena Kurz, Esthiomène or Lupus Vulvæ, *Journ. Obst. and Gyn., Brit. Emp.*, 1913, xxiii.

Morbid Anatomy and Histology. The two main features in this condition are ulceration and hypertrophy, both of which are present in varying degree in all cases. The whole vulva may be greatly deformed and altered in outline. The parts most frequently affected are the clitoris and labia minora. The latter project from the labial sulcus as sessile or pedunculated wattles, with an irregular surface divided up into convolutions by deep fissures. In the fissures ulceration takes place, and thus fistulæ may form.

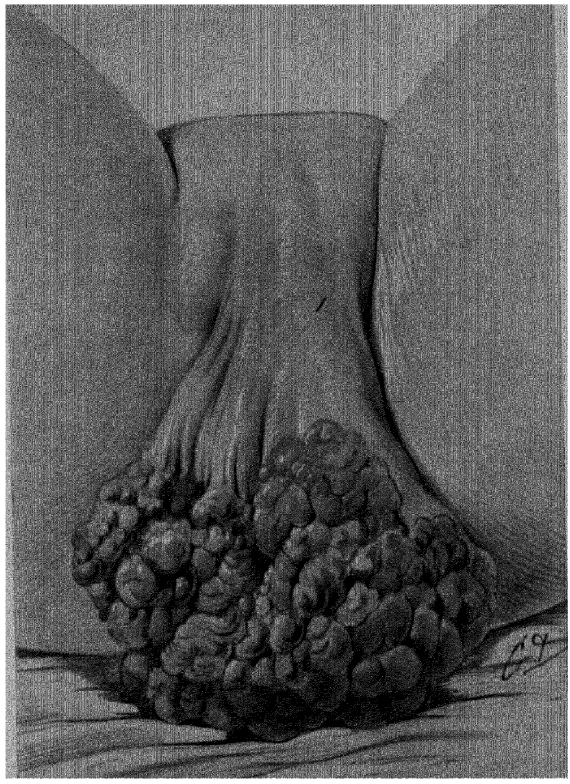


FIG. 175. ELEPHANTIASIS OF THE VULVA, WARTY VARIETY (Maclean). A large pediculated mass of warty growth overhangs the external genitalia, being attached to the anterior part of the vulva in the neighbourhood of the clitoris.

The skin is yellow or dead-white, dry and hard ; the hypertrophied tissues are firm, elastic to touch, and quite painless.

The extent of the ulceration, in a given case, seems to be inversely proportional to the amount of hypertrophy. In the most severe forms of the disease deep burrowing ulceration leads to destruction of tissue, followed by atresia of vagina, urethra, and rectum.

Histology. The chief features of the affected tissues are their density, the presence of patches of round-celled infiltration, vascular engorgement, thickened capillaries, endarteritis and mesarteritis of the larger vessels.

Prognosis. Early treatment results in recovery. Where the condition has existed for years, response to treatment is slight or *nil.* The tendency

is to fistulous formation, and death from exhaustion. Pelvic peritonitis, vomiting, diarrhœa, and pyrexia are the late symptoms of a case of esthiomène. In one of the six cases recorded by Kurz, malignancy (epithelioma) had supervened.

Treatment. In cases yielding a positive Wassermann reaction the treatment will consist in the injection of a salvarsan substitute (*see* p. 288), followed by the administration of mercury and iodide of potassium. Locally strict cleanliness is most important: frequent hip baths should be taken. *Lotio nigra* should be used freely, and ulcers painted with 5 *per cent.* solution of silver nitrate. The perineum should be kept dry and dusted with boric acid and calomel powder.

When there is no response to medical treatment the hypertrophic area

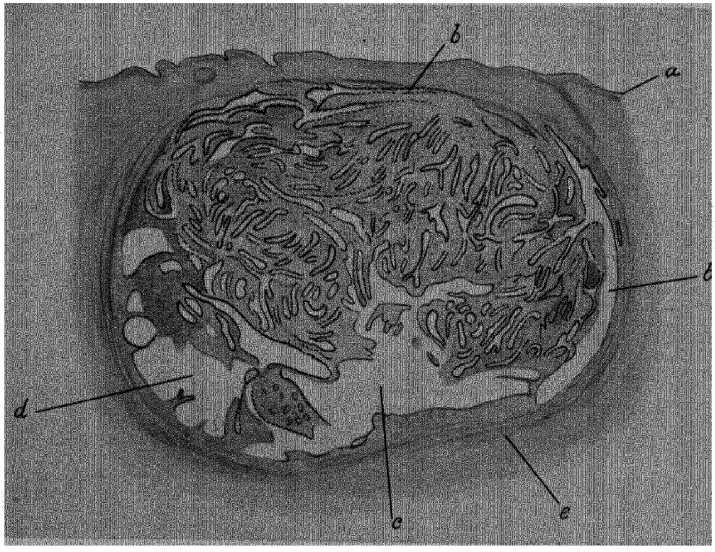


FIG. 176. ADENOMA OF THE UPPER THIRD OF THE RIGHT LABIUM MINUS (× 20 Schickele), which was situated close to the interlabial sulcus. (*a*) Surface-epithelium; (*b b*) gland-tubules; (*c*) space filled with round-celled exudation; (*d*) fatty tissue; (*e*) connective-tissue capsule of growth.

should be removed *en masse*, after which antisyphilitic treatment may be continued.

(5) **Elephantiasis.** Elephantiasis of the vulva is rare in this country, although comparatively common in women of the dark races. A fair number of cases have, however, been recorded, some being referred by the authors to syphilis, others being instances of true *elephantiasis arabum;* in some cases it is congenital (Ballantyne). An interesting example of true elephantiasis has been recorded by Maclean in which the disease affected the right buttock and lower limb as well as the vulva. The disease appears to begin in the labia minora, and pursues a very chronic course. In process of time large masses of nodular or warty growth, weighing several pounds, may be formed, which, becoming pediculated, hang down between the thighs, and show a pronounced tendency to superficial ulceration (Fig. 175). The warty

form (*E. verrucosa*) is commoner than the smooth form. The filaria may be non-existent in the blood even in cases of undoubted elephantiasis like that recorded by Maclean. Histologically, the growth consists of fibrous tissue containing many dilated lymphatic spaces, and often undergoing myxomatous degeneration. Drugs have no effect upon this disease, but as surgical removal of the hypertrophied masses is usually practicable in the vulva, the prognosis is more favourable than when the disease affects the lower limbs. Elephantiasis of the scrotum is relatively much more frequently observed than elephantiasis of the vulva.

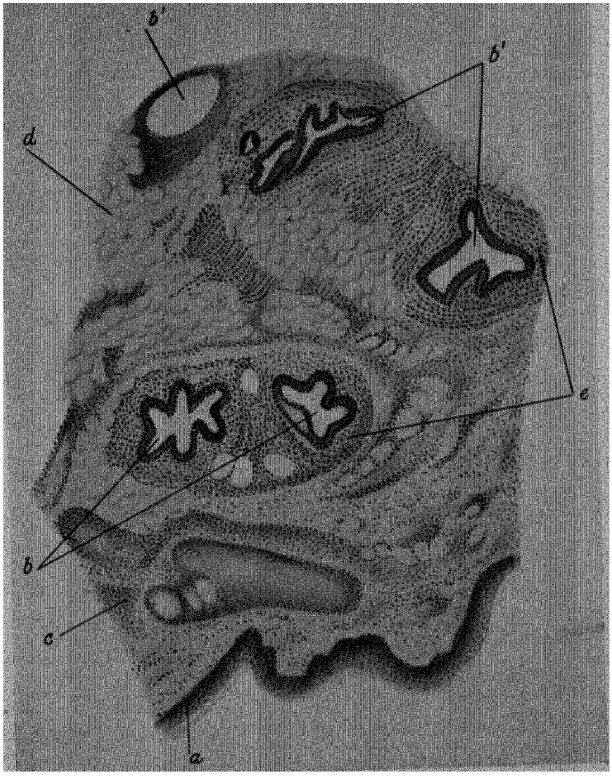


FIG. 177. SECTION OF ADENOMA SEEN IN FIGURE 176 EXCISED WITH A PORTION OF THE LABIUM MINUS × 68. (*a*) Epithelium ; (*b b'*) gland-tubules ; (*c*) round-celled infiltration ; (*d*) fatty tissue ; (*e*) "cytogenous mantle," which is a characteristic of Müllerian derivatives.

NEW GROWTHS OF THE VULVA

Fibroma is not uncommon. Beginning in the subcutaneous connective tissue, it usually becomes pediculated, but may be sessile and may attain a very great size. The large tumours often become the seat of superficial ulcers due to venous stasis and friction. Usually they are firm and hard, but may undergo myxomatous or calcareous degeneration. They cause no symptoms except those due to their bulk, and they are easily removed by dividing the pedicle and tying the vessels it contains.

Lipoma of the vulva is a rarer form of new growth than fibroma. It may occur in the greater labia either as a pediculated, or an encapsuled, or a diffuse growth.

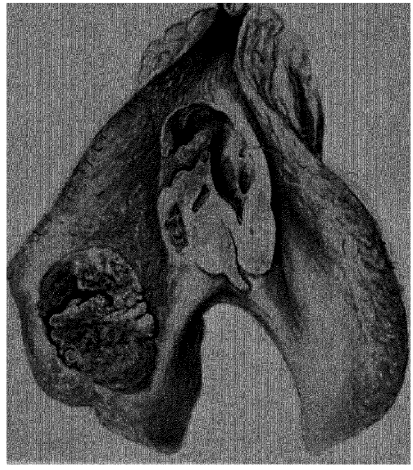


FIG. 178. EPITHELIOMA OF THE CLITORIS WITH A CONTACT-METASTASIS ON THE RIGHT NYMPHA.

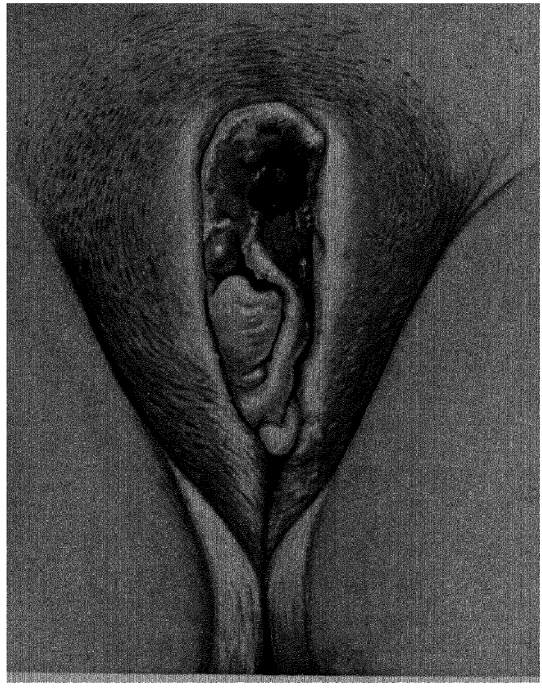


FIG. 179. SHOWING THE ASSOCIATION OF EPITHELIOMA (SQUAMOUS-CELLED CARCINOMA) OF THE VULVA AND LEUCOPLAKIA; the latter condition involves the labia and the perineum.

Papillomata. These frequently occur upon the skin-surfaces in cases of chronic gonorrhœa (*see* p. 260).

Teratomatous Cysts also occur, though very rarely.

Adenomata and Adenomyomata. *Adenomata* of the vulva are found in various situations: they may arise (1) in the upper part of the labium minus (*see* Figs. 176 and 177). (2) In the neighbourhood of the urethra (vulvo-urethral), in which position they may become malignant and form one variety of urethral cancer (*see* Fig. 197). (3) They may arise in Bartholin's gland (*see* p. 328). (4) Finally small adenomata may occur in the skin of

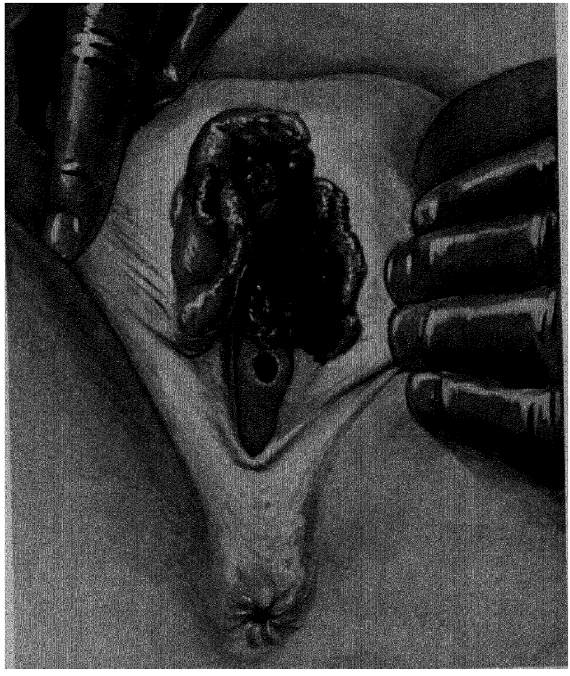


FIG. 180. THE SAME CASE AS IN FIGURE 179 WITH THE LABIA RETRACTED TO SHOW THE EXTENT OF THE MALIGNANT PROCESS. It has spread across the vestibule as far down as the orifice of the urethra.

the labium majus, where their origin can be traced to a sebaceous gland (*adenoma sebaceum*).

Adenomyomata are found in the upper part of the labium majus and in the region of the external abdominal ring. They are thought to belong to the class of embryonic tumours, and their origin is attributed to portions of Müllerian tissue carried down through the canal of Nuck by the round ligament. They may be solid throughout, or partly cystic (*see* Fig. 267, p. 444) in the latter case they almost invariably contain altered blood and swell up during menstruation. In their histology they resemble adenomyomata which arise in the uterus, for details of which the student is referred to the section dealing with these growths (*see* p. 445).

Myxomata have been described: they are probably degenerated pendulous fibromata.

Sebaceous and **mucous cysts** occur on the labium minus. They are not neoplasms, but are due to retention in the blocked ducts of these glands of sebum and mucus respectively.

Malignant Growths. The following malignant growths may arise primarily in the vulva, their relative frequency being in the order stated: *squamous-celled cancer*, *melanoma*, *sarcoma*, *adeno-carcinoma*, *endothelioma* and *rodent ulcer*. Secondary growths are very rarely found in the vulva, with the single exception of cases of chorionic carcinoma, which in this location has been observed with comparative frequency.

Epithelioma (Squamous-celled Carcinoma). The vulva is the rarest site

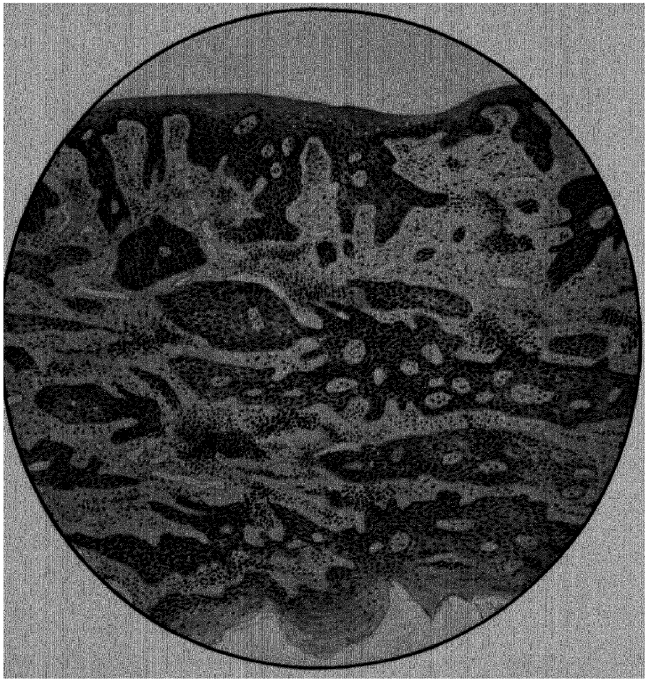


FIG. 181. SQUAMOUS-CELLED CARCINOMA OF THE VULVA. The section is through the base of the labium minus. The subepithelial tissues are seen to be permeated by cancer-processes arising from the deep epithelium.

in the female genitalia for cancer to develop. Vulval cancer is a disease of advanced age; its starting-points are the clitoris (Fig. 178), labia majora (Fig. 182), labia minora (Fig. 183), and the perineum. The growth is characterized by extensive new formation of tissue and by a tendency to early superficial ulceration; there is a diffuse infiltration of the surrounding tissues, with involvement of the inguinal lymphatic glands.

Epithelioma of the Clitoris. There is no uniformity of opinion as to which site, the clitoris or the labia, is the commoner as the starting-point of cancer. Individual experience differs on this point. In our own case we have seen more examples of cancer of the labia than of the clitoris. When the clitoris is primarily affected, the disease is seen to start on the prepuce as a hard nodule which quickly ulcerates; there is diffuse infiltration of the surrounding tissues and the inguinal glands are early involved, but not in all cases.

The course of the disease may be rapid or slow, but as the clitoris is very sensitive there is a better chance of early detection than when cancer starts in the labia. Fritsch has called attention to the frequency of peri-urethral extension from cancer of the clitoris. When ulceration is established the surface oozes, becomes moist, and the discharge rapidly becomes septic and offensive. There may be blood in the discharge, but free hæmorrhage is not characteristic even of the late stages. The relationship between cancer of the vulva and leucoplakia has been discussed in another place. The co-existence of these two conditions is well shown in Figures 179 and 180.

Epithelioma of the Labia. The disease most commonly starts on the

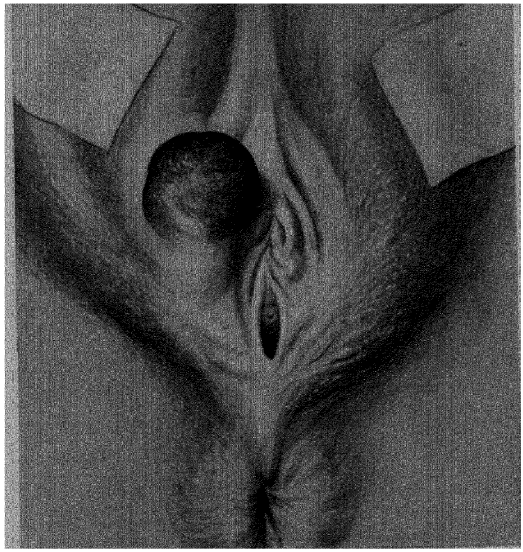


FIG. 182. EPITHELIOMA ARISING FROM THE INNER SURFACE OF THE RIGHT LABIUM MAJUS AND INVOLVING ALSO THE LABIUM MINUS OF THE SAME SIDE. Patient aged 68 years.

inner surface of the labium majus, whence it spreads to the labium minus (*see* Fig. 182). It may first appear as a hard nodule like that described on the prepuce of the clitoris, but it may attain the size of a small apple before ulceration commences; or it may first be discovered as a small excavated ulcer with indurated and everted edges, or finally it may present as a deep fissure. Ulceration gradually involves the whole of the labia and leads to a most offensive, thin, sero-purulent discharge. As in cancer of the clitoris, bleeding is not extensive, unless some large vessel becomes eroded by the malignant cells. A somewhat unusual form is that seen in Figure 183, in which the growth, involving the entire labium minus, presents a surface studded with papilliform processes. Such a picture might be more common were it not for the fact that ulceration is wont to occur before the growth attains the size of the one depicted in the above illustration.

An interesting feature of labial cancer is that it may be multiple, a fact due in some cases to implantation (*see* Fig. 178), whilst in others there is

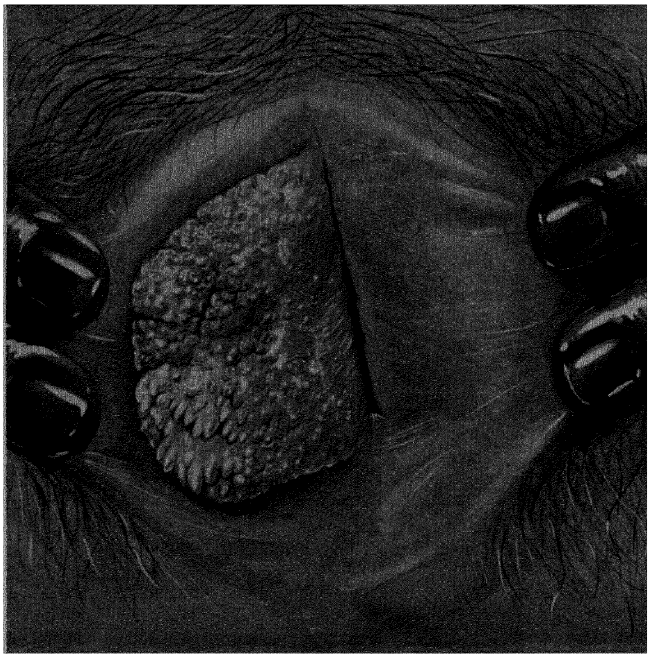


FIG. 183. EPITHELIOMA OF THE RIGHT LABIUM MINUS, the striking features of which are the papilliform surface and the absence of ulceration.

microscopic evidence of deeply seated outrunning processes of cancer-cells connecting surface-growths which are apparently independent.

The histological characters are those common to skin-cancer in other

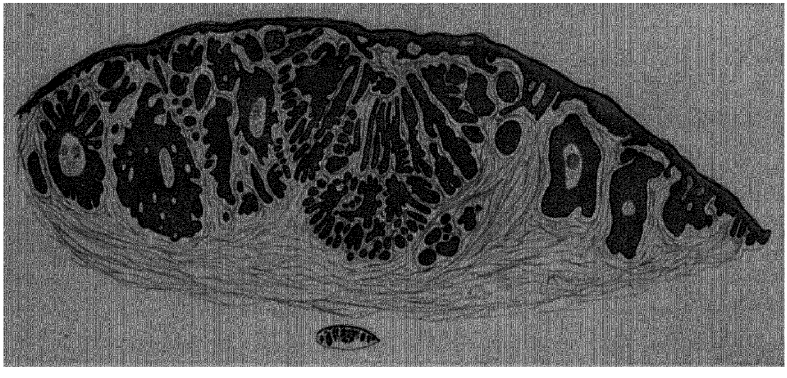


FIG. 184. RODENT ULCER OF THE LABIUM MAJUS SEEN UNDER A LOW POWER. Note the club-like epithelial processes which make up the growth and which have no connection with the surface-epithelium.

parts (*see* Fig. 181), the chief peculiarity being that there is a great abundance of epithelial pearls.

Adeno-carcinoma always starts in the gland of Bartholin or in the duct belonging to that structure ; it is described on page 329.

Rodent Ulcer. This type of malignant disease is very rare in the vulva. It arises in the dermis, and not from the surface-epithelium. It may start in the sebaceous glands or in hair-follicles, but has never been proved to originate in the sweat-glands. Arising in the *cutis vera* the growth spreads underneath the epidermis which becomes invaded from below, thus contrasting with an epithelioma which invades the dermis from the epidermis. The cell-growth forms flask-shaped masses, from which club-like processes project (*see* Fig. 184); these run underneath the epidermis, which shows no proliferation. The surface-epithelium becomes ultimately thinned out and rubbed off, exposing the subjacent growth, and thus an ulcer is formed.

The individual cells are round in shape and much smaller than those of

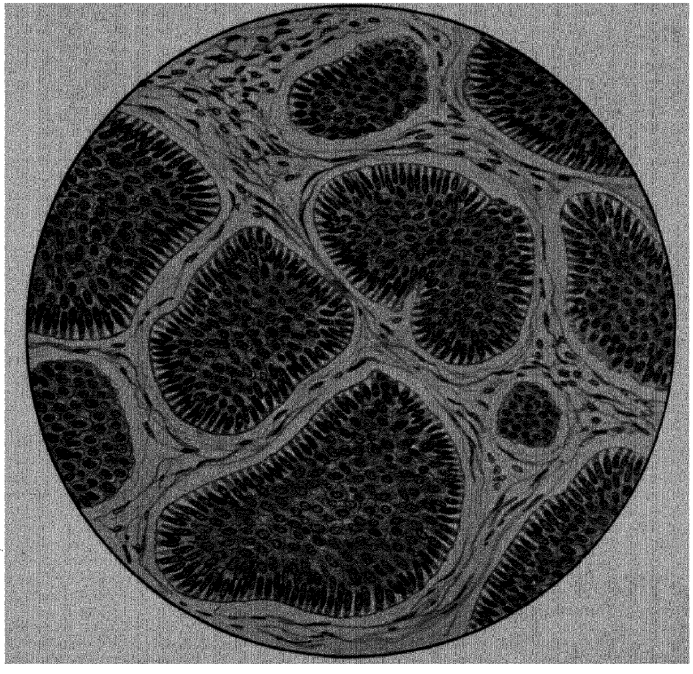


FIG. 185. EPITHELIAL PROCESSES OF RODENT ULCER OF THE LABIUM MAJUS UNDER A HIGH POWER. (The same growth is shown in Fig. 184.)

an epithelioma; they do not become horny but, on the contrary, show a great tendency to become vacuolated, and thus spaces are formed in the centre of the cell-masses (*see* Fig. 185).

'Cell nests' are seldom seen, and when present they are small and ill-developed.

Rodent ulcer of the vulva is only seen in elderly women and is exceedingly rare. If seen early it appears as a smooth, flattened nodule in the skin of the labium majus; it causes no pain, and is not accompanied by a zone of hyperæmia. Later on, the thin epithelium covering the centre of the papillæ ulcerates, after which, growth in the depths and surface-ulceration progress *pari passu*.

The ulcer has a smooth surface which is slightly depressed, and limited by an irregular, hard, rolled-over edge. The discharge is thin watery pus.

Lymphatic glands and viscera are never invaded, but by local infiltration the growth may spread to, and erode, the pubic bones. The progress of the growth is very slow indeed, and of all malignant epithelial growths the rodent ulcer is the least malignant. The treatment is free removal, bearing in mind the fact that the growth may extend for some distance underneath apparently healthy surface-epithelium.

Endothelioma. Stevens recorded the case of a pedunculated tumour of the labium majus resembling a fibroma in appearance and of slow growth, which proved on section to be an endothelioma of periendothelial type.[1]

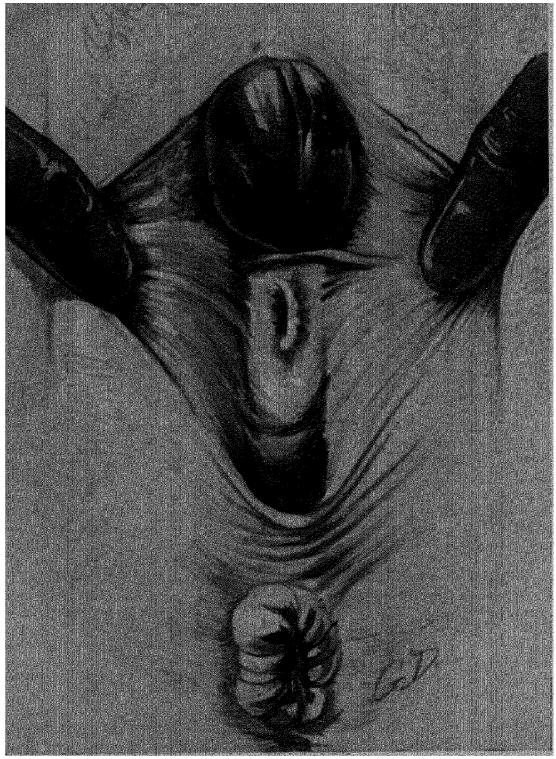


FIG. 186. MALIGNANT MELANOMA OF THE VULVA (Eardley Holland). The growth has arisen in the vestibule, between the clitoris and the urinary meatus.

Melanoma. This is a pigmented form of malignant new growth which occurs specially in deeply pigmented situations such as the choroid coat of the retina and certain areas of the skin; but it has also been known to develop in the mucous membrane of the hard palate (Treves), and of the gums, on the lips and in the cervix uteri. It is a rare disease in any situation and particularly so in the vulva, although in this situation it has been shown to occur rather more frequently than non-pigmented sarcoma. When occurring on the genitals it especially affects elderly women, 70 *per cent.* of the recorded cases having occurred above the age of fifty (Holland).

Melanoma of the vulva may be primary or secondary. In primary mela-

[1] T. G. Stevens, *Proc. Roy. Soc. Med.*, Obst. Sect., Dec. 6th, 1923.

noma the labium majus alone, or the labium minus and clitoris, are the most common points of origin ; but it occurs twice as often on the labium majus as on the nymphæ and clitoris, a fact which may be due to the excess of pigment in the former situation.

Pathology. This disease was originally described as a form of carcinoma, but as histological methods became more exact the majority were found to possess the structure of sarcomata. It is now known that some are carcinomata (*see* Fig. 187) and some sarcomata. Thus, Treacher Collins has proved that some of the melanomata which arise in the eyeball are carcinomata, and both types are also to be found in the skin. In the latter situation melanomata are more frequently sarcomatous than carcinomatous. The cervical



FIG. 187. MELANO-CARCINOMA OF THE VULVA. The cells of the new growth contain an abundance of pigment (melanin).

cases are regarded as pigmented sarcomata. From a microscopic examination of thirty-three recorded cases collected by Holland, twenty-six were classed as sarcomata, six as carcinomata and one uncertain. The cancerous type usually develops from a pre-existing pigmented mole. Of thirty-three skin-melanomata recorded by Eve, twenty-six were traced to a pigmented mole.

Macroscopically the growth is generally deep purple or black in colour, and usually of quite small dimensions, *e.g.* about the size of a filbert nut, but the growth shown in Figure 186 was said by Holland to be as large as a bantam's egg. It ulcerates early and bleeds readily. Secondary deposits are often more deeply pigmented than the primary growth.

Microscopically, whether sarcomatous or cancerous, the pigment in the growth varies greatly in amount. It consists of golden-brown granules of

melanin of variable size, distributed within the cytoplasm of the cells, in the fibrous connective tissue, and in the walls of the vessels. When aggregated in masses, the granules appear quite black, so that adjacent lymphatics, when choked with pigment, may resemble streaks of ink.

The decision in certain cases as to whether a melanoma is a sarcoma or a carcinoma is often difficult, and the pigmentation may be so abundant as to make it impossible to decide from the characters of the cells. Moles have an alveolar structure which will tend to render the appearances sarcomatous, but Unna and most other pathologists regard the molar variety as carcinomatous. In many cases the true nature must be left in doubt, hence the

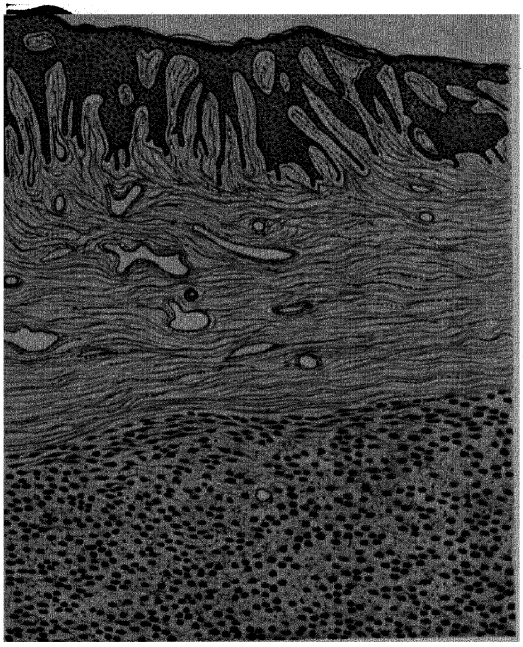


FIG. 188. MYXO-SARCOMA OF THE VULVA.

term *melanoma* must be understood to include both melano-carcinoma and melano-sarcoma.

Prognosis. This is grave; so great is the malignancy that according to Erichsen, if the primary growth is larger than a filbert, local treatment is of little value. Dissemination is rapid. In the case of vulval melanoma early involvement of the inguinal glands occurs. Out of twenty-six after-histories collected by Holland, only one patient was free from recurrence after three years.

Treatment. This consists in free excision of the growth and extirpation of the inguinal glands on both sides.

Sarcoma appears to be one of the rarest of the malignant tumours of the vulva; Blair Bell has succeeded in collating twenty-one cases of non-pigmented sarcoma from general literature, and this small number sufficiently indicates its rarity. It attacks the labium majus more frequently than other parts, and occurs at an earlier age than epithelioma and mela-

noma, 50 *per cent.* of the recorded cases having occurred between the ages of thirty and fifty. Histologically the growth may consist of spindle-cells, of round cells, or of both kinds; in other cases a form of myxo-sarcoma (*see* Fig. 188) occurs, as is the case with sarcomata of other parts. Diagnosis is only possible with the help of the microscope, and the treatment is free and early removal. The prognosis as regards recurrence is bad.

Tumours of the Perineum. Tumours in the perineum are very rare; those which have been recorded have not arisen *in situ*, but have pushed their way outwards and distended the perineum as a result of continuous

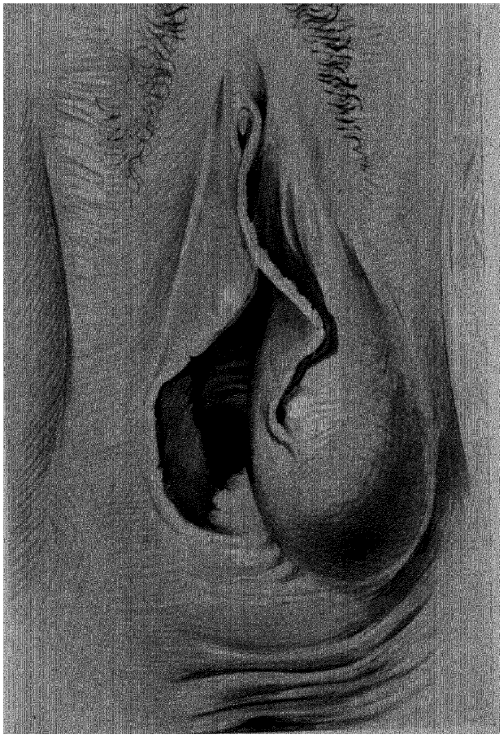


FIG. 189. BARTHOLINIAN CYST, FORMED BY DILATATION OF THE DUCT OF BARTHOLIN'S GLAND. The line of origin of the labium minus runs over the front of the swelling.

growth. A remarkable case recorded by Malcolm was that of a semi-solid, semi-cystic growth which weighed 39½ pounds. It proved to be a cystic fibromyoma. All the pelvic organs were normal and the growth appeared to have arisen from the parametric or paravaginal tissues. That it was not of fascial origin (fibroma) was proved by Shattock, who demonstrated unstriped muscle-fibres in the tumour.

MORBID CONDITIONS OF BARTHOLIN'S GLAND

Cysts. Both the duct, and the gland itself, may give rise to the formation of a cystic tumour. Cysts of the *duct* are true retention cysts due to stenosis of inflammatory origin, or more rarely to obstruction by a calculus.

The resulting tumour is oval or globular (Fig. 189), and at first opens out the posterior part of the labium majus, and the line of origin of the labium minus runs over the front of the swelling (Fig. 189). As the cyst enlarges, its upper limit rises until the entire labium majus becomes opened out, and the cyst may then appear to arise in the upper tissues of the vulva. Such large cysts may attain the size of a duck's egg and come to overlie the entire vulva (*see* Fig. 190). If the cyst is of large size, the line of origin of the labium minus may be entirely obliterated. The largest cysts, by dragging upon the upper part of the labia majora, acquire a wide pedicle and tend to become pendulous (*see* Figs. 190, 191). Cysts of the *gland* are probably produced in the same manner, but are much less common than those of the

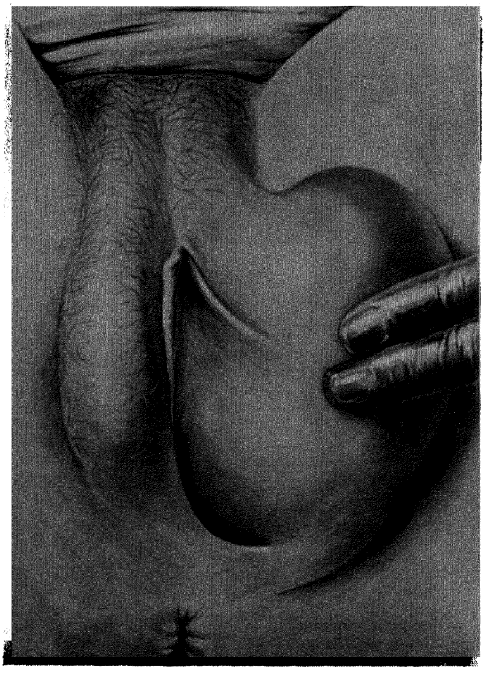


FIG. 190. LARGE BARTHOLIN'S CYST, SHOWING THE COMMENCEMENT OF PEDUNCULATION.

duct. They lie deeply beneath the posterior part of the labium majus, and sometimes burrow upwards along the lateral vaginal wall and backwards into the ischio-rectal fossa. The integumental coverings are lax, and the deformity is less pronounced. The cyst can be grasped between the finger passed into the vagina, and the thumb placed externally, and its size and depth thus estimated.

The fluid these cysts contain is usually thin and serous, but may be thick and coloured in long-standing cases. Figure 193 shows the characters of the wall of a Bartholin's cyst, and Figure 194 shows dilated (small cystic) spaces in the corresponding gland, produced by the obstruction in the duct.

The only *symptoms* associated with a Bartholinian cyst are mechanical in origin and slight in degree. Unless inflamed it causes no pain, and it is not

sensitive when touched. It is, however, somewhat prone to become infected from vaginal discharges, or sometimes as the result of injury, and an *abscess* may then be the result.

The treatment is surgical and may be found described on page 768.

Inflammation. The gland is not palpable when of normal size. When enlarged and indurated by chronic inflammatory processes it may be felt as a firm body of the size of a haricot bean or larger, lying deeply in the tissues beneath the posterior part of the labium majus (*see* Fig. 45, p. 56). On pressure a turbid fluid may exude from the ducts. In gonorrhœal infection

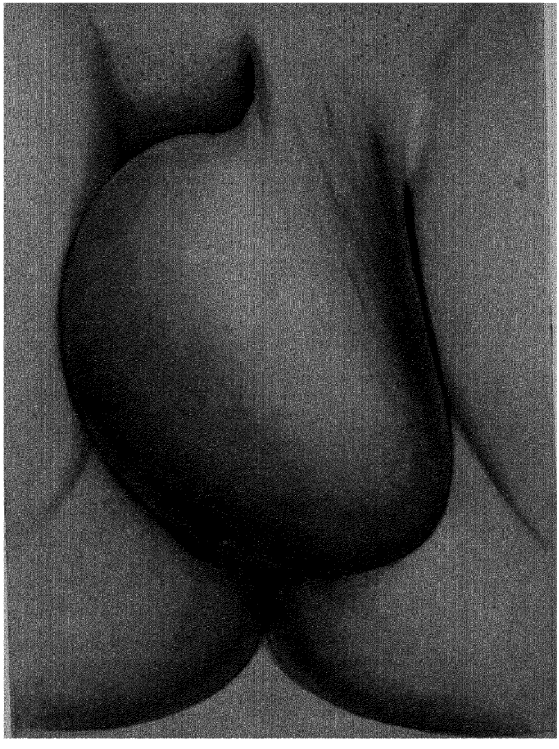


FIG. 191. LARGE CYST OF BARTHOLIN'S DUCT. It has opened up the entire labium majus of the right side and has become pendulous. All signs of the labium minus are obliterated.

a definitely purulent discharge can often be demonstrated in the same manner, long after the vulvitis from which it originally arose has disappeared. When thus chronically infected, a dull red zone of discoloration is usually seen around the mouths of the ducts, where they open on each side just external to the hymen. Cysts formed by obstructive dilatation of the duct may suppurate, the gland having been often infected before dilatation occurred. The suppuration is usually limited to the cyst, but may spread to the gland or to the surrounding cellular tissue, giving rise to a *labial abscess*.

An *abscess* may occur from acute infection of the gland itself, or of a

pre-existing cyst; usually the infection is gonorrhœal; in the case of a cyst, traumatism followed by septic infection from organisms in the skin, or in the vaginal secretions, is sometimes the cause. Suppuration is usually limited to the gland or to the cyst, but widespread inflammatory swelling of the labia may accompany the process. Not infrequently spontaneous rupture of the abscess occurs externally, giving rise to a sinus which may be very persistent. The *symptoms* of suppuration are pain, rapid enlargement of the swelling, redness, œdema and tenderness of the integumentary coverings; a moderate rise of temperature to 100° F. or 101° F. is also usually present. The *treatment* will be described on page 168.

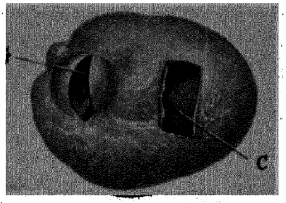


FIG. 192. CYST OF BARTHOLIN'S DUCT (NATURAL SIZE).
(G) Gland; (C) Opening made in cyst.

Tuberculosis of Bartholin's gland is very rare. A few cases only have been recorded.

New Growths of Bartholin's Gland. Solid tumours of Bartholin's gland

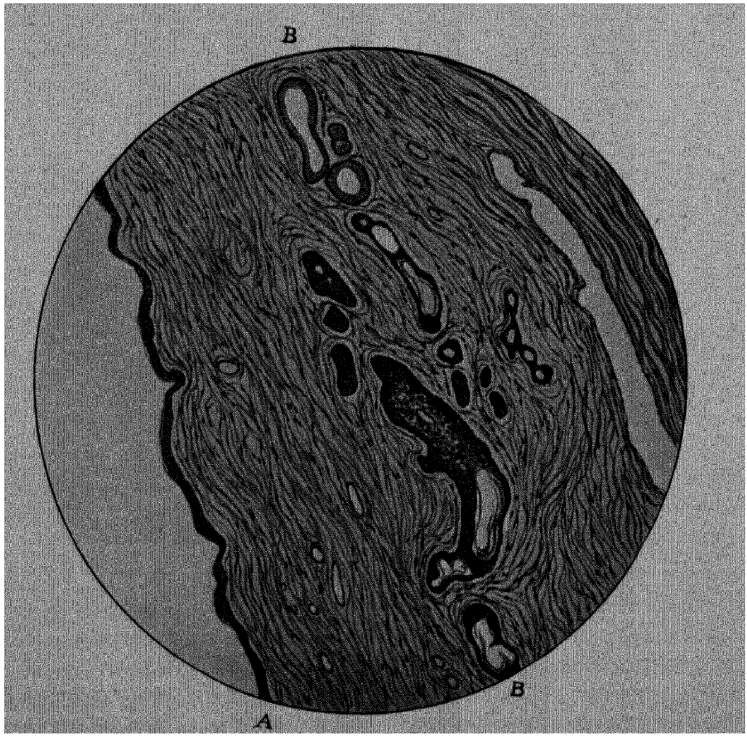


FIG. 193. SECTION THROUGH THE WALL OF A BARTHOLINIAN CYST.
(A) Lining composed of cubical epithelium which is becoming squamous; (B) Outlying processes of the gland.

are rare. Within the limits of our own knowledge they are confined to adenoma, endothelioma and adenocarcinoma.

(*a*) *Adenoma* has once been met with by one of us. The tumour pre-

sented at the vulva in the same way as a Bartholinian cyst. It was of firm consistence, rounded in shape, and the size of a walnut. It caused no discomfort except on coitus. There was no induration around it. The tumour shelled out quite easily. On naked-eye section it had a similar appearance to an adenoma of the breast. It was quite solid except for a small hæmorrhagic spot in the centre. Microscopically it consisted of racemose gland-tissue within fibrous trabeculæ.

(*b*) *Endothelioma.* This tumour is very rare in the Bartholinian gland. It differs in no way from this type of growth when found in other glands such as the parotid (*see* Fig. 195).

(*c*) *Adenocarcinoma.* This again is a very rare disease. The age at which

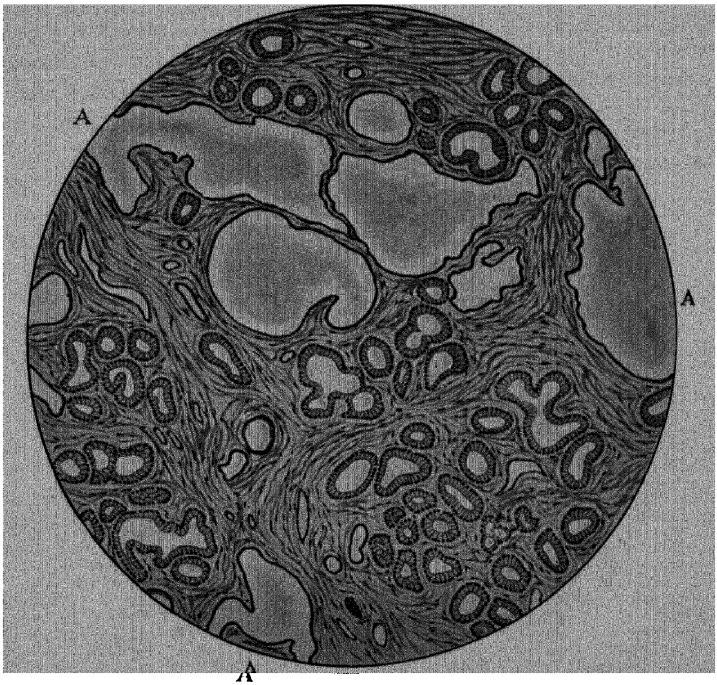


FIG. 194. BARTHOLIN'S GLAND showing (A) cystic spaces produced by obstruction caused through a retention cyst forming in the duct.

it occurs is given as between twenty-eight and ninety years, half of the cases occurring after the age of fifty years. Herbert Spencer has recorded one case; in that instance the columnar-celled growth appeared to have started in the deep part of the principal ducts.

Signs. Its first appearance is that of a tender, hard, nodular swelling in the region of the gland. The skin is sometimes discoloured and there may be local œdema, especially in the region of the hymen. The skin eventually becomes perforated and a large fungating mass protrudes on the surface. The growth has been found to have eroded the ramus of the pubes. The inguinal glands are affected early.

Symptoms. There is severe pain, especially on walking and during menstruation. In the early stages coitus is painful; later, it is of course impossible.

Prognosis. The outlook as regards recurrence is unfavourable.

The treatment of these conditions is surgical, free excision of the growth and adjacent glands being indicated, and also of a portion of the pubic bone if necessary.

LESIONS OF THE BLOOD- AND LYMPH-SYSTEMS

Hæmatoma Vulvæ. A hæmatoma of the vulva may result from a blow or a kick, or it may be due to rupture of a varicose vein caused by some violent exertion. It also sometimes results from deep-seated hæmorrhage due to imperfect hæmostasis in operations on these parts.

Symptoms. The patient complains of local pain and tenderness, and she may be very anæmic from loss of blood.

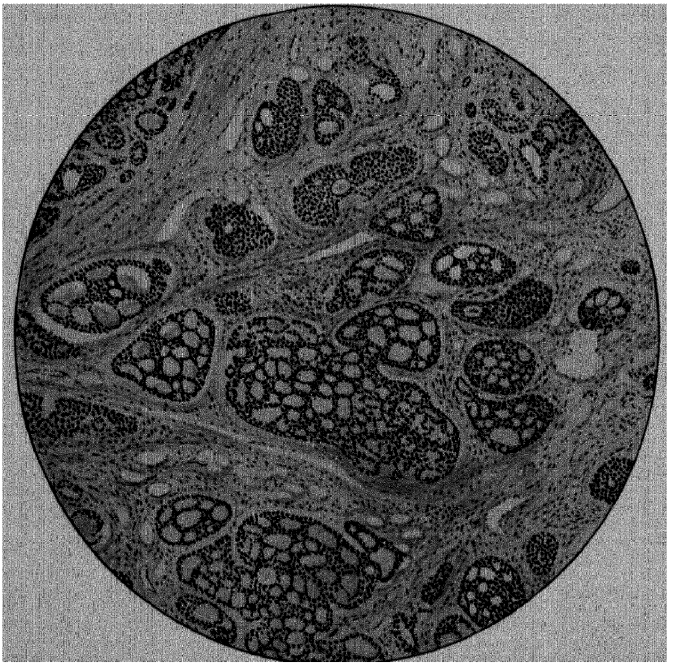


FIG. 195. ENDOTHELIOMA OF BARTHOLIN'S GLAND.

Signs. There is a dark, tender swelling of one or other labium majus; the skin or mucous surface may have given way leading to free external hæmorrhage, or a thrombus may project through the site of rupture in a varicose vein. The blood may escape into the cellular tissue *external to the pelvic fascia*, in which case it will distend the labium majus, and may track thence to the perineum behind and to the anterior abdominal wall in front. The consistence of the swelling will vary with the period that has elapsed since the injury. At first it is cystic, then doughy, and finally firm. If infection occurs, an abscess results. The blood may escape into the cellular tissues *beneath the pelvic fascia*, *i.e.* into the pelvic connective tissues, in which retroperitoneal situation it may form a swelling large enough to occlude the lumen of the vagina and to compress the rectum. This type of hæmatoma may arise from hæmorrhage originating in the cellular tissues,

below the pelvic fascia, and the blood perforating the fascia finally infiltrates the labium.

A vulval hæmatoma is more likely to be caused during the pregnant than during the non-gravid state, and it may form an obstruction to delivery.

Treatment. The patient must be kept in bed, and cold lead lotion applied. If infection occurs, free incision must be made and antiseptic fomentations applied.

Varicose Veins. The most marked examples of varicose veins of the vulva are seen as a complication of pregnancy, but the condition may be produced by any cause of obstruction to the pelvic veins.

Symptoms. The patient complains of aching pain and swelling of the vulva.

Signs. The veins stand out as tortuous dark blue structures in one or both labia. In severe cases they extend into the inguinal region. Usually they are soft and allow of expression of their contents, but they may appear as a mass of hard knotty cords, each the size of an index-finger, the hardness being due to thrombo-phlebitis. Blood may leak into the subcutaneous tissues producing a diffuse hardness under an intact, discoloured skin, or, as stated above, the skin may rupture as well as the veins, in which case there may be alarming and even fatal hæmorrhage.

Treatment. If the condition becomes extreme during pregnancy the question of inducing labour will have to be considered. If rupture is followed by severe hæmorrhage it may become necessary to expose the vein and tie it.

Œdema of the Vulva. The most marked examples of this condition occur in pregnancy complicated with albuminuria. It is also associated with renal disease apart from the gravid state, with cardiac disease, with varicose veins of the vulva, with vulvitis (*see* Fig. 172, p. 302), and with suppuration in the pelvic cellular tissue.

The swelling causes local pain and discomfort. In vulvitis, and in cases of œdema due to a systemic cause, the swelling is bilateral; it may be so extensive as to cause sloughing of the apposed surfaces of the labia majora.

Treatment. The patient should be kept at rest, and the foot of the bed tilted. If the œdema is extreme the tissues should be drained with a Southey's tube, and boric acid fomentations applied; meanwhile the cause of the condition must be treated as far as is possible.

LABIAL (INGUINAL) HERNIA

Labial hernia in women is much less common than the corresponding affection (inguinal hernia) in the other sex. Of the two common varieties of hernia in women—inguinal and femoral—the former is the more frequent.

A labial hernia may contain a knuckle of bowel or a piece of omentum; in addition to, or instead of, these structures may be found an ovary, with or without its companion tube, a uterus alone, or a uterus with the adnexa of one or both sides; Figure 86, page 134, shows an accessory uterine horn and an imperfect tube which were removed from a hernial sac. A few instances have been recorded in which a gravid uterus has been found in an inguinal hernia. It must be remembered that hydrocele of the *processus vaginalis*, or canal of Nuck, may closely simulate a labial hernia.

PERINEAL INJURIES

The anterior one-third of the perineal body is almost invariably lacerated to a certain extent in labour, the effect being to destroy the posterior commissure and fossa navicularis. In all considerable perineal lacerations the posterior vaginal wall is also involved, the tear here being usually lateral, and running upwards for an inch or more. In women who have had several children a similar tear is often found on each side. These tears persist in the form of sulci, which can be traced from the anterior edge of the perineum upwards and to one or other side, isolating the median portion of the vaginal wall, which often becomes prolapsed and its tissues thickened so as to form a median 'spur.' Similar injuries may be found in cases where the perineal body is fairly well preserved. These vaginal lacerations destroy the supporting fibres of the levator ani and the vaginal sphincter, the result being that the ostium vaginæ becomes relaxed and so distensible that three or four fingers can be passed into the vagina without inconvenience to the patient (*see* Fig. 337, p. 535). They are consequently important predisposing factors in the causation of *prolapse*. This relaxed condition of the vaginal introitus may exist without any greater injury to the perineal body than that mentioned above.

Frequently, however, damage more extensive than this is sustained by the perineal body, which may be lacerated up to, or even so as to include, the external sphincter ani muscle. Perineal lacerations may therefore be classified in three degrees: *first degree*, involving only the anterior one-third; *second degree*, involving the whole perineal body up to the anal sphincter; *third degree*, involving the anterior portion of the sphincter itself. Lacerations of the second degree greatly enlarge and distort the ostium vaginæ, but are not in all cases accompanied by prolapse, although the recto-vaginal septum is greatly attenuated. Those of the third degree produce a characteristic alteration in the appearance of the anus. Under normal conditions the pigmented perineal integument is thrown into shallow radiating folds by the persistent retraction of the superficial sphincter muscle (*see* Fig. 337). When this muscle has been lacerated anteriorly the divided ends retract so that the muscle becomes crescentic or horseshoe-shaped instead of circular. A small shallow pit in the skin on each side can often be seen which indicates the position of the retracted ends (*see* Fig. 529, p. 749). Further, while the radiating folds persist laterally and posteriorly, they are lost anteriorly. The competence of the sphincter may be so much injured that a portion of the rectal mucosa becomes prolapsed in the form of a bright-red sessile nodule, the size of a pea or even as large as a cherry. The grip of the sphincter upon the finger is always recognizably weakened. In slighter cases the patient may be conscious of weakness only when the bowels are relaxed, or when controlling the passage of flatus. In severe cases complete incompetence of the anus results.

The *treatment* of these injuries consists in repairing the perineum; this operation (perineorrhaphy) is described on page 738.

VAGINISMUS

This name was given by Marion Sims to a condition in which there is an abnormal hyperæsthesia of the external genital organs, which, when coitus is attempted, sets up reflex spasm of the muscles of the pelvic floor. The act of coitus is usually quite impossible.

Cases of vaginismus admit of division into two classes: (1) Those in which no apparent cause can be found; (2) those in which some local lesion is discovered.

The extreme hyperæsthesia in the first class must be regarded as a local manifestation of neurosis. The sensitiveness is more than a mere shrinkage from timidity, for the patient may be desirous that marriage should be consummated, and still unable to tolerate the attempt. The trouble is liable to what Matthews Duncan called "spontaneous variations," and may even disappear. Its manifestations, like those of other neuroses, are erratic; thus, whilst as a rule coitus is unendurable, and attempts at examination cannot be tolerated without an anæsthetic, at other times a patient can suffer the admission of the examining finger, and allow of an examination being carried out without difficulty. Again, a woman who has previously experienced coitus without hindrance may, for some unknown reason, develop vaginismus. In severe cases, any attempt at investigation will produce painful cramps and nervous excitement, the buttocks will be raised, the back arched, and the thighs pressed tightly together, and an anæsthetic must be given before the examination can proceed. Some cases are recorded in which coitus has commenced before the spasm of the levator ani muscle was set up, and then the spasm proved sufficiently intense to prevent withdrawal (*penis captivus*). Fritsch recorded a case in which he was obliged to chloroform the woman before the penis could be set free.

In the second class of case, local examination may reveal a small ulcer or fissure in the fossa navicularis, or a vascular caruncle or an inflamed hymen, or inflamed *carunculae myrtiformes*. All these are known causes of dyspareunia, and in a neurotic patient they may set up a painful reflex spasm, sufficient to prevent coitus altogether.

Prognosis. In the first class of case the prognosis must be guarded; on the whole it is not very hopeful. Even when pregnancy has followed suitable treatment, the condition may recur. These cases, being of functional origin, are sometimes amenable to treatment by 'suggestion.' In the second class the prognosis is good, as local causes admit of cure.

Treatment. Slight cases may be relieved by the application of a 5 *per cent.* cocaine ointment some ten minutes before coitus is attempted. If this fails the patient should be given an anæsthetic and the hymeneal ring forcibly dilated by vaginal dilators, leaving one of large size in the vagina for some hours afterwards. Dilators of increasing size should be inserted daily and left *in situ* for some hours. Another plan of treatment, which no doubt is the best, is to incise the sphincter, an operative procedure which will be found described on page 773.

Local conditions such as an inflamed hymen or urethral caruncle should be removed. Fissures may be divided, and ulcers excised or cauterized.

COCCYGODYNIA

The first account of this complaint was published in 1844 by J. C. Nott, who spoke of it as "neuralgia of the coccyx." This surgeon removed the last two coccygeal vertebrae from the patient, who had had a fall four years previously, but had suffered pain in the coccyx for only ten months. Caries had reduced the terminal segment to a mere shell. The symptoms disappeared after operation. The term *coccygodynia*, by which it is now known, was introduced by Sir James Simpson of Edinburgh.

From this complaint men are almost immune, the reasons assigned being that, in the male, the tubera ischii are closer together, and the coccyx, being higher up, is afforded a better protection from external violence.

Ætiology. Hirst states that three-quarters of the cases are due to injuries in labour, but the disease may occur as the result of a fall or a kick; on the other hand, there may be no history or sign of injury; and then rheumatism is usually the assigned cause. There is frequently temporary pain in a coccygeal joint following labour, which is easily understood, since backward displacement of the bone is bound to occur during the passage of the fœtal head, and laceration of ligaments, if not dislocation of a joint, may easily occur. There is no doubt that a nervous element is apparent in a large number of cases, even when it is agreed that there has been trauma to call it forth.

Pathological Anatomy. Hirst states that in the majority of cases there is a laceration of the ligaments of a coccygeal joint. He says the second coccygeal joint is more often affected than the first. The intervertebral disc is thickened and softened. There may be ankylosis of all the sacro-coccygeal joints. In one case described by the above author, there was an oblique fracture through the second coccygeal vertebra. In other cases the lower fragment was pulled forward at right angles to the upper, presenting a difficulty to subsequent labour.

Symptoms and Diagnosis. Pain is felt at the end of the spine, especially on sitting down. Defæcation and coitus are painful. Pressure over the coccyx causes pain.

On examination with the index-finger in the rectum and the thumb in the natal cleft, the fragment below the ruptured joint can be thrown out of the line of the upper fragment, and the sharp ridge of the upper fragment may be felt when the lower fragment is pushed back. It is impossible to do this with a normal bone (Hirst). In a thin subject a sharp ridge of bone may irritate the skin over it, and the latter may become inflamed.

Treatment. Many cases recover spontaneously, and it is well to try palliative treatment for some months. The part should be massaged with unguentum iodi, and the patient should rest. If no disease or injury can be demonstrated the patient should be treated as a rheumatic or hysterical subject. If other means fail coccygectomy should be performed (*see* p. 778).

DISEASES OF THE URETHRA

Inflammation. *Acute urethritis* has already been described (*see* p. 259); it is probably always of gonorrhœal origin. *Chronic urethritis* may follow an acute attack, or it may be chronic from the first, being set up by the passage of a foreign body from without, or of a calculus from within. It is sometimes accompanied by urethral ulceration. An abscess may result from infection of a diverticulum or pouch in the floor of the urethra. It presents as a tender elongated swelling in the anterior vaginal wall, which, on pressure, causes an escape of pus through the urethral orifice.

A suburethral abscess will likewise give rise to a swelling similar to the above, but, unless ulceration into the urethra has occurred, the contents cannot be expressed, and on passing a probe into the urethra the abscess cannot be explored. The treatment is described on page 767.

Tumours. Innocent tumours include caruncles, papilloma, mucous polypi and fibromata. Malignant tumours comprise carcinomata and sarcomata.

Urethral Caruncles. These small growths from the urinary meatus are of comparatively frequent occurrence. They rarely exceed the size of a pea, and are usually solitary and attached immediately within the posterior lip of the meatus. Some are sessile, rounded, pale red in colour, and only slightly sensitive to the touch ; others are pediculated, bright red in colour, often lobulated, and in some cases, but not in all, extremely sensitive to the touch. The paler sessile growths are found on examination to consist of granulation tissue with a covering of stratified squamous epithelium, *i.e.* they are *granulomata.* They are often associated with a chronic urethral discharge, and probably result from chronic infection of the peri-

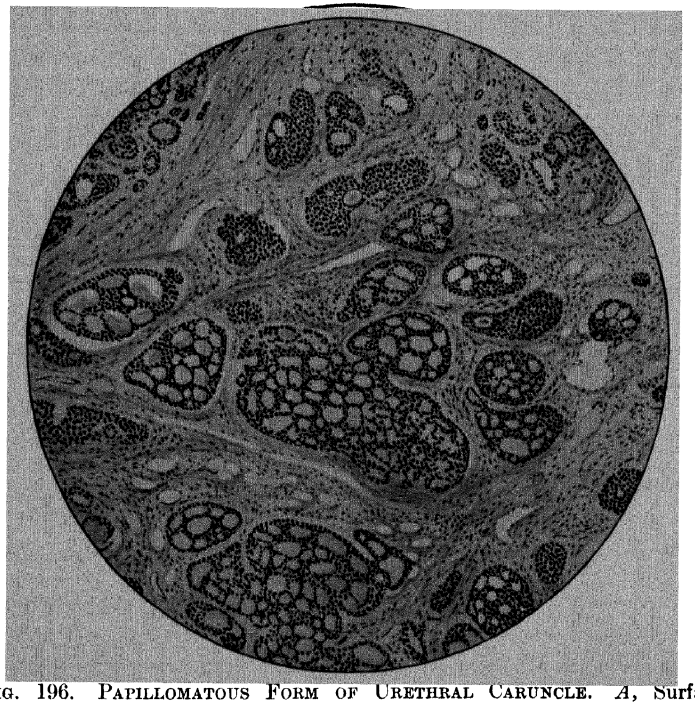


FIG. 196. PAPILLOMATOUS FORM OF URETHRAL CARUNCLE. *A*, Surface depression lined with stratified transitional epithelium ; *B*, a similar depression or crypt in transverse section. The stroma is very vascular, and infiltrated with leucocytes.

urethral glands, which are especially numerous near the meatus. The bright red pediculated growths, on the other hand, vary considerably in structure ; some contain glandular tissue, either in the form of crypts, tubules, or spaces lined with epithelium, which appear to arise directly from the peri-urethral glands, *i.e.* they are *adenomatous.* The stroma consists of a delicate connective tissue often infiltrated with leucocytes, in which the vessels are always very numerous. Others contain large and numerous cavernous blood-spaces in addition to the glandular elements, but these cannot strictly be called angiomatous. Others again are *papillomatous*, and present an irregularly broken surface, consisting of flat elevations with intervening sulci. The latter are lined with a thick layer of stratified epithelium of the transitional type common to the urinary passages. The epithelial covering is often lost

upon the surfaces of the elevations (*see* Fig. 196). The adenomatous caruncles are sometimes very sensitive, but observers have not succeeded in detecting nerves in them.

The chief *symptom* to which urethral caruncles give rise is painful and frequent micturition. The pain may be so severe as to lead to retention of urine. Sometimes slight irregular hæmorrhage occurs from a caruncle, and sometimes the sensitive ones occasion dyspareunia. Many caruncles give rise to no symptoms whatever, and are discovered, if at all, by accident.

The *treatment* is excision (*see* p. 764). Recurrence after operation may

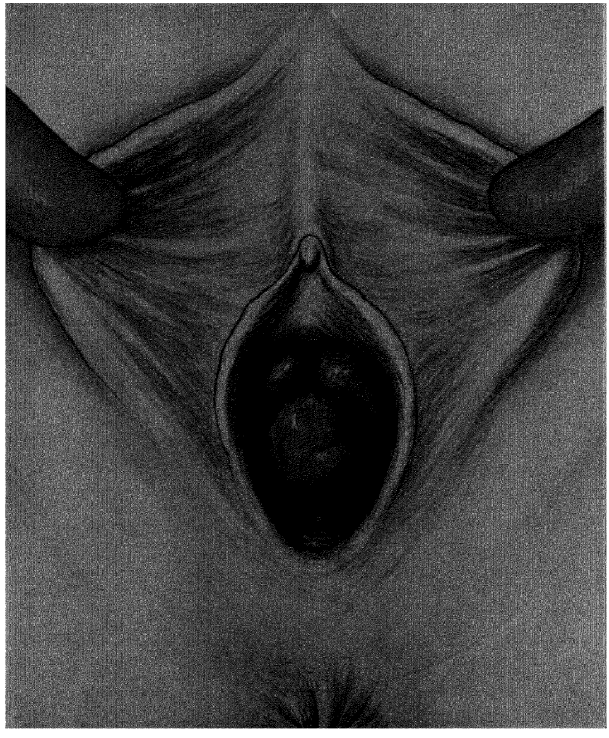


FIG. 197. ADENO-CARCINOMA OF THE PARA-URETHRAL GLANDS, FORMING A TUMOUR IN THE FLOOR OF THE URETHRA. In size and colour it resembled a black cherry.

occur. Occasionally a growth at first regarded as a caruncle recurs, and ultimately reveals the characters of epithelioma.

Compound papillomata have been found growing from the edges of the urethra. *Mucous polypi* and *fibromata* are very rare ; their nature has to be proved by microscopic examination.

Carcinoma of the Urethra. This disease may be secondary to cancer of the vulva, vagina, cervix or bladder, the urethra becoming involved by direct continuity. *Primary* cancer is very rare in the female urethra, which may be due to the fact that leucoplakia of the vulva never affects the vestibule or urethral orifice. Chronic inflammation probably plays a part in the etiology of malignant diseases here as elsewhere (Halle).

The symptoms occur late ; they are painful micturition, hæmorrhage, and discharge. When ulceration is established pain occurs independently of micturition.

The disease is rare ; Beckwith Whitehouse has collected forty-three cases, and three others have been reported by one of us. Whitehouse divides cancer of the urethra into *vulvo-urethral* and *urethral* varieties.

The *vulvo-urethral* variety presents three forms, (1) an irregular dark purple papillomatous growth which bleeds on contact, and which has to be diagnosed from a large urethral caruncle, and from an acute prolapse of the mucous membrane (compare Figs. 197 and 198) ; (2) an ulcerative form, situated in the floor of the urethral orifice ; (3) an induration around the meatus leading to stenosis.

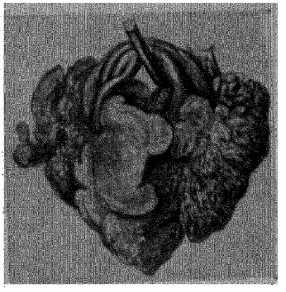


FIG. 198. PRIMARY CARCINOMA OF THE URETHRA : PAPILLIFEROUS TYPE. The pointer is in the urethral canal.

The *urethral* variety presents as (1) an irregular elongated ulcer, seen only by urethroscopic examination ; (2) a peri-urethral induration involving, as it extends, the whole length of the urethra.

This disease affects elderly women who have passed the age of the menopause. It begins either in the peri-urethral glands, when its histology is that

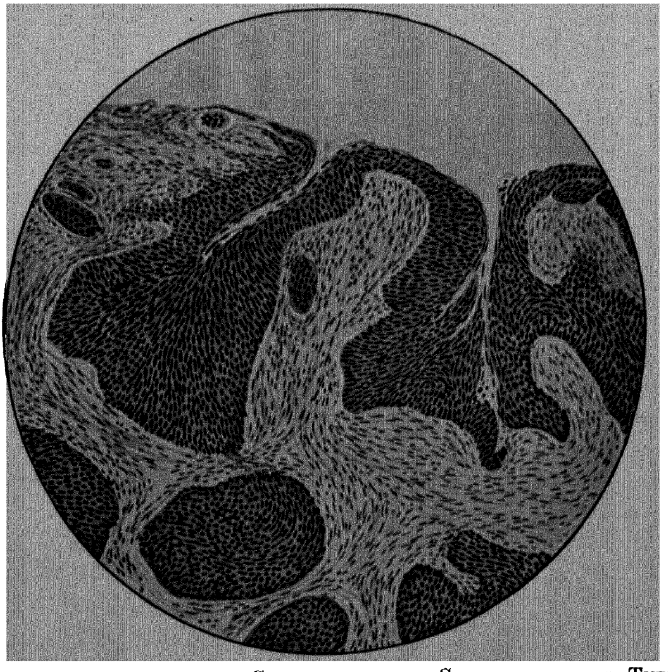


FIG. 199. VULVO-URETHRAL CARCINOMA OF THE SQUAMOUS-CELLED TYPE.

of an *adenocarcinoma*, or it starts in the surface-epithelium and forms a *squamous-celled cancer*. The floor of the urethra is the part first attacked,

and the growth spreads thence along the entire canal from the meatus to the bladder. The inguinal glands are involved in at least 20 *per cent.* of cases (Karaki). The disease may spread over the vestibule and through the vaginal wall, but shows little tendency to attack the bladder.

The *treatment* consists in free excision of the urethra and the inguinal glands on both sides. If a portion of the proximal end of the urethra can be saved, it should be stitched to the anterior vaginal wall. This was done in the case shown in Figure 197, and no incontinence followed the operation. If the sphincter of the bladder has to be removed in the operation, the neck

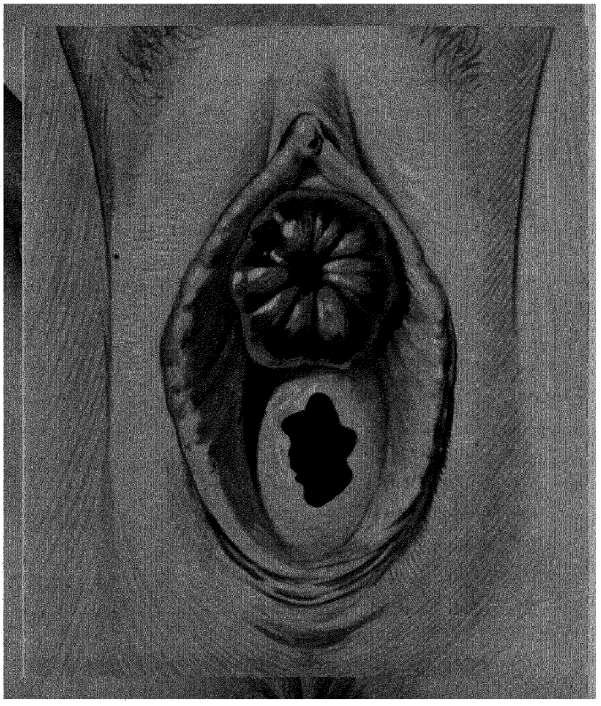


FIG. 200. ACUTE PROLAPSE OF THE URETHRAL MUCOUS MEMBRANE (Arnold Lea).

of the bladder should be closed and a permanent suprapubic fistula established.

Sarcoma of the Urethra is very rare ; only a few cases have been recorded. It has been found in elderly women and in infancy. The growth appears as a livid deeply fissured nodule, which bleeds on contact, and on section has a brain-like greyish appearance. The *treatment* is free removal.

Urethral Calculus. In women urethral calculus is rare. It may be due to a deposit of phosphates around a foreign body or around a migrated ligature. A vesical calculus may become arrested in the urethra.

Signs. The urethra will be tender to touch. The calculus may be felt through the anterior vaginal wall ; on passing a sound the latter will come in contact with the stone.

Symptoms. A calculus expelled from the bladder may, by obstructing the urethra, cause retention of urine. The symptoms of cystitis are usually

present, and added to these there is increased pain, and strangury due to the impaction.

Treatment. The calculus may be removed with forceps, or the posterior wall of the urethra may be incised through the vagina, the stone removed, and the wound closed with two layers of catgut sutures.

Prolapse of the Urethral Mucous Membrane (*see* Fig. 200). In its slighter manifestations this condition may be confused with the sessile forms of urethral caruncle. A partial or complete ring of mucous membrane becomes everted through the meatus; its colour is deeper than that of the mucous membrane of the vestibule, and it overhangs the edges of the meatus. Its attachment all round to the margins of this aperture can be readily demonstrated. It is usually accompanied by a certain amount of dilatation of the urethra, the patulous condition of the meatus probably being the determining cause. It may produce symptoms of irritability of the bladder similar to those met with in the non-sensitive urethral caruncles.

An *acute* form is sometimes met with in which a great part of the mucous membrane of the urethral canal becomes suddenly protruded through the meatus; the immediate cause appears to be straining at stool, the predisposing cause, dilatation of the urethra or prolapse of the anterior vaginal wall. The protruded mucous membrane becomes partially or completely strangulated, and forms a swelling which may be as large as a walnut (*see* Fig. 200). Its colour is deep red or nearly black, according to the degree of strangulation which has occurred; at the apex of the swelling a small aperture is to be seen through which urine slowly dribbles. This condition causes severe pain, dysuria, frequency or incontinence, and sometimes vesical tenesmus; the congested mucosa bleeds a little, either spontaneously, or whenever urine is passed. The condition is distinguished from a dark-coloured new growth by the fact that the urethral canal passes through its centre, whereas when a growth is present the meatus urinarius is always eccentric, and, more often than not, lies above the swelling, as was the case in the adenocarcinoma illustrated in Figure 197.

The *treatment* of the acute form is to reduce it, if possible, under anæsthesia; this may, however, be impracticable, and if reduced the prolapse sometimes recurs. Excision of the prolapsed portion of the mucous membrane must then be practised, as described on page 766.

Urethral Diverticulum. This is a pouch lying below the floor of the urethra and connected with the urethral canal by a narrow orifice. The urethral canal itself is of normal calibre. It is regarded by Routh as a retention cyst of the para-urethral glands which has formed an opening secondarily through the floor of the urethra.[1]

Treatment. These cystic swellings are prone to suppuration. They should be dissected out and the continuity of the urethral wall restored by suture.

Urethrocele. In this condition there is prolapse of the floor of the urethra, especially in its middle third. It is a common accompaniment of cystocele. Its treatment is included in the radical cure of the latter.

[1] Amand Routh, "Urethral Diverticula," *Trans. Obst. Soc.*, Lond., Vol. XXXII., 1890.

PART II: SECTION II

DISEASES OF THE VAGINA

THE vagina may be the seat of inflammation, ulceration, cysts, solid tumours (innocent and malignant). It is also subject to congenital anomalies, acquired defects, and injuries.

INFLAMMATION OF THE VAGINA: VAGINITIS: COLPITIS

Inflammation of the vaginal walls is not of frequent occurrence. The acid secretion (p. 206), the many layers of squamous epithelium (p. 50, *see* Fig. 40), and the absence of glands all act together to protect the vagina from infection. When the vaginal secretion is rendered alkaline by purulent discharges coming from above, and when the epithelium is sodden from the same cause, or subjected to the pressure of a neglected or ill-fitting pessary, the natural barriers to infection are broken down.

Causation. The commonest causes of vaginitis are gonorrhœal and streptococcal infections, the use of pessaries, excessive coitus, too frequent and too hot vaginal douches, the introduction of foreign bodies, the presence of fistulæ, necrotic and malignant uterine growths, and intestinal parasites. Among the rarer causes are specific and tuberculous ulcers, and also malignant disease of the vagina itself.

With regard to gonorrhœa we must repeat that this disease rarely causes primary vaginitis except in young subjects. In chronic cervical gonorrhœa a *secondary* vaginitis may be present, which is due to the septic organisms which have followed in the train of the gonococcus (*see* p. 263).

Primary vaginitis is seen in children, in whom it appears as a vulvo-vaginitis, a condition which may arise from other causes as well as from gonococcal infection (*see* p. 302).

Acute Vaginitis. The prominent symptoms are pain, throbbing, and a sense of burning heat. Dysuria and sometimes dyschezia are complained of. On inspection the mucous membrane is red, and roughened by the presence of swollen papillæ. It is covered with a copious purulent or muco-purulent secretion. On swabbing away the pus, the surface is found to be tender, and the tips of the papillæ may bleed. Externally there will be evidence of vulvitis; the labia may be adherent to one another with inspissated discharge, which later may cause intertrigo of the adjacent skin.

Vulvo-vaginitis of children (*see* Fig. 172, p. 302) is a form of acute colpitis which requires special mention. It begins as an infection of the vulva, whence it spreads to the vagina; it is to be found in children of all ages. As already stated, a considerable proportion of cases are due to gonorrhœal infection, which may be conveyed by towels or by fingers, or may be the result of criminal assault. In other instances the condition owes its origin to scratching, followed by infection by skin-organisms. Dirt and threadworms are often the cause of the pruritus which leads to scratching. Vulvo-vaginitis is

present in the rare cases of infection by the Klebs-Löffler bacillus, and also in the ulceration which follows measles and other exanthemata (*see* Vulva, p. 303).

The *treatment* of acute vaginitis is often very unsatisfactory and prolonged. The organism should be sought for by bacteriological examination, and a careful search also made for oxyurides. Mild antiseptic lotions should be used and strict cleanliness is essential. If the gonococcus is detected, treatment with 2 *per cent.* solution of collosol silver iodide is best. It may be introduced into the vagina through a small catheter or pipette.

Granular Vaginitis is a very rare form of colpitis, which is nearly always due to a gonococcal infection in a pregnant woman. The condition is accompanied by pain and an abundant yellow-green discharge. It is termed *granular* because of the presence on the mucous membrane of small indurated nodules of a deep red colour.

Membranous or Aphthous Vaginitis may be caused by the presence of the *oidium albicans* or of monilia in debilitated subjects at the end of a long illness. It is due to an extension of aphthous vulvitis (*see* p. 303).

Pseudo-membranes may also form after the application of caustics.

Three specific forms of vaginitis must also be mentioned (although their occurrence is rare), viz. diphtheritic, septic, and emphysematous vaginitis.

Diphtheritic Vaginitis appears as a form of the membranous variety; it occurs in children as a specific type of vulvo-vaginitis (*see above*). It may lead to complete or to superficial stenosis of the vagina. In diphtheritic cases, local treatment should be accompanied by use of the diphtheria antitoxin.

Septic Vaginitis may occur in the puerperium as a result of the infection of vaginal lacerations, when it may lead to the formation of a false membrane containing streptococci or a mixture of pyogenic organisms. Apart from child-bearing, it may be secondary to ulceration from malignant disease, or from retained pessaries. The foul discharges from cancer of the cervix, or from a sloughing myoma, may likewise set up this condition.

Emphysematous Vaginitis. This is a rare disease characterized by the formation of small, hard, purple papules, which become pustular and fill up with gas to form bullæ. As with granular vaginitis, this condition has been most often observed in pregnant and puerperal women who have become infected with the gonococcus.

Chronic or Catarrhal Vaginitis. This form of vaginitis is fairly common, being one of the most frequent causes of leucorrhœa. The mucous membrane is reddened, and there is a fairly abundant, yellowish, muco-purulent discharge. On careful inspection of the vaginal wall, numerous small areas of a deeper red than the surrounding mucosa are apparent; sometimes these spots bleed when firmly wiped with cotton wool. The changes are often most marked in the vaginal fornices. Occasionally small vesicles or pustules may be observed on the surface. Microscopically the vaginal wall shows round-celled infiltration of the subepithelial connective tissue, and extensive desquamation of the superficial epithelial layers; at spots corresponding to the deep red areas, the epithelium may be completely shed, laying bare the connective tissue. The discharge is neutral or alkaline in reaction, and contains many pus-cells in addition to shed epithelium.

Senile Vaginitis. In women who have passed the climacteric age, or in younger women after an artificial or operative menopause has been pro-

duced, a severe form of catarrhal vaginitis is often met with which may be called *senile vaginitis*. In this form the deep red areas already noted are large and numerous, and often especially affect the ostium vaginæ (*see* Pl. XII, p. 307). Epithelial desquamation is more extensive, and from the formation of large areas of superficial ulceration two results may follow: (1) Fibrotic thickening and contraction of the connective tissue may occur, leading to irregular puckering of the vaginal wall or to narrowing of the lumen; (2) abraded surfaces which become apposed to one another may adhere, forming transverse septa, or, when affecting the fornices, shutting off small pockets from the main vaginal canal.

This form of vaginitis is accompanied by a profuse, thin, purulent discharge which may be blood-stained. The relative severity of the process is to be attributed to atrophy of the mucosa and loss of the protective vaginal secretion, which render the tissues less able to resist bacterial invasion.

Diagnosis of the Cause of Vaginitis. The discharge should always be examined for the exciting organism; in the case of the gonococcus it must be remembered that it quickly disappears from the vagina, so that only the germs of a secondary infection may be found, hence a negative result does not exclude gonorrhœa. A swab should always be taken from the cervix or urethra, as the gonococcus persists for a longer period in these situations (*see* p. 259). The associated conditions will help to confirm a suspicion of gonorrhœa, *e.g.* cervicitis, urethritis, Bartholinitis, may be present as confirmatory evidence. For the bacteriological diagnosis in vulvo-vaginitis of childhood, Sinclair made use of the urethroscope in the investigation of eighty-three cases. This author states that in about 22 *per cent.* of these the gonococcus would have escaped detection without the use of this instrument.

Treatment of Chronic Vaginitis. Vaginitis is curable by douching and local applications, supplemented by attention to the general health, and avoidance of local irritation.

Douches are chiefly useful in removing discharges, and thus lessening the irritation which their contact with the mucosa causes, and in preventing the decomposition of retained secretions. The simple saline douche, consisting of a teaspoonful of sodium chloride to a pint of warm water, is the most generally useful, or one of the weak antiseptic douches may be employed instead. It is impossible for the weak solutions used as antiseptic douches to exercise any marked bactericidal action upon organisms which have penetrated the vaginal epithelium.

Local applications are also required and may be made directly through a speculum, or by the use of medicated vaginal pessaries. Surgical disinfection of the vaginal walls under anæsthesia may be necessary in gonorrhœal cases. The most useful applications *per speculum* are solution of nitrate of silver (10 to 20 gr. to 1 oz.) and a 2 *per cent.* solution of iodine; the vaginal walls may be swabbed with these solutions twice or three times a week, after careful wiping with cotton-wool swabs to remove secretion. Medicated pessaries containing ichthyol, resorcin, iodex, and similar antiseptic substances may be introduced by the patient into the vagina every night; as the medium melts the antiseptic becomes distributed over the vaginal walls. The douche should be used shortly before introducing the medicated pessary.

General treatment consists in the suspension of marital intercourse,

avoidance of alcohol and cigarette-smoking, and attention to the daily evacuation of the bowels.

ULCERATION OF THE VAGINA

Ulceration occurs under the following conditions:

(1) From pressure exerted by a neglected or ill-fitting pessary; occasionally also from foreign bodies introduced for purposes of masturbation, or for the prevention of conception, or by insane persons, with no purpose whatever. Fistulous communications with the rectum or with the bladder may result from this form of ulceration.

(2) From lacerations which have become infected; these may occur in the puerperium in association with sapræmia or septicæmia, or at other times from traumatism.

(3) From friction in the case of advanced prolapse of the second and third degrees.

(4) From tuberculous or syphilitic deposits, or from malignant growths.

Local or general vaginitis necessarily accompanies ulceration.

NEW GROWTHS

Vaginal Cysts. Small cystic tumours of the vaginal wall are not uncommon, but they very rarely exceed the size of a cricket ball. They are more often met with on the anterior and lateral walls than on the posterior wall. They bulge into the vaginal canal, the covering mucous membrane becoming thin and translucent. Occasionally they become polypoid. In the anterior wall they may be accompanied by prolapse (cystocele); indeed, these two conditions may be readily mistaken for one another, for the cyst may be large enough to protrude through the vulva (*see* Fig. 201). The larger ones may also burrow deeply into the pelvic cellular tissues. The contents are usually thin and colourless, but may be tinted by altered blood. In the smaller cysts, a single layer of columnar epithelium is generally found; in the larger cysts this is often entirely, or almost entirely, lost; they are almost always unilocular.

Cysts of this character are believed to arise from persistent portions of Gartner's duct (*see* p. 68). On two occasions we have met with cysts in the upper part of the posterior vaginal wall, which proceeded from growths of an adenomyomatous nature arising in the recto-vaginal septum. In each case they contained a serous blood-stained fluid. Very rarely multilocular cyst-adenomata occur in the vagina; occasionally, also, small cysts with an endothelial lining are found, which have no doubt arisen from dilated lymphatics. Although the vagina, like the Fallopian tubes, does not normally contain any glands, nevertheless, under the influence of inflammation, cells grow down from the basal layer of the epithelium in the form of solid processes, from which glandular tubules may ultimately develop. From these 'glands' small cysts arise, which may be so numerous as to be studded all over the vaginal surface. The condition in this extreme degree is very rare, and has been described by Bonney and Glendinning as *adenomatosis vaginae*. In fewer numbers, or as isolated examples, such cysts are not uncommon.

Symptoms and Treatment. Vaginal cysts give rise only to symptoms of mechanical origin; they may protrude at the vulva, causing discomfort and bearing-down pain, or they may occasion difficulty in coitus. They may be

dealt with surgically by partial or complete excision (*see* Operations, p. 776).

Vaginal Fibromyomata are much rarer than cysts. In structure and appearance they resemble uterine fibroids, but the proportion of muscle which they contain is relatively small. They seldom reach the size of a cricket ball, and are often pediculated ; they are much more frequently met with in the anterior than in the posterior wall. Unlike uterine fibroids, they

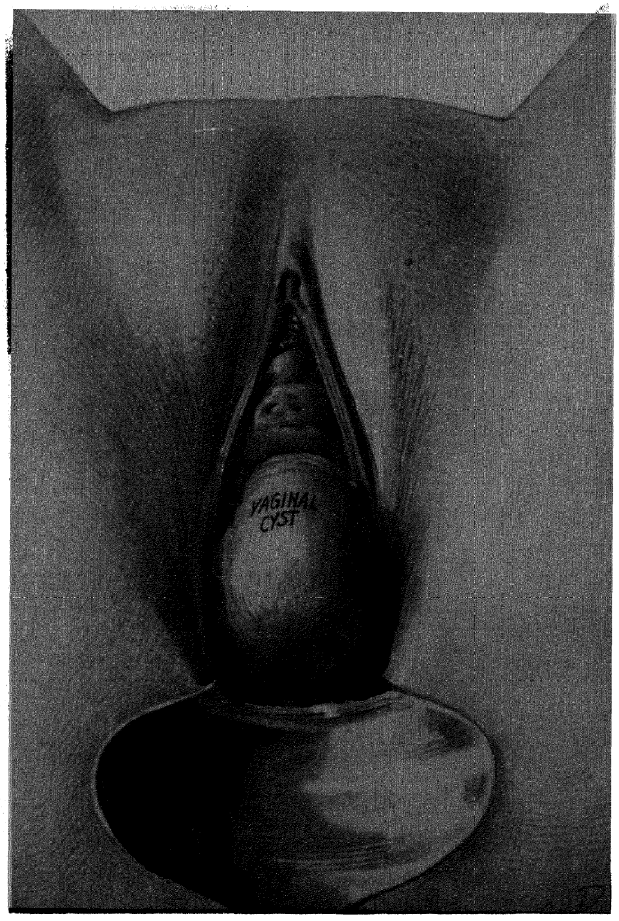


FIG. 201. CYST OF THE ANTERIOR VAGINAL WALL. The cyst protrudes through the vulva when exposed with a speculum.

are generally solitary. They give rise to mechanical symptoms only, and can be readily removed by enucleation.

Vaginal Papilloma. Benign polypi having the structure of papillomata have been recorded by Strachan as found in the vagina of infants.[1] In each of the two cases described the polypus arose from the anterior vaginal wall half an inch above the urethra and protruded at the vulva.

Chorionic Carcinoma (Chorionepithelioma). This rare disease may occur

[1] "Benign Polypi of the Vagina in Infants": Gilbert Strachan. *Proc. Roy. Soc. Med.*, Vol. XIX., No. 7, p. 78, May, 1926.

primarily in the vagina, but usually it is secondary to a corresponding growth in the uterus. A case of primary chorionic carcinoma of the vagina has been recorded by Berkeley, and we have seen one such case, where, since removal, the patient has been free from recurrence for some years. The growth appears as a purple nodule not unlike a thrombosed vein; when secondary, there may be more than one of these livid bosses present. In a case at the Samaritan Hospital there were two metastases on the anterior vaginal wall, both of which were visible on separating the labia. These growths are extremely vascular and bleed freely on contact. Primary growths have been known to disappear spontaneously.

Carcinoma of the Vagina. Cancer is met with in the vagina as a primary or as a secondary growth.

Primary cancer is rare, the subjects of the disease being usually elderly

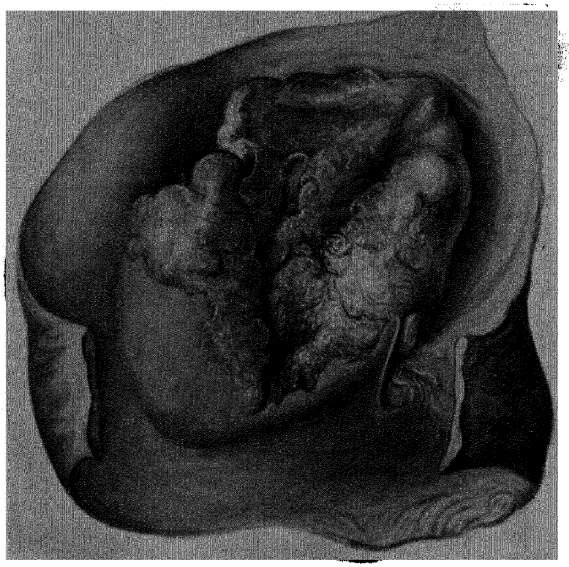


FIG. 202. PRIMARY SQUAMOUS-CELLED CANCER OF THE VAGINA. The growth occupied mainly the posterior wall, but in its upper part it ran around the lateral wall and reached to the midline anteriorly. In the latter situation the bladder-wall was very adherent.

women, although a few cases have occurred between twenty-five and thirty years of age. In some cases it has supervened upon prolonged irritation from a neglected pessary; occasionally it complicates prolapse of the vaginal walls. In the majority of instances the disease begins in the posterior wall (*see* Fig. 202) in the form of a circumscribed area of induration; this enlarges in all directions and tends to become ulcerated superficially. Several isolated patches of the disease may be met with, or it may surround the vaginal canal, forming an annular stricture. The paravaginal cellular tissue is early infiltrated; when the neighbourhood of the vulva is encroached upon, the superior group of the superficial inguinal chain of glands may be infiltrated. From the remainder of the vagina the lymphatics pass mainly into the inferior group of the internal iliac glands, but a few of the uppermost join

with those of the cervix, and pass into the superior set of iliac glands (*see* p. 65). A rectal fistula is a frequent accompaniment of the later stages of vaginal cancer; a bladder-fistula may also be formed, but is of much rarer occurrence. Histologically the growth presents the usual appearances of a squamous-celled carcinoma (*see* Fig. 203).

Secondary cancer is more common and may be met with as an extension from cancer of the cervix or of the rectum; more rarely it arises from cancer of the uterine body, the metastases being formed from implantation of living cancer-cells carried down from the uterus with blood or other discharges. An instance has also been recorded which was secondary to cancer of the Fallo-

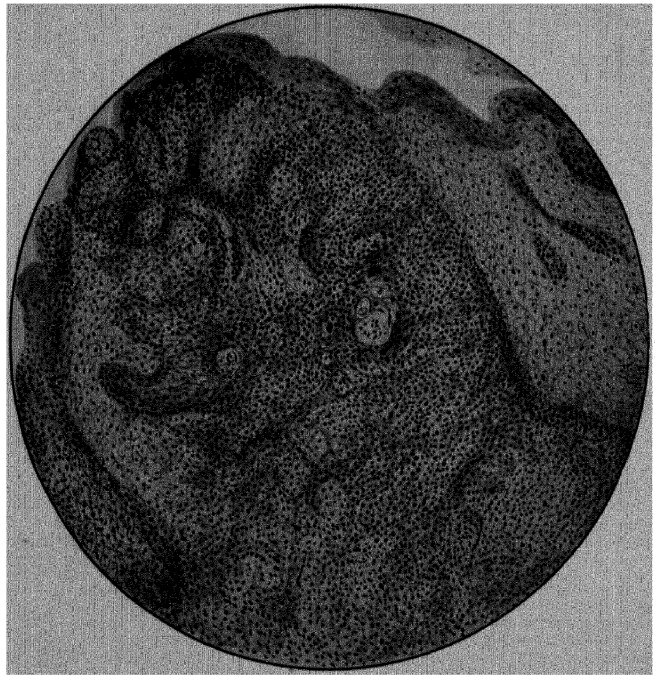


FIG. 203. PRIMARY SQUAMOUS-CELLED CANCER OF THE VAGINA. Microscopic section of growth shown in Figure 202.

pian tube, and Doran recorded a case of malignant hypernephroma of the vagina secondary to a growth in the kidney.

The *symptoms* are indistinguishable from those of cancer of the cervix (*see* p. 483); the amount of bleeding is, however, small. Digital examination shows the vaginal wall to be the seat of the growth, and the cervix may be found at a higher level than the upper limit of the growth and quite unaffected by it. Fixation of the vagina occurs early from involvement of the peri-vaginal cellular tissues.

Treatment. In the early stages excision of the affected portion of the vaginal canal may be practised or, better still, the entire vagina and uterus may be taken away together *en masse* from below. This severe operation is not practicable if the cellular tissue has become affected. The prognosis as regards recurrence is unfavourable.

Surgical disinfection of the vaginal walls under anæsthesia may be necessary in gonorrhœal and trichomonad cases. The most useful applications *per speculum* are a solution of nitrate of silver (10 to 20 gr. to 1 oz.), a 2 *per cent.* solution of iodine and a 2 to 4 *per cent.* solution of mercurochrome; the vaginal walls may be painted with these solutions twice or three times a week, after thorough douching to remove secretion. Medicated pessaries containing ichthyol, resorcin, iodex, acriflavine, mercurochrome, and similar antiseptic substances may be introduced by the patient into the vagina every night; as the medium liquefies the antiseptic becomes distributed over the vaginal walls. A saline or 2 *per cent.* sodium bicarbonate douche should be used shortly before introducing the medicated pessary.

General treatment consists in the suspension of sexual intercourse, avoidance of alcohol and tobacco, the oral administration of glucose, and attention to the daily evacuation of the bowels.

ULCERATION OF THE VAGINA

Ulceration occurs under the following conditions:—

(1) From pressure exerted by a neglected or ill-fitting pessary; occasionally also from foreign bodies introduced for purposes of masturbation, the prevention of conception, or by insane persons. Fistulous communications with the rectum or with the bladder may result from this traumatic form of ulceration.

(2) From lacerations which have become infected; these may occur in the puerperium in association with puerperal toxæmia or septicæmia, or at other times from traumatism.

(3) From friction in the case of severe prolapse of the second and third degrees.

(4) From tuberculous or syphilitic infection.

(5) From malignant neoplasms.

Local or general vaginitis necessarily accompanies ulceration.

TRAUMATIC LESIONS OF THE VAGINA

The vagina is frequently *lacerated* in parturition, and from prolonged *compression* during labour, portions of the anterior wall may slough, giving rise to a vesico-vaginal fistula. Sometimes the vaginal wall is *perforated* through violence; the commonest position is the posterior fornix, an injury which may result in septic peritonitis. This may occur in procuring an abortion by an unskilled person, from self-mutilation by the insane, or, more rarely, from falls astride a sharp instrument or from gun-shot wounds. Severe lacerations of the vagina have occasionally occurred during *coitus;* such lacerations usually affect the posterior vaginal wall as an extension from the hymen. In a few instances, however, extensive lacerations of the vaginal fornices have occurred, leading to profuse bleeding.

The immediate *treatment* of vaginal lacerations consists in disinfection of the wound, arrest of bleeding, and repair by suture. If the parts are severely contused it may be difficult to expose and tie the bleeding point, and in such cases the rent in the vaginal wall may be packed with antiseptic gauze. Injuries involving the wall of the bladder frequently resul'

later in the formation of a vesico-vaginal fistula; this condition may accordingly be conveniently considered here, along with certain other forms of vaginal fistulæ.

Urinary Vaginal Fistulæ. The most common type is that in which direct communication is established between the bladder and the vagina (*vesico-vaginal*). Occasionally, in extensive injuries, the anterior lip of the cervix may be destroyed (*see* Fig. 228), or so deeply lacerated that the cervical canal also communicates with the bladder (*vesico-cervical*). Direct communication may also be established between the ureter and the lateral vaginal fornix (*uretero-vaginal*); the usual cause of this lesion is an undis-

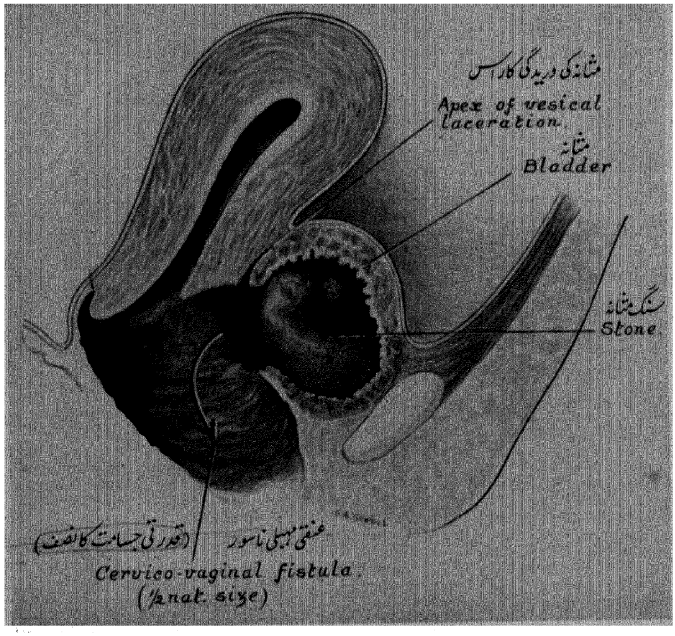


FIG. 228. VESICO-CERVICO-VAGINAL FISTULA: the result of obstetric injury and subsequent sloughing. The anterior lip of the cervix has been extensively destroyed; the aperture in the anterior vaginal wall admitted three fingers. A large vesical calculus has formed as the result of chronic cystitis.

covered injury to the ureter in the course of such a procedure as hysterectomy, or ligation during a radical operation for uterine prolapse.

Vesico-vaginal fistulae are situated in the upper half of the anterior vaginal wall. They are seldom of larger size than will admit the tip of the index finger; exceptionally, however, fistulæ of thrice this size are seen, while, on the other hand, they may be as small as a pin's head. Those of only moderate size are readily recognized on exposing the anterior vaginal wall with the aid of a speculum (*see* Fig. 614, p. 917). The vesical mucous membrane frequently becomes prolapsed and overhangs the edges of the aperture, whilst the margin of the opening in the vaginal wall is formed by a dense white ring of cicatricial tissue. Urine may be seen escaping through it in small intermittent overflows, as it

vaginal fistula; this condition may accordingly be conveniently considered here, along with certain other forms of vaginal fistulæ.

Urinary Vaginal Fistulæ. The commonest form is that in which direct communication is established between the bladder and the vagina (*vesico-vaginal*); sometimes, in extensive injuries, the anterior lip of the cervix may be destroyed (*see* Fig. 205), or so deeply torn that the cervical canal also communicates with the bladder (*vesico-cervical*). Occasionally direct communication is established between the ureter and the lateral vaginal fornix (*uretero-vaginal*); the usual cause is an undiscovered injury to the ureter in the course of such procedures as hysterectomy, resulting in the formation of a fistula.

Vesico-vaginal fistulae are situated in the upper half of the anterior vaginal wall. They are seldom met with of larger size than will admit the tip of the index finger; exceptionally, however, fistulæ of thrice this size are seen, while, on the other hand, they may be as small as a pin's head. Those of only moderate size are readily recognized on exposing the anterior vaginal wall with the aid of specula (*see* Fig. 539, p. 759). The vesical mucous membrane becomes prolapsed, and overhangs the edges of the aperture in dark-red folds; the margin of the opening in the vaginal wall is formed by a dense white ring of cicatricial tissue. Urine may be seen escaping through it in small intermittent overflows, as it is delivered into the bladder through the ureters. The smallest fistulæ are more difficult to discover; a probe gives assistance in the search, and if necessary a coloured, sterile fluid can be used to distend the bladder, when the escape into the vagina will be readily seen. The vaginal walls and vulva always show a good deal of inflammatory change set up by the constant irritation of the urinary overflow. The condition may be complicated by cystitis and decomposition of urine, when extensive excoriation of the mucous membranes and skin may occur, and deposits of ammonia salts collect upon the edges of the fistula. In rare instances calculi, large enough to occupy the entire bladder-cavity, may be formed. The calculus shown in Figure 205 measured 5 inches in circumference.

Vesico-vaginal fistulæ may also be set up in advanced stages of carcinoma of the cervix, or of the vagina, by direct invasion of the bladder-wall, and ulceration of the growth.

Ureteral fistulae are situated in the vaginal fornices; the aperture is always small, and may be difficult to discover. The local changes in the vagina and vulva are the same as those just described.

Urinary fistulæ, although they cause intense physical discomfort and mental distress, are not attended by serious consequences to the general health, and unless cystitis occurs the risk of ascending infection does not appear to be great. Bladder-fistulæ may be dealt with by the plastic operations described later on (*see* p. 761). Ureteral fistulæ are usually best dealt with by removal of the corresponding kidney, a careful cystoscopic examination being first made to determine which ureter has remained in communication with the bladder. Attempts to effect an anastomosis between the distal end of the divided ureter and bladder have seldom been successful as a mode of treatment for ureteric fistulæ.

PART II: SECTION III

DISEASES OF THE UTERUS

A. INFLAMMATION AND ALLIED CONDITIONS

(*a*) ACUTE ENDOMETRITIS
(*b*) CHRONIC CORPOREAL ENDOMETRITIS
(*c*) ALLIED CONDITIONS
(*d*) CERVICAL ENDOMETRITIS
(*e*) CHRONIC METRITIS

ENDOMETRITIS

In this section will be described the various results of inflammation affecting the uterus and also certain processes which, although allied to inflammation, are not demonstrably inflammatory in their nature. The latter are grouped for convenience along with *Chronic Endometritis* and are spoken of as *allied conditions;* their clinical importance is considerable, and their pathology is debatable; it will therefore be necessary to deal with them at some length. The true inflammatory changes, *i.e.* those in which there is histological evidence of inflammation, are probably due in the first instance to *infection;* nevertheless it is not always possible to determine the nature of the infective agent. It will be understood that an inflammatory process attacking the endometrium will tend to spread by continuity of tissue to the uterine muscle; therefore in any case of infective endometritis an element of metritis may also exist. Experience shows that, except in cases of acute infection the muscular tissue is not extensively invaded, and the changes in the endometrium form the important feature. In some cases of chronic infection, however, the whole muscular wall may become affected, giving rise to one variety of the condition known as chronic metritis.

ACUTE ENDOMETRITIS

There is only one type of this disease and that is due to infection. The infection of the endometrium occurs in both puerperal and non-puerperal cases. In the former *sapraemia* and *septicaemia* will be the clinical results of the infection (*see* pp. 211 and 215). Of the non-puerperal causes *gonorrhœa* is probably the most important. Other conditions leading to acute endometritis are of an essentially septic nature and include necrotic fibroids, degenerating carcinomata, infection of hæmatometra, the passage of a septic instrument, and the results following the use of strong caustics.

Our knowledge of the histology of acute endometritis is, in the main, derived from examination of sapræmic and septicæmic uteri; for it is quite exceptional that opportunity is afforded of examining the endometrium in

a case of acute gonorrhœal endometritis, whilst in pyometra the mucosa, as already seen, is reduced to a layer of septic granulation tissue (*see* Fig. 141, p. 214).

Therefore for an account of the morbid anatomy, diagnosis, and symptoms of acute corporeal endometritis the student is referred to the section dealing with uterine sepsis and pyometra (*see* pp. 210 and 213).

Subacute Endometritis. This condition is exemplified in association with retained products of gestation and in sub-involution, conditions which have been fully discussed already (*see* p. 248).

CHRONIC ENDOMETRITIS

This condition must be separately considered in the body and in the cervix, and may be classified as follows :

(I) *Chronic Corporeal (Interstitial) Endometritis.* The stress of the changes falls upon the stroma, but in some types, glandular increase is also present. Accordingly the main inflammatory changes in all cases are interstitial, and the name of ' interstitial endometritis ' adequately describes them all. Certain varieties must, however, be recognized, as follows :

Interstitial Endometritis { (*a*) Atrophic. / (*b*) Hyperplastic. { (1) Diffuse-fungous. / (2) Polypoidal-cystic.

Allied Conditions. (*a*) ' Glandular endometritis ' (so-called) ; (*b*) Post-climacteric atrophy (so-called ' atrophic endometritis ') ; (*c*) Simple adenoma of the endometrium ; (*d*) Massive menstrual exfoliation.

(II) *Chronic Cervical Endometritis.*

CHRONIC CORPOREAL ENDOMETRITIS

(Interstitial Endometritis)

Pathology. Before proceeding to the study of this subject the student must revise his knowledge of the anatomy of the endometrium (*see* p. 14) and also refer to the description given on pages 78-83 of the changes which occur in the mucous membrane of the uterus as the result of menstruation. It will have been gathered from the section on Menstruation that the endometrium varies greatly in its histological characters within purely physiological limits. It is possible to classify these normal variations according to the particular time at which they appear in the menstrual cycle. Thus the endometrium shows (1) post-menstrual, (2) interval, (3) premenstrual, and (4) menstrual changes.

It is evident that these cyclic variations must never be lost sight of in our endeavours to decide, by microscopic examination, between what is normal and what is pathological. The credit of pointing out the importance of considering the menstrual changes in connection with the question of endometritis is due to Hitschmann and Adler (*see* p. 79). The view taken by these authorities is that there is only one form of chronic endometritis, and that is the *interstitial* variety. This view was adopted in the previous editions of this work, and to it we still adhere to the exclusion of the anatomical classification of Gebhard and Ruge, which makes no allowance for cyclical variations of structure incidental to menstruation.

Bearing in mind these cyclic changes, we will now pass on to consider the means at our disposal for arriving at a correct diagnosis of chronic interstitial endometritis. In most organs of the body a chronic inflammatory process does not admit of much controversy, but there are certain special difficulties peculiar to a variable structure like the endometrium which render a correct decision on the question of the presence of chronic inflammation unusually difficult. The recognition of inflammation will depend upon changes in the *stroma* rather than changes in the glands.

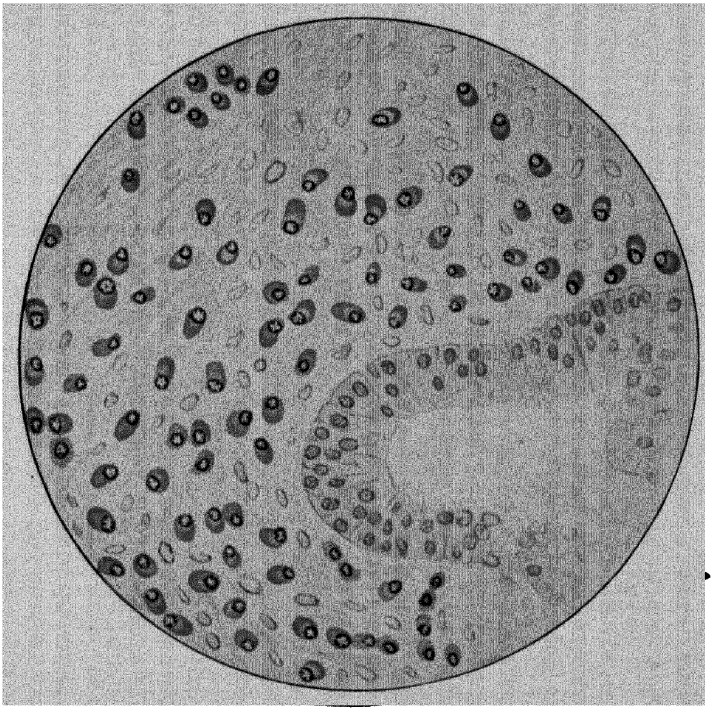
(A) *Changes in the Stroma.* (1) *Œdema.* This has been said to be evidence of inflammation, but as it is normally present in the premenstrual stage it cannot be regarded as pathognomonic of inflammation in the endometrium.

(2) *Round-celled Infiltration.* In dense tissue, like muscle for example, the presence of a round-celled exudation is easy of detection, but in a richly cellular structure such as the corporeal endometrium its recognition is more difficult. In the normal stroma we find an abundance of lymphocytes and connective-tissue cells, and just before menstruation a limited number of polymorphonuclear leucocytes are also present. In the subacute, and to a less degree in the chronically inflamed endometrium, there are accumulations of polymorphonuclear leucocytes around the glands and sometimes actually in the lumina. These may also often be found diffused throughout the superficial layers of the stroma underneath the surface-epithelium. The distribution of these cells is often patchy; their diagnostic value depends upon their aggregate numbers, upon their deep-staining properties, and upon the contrast between their irregular-shaped nuclei and the symmetrical nuclei of the adjacent lymphocytes; moreover, a leucocyte is slightly larger in size than a lymphocyte.

(3) *Plasma-cells.* This is another exudation-cell, and when present in large numbers it forms the most reliable index we have to the presence of a true *chronic* inflammation. Many authorities dispute the value of the plasma-cell as a diagnostic feature of chronic inflammation, but we agree with Hitschmann and Adler as to its paramount importance. A few plasma-cells may be found in the normal endometrium, just as may a few polymorphonuclear leucocytes, but in the chronically inflamed membrane plasma-cells are abundant (*see* Pl. XVI), so that their diagnostic value is dependent on the numbers present. It may be said that during the *subacute* stage of endometritis the inflammatory exudate consists of a diffuse or patchy distribution of polymorphonuclear leucocytes, and that when the inflammation becomes *chronic* the exudation consists of plasma-cells which have replaced the leucocytes.

So important is the plasma-cell in the diagnosis of chronic endometritis, that we must now describe its characters fully.

The plasma-cell is twice the size of a lymphoid cell, it contains a large amount of basophilic cytoplasm, its outline is polyhedral and irregular; there is often a pale area around the nucleus, which is eccentric, has a wheel-like appearance, and shows a stellate arrangement of its chromatin bodies. The origin of the plasma-cell is variously given. Unna says it is developed from connective tissue; the prevailing idea is, that the plasma-cell is developed from the lymphocytes of the blood or lymph. In chronic endometritis it is found in large numbers, often making up the entire exudate, and it is easily differentiated from the other elements of the endometrium.



ENDOMETRITIS showing Plasma-cells (red) and Lymphocytes (pale blue) stained by the Unna-Pappenheim process.

To face page 352.

Plate XVI shows plasma-cells in the endometrial stroma stained by the Unna-Pappenheim method ; the chromatin of the nuclei stains green, the cytoplasm red.

The details of the special method of staining for plasma-cells will be found in text-books of Pathology.

At present the diagnosis of subacute and chronic endometritis depends, therefore, upon the finding of (1) round-celled exudation, and (2) an exudate consisting of plasma-cells distributed in patches or diffused throughout the stroma ; but, as in inflammation elsewhere, there are vascular changes to be considered as well. These, in the subacute stage, amount to (3) dilatation of the vessels, and in the chronic stage to (4) the formation of new vessels, and thickening of the old vessel-walls. Following on the above changes we get in the stroma, (5) the inevitable fibrosis which characterizes all chronic inflammatory lesions. This introduces another difficulty in the case of the endometrium, since in diagnosis we shall be called upon to distinguish between the physiological atrophy of the membrane, which occurs after the menopause, and pathological fibrosis. The latter must also be differentiated from the compressed and relatively dense stroma of the post-menstrual phase.

(B) *Changes in the Glands.* The usual effect of chronic inflammation occurring in the neighbourhood of epithelium is to produce proliferation of the epithelial cells. This appears not to take place in the case of the uterine glands ; at any rate, it is not constant enough to make it a characteristic feature of chronic endometritis. As a rule, the size and shape of the glands will vary with the phase in the menstrual cycle ; but it would seem that in some cases the inflammatory state of the stroma is capable of *inhibiting the involution which normally occurs in the glands after menstruation*, thus preserving as permanent, the glandular hyperplasia characteristic of the premenstrual stage. It is possible in such cases to find, at all periods of the menstrual cycle, signs of an interstitial inflammation combined with the glandular hypertrophy and hyperplasia, which are *normal* only in the premenstrual phase. In addition to hypertrophy and hyperplasia of the glands, many of the cells lining their lumina retain their secretion and are converted into goblet- or beaker-cells.

We will now enumerate in tabular form the changes in the endometrium which, in our opinion, are due to inflammation, and which, therefore, constitute true endometritis.

The Inflamed Corporeal Endometrium shows :	*The Normal Corporeal Endometrium shows :*
(1) Mucus *within the cells* of the glands.	(1) Mucus *in the lumina* of the tubules only.
(2) Polymorphonuclear leucocytes in large numbers.	(2) Polymorphonuclear leucocytes few in numbers, and present in the premenstrual stage only.
(3) Round-celled exudation in the superficial muscular layers.	(3) None.
(4) Plasma-cells in abundance.	(4) Plasma-cells few, single, or none.
(5) New vessels, many with thick walls.	(5) Thin-walled blood-vessels only.

The Inflamed Corporeal Endometrium shows :	*The Normal Corporeal Endometrium shows :*
(6) Invasion of superficial muscle by some of the tubules of the endometrium.	(6) Invasion of muscle by glands far less pronounced.
(7) Fibrosis of stroma, with glands reduced in size, and thick-walled blood-vessels.	(7) Fibrosis of stroma, with shrinkage in size of some glands and cystic distension of others, but no thick-walled vessels.

Only conditions which fulfil the criteria laid down above can properly be named *chronic endometritis*, and we shall limit this title strictly to them. As already mentioned, two histological varieties of chronic endometritis may be recognized, but, before describing their characters, the question of their causation must briefly be considered.

Etiology. In some instances a direct connection with an infection can be established, and most of such cases are gonorrhœal. In others there is a definite history of preceding septic infection to which the condition may reasonably be attributed. In others, however, there is no history of infection from without ; the possibility of an infection by the blood cannot, however, be excluded, and consequently even these cases may be due to infection of an unrecognized type. Owing to the multiplicity of organisms present, a bacteriological diagnosis of chronic infective lesions is usually impracticable in all parts of the body.

Chronic endometritis cannot be definitely proved to be gonorrhœal except by demonstrating gonococci in the glands, or in the stroma of the endometrium. Cultures from the corporeal secretion are very difficult to obtain free from contamination by cervical discharge, and, as we shall see later, there is no doubt that cervical endometritis is frequently gonorrhœal. Cases of chronic endometritis associated with definite signs of old gonorrhœal infection may, however, be presumed to be gonorrhœal, and in such, the changes described as interstitial endometritis are frequently met with. There are, however, no histological features specially characteristic of gonorrhœa (*see* p. 263).

Chronic endometritis associated with retained products of conception may be assumed to be septic, and so may cases which immediately follow an infection resulting from miscarriage, labour, or operative interference within the uterus, even if it be of such an inconsiderable character as the passage of the uterine sound. In such cases the lesion is often subacute rather than chronic. In these cases, also, the appearances are not definitely characteristic.

Varieties. Two varieties of chronic (interstitial) endometritis may be recognized in which the histological changes are sufficiently distinctive to justify their being regarded as definite varieties. In the *atrophic* variety the stress of the changes falls upon the stroma of the endometrium, the glands being only secondarily affected as a mechanical result of the changes in the surrounding stroma. In the *hyperplastic* variety changes occur in all the elements of the endometrium. As will appear, they are in the main hyperplastic changes, but associated with these are others which can only be regarded as the result of an inflammatory process. It will be recollected

that hypertrophy is a common result of chronic inflammation of mucous membranes in all parts of the body.

(*a*) **Atrophic Form.** In this form there are two stages to be recognized : (1) an acute or subacute stage, and (2) a chronic stage.

In the *first stage* the mucous membrane is reddened and swollen. We have here a true inflammatory process which leads to exudation of serum, red blood-corpuscles, and leucocytes into the stroma. By pressure the

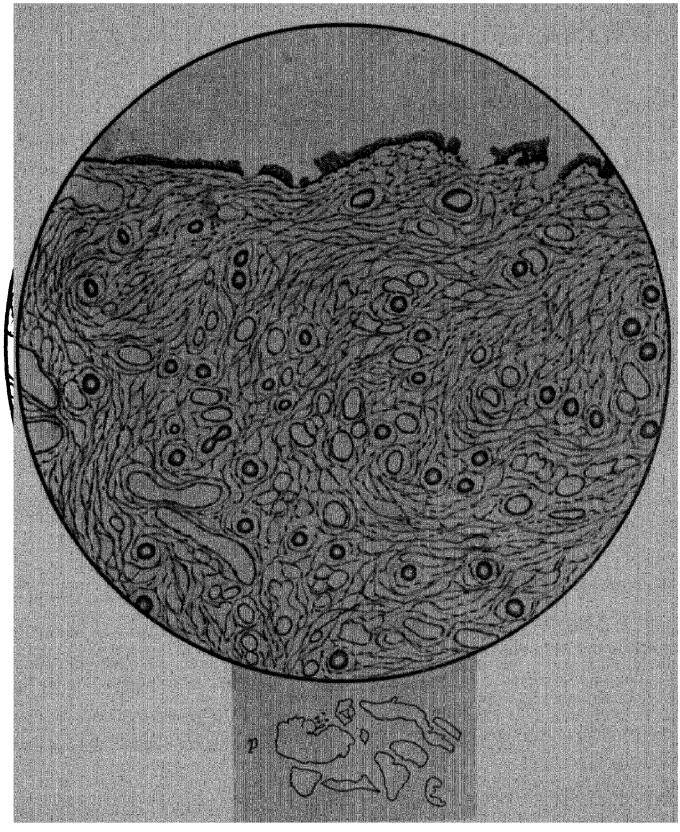


FIG. 206. SHOWING ATROPHIC (INTERSTITIAL) ENDOMETRITIS : CHRONIC STAGE. The fibrotic state of the stroma is apparent. The glands are small and compressed, and many have lost their epithelium. The inset represents the outlines of the tissues on the microscopic slide. It shows a small polypus (*p*), but the other fragments demonstrate the atrophic condition of the mucous membrane.

glands become smaller, and they are more widely separated from one another by the infiltrated stroma. This stage is met with in ascending gonorrhœa and in sepsis following abortion. In the *second* or *chronic stage* the endometrium is thinner than normal (*see* Fig. 206). The stroma is denser owing to the presence of fibroblasts and fully-formed connective tissue. The glands are small and scanty ; many have lost their epithelium and appear as small cysts devoid of a lining. In both the subacute and chronic forms, but especially in the latter, plasma-cells are to be found in abundance. It

may therefore be taken for granted that this is a true endometritis, and always produced by infection. It may be accompanied by *chronic metritis* (*see* p. 373).

Difficulties in diagnosis may arise in consequence of the resemblance between the large stroma-cells seen in this form of endometritis and the cells of a decidual membrane, or those of a sarcoma. As the differential diagnosis is important, the diagnostic points may be contrasted thus:

Interstitial Endometritis	*Decidua*
(1) In the acute and subacute stages enlarged stroma-cells are grouped in patches, not uniformly distributed.	(1) The *decidua compacta* is formed from the whole of the superficial layer of the endometrium, and is therefore uniform and general.
(2) The stroma-cells are never so large as the decidual cells.	(2) The decidual cells are much larger than the stroma-cells in endometritis, and are very rich in protoplasm.
(3) The stroma-cells vary in shape and size.	(3) The decidual cell is remarkably uniform in shape and size.
(4) The stroma-cells are separated by a loose reticular intercellular substance.	(4) Decidual cells lie close together, hence the term 'compacta.'

In the more advanced and chronic stages the young fibrous-tissue cells have to be distinguished from fibro-sarcoma.

Interstitial Endometritis	*Fibro-sarcoma*
(1) In young fibrous tissue the cells vary slightly in size and shape.	(1) In fibro-sarcoma there is much greater variability in size and shape of cells, and in their staining capacity.
(2) The nuclei are quite simple.	(2) The nuclei show mitotic figures.

(*b*) **Hyperplastic Form.** Two sub-varieties may be distinguished: (1) diffuse-fungous; (2) polypoidal-cystic.

(1) *Diffuse-fungous Form.* In this form of endometritis the mucous membrane is uniformly thickened and tends to the formation of polypoidal masses. Histologically it combines hypertrophy of gland-tissue with hyperplasia of the stroma (*see* Fig. 207). The glands are as large as those seen in the premenstrual stage, whilst the stroma is as dense as it is in chronic interstitial endometritis. It is probably a true inflammatory condition, and the following features lend support to this view.

In the fibrotic stroma are seen thick-walled blood-vessels which are totally unlike the capillary vessels seen in the normal endometrium at its fullest premenstrual development (compare Fig. 207 with Fig. 66, p. 80). The connective-tissue cells are in every stage of maturity from young fibroblasts (*large stroma cells*) to fully developed strands of fibrous tissue. Many of the columnar cells lining the glands are seen to contain goblets of mucus, which is another distinction—as in the normal mucous membrane of the

cavum uteri there are no goblet-cells, except occasionally during the few days which make up the premenstrual phase (*see* p. 15). Finally, plasma-cells are often found in abundance. There is a tendency to the formation of distension-cysts due to the occlusion of the stomata of the glands on the surface of the endometrium. Indeed, this form merges into the variety next to be described.

(2) *Polypoidal-cystic Form.* This variety is probably an advanced stage

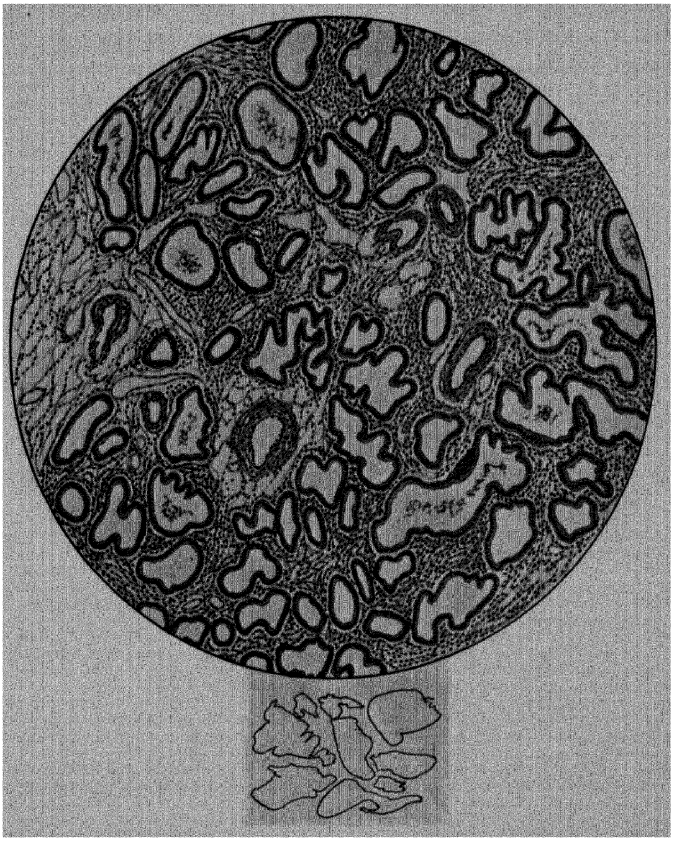


FIG. 207. SHOWING DIFFUSE FUNGOUS ENDOMETRITIS. The glands are as large and as complicated as those seen in the premenstrual stage of the healthy endometrium, but the stroma is very dense owing to the presence of young fibrous tissue. The important feature is the presence of thick-walled blood-vessels. Under a high power goblet-cells were seen in the epithelium. The inset shows outline of tissue on slide.

of fungous endometritis in which the endometrium has become more polypoid and the cystic condition of the glands more marked (*see* Fig. 209). The condition is comparable to the synovial fringes formed in chronic synovitis of the knee-joint (*see* Fig. 208). The polypoidal masses are covered by surface-epithelium, except upon their attached side. During curettage a polypoid portion of endometrium may easily be missed by the curette, and if this happens the symptomatic menorrhagia is apt to persist, a fact which

renders this form of endometritis more difficult to treat than the other forms above mentioned.

In both diffuse-fungous endometritis and polypoidal-cystic endometritis the deepest lying tubules can be seen to dip down into the muscle-tissue for a considerable distance, and in uteri which have been removed it is found that the muscle-walls are hypertrophied (Fig. 208).

There can be little doubt that both conditions are the result of a chronic infective process, as in the case of the atrophic form ; indeed, it is more than likely that fungous and cystic endometritis are later results of an inflammatory process which, starting in the premenstrual phase, *has prevented the normal involution of the glands from taking place*, so that a hyperplasia and hyper-

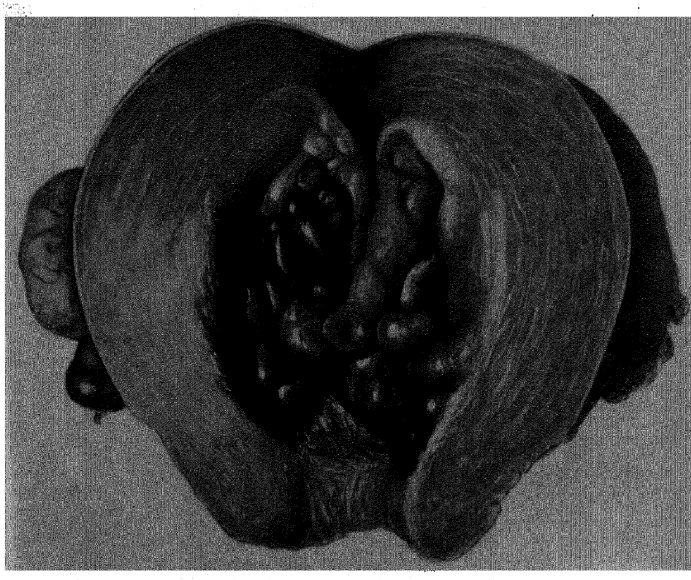


FIG. 208. ILLUSTRATING THE POLYPOIDAL-CYSTIC FORM OF CHRONIC CORPOREAL ENDOMETRITIS. These extreme changes in the endometrium are the result of hyperplasia, both of glands and stroma, produced by chronic inflammation.

trophy of glands, which was originally physiological and transitory, has become pathological and permanent, because the inflamed stroma has *arrested the involution* which is normal to the post-menstrual period.

ALLIED CONDITIONS

There are a number of conditions which in the past have been wrongly regarded as varieties of ' chronic endometritis ' ; none of them, however, fulfil the conditions laid down above as characteristic of a chronic inflammation. One of them, viz. ' *glandular endometritis*,' is the condition of the endometrium normal in the premenstrual phase ; another, ' *atrophic endometritis*,' is a normal post-climacteric change, which coincides with the general decline of activity in the sexual organs : a third, *simple adenoma*, is more properly regarded as a new growth ; whilst a fourth, ' *exfoliative endo-*

metritis,' is a menstrual disorder which has never been proved to be inflammatory. The first *two* of these conditions, although not instances of endometritis at all, must be briefly referred to here in order fully to explain the present view of the subject, the *third* being dealt with as a new growth of the uterus (*see* p. 447), and the *fourth* as a disorder of menstruation (*see* p. 165).

'Glandular Endometritis.' Ruge in 1879, and Gebhard in 1899, described under this name a condition of the endometrium frequently observed in minor gynæcological affections. The condition was pronounced by them

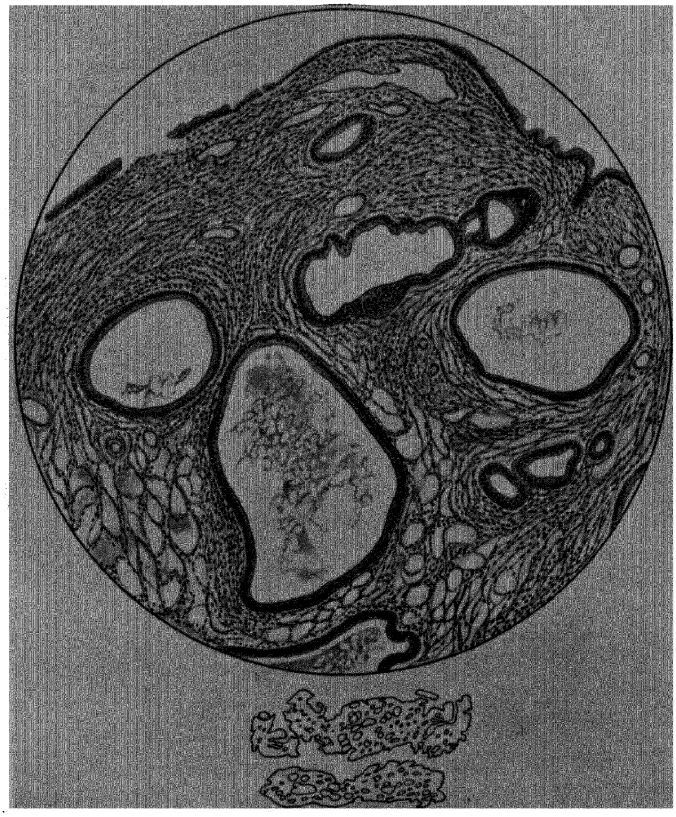


FIG. 209. POLYPOIDAL-CYSTIC ENDOMETRITIS. × 65. Note the density of the stroma and the large size of the dilated glands. The inset is a drawing of the scrapings as seen on the microscopic slide by the naked eye.

to be inflammatory; the microscopic appearances were definite and readily recognizable; they were seen with extraordinary frequency under conditions which called for the operation of curetting. The conclusions of Ruge and Gebhard received general acceptance, and thus the belief arose that 'glandular endometritis' was one of the commonest pathological conditions known to the gynæcologist.

It is to Hitschmann and Adler that the credit must be given of first pointing out the error which had been made by Ruge and by Gebhard. Their work, published in 1907, upon the cyclical changes in the endometrium

in connection with menstruation, has been described in another place (p. 80), and it suffices here to point out that the changes supposed to be characteristic of ' glandular endometritis ' are in reality identical with the changes regularly and normally observed in the premenstrual phase. Owing to the special character of the functional changes which the endometrium undergoes, glandular changes *alone* cannot be accepted as evidence of inflammation. Yet apart from the glands there is no evidence whatever of any inflammatory

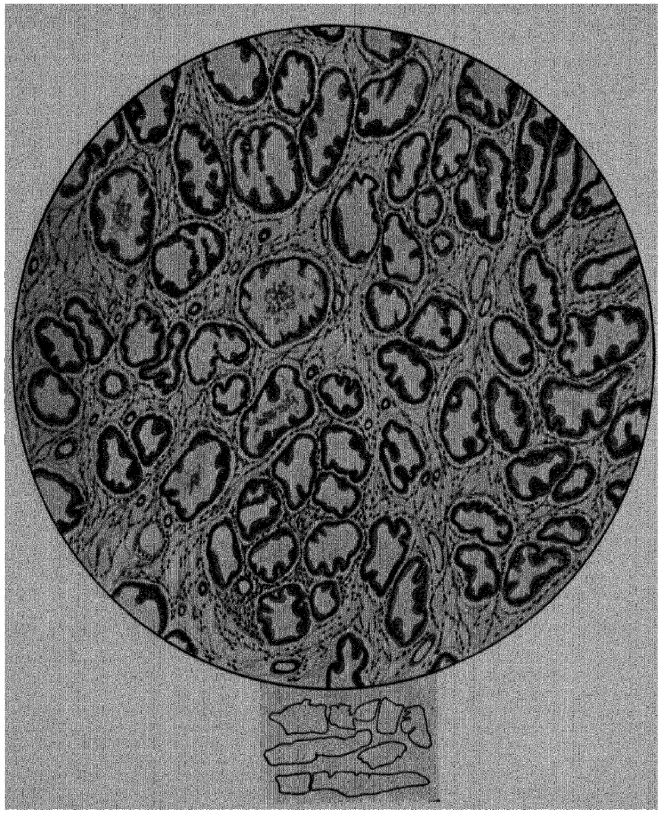


FIG. 210. SHOWING THE SO-CALLED GLANDULAR ENDOMETRITIS. This is the normal appearance of the endometrium in the premenstrual state. Note the crenated appearance of the tubules, the ingrowing fern-like tufts and the dilated condition of the glands. Contrast also the delicacy of the stroma with the density of that seen in the hyperplastic form of interstitial endometritis (fungous endometritis), Figure 207.

changes in the condition we are considering. It follows that what has been called ' glandular endometritis ' is not a pathological condition at all.

In order to demonstrate the identity of the premenstrual changes with so-called glandular endometritis Figures 210 and 211 are here given ; they represent sections which were made from curettings several years ago, and were then regarded as typical of ' glandular endometritis ' (compare with Figs. 66 and 70, pp. 80 and 82).

' Atrophic Endometritis ' (*Post-climacteric Atrophy*). Concurrently with the shrinkage of the uterus at and after the climacteric, the endometrium

becomes atrophic and thin ; the glands change their direction in relation to the surface-epithelium ; originally running at right angles to it they now take an oblique course (Fig. 212) ; they are reduced in size, their orifices become occluded, and they may form small cystic follicles (Fig. 213). The stroma becomes fibrotic, and presents much the same appearances as those seen in the atrophic stage of interstitial endometritis. This is a normal involution-change which occurs after the cessation of the ovarian function.

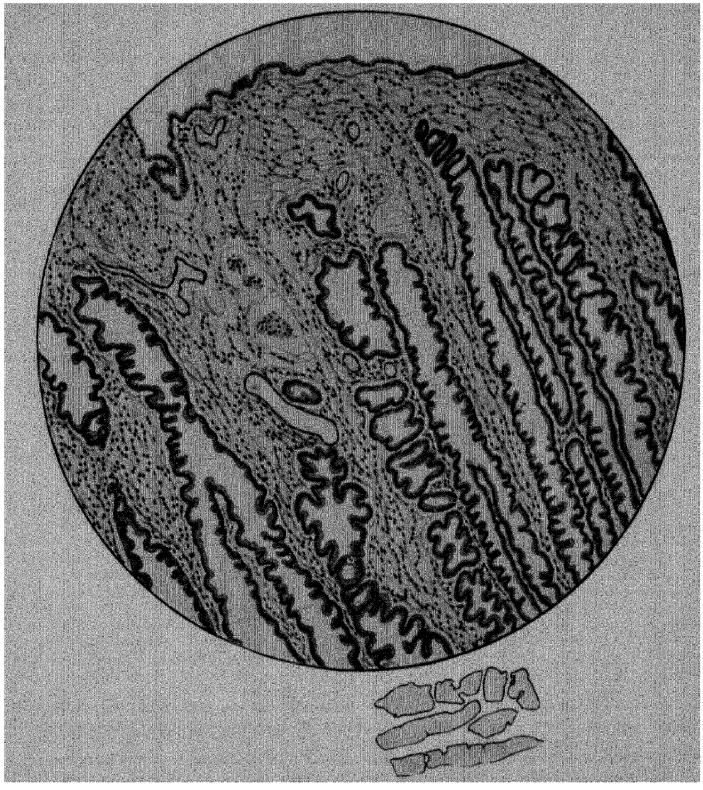


FIG. 211. FROM THE SAME SLIDE AS FIGURE 210. The corkscrew-like appearance of the glands is shown, and also the branching. The compact superficial stratum is in process of formation, but no patches of decidua-like cells have formed as yet. Compare Figure 70, page 82, which is an advanced stage of the condition shown in this figure, the formation of the cavernous layer being also more advanced.

There is nothing pathological in the alteration of structure which the endometrium undergoes as described above. Therefore, like the glandular variety, this so-called '*endometritis atrophicans*' must be excluded from the class of true chronic endometritis. It is quite common, however, for infection to be grafted on to this condition, and when it occurs true *senile endometritis* results. The latter has already been described in the section dealing with Infections (p. 223).

Occasionally in this post-climacteric atrophy the surface-epithelium, and that lining the glands, undergoes metaplasia and becomes squamous ; to this

senile change the term *leucoplakia uteri* has been given, and it helps to account for the occasional occurrence of squamous-celled cancer in the body of the uterus.

Simple Adenoma of the Endometrium. This condition will be described under Benign Epithelial New Growths of the Uterus (*see* p. 447).

Menstrual Exfoliation (exfoliative endometritis) has already been described under Disorders of Menstruation (*see* p. 165).

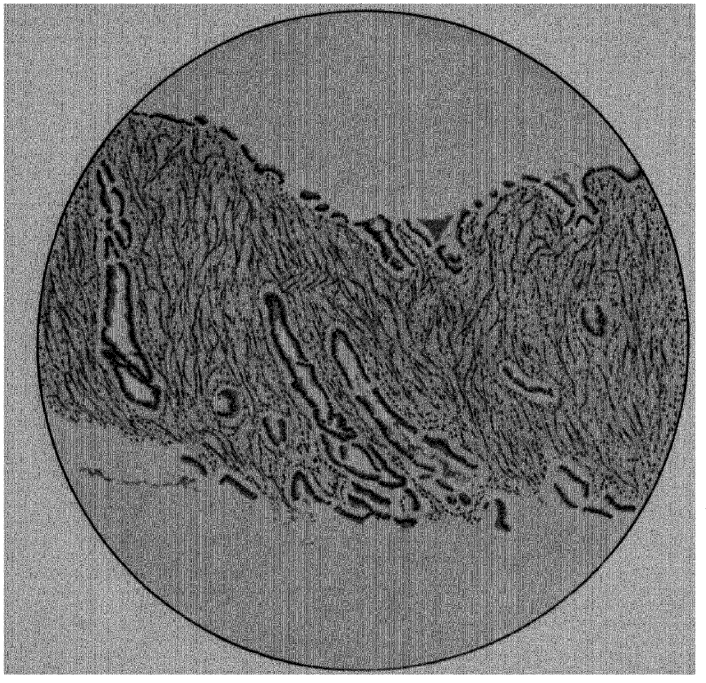


FIG. 212. SHOWING THE CHANGES WHICH OCCUR IN THE ENDOMETRIUM IN OLD AGE. × 65. The surface-epithelium is desquamating, the glands are running obliquely to the surface, and their epithelium is degenerated. The stroma is very fibrotic, and the entire endometrium is thin.

CERVICAL ENDOMETRITIS : EROSION : NABOTH'S FOLLICLES

It has already been shown that the cervical endometrium differs essentially in its anatomical features from the endometrium of the body of the uterus. Pathologically, and clinically also, the cervical part of the endometrium deserves special consideration. In spite of the continuity of the surface-epithelium at the internal os, the spread of inflammation to the cavity of the uterus from the cervix is by no means invariable, and even when both body and cervix are involved, the effects may be much more marked in the latter than in the former.

Macroscopically, cervical endometritis is evidenced by redness and swelling of the mucous membrane around a patulous external os, together with an abundance of muco-purulent secretion from the cervical canal. One or more small mucous polypi are not infrequently seen attached near the margin of the inflamed os, or projecting from the cervical canal.

Histologically, there is a round-celled infiltration beneath the columnar epithelium lining the cervical canal and also around the glands which lie deep in the cervical tissue (Fig. 214). At first the epithelium proliferates, the cells are filled with mucus and are rapidly shed. The glands swell up, become cystic, and are filled with their own secretion, in which aggregations of leucocytes are often seen. Proliferation followed by desquamation of the gland-epithelium occurs, leaving cystic spaces devoid of epithelium (*see* Fig. 15, p. 19). Ultimately the squamous epithelium adjacent to the

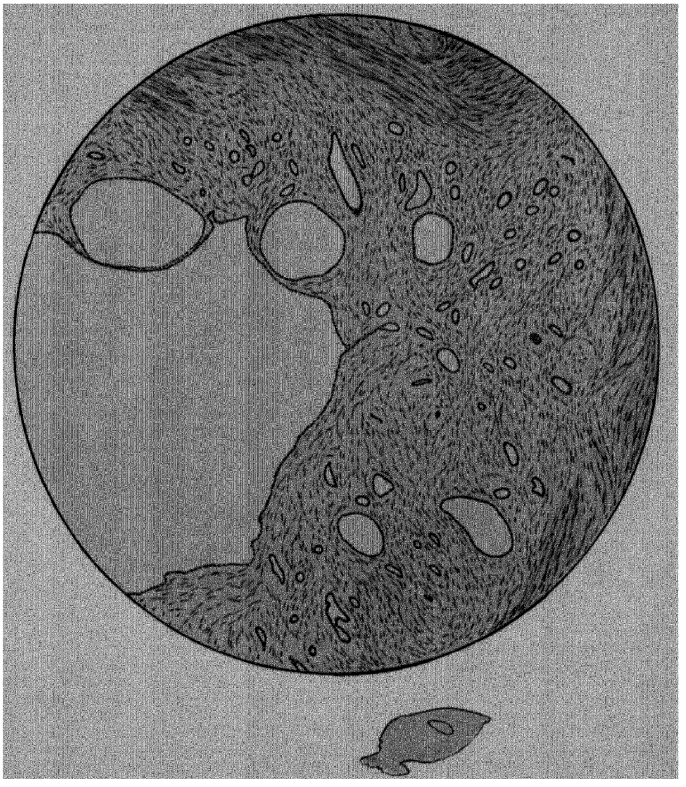


FIG. 213. SHOWING THE ENDOMETRIUM OF A PATIENT IN WHOM THE MENOPAUSE OCCURRED AT THE EARLY AGE OF THIRTY-SIX. Note the fibrotic stroma, the loss of epithelium in the glands and their cystic condition. The inset shows the naked-eye view of a section taken transversely through the cavity of the uterus, surrounded by a zone of uterine muscle; the *cavum uteri* being the small oval space.

external os is thrown off by a desquamative process, and a true ulcer, followed by 'erosion,' is formed in this situation. During the process of repair, the degenerated cervical glands become invaded by fibroblasts and disappear. The surface-epithelium, both in the canal and on the vaginal aspect, is renewed by the development of new cells, but the stroma remains chronically thickened by the addition of fibrous tissue, whilst the original tissue shows hyaline degeneration and marked thickening of the walls of the blood-vessels.

Erosion or Catarrhal Patch. Most intimately associated with inflammation of the cervical endometrium is the common lesion known clinically as *Erosion*, but to which Barbour has given the name of *Catarrhal patch*. The correct pathological name for the condition is *pseudo-adenoma*, glandular proliferation and epithelial *displacement* being combined with, and being indeed due to, an inflammatory process. A benign adenoma (a definite neoplasm) also occurs in the cervix and must be carefully distinguished from pseudo-adenoma due to inflammation (*see* p. 447).

Pathological Anatomy. In order to understand *erosions* the student must

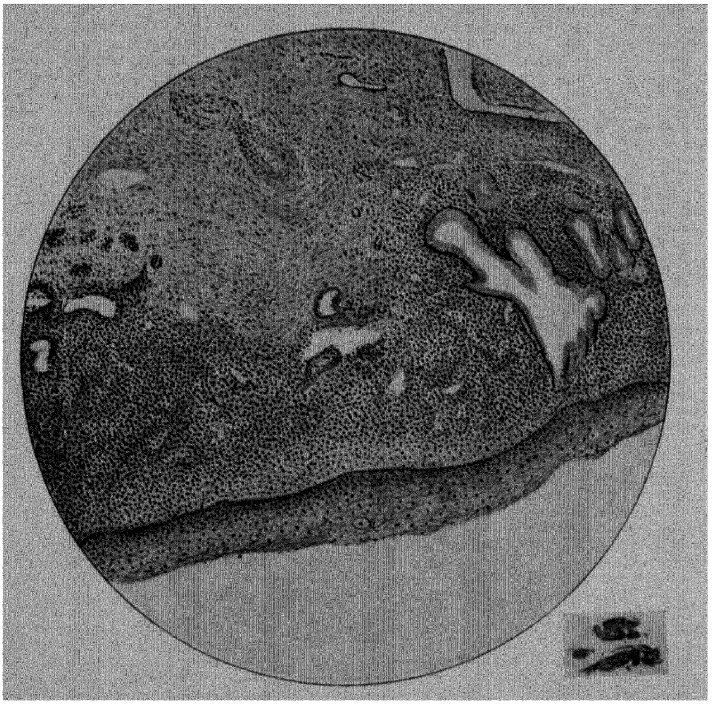


FIG. 214. SECTION THROUGH THE VAGINAL PORTION OF THE CERVIX FROM A CASE OF CERVICAL ENDOMETRITIS. × 105. There is an extensive round-celled infiltration of the tissues. This has spread from the cervical canal to the deep aspect of the intact squamous epithelium. At a later stage the squamous epithelium is thrown off, and true ulceration, followed by *erosion*, around the external os is thus produced.

be familiar with the appearances and structure of the normal cervix already described on pages 16–18.

In the fœtus the true mucous membrane extends beyond the external os, so that the lining of the cervical canal, in early life, spreads itself out for a variable distance upon the free vaginal surface of the cervix. When this fœtal condition persists it gives rise to what is known as a *congenital erosion*. This explains how it is that we find sometimes *erosions* on the cervix in the cases of young virgins, and in the absence of inflammation. Congenital erosions are, however, uncommon, and with this exception we are convinced that *erosions* are caused by inflammation.

Microscopically, it is quite impossible to distinguish any difference between an *ectropion* produced by laceration of the cervix (*see* Figs. 317 318, p. 506) and a cervical *erosion*, since the latter presents the same characteristics as everted and inflamed cervical endometrium.

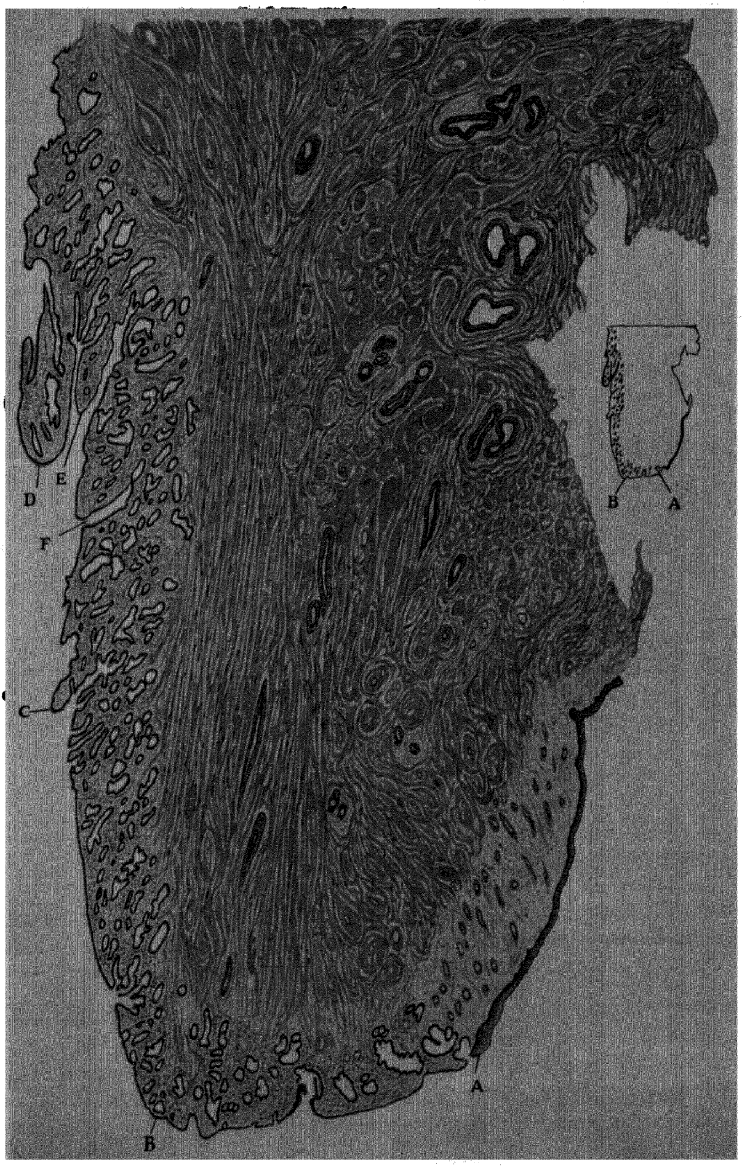


FIG. 215. LONGITUDINAL SECTION OF THE PORTIO VAGINALIS, SHOWING THE MICROSCOPICAL CHARACTERS OF AN EROSION. From B to A the squamous epithelium has been replaced by an erosion continuous with the cervical endometrium, which it resembles in structure. At C E F are seen the folds of cervical endometrium known as the *arbor vitae*. At D the endometrium has become polypoidal.

The naked-eye features of an ' erosion ' present considerable variations ; it has been customary to group these under three headings which are regarded as clinically descriptive of them. The terms in use for this purpose—*simple, papillary, follicular* ' erosions '—may conveniently be retained so long as the student bears in mind that they only represent progressive grades in one and the same pathological process. Plate XV shows the naked-eye appearances of each variety. Figure 216, A, demonstrates the histology of a *simple* erosion, which is thus seen to be an inflammatory area covered by a single layer of epithelium. Figure 217 shows one form of *papillary* erosion. Figure 218, G, shows another pathological variety of the papillary form, whilst Figures 215 and 219 show the *follicular* type. It will be seen that the papillary and the

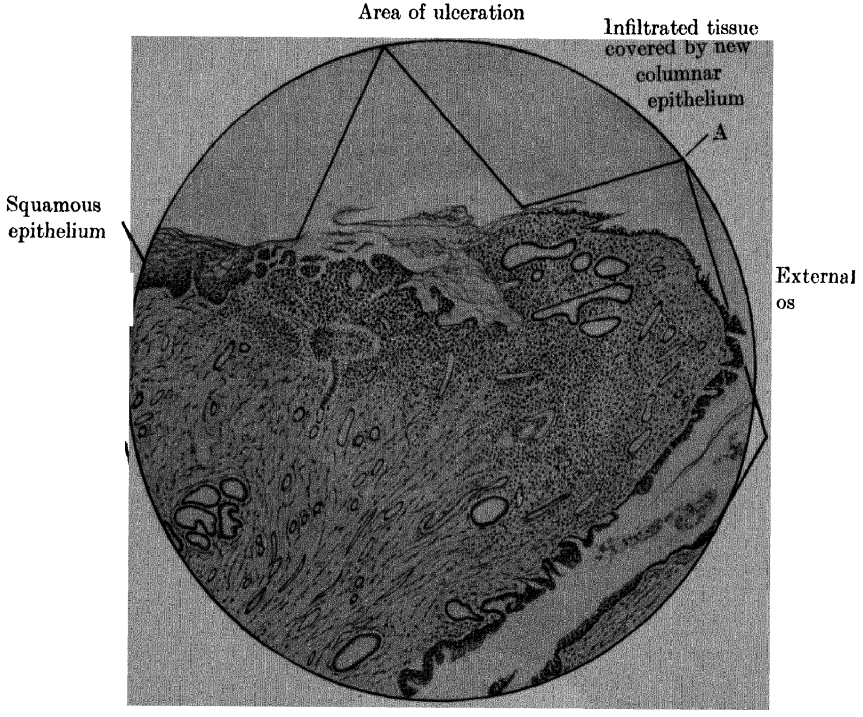
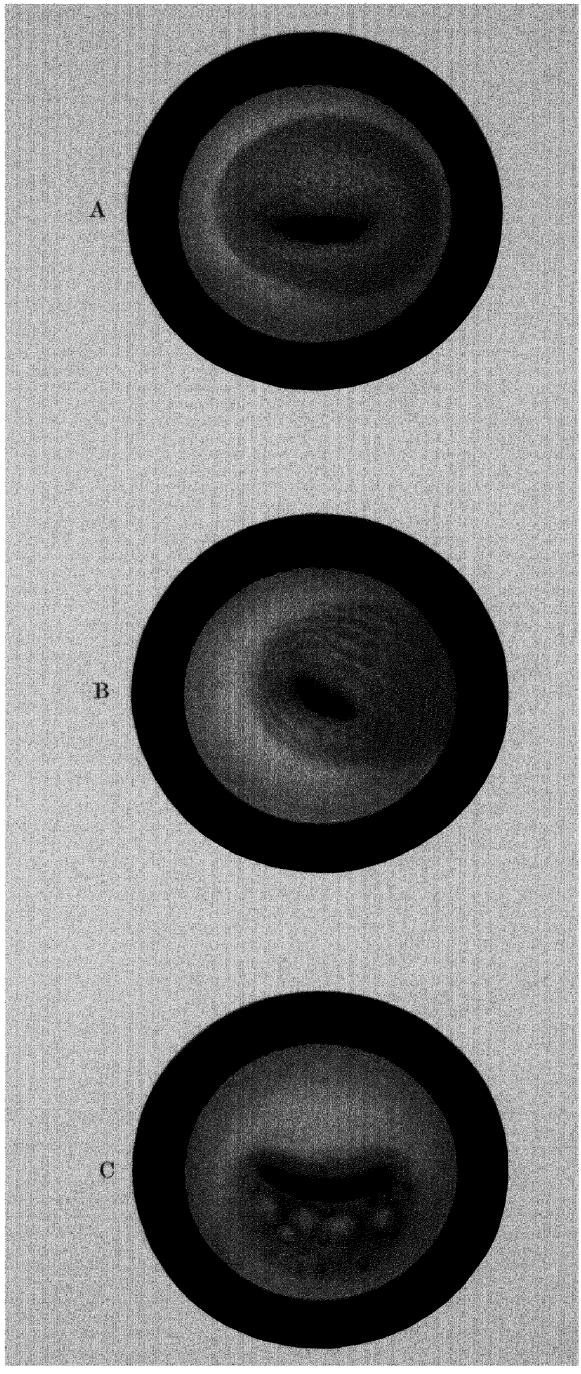


FIG. 216. SHOWING THE INFLAMMATORY ORIGIN OF AN ACQUIRED *Erosion*. An inflammatory exudation has spread from the cervical canal outwards underneath the vaginal surface of the cervix.

follicular types only vary in the size of the glands which open on the surface. In the latter the glands are larger and more distended, so that cysts or ' follicles ' may appear on the surface as naked-eye objects (*see* Pl. XVII (C)).

The microscopic characters of an erosion are those of the cervical endometrium *plus* the signs of inflammation. / The result is a *proliferative pseudo-adenomatous* condition consisting of a surface-layer of columnar epithelium through which open the mouths of branching glands which lie immediately beneath (*see* Figs. 217, G, and 218, G). Under the columnar epithelium and surrounding the glands there are always aggregations of inflammatory round cells, and we have repeatedly found an abundance of plasma-cells in the sub-epithelial exudation. In places, the inflammatory exudation comes



EROSION OF CERVIX, Naked-eye appearances of :—A—Simple. B—Papillary Erosion. C—Follicular.

To face page 366.

to the surface, and is not covered by epithelium, either squamous, or columnar Such areas, therefore, are examples of true ulceration (*see* Fig. 217). They will be covered by the proliferating columnar epithelium at a later stage (*see* Fig. 216).

We have come to regard an acquired *erosion*, therefore, as the result of nature's attempt to heal an ulcer by covering it with epithelium. The columnar character of the latter is due to the fact that, for the most part, it is derived from the epithelium lining the canal, an acquired *erosion* being analogous, so far as the behaviour of the epithelium is concerned, to a congenital *erosion*, where the epithelium of the canal does not end abruptly at the internal os, but trespasses on the surface of the vaginal cervix.

We have, however, repeatedly found that the basal layer of the *squamous* epithelium is capable of producing columnar cells, and these, by dipping down into the non-glandular fibro-muscular layers, produce branching glandular crypts. In our opinion, therefore, the glands seen in an *erosion* may be derived from two sources, (1) from proliferation of the true cervical



FIG. 217. SHOWING A PAPILLARY EROSION. × 80. The superficial layers of squamous epithelium have been shed. The basal layer remains and is seen covering the papillæ. At G is seen a glandular depression (filled with secretion), which has been formed from the basal layer of the surface-epithelium. The clinical appearances were those of an erosion of papillary type.

endometrium, (2) from proliferation and metaplasia of the basal cells of the squamous epithelium which covers the vaginal portion of the cervix (*see* Figs. 218, 219 and 220). When such secondary gland-formation occurs, the glands may open on the surface producing the *papillary* form of *erosion* (*see* Fig. 217); others may present as closed follicles, which become distended by their own secretion to form cysts, producing what is known as a *follicular erosion* (*see* Pl. XVII and Figures 215 and 218, H).

When an inflammatory exudate is covered by a *single layer* of columnar epithelium the condition as stated above is spoken of as a *simple erosion* (*see* Fig. 216).

All these types may, however, be produced, not by ulceration and healing, but by a proliferative adenomatous invasion (*congenital*) of the surface of the *portio vaginalis* by the endometrium lining the canal.

Thus an *acquired erosion* is a true inflammatory lesion, while the *congenital* type is due to adenomatous invasion. In *acquired erosion* the inflammatory process has excited epithelial proliferation, with the object of covering over an ulcer. The process is sometimes discovered when only partially com-

plete ; portions of the surface of the ulcer are then apparent, uncovered as yet by epithelium (*see* Fig. 216).

Unfortunately for nature's process, when once epithelial invasion has been started (even when, as here, it is quite benign) it is not easily checked,

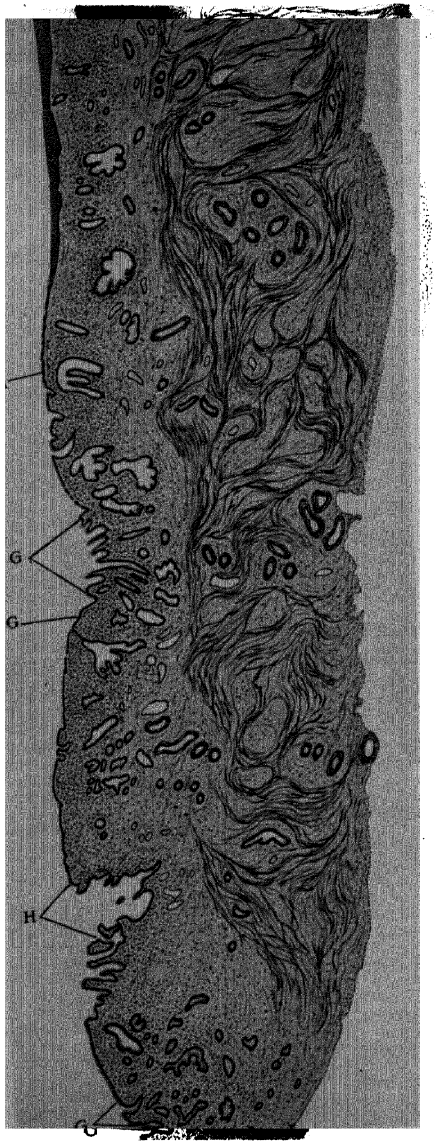


FIG. 218. SHOWING A FOLLICULAR EROSION ON THE PORTIO VAGINALIS. At A the squamous epithelium has become thinned out, and only the basal layer is left. The basal layer is continued along the remaining surface and sends down gland-like tubules into the stroma at points marked G. The deeper parts of the tubules are seen as epithelial lined spaces (H) (follicular erosion).

and instead of normal healing it results in epithelial overgrowth. This is what happens in an *erosion*, so that instead of a healed ulcer, we find a proliferative adenomatous process as the result, to which the term *pseudo-adenoma of the cervix* might logically be applied.

Naboth's Follicles. This is the name given to cystic cervical glands, when they are large enough to be clinically recognized. They push forwards the squamous epithelium, and project as tense, shining, bluish-looking, rounded bodies on the vaginal surface of the cervix. They are frequent enough, apart from any known lesion, to cause anatomists to figure them as a usual characteristic of the normal cervix (*see* Fig. 15, p. 19). These cysts may attain the size of a pea; more rarely they have been found as large as a grape. When punctured, very thick tenacious mucus escapes. After such a cyst has opened on the surface, if the lining is not destroyed, it may proliferate.

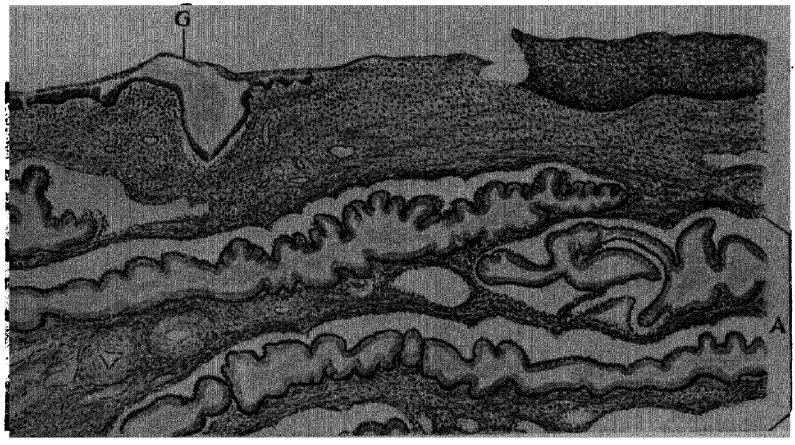


FIG. 219. SHOWING A SECTION OF THE PORTIO VAGINALIS WHICH IS COVERED ONLY BY THE BASAL LAYER OF SQUAMOUS EPITHELIUM. × 105. Beneath this there is a gland (G), the columnar epithelium of which is pushing aside the basal layer of the squamous epithelium from which it may have arisen. (A) shows the tubules of an adenomatous growth referred to on page 450. The surface on the right shows squamous epithelium.

and trespass upon the squamous-celled surface and set up an *erosion* in this way. It thus happens that the cavity of a previous Naboth's follicle may be seen to open on to an *erosion*. In gonorrhœa, the contents of a Naboth's follicle may become infected, and on puncture muco-pus will then escape.

Naboth's follicles may sometimes appear beneath the surface of a healed *erosion*. This means that whilst the surface has become normal, some of the deep follicles have not been destroyed, but have become enlarged by distension until they show through the new superficial epithelium; in other words, healing has not occurred in the depths.

CLINICAL FEATURES OF CHRONIC ENDOMETRITIS

In considering the clinical features it is unnecessary to distinguish between endometritis of the body and of the cervix; the two conditions almost invariably occur together, although in some instances the chief changes are corporeal, in others cervical. The different conditions of the

endometrium described in the preceding pages are not distinguishable clinically from one another; the same group of symptoms may be present in all. Accordingly, the clinical features of chronic endometritis must be considered generally, without reference to individual varieties.

These conditions are met with in all classes of life, and in all phases of sexual activity. Frequent among married women, both sterile and parous, they are also by no means uncommon in virgins. In the former, the possibility of an infective cause must always be considered; but in many such cases no clinical evidence of a preceding infection can be discovered. Occa-

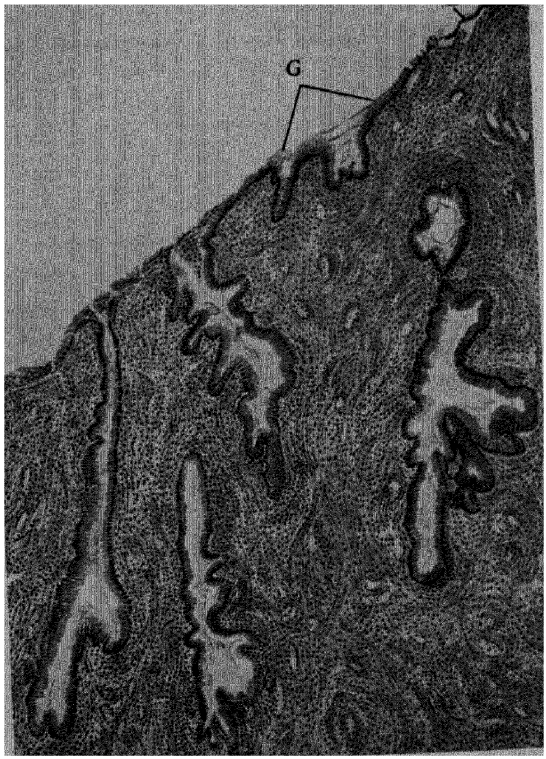


FIG. 220. CERVICAL EROSION (SIMPLE FORM). Vertical section through a patch showing (B) basal layer of surface-epithelium from which glandular depressions (G) have been formed.

sionally occurring soon after puberty, they may be met with at any subsequent age, up to the time when post-climacteric atrophy sets in. They do not occur before puberty or after the menopause.

Chronic endometritis is to be regarded as a minor ailment, and the symptoms to which it gives rise are seldom clinically severe. Four symptoms are so commonly met with in these cases that their presence in association with one another suggests at once the nature of the ailment; they are *leucorrhœa*, *menorrhagia*, *dysmenorrhœa*, and *pelvic pain*. Undoubtedly this syndrome may be met with in other conditions such as fibroid tumours, but

chronic endometritis is of commoner occurrence than fibroids, and should be thought of first.

The *leucorrhœa*, which is invariably present, is due to glandular hypertrophy resulting in increased secretion, and the chief source of the discharge is usually the cervix, where more or less extensive *erosions* are nearly always to be found. The discharge is whitish or yellowish-white in colour, and usually non-irritating; often it contains portions of the viscid, ropy material which is characteristic of the secretion of the cervical endometrium.

Menorrhagia, though equally regular in occurrence, is more variable in degree. As a rule the menstrual loss is of moderate severity, distinctly more than is habitual to the patient, but not sufficient to cause marked anæmia and exhaustion. The duration of the period is nearly always definitely prolonged. In rare instances, however, profuse hæmorrhage occurs which confines the patient to bed, and may even be alarming. The increased menstrual loss is due partly to the increase in thickness of the uterine mucosa, partly to the increased vascularity which attends all new formation of tissue.

Dysmenorrhœa is quite as frequently met with as the two preceding symptoms. In nulliparous subjects it is even more frequent, but in parous women it is definitely less common than either leucorrhœa or menorrhagia (Donald and F. Shaw). It is seldom really severe, although occasionally acute cases of dysmenorrhœa are found to be associated with chronic endometritis. The pain can only be referred to the abnormal condition of the endometrium, the abnormally thick and bulky mucosa to some extent interfering with the expulsive power of the uterus, and thus exciting spasmodic contractions.

Pelvic Pain. Many patients complain of dull pain, of a chronic character, during the menstrual *interval*. This symptom is, however, absent in something like 60 *per cent.* of cases (Donald and F. Shaw). Usually the pain when present is referred to the lower abdomen, more commonly to the left than to the right side; sometimes backache is complained of.

Apart from the characteristic syndrome, other symptoms are occasionally observed. *Irregular bleeding* in the menstrual interval may occur; sometimes this takes the form of an occasional show for a few hours or a day or two, sometimes a quick, sharp spurt of bleeding may occur lasting only a few hours; in rare instances it may occur after coitus. If mucous polypi are found in the cervix (*see* p. 428), bleeding such as this is readily explained, but polypi are not always present in such instances.

Neurasthenia and marked derangement of the general health, including dyspepsia, constipation, mental depression, etc., are not infrequently associated with chronic endometritis and its *allied* conditions, especially in cases of long standing. How far these symptoms can be directly referred to the condition of the uterus is doubtful. Two things are clear, however, viz. that neurasthenic symptoms are liable to arise in all cases of long-standing ailments, and that when the sexual organs are at fault the liability to neurasthenia is especially great in both sexes.

In parous women, chronic endometritis may coincide with a period of sterility, and after a successful curetting conception again occurs. And further, nulliparous women, subjects of this affection, may remain sterile until relieved by curetting. It is therefore probable that these abnormal conditions of the endometrium are unfavourable to conception.

It must next be borne in mind that chronic endometritis is frequently

complicated by other pelvic lesions. What has hitherto been said has reference only to uncomplicated cases. Three other associated conditions are frequently found, however, viz. *backward displacement*, *prolapse*, and a *small fibroid tumour*. The last-named condition may cause symptoms indistinguishable from those of chronic endometritis, and whenever the clinical features of an individual case are unusually severe, the presence of a fibroid tumour should be suspected. In such cases the growth may be interstitial in position, and of such small size that it is very difficult to recognize it clinically. Well-grown fibroids of considerable size often give rise to symptoms very similar to the syndrome of chronic endometritis, but their presence is readily recognized, and errors of diagnosis should not occur.

Backward displacement and prolapse are conditions the symptomatology of which will be considered later.

It is therefore important for the student to bear in mind that pelvic lesions are often multiple, and that the detection of one, probably the most obvious, does not necessarily exhaust the diagnosis; in the case of chronic endometritis, the commoner complications should be borne in mind and care taken not to overlook them.

Physical Signs. The uterus in chronic endometritis is always the seat of slight symmetrical enlargement, and the cavity, as measured by the sound, is lengthened for ½ to ¾ of an inch. The diagnosis, as far as the condition of the corporeal endometrium is concerned, therefore rests upon the association of these physical alterations with the symptoms which have just been described. It has, however, been pointed out that the cervical endometrium is nearly always affected as well, and as this part of the uterus is accessible to visual examination as well as to touch, confirmatory evidence can usually be obtained from it. In cervical endometritis the three following changes may be found on examination *per speculum*: (*a*) Dilatation of the canal, especially of the external os, associated with eversion when well-marked parturient lacerations are present; (*b*) the presence of '*erosion*' (*see* Pl. XVII) either in the form of a ring round the os, or on one or other lip, or on both lips, but unequally; (*c*) an excess of the characteristic clear, or turbid viscid cervical secretion. Only in active infective conditions does the secretion become actually purulent. In parous women the increased size of the canal is often very marked, and the index-finger may be passed up to the internal os. In a few cases one or more small mucous polypi will be seen protruding from the canal, or attached to the lips of the os; they form part of the general overgrowth of the cervical mucosa (*see* Fig. 208, p. 358).

When there is no *erosion*, the chief lesion is usually in the uterine body; the secretion then found issuing through the external os is not the characteristic cervical mucous, but a thinner, pale yellowish fluid.

Treatment. The majority of cases of chronic endometritis can be cured by curetting, although this operation may sometimes have to be repeated before a satisfactory result is obtained. Cases in which well-marked neurasthenia, or other derangement of the general health is present, do not yield such favourable operative results; these may either be treated throughout by medical means, or if curetting is performed this should be supplemented by appropriate medical treatment. Curetting will not cure neurasthenia, or chronic dyspepsia, and this should be clearly in the minds of both the doctor

and the patient. The details of the operation of curetting will be described in another section (*see* p. 721). If a well-marked *erosion* is present, curetting is not sufficient, for the glands of an *erosion* penetrate the cervical tissues too deeply to be removed by scraping. The eroded areas should therefore at the same time be removed by excision, as described on page 727. In American clinics diathermy is widely taking the place of excisions of cervical tissue in the treatment of chronic cervicitis.

The benefit derived from curetting is not immediate. The first period may show little improvement. But gradually the conditions improve during the three to six months which follow the operation, until the maximum amount of benefit has been attained.

It must not be concluded that an operation is to be enforced upon all women who are subjects of chronic endometritis. The condition is not in itself serious enough to justify such an attitude. When only the symptoms directly referable to the uterus are met with, and these are well marked, operation may be advised with confidence. When other symptoms of the neurasthenic type predominate the indication for operation is not so clear.

Such cases may be more successfully treated by medical means. Many are the subjects of chronic toxæmia, usually of intestinal origin, sometimes of some other variety, such as oral sepsis, which is especially common in the 'hospital class.' In such cases the uterine condition is of minor importance and success cannot be attained by treating it alone. The medical treatment, therefore, embraces many matters quite outside the scope of this work. Direct treatment of the uterine condition by medical means is necessarily symptomatic. The amount and duration of the monthly loss may be checked by the use of drugs, in the manner explained in a previous section (p. 116).

CHRONIC METRITIS AND ALLIED CONDITIONS

Under this term are included for convenience three different pathological conditions, all of which are closely allied in their clinical features although divergent in etiology and structure, only one being a true inflammatory process. As will appear later, the name 'Chronic Metritis' is, from the standpoint of pathology, inexact, but it is convenient to retain it, partly because its use has become general, and partly for the reason that no exact pathological designation for the whole group is practicable. Another name which has been widely applied to the same group of conditions is *uterine fibrosis;* the use of this name we propose to discontinue, for, as will be seen, it is even less appropriate than 'chronic metritis.' It will be most convenient, in the case of chronic metritis, to consider the clinical features first, and the pathology afterwards.

Clinical Features. These conditions are met with mainly, but not exclusively, among parous women. Two series of cases (totalling seventy-four) have been recorded by Fletcher Shaw, and one series of ninety-one by Briggs and Hendry, and in both these series approximately the same proportion of cases is found in which pregnancy occurred, viz. 85 to 86 *per cent.* The importance of *pregnancy* as a causal factor is clearly indicated by these figures.

As regards *age*, about two-thirds of the cases occur between forty and fifty years. Below thirty years the condition is very rarely met with, but Briggs and Hendry have recorded a case at twenty-eight and Shaw one at

twenty-three. Cases of severe hæmorrhage at puberty are occasionally met with which are clinically intractable, and may possibly form a separate group, but opportunities for histological examination of the uterus in these cases must be awaited before a decision can be arrived at.

The characteristic clinical feature of all cases is *severe menstrual bleeding* without evidence of any new growth in the uterus, such as a fibroid tumour or cancer. Other symptoms of minor importance usually met with are *pain* and *leucorrhœa*. The symptoms are but slowly progressive, and the majority of cases do not come under observation until the symptoms have been in existence for several years.

The severity of the hæmorrhage is very variable. Usually its duration much exceeds that of a normal period, and the menstrual interval in a severe case may be reduced to a week or less. Occasionally sharp attacks of profuse bleeding occur, for a few hours, in the course of a prolonged hæmorrhage of moderate severity. The patient may be reduced to a condition of profound anæmia by frequent recurrence of such hæmorrhages. As a rule, however, the amount of bleeding is not alarming, although it greatly exceeds that of normal menstruation. Excessive pain during the period is uncommon. Usually the patient is exhausted by the prolonged period, and requires a week or more to recuperate. Occasionally, attacks of slight bleeding occur during the intervals. The usual remedies for uterine hæmorrhage, including hot douches, do not control the bleeding at all.

In the menstrual intervals a certain amount of more or less constant dragging pain is complained of, which is probably due to the weight of the enlarged uterus (*vide infra*). Unless complications, such as chronic inflammation of the tubes and ovaries, are present, pain is seldom severe.

Physical Signs. In a simple case the only abnormal condition found on examination is a symmetrical enlargement of the uterus of moderate extent. In consistence the organ is unusually hard, and often it is sensitive or even painful when handled. The sound, if passed, will show that the uterine cavity is elongated, but a measurement of more than 3½ inches is seldom found. No other abnormality is present in a simple case.

Two complications are, however, of common occurrence, viz. backward displacement of the uterus, and tubo-ovarian inflammation. These conditions of themselves tend to cause the same symptoms, viz. menorrhagia, pain, and discharge, and consequently their presence merely increases the severity of the case. This is especially true of tubo-ovarian inflammation, and when this condition is present it must be regarded clinically as the predominant lesion, the treatment of which is of more immediate importance than the metritis.

Certain diseases, such as chronic nephritis and general arterio-sclerosis, sometimes occur in connection with *chronic metritis*, and they may perhaps be shown in the future to have some causal connection with it. It is important that such conditions when present should not be overlooked.

Pathology. However much the histology may vary, there are certain gross changes which are fairly uniform. The uterus is symmetrically enlarged, the thickness of its walls being about twice the normal (*i.e.* 1 inch or more instead of ½–¾ inch) (*see* Fig. 221). The cavity is enlarged, being often 1 or 2 inches longer than normal. The uterus as a whole feels abnormally hard and rigid. On section the walls appear more fibrous, *i.e.* paler, and the vessels stand out more prominently than normal (Fig. 222).

As a rule the endometrium is thin, although occasionally pieces of thickened mucous membrane may be removed by the curette. Associated lesions, such as salpingo-oöphoritis, may be present.

Classification. Fletcher Shaw has described three distinct pathological groups, all answering to the above general description and all yielding similar symptoms. We shall best fulfil our purpose by adopting this classification. The etiology of each group is different and the distinction is based on the histological findings, so that the classification is purely pathological. It comprises : (1) Chronic metritis, in the strict and limited sense of the term to be defined below ; (2) chronic sub-involution ; (3) hypertrophy.

Fletcher Shaw noted with regard to the relative frequency of the above groups that in 95 *per cent.* of cases in which hysterectomy was performed for

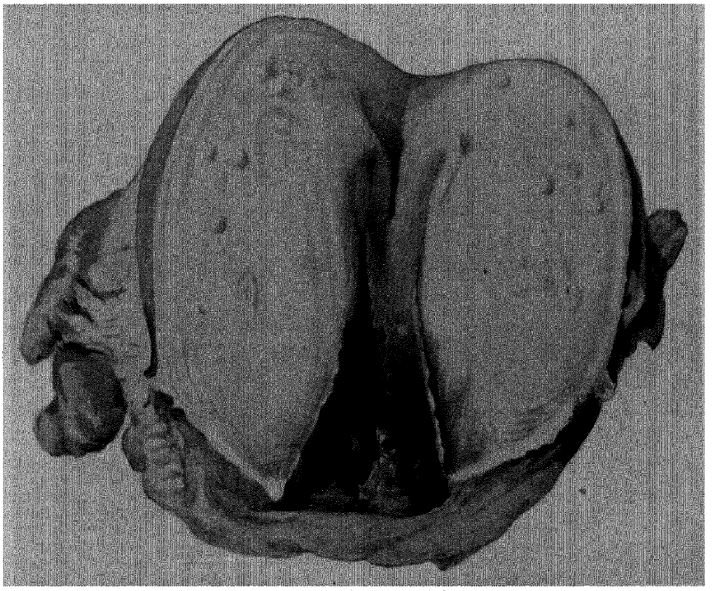


FIG. 221. CHRONIC METRITIS, SHOWING GREAT THICKENING OF THE UTERINE WALLS AND THICKENED VESSELS WITH PATENT MOUTHS.

chronic metritis the histological condition was *sub-involution ;* in 4 *per cent.* it was *hypertrophy ;* and in 1 *per cent.* it was true *chronic metritis, i.e.* a late result of acute interstitial inflammation. It must be recollected that these three groups may overlap ; *e.g.* a sub-involuted uterus may be also the seat of a chronic inflammation.

It will be understood that whilst the term *chronic metritis* is retained for general application, speaking from the purely pathological standpoint, pure cases of chronic inflammation are but seldom met with, and that most cases described as *chronic metritis* are really examples of sub-involution. We have already expressed the view however that in spite of the absence of clinical or microscopic evidences of inflammation, sub-involution itself is usually due to a mild form of sepsis (*see* p. 221).

(1) *True Chronic Metritis.* The state of the muscle-wall of the uterus in cases of acute sepsis has already been described in the section dealing with

uterine sepsis (*see* p. 211). It is fair to assume that in acute gonorrhœal infection the same inflammatory exudations occur as in puerperal sepsis, but most probably they are not so intense. In the later stages these have disappeared, having given place to fibrous-tissue formation. The fibrous tissue is most marked in the outer third of the muscle-wall, but it extends throughout the entire musculature, so that the muscle-bundles, suffering from pressure of the excess of fibrous tissue, become diminished in size and more widely separated than normal (*see* Pl. XVIII). The elastic tissue is not affected, either as regards amount or distribution.

The only histological change in the myometrium in pure chronic metritis is, therefore, an increased amount of fibrous tissue situated mainly in the outer third of the muscle-wall; the associated endometrial changes are those described under Chronic Interstitial Endometritis (*see* p. 357).

(2) *Chronic Sub-involution.* Before describing the changes in the uterus

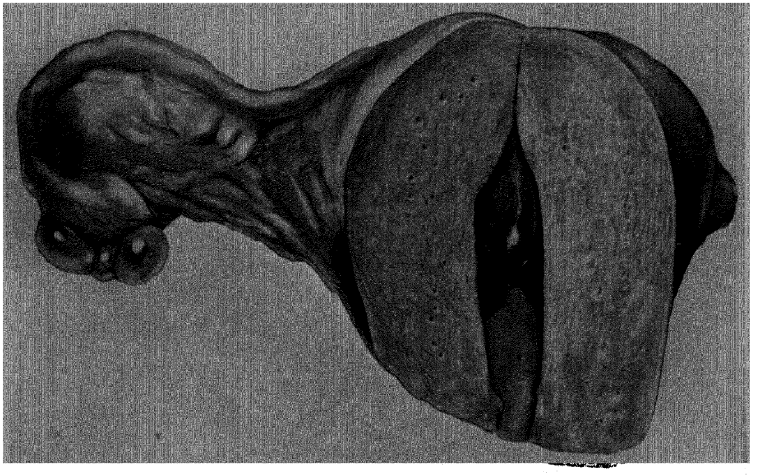
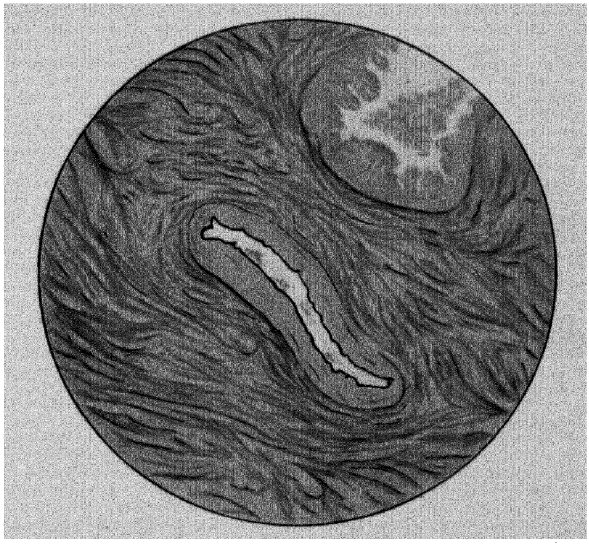


FIG. 222. CHRONIC METRITIS ASSOCIATED WITH CHRONIC SALPINGO-OÖPHORITIS AND AN INTRA-UTERINE MUCOUS POLYPUS. Note the thickening of the arterial walls.

which are produced by sub-involution, we shall mention those by which normal involution is characterized, as described by Goodall.

During *normal involution* there is a rapid diminution in the amount of muscle-tissue, which is probably brought about by atrophy, fatty degeneration, and perhaps peptonization and liquefaction of the muscle-fibres, the waste products thus rendered soluble being carried off by the lymph-stream. Changes also occur in the vessel-walls, the effect of which is to reduce the size of the lumina of the vessels; this is best seen in those of the retro-placental site. Many of the vessels become completely occluded by thrombosis; in some the blood-clot is seen to have become canalized, leaving a still patent but notably diminished lumen.

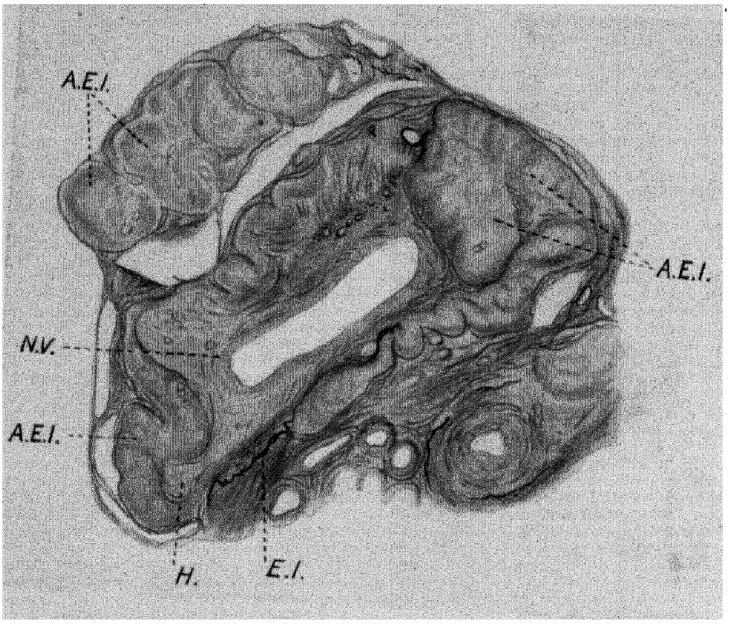
In the *arteries*, the fibrous tissue in both tunica media and tunica adventitia swells and undergoes hyaline change, while the elastica interna also becomes swollen and thickened. The staining reactions of this degenerated elastic tissue are profoundly altered, becoming, in the case of young tissues,



THE UTERINE WALL IN TRUE CHRONIC METRITIS. Note the large amount of fibrous tissue stained red in the wall of the uterus. The elastic tissue is confined almost entirely to the elastica interna of the vessels.

Stain: Weigert and Van Gieson. (Fletcher Shaw.)

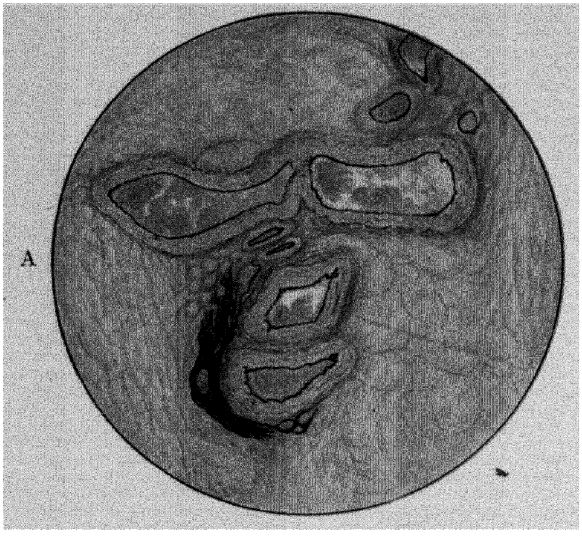
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SHOWING HOW AFTER PARTURITION THE NORMAL PROCESS OF INVOLUTION AFFECTS THE ARTERIES IN THE UTERINE WALL (Goodall). Section of a large vessel containing a new smaller one. The elastica interna (*A.E.I.*) of the original vessel has undergone colloid change in all its course, except at one spot (*E.I.*), where it retains its black stain and where the muscularis of the old tunica media remains, though interspersed with elastic tissue. (*H.*) denotes the inter-arterial space filled with hyaline substance. (*N.V.*) = the new vessel within the old one. In the upper left corner is shown a large corrugated degenerated elastica interna of a vessel cut more or less parallel with its long axis. It contains in its central part a minimum of red hyaline tissue. In the right lower corner is seen a partially atrophic old vessel of small calibre with a still smaller new vessel in its lumen. A relatively large interarterial space filled with red hyaline tissue is present.

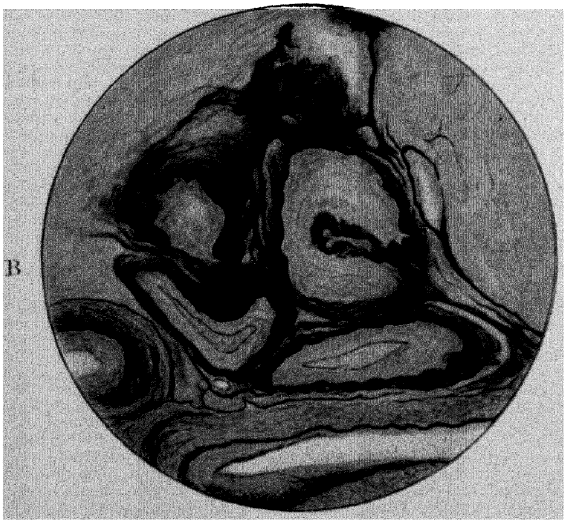
After Goodall.

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A.—Vessels in a normal Parous Uterus. All these vessels are new-formed, the remains of the old vessel-walls having been completely absorbed, except in the left bottom corner of the figure. Here two vessels retain some elastic tissue stained black outside their wall. This elastic tissue is the remains of the elastica interna of the old large vessel within which the two new ones were formed.

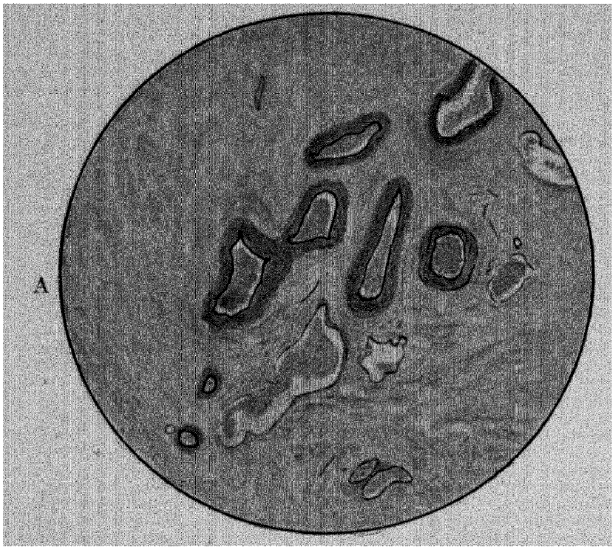
Stain: Weigert and Van Gieson. (Fletcher Shaw.)



B.—Vessels in a specimen of Chronic Metritis due to Subinvolution. These new-formed vessels, each with a narrow elastica interna, are surrounded by masses of black tissue, which are the degenerated remains of the elastica interna of the old vessels.

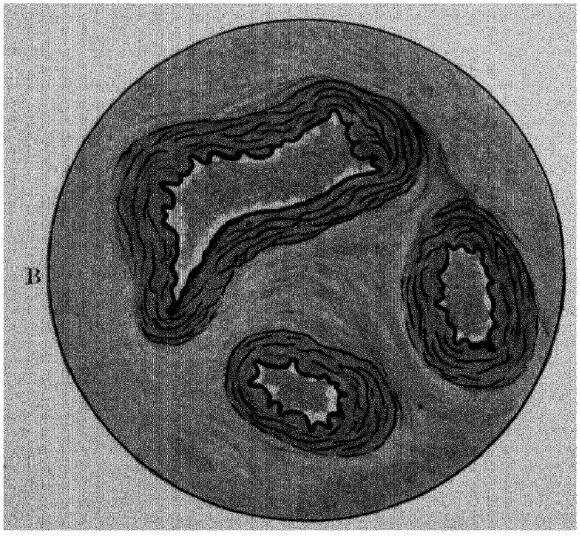
Stain: Weigert and Van Gieson. (Fletcher Shaw.)

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VESSELS IN A SPECIMEN OF CHRONIC METRITIS DUE TO HYPERTROPHY. These vessels are indistinguishable from those found in a virgin uterus (*vide infra*).

Stain: Weigert and Van Gieson. (Fletcher Shaw.)



ARTERIES IN A VIRGIN UTERUS. The elastic tissue is most abundant in the internal elastic lamina of the arteries.

Stain: Weigert and Van Gieson. (Fletcher Shaw.)

To face page 377.

brick-red, and finally, in late stages, yellow (Pl. XIX, A.E.I.), with Weigert's stain, which colours healthy elastic tissue black.

The hyaline tissue of the media next invades the elastica interna, and enters the lumen of the thrombosed vessel. The hyaline material which has entered the lumen becomes invested with endothelial cells which form the lining of a new vessel within the old one (Pl. XIX, N.V.). This takes place within the old vessel, so that we have a new small artery, surrounded by the remains of the elastica interna and tunica media of the old one (Pl. XIX, A.E.I. and N.V.). The old vessel-wall in complete involution would totally disappear, but involution is seldom complete, so that traces of some of the old vessels usually remain to stamp a normal parous uterus (Pl. XX, A).

In *sub-involution* the most noticeable feature is the persistence of a *large* amount of tissue which belonged to the old vessels. We thus find new vessels surrounded by masses of degenerated *elastic tissue* derived from the swollen elastica interna of the old vessels. This residual tissue now regains its normal staining properties, and appears black instead of brick-red, when stained by Weigert's Method (Pl. XX, B). Sometimes this elastic tissue is interspersed with muscle-tissue representing remains of the old media (*see* Pl. XX, A).

In the *veins* there is no definite elastica interna, but the walls contain a good deal of elastic tissue intermixed with fibrous tissue. During involution the fibrous tissue swells and becomes hyaline ; this reduces the lumen of the vein. This hyaline tissue normally becomes converted into muscle, but when involution is impaired (sub-involution) it is converted into *elastic tissue* instead of muscle.

During involution the fibrous and elastic tissues of the *uterine musculature* undergo the same change as in the vessel-walls, *i.e.* they swell and become hyaline, afterwards becoming partly absorbed. In sub-involution absorption of the excess is arrested, and this excess is replaced by fibrous and elastic tissue, so that more of the latter remains than is seen in a normal nulliparous uterus.

It will thus be seen that an excess of elastic and fibrous tissues forms the predominant feature of a sub-involuted uterus. The cause of this imperfect involution is usually, if not always, *sepsis* of a moderate degree (*see* p. 211). The infection may be so slight as to give no other sign of morbidity save the sub-involution. On the other hand, the sepsis may give rise to peri-uterine infection. Contributory causes are *age*, *multiparity*, and *general acute* and *chronic diseases*, which cannot be discussed in this connection.

(3) *Hypertrophy.* According to Fletcher Shaw 4 *per cent.* of the cases of *chronic metritis* must be classed as chronic, non-inflammatory hypertrophy and hyperplasia. The type of patient in which this is to be found is a nullipara, at or near the menopause, suffering from a chain of symptoms of which hæmorrhage is the most marked. The only physical sign is a symmetrically enlarged firm uterus. All signs of inflammation are absent.

The pathology of such a uterus is very different from the preceding varieties. The most marked feature is the great thickening of the endometrium. To this is added an increased thickness of the muscular walls. Muscle and fibrous tissue maintain their normal *relative* proportions (*see* p. 18), only there is a proportional increase of each of these constituents. The amount of elastic tissue and its distribution is similar to that of a normal virgin uterus (*cf.* Pl. XXI, A and B). In fact, all the component tissues maintain their virginal proportion (*see* Pl. II, p. 18), the changes being

purely quantitative, not qualitative. Histologically, no distinction can be made between the hypertrophic and the normal uterus.

The explanation of the enlargement is that there is a primary adenomatous hyperplasia of the endometrium (*see* Fig. 271, p. 447), which causes excessive hæmorrhage. The increased thickness of the muscular wall is regarded as due to a work-hypertrophy produced in the endeavour to expel the swollen endometrium, which is treated as a foreign body.

Some observers, including Beckwith Whitehouse, have advanced the view that some cases of chronic metritis are due to syphilis, but it has never been proved that syphilis alone can produce any of the changes which have been described as characteristic of the three main varieties.

Mechanism of the Bleeding. There are probably two main factors which determine the character and the severity of the bleeding, in cases of chronic metritis. The first is the associated thickening of the endometrium, which is present in a certain proportion of cases; the second is the obstacle to efficient retraction of the uterine muscle, which results from the presence of a relative excess of elastic tissue or, in some cases, of fibrous tissue. This second factor is obviously not present in cases of simple hypertrophy. The importance of uterine contraction in arresting menstrual bleeding has been already explained (*see* p. 85) and need not be further alluded to. A subsidiary factor, which must not be overlooked, is the frequent association of inflammatory lesions of the adnexa, the effect of which is to favour pelvic congestion during menstruation.

Treatment. Experience has conclusively shown that medicinal treatment of *chronic metritis* is useless. Drugs which control uterine hæmorrhage in other conditions are of no benefit, and the same must be said of balneotherapeutics, douching, and intra-uterine applications. Even the resulting anæmia cannot be successfully treated while the periodic losses of blood continue to recur.

Curetting is sometimes of temporary benefit, but is never permanently curative. From what has been said of the mechanism of bleeding in these cases, it will be clear that removal of the thickened endometrium will not, except in the rare hypertrophic form, restore normal conditions in the uterus, although it removes one of the factors which produce hæmorrhage. In some instances curetting is not even of temporary benefit, and this is especially true of cases in which the endometrium removed by the curette is not obviously thickened. Owing to the difficulty of making the clinical diagnosis between chronic *endometritis* and chronic *metritis* when the case first comes under observation, curetting is, as a rule, first performed, and the non-success of this operation is an important diagnostic aid. The inefficiency of curetting is a clinical point which is firmly established by general experience.

The only other operative measure available is removal of the uterus, the ovaries being both conserved if healthy. This, of course, definitely arrests the bleeding and is accordingly a certain cure. To remove an important organ which shows so few pathological changes as does the uterus in chronic metritis, undoubtedly appears a disproportionately severe surgical procedure. The amount of suffering, ill-health, and physical disability caused by this condition is, however, very great, and in this must be sought the real justification of the radical operation. The sudden arrest of menstruation is liable to entail certain disagreeable results which have been already

referred to, but these are only slight disadvantages in proportion to the relief which the operation brings.

Radio-therapeutics. An alternative to removal of the uterus has been made available during the last few years by developments in the therapeutic uses of radium and X-rays. The technique is the same as that employed for the radio-therapeutic treatment of fibroid tumours, and the matter will be more fully dealt with in that connection.

Considerable experience of the use of radium in chronic metritis has been obtained, with results that may be considered favourable. A tube of 150 mg. of radium may be placed in the vaginal roof, or a tube of 100 mg. of radium may be introduced into the uterine cavity after dilating the cervix under anæsthesia. In each case the radium-tube should be contained in an aluminium filter 2 mm. in thickness, and this should be enclosed in a piece of rubber tubing; the whole can be sterilised by boiling without injury to the radium. When placed in the vagina, the tube should be carefully packed around with several thicknesses of sterilized gauze in order to protect the vaginal wall from its influence. The average period of exposure is twenty-four hours, and the treatment may be repeated at intervals of four to six weeks as may be necessary.

B. NEW GROWTHS AND CASTS OF THE UTERUS

(*a* FIBROID TUMOURS
(*b*) POLYPI
(*c*) CASTS
(*d*) ADENOMYOMA
(*e*) ADENOMA
(*f*) MALIGNANT GROWTHS

FIBROID TUMOURS

GENERAL PATHOLOGICAL ANATOMY

These tumours occur in great diversity of size, shape, and distribution; they are subject to a variety of secondary changes, and frequently induce secondary changes in neighbouring organs; their description must necessarily be somewhat lengthy.

Fibroids may develop in any part of the uterus, but are much commoner in the body than in the cervix, only 8 *per cent.* of all uterine fibroids being situated in the cervix. In rare cases they arise also in the round ligament. They are almost invariably multiple, probably not more than 1 to 2 *per cent.* occurring as single tumours. They may, under certain conditions, attain enormous size, and all gradations may be met with down to small growths of the size of a split pea or a millet seed. They may symmetrically enlarge the organ in which they grow, or they may distort its shape, or, being attached to the uterus only by a pedicle, they may attain a large size without producing any considerable alteration in the bulk or shape of the parent organ. When multiple, one growth frequently attains a size predominant over the others; the number to be found in a single uterus is, as a rule,

comparatively small, but occasionally enormous numbers of small growths are met with, none of which attains considerable size.

Fibroid tumours are solid growths arising in the muscular tissue of the uterine wall. In the early stages they are invariably enclosed within a well-formed capsule, from which they receive their blood-supply; their vessels therefore enter at the periphery, and the central parts of these tumours are less vascular than the peripheral parts. As they increase in size they may either grow outwards beneath the peritoneum or inwards beneath the mucosa, or they may remain surrounded by a definite layer of uterine muscle,

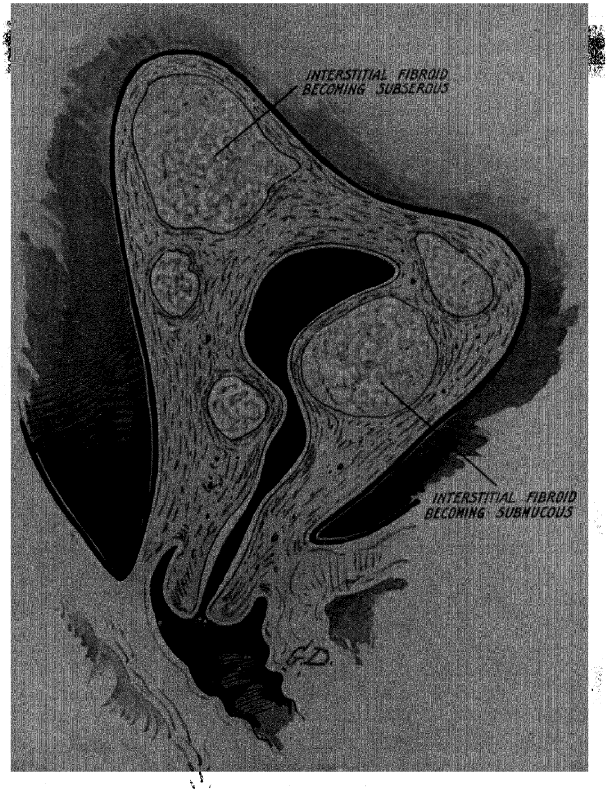


FIG. 223. THE FORMATION OF SUBMUCOUS AND SUBSEROUS FIBROIDS (diagrammatic). *a*, *a*, Small interstitial fibroids.

i.e. completely enclosed with the uterine wall. Three varieties are thus produced which are respectively called *subperitoneal*, *submucous*, and *interstitial* fibroids. It will be understood that the great majority of fibroids are at first interstitial; the greater number are small, but such tumours may attain a size sufficient to distort the uterus, and protrude upon the mucous or peritoneal surface; being enclosed within their capsule, and surrounded outside this with a complete zone of muscular tissue, they are, however, still interstitial (*see* Fig. 223). As they grow they may pass outwards, being, as it were, extruded from the muscular wall so as to reach and displace the peritoneal coat; or they may pass, in the same manner, inwards into the cavity,

raising the mucous membrane. As a result of this process the tumour escapes from its capsule, so that the greater part is covered only by peritoneum or endometrium. Both subperitoneal and submucous fibroids may retain a sessile attachment to the uterine wall, or may become polypoid by the formation of a distinct pedicle, which sometimes attains the length of 2 or 3 inches (*see* Fig. 224). In the case of sessile tumours, a portion of the capsule at the base usually persists, allowing the tumour to be readily shelled out of the uterine wall.

Fibroid tumours vary greatly in consistence; the great majority are

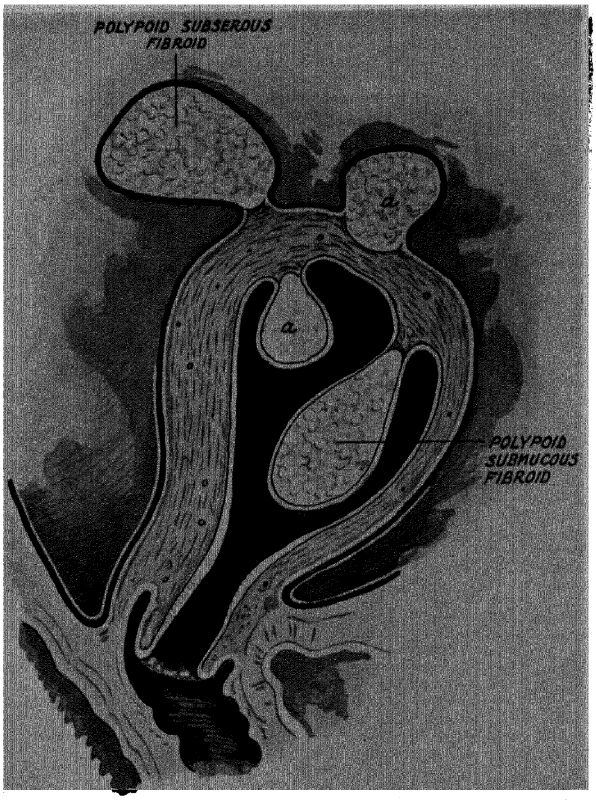


FIG. 224. THE FORMATION OF POLYPOID FIBROIDS (diagrammatic). The growths, *a*, *a*, still retain a sessile attachment to the uterine wall; the other two have been completely pushed out of the muscular layer.

hard and inelastic in texture; some are of wooden or almost stony hardness; others are soft, and some are cystic. It is probable that all fibroids are originally hard, softening being almost invariably due to degenerative changes; softness, however, in rare cases results from œdema, and more rarely still from extreme vascularity. On section, their colour is usually paler than that of the cut uterine wall; those which are moderately hard show upon their cut surface a whorled arrangement of curved, interlacing fibres, which has been aptly likened to a ball of rolled worsted. The softer growths do not show this appearance. The capsule consists, like the muscular

wall of the uterus, very largely of muscle-fibres; when divided it retracts along with the uterine wall, and tends to extrude the tumour from its bed. If an interstitial fibroid is hemisected *in situ* after operative removal of the uterus, this phenomenon will usually be observed slowly to take place. A minor result of this process is to make the cut section of the tumour not flat, but slightly convex.

Microscopic Appearances. Fibroid tumours consist of plain muscle and



FIG. 225. A SECTION OF A HARD FIBROID TUMOUR (low power). The arrangement of the interlacing bundles of fibres is well shown.

white fibrous tissue in varying proportions. The smallest fibroids consist entirely of muscle-fibres, and these may correctly be termed *myomata*. By the time they reach a diameter of 1 cm. there is a considerable proportion of fibrous tissue present, and accordingly the name *fibro-myoma* or *fibroid* may be correctly applied to these growths. The nuclei of plain muscle fibres are short, thick, straight, or slightly curved rods with rounded extremities: the nuclei of fibrous tissue cells are spindle-shaped and curved and are both longer and more delicate than the muscle-nuclei (*see* Fig. 226). When seen in cross-

section it is not easy to distinguish connective tissue from muscle-fibres except by the differential stain of van Gieson, by which muscle is stained yellow and fibrous tissue pink (*see* Pl. II., p. 18). The intermingled muscle and connective tissue fibres are arranged in small bundles which interlace in curves of varying direction, thus producing the whorled arrangement shown in Fig. 225, and often observable with the naked eye. In a hard fibroid the number of vessels seen under a low magnification, in a single field of the microscope, is very small; the majority are of the capillary type, but large vessels with thick walls can also be found. Some fibroid tumours are, however, of softer consistence and much more vascular than this, showing very large numbers of well-formed arteries in the microscopic field. Occasionally the degree of vascularity is extreme, the tumour being permeated with blood-vessels and blood-sinuses; to these the name *telangiectatic fibroids* was applied

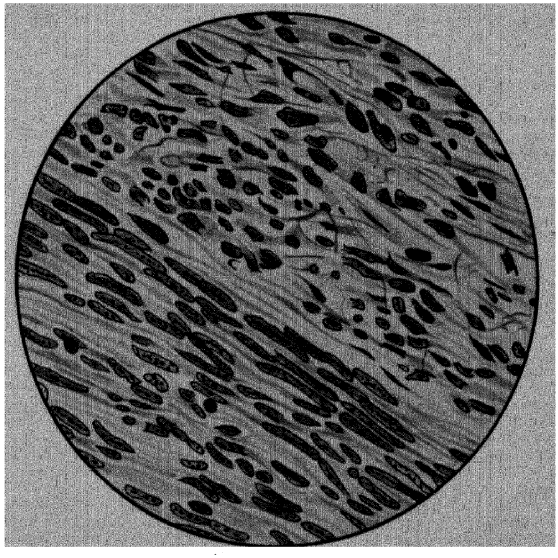


FIG. 226. THE ELEMENTS OF A FIBROID TUMOUR (high power). In the lower half of the Figure are seen bundles of the rod-shaped nuclei of plain muscle arranged in parallel planes. Above are seen the spindle-shaped and stellate nuclei of connective tissue cut in different planes.

by Virchow. These soft vascular growths may belong to either of the three varieties just described, and are often non-capsulated. The capsule of a fibroid tumour differs from the tumour-tissue chiefly in three points: (1) It is of much looser texture, and is composed in the main of parallel bundles of muscular and fibrous tissue; (2) it contains large numbers of vessels, some being arteries, the majority capillaries and veins (*see* Fig. 227); (3) the muscle-laminæ are frequently separated by lymph-spaces.

In a small number of fibroid tumours, gland-tubules may be found on a careful microscopic search, surrounded by a zone of highly cellular tissue, which closely resemble the glands of the endometrium (*see* Fig. 11, p. 15). All such tumours are to be regarded, not as ordinary fibroids, but as one type of *adenomyomata*, and these will be considered in a later section (*see* p. 436).

It will now be necessary to describe more in detail the characters of the three varieties of fibroid tumour.

Subperitoneal (Subserous) Fibroids. These growths are nearly always multiple and may attain enormous size. Since they have greater freedom of growth, subperitoneal fibroids are able to attain a greater size than the other varieties, and apart from degenerative changes, the largest specimens met with are of this description. Figure 228 is fairly typical of this class. It will be noticed that the uterus itself is not much enlarged and lies in the centre of the mass formed by the tumours; it is also slightly rotated on its long axis, so that the anterior surface faces to the left. On the right side are two subperitoneal growths, sessile, and smooth on their surface; on the left is a single large pediculated growth showing a well-marked nodular surface quite different from those on the other side. Near the right cornu are two smaller growths, the anterior sessile and smooth, the posterior pediculated

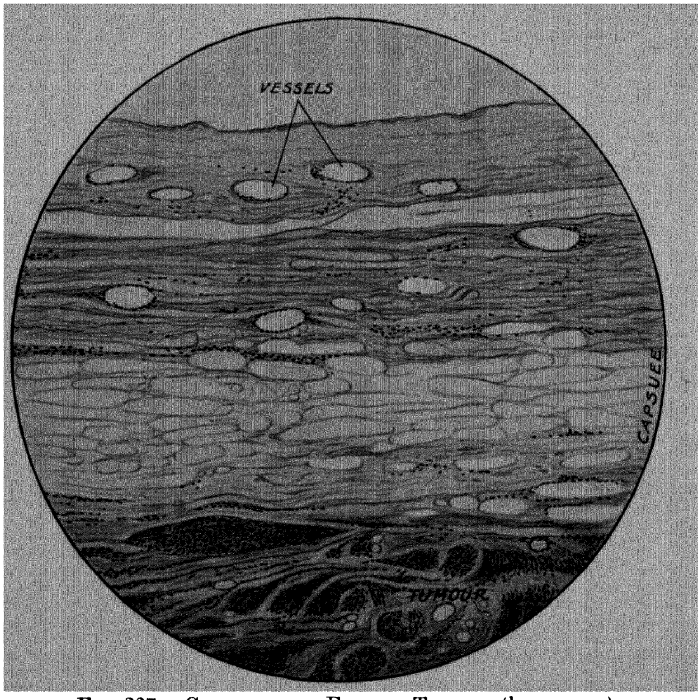


FIG. 227. CAPSULE OF A FIBROID TUMOUR (low power).

and nodular. It is obvious that the pedicle of the largest growth is long enough to permit of the occurrence of axial rotation of the tumour or torsion of the pedicle (*see* p. 404).

Unless inflammatory changes have occurred, the peritoneal covering of a subperitoneal fibroid is connected with the tumour only by a thin layer of the general subserous connective tissue; accordingly it can be readily stripped off when divided. *The blood-supply* is mainly derived through the uterine attachment and is often scanty, these tumours being as a rule less vascular than either of the other varieties. Sometimes the main blood-supply is derived from a source external to the uterus, the commonest being the omentum. Cullen has described a uterine fibroid isolated and lying in omental tissue, and one of us discovered a similar condition, but in this instance the tumour was attached to the peritoneum of the anterior abdominal wall in

addition to omentum, although quite free from the uterus. Cullen has given the name of 'parasitic fibroids' to such isolated growths. Sometimes, however, the stalk of attachment to the uterus is thick and fleshy and contains vessels of large size. Histologically, subperitoneal fibroids consist almost entirely of fibrous tissue in which extensive hyaline and cystic formation is common.

Subperitoneal fibroids, when of large size, rise above the pelvic brim into the abdominal cavity; when of smaller size they remain in the pelvis, and may then occupy, and distend, the pouch of Douglas, or they may rest upon the fundus of the bladder.

Retroperitoneal Fibroids. Fibroids which grow from parts of the uterus which have no peritoneal covering—the lateral walls and the anterior wall

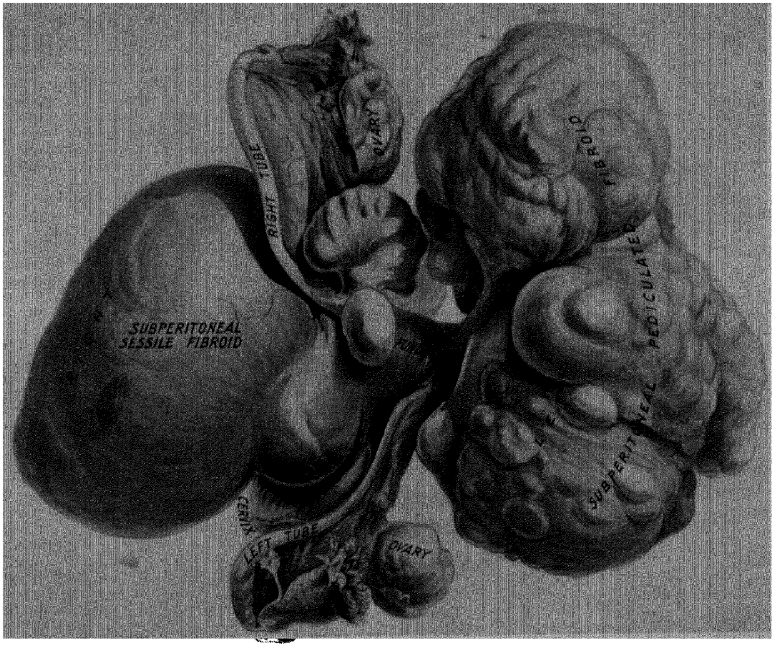


FIG. 228. MULTIPLE FIBROID TUMOUR, weight 7 lbs. Nullipara, aged 49. The large nodular fibroid had a pedicle 2 inches long. The uterus had rotated, bringing the right cornu forwards.

below the peritoneal reflection—grow out beneath the peritoneum, and when of large size occasion great alterations of the normal pelvic relations. When in this way they pass between the layers of the broad ligament they first distend that structure (*see* Fig. 229), then, growing laterally, they may raise the peritoneum covering the lateral pelvic wall, and open the mesentery of the pelvic colon or of the sigmoid flexure, so that this part of the gut comes to lie directly upon the surface of the tumour; on the right side they may pass in the same way behind the cæcum and the vermiform appendix; passing backwards they may raise the floor of the pouch of Douglas up to the level of the sacral promontory; passing forwards they obliterate the utero-vesical pouch, raise the bladder high above the pelvic brim, elongate the urethra

and displace the ureters. Fibroids which thus distort the general peritoneal relations of the pelvis are often called *retroperitoneal*. Examples of retroperitoneal fibroids are seen in Figures 229 and 230. In Figure 229 the tumour has opened up the left broad ligament, elongating the Fallopian tube which curves over its surface ; the right broad ligament with its tube and ovary are seen to be unaffected. A great part of this tumour lay beneath the floor of the pouch of Douglas, which was elevated nearly to the level of the sacral promontory. Figure 230 shows a very large growth which occupies the right broad ligament, the peritoneum being intact over the summit of the growth.

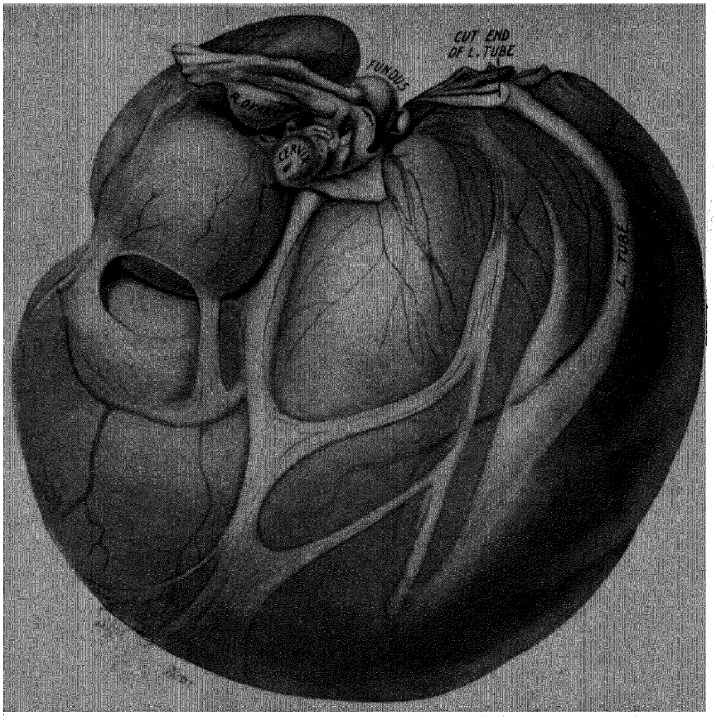


FIG. 229. LARGE RETROPERITONEAL FIBROID TUMOUR, weight 30 lbs. Nullipara, aged 55. The tumour consists of two lobes of unequal size ; between them lies the uterus, which is only slightly enlarged. The larger lobe has expanded the left broad ligament, stretching the tube over it ; the left tube is divided near the uterus.

It thus affords a good illustration of the relations as seen before operation. When the ureters are displaced by these growths, one or other ureter may become compressed, leading to atrophy of the kidney, or to dilatation of the ureter, and hydronephrosis.

Interstitial Fibroids. These tumours are usually small or of only moderate size ; they cause less distortion of the uterus and less disturbance of the general pelvic relations than subperitoneal fibroids. The enlargement of the uterus which they produce is sometimes fairly symmetrical (*see* Fig. 231), but more or less distortion is usually met with. They occur in the anterior and posterior walls, and in the fundus. Solitary fibroids are usually of the

interstitial variety, but the general rule that fibroids are multiple applies also to the interstitial variety; there are generally several, and in the great majority of instances they occur in company with subperitoneal or submucous growths, or both.

Submucous Fibroids. These tumours are usually of comparatively small size; they are generally globular or ovoid in shape, and tend in the natural

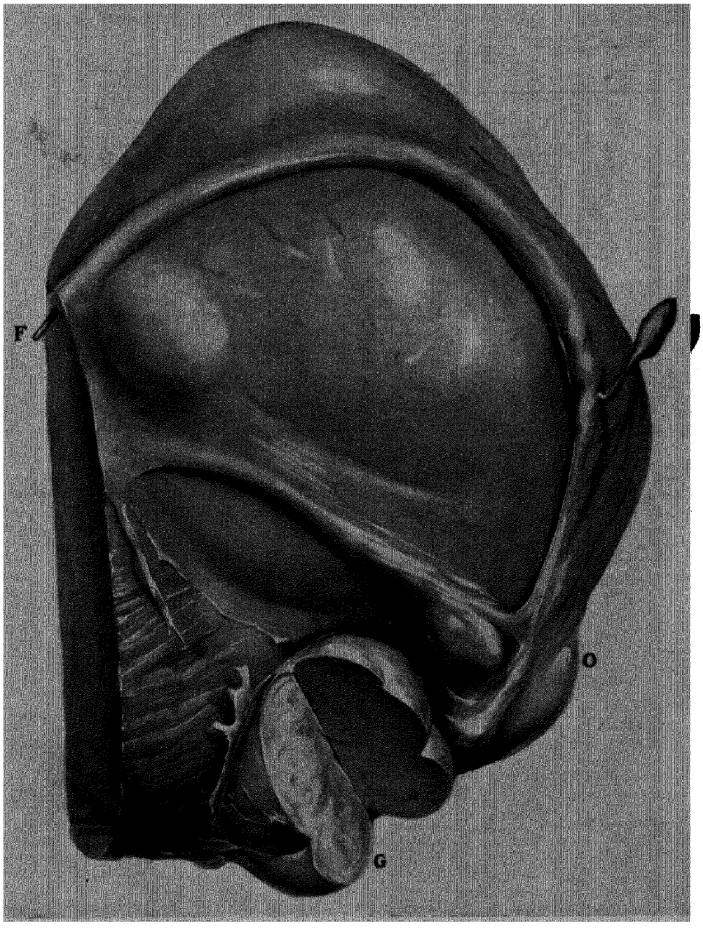


FIG. 230. SHOWING AN INTRALIGAMENTARY (RETROPERITONEAL) FIBROID OF THE RIGHT SIDE. F, Fallopian tube into which a bristle has been passed; the ovary, attached to its elongated ligament, lies 1 inch internal to the letter O; G, small lobe growing from the large fibroid tumour.

course of events to become polypoid. By encroachment upon the uterine cavity they act as foreign bodies in increasing the normal contractions of menstruation, or actually in exciting contractions in the intermenstrual periods, the effect of which is still further to extrude the tumour until it becomes polypoid. Fibroids which protrude upon the peritoneal aspect do not produce this effect. Submucous fibroids are often solitary, and as such they

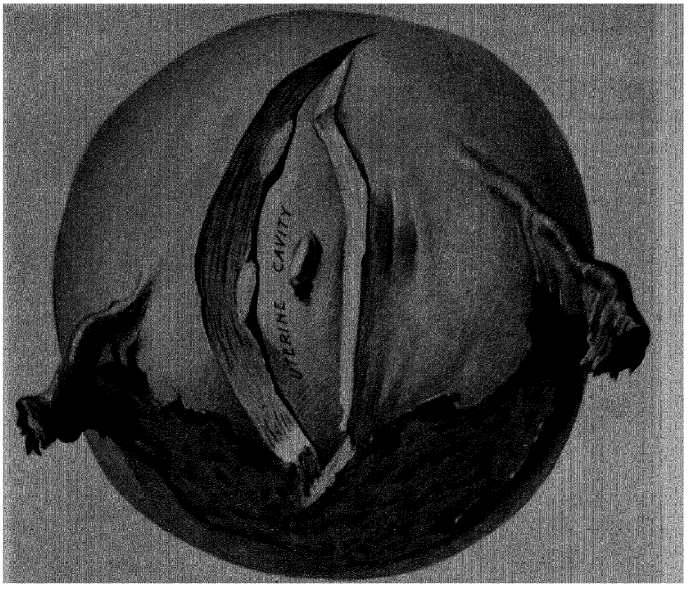


FIG. 231. INTERSTITIAL FIBROID TUMOUR IN THE ANTERIOR WALL OF THE UTERUS. Multipara, aged 62. The uterus and fibroid form a large tumour of globular shape.

enlarge the uterus symmetrically and distend its cavity, which they fill u like a cast (so-called ' cup-and-ball ' fibroid) (*see* Fig. 232). They are, how

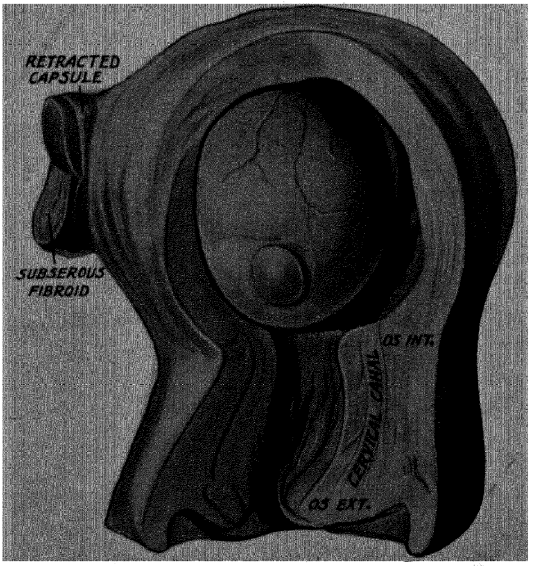


FIG. 232. SESSILE SUBMUCOUS FIBROID TUMOUR (Charing Cross Hospital Museum). Nullipara, aged 51. The tumour is globular in shape and completely fills up the enlarged uterine cavity.

ever, sometimes multiple, and in such cases various phases of the process of extrusion may be met with in a single uterus, some being still partly embedded in the musculature, others completely submucous but sessile, others definitely polypoid (*see* Fig. 233). Very occasionally they are so numerous and so crowded together in the uterine cavity as to become polygonal from mutual pressure, like faceted calculi in the gall-bladder (*see* Fig. 234). In this specimen the uterine cavity was packed with small submucous fibroids,

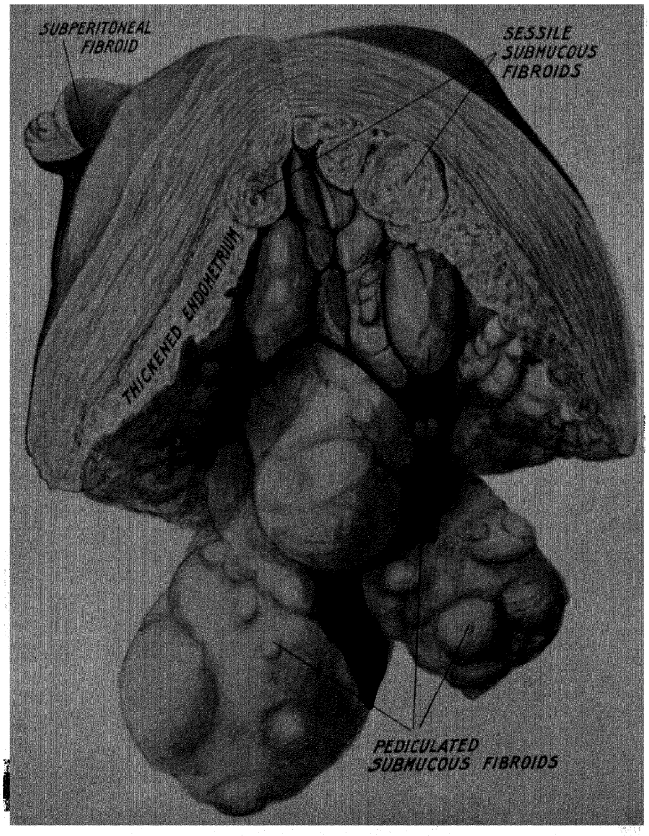


FIG. 233. UTERUS CONTAINING AN UNUSUALLY LARGE NUMBER OF SUBMUCOUS FIBROID TUMOURS, SOME SESSILE, OTHERS POLYPOID. Nullipara, aged 38. The endometrium is seen to be enormously thickened.

which had been compressed by being closely packed together. Like subperitoneal growths, submucous fibroids usually present an even surface, but sometimes they are nodular as in Figure 233.

In becoming polypoid, submucous fibroids escape from their capsule, and are then covered immediately by the mucosa. The essential steps in the process of pediculation are, a gradual yielding of the capsule, and subsequent extrusion of the growth from its bed by uterine contractions. When the process of pediculation is complete, the pedicle consists of an investment of endometrium, within which is a fibro-muscular core, representing what is

left of the base of the capsule. It is seldom more than $\frac{1}{2}$ inch in thickness. Comparatively few vessels enter the polypus through its stalk, the blood-supply being chiefly derived from the covering endometrium. Accordingly, when the pedicle is divided in removing the polypus, there is little or no bleeding from it, for the vessels it contains are small, and are spontaneously closed by retraction of the divided muscular and elastic fibres.

Fibroid polypi not infrequently become expelled through the cervix into the vagina, the cervical canal becoming dilated, as in labour or abortion. Uterine contractions no doubt form the essential factor in this process, the

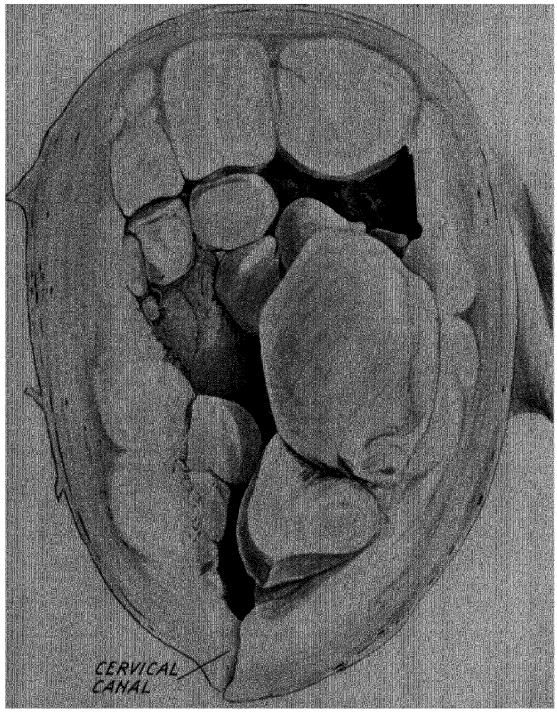


FIG. 234. MULTIPLE SUBMUCOUS FIBROID TUMOURS. Nullipara, aged 31. The uterus contained sixty separate fibroid growths, the greater number of which were submucous. They were closely packed together in the uterine cavity, and some were moulded by pressure of contiguous growths.

polypus acting as a mechanical dilator; the function known as 'uterine polarity' may aid in producing this result. Elongation of the pedicle occurs during this process, and it is not very uncommon for a stalk 1 or 2 inches long to be produced. Complete detachment of a polypus by separation of its pedicle sometimes occurs in the puerperium, but is extremely rare under other conditions; if of small size, the tumour is then spontaneously expelled from the vagina; if retained it becomes infected, and sloughing results.

Polypi which have been expelled through the cervix are specially liable to injury and to infection. Superficial ulceration of the mucous covering from friction or other injury may occur, and give rise to serious hæmorrhage.

Polypi which have occupied this position for some time may, however, acquire by metaplasia a covering of stratified epithelium similar to that of the vaginal wall; by this they are protected both from injury and infection.

After the polypus has passed through the cervix, the canal retracts upon the pedicle, but though much smaller than the tumour it remains somewhat

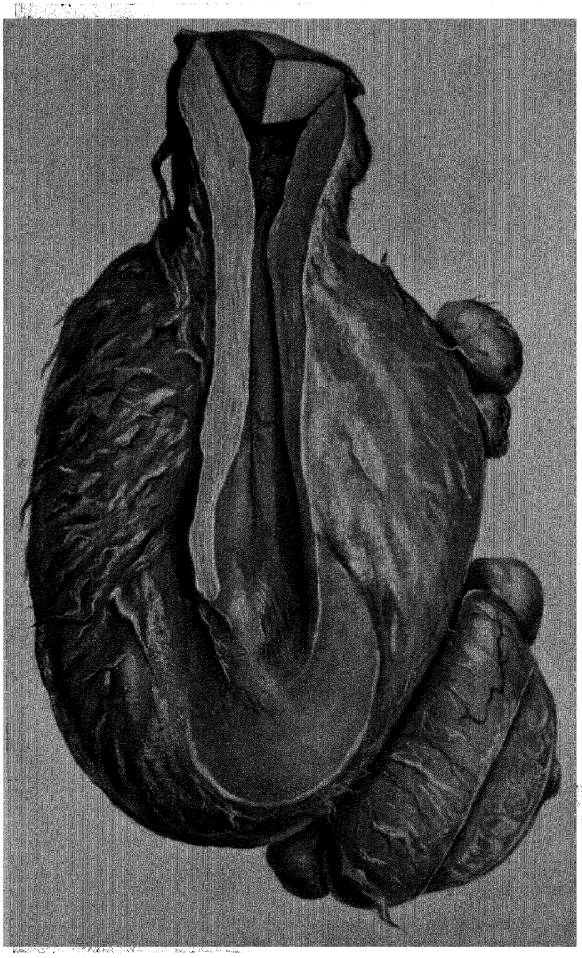


FIG. 235. INTERSTITIAL (TRUE) CERVICAL FIBROID TUMOUR SEEN FROM IN FRONT. Virgin, aged 34. The body of the uterus is situated upon the summit of the tumour. The cervical canal is elongated and the external os is opened up. On the left side are seen secondary lobes of the growth. The left ureter lay deeply in the sulcus between the lower lobe and the main tumour.

dilated. Polypi arising from the fundus may, during expulsion, cause *inversion of the uterus*. The inversion is usually partial and subsides after the removal of the growth. On page 526 is seen a total inversion of both uterus and vagina, produced by a fibroid polypus; this is very rare.

Cervical Fibroids. Only 8 *per cent.* of fibroids arise in the cervix; the

remainder are corporeal. They are almost always solitary, differing sharply in this particular from those of the body. They may arise in the cervix above the vaginal reflection, or in the *portio vaginalis* itself. Of the former some are interstitial (true cervical fibroids) (*see* Fig. 236), others are attached to the wall of the cervix by a narrow pedicle or by a broad base, and are, strictly speaking, retroperitoneal tumours (pseudo-cervical fibroids) (*see*

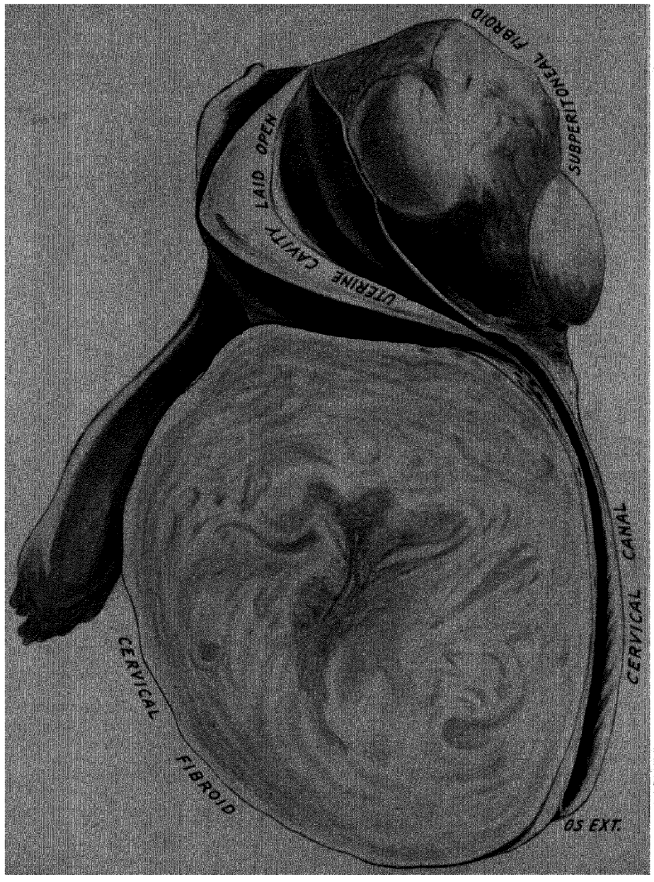


FIG. 236. INTERSTITIAL (TRUE) CERVICAL FIBROID TUMOUR, DIVIDED ANTERO-POSTERIORLY. Nullipara, aged 32. The cervical canal is displaced to one side and elongated (3¾ inches); the uterine body is elevated above the tumour.

Figs. 237 and 238). Either of these varieties, but especially the latter, may attain a large size, and from their anatomical relations they naturally give rise to severe pressure symptoms, and to displacement of neighbouring organs. As will be readily understood, from its contiguity to the supra-vaginal cervix, the ureter is liable to displacement, and even to compression, by these tumours. The uterine arteries are also liable to be displaced either anteriorly or posteriorly.

Interstitial or true cervical growths arise more often in the posterior than in the anterior wall; they elongate the cervical canal and they may displace it

to one or other side (*see* Fig. 236). They usually form oval or globular tumours with the uterine body placed upon their summit, which, unless it also contains fibroid growths, remains approximately of normal size. *Subperitoneal* or *pseudo-cervical* fibroids usually occupy and distend the broad ligament, retaining an attachment by a narrow neck to the supra-vaginal cervix. They are often completely encapsulated as in Figure 237. They displace the uterus to the opposite side of the pelvis, and usually elongate it; in the specimen, from which Figure 237 was drawn, the uterus measured 4 inches from fundus

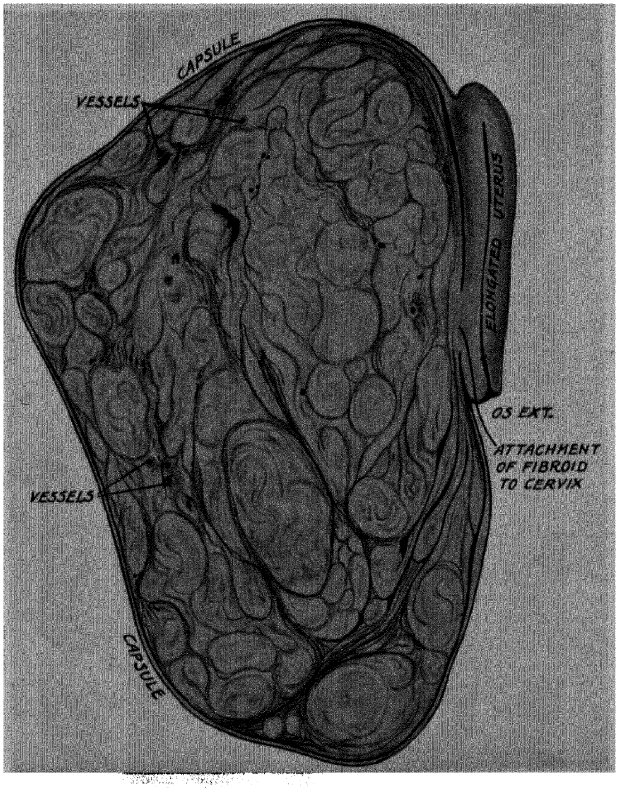


FIG. 237. PSEUDO-CERVICAL FIBROID TUMOUR, INTRALIGAMENTARY IN POSITION. Nullipara, aged 47. The tumour is attached to the uterine wall at about the level of the internal os *by a narrow pedicle*. The uterus is elongated (4 inches), and was displaced laterally by the tumour.

to os externum. In the very large tumour represented in Figure 229 the larger lobes had an attachment by a narrow pedicle to the side of the supra-vaginal cervix.

Fibroids growing from the *portio vaginalis* are usually of small size. They begin as interstitial growths, but may become polypoid as in Figure 239, in the same manner as fibroids of the body, *i.e.* they become extruded beneath the mucous membrane of the cervical canal, and develop a pedicle in the manner already described.

Coincident Changes. The growth of fibroid tumours is frequently attended by a number of other changes in the uterus or the other pelvic organs, which

may be called coincident changes, since their etiological relation to these tumours is not settled. The *endometrium* may be entirely unaffected when subperitoneal fibroids alone are present; submucous and interstitial growths are, however, almost always accompanied by marked thickening of the mucous membrane, due to a proliferative glandular hyperplasia, and it is not uncommon to find extensive hæmorrhages in the stroma. The overgrowth of the endometrium and the co-existence of fibromyoma may possibly be due to some common cause, *e.g.* excess of ovarian hormone. To the

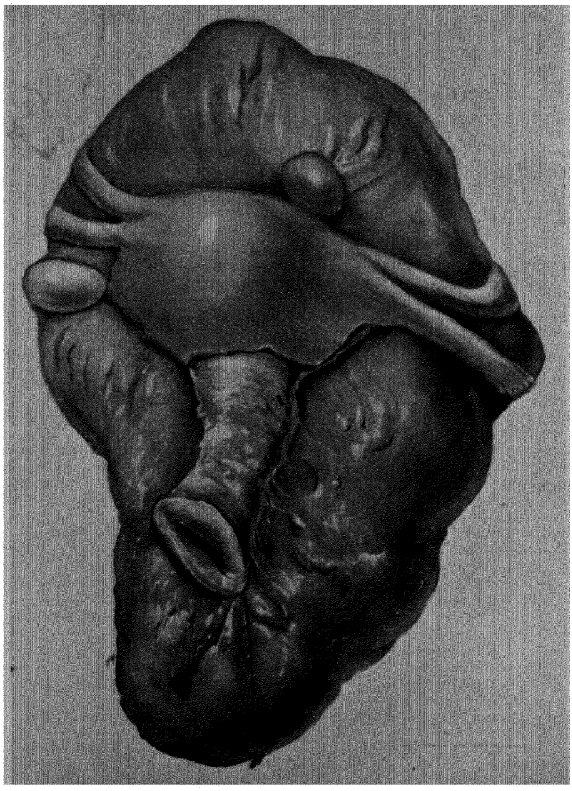


FIG. 238. PSEUDO-CERVICAL FIBROID (*i.e.* a retroperitoneal growth) arising from the front aspect of the cervix by a *broad base* (after Schickele). *Cf.* Figure 237, in which the tumour arises by a *narrow pedicle* from the back of the cervix.

endometrial hyperplasia one of the symptoms commonly associated with fibroid tumours is probably due, viz. leucorrhœa, and the increased monthly bleeding, also met with, is probably in part occasioned by the same condition. Mucous polypi may also be found growing from the endometrium in association with fibroids of the body of the uterus.

The *cavity* of the uterus is, of course, greatly enlarged when there are multiple submucous growths as in Figures 233 and 234. It is also enlarged by single submucous tumours, such as in Figure 232. Interstitial growths distort and displace the cavity without necessarily causing much enlargement. Subperitoneal growths may elongate without dilating the uterus. In

large multiple tumours of the interstitial variety, the uterine cavity often occupies an eccentric position, lying in front, behind, or on one side of the tumour (*see* Fig. 236).

Rotation of the uterus may occur with fibroids, partial strangulation of the tumour may result, and in the case of Bastianelli the torsion of the body on the cervix was so extreme as to cause amputation through the supra-vaginal cervix. Large retroperitoneal growths may produce wide displacements of the uterus, elevating it high above the pelvic brim, or

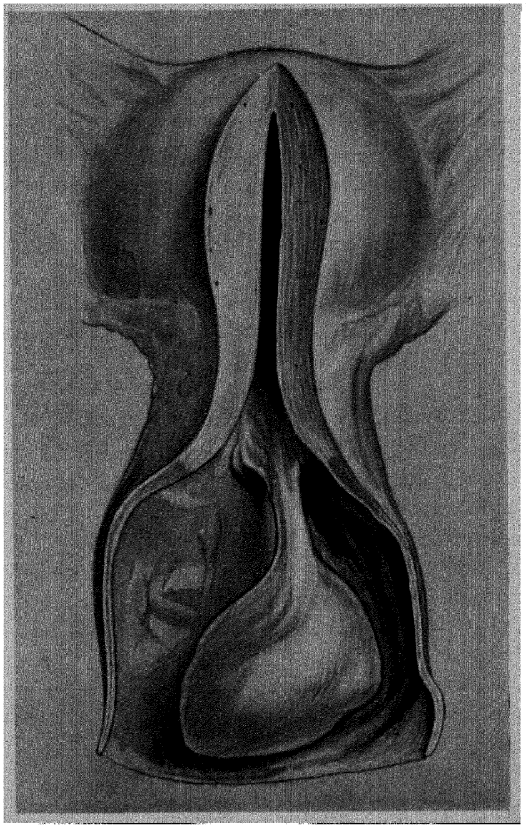


FIG. 239. FIBROID POLYPUS ATTACHED BY A LONG PEDICLE TO THE POSTERIOR LIP OF THE EXTERNAL OS (Charing Cross Hospital Museum).

displacing it far to one or other side (*see* Fig. 229). Submucous growths attached to the fundus may cause chronic inversion of the uterus (*see* Fig. 330, p. 526).

Ovaries and Fallopian Tubes. Observations upon fibroid uteri removed by operation have made it abundantly clear that coincident disease is frequently present in the tubes and ovaries. Tracey has collated a large number of cases (3,561) recorded by different operators, and in this series it was found that 20 *per cent.* showed definite disease in the ovaries, and that a somewhat smaller proportion—14·5 *per cent.*—showed definite morbid changes in the Fallopian tubes. Among the conditions thus met with may be mentioned cystic tumours of the ovaries, chronic inflammation of the ovaries,

hydrosalpinx, and pyosalpinx. This high rate of frequency clearly points to something more than coincidence; in all probability there is a causal relationship between these morbid conditions, but which is primary, and which consecutive, we do not at present know. It might be suggested, for example, that tubal inflammation leads to sterility and sterility to the development of fibroids.

Blood-vessels. The uterine arteries and lymphatics form the main nutritive supply of large fibroid tumours; they may be greatly hypertrophied, and irregularly distributed over the growth, sometimes entering it in front or behind instead of at the side. The ovarian arteries are usually much less hypertrophied than the uterine arteries. Large venous plexuses are usually found in the broad ligaments, and sometimes superficial veins of very large size, covered by peritoneum only, course over the surface of the tumour. These varices may rupture either spontaneously or as the result of traumatism, causing serious internal hæmorrhage. In the case of large tumours the lymphatics of the broad ligaments may be enormously dilated even to the size of a little finger. These subside on the removal of the tumour and cannot be demonstrated without injection.

Ascites with Fibroids. This is rare, but it sometimes occurs with large, movable, pediculated subperitoneal growths, especially those which receive a large blood-supply from the omentum, or those in which partial rotation of the uterine pedicle has taken place.

SECONDARY CHANGES IN FIBROIDS

Largely owing to the disparity between the size of fibroids and their blood-supply, these tumours are extremely liable to degenerative and other changes, which may be enumerated as follows:

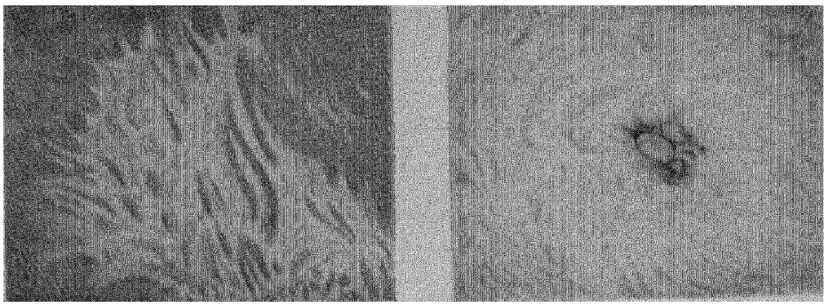
(A) *Degenerative changes.*
- (1) Atrophy.
- (2) Hyaline degeneration.
- (3) Cystic degeneration (hyaline liquefaction).
- (4) Fatty degeneration.
- (5) Calcareous degeneration.
- (6) Necrosis, necrobiosis.

(B) *Circulatory changes.*
- (1) Œdema and lymphangiectasis.
- (2) Axial rotation leading to:
  - (*a*) Congestion.
  - (*b*) Interstitial hæmorrhage.
  - (*c*) Necrosis.
  - (*d*) Detachment of tumour.

(C) *Angiomatous or telangiectatic changes.*

(D) *Infective changes* leading to:
- (1) Inflammation.
- (2) Suppuration (localized abscess).
- (3) Gangrene and sloughing.

(E) *Malignant changes.*
- (1) Sarcoma (malignant leiomyoma).
- (2) Peri-endothelioma.
- (3) Endothelioma.

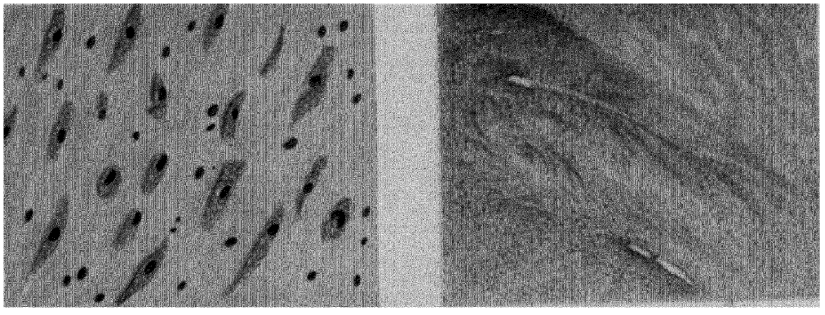


A

Irregular Hyaline Liquefaction. A stage in the production of a cyst with ragged walls.

B

Hyaline Degeneration of Collagen-Fibres. The nuclei of muscle-cells are faintly stained.

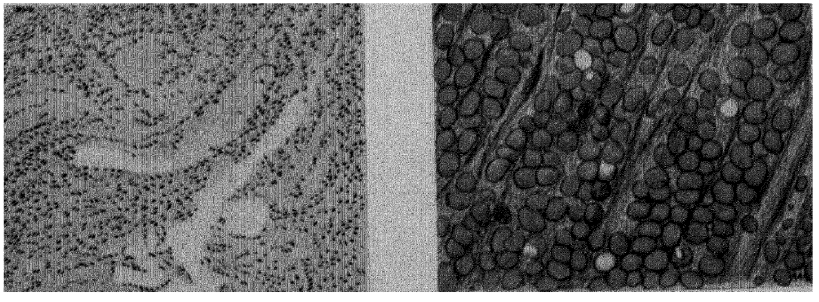


C

Fatty Fibroid. Fat-droplets are seen in the muscle-cells replacing the normal cytoplasm.

D

Fatty Degeneration as seen in a Red Fibroid. The droplets of fat are very small.



E

Œdematous Fibroid. The lymphatics are dilated by stasis and the œdema-fluid is seen to be fixed as flocculent granular material (stained pink) in the stroma.

F

Fatty Fibroid. The large fat-droplets run in the direction of the muscle-bundles.

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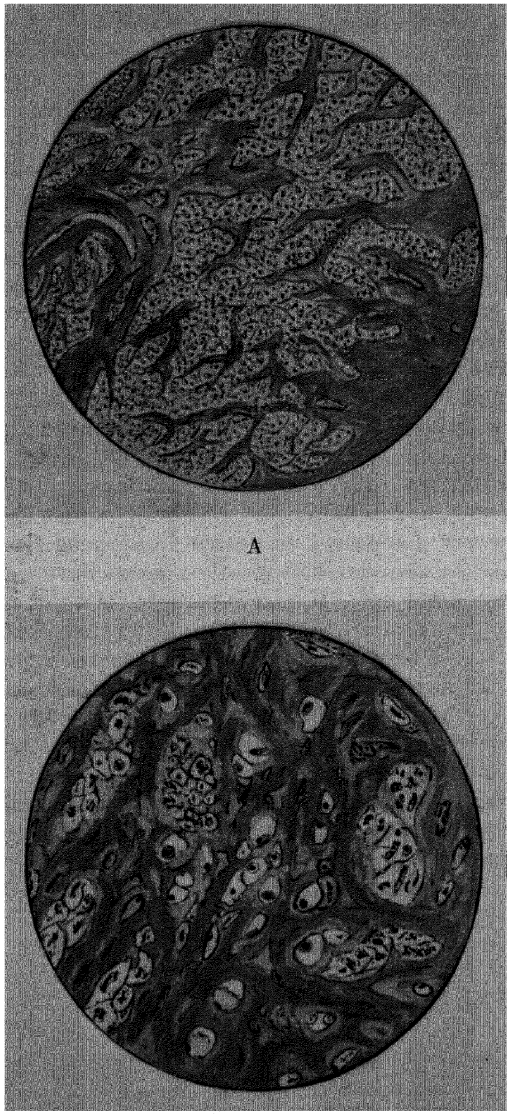
Atrophy. With the cessation of the ovarian function after the climacteric, a certain number of fibroids undergo spontaneous atrophy and consequent reduction in size. Instances are recorded of the total clinical disappearance of these growths after menstruation has ceased. This, however, must be regarded as quite an exceptional sequence of the change of life. Atrophy of fibroids is no doubt brought about by the same causes as those which produce atrophy of the normal uterus at the same period of life.

The employment of X-rays in the treatment of fibroids has, during the past few years, been extensive in continental clinics, and it is claimed that atrophic changes are thus artificially produced in these tumours similar to the atrophy which is known to occur in some of them after the menopause. There is sufficient clinical evidence on record to show that reduction in size of fibroids does occur after the cross-fire application of X-rays. This result is probably due more to a primary atrophy of the ovaries than to the direct influence of the rays upon the tumour itself, all observers being agreed that atrophy of the ovaries can be produced by X-rays suitably applied (*see also* p. 425). Atrophy of fibroids may be also artificially produced by total oöphorectomy, and this operation was introduced in 1882 by Lawson Tait for the express purpose of reducing the size of fibromyomata, but has now been abandoned.

Hyaline Degeneration. The substance *hyalin* is one of a group to which also belong glycogen, mucin, amyloid, and fibrin, in that they all have the one common property of appearing opalescent like ground glass. In chemical composition these substances vary greatly; some have definite chemical reactions, but most have not. Hyalin is perhaps the most indefinite of the entire group; it shows no distinctive chemical reaction, but fortunately it exhibits very marked tinctorial properties, which render its discovery a matter of ease. Hyaline degeneration is a change which occurs in smooth muscle, in connective tissue, and in blood-vessels. In fibroids it most commonly commences in the bundles of collagen and fibroglia-fibrils which make up the connective tissue. The normal structure of the latter disappears and is replaced by colourless homogeneous material, which stains deeply with eosin and fuchsin. Muscle-cells have been shown to demonstrate the same change in their centre, which then stains deeply with eosin. This is regarded by some authorities as a post-mortem change and may be ignored so far as hyaline degeneration in fibroids is concerned, since it is comparatively rare. In fibroid tumours hyaline degeneration of vessels occurs, but it is not common; indeed, the vessels as a rule resist this change to the last, so that it is not unusual to see healthy-looking vessels lying free in spaces where liquefaction of hyaline tissue has occurred. It should be understood, therefore, that practically always, hyaline degeneration starts in the connective tissue which envelops the muscular bundles (*see* Pl. XXII, Fig. A). When the blood-vessels of a fibroid are markedly hyaline it is more than likely that the growth shares with other organs in a general blood-vascular degeneration.

The majority of fibroid tumours show some degree of hyaline change, even when quite of small size and when situated in the vascular muscle-wall of the uterus. As the extent of the degeneration varies inversely with the blood-supply, hyaline change is most marked in pediculated subserous growths, on account of their defective nutrition. It is also seen in submucous polypi, where it favours necrosis. A point of considerable importance is that the surrounding hyaline material exerts compression on the muscle-

cells. The nuclei of the latter resist to the last, but the cell-bodies quickly disappear, leaving only the nuclei, which finally are broken up into granular fragments and disappear likewise (*see* Fig. 240). In some cases the muscle-



A

B

FIG. 240. HYALINE DEGENERATION. A, COLLAGEN REPLACED BY HYALIN. The latter forms branching trabeculæ which ramify among the muscle-bundles. B, EFFECT OF HYALIN ON THE MUSCLE-CELLS. The latter are swollen and their nuclei are broken up into granular fragments.

cells, which are snared by a hyaline trabecular network, take on a malignant activity and become sarcomatous ; this establishes *a close association between hyaline degeneration and sarcomatous change in fibroids.*

Cystic Degeneration. Hyaline Liquefaction. This is the colliquative stage of the hyaline change, *i.e.* by the liquefaction of the hyaline deposit, "*cysts*" or spaces are formed within the tissues of a fibroid. The distribution of the hyaline material will determine the characters of the cavities which are produced by liquefaction. If the hyalin is laid down in uniform plaque-like masses, large cysts will result. When the hyalin is more discrete and trabecular (Fig. 240A) multiple cysts will be formed which, by the breaking down of intervening septa, tend to fuse and become unilocular (*see* Fig. 241).

The cavities thus produced are not cysts, that is to say they have no endothelial lining. Their walls, which may be either ragged (*see* Fig. 240

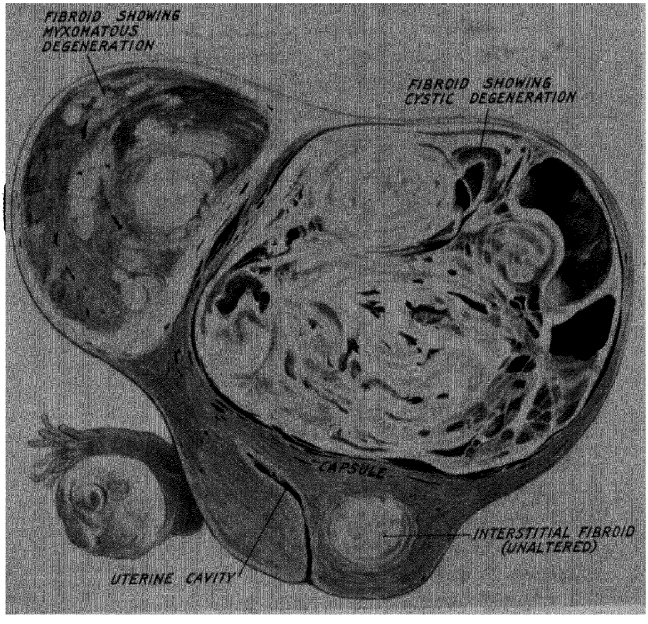


FIG. 241. MULTIPLE FIBROID TUMOUR OF THE UTERUS. Multipara, aged 39. The largest fibroid shows well-marked cystic degeneration; the smaller one on the right shows the earlier stage of hyaline liquefaction.

and Pl. XX, Fig. A) or smooth (*see* Figs. 241 and 242), are composed of hyaline tissue which has not as yet undergone liquefaction. The spaces enlarge by the spread of liquefaction, and, as stated above, by the breaking down of trabeculæ between small cysts (*see* Fig. 241).

The fluid-contents of *cysts* produced by liquefaction of hyaline areas varies considerably. It is commonly straw-coloured and highly albuminous; it never contains mucin, or pseudo-mucin. It may coagulate spontaneously, but that which is obtained from the larger cysts remains fluid. It is not uncommon to find the fluid coloured by blood-pigment, so that it may be turbid, greenish-brown, red, or reddish-brown.

Cystic degeneration is not always due solely to liquefaction of hyaline areas. It follows red necrosis, which is a change, probably always preceded by hyaline degeneration. If red necrosis intervenes between

hyaline and cystic degeneration, the contents of the cyst may resemble pure venous blood in appearance, but we have found that the fluid contains no fibrin-ferment and therefore does not coagulate. The muscle-fibres in the walls of such a cyst will contain fatty globules, whereas in the case of cystic hyaline areas, where there has been no development of red necrosis, or *necrobiosis* as it is called, there will be no fat.

It may be concluded that the majority of *cysts* found in fibroids are pseudo-cysts derived from liquefaction of hyaline deposit. True cysts do exist in fibroids, and these will be referred to under *Lymphangiectasis*.

Fatty Degeneration. This change is far less commonly observed than is

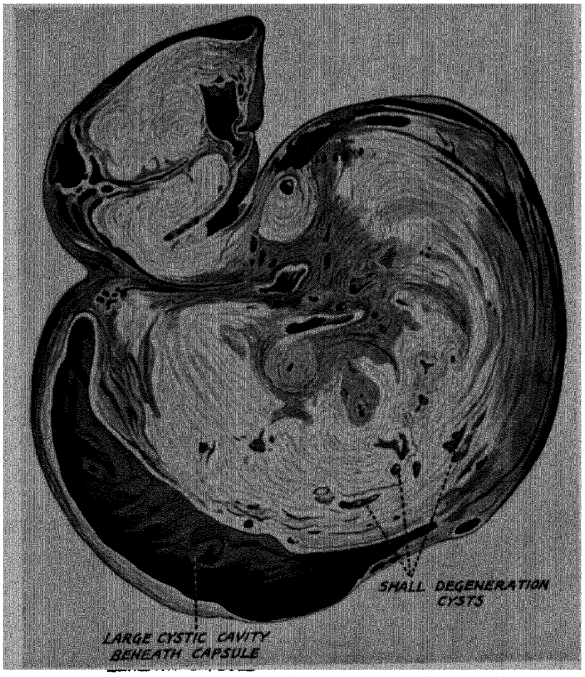


FIG. 242. LARGE RETROPERITONEAL FIBROID TUMOUR. A large subcapsular cystic space has been formed in the lower part of the Figure, and many smaller spaces in other parts. The large cystic space has smooth walls, *cf.* Figure 241.

hyaline degeneration. It is an essential precursor to calcareous deposition, which is not an infrequent change, especially in fibroids found in elderly subjects. The probability, therefore, is that fatty degeneration has often in the past escaped detection for want of suitable staining reagents. For the study of the fatty stage in the degeneration of fibroids, the fresh tissue should be taken, frozen sections made, and stained with Sudan III. The section is then mounted in Farrant's solution. The fat-droplets are picked out as deep orange or sunset-red globules. They lie inside the muscle-fibres and therefore are arranged in the direction of the muscular bundles. The macroscopic appearance of fat in a fibroid is variable, being influenced by associated conditions due to changes in the blood. The cut surface of a fatty

fibroid may be pale yellowish in colour, but it is often tinted by soluble blood-pigment. The normal whorled appearance is obscured, and the surface is homogeneous.

Microscopically, the changes are those of hyaline degeneration to which the deposition of fat-globules is added. Thus there are seen (1) irregular and scanty nuclear staining ; (2) granular and hyaline change ; (3) fat-globules running in the original direction of the muscle-fibres (Pl. XXII, D) ; (4) fat within wandering phagocytes, both inside and outside lymphatics ; (5) signs of vascular degeneration, engorgement, thrombosis, and fibrin-deposits in the vessels.

The above description applies to a true degenerative process, which is, as already stated, a precursor of calcareous degeneration. It also invariably precedes necrosis, a point to which further reference will be made.

The presence of fat in a fibroid appears in some rare instances to be due to a *vital* but depraved activity, which is akin to lipoma formation elsewhere in the body. Such terms therefore as *lipomyoma*, *fibro-lipomyoma*, and *lipomatosis* have been used to describe this pseudo-growth.

Microscopically, the fat-globules in *lipomatosis* are as large as those seen in an ordinary lipoma, whereas in ordinary fatty degeneration the droplets are extremely minute (compare Fig. C and Fig. D, Pl. XXII). The naked-eye characters are also totally different. The whorled appearance of the fibrous elements of the tumour may remain. There is no evidence of necrosis nor of thrombosis. Figure C, Plate XXII, shows that even in this condition the fat is formed at the expense of the muscle-fibres, so that how far it is justifiable to regard the change as degenerative, and how far it is neoplastic, must be left undecided.

Calcareous Degeneration. The deposition of lime-salts in fibroids is quite commonly observed in elderly subjects. Preceding the deposit of these salts, the tissues contain fatty substances known as lipoids, some in the form of lipoid-fat, some as lipoid-soaps ; in other words, malnutrition has led to hyaline and fatty degeneration. The fat combines with the albumen of the dead cells to form soap-albumen. The latter forms insoluble double calcium-soaps with calcium derived from the blood ; finally by combining with CO_2 and PO_4 carbonates and phosphates of lime are deposited as insoluble salts in the dead tissues.

Calcareous degeneration of fibroids may affect the periphery of the growth only, producing a shell-like investment, or the deposit of lime salts may be diffused throughout the whole substance of the tumour, producing the so-called *womb-stone*.

Calcification of a fibro-myoma may be clinically detected by the use of X-rays.

Necrosis. Necrobiosis. Necrosis is to be found according to Tracey in 5 *per cent.* of fibroids removed by operation. The central parts of the tumour, being the most remote from its blood-supply, are most prone to undergo necrotic change. The demarcation of a necrotic area may be sharp, or it may be indefinite. The colour of the dead tissue varies with the blood-vascular changes in the neighbourhood ; it may be yellow-grey, grey-brown, greyish purple, magenta-red or mahogany-red. Necrotic patches are liable to occur in subserous, interstitial, and submucous fibroids. The change is invariably preceded by hyaline and fatty degeneration.

The term *necrobiosis* is generally used to indicate partial destruction or

death of the tissues, in contradistinction to *necrosis* or total death ; but the term has received a narrow application, and has been employed to designate a particular form of degeneration of fibroids which is frequent in pregnancy and in the puerperium. From its colour it has also been known as *red*

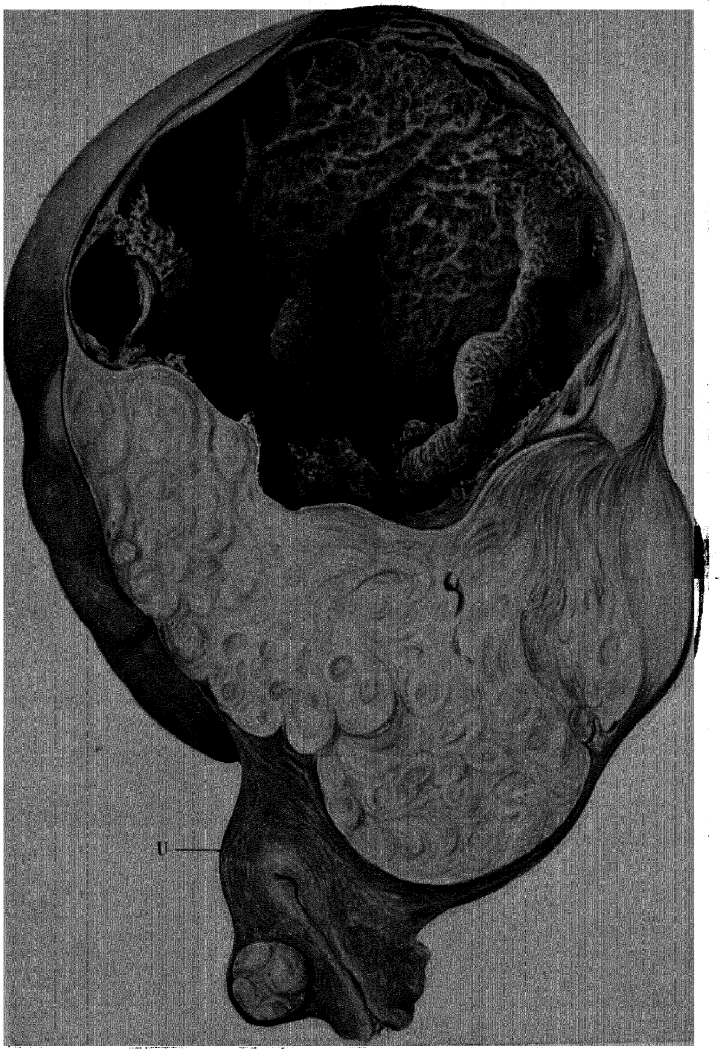
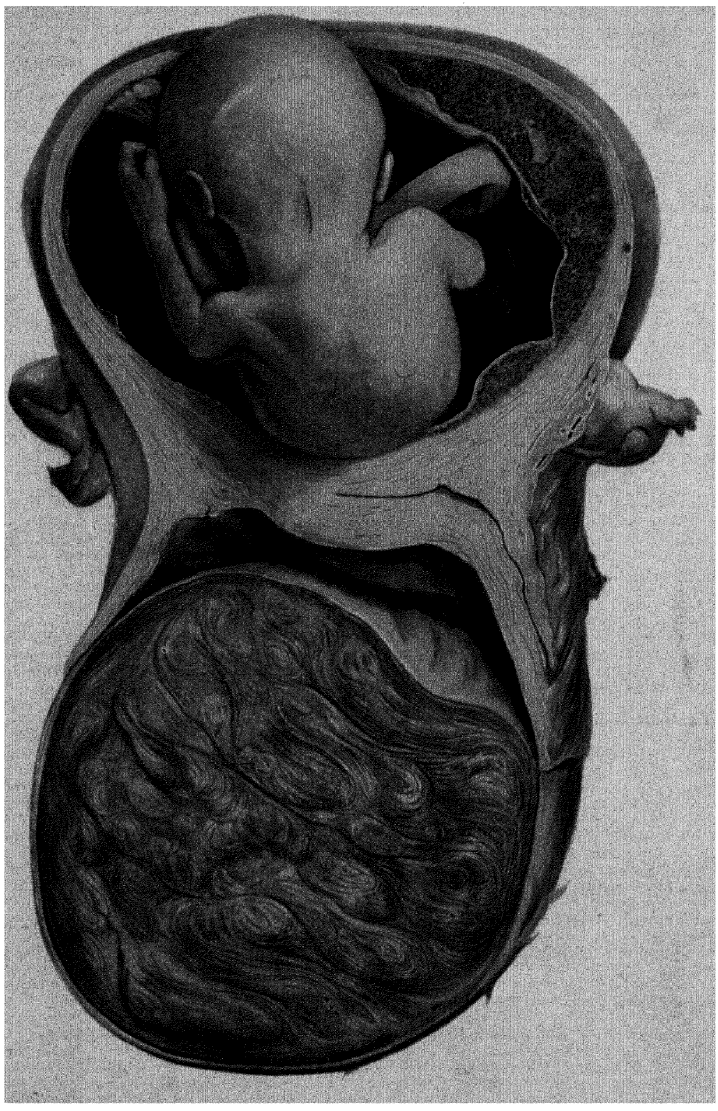


FIG. 243. LARGE SUBSEROUS FIBROID ATTACHED TO THE UTERUS BY A BROAD BASE. The upper half of the tumour is cystic. The cyst shows a convoluted false membrane. The contents were viscid blood-stained fluid, and the original change was hyaline degeneration, probably followed by red necrosis. U, Uterus.

degeneration. A reason for using the term *necrobiosis* is, that there is clinical evidence to support the view that certain necrobiotic fibroids, *i.e.* cases of red degeneration, can actually recover their vitality ; that is to say, the clinical signs of tenderness and pain, and also the rise of temperature which



PREGNANCY IN A FIBROMYOMATOUS UTERUS. The fibroid has undergone "red degeneration."

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sometimes occur, may subside after having caused a protracted and tedious puerperium.

Red fibroids are of comparatively soft consistence. On section they resemble raw or partly cooked beef-steak; they give off a peculiar fishy odour; dilated and thrombosed vessels may sometimes be seen in the capsule, and more occasionally in the interior of the growths. The colour is due to the tissues being stained by soluble blood-pigments set free by hæmolysis, which Leith Murray attributes to the action of the lipoid substances that are always present. The actual chemical nature of the soluble colouring material is undecided, nor is it yet determined what relation, if any, the hæmolysis has with the thrombosis which is so commonly present.

Microscopically, the stage at which the degeneration has arrived is estimated by the number and appearance of the cell-nuclei, and by the behaviour of the cytoplasm to differential stains; the more necrotic the growth, the less the differentiation, and the more diffuse becomes the staining. Red fibroids have no special characteristics in this respect. The microscopical features enumerated under *Fatty Degeneration* (p. 400) hold good for any form of necrosis irrespective of its colour, so that under the microscope it is impossible to tell red necrosis from yellow or any other colour. *Red* degeneration is therefore not a *pathological type*. Nevertheless it has assumed a special clinical significance from its frequent association with the gravid or puerperal uterus. It may, however, be found in the non-pregnant state. Plate XXIII shows a fibroid in a state of total red degeneration in a uterus four and a half months pregnant.

Necrotic areas may be red, yellow, or white, but whatever their colour may be, they are not due to infection. When bacteria are found, the infection is secondary.

Œdema and Lymphangiectasis. It is common to speak of a fibroid which is soft, and exudes an abundance of fluid on section, as being *œdematous*. The majority of cases so described are really examples of the liquefaction which results from hyaline degeneration. True œdema is uncommon; liquefaction, however, is frequently observed in fibroids; it may be accompanied by œdema, but it must be clearly understood that the two processes are separate and distinct.

An œdematous fibroid feels semi-fluctuant, and clinically the consistence of the uterus is suggestive of pregnancy. On section much serum escapes. After preservation for many weeks in Kaiserling's solution the cut surface becomes concave, and sulci appear between the lobes of the growth. The fluid contains only a scanty amount of albumen, which contrasts with the highly albuminous fluid found in cases of hyaline liquefaction.

When microscopically examined, an œdematous fibroid shows the muscle-bundles separated by a flocculent or granular material formed of the constituents of the transudation which have become fixed in the hardening process (*see* Fig. E, Pl. XXII). The muscle-fibres themselves are swollen from intracellular transudation, so that in transverse section they appear as large clear cells with unstained cytoplasm.

In œdematous fibroids the lymphatic channels are dilated; sometimes this is marked enough to justify the condition being described as *lymphangiectasis*. The dilatation of lymph-channels and the transudation of serum are the results of some mechanical compression, just enough to produce a

gradual, partial obstruction in the lymph-circulation. Impaction of the tumour in the pelvis is the commonest cause of true œdema.

Axial Rotation. A stalked subperitoneal fibroid sometimes becomes twisted, *i.e.* rotated upon its axis; when the twist is extreme, the uterus to which the tumour is attached sometimes participates in the rotation. As already mentioned, in a case recorded by Bastianelli, of Rome, gradual torsion of a fibromyomatous uterus effected complete supravaginal amputation of the organ (Kelly-Cullen). Axial rotation is an accident which occurs to ovarian tumours much more frequently than to fibroids, and the general considerations concerning its occurrence will be referred to later on in that connection (*see* p. 636).

In the case of fibroid tumours rotation is usually partial only, for the thickness of the pedicle prevents the twist from completing more than half a circle. It is still more unusual for the *uterus* to become rotated through a complete circle, but even partial rotation may lead to occlusion of the cervical canal, and the accumulation of menstrual blood in the uterus (hæmatometra). Fibroids which have rotated assume a deep plum-colour from congestion, and extensive interstitial hæmorrhage is found on microscopic examination. The tumour also, as a rule, contracts extensive adhesions to neighbouring organs. Occasionally the nutrition of the pedicle beyond the twist is greatly interfered with, atrophy occurs, and the tumour becomes detached from the uterus. It is then nourished through vascularization of the adhesions which it has contracted; omental adhesions are the most important as sources of this alternative blood-supply (*parasitic fibroids*).

Acute symptoms similar to those which will be described in the case of ovarian tumours may be met with when fibroids become suddenly twisted. This is, however, exceptional, such instances in our experience being associated with pregnancy, in which connection we have met with two examples. As a rule the rotation occurs gradually, and the symptoms referable to the torsion are inconsiderable, or may even be absent.[1]

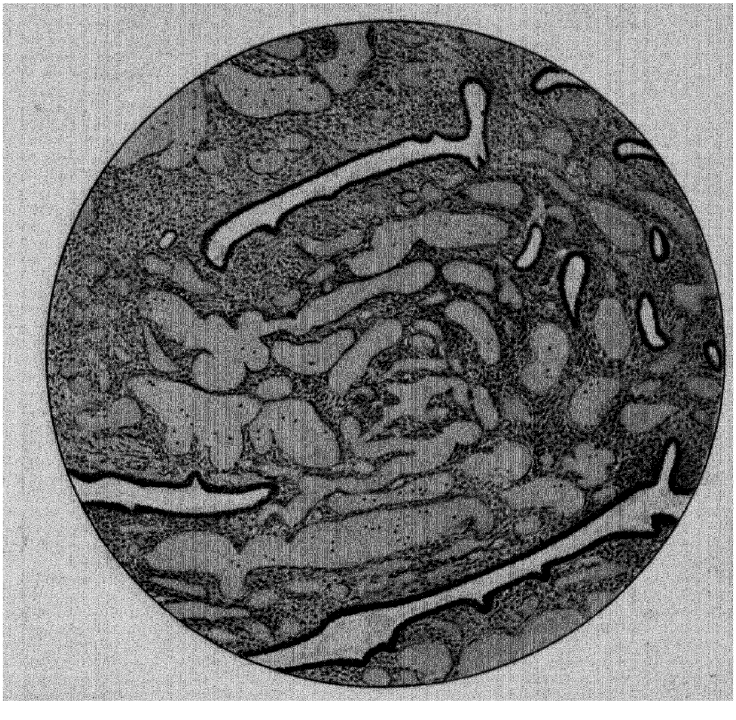
Angiomatous or Telangiectatic Changes. True angiomata, *i.e.* growths composed of a new formation of blood-vessels, are rare in fibroids; they are, however, occasionally found, the new vessel-formation being apparently independent of degenerative or necrotic change.

The engorged vessels around necrotic areas, particularly the type known as *red degeneration*, are sometimes so pronounced as to be described as telangiectases. This does not imply that new vessels have formed, but that, owing to stasis and engorgement, every pre-existing vessel has come into prominence. The same change is seen to follow congestion in those submucous fibroids which have suffered from compression during expulsion (*see* Pl. XXIV), and in subperitoneal fibroids which have undergone extreme torsion of their pedicle.

Infective Changes. When fibroid tumours become infected the endometrium is usually the channel of infection; from this it follows that submucous growths are the most, and subperitoneal growths the least liable to become affected in this way. Another possible source of infection is the bowel, the fibroid being then attacked from its peritoneal surface. In very rare cases infection appears to occur through the blood.

Sometimes the whole of a large fibroid tumour, consisting of the uterus

[1] For a record of cases of torsion of the myomatous uterus, *see* 'Fibroids and Allied Tumours' (Lockyer), Appendix, pp. 561—566.



FIBROADENOMATOUS POLYPUS OF THE CERVIX, showing vascular engorgement due to stasis. This is not an example of telangiectasis, *i.e.* there is no formation of new vessels.

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and several growths, becomes inflamed, resulting in the formation of general adhesions which may involve practically the whole of its peritoneal surface and attach the tumour firmly to bowel, omentum, the uterine adnexa, and the parietal peritoneum. Coincident salpingo-oöphoritis is also always present. In such cases the uterus is probably attacked from both sides; from the endometrium by an infection which has ascended from the vagina, and from the peritoneum by the pelvic peritonitis, resulting from the tubal infection. In cases such as these, pain and menorrhagia are prominent symptoms, but the existence of peritoneal adhesions alone does not always cause pain, and their presence may remain unsuspected until the abdomen has been opened. Instead of the whole tumour thus becoming infected, individual growths may be attacked, the infective process ending in suppuration or sloughing.

Suppuration, or the formation of an abscess in a fibroid growth, is very rare, but instances have been recorded both in interstitial growths (endometrial infection), and in subperitoneal growths (bowel infection). The abscess may be evacuated in the former case into the uterine cavity, in the latter through the bowel.

Sloughing occurs almost solely in connection with submucous or polypoid growths, the source of infection being a pre-existing purulent discharge; or in some cases it is accounted for by operative interference or instrumentation, obstetric or gynæcological, of the uterine cavity. While the capsule of the tumour is intact, sloughing probably never occurs; when the capsule has been torn, either in the natural process of extrusion of the tumour, or by operative interference, infection is prone to lead to sloughing. It is most commonly met with in connection with puerperal septic infection of the uterus. The processes of sloughing and extrusion go on together, and profuse irregular hæmorrhage often accompanies them. Fever, as a rule, is of moderate degree, for free drainage can take place through the cervix, rendered patulous by the uterine contractions which accompany the process of extrusion. Histological examination of expelled fragments of the growths is in these cases often inconclusive, for the staining-reactions of the dead tissues are lost.

Adhesions are not commonly formed by fibroid tumours, and are much less frequent than is the case with tumours of the ovary. In Tracey's series of 3,561 cases the tumour was found adherent in only 3·5 *per cent.* Adhesions occur under three different conditions: (1) localized adhesions may form over an area which has undergone degeneration, the omentum being as a rule the structure to which the abnormal attachment is contracted; (2) localized adhesions may be found in the neighbourhood of an extra-uterine source of infection, *e.g.* an inflamed Fallopian tube or ovary, the vermiform appendix, or a coil of intestine; (3) general adhesions of the whole peritoneal surface of the tumour may occur from uterine infection.

When adhesions are present the tumour seldom entirely loses its mobility, and their recognition before operation is a matter of difficulty. They do not in all cases cause pain, and except that they increase the operative difficulties of removal, they are not of great moment.

MALIGNANT CHANGES IN FIBROIDS

Fibroids being exclusively mesenchymal growths, the only type of malignant metaplasia which they can possibly undergo must be mesoblastic

likewise. We may thus have (1) malignant leiomyomata, which are very cellular and capable of producing metastases, although they are not histologically malignant; (2) sarcomata, formed by malignant metaplasia from the muscle-cells (*see* Figs. 245 and 246) and from the connective-tissue cells of a fibroid; (3) peri-endotheliomata and endotheliomata, which are types

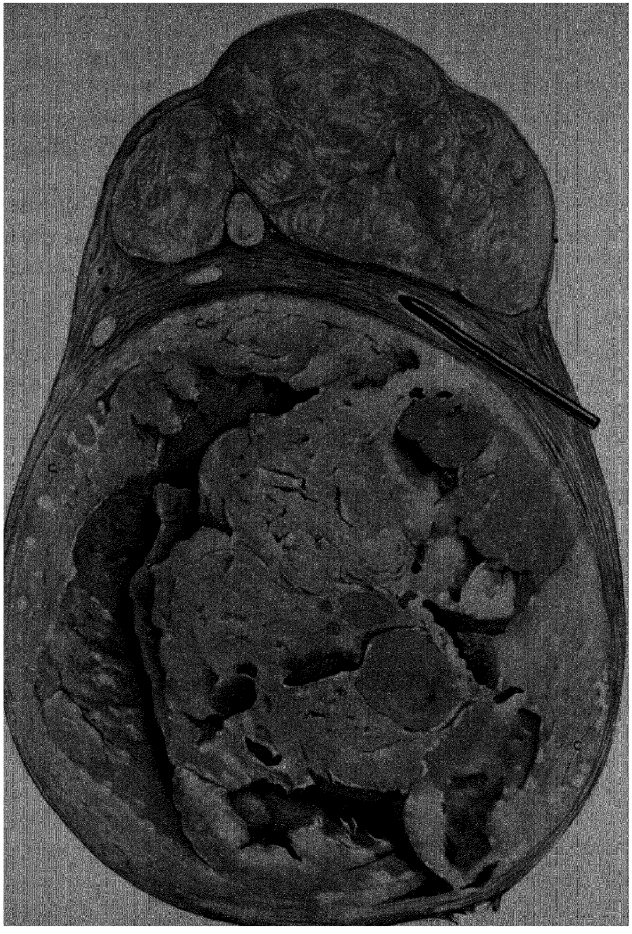


FIG. 244. SARCOMATOUS METAPLASIA IN A FIBROID TUMOUR. The lower and larger growth shows areas of smooth homogeneous sarcoma. The large cystic space was an abscess-cavity. The smaller ones were blood-cysts. The capsule of this growth was calcareous. Compare the whorled appearance of the fibroid seen above with the smooth section of the sarcoma seen below.

of sarcoma of low malignancy arising from the blood-vessels and lymphatics of a fibroid. Epiblastic tissue being absent, it is impossible for epitheliomata and carcinomata to develop from within a fibro-myomatous tumour. A fibroid may, however, be *invaded* by a co-existing carcinoma or sarcoma.

Sarcomatous Metaplasia. The possibility of sarcomatous change occurring in a fibro-myoma was once held to be doubtful, but it is now generally

admitted. The natural history of a fibro-myoma, the type-cells of which are the embryonic fibroblast and the leioblast, would not be complete without faculty of demonstrating malignant metaplasia.

Frequency. Fehling and also Martin found sarcomatous metaplasia in fibroids in about 2 *per cent.* of cases. Cullen found this change in 1·21 *per cent.*, Noble in 1·8 *per cent.*, and Tracey in 1·5 *per cent.* of cases. The most recent statistics have reduced the proportion to even smaller dimensions, so that it is now regarded as slightly under 1 *per cent.*

It is a well-known clinical fact that fibroid polypi, *i.e.* pediculated submucous fibroids, which on section have appeared innocent, may recur again and again, and have ultimately been found to have undergone sarcomatous change. Every variety of fibroid may become affected.

Naked-eye Appearances of Sarcomatous Areas. Early sarcomatous change

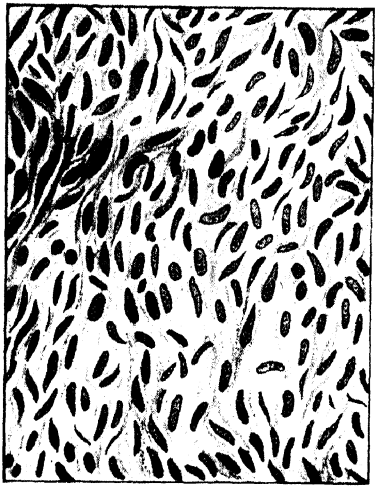


FIG. 245. SARCOMATOUS METAPLASIA OF THE MUSCLE-CELLS OF A UTERINE FIBROID TUMOUR. The short rods are unaltered muscle-cells, the spindle- and oat-shaped cells are malignant.



FIG. 246. SARCOMATOUS METAPLASIA OF THE MUSCLE-CELLS OF A FIBROMYOMA OF THE UTERUS. Note the branching processes of the cells.

in a fibroid cannot be recognized macroscopically, but when the condition is well established, the gross features of the malignant area afford a striking contrast to the surrounding unchanged fibromyomatous tissue. The area is often sharply defined, owing to the cut surface being homogeneous and not whorled as it is in the section of a fibroid (*see* Fig. 244). It is yellowish in colour instead of being pearly white, and the malignant tissue is much softer than the unaltered fibro-myomatous tissue by which it is surrounded. The sarcomatous area may become cystic, and encysted collections of blood or blood-stained fluid may be present. These blood-cysts are formed from the giving way of embryonic, thin-walled capillary vessels. Sarcomatous change usually commences in the central part of a fibroid (*see* Fig. 244).

Microscopic Appearances. To study metaplasia, sections must be taken from the junction between the altered and the unaltered portions of a fibro-

myoma, *i.e.* at the periphery of the malignant area. There are two possible sources of origin for a sarcoma developing in a fibroid, viz. *connective tissue* and *muscle*. In the former, the intermuscular fibrous tissue becomes abnormally cellular. Between the masses of new (sarcoma) cells the muscle disappears entirely or in part, so that a trabecular appearance is given to the growth. Whilst increasing in size, the cells of the new growth develop processes (*see* Fig. 246), and some of them become angular ; the nuclei reach the size of epithelial nuclei and they show mitotic division. The growth contains many thin-walled capillary vessels, which become dilated to form

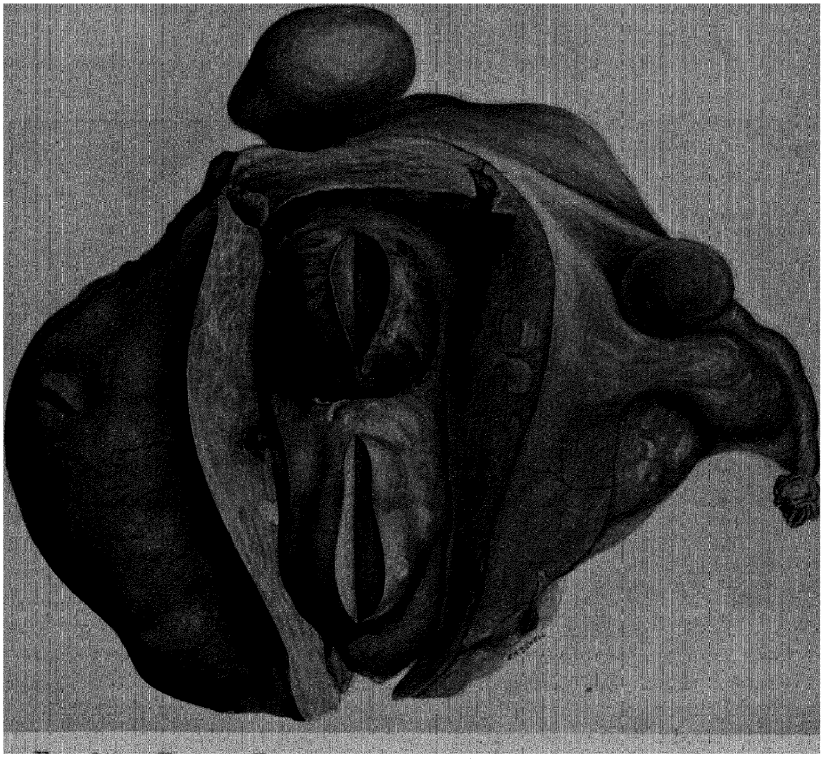


FIG. 247. FIBROID TUMOUR INVADED BY SARCOMA. Two sarcomatous nodules are seen projecting as submucous growths into the cavity of the uterus. The microscopic appearances are shown in Figure 248.

blood-cysts, and often show lacerations which have produced interstitial hæmorrhage. A section taken through the centre of the growth will show it to be composed of an admixture of spindle and round cells. It is possible that both connective tissue and muscle may take part in a malignant metaplasia simultaneously. On the other hand, it has been proved that the change may arise in the muscle-tissue only (*see* Figs. 245 and 246). Sarcomatous metaplasia of muscle leads to a myosarcoma, or, to give it its full name, a leio-myosarcoma ; it is characterized by a preponderance of spindle cells and cells with processes (*see* Fig. 246), and is loosely referred to as a spindle-celled sarcoma. The round cells of lower type seen in malignant metaplasia of connective tissue are less in evidence or altogether absent.

Attention has already been drawn to the close association of hyaline degeneration of connective tissue and malignant metaplasia of muscle.

Fibromyomata are sometimes *invaded* by a sarcoma arising primarily in the uterine wall (*see* Figs. 247 and 248), and it is due to this fact that doubt has arisen as to a true malignant change arising *de novo* in the fibromyomatous tissue itself.

A circumscribed sarcoma starting in the muscle-wall of the uterus is difficult to distinguish from one starting in the muscle of a fibroid tumour, as both may be fibro-sarcomata, and both may possess a capsule, so that in certain cases it is impossible to pronounce judgment as to the starting-place of the malignant process. If the malignant change is found in the centre of a large fibroid, it is fair to assume that it started primarily in the tumour.

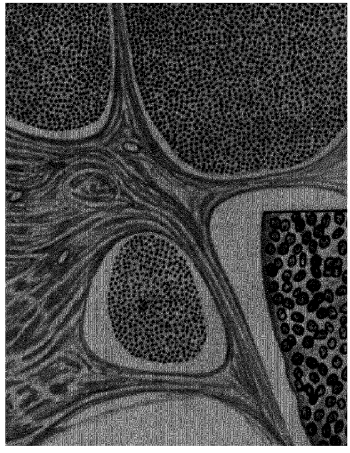


FIG. 248. SARCOMATOUS INVASION OF A FIBROID TUMOUR. The inset (I) shows the sarcoma-cells under $\frac{1}{6}$ inch objective.

Endotheliomatous Change in Fibroids. The occurrence of endo- and periendo-theliomatous changes in fibromyomata is very rare. They will therefore be referred to under Sarcomata (*see* p. 461).

Fibroid Tumours and Cancer of the Uterus. The association of fibroids and malignant uterine growths may occur in two different forms: (1) fibroid tumour with cancer of the cervix (*see* Fig. 249); (2) fibroid tumour with cancer of the body (*see* Pl. XXV). In both forms the fibroid and the carcinoma are independent diseases, cancer having attacked a uterus already the seat of a fibroid growth.

With regard to *cancer* it may definitely be stated that in 3 or 4 *per cent.* of cases of fibroid tumours removed by hysterectomy, carcinoma has been found, and with somewhat greater frequency in the body than in the cervix. Thus in 1,400 cases Kelly and Cullen found cancer of the body in 1·78 *per cent.*, and of the cervix in 1·28 *per cent.*; in 1,118 cases Noble found cancer of the body in 2·4 *per cent.*, and of the cervix in 1 *per cent.* Tracey in 3,561 cases (collated) found cancer of the body in 1·7 *per cent.*, cancer of the cervix in 0·7 *per cent.* In considering the subject of uterine cancer later on, it will be seen that this disease occurs with much greater relative frequency in the cervix than in the body; when associated with fibroid tumours the relative proportions are thus reversed.

The subjects of fibroid tumours are more frequently sterile than other women, and this fact in part accounts for the greater frequency with which, in these women, cancer occurs in the body than in the neck of the uterus.

The association of cancer and fibroids is rarely, if ever, seen before the age of forty. The view has been advanced that the figures already given lead to the conclusion that the subjects of fibroid tumours are more liable than other women to the development of cancer in later middle age. It is doubtful if this conclusion is justified; it must be recollected that the

statistics are compiled only from cases submitted to the operation of hysterectomy, *i.e.* from only a proportion of the total number of women in whom fibroids occur. If it were possible to calculate the association of cancer with fibroids generally, and not alone with cases operated upon, the aspect of the matter would probably be greatly changed.

More than 300 cases have been recorded in which cancer was recognized in the cervical stump left after the operation of supravaginal amputation for a fibroid tumour. In our experience this has occurred as late as two and a half years after the uterus was amputated for fibroids. This

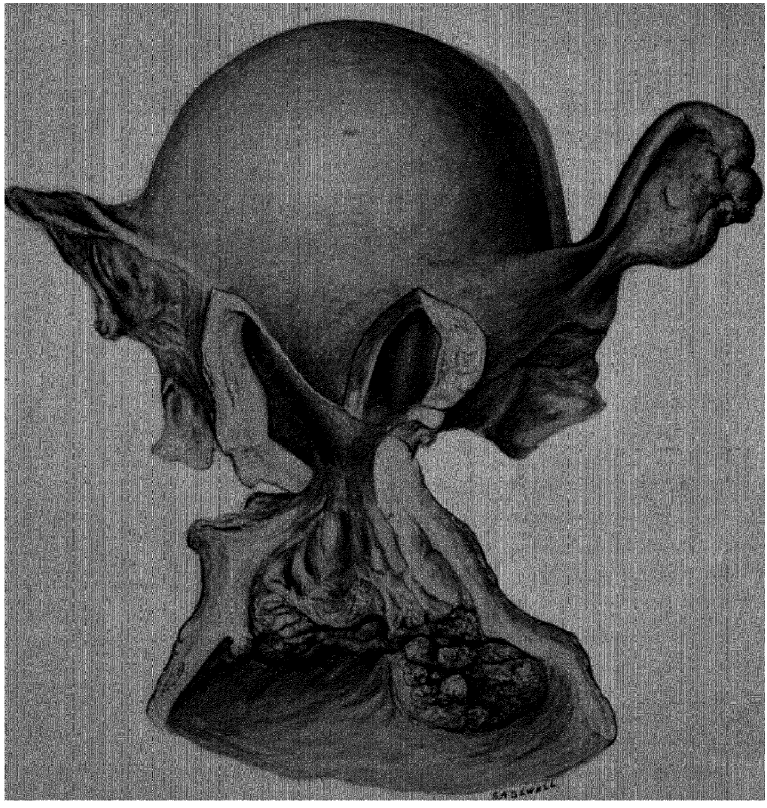
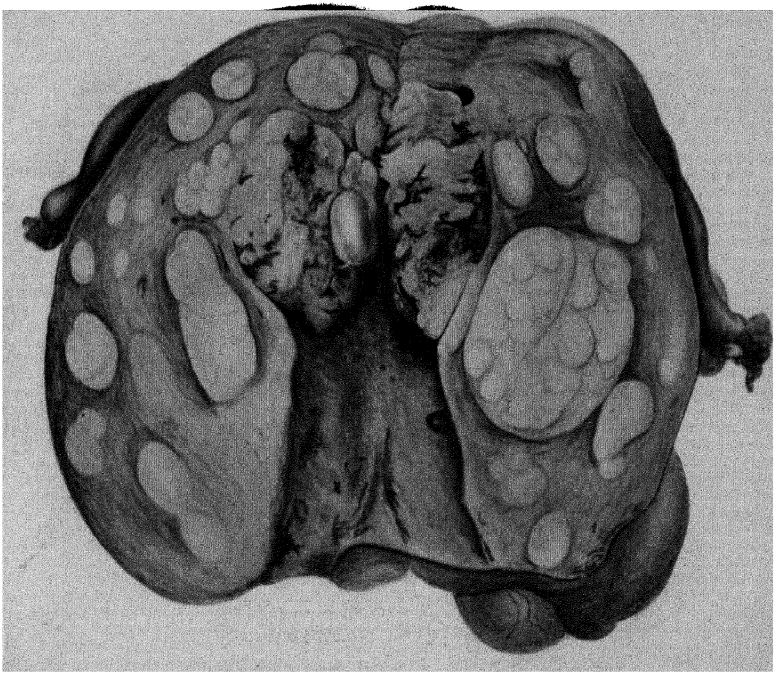


FIG. 249. CANCER OF THE CERVIX ASSOCIATED WITH FIBROID TUMOUR OF THE BODY OF THE UTERUS. Patient *aet.* 49.

cannot, however, be held to imply any special liability of the cervical stump to become cancerous, since serial sections of 900 hysterectomies have shown cancer co-existing in the cervix in more than 2 *per cent.* of the cases.

The *diagnosis* of malignant changes in fibroid tumours, or of the concurrent formation of a malignant growth in the uterine body, can seldom be made before the removal of the tumour. The possibility of malignancy must, however, always be entertained under the following circumstances: (1) When the tumour enlarges after the menopause is over; (2) when bleeding returns after the menopause is over; (3) when ascites, anæmia, or



A UTERUS WHICH IS THE SEAT OF MULTIPLE MYOMATA AND CANCER OF THE ENDOMETRIUM. The cancerous process had invaded some of the adjacent myomata. Patient æt. 54.

To face page 410.

wasting appear; (4) when after the age of forty, the tumour is soft in consistence and grows rapidly; (5) when recurrence takes place, *e.g.* after the removal of a polypus.

Under these circumstances the removal of the uterus should not be delayed.

FIBROIDS AND PREGNANCY

This subject is fully dealt with in text-books of Midwifery, but inasmuch as the treatment frequently comes under the notice of the gynæcologist, a short *résumé* is here given.

Treatment. Labour at term may be awaited unless (1) severe complications due to the tumour arise, or (2) the tumour is so situated as inevitably to cause insuperable obstruction during labour. In the former case the offending tumour should, if possible, be removed by myomectomy and the uterus allowed to remain. Even with improved modern technique this operation is attended with considerable risk of abortion, for Devine has collected 130 cases with an abortion rate of 23 *per cent.* It is often difficult to decide during pregnancy whether a fibroid tumour will cause obstruction in labour or not. If the fibroid is cervical, serious obstruction cannot be avoided. If it is corporeal and does not involve the lower part of the body, the probability is that it will not do so. There are, however, many fibroids intermediate in position, the effect of which on labour is doubtful. In many instances tumours apparently involving the lower uterine segment will become drawn up during labour, so as to clear the pelvic brim and allow of the passage of the child. When obstruction in labour can be foretold with certainty, or even with probability, it is better to deliver by Cæsarean section than to allow the patient to run the serious risk associated with labour. With this operation may be combined (*a*) myomectomy (*Caesarean myomectomy*), if the fibroid is solitary and can be easily enucleated, and the patient is under forty; (*b*) hysterectomy (*Caesarean hysterectomy*) with conservation of healthy ovaries under all circumstances. The former, although theoretically preferable, may prove to be a more difficult and dangerous operation than Cæsarean hysterectomy; on the other hand, Cæsarean hysterectomy at or near term is no more serious than hysterectomy at an earlier period, when the fœtus is non-viable, and is, therefore, on the whole the best method of dealing with such cases. In the interests of the child operation should be postponed until term is reached. Induction of abortion or premature labour when fibroids are present cannot be recommended; the position of the fibroid tumour may render dilatation of the cervix difficult, and if interference is necessitated in order to evacuate the uterus, serious mechanical obstacles may have to be overcome.

GENERAL CLINICAL FEATURES OF FIBROID TUMOURS

Uterine fibroids are among the commonest tumours to be found in any part of the human body. From post-mortem records the statement has been made that in from 20 to 25 *per cent.* of all women who reach adult age fibroid tumours can be found in the uterus. No safe conclusions can, however, be drawn from records of autopsies, which only comprise a small percentage of the number of deaths in the community. There appears to be good reason to believe that fibroids occur more frequently in black than in white races. This is certainly true of the negroes of the United States, and

Gaillard Thomas stated that some competent observers regarded fibroids as of almost constant occurrence in negresses over thirty years of age.

The relative frequency of occurrence at different ages is a point upon which it is difficult to obtain reliable evidence. They may arise in any part of the sexual period of life, but there is no evidence that they ever occur before puberty, or that they arise *de novo* after the menopause. Many cases come under clinical observation for the first time after the climacteric has been passed, but in such cases the tumour has probably been in existence for some time. Before twenty-five years they are rare ; before twenty they are very rare. The greatest care is required in distinguishing sarcoma from fibroids in subjects under twenty years of age.

A point of great practical importance is the age at which fibroid tumours most frequently give rise to symptoms leading to the discovery of their existence. In many cases these tumours do not cause any disturbance until they have grown to a considerable size, and the time when they come under observation is by no means the same as the time at which they arise. There is general agreement that it is in the decade thirty-five to forty-five that fibroid tumours are most likely to become troublesome, and during these years a greater number of operations for these tumours are performed than in any other decade.

Conflicting statements have been made as to the relative frequency of their occurrence in married and unmarried women. The association of sterility with fibroid tumours has attracted a good deal of attention, and it appears that in fact about 30 *per cent.* of women with fibroid tumours are sterile. If we take it that 10 *per cent.* is the average sterility rate, it follows that the subjects of fibroids show a rate of three times the average. Some clinical observers regard sterility as a factor favouring the formation of these tumours, others regard fibroids as the cause of the sterility. It has been already pointed out that chronic inflammatory changes in the Fallopian tubes are found with unusual frequency in association with fibroids. These changes being bilateral, necessarily cause sterility apart from the question of the tumours, and therefore it is obviously not correct to attribute sterility to the fibroid, if the tubes are sealed by inflammation. The sequence of events in such cases is probably—salpingitis, sterility, fibroid-tumours; sterility may in such circumstances be a predisposing factor of fibroid tumours. There is, on the other hand, no doubt that many women with fibroids have previously borne children, and the supposition would in most cases be unwarrantable that these fibroids were not in existence during the period of fertility. The matter cannot at present be carried further than to say that sterility may be a predisposing cause of the growth of fibroids ; on the other hand, we must assume that only those fibroids, which by their situation involve the uterine cavity, are factors of importance in the causation of ' absolute ' or ' relative ' sterility.

The actual conditions, local or general, to which the formation of uterine fibroids is due are quite unknown.

SYMPTOMS

The symptoms which a fibroid tumour may cause are very variable. In many cases a small tumour gives rise to none whatever ; it is compatible with unimpaired health, and is discovered only by chance. Others of larger size attract attention from their bulk, which causes a noticeable

abdominal enlargement, and often a loss of symmetry from the nodular character of the growth. This is a point of distinction from the enlargement due to an ovarian cyst which is usually regular and uniform. There is, however, a general tendency for fibroids, which may for years have been innocuous, to give rise in the end to symptoms of greater or less severity. Very few women, subjects of fibroid tumours, escape suffering from certain ill-effects at some time or other, although their appearance may be delayed for many years.

Fibroid tumours may give rise to *abdominal enlargement, haemorrhage, pain, pressure-symptoms, disturbances of the reproductive functions, and leucorrhœa;* in consequence of prolonged ill-health, certain other indirect or remote symptoms may supervene, *e.g. anaemia, constipation, dyspepsia, and neurasthenia.* And further, in consequence of secondary changes in the tumour, striking developments may occur in the clinical features, consisting sometimes of aggravation of pre-existing symptoms, sometimes of the appearance of acute or subacute abdominal disturbances, sometimes of sudden disturbance of the functions of the bladder (retention of urine).

The subject will be best considered by taking the chief symptoms individually.

Hæmorrhage. Excessive monthly bleeding (menorrhagia) is the commonest disturbance produced by fibroid tumours; yet it is by no means constant in occurrence. Tumours of large size may exist without it, while often, excessive or even dangerous hæmorrhage may be produced by others quite small in size. Bleeding is, in fact, dependent upon the situation rather than the size of the growth. Several other factors in the causation of the hæmorrhage must, however, be recognized: (1) Increased size of the uterine cavity and therefore an increased area covered by endometrium; (2) coincident thickening of the endometrium; (3) mechanical obstacle, caused by the tumour, to muscular contraction of the uterus, which is an important factor in arresting menstrual bleeding under normal conditions; (4) formation of mucous or fibroid polypi; the latter may give rise to bleeding of the most serious degree. When degenerative or malignant changes occur, or when the tumour becomes infected, a fresh set of conditions favourable to hæmorrhage are introduced which will be referred to later on. Subserous, intraligamentary, or retroperitoneal fibroids may exist and even attain a large size without greatly affecting the uterine cavity and the endometrium, and therefore without giving rise to hæmorrhage. Small submucous growths on the other hand may suffice to bring about bleeding of a serious character. Sometimes a submucous fibroid with an enlarged uterine cavity may be found in cases where there has been no increase of bleeding at all, but, generally speaking, fibroids of this class are characterized clinically by abnormal bleeding. The interstitial ones occupy an intermediate position as regards their tendency to produce hæmorrhage.

In severe cases monthly periods are prolonged and excessive, with shortening of the menstrual intervals. The regularity of the menstrual rhythm is not well maintained when there is pronounced menorrhagia, variations of several days being not uncommon. When of only moderate severity, menorrhagia may continue for a long time without greatly affecting women who in other respects are healthy. But the capacity of an individual to recover from periodic losses of blood is variable, and many women pass into a condition of chronic anæmia, when, judged by average standards, the

amount of bleeding has not been severe. Thus, bleeding must be judged rather by its effects than its amount. When the patient complains that it takes her a week or two to recover energy after her period, it is certain that she is losing more blood than can be made up without general ill-effects. Blood-counts should be made, and the condition of the heart and the circulation carefully noted in such cases.

Intermenstrual bleeding is relatively uncommon with fibroids which are not undergoing secondary changes. Slight bleeding of this character may occur with submucous or interstitial fibroids, and is to be attributed to the coincident thickening of the endometrium. This condition of the endometrium is favourable to the formation of mucous polypi, and these structures still further increase the tendency to irregular bleeding. When this form of hæmorrhage is really profuse it will generally be found that a fibroid polypus is present, or is in course of formation. A small polypus of this variety may give rise to bleeding of the most alarming severity owing to laceration of the vessels in its capsule during the process of extrusion.

Instances of fatal bleeding from fibroids, although very uncommon, have been from time to time recorded—not as the result of a single overwhelming loss of blood, but from the recurrence of severe losses at short intervals. After severe bleeding an amount of fresh hæmorrhage may prove fatal which would be borne by a normal individual without difficulty.

Internal bleeding sometimes occurs from fibroid tumours. Large subperitoneal veins are formed in many instances, and they may become varicose, or a venous aneurysm may be formed as in the case recorded by Spencer. In the exposed position they occupy, crossing the surface of a large tumour, they may be ruptured by direct injury giving rise to serious internal hæmorrhage. From compression against the sacral promontory ulceration of the wall of the vein may occur, as in a case recorded by Bruce Clarke. Occasionally a fibroid tumour has been lacerated by a violent blow on the abdomen, and this also gives rise to profuse internal bleeding.

One other point must be noted in regard to the influence exerted by fibroids upon bleeding from the uterus, viz. that the menopause is very commonly delayed for several years beyond the average date of its occurrence. The climacteric age when fibroids are present should probably be regarded as from fifty to fifty-five, instead of as from forty-five to fifty. This change is not confined to cases characterized by abnormal bleeding, but is a common feature of fibroids of all varieties. Cases in which *irregular* hæmorrhages continue after the usual climacteric age has been reached, must not be regarded as instances of delayed menopause; only cases in which the monthly losses continue to be regular can properly be so regarded.

Pain. Pain is not a common symptom of fibroid tumours; when present it is in many cases directly due to complications affecting either the tumour itself, or other structures adjacent to the uterus.

Uncomplicated fibroids may, however, occasion pain in two ways: (*a*) by making the menstrual process painful; (*b*) by compressing the vessels and nerves around them (pressure-symptoms).

Dysmenorrhœa may be attributed either to mechanical interference with uterine contraction caused by an interstitial or submucous growth, or to excessive muscular contraction induced reflexly by the presence of a fibroid polypus. Severe menstrual pain is quite uncommon with uncomplicated fibroids, and as in the case of hæmorrhage, those which are subserous are the

most innocuous in this respect. Many of the complications referred to below as causes of pain may also occasion dysmenorrhœa, so that this symptom cannot be attributed directly to the tumour unless it is met with in an uncomplicated case.

Pain from pressure may be caused by fibroids which completely fill up the pelvic cavity, but in such cases other symptoms, also due to pressure, arise, and the various effects of pressure will therefore be described together later on.

When *severe* pain, whether menstrual or intermenstrual, is complained of, the presence of complications should be suspected. Perhaps that most frequently met with is *coincident disease of the tubes and ovaries*, the nature of which is referred to on page 395. Chronic inflammation of these organs may occasion more or less constant abdominal pain or discomfort with resulting physical disability, and also may give rise to recurring attacks of pain of a severe character. Further, an ovarian cyst may co-exist with a fibroid tumour, and in such a case the ovarian cyst shows an unusual liability to become adherent in the pelvic cavity. Being held down in the pelvis by the superimposed uterine tumour, its circulation is impeded, and an inflammatory reaction is readily set up around it leading to plastic peritonitis.

In the second place, changes may occur in the tumour itself which give rise to pain. Of these changes the one which most frequently causes pain is *infection;* the sources of this infection and the resulting changes in the tumour are described on page 404. *Acute* infection leading to sloughing of a submucous or interstitial fibroid gives rise, in the initial stages, to acute pain and fever. *Chronic* infection leads to the formation of peritoneal adhesions around the tumour, and sometimes to thickening and induration of the cellular tissue. Often chronic tubo-ovarian inflammation is also present, the infective process having travelled through the uterus to reach the tubes. Adherent fibroids may be attended by pain of a subacute and more or less constant character, which is usually aggravated before and at the beginning of each monthly period, *i.e.* dysmenorrhœa of the secondary type may be present.

Red degeneration or *necrobiosis* is also in many cases, although by no means invariably, associated with pain; rise of temperature, although not always a regular concomitant of the pain, may occasionally be also present.

Axial rotation of a subserous stalked fibroid, or of a uterus containing a fibroid tumour, causes pain at first by interfering with the venous return from the tumour, and later by setting up peritonitic adhesions around it.

When *pregnancy occurs* in a uterus the seat of fibroid tumours, severe symptoms may supervene from acute torsion of a pedunculated growth. This has twice been met with by one of us (C. L.). Apart from such a rare occurrence, a good deal of pain is often complained of, which may continue throughout pregnancy, and may even be prolonged into the puerperium. This does not in all cases arise from degenerative processes, although pregnancy is one of the conditions specially favourable to the occurrence of red degeneration. Sometimes the fibroids increase rapidly in size, concurrently with the uterus, and the resulting total volume of the tumour becomes very large, so that the effects of pressure cannot be excluded. Often, however, the fibroids are painful on palpation, while the part of the uterus which contains the ovum is not, suggesting that some change has occurred in the fibroids themselves.

There is no means of distinguishing, from the clinical character of the pain, the nature of the complication to which it is due. Usually the pain is referred to the lower abdomen and is more marked upon one side than the other, and it may extend down the thighs. Lumbar and sacral pain is, generally speaking, characteristic of pressure from a fibroid which has filled up the pelvis. Recurring acute or subacute attacks of abdominal pain suggest inflammatory complications involving the tubes and the peritoneum. Fibroids which give rise to pain are also commonly tender to palpation, while unaltered fibroids are not.

Pressure-Symptoms. The clearest effects of the pressure exerted by a fibroid tumour are to be found in the case of the bladder; these effects, however, are not seen with so much frequency as might be expected from the anatomical relations of the bladder to the uterus. Heavy fibroids of large size extending from the pelvis into the upper abdomen might be expected seriously to interfere with the diastole of the bladder; in point of fact they do not, except in a comparatively small proportion of cases. The bladder appears to possess a remarkable facility in accommodating itself to altered conditions; if its dilatation in the usual directions is impeded, it dilates in other directions with little loss of its retentive capacity. So long as a tumour superimposed upon the bladder is not fixed, but retains a fair degree of mobility, the only bladder-symptom is, as a rule, moderate frequency of micturition; in the case of very large tumours this may become severe.

It is in the case of fibroids impacted in the pelvis that the most marked disturbances of the bladder are met with. These tumours often raise the floor of the bladder high above the level of the symphysis pubis; this will occur when the uterine tumour is retroverted, and is large enough to fill the pelvic cavity tightly, or when the fibroid develops beneath that portion of the base of the bladder which lies in contact with the uterus. The bladder then becomes an abdominal viscus even when empty, and an inevitable consequence is that the urethra becomes lengthened. Probably this lengthening is accompanied by increased tension leading to narrowing of the lumen of the canal. A bladder thus displaced is therefore liable to become the seat of *retention of urine*, which is probably due chiefly to narrowing of the urethra interposing an increased resistance to the expulsion of the bladder contents. The conditions are of course similar to those found in retroversion of the gravid uterus at the end of the third month. Yet retention occurs more frequently in this case than in the case of fibroids, probably because in the latter the changes are more gradually brought about.

When retention of urine occurs under the conditions just described, the first attack often coincides with menstruation, or with the premenstrual congestive phase. Fibroid tumours can often be observed definitely to increase in size during the week preceding a monthly period, and this may raise the difficulties which the bladder has to encounter to a point at which it is impossible for it to overcome them. Sudden and complete retention, calling for the use of the catheter, is the usual form, and after a day or two in bed, with regular catheterization, the bladder will recover its functions, and recurrence of the trouble may be postponed for several weeks or months. The subsidence of the menstrual congestion, favoured by the horizontal position of the body, brings about sufficient reduction in size of the tumour to relieve the difficulty. The degree of congestion occurring at menstruation

is probably variable, and therefore recurrence of the trouble does not necessarily occur at the next period.

It must not be forgotten that incontinence is a frequent symptom of retention. If the bladder becomes gradually over-distended from the accumulation of residual urine, the organ being unable to void its contents completely, the distension may remain unrecognized. Leakage occurs when the sphincter becomes relaxed from over-distension of the bladder itself.

Actual difficulty in passing urine, frequency and pain during and after micturition, may also be complained of, but only when evidence of urinary infection is absent can these symptoms be attributed to pressure by the fibroid.

The *ureter* may be displaced by intraligamentary or retroperitoneal fibroids, which burrow beneath it, raise it up, and stretch it. In many cases no ill-effects follow, but occasionally the ureteral lumen becomes narrowed, urine ceases to flow freely from the kidney, and hydronephrosis occurs; in still rarer instances the kidney on the affected side atrophies. Compensatory hypertrophy of the remaining kidney may, however, prove adequate to the needs of the body, even in such cases, so that no clinical symptoms of renal disease may appear. Should urinary infection occur in a case in which the ureter has been thus obstructed, the kidney of the affected side will suffer severely, being less resistant to infective organisms, on account of the back pressure to which the renal pelvis is subjected. This was exemplified in a case seen by one of us (T.W.E.) in which a severe bacillus coli pyelitis of the left side appeared to be kept up by the pressure of a fibroid nodule on the pelvic portion of the ureter.

Blood-vessels may show signs of direct compression by fibroid tumours, although, even with those of the largest size, the vessels may escape. The external iliac vessels at the pelvic brim are sometimes affected in this way, and the soft muscular floor upon which they lie perhaps accounts for the frequency with which they escape injurious pressure. The usual result of pressure is varicose or œdema veins of the lower extremities; one side alone may be affected. More rarely a true thrombotic phlegmasia is seen from formation of a clot in the external iliac or femoral vein.

The inferior hæmorrhoidal vessels are also liable to pressure, resulting in aggravated forms of piles.

The Intestine. Cases of intestinal obstruction due to fibroid tumours occasionally occur. In the majority, the rectum or pelvic colon has been the seat of obstruction, due to compression by a hard, fixed pelvic fibroid; several of such cases have been recorded in elderly women when the tumour has been found to be calcified. The small intestine is also sometimes affected by a coil becoming nipped between the tumour and some unprotected bony surface on the pelvic brim, such as the sacral promontory or sacral ala (Barris).[1] Acute intestinal obstruction has also occurred by the small intestine being gripped in a sulcus between two lobes of a rapidly growing fibroid, as noted by Spanton.[2]

The *upper abdominal viscera*—stomach and liver—may be so much compressed by a very large fibroid growing upwards beneath the costal

[1] Barris, *Proc. Roy Soc. Med.* (Obst. and Gyn. Sect.), vol. iv, pt. ii, p. 108, 1911.
[2] W. D. Spanton, *Proc. Roy. Soc. Med.* (Obst. Sect.), vol. ii, pt. ii, p. 87, 1908.

arch that their functions are seriously interfered with. It is only with tumours of quite uncommon size that this will occur, and at the same time embarrassment of respiration and of cardiac action may be seen.

Functional disturbances of digestion, in women who are the subjects of fibroids of moderate size, *i.e.* which do not exceed the level of the umbilicus, are often loosely spoken of as pressure-effects. This is, however, not so; symptoms of this kind are independent of the tumour, and can usually be relieved by general measures. Constipation is also often so regarded but without justification, as is clearly seen when the constipation continues unrelieved after the removal of the tumour.

Nerves are the least liable of all adjacent structures to be compressed by pelvic tumours. Only fibroids which burrow underneath the pelvic peritoneum can affect them directly, and it is remarkable in how few instances any clinical evidence of nerve-compression can be found. Muscular paresis is practically unknown, and pain when present does not follow the distribution of the nerves. Cases of sciatica, for example, are quite uncommon in association with fibroid tumours which, from their situation, might be expected to exert direct pressure upon the sciatic nerve.

Reproductive Disturbances. The reproductive functions may be disturbed by fibroids in several directions. *Sterility* is found in about 30 *per cent.* of cases; a considerable proportion of women with fibroids have borne children previous to the discovery of the tumour. During pregnancy there is an increased risk of abortion; during labour serious difficulties from obstruction occasionally occur. During the puerperium there are risks of sloughing if the uterus should become infected; a submucous tumour even when uninfected may be extruded with profuse hæmorrhage, or a severe form of degeneration, such as *necrobiosis*, may occur. Yet it is quite possible for a woman with a fibroid tumour to bear not only one child, but several, without mishap. Submucous and interstitial growths are more harmful to the reproductive functions than subserous ones; and only those which arise in the cervix or the lower part of the uterine body are liable to cause obstructed labour.

Leucorrhœa. This is a frequent but unimportant symptom. It is due mainly to the coincident thickening of the endometrium. Sources of discharge, which are independent of the tumour, such as cervical 'erosion' or mucous polypi, may also contribute to it. The discharge is of the common mucous or muco-purulent type which has been already described on page 120. Departure from this type rarely occurs except from secondary changes in the tumour. From infection, an offensive discharge may occur, which in the case of sloughing fibroids may be extremely putrid. A thin or watery, coloured discharge may occur when cystic degeneration has taken place. The significance of bleeding in the menstrual intervals has been already referred to.

From what has been said it will be seen that the clinical results of the presence of a fibroid tumour are very variable. Under favourable circumstances it is not incompatible with unimpaired general health, and it may remain quiescent for many years, during which its existence is unsuspected. At the same time, in the majority, a certain amount of trouble accompanies a fibroid tumour, the severity of the symptoms being graduated, from what is almost negligible, up to a degree at which the general health is profoundly

affected. And further, tumours which have remained quiescent for several years may at any time, from change in their mode of growth (*e.g.* extrusion into the uterine cavity), or from secondary changes, suddenly reveal their presence by symptoms of a more or less serious character.

There are certain special risks inseparable from each variety of fibroid; thus submucous growths may become polypoid or may slough; interstitial and subserous growths may undergo cystic degeneration or *necrobiosis;* subserous stalked growths may become twisted; all varieties may become infected by an ascending infection of the genital tract, and also, in some cases, from the bowel. Recorded instances in which fibroids have directly caused a fatal result are extremely rare, taking into consideration the great frequency of their occurrence. In consequence of the variety of unfavourable influences which they may exert, however, both directly and through the changes they induce in other organs, fibroids occupy a position among histologically benign neoplasms which is unique. No other structurally innocent tumour produces such widespread and unfavourable effects as are so often seen with fibroids.

PHYSICAL DIAGNOSIS OF FIBROIDS

Fibroids usually occur as multiple tumours, although occasionally they are solitary; some grow outwards beneath the peritoneal covering, producing a nodular mass; others remain interstitial or submucous, when the surface of the uterus is generally smooth; the great majority are inelastic solid growths, but they may become of stony hardness from calcification; or they may become softened or definitely cystic in character from degenerative changes. Usually insensitive to touch, they may become tender or even acutely painful from secondary changes. Further, they vary in size from tiny nodules up to a mass large enough greatly to distend the entire abdominal cavity. It will be clear that the physical diagnosis of tumours so varied in character may present great difficulties. For purposes of note-taking those which do not extend above the pelvic brim may be called *small* fibroids; those which extend above the pelvis but do not exceed the level of the umbilicus—*medium-sized;* those which exceed the level of the umbilicus—*large* fibroids.

In the first place certain points applicable to fibromyomata of all sizes should be borne in mind. *Submucous* fibroids tend to produce a symmetrical enlargement or expansion of the uterus similar to that of pregnancy, together with a proportionate elongation of the uterine cavity which, under favourable conditions, can be detected by the sound. A measurement of as much as 6 inches may be obtained, and under no other conditions except pregnancy is the uterine cavity lengthened to such an extent. It must, however, be recollected that owing to distortion of the uterine cavity (*see* Fig. 236) the sound may fail to pass up to the fundus, so that a short measurement cannot be trusted in all cases. *Interstitial fibroids* tend to produce an asymmetrical tumour, the surface of which is smooth and regular; elongation of the uterine cavity may be detected as in the former case. *Multiple subserous* fibroids tend to produce a tumour of quite irregular shape and of nodular surface; individual masses of the tumour may be movable independently of the whole, showing that they are stalked, or loosely attached though sessile; the uterine body may sometimes be made out among the masses of which the tumour consists, and may not be greatly enlarged nor its cavity

greatly, if at all, lengthened. Subserous nodules vary a good deal in consistence and in the degree of smoothness of their surface. Sometimes a *solitary subserous* fibroid attains a very large size, forming a smooth-walled tumour, the connection of which with the uterus may not be easy to demonstrate.

Lastly, it must be recollected that in multiple fibroids all three classes are often represented, which introduces a further element of complexity into the physical characters of the resulting tumour. It follows from what has been said, that a uterine fibroid tumour may be so large, and of such irregular shape, that it bears no resemblance to the parent organ.

Certain diagnostic points may now be noted which serve to distinguish all *tumours of uterine origin from others*, and which are applicable to all kinds of fibroid.

There are two pelvic organs in which tumour-formation is common, the uterus and the ovary; uterine tumours are with few exceptions solid growths; ovarian tumours may be either cystic or solid, but cystic tumours predominate in the proportion of about 9 to 1. A solid tumour occupying the pelvis or the lower half of the abdomen may therefore presumptively be regarded as uterine in origin; a cystic tumour in the same position may presumptively be regarded as ovarian.

Under favourable conditions, the distinction between cystic and solid tumours is made with ease; a dense inelastic mass is readily recognized by palpation as solid, while a lax cyst, filled with thin fluid, readily yields fluctuation and a fluid thrill. But solid tumours are not all densely hard, nor do all cysts yield a fluid thrill; by softening of the tissues a solid tumour becomes yielding, and by subdivision into small loculi, the contents of which are always thick and may be even semi-solid, a cyst may become resistant; the result is that the distinctive characters of each become obscured.

Another factor which affects facility of diagnosis is the condition of the abdominal walls. When the muscles are not unduly resistant and the amount of adipose tissue is small, the conditions are favourable. In the case of obese women the difficulty of determining the character of an abdominal tumour is very much increased, for through a thick abdominal wall solid and cystic growths feel very much alike.

A tumour in the pelvis or lower half of the abdomen which is definitely solid in consistence is therefore probably a uterine fibroid. Confirmatory evidence of its uterine origin may be sought in several directions.

The first point is the *relation of the cervix* to the tumour. In some instances it is easy to demonstrate the continuity of the vaginal cervix with the tumour; thus in medium-sized fibroids which lie above the pelvic brim and are non-adherent, the cervix can be felt on bimanual examination to pass upwards into the mass, and on gently rocking the tumour from side to side with a hand placed on the abdomen, it will be seen that the least movement is shared by the cervix. This test must not be sought by pressing the tumour down into the pelvis, as this would depress the cervix even if the tumour were only superimposed upon the uterus. In the case of small pelvic tumours the same test can often be applied, but owing to the more confined space in which they lie, lateral movement of the tumour is necessarily more restricted. In the case of a retroverted uterine fibroid tumour, the continuity of the cervix can be readily felt through the posterior fornix.

The *sound* is an instrument upon which little reliance can be placed in

the diagnosis of uterine tumours. As already stated, owing to encroachment of the growth upon the lumen of the uterus, an elongation of the cavity may escape detection by the sound, and further a large uterine tumour may exist without producing any elongation of the cavity. Therefore measurements with the sound, unless definitely increased above the normal, are valueless. Sometimes the *direction* in which the point of the sound passes is a useful indication; if it passes into the tumour-mass, the probability of the uterus being involved is of course very great, although even then it must be recollected that the uterus may be adherent to the tumour and not form part of it. For reasons already stated, the use of the sound, except under anæsthesia, is not to be recommended (*see* p. 213).

Examination under anæsthesia may demonstrate the *independence of the ovary on each side* from the tumour; but for a definite result the conditions must be favourable, *i.e.* the tumour of moderate size, and the abdominal walls thin.

These general points having been considered, it will be convenient to take up the diagnosis of certain types of fibroid tumour.

Small Fibroid Tumours. The simplest diagnostic instance is the small submucous or interstitial fibroid. This gives rise to a smooth-walled, solid, pelvic tumour, the continuity of which, with the cervix, is usually easy to determine. In the case of a submucous growth, or an intra-uterine polypus, the enlargement may closely resemble in outline that due to pregnancy, the uterus being expanded so as to become approximately globular. Interstitial growths may cause distortion in shape, when the differentiation from a gravid uterus is much easier. These growths have not, as a rule, the densely hard consistence of the larger tumours, which are mainly subserous.

Four points of distinction from a gravid uterus may be sought for:

(1) The *menstrual history* is usually distinctive; in normal pregnancy amenorrhœa is almost invariable; with fibroids amenorrhœa is almost unknown until the climacteric age, with the sole exception that pregnancy may occur in a fibroid uterus with resulting amenorrhœa. From pathological causes, however, pregnancy may give rise to irregular or continuous bleeding, which may equally be caused by a fibroid tumour.

(2) In primigravidæ changes indicative of pregnancy may be found in the *breasts*, such as hypertrophy of breast-lobules, increased pigmentation of the areola, and the presence of secretion which can be expressed through the nipple. Of these changes, one, viz. the presence of secretion, may also be met with in fibroid tumours; the other breast-changes just mentioned are, however, only seen in pregnancy.

(3) The *condition of the cervix* is a point of distinction to which great importance must be attached. Softening such as is met with in pregnancy does not occur with fibroids, the cervix being often unusually hard and resistant. If ordinary care is taken the mistake will not be made of confusing an *erosion* with the softening of pregnancy. A certain amount of purplish discoloration of the mucous membrane of the cervix like that of pregnancy is sometimes seen with fibroids.

(4) *Intermittent contractions* may be detected in a uterus of the third or fourth month of pregnancy; at this period the contractions are feeble and care is necessary to detect them. Often they produce a recognizable alteration in the shape of the uterus rather than a change of consistence. But when recognized they constitute an important sign of pregnancy. Intermittent

contractions do not occur in a uterine fibroid tumour except when pregnancy is also present.

The diagnosis of the occurrence of pregnancy in a fibroid uterus will be referred to later on.

Medium- and Large-sized Fibroid Tumours. These tumours are much more diversified in character than the small ones. As a rule the growths are multiple, and when a number of subserous nodules or masses are present, the resulting tumour is quite irregular in shape, and does not retain the median position of the parent organ, but extends much further to one side than the other. These tumours are nodular or bossy on the surface, or they may consist of two or more large masses which can be moved independently of one another. The constituent masses are often of diverse degrees of hardness. Sometimes a portion of the tumour may be so freely movable as to suggest that it is pediculated. Occasionally solitary fibroids attain a very large size, forming smooth-walled single tumours, which are approximately median in position, and uniform in consistence.

There is seldom any difficulty in demonstrating the pelvic connections of a large fibroid tumour. Even in the case of pediculated subserous growths the pedicle is very rarely long enough to enable it to ride free above the pelvic brim, as may happen with an ovarian cyst (*see* p. 644). In nearly all cases some portion of the tumour remains pelvic, and on abdominal examination it can be followed downwards into the pelvic brim (*see* p. 98). For this reason they are, generally speaking, less mobile than ovarian tumours, especially as regards movement in a vertical plane, this movement being checked by the cervical attachments.

On auscultation of a large fibroid tumour a *souffle* can often, but not in all cases, be detected over some part of the tumour. It is similar in character, although seldom so pronounced, as that produced by a gravid uterus. This sign is, strictly speaking, merely an indication that large superficial arterial branches are present on a part of the tumour which is accessible to the stethoscope. The anatomical arrangements of the blood-supply of the uterus favour the formation of such vessels when the organ becomes greatly enlarged either from tumour-formation or from pregnancy. In the case of ovarian tumours, a souffle is never heard.

With fibroid tumours of this class, the conditions found on *internal examination* are very variable. In some cases, the tumour lies entirely above the pelvic brim, and can be reached only with difficulty, if at all, *per vaginam*; the cervix and the lowest part of the uterine body are not involved, and the lower pole of the tumour consequently forms a narrow neck. In other cases, a portion of the tumour may lie in the pelvis, and may be felt as a protuberance springing from the lower part of the uterus. Occasionally a fibroid tumour is seen which not only rises well above the pubes but also more or less completely fills the pelvic cavity. Sometimes such tumours have arisen in the posterior uterine wall, and have become moulded exactly to the pelvic cavity; they are practically immovable and are described as *impacted*. More often these tumours are either *retroperitoneal* in position, or they arise in the cervix (*cervical fibroids*). The physical characters of these varieties of fibroids deserve special consideration.

Retroperitoneal fibroids (*see* p. 385) of large size cause more extensive changes in anatomical relations than any other pelvic tumours. On *abdominal* examination, their only striking feature is their immobility;

much less lateral movement is possible than with the ordinary varieties. On *pelvic* examination, two points, as a rule, attract attention. In the first place the cervix is frequently displaced to a very marked extent, in an upward and forward direction. It may lie above the upper border of the pubes and be almost inaccessible to the finger ; the anterior vaginal wall is at the same time elongated, and its direction has become nearly vertical.

The second point is that the tumour-masses may extend downwards into the pelvic cavity to a great depth. The largest part is usually found behind, where it may open up the cellular tissue of the recto-vaginal septum until it extends as far as the middle of the posterior vaginal wall. The formation of such a tumour-mass necessarily raises the cervix and pushes it forwards. On *rectal* examination, the size and consistence of such a mass can be better felt than *per vaginam*. Sometimes a large retroverted fibroid tumour, or a tumour with a large subserous outgrowth from the posterior wall, gives rise to similar pelvic conditions.

Cervical Fibroids. These tumours rarely extend higher than the level of the umbilicus. They are almost always solitary, and form firm, smooth-walled tumours of oval outline. Occasionally a movable nodule can be felt upon the summit, which represents the upper part of the uterine body (*see* Fig. 235). On vaginal examination they are found to extend deeply into the pelvis and to be nearly fixed. The vaginal portion of the cervix is always, to a greater or less extent, involved in the tumour. In an extreme case the characteristic finger-shaped process of the *portio vaginalis* is entirely absent ; in the vaginal vault is then felt a smooth, oval or conical mass, and upon the surface of this mass careful examination will detect a small aperture surrounded by a slightly raised lip, representing the external os. In a less extreme case the lowest part of the vaginal portion is preserved and may be recognized by touch, while the tumour is felt to expand rapidly above it. Both conditions form a striking contrast to those cases in which the cervix is not implicated and a well-formed neck remains.

The largest fibroid tumours, especially as they may become cystic, can only be compared with ovarian growths, and their physical diagnosis will be considered in the section on the Diagnosis of Ovarian Tumours (pp. 645 and 649).

Pathological Diagnosis. The exact diagnosis of the histological nature of a uterine tumour cannot be made until it has been removed, carefully inspected throughout, and submitted to expert microscopical examination. Clinical diagnosis can therefore never be more than the estimation of probabilities, and it calls for no detailed discussion. An unaltered fibroid tumour may be confidently recognized by the following three steps of diagnostic reasoning :—

(1) A solid tumour is present with pelvic connections. Probably the patient suffers from excessive monthly bleeding, or from irregular hæmorrhages, but these symptoms are sometimes absent. (2) The tumour is recognized as uterine from its relation to the cervix, and possibly from the presence of an unaltered ovary on each side. (3) It is assumed to be innocent in character from (*a*) the long duration of the symptoms, and sometimes the known presence of a tumour for a long period ; (*b*) the mild and unprogressive character of the symptoms, and the well-maintained health of the patient.

Any departure from this clinical outline arouses suspicion of the existence of some complication which may be of the nature of an infection, or of an intrinsic change in the character of the neoplasm.

Reference has been made already to the fact that sarcomatous changes have been sometimes unexpectedly found in isolated areas of fibroid tumours systematically examined after removal. Again, carcinoma may appear in the endometrium of a fibromyomatous uterus, giving rise to no symptoms at first, or only to slight irregular bleeding. In the early stages of these malignant processes there are no clinical data to warn the clinician of their presence.

It follows from this, that after its removal a fibroid tumour should be carefully examined, and if its naked-eye characters are equivocal, an expert histological diagnosis should be sought.

The occurrence of *red degeneration* can usually be clinically recognized. It is met with predominantly in connection with pregnancy or the puerperium; it gives rise to local pain referred to some part of the tumour, and occasionally to mild pyrexia with symptoms of general illness; the affected part of the tumour becomes tender to touch and is recognized by the patient as the seat of the pain she complains of. Nevertheless, well-marked necrobiosis may be found in a portion of a tumour although the symptoms did not suggest that this change had occurred.

TREATMENT OF FIBROID TUMOURS

There are no means known by which the formation of fibroid tumours can be prevented, or their subsequent growth controlled. Medical and therapeutic measures may be successful in palliating the symptoms to which they give rise; cure can be obtained by surgical measures, or in some instances by the use of radium or of large doses of Röntgen rays.

Not all fibroids require treatment; unless symptoms clearly attributable to their presence are met with no treatment need be adopted, and in many cases it is better that the patient should not be informed of the existence of the tumour. The personal experience of one of us (C. L.) has led him to believe that in 55 *per cent.* of all fibroids no treatment is required. It must be recognized that considerable difference of opinion exists upon this matter, and no individual view would meet with universal acceptance.

It will be generally agreed that symptomatic treatment can never be curative; it is, however, useful on occasion, either by way of preparation for operation or in an emergency.

Symptomatic Treatment. When *menorrhagia* is the only symptom caused by a fibroid tumour, rest in bed during the monthly period is sometimes sufficient to reduce the flow to moderate limits, within which it does no harm. Over-exertion, or chill during menstruation, may occasion a violent or protracted hæmorrhage.

Haemorrhage and *anaemia* are interdependent conditions, and both must be treated if success is to be attained.

The medicinal treatment of uterine hæmorrhage has been already described on page 116; it only remains in this place to indicate that in cases of bleeding from fibroid tumours preparations of ergot are seldom successful. The prospects of efficiently controlling hæmorrhage from fibroid tumours with drugs are not good.

Bleeding of the most severe type can usually be temporarily controlled by plugging the vagina. In these cases, the uterine cavity also can sometimes be plugged in an emergency, as the cervical canal is patulous, but the greatest care is required to avoid infection if this method is employed.

After a severe hæmorrhage, the patient should be kept in bed and treatment directed to the resulting anæmia. Iron, given by ' intensive ' injections of ferruginous serum, or in some of its milder forms, hæmoglobin, bone-marrow, raw-meat juice, and a liberal supply of milk, are the more important items in the treatment. The ability of different persons to recover from large losses of blood is variable ; many women appear to suffer little and recover rapidly ; others do not properly recover even when treated in the manner just indicated, and successive hæmorrhages, in already anæmic patients, become more and more difficult to control.

Pain and Pressure-Symptoms. Pain may be due to secondary changes in the tumour, such as degeneration or inflammation, or to pressure upon other viscera, or upon nerves.

Pressure upon the bladder, causing frequency of micturition, incontinence or retention, is most often met with in connection with menstruation—either during or immediately before the period, and is probably due to a slight increase in the size of the tumour from congestion. Under these circumstances, retention requires the regular use of the catheter until in the natural course the tumour diminishes in size, the pressure is relieved, and the bladder recovers. Retention occurring in the menstrual intervals can also be temporarily relieved by rest in bed and the catheter. In a few fortunate cases it may be possible to give more permanent relief by pushing the tumour out of the pelvis and above the pelvic brim, under anæsthesia if necessary. A small fibroid tumour in a prolapsed uterus causing bladder-symptoms may be usefully treated by a pessary, if the condition of the perineum allows of the instrument being retained.

Treatment by Irradiation. It has now been shown conclusively that certain classes of fibroids can be successfully treated by radium or with X-rays. The use of X-rays for this purpose was suggested by the observations of Albers-Schonberg (1903) and others who succeeded him, upon the destructive action of the rays upon the genital glands of animals. It was shown that atrophy of the ovaries with more or less complete destruction of Gräafian follicles, and fibrotic changes in the interstitial tissue, occurred in animals, and later observations have shown that similar results are produced in the human ovary. The effect of prolonged and repeated exposures in women is completely and permanently to arrest menstruation. This implies that all the follicles have been destroyed, functionally if not anatomically, and as a small amount of active ovarian tissue suffices to keep up menstruation, total destruction is the result aimed at. Clinical and histological observations have shown that in addition, the rays exert a direct effect upon the tissues of the fibroid tumour itself, resulting in atrophic changes. The indirect action through the ovaries is, however, the more important.

These effects are produced by some, but not all, of the rays given out by an X-ray tube. The so-called *hard*, *penetrating*, or *γ-rays* alone reach the deep parts of the body ; the *soft* rays, and the various *secondary* rays emitted, are absorbed by the skin and are the cause of X-ray burns and X-ray dermatitis ; these must be excluded by special methods of filtration. The technique of X-ray treatment of fibroids is consequently complicated, and special apparatus is required, and also special experience on the part of those using it.

The treatment is prolonged, for exposures can only be made at suitable intervals. It does not, however, interfere with the patient's habitual activi-

ties, and involves no risk to life when cases are selected with care. The few fatal results which have been recorded were clearly due to failure to recognize complications which should have contra-indicated the use of X-rays.

A comparatively large experience of the results of X-ray treatment has now been gained, and it is certain that in properly selected cases complete cessation of both menstrual and irregular hæmorrhages can be obtained, and in addition, in certain cases, diminution in size or, exceptionally, complete disappearance of the fibroid has been observed. The chief effect, and that most regularly seen, is control of bleeding. The condition produced is, in fact, an artificial menopause due to atrophy of the ovaries, and the general symptoms which occur with the normal menopause, such as *flushings* (*see* p. 92), are met with.

Radium produces clinical effects similar to those of Röntgen rays, but these effects are produced mainly by the action of the rays on the uterus; the ovaries are less affected, owing to the restricted area of penetration of these rays. Consequently the physiological disturbance which accompanies the artificial menopause is less than when X-rays are employed. The radium is introduced into the uterine cavity, after preliminary dilatation and curettage; consequently an anæsthetic is required, and the procedure may have to be repeated once or twice before the full result is obtained. It therefore lacks the simplicity of X-ray treatment, although it has the countervailing advantages which have been just mentioned.

The normal intra-uterine dosage is 150 mg. of radium bromide left in the uterine cavity for twenty-four hours. A filter of 2 mm. of lead or aluminium is employed, and the metal case is enclosed in rubber tubing. This can be sterilized by boiling, and after introduction of the tube, the cervix and upper part of the vagina are plugged with ribbon gauze to prevent displacement of the tube. The patient should be kept in bed during the treatment and for one complete day afterwards.

The cases held to be suitable for irradiation are fibroids of small or medium size, which present no sign of degeneration or inflammatory changes, occurring in women of forty years of age or upwards. Large tumours which exceed the level of the umbilicus should be surgically removed on account of their bulk. Women below the age of forty suffer much from the effects of destruction of the function of the ovaries, and consequently at that age X-ray treatment should not be advised. Degeneration and inflammatory changes should always be regarded as indications for operative removal of these tumours.

Surgical Treatment. Under the following conditions it is agreed that *surgical treatment should not be delayed:*

(*a*) When the tumour exceeds the size of a seven months gravid uterus; the bulk of the mass is then a sufficient reason for its removal.

(*b*) When the tumour is increasing rapidly in size, or is accompanied by pain or by irregular bleeding.

(*c*) When a fibroid which has been quiescent, becomes troublesome in any way after the menopause.

(*d*) When palliative treatment fails to control bleeding, and there is advancing anæmia.

Myomectomy, or the excision of the tumour from the uterus, is a procedure which can be carried out both by the vaginal and the abdominal routes. *Per vaginam* it is the operation employed for the removal of all fibroid polypi

and it also has extensive use for sessile submucous growths even when these are of considerable size. In such cases it is customary to raise the bladder off the cervix and to incise the latter (hysterotomy) in order to give access to the growth. The capsule of the tumour is then divided and the latter cut into fragments (*morcellement*) of a size capable of removal. This combined procedure of myomectomy with *morcellement* is the operation of choice in cases of sloughing submucous fibroids, since the risk of septic peritonitis which an abdominal operation would entail is avoided.

Myomectomy per Abdomen. This is the operation of choice in the case of solitary tumours in young women, in whom the conservation of the uterus is, of course, desirable. The technique of this operation has recently been greatly improved by Bonney,[1] and it can be successfully undertaken even when a large number of growths are present. In order to decide the relative value of myomectomy and hysterectomy we must know (1) the mortality rate of the two operations, (2) the number of children born after myomectomy to women who were previously sterile, and (3) the number of myomectomy-cases which have required subsequent surgical interference.

(1) The latest statistics show that there is little to choose between the two operations as regards their mortality rate. In the statistics of the Mayo clinic (1920) a series of 741 myomectomies gave a primary mortality rate of 0·9 *per cent.* In the 220 cases of Bonney's series the mortality was 2·09, while Giles records 78 myomectomies with one death. It will be seen that these results compare favourably with those of hysterectomy (*see* p. 672).[2]

(2) We are not yet in a position to judge of the value of the uterus as a child-bearing organ after myomectomy. In one series of cases 25 *per cent.* of women under forty became pregnant subsequent to myomectomy, but we are not told whether these pregnancies were carried to term or whether these patients were previously sterile. In the 741 cases which make up the Mayo series twenty-three married women who were previously sterile had one or more children after myomectomy.

(3) Giles[3] states that in his series 10 *per cent.* of the cases of myomectomy subsequently developed fibroids, but we are not told how many required interference. In the 741 cases of the Mayo series nineteen (2·56 *per cent.*) required 'secondary' operations. These were performed mostly for inflammatory disease, but some for recurrence of fibroids.

It would seem fair to draw the conclusion that when surgical interference for fibroids is necessary during the fertile period of life myomectomy should be considered as the operation of choice, but when this operation is undertaken permission to remove the uterus, if this is found to be necessary, should be obtained.

Hysterectomy, with conservation of the ovaries when healthy, is the operation which will be found most generally useful for fibroid tumours. The artificial menopause which follows is not, as a rule, more severe than that which occurs naturally. If both ovaries are removed as well as the tumour, and the patient is under forty years of age, the climacteric symptoms may be mitigated by ovarian grafting.

[1] Bonney, *Jl. Obst. and Gyn., Brit. Emp.*, vol. 29, No. 4, 1922; vol. 30, No. 3, 1923; vol. 32, No. 1, 1925; *Lancet*, 1922, vol. ii, 745.

[2] For the Primary Mortality-Rate of Total and Subtotal Hysterectomy, see "Treatment of Fibroids," C. Lockyer. *Trans. Med. Soc. Lond.*, vol. xlvii, 1924.

[3] Giles, *Diseases of Women*, Bland-Sutton and Giles, 8th edition, 1926.

Which form of hysterectomy should be adopted is a continuous subject of debate. Our choice favours the routine employment of total hysterectomy.

As previously mentioned, there are over 300 cases recorded of cancer of the cervical stump after subtotal hysterectomy; also co-existing cervical cancer has been found in more than 2 *per cent.* of cases in a series of 900 hysterectomies for fibroids. Total hysterectomy is the more difficult operation and takes longer to perform; also in a few cases the removal of the cervix would entail a little additional risk owing to the presence of dense pelvic adhesions. This being so, we have no doubt that the easier and quicker supravaginal amputation of Baer will always find a place in the surgery of fibroids, but in our opinion it should be limited to the cases of fibroids which occur in sterile married women and in virgins.

UTERINE POLYPI

Only two kinds of polypi are common in the uterus, *mucous* or *adenomatous* polypi and *fibroid* polypi. The former have their seat of election in the lower part of the cervical canal near the os externum, but may also occur in the uterine body. The latter, on the contrary, have their seat of election in the body, but occasionally occur in the cervix. Polypi which combine the characters of both kinds (*fibroadenomatous*) are not uncommon in both body and cervix.

Mucous or **adenomatous** polypi are small, soft, pediculated structures which are usually multiple, and of the average size of a pea, although they may sometimes attain the size of a cherry or even of a walnut. The variation in size will be appreciated by referring to Figure 251. As seen at the mouth of the cervical canal they are of a light pinkish or red colour, and are attached either to an area of *erosion*, or to the cervical endometrium within the canal. By their colour they are sharply distinguished from the vaginal mucosa. Though usually solitary, they may occur in groups of two or three. When occurring in the corporeal endometrium they are usually not discovered until removed by the curette (*see* No. 19 in Fig. 251, and Fig. 250). In Figure 256 is shown a mucous polypus attached to the lateral border of the uterus which escaped removal, although the operation of curetting was twice performed. Hyperplasia, both of the cervical and corporeal endometrium, and cervical *erosion* are common accompaniments of mucous polypi. Polypi may also be met with in cases of chronic metritis (*see* Fig. 255).

On histological examination they are seen to consist of a connective-tissue stroma of loose texture supporting numerous glands, some of which open upon the surface, others have become dilated and form small retention cysts (*see* Fig. 252). These glands are lined with cylindrical epithelium similar to that of the endometrium. The stroma is extremely vascular, the microscopic field showing a large number of vessels, both arterial and venous; the former frequently show also thickening of their outer and middle coats (endarteritis). Some of the thin-walled vessels seen in Figure 252 may be dilated lymphatics, the majority are veins of large calibre. Sometimes, as the result of stasis due to compression of their pedicle during extrusion, the vessels become engorged with blood (Pl. XXIV, p. 404) and the polypus assumes a dark purple colour. The surface of a cervical mucous polypus somewhat resembles that of an *erosion* (compare Fig. 215, p. 365); it has an incomplete epithelial covering of cylindrical cells, chiefly found in the neighbourhood of the mouths of the glands. The firmer fibroid or fibro-adenomatous polypi

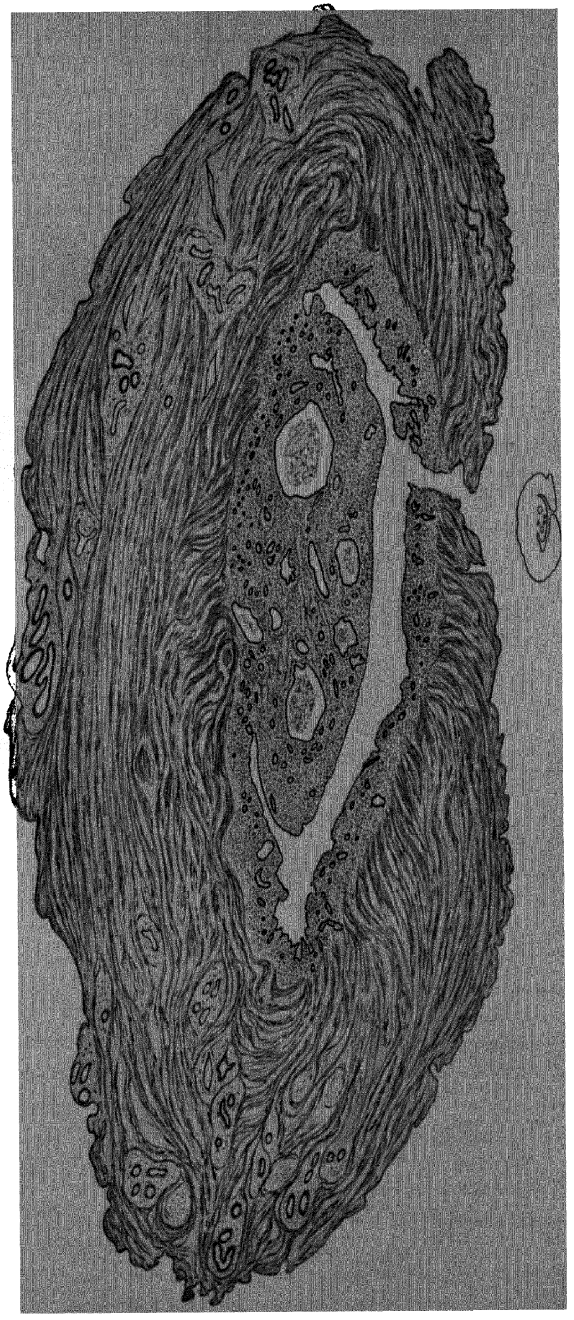


FIG. 250. TRANSVERSE SECTION THROUGH THE UTERINE WALL, showing a cystic polypoidal overgrowth of the endometrium. There is general hyperplasia of the endometrium, which will be appreciated by comparing this Figure with Figure 16, page 20

often have a covering of well-developed stratified squamous epithelium like that of the vaginal mucosa ; and sometimes the surface of the same polypus may show cylindrical epithelium in one part and stratified squamous

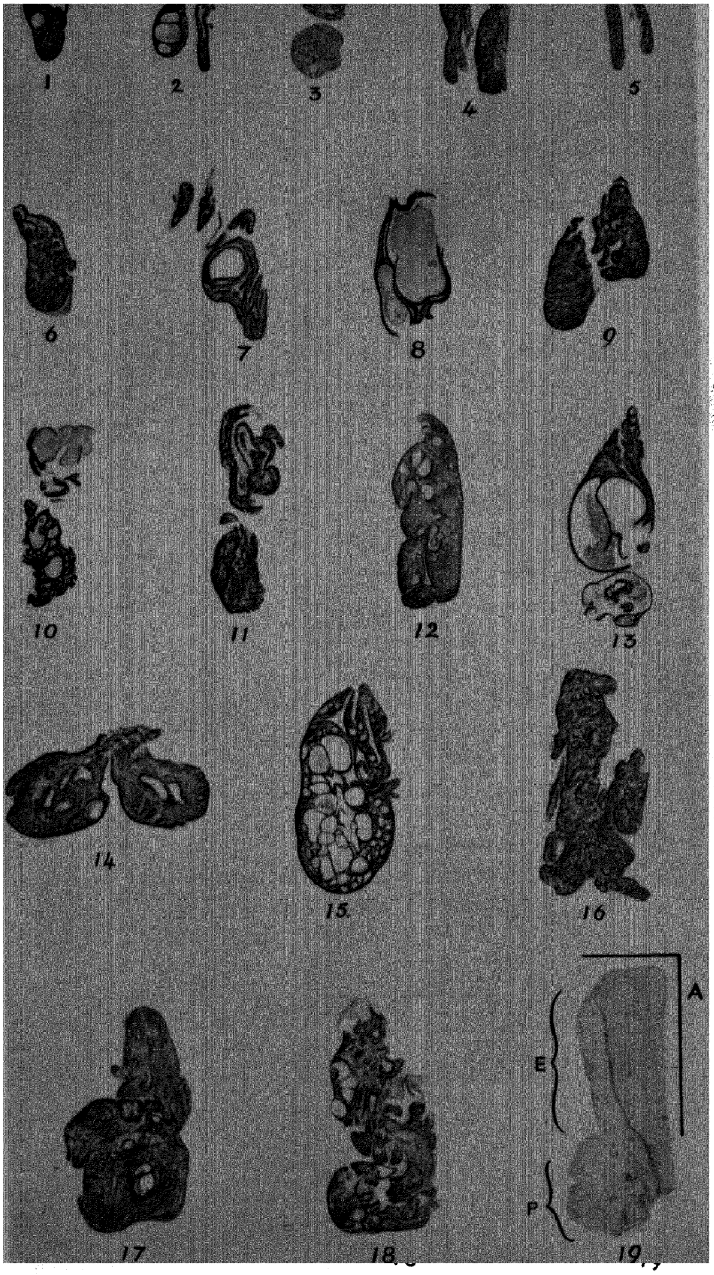


FIG. 251. MUCOUS POLYPI OF THE UTERUS. Nos. 1–18 show cervical polypi. No. 19 shows a corporeal polypus. A, Muscle-wall; E, endometrium; P, polypus. All the figures represent the actual size of sections of the growths prepared for microscopic examination. It will be noticed that the majority of the polypi are cystic.

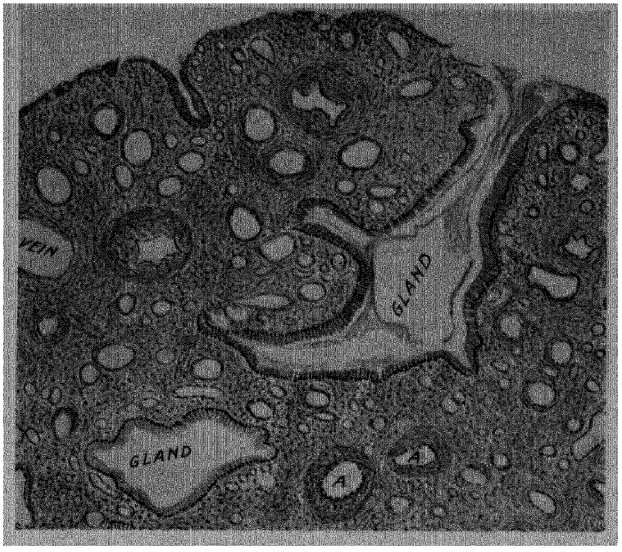


FIG. 252. MUCOUS POLYPUS OF THE CERVIX. The stroma is very vascular and shows numerous large arteries with thickened walls, and also many veins and lymphatics.

epithelium in another (*see* Figs. 253 and 254). Parts of the surface covered with squamous epithelium are smooth, parts covered with cylindrical epithelium are velvety in texture.

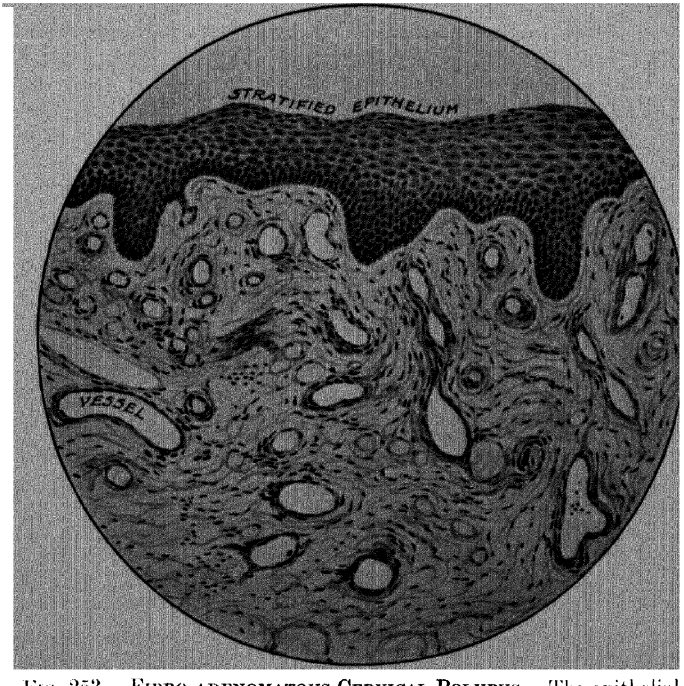


FIG. 253. FIBRO-ADENOMATOUS CERVICAL POLYPUS. The epithelial covering consists of a thick layer of stratified squamous epithelium like that found on the vaginal wall. The stroma consists of very vascular fibrous tissue.

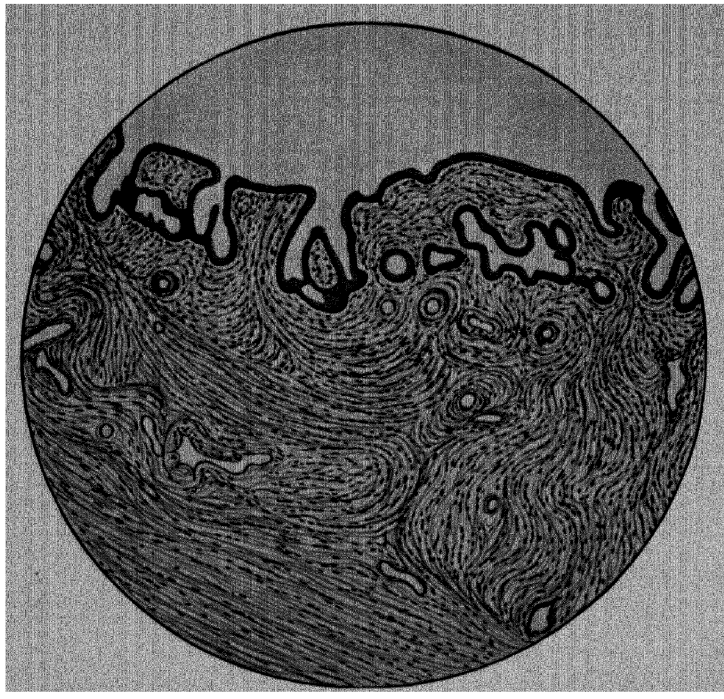


FIG. 254. FIBRO-ADENOMATOUS CERVICAL POLYPUS. From the same specimen as Figure 235. The surface is papillomatous and covered completely with a single layer of columnar epithelium. The stroma consists of vascular fibrous tissues.

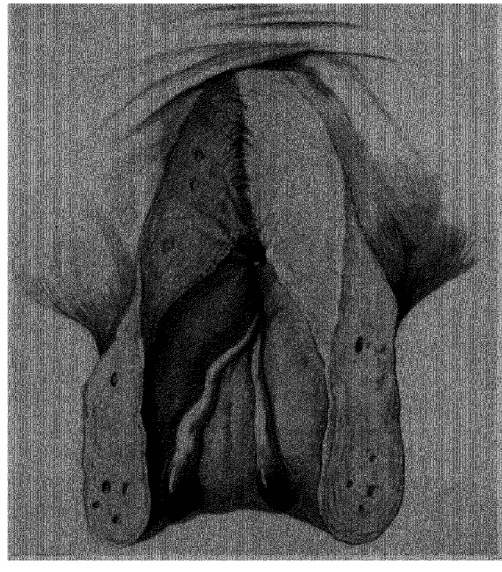


FIG. 255. MUCOUS POLYPI ATTACHED AT THE LEVEL OF THE INTERNAL OS IN A CASE OF CHRONIC METRITIS. The free ends of the long slender polypi have undergone necrotic changes.

Two *symptoms* are commonly associated with mucous polypi, viz. *haemorrhage* and *leucorrhœa ;* it will be recollected that the same symptoms are

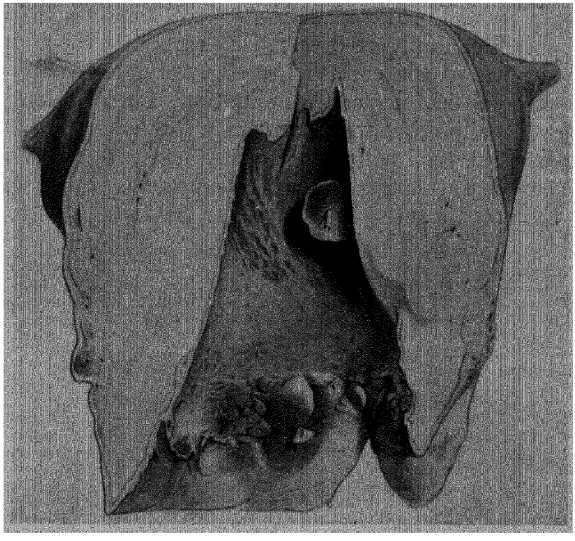


FIG. 256. MUCOUS POLYPUS OF THE ENDOMETRIUM IN A CASE OF CHRONIC METRITIS. The fibro-muscular wall of the uterus is greatly thickened (Charing Cross Hospital Museum).

often caused by chronic endometritis (*see* p. 370). Profuse or protracted monthly loss results from intra-uterine (usually fibroid) polypi, and irregular

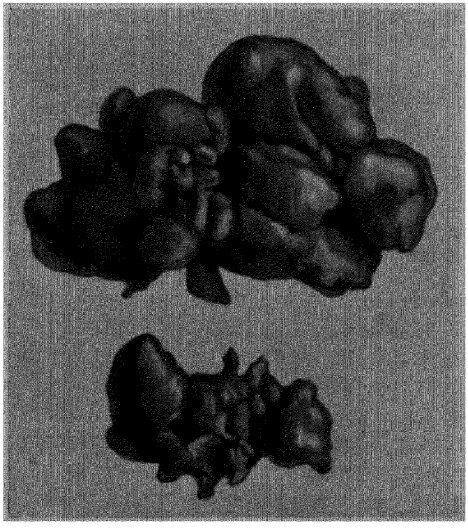


FIG. 257—POLYPI FROM THE CERVIX OF A CHILD ÆT. ONE YEAR AND SEVEN MONTHS (after C. de W. Gibb).

or occasionally continuous slight bleeding from cervical (usually mucous) polypi ; often both types of bleeding are met with in severe cases. A mucous

polypus of small size sometimes causes hæmorrhage so severe as to endanger life.

The *diagnosis* of cervical polypi is very simple, for they can be felt with the examining finger and inspected with the aid of a speculum (*see* Fig. 255). Intra-uterine polypi can only be detected by exploring the uterus with the finger, or by the use of the curette (*see* Fig. 256). All polypi should be submitted to careful histological examination, for apparently innocent growths may eventually prove to be sarcomata (*see below*).

The *treatment* of cervical polypi is to seize them with forceps, crush, and then twist them off by tearing through the pedicle. Small ones may be destroyed by the actual cautery. It is well at the same time to curette the

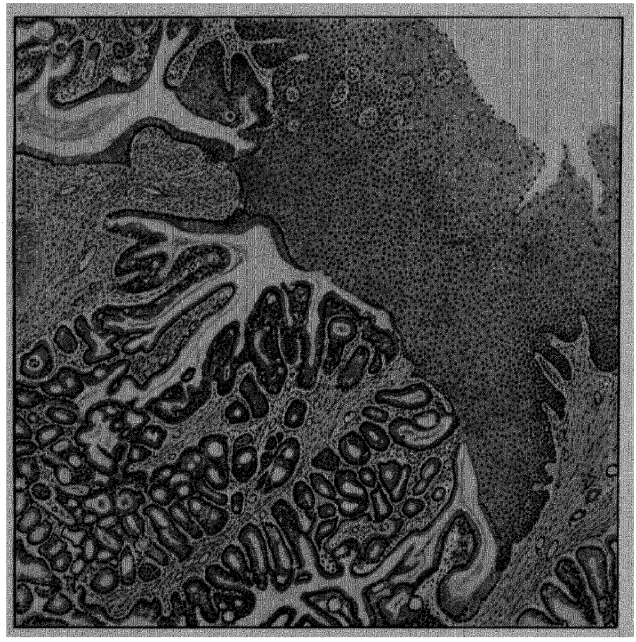


FIG. 258. SECTION OF INSET SEEN IN FIGURE 259 UNDER HIGHER MAGNIFICATION. IT SHOWS A PAPILLIFEROUS CARCINOMA ARISING FROM THE BASAL LAYERS OF THE SURFACE-EPITHELIUM. × 90.

uterus, as hyperplasia of the endometrium so frequently accompanies mucous polypi.

Fibroid polypi have been described in the section dealing with fibroid tumours of the uterus (pp. 389 and 395).

Placental polypi are a sequence of incomplete abortion, or of retention of a piece of placenta after labour. Hæmorrhage occurs from partial separation of the retained structures, or from imperfect uterine retraction. Coagulation of effused blood takes place upon the surface, and gradually the mass grows by accretion, until it may fill the uterine cavity, and project at the external os. These polypi are always single.

Malignant Polypi. All polypi removed from the uterus, whether from cervix or body, should be examined histologically, and if found to be malignant the uterus should be removed.

The more usual type of malignancy encountered in polypoid form is sarcoma, and this should always be suspected in cases where polypi recur after removal; sometimes the 'polypus' proves to be the lower pole of a submucous sarcoma which has protruded through the cervix (*see* Fig. 278, p. 454).

The cervix is one of the sites of election for sarcomatous growths occurring in infancy. The grape-like sarcoma may start as a polypus of the cervical endometrium. The polypoid growth illustrated in Figure 257 was reported by a competent pathologist as consisting of unstriped muscle and connective tissue. Its interest lies in the fact that it was removed from the cervix of a child aged nineteen months.

Malignant polypi of epithelial origin are rare. The one illustrated (Fig. 259) was a polypus which took the form of a papilliferous carcinoma of the cervix.



FIG. 259. CERVICAL POLYPUS WHICH HAS ASSUMED THE FORM OF A PAPILLIFEROUS CARCINOMA.

Diagnosis of an Intra-uterine Polypus. In all cases of severe hæmorrhage, whether menstrual or irregular, for which there is no obvious cause in the cervix or vagina, the possibility of a polypus in the uterine cavity must be considered. Small mucous polypi occasion only slight enlargement of the uterus, of the same character as that found in chronic endometritis. Fibroid polypi are always large enough to cause considerable increase in the size of the uterus, and in some cases it may be felt to be as large as a cricket ball. Usually the uterus is globular in shape, and its walls are smooth, unless other interstitial or subserous fibroid growths are also present. In consistence the uterus is harder than normal. Bimanual examination may set up considerable hæmorrhage. The sound gives a long measurement in these cases, unless its passage is checked by the polypus; sometimes the tip of the sound may be felt to impinge upon the polypus and then slip past it. Usually, however, the sound fails to elicit definite signs of its presence. If the internal os is open the polypus may be seen, or felt by the finger.

In the great majority of cases, the diagnosis can only be made by dilating the cervix, and then exploring the uterine cavity with the finger. Fibroid polypi feel firm and smooth, and do not bleed severely when touched; mucous polypi are soft and compressible; placental and malignant polypi are soft and friable, and may bleed profusely under examination. The placental polypus can readily be detached with the finger, leaving the uterine wall smooth; further, it is associated with a history of hæmorrhage dating from an antecedent miscarriage or labour.

As previously stated, it is of great practical importance that all uterine polypi removed by operation should be examined histologically, since apparently innocent growths may prove to be malignant.

The *treatment* of an intra-uterine polypus is to remove it and curette the uterus, after first dilating the cervix, unless this has been already effected by the polypus.

UTERINE CASTS

Casts of the uterine cavity of four distinct kinds are known to occur: (1) Decidual casts; (2) massive menstrual exfoliations; (3) fibrinous casts; (4) blood-casts.

(1) *Decidual casts* are passed most commonly in cases of extra-uterine gestation; these have already been described (*see* p. 174). Much the same type of cast is more rarely passed in cases of uterine pregnancy which end in abortion (*see* Fig. 260). The cast in this case is similar to that which is seen in ectopic pregnancy, and no trace of an ovum can usually be found. It has been attributed to inflammation of the endometrium preceding, or subsequent to, implantation of the ovum, but in a series of cases investigated by one of us no history of infection was obtainable, and all evidence of an extra-uterine pregnancy was wanting.

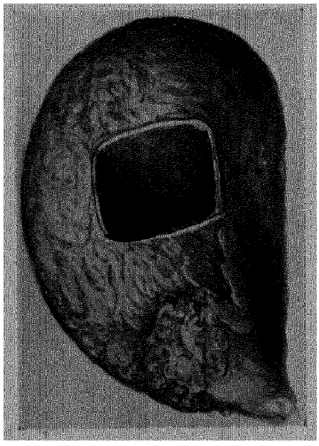


FIG. 260. DECIDUAL CAST, PASSED AS AN ABORTION. The fœtus had been absorbed.

(2) *Massive menstrual exfoliation* has already been described (p. 165).

(3) *Fibrinous casts* are occasionally passed during the course of one of the specific exanthems (*see* Fig. 261); they are not a consequence of pregnancy, and contain no recognizable portions of the endometrium in their wall. They appear to be a local phenomenon due to a general blood-infection.

(4) *Blood-casts*. These are the rarest of all; an example is shown in Figure 262. This cast forms a complete mould of the cavity of the uterus, from the fundus to the external os; its lower end consists of a conical portion about 1 inch in length, which is separated from the body of the cast by a shallow sulcus corresponding to the position of the os internum. The specimen shown in the Figure consisted of a solid mass of coagulated blood, and was passed from the uterus by a woman who afterwards died from acute septicæmia of tonsillar origin.

ADENOMYOMA

An adenomyoma is a new formation consisting of gland-elements and muscle-tissue, to which is added a certain amount of remarkably cellular connective tissue around the glands. The commonest situation in which adenomyomata are found is the female genital tract, and the uterus itself forms the site of election for most of these tumours. They are also met with in extra-uterine situations, notably in the round ligaments, the ovaries, and in the rectogenital (recto-uterine and recto-vaginal) connective tissues.

Etiology. To discuss the etiology of adenomyomata intelligently we must bear in mind the above fact, viz. that this condition is met with, not only in pelvic, but in extra-pelvic situations; this helps to explain that no single causal factor is forthcoming. The trend of modern opinion is to regard *intra-pelvic* adenomyomata as being derived from the mature uterine mucosa. Cullen, the greatest authority on these structures, as early as 1908 upheld this view. According to his diverticular theory the starting-point of the growth was a diverticulum from the corporeal endometrium penetrating into the muscle of the uterine wall; further, the invading structure could spread into adjacent tissues and cause extra-uterine growths.

The researches of Sampson (1921-1922) on hæmorrhagic cysts of the

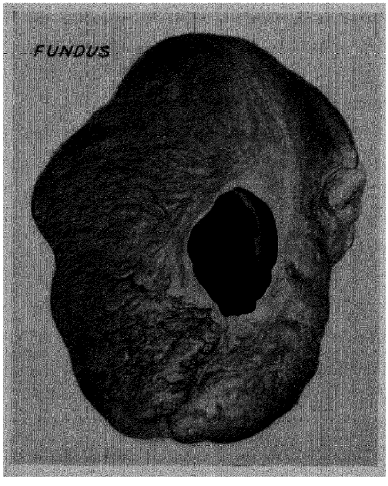


FIG. 261. FIBRINOUS UTERINE CAST. The wall consisted of fibrinous material and contained no endometrial tissue. The contents were fluid blood. From a case of typhoid fever.

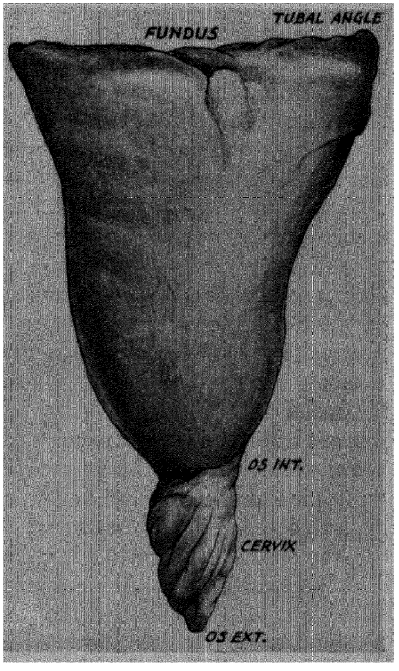


FIG. 262. COMPLETE UTERINE BLOOD-CAST. From a case of tonsillar septicæmia.

ovary have thrown a new light on the etiology of this type of growth, so that what was formerly stated upon the subject requires some alteration. Sampson was the first to point out that endometrial fragments shed during menstruation may regurgitate and pass along the Fallopian tubes, thus effecting what he calls a "cellular spill," on to the adjacent structures—ovaries and peritoneum. It is claimed that in such situations they may form grafts possessing the power of growth and invasion. By a process of erosion the endometrial grafts are said to penetrate into the ovarian substance, develop there, and produce the well-known hæmorrhagic cysts of the ovary. These observations have the support of many observers including Blair Bell and Vernon Bailey, so that the etiology of 'adenomyoma' as it occurs in the ovary, appears to be definitely cleared-up,

i.e. it is regarded as the product of grafts derived from the mature corporeal endometrium. Granting this much it is conceivable that the same endometrial grafts when alighting on the floor of the pouch of Douglas, may account for certain of the adenomyomas which are to be found in the recto-genital space. We must interpolate in passing that the viability of endometrial tissue cast off during menstruation has been denied (unjustifiably we think) by Novak and Telinde.

It will be noted that Sampson's theory does not invalidate, but rather supplements, that of Cullen by affording an explanation of *how* the endometrial tissue may reach certain extra-uterine situations. Thus for all intra-pelvic adenomyomas we can accept the uterine endometrium as the source of origin. When the growth appears in the uterine wall, Cullen's diverticular theory holds the field, and for extra-uterine situations we have Sampson's theory of epithelial shedding or "cellular spill," as an explanation. The presence or absence of muscle in the growth will depend upon the histology of the invaded tissue and is of no etiological importance whatever. The fact that to what we speak of as an 'adenomyoma' Sampson applies the term 'adenoma,' and Blair Bell 'endometrioma,' need not confuse the issue from the etiological standpoint since the presence or absence of muscle does not influence the question of causation. There remain to be accounted for the adenomyomas in extra-pelvic situations.

Adenomyomas have been found in the alimentary tract, the umbilicus, the round ligament, the inguinal canal, and in many other localities. In some of these situations it seems to us improbable that the glandular and connective-tissue elements of the growth can have arisen from the uterine mucosa. In the case of the inguinal growths it is possible that embryonic Müllerian rests have been dragged down by the round ligament during its descent into the inguinal canal, and have there formed the starting-point of the adenomyoma. With this view Cullen agrees, but Sampson regards these "ectopic endometriomas" as metastases produced by vascular dissemination such as occurs in malignant neoplasms.

For analogous growths in the alimentary canal, umbilicus, appendix, liver, and kidney, we must seek an explanation of their origin in a study of the behaviour of epithelium in the presence of inflammation. Chronic inflammation beneath a mucous surface, a serous surface, or the skin, produces an infiltrative proliferation on the part of adjacent epithelium. This epithelial proliferation is at first a protective process such as is seen in the covering over of an ulcer, but it can, and does, overstep the limit of physiological hyperplasia by producing epithelial tubules, which give all the appearances of a glandular invasion.

The newly-formed tubules set up irritation in the tissues which they invade; the evidence of this is that the invaded tissues themselves undergo hyperplasia. The result is an adenoma when muscle is absent, an adenomyoma when muscle is present, or a fibromyoadenoma when connective tissue hyperplasia as well as muscle-hyperplasia is in evidence.

Peritoneal endothelium (serosal epithelium) behaves in the same way as that above stated. This was first pointed out by Iwanoff who originated the 'serosal' theory which attributes the source of the gland-elements in adenomyoma to the peritoneum (serosal epithelium).[1]

[1] For a further consideration of this subject, see "Fibroids and Allied Tumours," C. Lockyer. Macmillans, 1917.

The above considerations enable us to classify adenomyoma into :—

I. Intra-pelvic or Genital Adenomyoma

A. Uterine { (1) Central or diffuse Adenomyoma
(2) Peripheral or circumscribed Adenomyoma

B. Extra-uterine
(1) Ovarian
(2) Adenomyoma of round ligament (intraperitoneal)
(3) Rectogenital

II. Extra-pelvic
(*a*) Inguinal adenomyoma (round ligament) and labial adenomyoma
(*b*) Alimentary
(*c*) Umbilical
(*d*) Liver, gall bladder, kidney and skin.

All the varieties included in I., the Intra-pelvic or Genital, can originate from the mature corporeal endometrium.

To explain the existence of II., *i.e.* the extra-pelvic growths, a development from fœtal rests (Müllerian) or the theory of epithelial heterotopy (inflammatory theory) must be invoked.

A. **Uterine Adenomyomata.** (1). *Central or Diffuse.* The epithelium in this type arises from the mature uterine mucous membrane. It therefore belongs to the *diverticular* variety of Cullen. Some authorities state that the cause of the invasion of the muscular walls by the mucous membrane is a pre-existing endometritis, but, although this is a very probable explanation, it needs further proof. The invasion may occur into the substance of a pre-existing fibroid, but more frequently it takes place into the walls of the uterus, and not into a pre-existing growth.

The muscle and connective tissue of the invaded area undergo hyperplasia, probably in response to an irritation caused by the ingrowing epithelium; the result is, that a diffuse thickening of the wall of the uterus occurs. The *posterior* wall of the uterus is most commonly affected in this way, but the change may extend to the entire body of the uterus; it does not spread into the cervix, diffuse uterine adenomyoma being confined entirely to the body, and affecting the upper, rather than the lower, part of the organ (*see* Fig. 263).

There is no definitely circumscribed limit to a centrally situated growth; it is essentially a diffuse condition. The mucous membrane covering the area involved may appear quite normal or it may be thickened. The mouths of the down-growing crypts can sometimes be seen upon the mucous surface, and small cystic spaces may be formed in a late stage of the disease, giving a honeycombed appearance to the cut surface of the tumour (*see* Figs. 264 and 265).

On section the growth is often found to be extremely hard, but cystic changes may cause it to become softened. The cut raw surface shows a whorled appearance (*see* Fig. 263), not unlike that seen in fibromyoma, but the usual pearly white colour is wanting, the surface being of a duller white or even pinkish. It is therefore not so sharply defined as a fibroid, either as regards its colour or its outlines.

The general effect on the size of the uterus is variable. The organ may be of normal dimensions or may reach the size of a three-months gestation. It is common to find small fibroids (either single or multiple) present, which render the outline of the uterus nodular or irregular. When no fibroids are present the general shape of the uterus is not much altered. Adhesions to

neighbouring structures are common. Adnexal inflammation is very frequent, even more so than is the case with fibromyomata.

Structure. The epithelial invasion takes the form of tubules which show repeated branching, and which are lined by ciliated columnar epithelium. Their lumina sometimes contain pigmented bodies, thought to be associated with the function of menstruation and to consist of altered blood. These branching tubules run in connective-tissue spaces between the muscle bundles (Pl. XXVI.) and a characteristic arrangement is for a number of tubules to run along a connective-tissue space. Such a series of outrunners proceed from a discrete mass of gland-tubules packed more closely together, but whether seen singly or in masses, the tubules are surrounded by hyper-

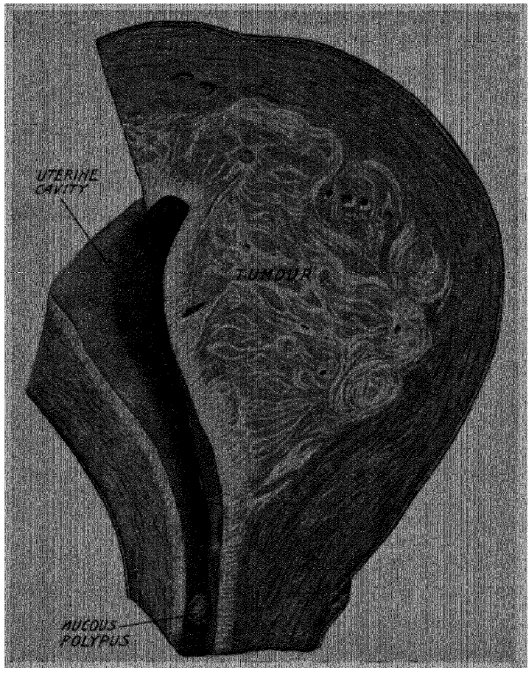
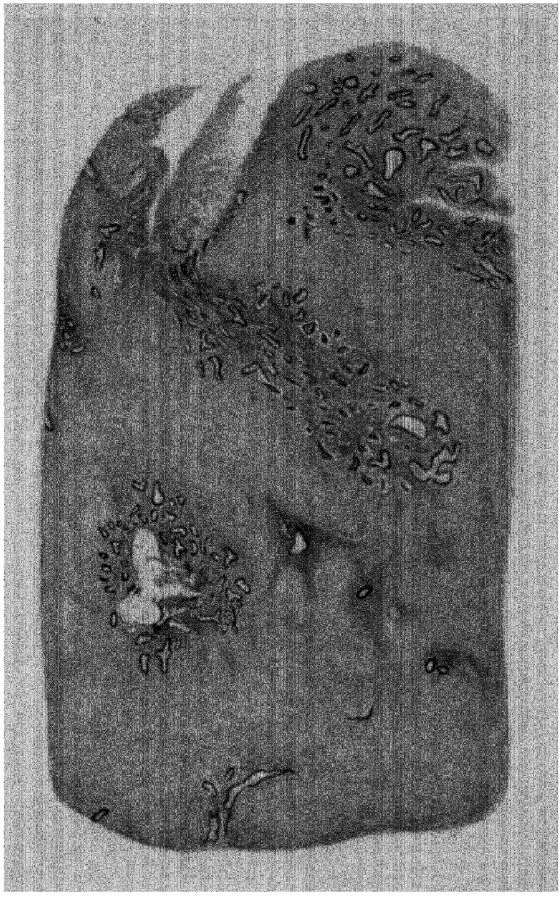


FIG. 263. ADENOMYOMA OF THE UTERUS, DIFFUSE FORM. (Cullen.)

plastic connective tissue. The latter is very cellular, and resembles the stroma of the endometrium in its appearance. Moreover, this tissue, to which the name of the *cytogenous mantle* is applied, has been shown to undergo decidual reaction during pregnancy. With the formation of cysts from distension of the lumina of the tubules, the *cytogenous* mantle may be diminished in amount even to actual extinction, otherwise this characteristic tissue forms one of the most constant and most marked histological features of an adenomyomatous growth.

A. (2) *Peripheral or Circumscribed.* In comparison with the preceding, this variety is extremely rare. According to Von Recklinghausen it forms a small nodular growth situated near the *cornu uteri*, and generally on the posterior wall of the uterus. It has since been shown that most of these cornual growths are really examples of *salpingitis nodosa* (*see* p. 560), occurring in the isthmic and interstitial parts of the Fallopian tube.



ADENOMYOMA UTERI, showing gland-tubules invading the muscularis from the endometrium.

To face page **440.**

Quite a different type of peripheral adenomyoma is that to which Cullen has drawn particular attention. It is the outward protrusion of a central mucosal growth, which may produce a subperitoneal tumour of considerable size. The outward protrusion of growth may be subperitoneal, or it may project into the layers of the broad ligament. A definite communication between the cavity of the uterus and the gland-tissue of such growths has been proved in several cases. In the case of Döderlein and Herzog, pregnancy occurred within the cavity of an adenomyoma situated in the left broad ligament. There is no doubt therefore that some adenomyomata behave exactly as fibroids, in undergoing partial extrusion from their

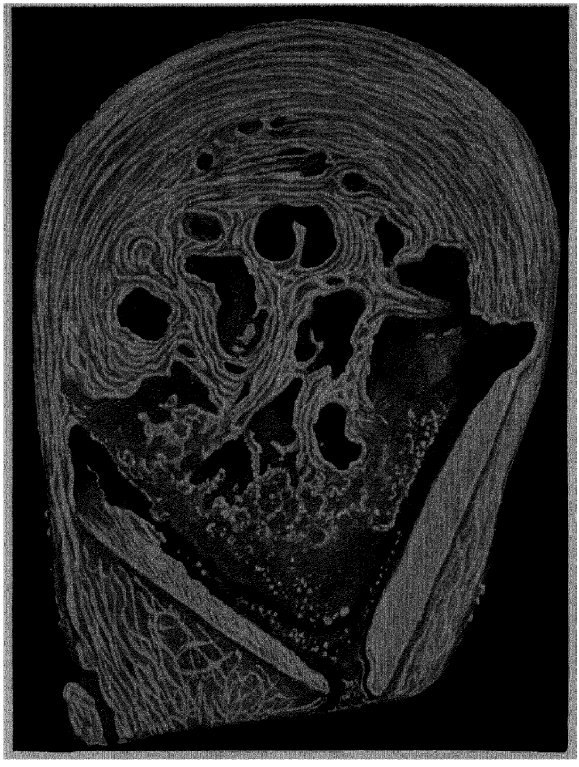


FIG. 264. SHOWING THE HONEYCOMBED APPEARANCE OF THE SUBMUCOUS PORTION OF AN ADENOMYOMA OF THE UTERUS.

original interstitial position. This fact strongly suggests that adenomyomata, in certain instances, are fibroids which have suffered mucosal invasion.

Just as some adenomyomas by a process of extrusion, become subperitoneal and intra-ligamentary, so others by projecting inwards become submucous; in both instances it may be assumed that the original growth was a fibroid which has been subjected to invasion by the epithelium of the mucous membrane. Such growths are to be distinguished from the diffuse variety previously described in which there is no evidence of a pre-existing fibroid.

B. (1) *Adenomyoma of the Ovary.* This condition to which the name of Endometrioma has been given by Blair Bell has already been fully alluded to

and will be found described on pages 592–596 under the heading of Ovarian Haematomas because its clinical features are those of an adherent ovarian blood-cyst.

B. (2) *Adenomyoma of the Round Ligament.* Adenomyomas occur on the round ligament in three situations: (1) between the uterus and the internal abdominal ring (intra-peritoneal); (2) in the canal of Nuck (intra-parietal); and (3) outside the external abdominal ring (extra-parietal). When found in the vicinity of the external ring, cystic adenomyomas are difficult to distinguish from hydrocele of the canal of Nuck; in fact, the diagnosis is generally made by microscopic examination after removal. A definite pedicle attaching the cystic growth to the round ligament can be made out, when it is not densely adherent to all the surrounding structures. The contents of the cyst are often blood-stained and chocolate-coloured. These tumours are

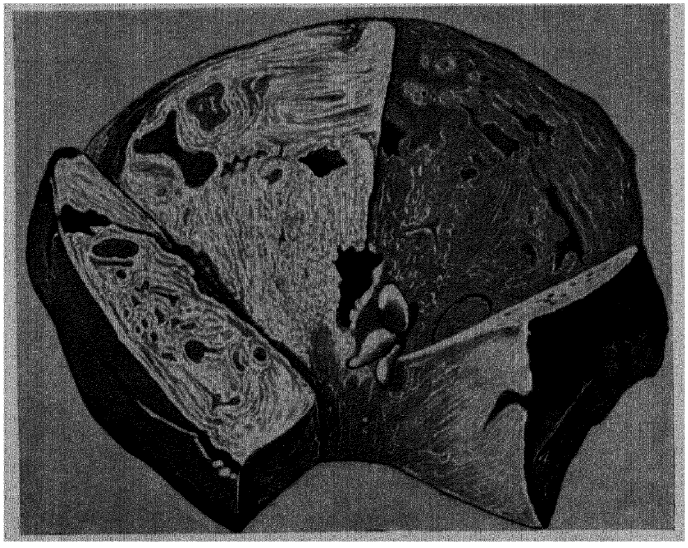


FIG. 265. DIFFUSE ADENOMYOMA OF THE UTERINE BODY SHOWING CYSTIC SPACES. From one of the latter, three tiny mucous polypi project.

usually unilateral, they sometimes extend to the *labium majus* (*see* Fig. 267), and they swell up and become painful during menstruation; by these symptoms some few cases have been clinically diagnosed.

The uterine end, and the distal end, of the round ligament form the sites of election of these tumours; three times as many adenomyomas are found in the latter situation as in the former. It seems to us far more likely that heteroplastic changes in embryonic Müllerian mucosa accounts for these growths, whether they occur in an intra-peritoneal or in an extra-peritoneal situation, but as the graft-theory cannot be excluded for the former we have included these tumours in both Groups I and II (*see* p. 439).

B. (3) *Adenomyoma of the Rectogenital Space.*[1] The rectogenital space is

[1] Although we have, in our endeavour to effect an etiological uniformity, included rectogenital adenomyoma among those produced by a 'cellular spill' of mature endometrium it seems impossible to exclude other sources of origin, *e.g.* from the peritoneum or from the vaginal epithelium.

the cellular interval between the rectum behind and the cervix uteri and vagina in front. It is one of the sites of election for *extra-uterine* adenomyomas. The majority of the growths which have been observed in this situation are quite small, but in several instances the tumours have been very extensive, conveying the impression that they were malignant.

The small growths appear as adherent nodules, which are felt by the examining finger to lie above the posterior vaginal fornix, and sometimes to cause a projection into the posterior vaginal vault. In size, these nodes are often not larger than a cherry or small chestnut. They are often painful and are a source of dyspareunia, a fact which leads to their early detection in married women. They are often more adherent to surrounding structures than are the small fibroids which are sometimes to be met with in the posterior fornix. They lack the tense elasticity of a vaginal cyst, and sometimes they cause the vaginal mucous membrane to become puckered and even papillary (*see* Fig. 266), whilst the surface of a cyst is always smooth. Small nodes have been found to be adherent to the rectum or to the cervix, and even to the ischial spine. When a fixed hard nodule can be felt above the posterior fornix on vaginal examination, the presence of adenomyoma of the recto-genital space must be thought of, especially if there is a complaint of painful coitus.

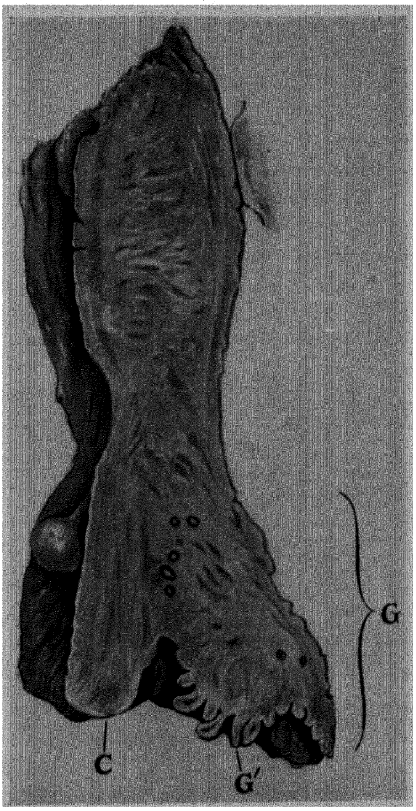


FIG. 266. SAGITTAL SECTION OF THE POSTERIOR WALL OF THE UTERUS, showing G, adenomyoma adherent to the back of the cervix (C); G′ shows the irregular papillary condition of the growth in the posterior vaginal fornix (after Kleinhaus).

If the early nodular stage passes unobserved, the growth may spread in a diffuse manner and invade the surrounding structures. It may invade the muscular and submucous coats of the rectum, the muscular wall of the cervix, and the cellular tissues at the base of the broad ligament. The left broad ligament is generally more affected than the right. As the growth enlarges, it may raise the peritoneum of the pouch of Douglas and even strip up the peritoneum from the posterior uterine wall. The vaginal mucosa becomes fixed to the growth both over the posterior fornix and to a variable part below it. The vaginal mucous membrane itself becomes invaded by the glandular elements which ultimately penetrate it and give rise to a bleeding papillary surface (*see* Fig. 266). Usually the tumour forms a densely hard fixed mass with indefinite outlines, and the cervix, rectum, and vagina are

absolutely fixed to it (*see* Fig. 270). During pregnancy, however, it becomes softer and increases in size. *Per rectum*, a hard tumour can be felt in the anterior or antero-lateral wall; the rectal mucous membrane is movable over it, although the mass may be large enough to reduce the lumen to a very small capacity and to give the impression of a malignant tumour.

Symptoms. The most notable symptom is dyspareunia in the early stages, and later when the growth has become diffuse there is obstinate constipation and painful defaecation; more rarely actual obstruction occurs. There is, however, no rectal hæmorrhage. As soon as the growth penetrates and begins to destroy the vaginal mucosa, there is a hæmorrhagic discharge *per vaginam*. The symptoms and signs of an associated myoma and of adnexal disease (including ovarian endometrioma) are sometimes superadded.

II. Extra-pelvic Adenomyoma. The only varieties of extra-pelvic adenomyoma we need mention are those found in the labia and outside the external abdominal ring. These may be termed labial or inguinal according to their situation. They are regarded by us as having originated in Müllerian relics brought down by the round ligament. The labial growth here illustrated was removed from a multipara aged forty-two years; it had grown very

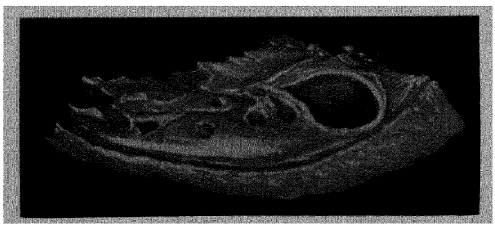


FIG. 267. NAKED-EYE SECTION OF ADENOMYOMA OF RIGHT LABIUM MAJUS removed from a ii para *æt.* 42. The tumour had existed for three years. (J. Stewart-Henry.)

slowly. It was tender and became quite painful during menstruation, but it did not swell up during the flow as such tumours are prone to do.[1]

Diagnosis of Adenomyoma in General. The majority of cases occur in women between the ages of thirty and fifty years. Sterility is said to be twice as common as it is with fibroids. Menstruation is excessive in over 60 *per cent.* and dysmenorrhœa occurs in about 50 *per cent.* of cases. It is exceptional to meet with infantilism or mal-development. Pelvic peritonitis of varying degree is present in one-half of the cases. Polano found adhesions in 89·5 *per cent.* of his collated cases. Fibromyomas of the uterus and adrenal disease form very common associations.

Uterine adenomyomas cannot be distinguished clinically from fibroids, nor in all cases from chronic metritis. Recto-genital tumours are liable to be mistaken for cancer of the rectum and for cancer of the vaginal vault, when the latter is ulcerated. The condition has been diagnosed as diffuse hæmatocele and as pelvic abscess. Microscopic examination of an excised portion is the only certain mode of diagnosis.

Prognosis. Sloughing and necrosis have never been recorded in adenomyomata, and these tumours rarely become malignant. There is not

[1] Our thanks are due to Dr. J. Stewart Henry, of Montreal, for the illustrations and history of this case. Dr. Henry regards this growth as a metastasis produced by vascular dissemination

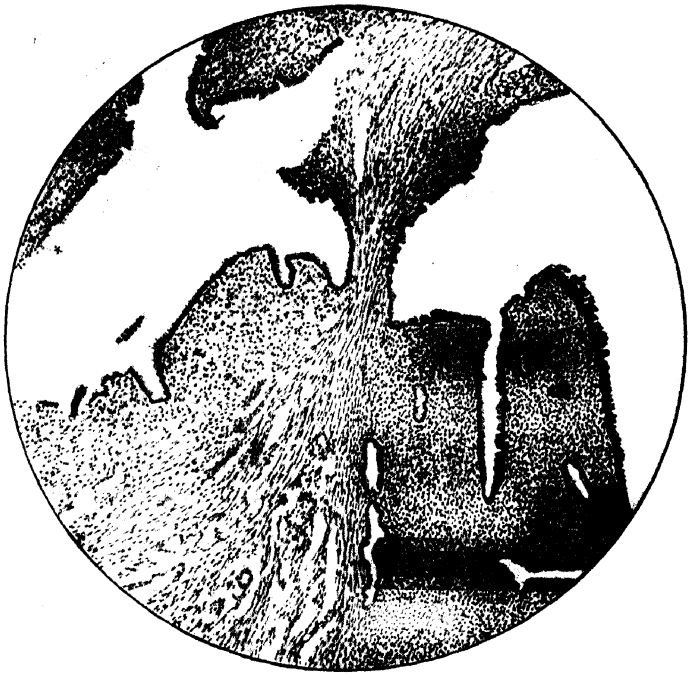


FIG. 268. MICROSCOPIC SECTION OF ADENOMYOMA OF RIGHT LABUM MAJUS removed from a ii para *æt.* 42. The tumour had existed for three years. (J. Stewart Henry.)



FIG. 269. ENLARGED VIEW OF STROMA WITH GLAND. From preceding figure. (J. Stewart Henry.)

the same tendency at the menopause to spontaneous shrinkage, and cessation of menorrhagia and of pain, as is seen in some fibroids, hence it must be admitted that the outlook is worse with adenomyoma than with fibromyoma.

Curetting and medical treatment, which sometimes do good in cases of fibroids, aggravate the symptoms in adenomyomata. The infiltrative faculty of adenomyoma also increases the gravity of the prognosis.

Treatment. Small non-encapsulated nodules at the cornua of the uterus have been excised with cessation of symptoms, but enucleation is quite impossible. The removal of a wedge-shaped portion of the uterine wall wide enough to be quite free of the indurated area should be carried out. For the diffuse variety nothing but total hysterectomy should be performed.

For extensive growths in the rectogenital space, it has been shown that

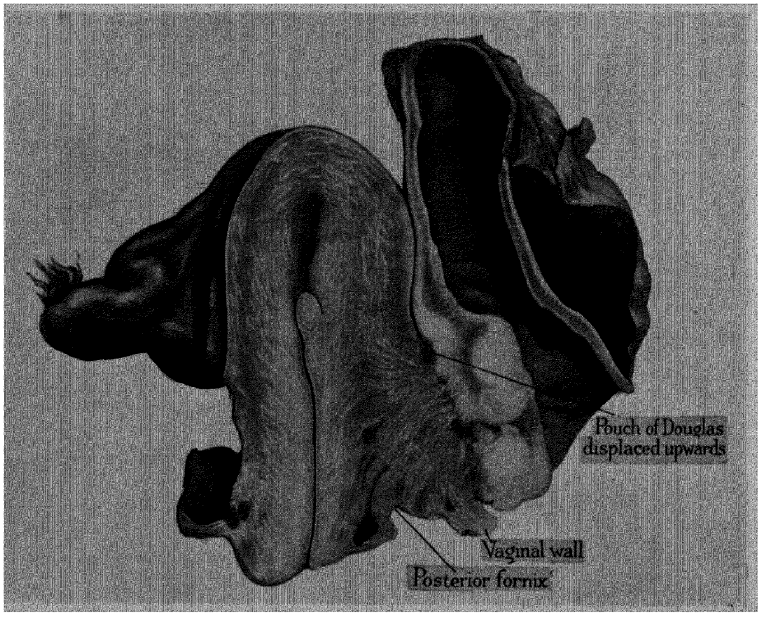


FIG. 270. ADENOMYOMA OF THE RECTO-VAGINAL SEPTUM. The growth has invaded the cervix and the rectum. It has caused a narrowing of the lumen of the bowel.

total removal of the growth or excision of the invaded bowel is unnecessary. These growths do not cause *uterine* hæmorrhage. The chief indication for operation is the danger of chronic intestinal obstruction from stenosis of the bowel. Moreover, ulceration into the vagina is very liable to occur. When assured by microscopic proof that the case is one of innocent epithelial invasion and not carcinoma, the removal of the entire uterus together with as much of the growth as possible is the best procedure.

In cases where the physical signs resemble those of a dense parametritis, and where removal by operation would be difficult or impossible, repeated small doses of radium have been known to cause the induration to disappear, and this treatment deserves a trial.

BENIGN EPITHELIAL GROWTHS OF THE UTERUS

Simple Adenoma (Adenomatous Hyperplasia). From what was stated in dealing with the so-called 'glandular endometritis' (*see* p. 359), it will have been gathered that in most cases the hypertrophy and hyperplasia of gland-structures, which are so frequently encountered in the endometrium, are either to be regarded as the results of physiological variations referable to the function of menstruation, or as the results of an

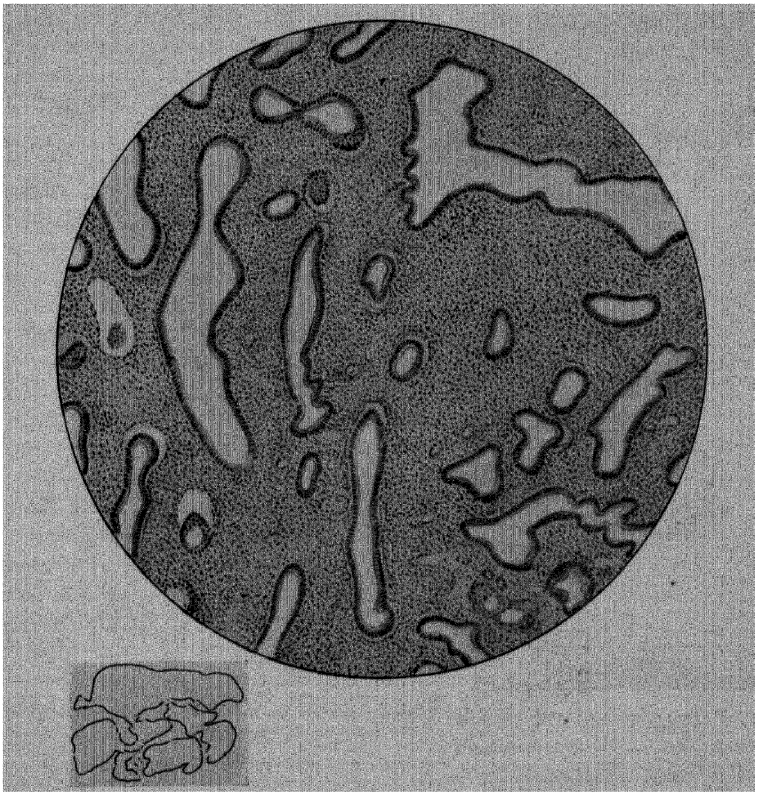


FIG. 271. SIMPLE ADENOMA (ADENOMATOUS HYPERPLASIA) OF THE ENDOMETRIUM REMOVED FROM A VIRGIN. The inset shows the size of some of the portions removed by curettage. Note that although the glands are enlarged they are widely separated by a uniformly hyperplastic stroma (*cp.* Fig. 211, p. 361).

inflammatory process. We agree with Hitschmann and Adler, however, in maintaining the view that there is a *true pathological hyperplasia* of the gland-elements of the endometrium, which is *not* caused by inflammation, but is of the nature of a *true new growth*. The condition is associated with abnormal menstruation and its causation, like that of other neoplasms, is unknown. To this condition the name of *simple adenoma* must be applied.

The growth consists of a glandular hyperplasia in which there is no evidence of inflammation of the stroma. Clinically it is associated with extreme menorrhagia, and sometimes with dysmenorrhœa. We have seen

it in virgins and also in young married women who were childless, and in whom no source of infection could be traced.

The mucous membrane is enormously thickened both by hypertropy and hyperplasia, affecting glands and stroma alike (*see* Fig. 271). During curettement, large soft masses of adenomatous tissue are brought away. Microscopically, the diagnosis of simple adenoma is the most appropriate; thick-walled blood-vessels and other signs of chronic inflammation in the stroma are wanting (*see* Fig. 271). When this glandular hyperplasia is localized, or when it is more marked over a circumscribed area than over the remainder of the corporeal endometrium, a true corporeal mucous polypus is the result (*see* Uterine Polypi, Figs. 250 and 251, p. 429).

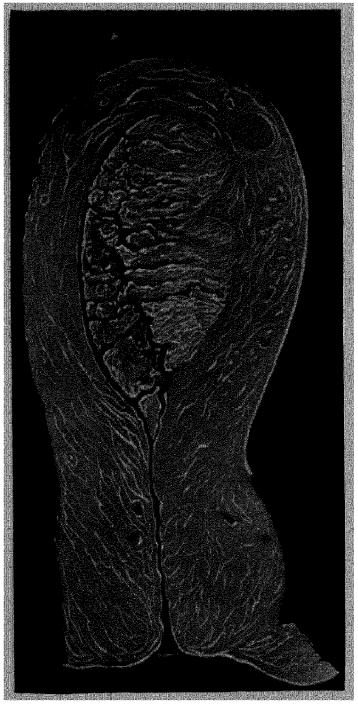


FIG. 272. PAPILLIFEROUS ADENOMA OF THE ENDOMETRIUM. From a specimen in the Royal College of Surgeons (Bland Sutton). The entire uterine cavity is filled with an adenomatous growth composed of villous tufts closely packed together. For the microscopical features of this type of growth *see* Figure 273.

Prognosis. The condition is very liable to recur after curetting, which is a further manifestation of its neoplastic nature. Simple adenoma of the endometrium as seen in young subjects shows no tendency to become malignant, but it causes a secondary work-hypertrophy of the muscular walls of the uterus, so that the organ becomes chronically enlarged and indistinguishable clinically from a case of chronic metritis (hypertrophic form) (*see* Pl. XXI (A), p. 43).

Papilliferous Adenoma (Villous Tumour of the Endometrium). This is also a rare condition, and histologically it is closely allied to, if not indistinguishable from, that above described. It occurs, however, at a later period of life, *i.e.* after the menopause, the youngest recorded case being fifty-two and the oldest eighty-four. Any influence, therefore, which the ovaries might exercise upon the uterine mucous membrane will have ceased. The symptoms accordingly are different; instead of excessive menstruation there is blood-stained vaginal discharge, which may be continuous and which, coming on in the climacteric period or later, suggests the presence of cancer of the body of the uterus. The term *villous tumour of the body of the uterus* was given to this growth by Bland Sutton, because it resembles a villous papilloma of the bladder, excepting that the investing epithelium is of *columnar* type in the uterine growth (*see* Fig. 273) and *transitional* in that arising from the mucous membrane of the bladder. The subjects in whom papilliferous adenoma is found are generally nulliparous. The growth may arise from one wall of the uterus or it may be diffused over the endometrium (*see* Fig. 272). It may be the only pathological condition present or it may be associated with a fibroid tumour.

Papilliferous adenoma and cancer are not found together, but portions of the former may infiltrate the uterine wall, whilst other parts of the same growth are still benign.

Diagnosis. Papilliferous adenoma of the uterus in elderly subjects has to be differentiated from adenocarcinoma (*see* p. 478). The symptoms and clinical features are similar in each case, therefore the nature of the new growth can only be determined by histological investigation of the scrapings removed by curettage. In some cases this may prove easy, and no doubt will arise as to the simple nature of the case, the tubules being lined by a *single* layer of columnar epithelium, and but little or no invasion of the uterine muscle is present. On the other hand, there are cases, *e.g.* that reported by



FIG. 273. PAPILLIFEROUS ADENOMA OF THE UTERUS (Malcolm). The growth did not invade the muscular walls of the uterus. The uterus was also the seat of a medium-sized fibroid. Some of the tubules show epithelial proliferation.

Bland Sutton (*see* Fig. 273), in which considerable difficulty will be found in deciding whether the amount of penetration of the uterine wall by the gland-tubules constitutes malignancy or not.

Curettings obtained from repeated recurrences have shown in some cases a benign structure, but upon removal of the uterus its walls have been found to be invaded by a growth indistinguishable from a tubular carcinoma (Targett).

Prognosis. From the above facts it will be seen that a villous papilloma of the uterus, although histologically benign, possesses the power of infiltration and invasion of the muscular walls of the uterus; in other words, it must be regarded as a clinically malignant growth.

Treatment. If curettings obtained from the uterus *of an elderly subject*

reveal the presence of a histologically benign papilliferous adenoma the case should be treated by hysterectomy.

Simple Adenoma of the Cervix. True adenoma is an extremely rare condition in the cervix. As will be shown later, when the *columnar* epithelium of the cervical glands proliferates, the tendency usually is towards the development of cell-metaplasia and malignancy, the resulting neoplasm being a *squamous-celled* carcinoma. Less frequently a true *adeno-carcinoma* of tubular type develops, in which a marked resemblance to gland-tissue is produced. Rarest of all is the formation of a simple adenoma possessing an essentially benign structure. The only case of which we have had experience was that of a woman aged thirty-six years, who had been married eleven years

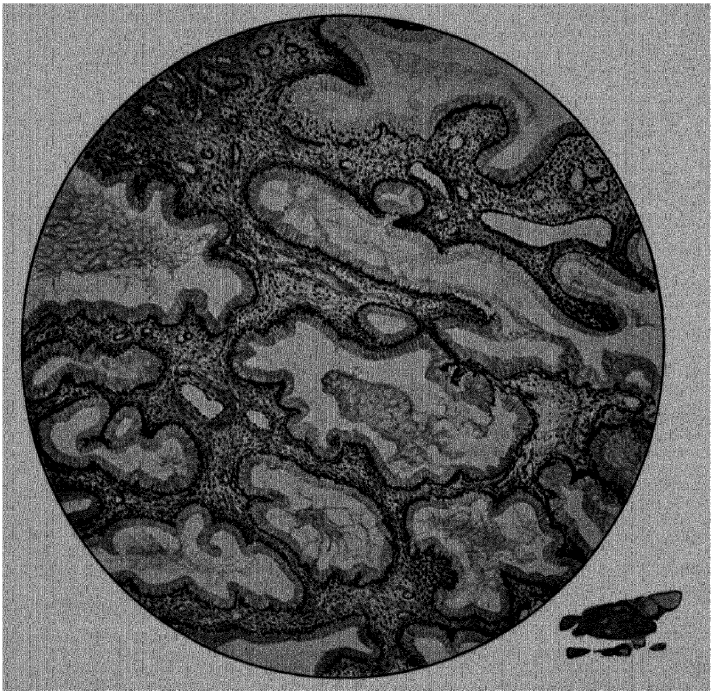


FIG. 274. SIMPLE ADENOMA OF THE CERVIX. From a sterile woman aged thirty-six years.

and was sterile. She had suffered from *profuse leucorrhœa from* childhood. Other symptoms were *haemorrhage on coitus, menorrhagia, metrorrhagia*, and a constant *dragging pain*. On examination the surface-epithelium of the vaginal cervix was mostly replaced by a papillary, hæmorrhagic growth, which was deeply fissured as if cut with a knife. In growth the colour was a deep-red, it bled freely on contact, but was far more resistant and tougher than a carcinoma. The supra-vaginal cervix was hard and the body of the uterus was spherical and bulky. Curettage brought away very little corporeal mucous membrane. Microscopically, the cervical growth consisted of long, straight gland-tubules, some of which gave off secondary branches (*see* Figs. 274 and 219, p. 369). The tubules were dilated and filled with mucus; their lining epithelium consisted of a single layer of tall columnar cells with basal nuclei. In places the surface-epithelium was intact, whilst elsewhere

it was thinned out over the growth, and gradually disappeared where the latter became flush with the surface. Surrounding the growth was a certain amount of inflammatory infiltration, and beneath it the cervix was hard and fibrotic. The condition was unaccompanied by any other pelvic lesion. Vaginal hysterectomy was performed after a portion of the growth had been examined microscopically.

This new growth differs from an *erosion* (*pseudo-adenoma*) by its deeper penetration into the cervical tissue, by the larger size of the gland-tubules, and by the coarser character of its tufted papillary surface-processes; clinically, it is much more hæmorrhagic than is an *erosion*, more closely resembling the appearances seen in tuberculous cervicitis (*see* Figs. 156 and 157, p. 274).

MALIGNANT GROWTHS OF THE UTERUS

A. MESOBLASTIC—(*a*) SARCOMA, INCLUDING ENDOTHELIOMA AND PERIENDOTHELIOMA

B. EPIBLASTIC { (*a*) CARCINOMA { CERVICAL / CORPOREAL ; (*b*) CHORIONIC CARCINOMA }

SARCOMA OF THE UTERUS

Sarcoma forms less than 0·5 *per cent.* of all malignant growths of the uterus and is therefore one of the rarest forms of malignant tumour of this organ. The relative frequency of sarcoma and carcinoma is about 1 to 40–50.

Sarcoma may start primarily in the body or in the cervix, the relative frequency of these two sites being as 5 to 1. Thus in its site of origin uterine sarcoma presents a striking contrast to uterine carcinoma, which is much commoner in the cervix than in the corpus uteri. Moreover, the epithelial and the mesoblastic components of the uterus present a strong contrast as regards their relation to neoplasms. The mesoblast (muscle and connective tissue) is a common source of origin for benign tumours (fibromyomata), whilst mesoblastic malignant growths (sarcomata) are rare. On the other hand, the epithelium is a common site of origin for malignant tumours (carcinomata), whilst benign growths (adenomata, papillomata) are very rare, and papillomata should be regarded as clinically malignant when they occur. It is the uterine epithelium, therefore, which is responsible for the extreme proneness to malignancy which is displayed by the uterus.

Another point of contrast is the fact that in the rarer form of carcinoma, *i.e.* the corporeal, the prognosis is relatively good; whilst in sarcoma of the uterine body (as also of the cervix) the prognosis is very bad.

For descriptive purposes sarcomata of the uterus may be classed as follows:

I. Sarcoma of the fibro-muscular tissue (parenchyma). { (*a*) Diffuse. (*b*) Circumscribed. (*c*) Arising in a fibromyoma.

II. Sarcoma of the endometrium
- (*a*) Diffuse.
- (*b*) Circumscribed—including 'grape-like' sarcoma of cervix.

III. Special forms of sarcoma.

IV. Endothelioma and periendothelioma.

Sarcoma of the Uterine Wall. Two types of sarcoma arise from the uterine wall: (*a*) the diffuse; (*b*) the circumscribed; a third arises in a pre-existing fibroid.

(*a*) *Diffuse.* This is the rarest form of all. It causes a uniform enlarge-

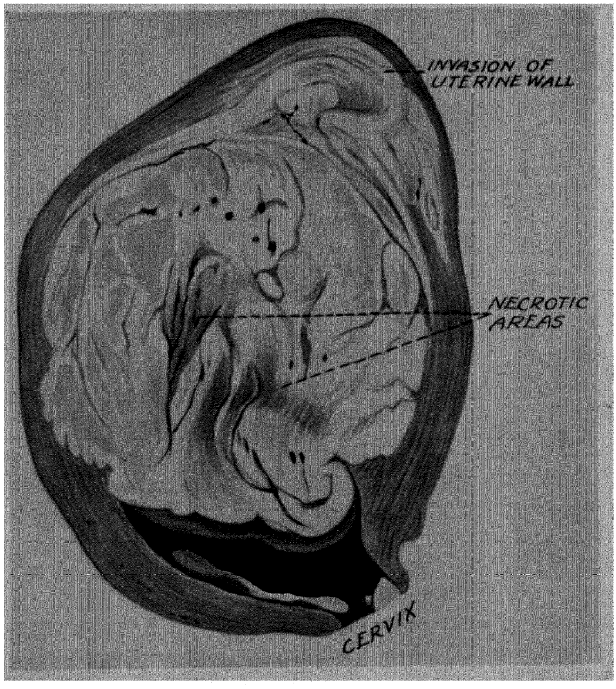


FIG. 275. CIRCUMSCRIBED SARCOMA OF THE UTERINE WALL. Multipara, aged 60. At the fundus the growth has invaded the uterine wall; the lower part projects into the uterine cavity.

ment, producing a condition resembling the gravid uterus in shape and consistence. The sarcoma-cells (round and spindle) are diffused throughout the entire thickness of the uterine wall. This form is said to be of connective-tissue origin.

(*b*) *Circumscribed.* This variety occurs as a solitary globular mass of softish friable consistence, which in its early stage may show a certain amount of encapsulation (*see* Fig. 275). In colour it is dull yellowish, in consistence it is homogeneous, and shows none of the fibrillated appearances characteristic of fibroids. Its surface is often discoloured from patches of necrosis (*see* Fig. 244, p. 406) and interstitial hæmorrhage. These growths may contain cystic spaces filled with straw-coloured or blood-stained fluid. The smaller cysts may be due to œdema, the larger are either definite lymphangiectases,

or else spaces formed by the breaking down of necrotic tissue. Dilated blood-vessels forming large sinuses (telangiectases) may sometimes be met with. The microscopic appearances are variable, the cells being often of mixed type ; round, spindle and giant cells may all exist in one and the same sarcoma (*see* Fig. 279).

These growths are interstitial in their origin, and as such they are only of moderate size, but they may become both submucous (*see* Fig. 276) and subserous, and under these circumstances they may attain considerable dimensions, the largest on record weighing forty pounds (Piquand). A

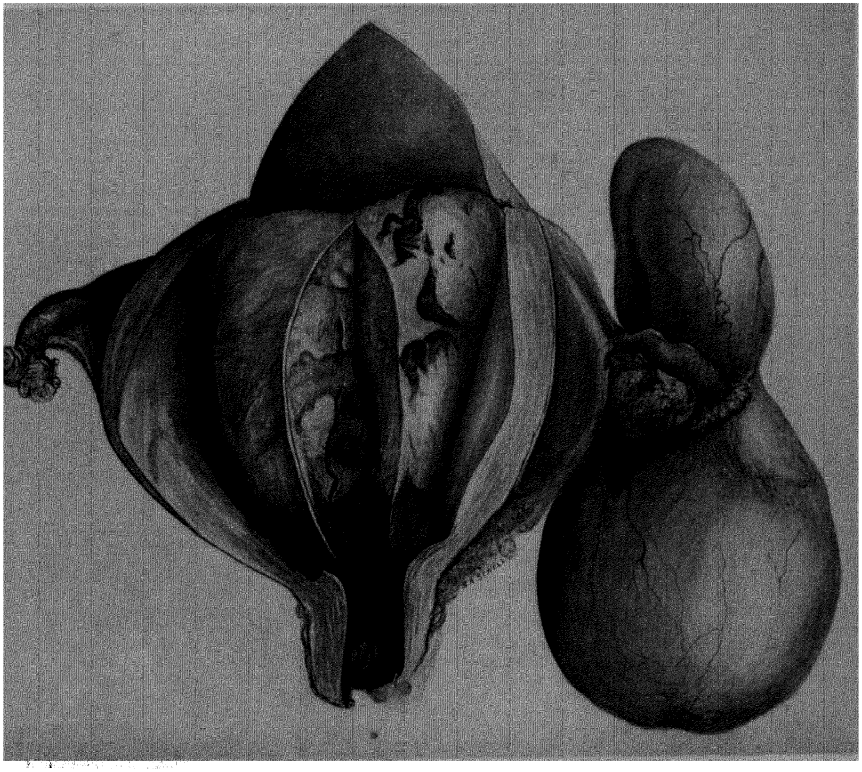


FIG. 276. CIRCUMSCRIBED SARCOMA OF THE UTERUS. The growth forms a circumscribed submucous tumour of the anterior wall of the uterus (the uterus is opened from behind). On the right side there is a teratomatous cyst of the ovary.

point of clinical importance is the liability of these growths to become polypoid. Figure 278 shows such a one from which three polypi were removed prior to hysterectomy. In a number of these polypoid cases inversion of the uterus has occurred, inversion being more common in association with sarcomatous than with myomatous polypi. It has been suggested (A. R. Simpson) that inversion is favoured by malignant infiltration producing a softening and paralysing effect on the uterine muscle. Circumscribed sarcoma of the *cervical wall* is rare. Figures 280 and 281 show the naked-eye and microscopic features of such a growth.

(*c*) *Sarcomatous Metaplasia in a Fibromyoma.* We have already stated

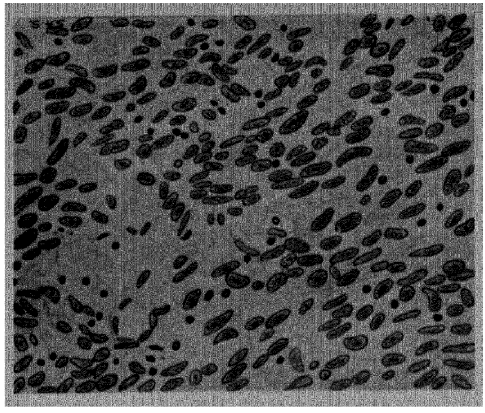


FIG. 277. SARCOMA OF THE UTERUS. Showing the microscopic structure of growth seen in Figure 276. Mitotic figures are seen in the nuclei of the oval cells.

that the types of primary malignant changes which are to be met with in a fibromyoma are malignant leioma, sarcoma, endothelioma and periendothelioma. A fibroid may also be invaded by a co-existing sarcoma. The frequency with which sarcomatous changes are found in fibroids is about 1 *per cent.* The malignant change usually takes place in the centre of the tumour (*see* Fig. 244, p. 406). Often several fibroids are present, while only one shows

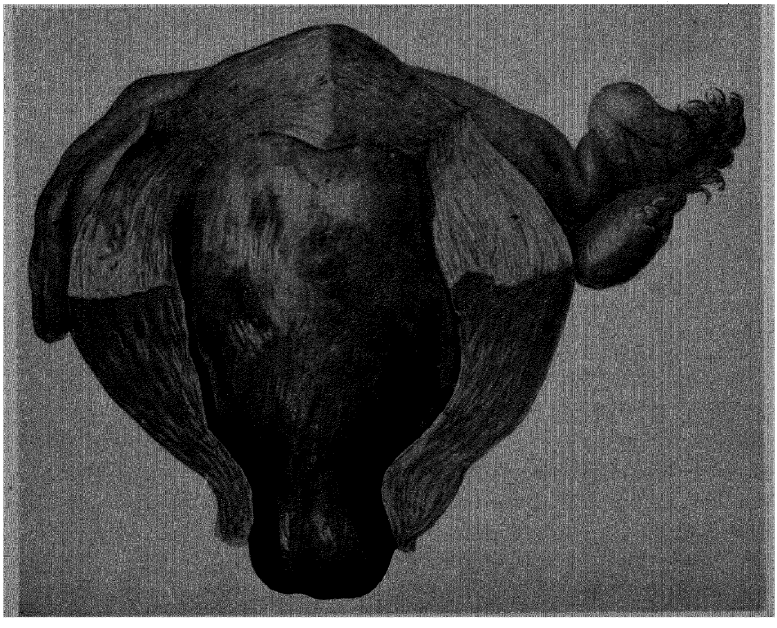


FIG. 278. SARCOMA OF THE UTERUS. The uterus, opened posteriorly, shows a submucous sarcoma. The lower pole of the growth dilated the cervix and presented as a polypus in the vagina. There was a secondary subperitoneal nodule attached to the fundus uteri. The histology of this nodule is seen in Figure 279.

sarcomatous changes. The naked-eye appearances are the same as those already described as characterizing a circumscribed sarcoma. Sarcomatous change may occur in all three of the primary varieties of uterine fibroids, but is relatively more frequent in those which remain intramural. In most cases the sarcoma-cells are thought to be due to metaplasia of the connective-tissue cells of a fibroid, but many observers, including ourselves, have been able to trace a direct transformation of the muscle-fibres (*see* Figs. 245 and 246, p. 407). It is possible that in some cases the sarcoma-cells arise from both sources simultaneously.

The term *malignant leioma* (leiomyoma) is synonymous with *malignant myoma*, the definition of leioma being a tumour of mesenchymal origin, of

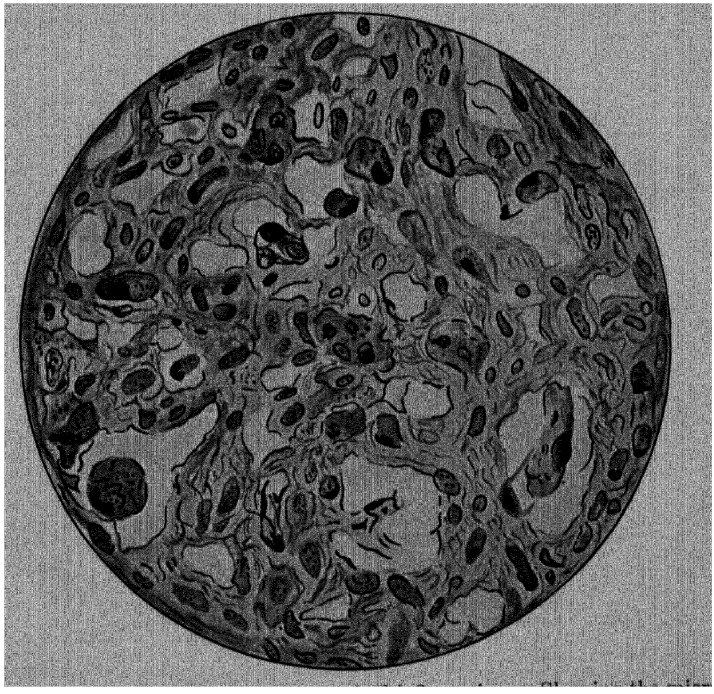


FIG. 279. SARCOMA OF THE UTERUS. $\frac{1}{6}$ obj. 3 eyepiece. Showing the microscopic characters of a subperitoneal nodule from the specimen drawn for Figure 278. Many multi-nucleated giant cells are seen.

which the cells tend to differentiate into smooth muscle-cells. The type-cell is the smooth muscle-cell such as we see in the uterine wall. Malignant *leioma* is a term reserved for a rare type of myoma consisting solely of young actively growing unstriped muscle-tissue. It therefore gives the microscopic appearance of being benign. Its malignant nature is revealed by the presence of metastases in various parts of the body, such as the lungs, liver, pelvic cellular tissues and intestines. In a case which one of us examined, there were pulmonary and rectal growths resembling in structure the primary myoma of the uterus. From such cases we learn that young muscle-cells may behave in a malignant manner without undergoing anaplasia or reversion to embryonic type. In a *myosarcoma* the muscle-cell reverts to a more elementary type, and provides microscopic evidence of malignancy. A

malignant *leioma* affords no such histological proof of its malignant capabilities; it shows young myoblasts and fibroblasts causing the myomatous tissue to appear more cellular than is normal, and in the absence of metastases the only histological diagnosis which is possible is that of an actively growing myoma.

Sarcoma of the Endometrium. This is a much rarer form than that derived from the muscle-wall; there are two varieties to be considered:

(*a*) *Diffuse.* Cases where an intramural sarcoma has become submucous and polypoid are difficult to distinguish from those of *endometrial* origin. In general appearance the mucosal form corresponds with the intramural, but

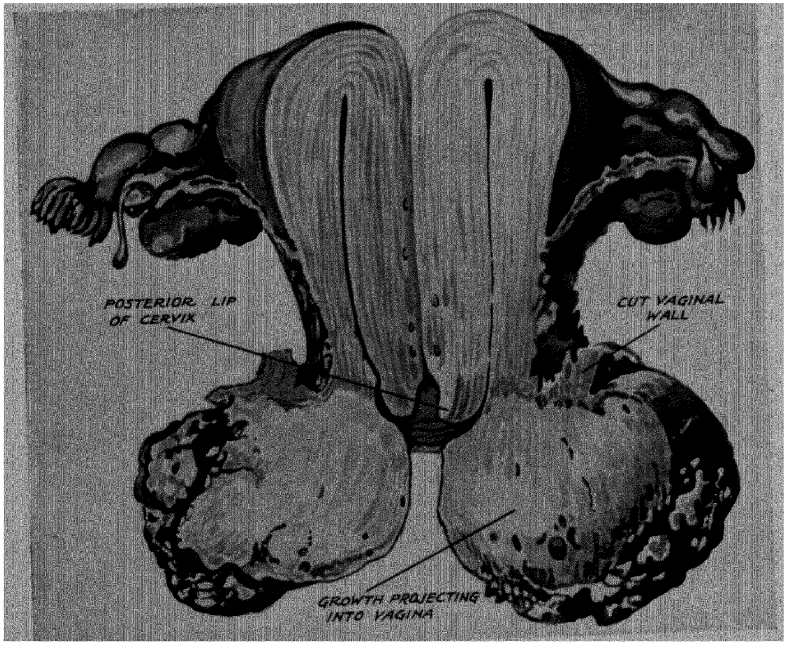


FIG. 280. SARCOMA OF CERVIX UTERI, SINGLE WOMAN ÆT. 29 (T. G. Stevens). The growth appeared to start in the *fibro-muscular* wall of the cervix and not in the cervical endometrium. *Cp.* Figure 282, which shows an *endometrial* sarcoma of the cervix.

the tissues are softer and more friable, and loose pieces may be found lying free in the uterus, and perhaps discharged through the cervix. The growth usually arises in the endometrium near the fundus, whence it spreads so as to involve the whole mucous membrane of the body; generally it stops short at the internal os, but it may involve the cervical endometrium as well. The uterus becomes soft and uniformly enlarged, resembling the pregnant organ. On section the endometrium is seen to be thickened, its inner surface may be shaggy and even polypoid. This type of growth has been known to block the cervix and cause both hæmato- and pyometra. Histologically it may be classed with the round-celled sarcomata.

(*b*) *Circumscribed* sarcoma of the endometrium begins as a nodule which may grow outwards into the muscular wall, or inwards towards the cavity,

the latter being more frequent (*see* Fig. 247, p. 408). In the uterine cavity it tends to become polypoid, dilating the cervix and passing into the vagina, where, owing to strangulation and infection, it will appear as a dark red, sloughy growth. This type of endometrial sarcoma may arise in the cervix, where it may be difficult to distinguish from a proliferating epithelioma.

One form of circumscribed sarcoma of the cervical endometrium presents very distinctive clinical features, appearing as a vesicular growth generally referred to as 'the grape-like sarcoma of the cervix,' or *sarcoma cervicis botryoides*. This is a very malignant multiple-polypoid growth characterized

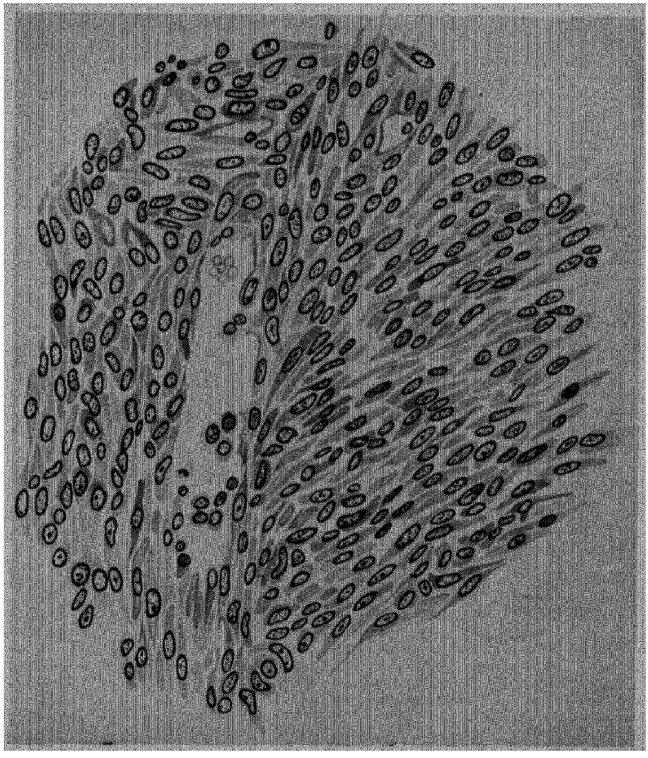


FIG. 281. PARENCHYMATOUS SARCOMA OF CERVIX UTERI (T. G. Stevens). Microscopic features of specimen shown in Figure 280. They are those of a myosarcoma.

by the formation of a collection of globular grape-like vesicles connected in irregular series, or attached to the uterine wall by delicate stalks. Its growth is rapid, and it may fill up and distend the vagina (*see* Fig. 282). It is met with in infancy, in adolescence, and after the menopause. The cyst-like masses are due to œdematous infiltration occurring in a rapidly growing sarcoma. Microscopic examination reveals a covering of squamous or cylindrical epithelium and a stroma of mixed large, round and spindle cells, separated by œdematous spaces. In some specimens striped muscle-fibres and hyaline cartilage have been found.

Special Forms of Sarcoma. Sarcomata of the uterus, like those of other organs, show a tendency to the formation of tissues of a higher grade

of development, thereby forming tumours of great pathological complexity. Such growths being of great rarity need only be enumerated. The *malignant leioma* already mentioned may be put into this category. *Primary melano-sarcoma* of the uterus with secondary deposits in the brain and other organs has been recorded as arising in the cervix. *Myxo-sarcoma*, giving the mucin reaction with acetic acid, occurs; *lympho-sarcoma*, soft growths composed of typical lymphoid tissue, have been reported by Gow and others. *Lipo-myosarcoma* has been described by Sitzenfrey. *Angio-sarcoma*, *chondro-sarcoma*, *adeno-chondro sarcoma*, and *rhabdo-myosarcoma* have all been recorded. Tumours closely allied to endotheliomata have been described

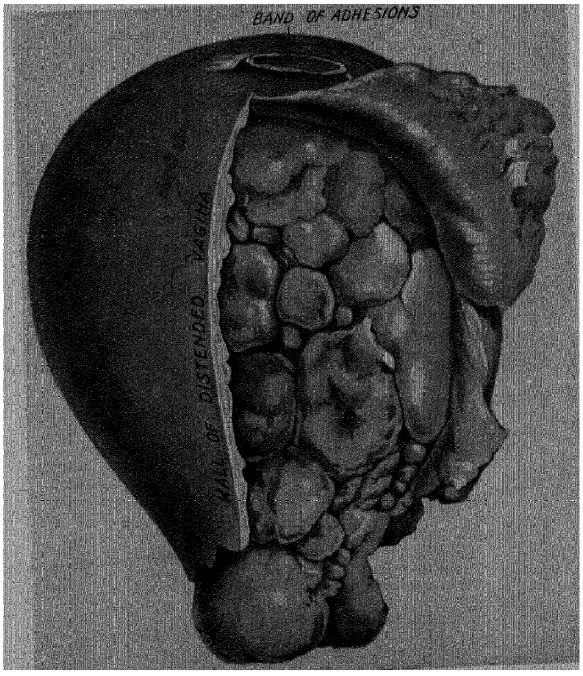


FIG. 282. VESICULAR OR GRAPE-LIKE SARCOMA OF THE CERVIX (Curtis). Infant, 12 months old. The uterus and vagina were removed by an abdominal operation. The vagina is distended with masses of growth, which are shown by reflecting a portion of the vaginal wall. The uterus is not seen.

as a combination of carcinoma and sarcoma under the title *Carcinoma sarcomatodes*; in this connection it may be recalled that sarcoma has been produced in a mouse by implantation of cancer-cells.

Spread of Uterine Sarcoma. The intramural form is of relatively low malignancy, probably because it remains encapsuled until it has attained considerable size. The channel of dissemination is the bloodstream; the large size and the delicate walls of the new vessels favour the entrance of sarcoma-cells, and their presence can often be demonstrated in the lumina as in Figure 283. After passing through the uterine wall the growth invades the bladder, the Fallopian tubes, the ovaries, and the pelvic lymphatics. In fatal cases submitted to autopsy, visceral metastases are found in over 70

per cent. (Veit), the organs most frequently affected being the lungs and the liver; metastases also occur, though much less frequently, in the intestines, the spleen, and the kidneys. Urinary and fæcal fistulæ are seldom caused by sarcoma.

Clinical Features. Sarcoma of the uterus occurs both in infancy and childhood, and an instance in a fœtus has been recorded by Phillips; but the great majority of cases occur in women who have passed the menopause. From a study of 438 cases, Veit concludes that from forty-five to sixty years of age represents the time at which women are most prone to uterine sarcoma. One-fourth of the patients are nulliparous and three-fourths parous.

As previously stated, sarcoma attacks the body of the uterus more often than the cervix, differing sharply in this respect from cancer. It also forms a

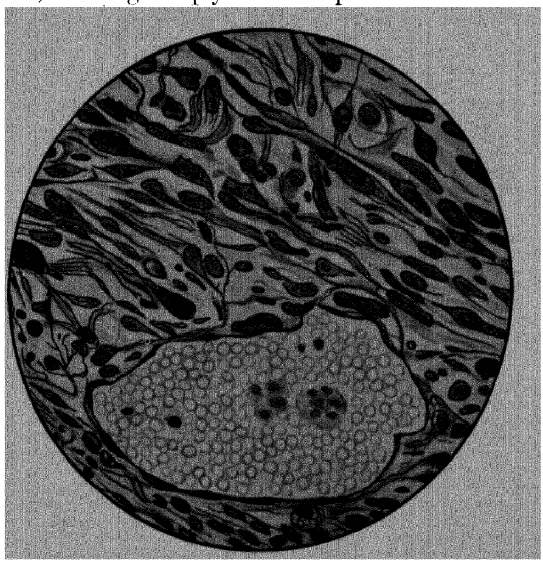


FIG. 283. SARCOMA OF THE UTERUS. The growth consists of round, spindle, and giant-cells; the large vein shows a giant-cell and a cluster of sarcoma-cells in its lumen, illustrating the mode of dissemination characteristic of sarcoma.

much larger tumour than cancer, and so occasions much greater enlargement of the uterus. Usually the enlargement is fairly symmetrical, but may be irregular if the growth projects beneath the peritoneal coat, or if fibroids are also present. Vesicular sarcoma, when it occurs in the cervix, is easy of recognition by direct examination.

The *symptoms* to which sarcoma gives rise are *haemorrhage*, *discharge* and *pain;* it will therefore be apparent that the symptoms do not allow of its being distinguished from cancer (*see* p. 484). The *bleeding* is irregular, or continuous, but is seldom profuse. Before the menopause the first indication of hæmorrhage may be progressively increasing menorrhagia. The *discharge* is watery and blood-stained, and becomes offensive at an early stage. *Pain* is severe and occurs comparatively early; this is probably due to the relatively rapid rate of growth. Constitutional symptoms, such as headache, sleeplessness, anæmia, and loss of flesh, sometimes appear early and are out of pro-

portion to the amount of hæmorrhage and discharge ; such symptoms should arouse suspicion of malignancy without reference to the size of the uterine tumour. The marked tendency of all sarcomatous growths to necrose (*see* Fig. 284) and become infected is well known ; this results in septic poisoning

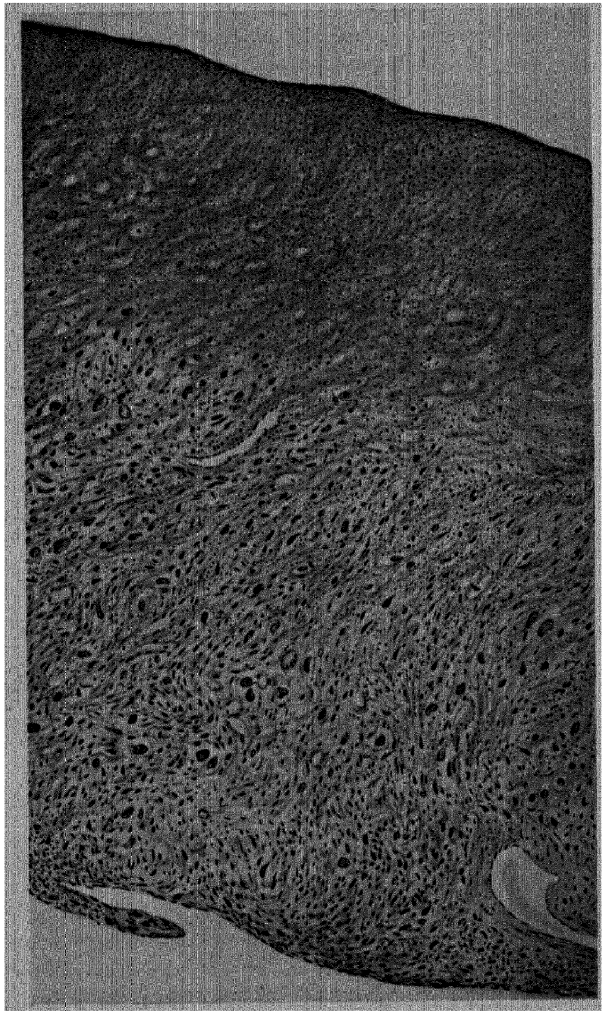


FIG. 284. SARCOMA OF THE UTERUS. × 105. Showing a wide zone of necrosis on the surface of the growth. The growth demonstrates a common feature of uterine sarcoma, *i.e.* a mixture of cells comprising spindle, round, oat-shaped and giant-cells.

and Veit calculates that of the mortality from uterine sarcoma 85 *per cent.* is to be attributed directly to cachexia and sepsis.

The *treatment* consists in total extirpation of the uterus and its adnexa without delay ; the abdominal is preferable to the vaginal operation as allowing of freer removal of the broad ligaments and inspection of the other pelvic organs. Good results are said to be obtained by the use

of radium. The prospect of recurrence is highest in the round-celled type of growth arising in the endometrium, but it is great in every variety. The least-malignant of all is the sarcoma which develops in a fibroid.

Endothelioma and Peri-Endothelioma of the Uterus. These are malignant growths arising from proliferation of the cells lining the blood-lymph-vessels of the tunica interna and the tunica externa (respectively). They possess no naked-eye characters by which they can be distinguished

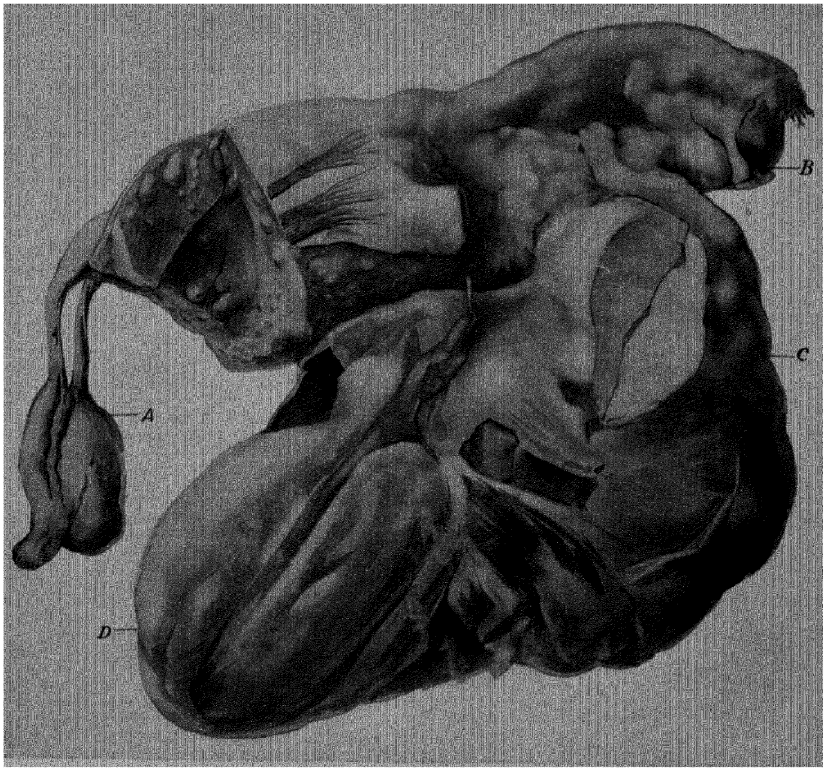


FIG. 285. PERI-ENDOTHELIOMA OF THE UTERUS SEEN FROM THE FRONT (Doran and Lockyer). The cavity of the uterus with small nodules of the growth in the wall is shown on the right side. A, Right ovary. B, Left tube and meso-salpinx infiltrated with new growth. C, Large solid growth in left broad ligament. D, Cystic part of growth in left broad ligament. The patient was free from recurrence five years after operation.

from other kinds of malignant growth ; careful examination of the tissue by an expert microscopist is required for their recognition.

These forms of malignant tumours are regarded as sarcomata possessing a low type of malignancy ; they are commoner in the ovary than in the uterus. The macroscopical and histological characters of uterine peri-endothelioma are well shown in the accompanying illustrations (Figs. 285, 286, and 287), while the appearances of endothelioma will be described later (*see* p. 620). In regard to prognosis endotheliomata and peri-endotheliomata

differ markedly from sarcomata, on account of their lower grade of malignancy. The chance of recurrence after removal is decidedly less than it is with sarcoma proper.

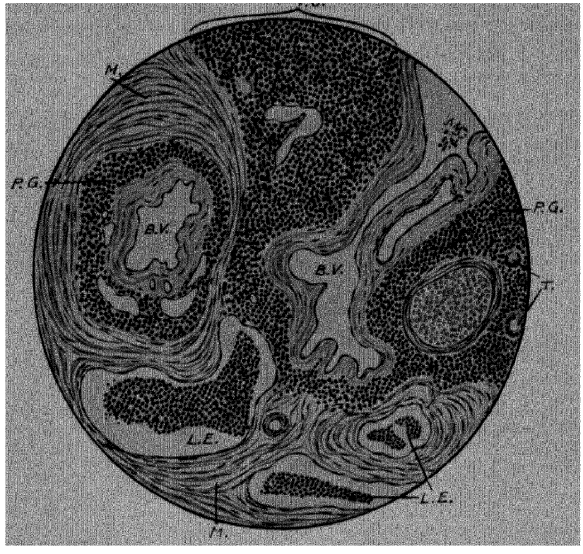


FIG. 286. SECTION OF PERI-ENDOTHELIOMA OF THE UTERUS (Doran and Lockyer), showing the microscopic appearances of tumour in Figure 285. *B.V.*, Blood-vessel; *L.E.*, Lymphatic Embolus; *P.G.*, Peri-endotheliomatous Growth; *M.*, Uterine Muscle; *T.*, Tubules from Mucosa.



FIG. 287. PERI-ENDOTHTHELIOMA OF THE UTERUS (Low Power) (Johnstone). Whorls of epithelioid cells are arranged around vessels; the endothelium of the latter is intact.

CANCER OF THE UTERUS

Carcinoma is more frequently met with in the uterus than all the other malignant growths taken together. Two organs in the female sex show a greater predisposition to cancer than any others, viz. the breast and the uterus, the liability of these two being about equal. From a study of the

cancer-statistics of large clinics it appears that in women affected by cancer, the organ primarily attacked is the uterus in about 30 *per cent.* of all cases (Welch, Orth). Although Gye and Barnard [1] have demonstrated a definite cancer-virus none of the experiments, so far, have thrown direct light on the origin of cancer, much less on the special predisposition to cancer of certain organs of the body, such as the uterus and mamma.

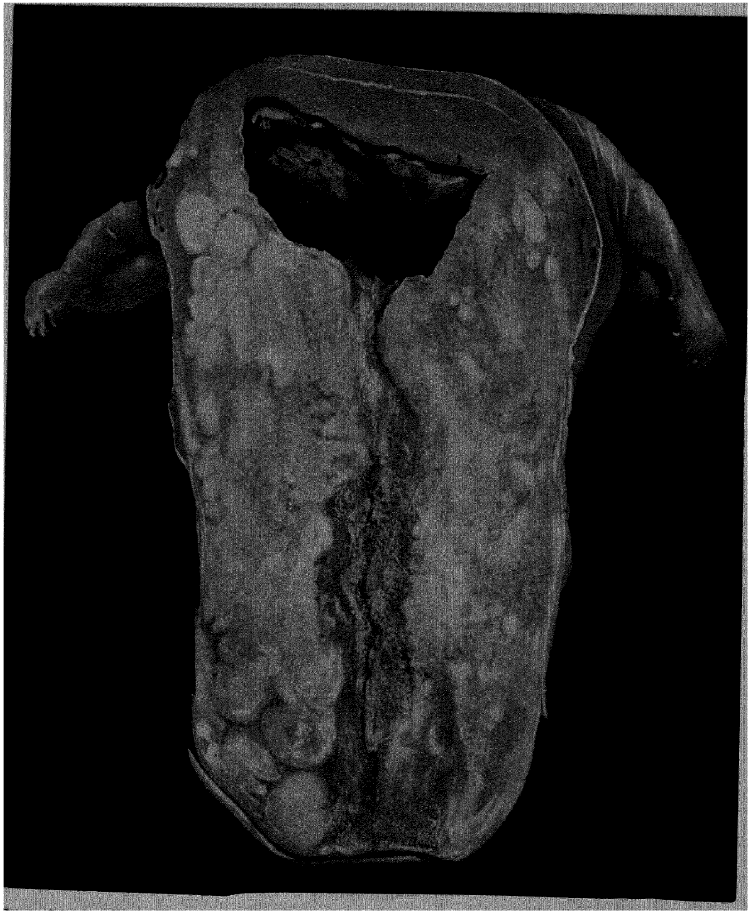


FIG. 288. GENERAL CARCINOMATOSIS OF THE UTERUS; THE DISTINCTION BETWEEN BODY AND CERVIX IS LOST. The uterine cavity was dilated by blood (hæmatometra) (*cf.* Fig. 139, p. 213).

Traumatism and *chronic irritation*, *e.g.* a long-standing inflammation, are generally accepted as predisposing causes of cancer. Both the breast and the uterus are especially exposed to risks of injury; the former from its exposed situation, the latter from the effects of child-bearing. And further, both organs are frequently the seat of chronic inflammatory processes. Another predisposing cause of cancer is *senescence*,

[1] "The Ætiology of Malignant New Growths," by W. E. Gye, M.D., Lond., *Lancet*, July 18, 1925.

i.e. old-age changes, in tissues; both these organs are subject to such changes as soon as the period of sexual activity has passed, *i.e.* at a much earlier age than the tissues of the body generally.

Cancer may attack either the cervix or the body of the uterus; in rare instances both divisions are affected in a single case, as seen in Figures 288 and 290. The cervix is much more frequently attacked than the body, but it is very difficult to define with accuracy the relative frequency of the

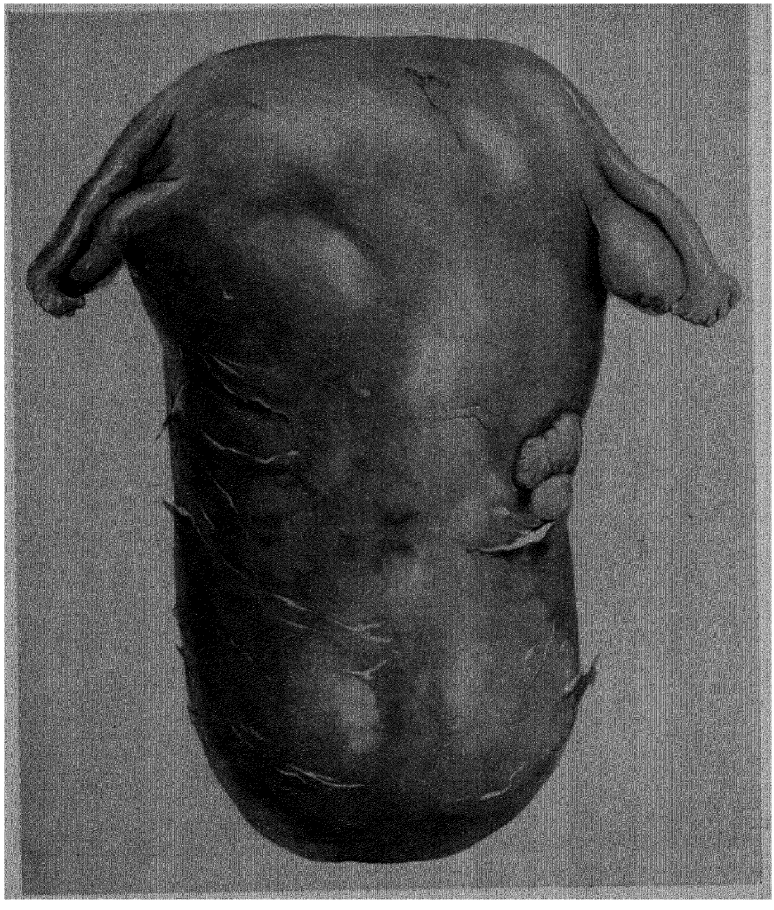


FIG. 289. POSTERIOR VIEW OF THE SAME UTERUS AS SHOWN IN FIGURE 288.

two. From a study of post-mortem statistics it would appear that 95 *per cent.* of cases of uterine cancer are cervical, and only 5 *per cent.* corporeal. Clinical statistics give a higher proportion of cases of corporeal cancer than this. Thus Wilson has recorded a series of 596 consecutive cases of uterine cancer observed by him in Birmingham, and in 11·25 *per cent.* the primary seat of the disease appeared to be the body. It is not, however, in all cases possible to say in which division of the uterus the disease first appeared.

Cervical and corporeal cancer present so many points of anatomical

and clinical difference that they are entitled to consideration as distinct diseases.

CANCER OF THE CERVIX

Pathological Anatomy. Cancer may arise in the cervix in two different positions: (*a*) from the deep layers of the epithelium of the portio vaginalis (*cervical cancer*); (*b*) in the cervical endometrium, *i.e.* the mucous membrane lining the cervical canal (*endocervical cancer*).

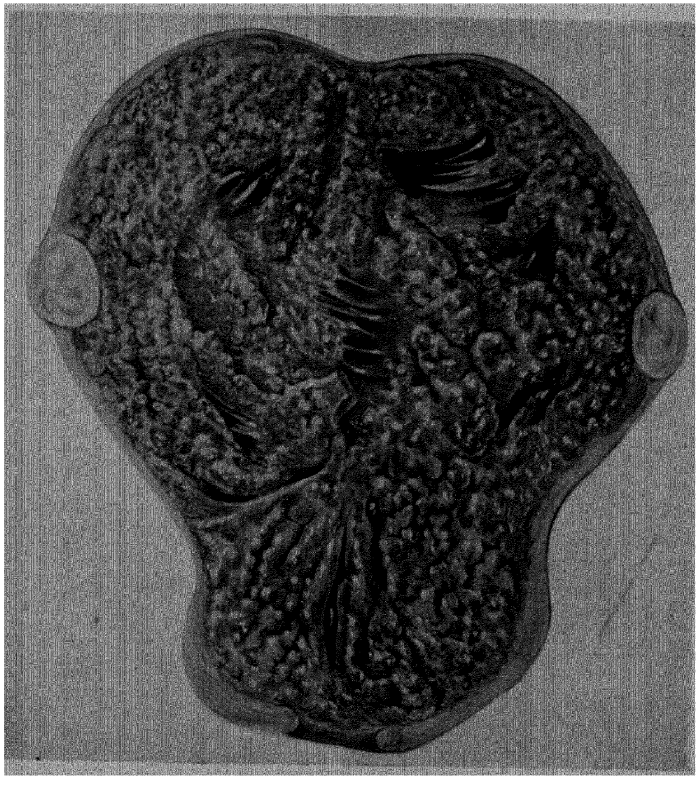


FIG. 290.—GENERAL CARCINOMATOSIS OF THE CORPUS AND CERVIX UTERI. The uterus has been laid open from the front.

Some pathologists believe that it may arise in the epithelium derived from fœtal relics, but this is an hypothesis which it is equally difficult to prove or to refute. It has commonly been taught that cancer of the cervix may be systematically distinguished as (*a*) cervical cancer, which, arising in the squamous epithelium of the portio, is a *squamous-celled* cancer, and (*b*) endocervical cancer, which, arising in the columnar epithelium of the cervical endometrium, is therefore an *adeno-carcinoma*. Careful examination, however, of a large series of cervical carcinomata has demonstrated that this simple and apparently logical classification breaks down; in fact, it is often impossible to decide, either by naked-eye or (in advanced cases) by histological examination, whether a cancer started in the squamous

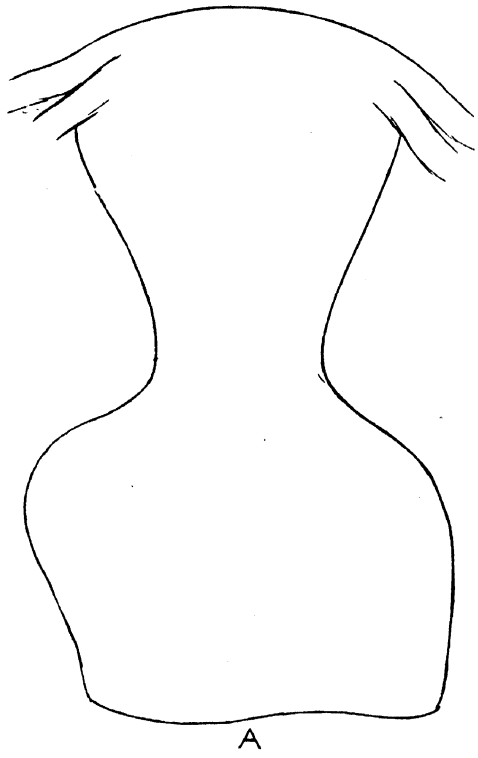


FIG. 291. OUTLINE (DRAWN TO SIZE) OF THE UTERUS AND A PORTION OF THE VAGINA COVERING THE CERVIX IN A CASE OF ENDOCERVICAL CANCER. The uterus was removed by Wertheim's total hysterectomy. The cervix in this case is shown in the following Figures, 292 and 293.

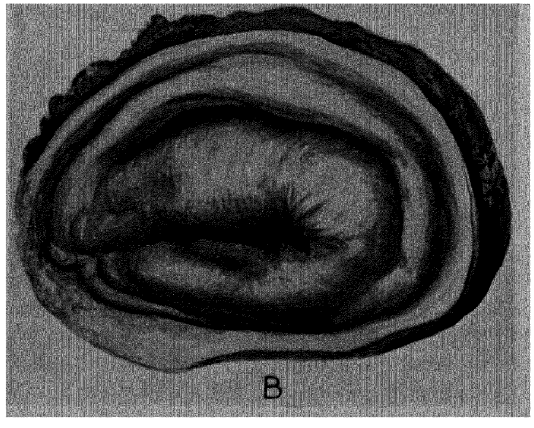


FIG. 292. VAGINAL ASPECT OF THE CERVIX IN THE CASE OF ENDOCERVICAL CANCER seen in Figures 291 and 293. There is an old laceration present, but the vaginal surface is intact and not involved in the malignant growth (*see* Fig. 293).

epithelium of the *portio vaginalis* or in the columnar epithelium of the cervical endometrium. This inability to prove the site of origin in cases of cancer of the cervix is due to the marked disposition of the epithelium of the cervix to undergo metaplasia. This change is very liable to occur in the case of the columnar epithelium, not only in cells already cancerous, but also in what may be called the *pre-cancerous stage*. In cases of cervical catarrh and cervicitis, with or without ectropion of the cervical mucous membrane, the columnar epithelium may be seen assuming the characters of squamous epithelium. In the same manner squamous-celled carcinoma may be seen to arise from the columnar cells of the endometrium, as well

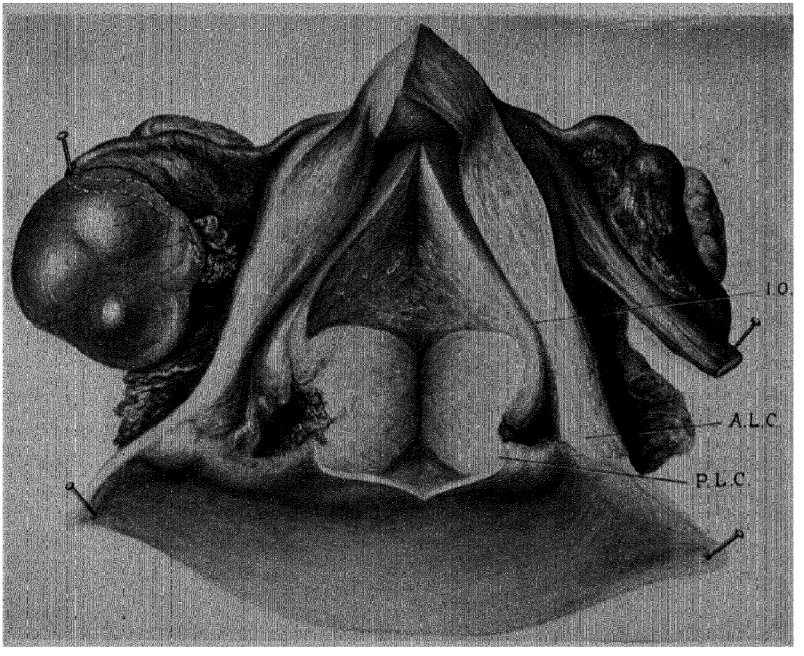


FIG. 293. ENDOCERVICAL CANCER. The specimen has been laid open from the front to show that the growth has started in the cervical endometrium and not in the epithelium covering the *portio vaginalis* (*see* Fig. 292). I.O., Internal os. A.L.C., Anterior lip of cervix. P.L.C., Posterior lip of cervix. Between these two points lies the cervical canal, which on the right side shows an ulcerated area, the starting-point of the malignant growth (*see* Figs. 294, 295, 296).

as from the squamous epithelial investment of the portio vaginalis. *Almost all carcinomata of the cervix belong to the squamous-celled type.*

The Squamous-celled Cancer. From the above remarks it will be seen that this variety may arise from the portio vaginalis (cervical cancer) or from the endometrium of the cervix (endocervical cancer). The growth arising from squamous epithelium starts in the deep layers, in which proliferating cells form buds and solid processes which dip into the subjacent fibromuscular tissues. Whilst the downgrowth is taking place, the cells in the superficial layers are thrown off, so that between

the downgrowing epithelial processes the surface-epithelium is thinned out and may even be absent. The rate of growth may be estimated by the features assumed by the invading solid processes—the more rapid

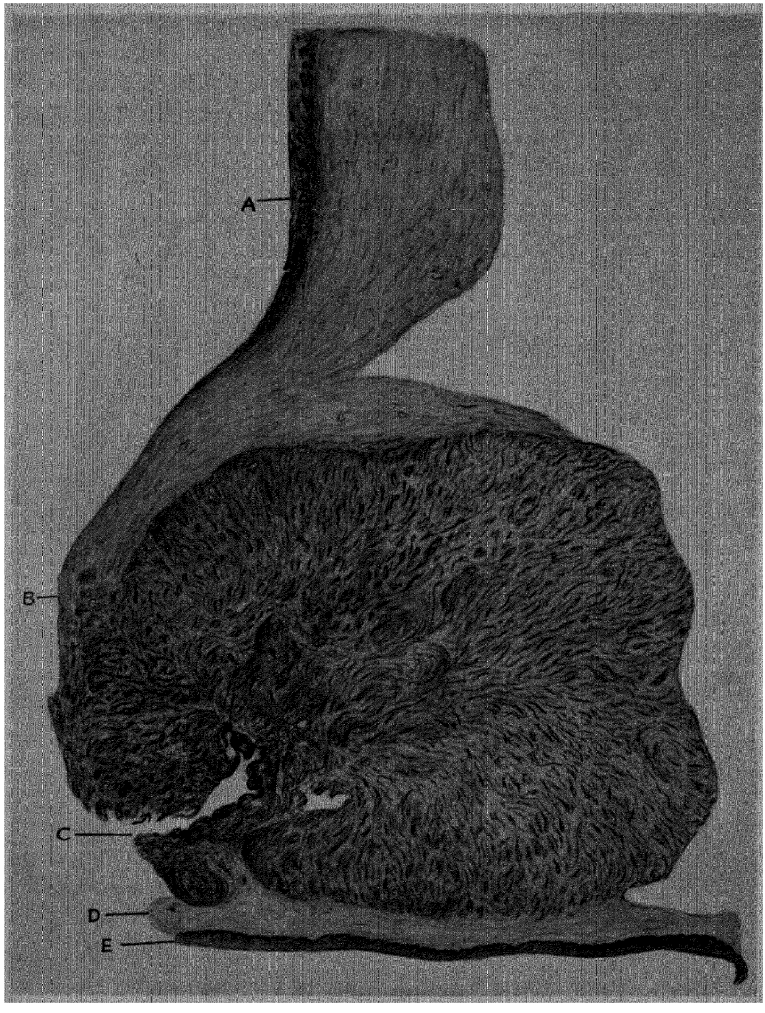


FIG. 294. SAGITTAL SECTION OF SPECIMEN SHOWN IN FIGURE 293 (×4), SHOWING A SQUAMOUS-CELLED CANCER STARTING IN THE CERVICAL ENDOMETRUM. A, Corporeal endometrium. B, Cervical endometrium. C, Malignant ulceration of cervical endometrium. D, Fibro-muscular tissue of cervix free from growth. E, Healthy surface of *portio vaginalis cervicis*. The microscopic characters of the growth are seen in Figures 295, 296.

the growth, the larger and thicker are the cancer-masses, and the more diminished becomes the connective tissue framework.

Microscopic Appearances of a Squamous-celled Cancer. The characteristic appearances are only to be found at the advancing edges of the

growth, and sections required for diagnosis should always be taken from this part. It has been pointed out that from the deep layers of the stratified epithelial covering of the normal cervix shallow digitate processes project into the subjacent connective-tissue layers (*see* Fig. 297). Cut in transverse section these processes appear under the microscope as small islets of epithelial cells, uniform in character, surrounded by connective tissue from which they are sharply differentiated. In squamous-celled cancer the new growth is formed by the production of large, branching, solid epithelial offshoots from the deep layer of cells on



FIG. 295. SECTION OF THE GROWTH SHOWN IN THE PRECEDING FIGURE. It was taken from point C in Figure 294, *i.e.* through the free edge of the ulcerated area in the cervical canal. The growth is composed of solid, clubbed, branching processes of squamous epithelial cells. The latter can be seen to arise from the columnar epithelium of the superficial and deep glands of the cervical endometrium (*see also* Fig. 296).

such processes as these (*see* Fig. 298); they penetrate the healthy tissues deeply and destroy them in their advance. In transverse section they appear as masses of epithelium of various shapes and sizes, more or less sharply bounded by a well-defined fibromuscular stroma, representing the normal tissues of the cervical wall. In these masses the peripheral layer of cells is cubical (*see* Fig. 296); passing towards the centre, the cells are more irregular and tend to become polygonal. In the central parts may occasionally be seen small areas of flattened cells arranged concentrically, the so-called *epithelial pearls*, but this is a change which is seldom seen in squamous-celled carcinomata of the cervix, since the majority arise from columnar and not from squamous epithelium. Instead, the central cells

of a cancerous area become softened and degenerated to form a fluid or semi-fluid pulp in which free nuclei and leucocytes, but no cancer-cells, are seen. By this colliquative necrosis, gland-like spaces lined by many layers of epithelium are produced, but the cells lining such spaces always preserve their squamous characters. Such a condition superficially resembles, but should not be regarded as, adeno-carcinoma.

Around the cancer-areas the stroma often shows a certain amount of round-celled infiltration and œdema, and the cancer-cells may be seen escaping into, and invading, the connective tissues. In the more advanced portions of the growth the fibromuscular stroma is not seen; the cancer-cells become more widely disseminated and penetrate the surrounding



FIG. 296. VIEW UNDER HIGH POWER (×278) OF SECTION SHOWN IN FIGURE 295, showing the squamous character of the malignant cells and their origin from the columnar epithelium of the cervical endometrium.

tissues, destroying them in their advance, so that large areas of the growth consist of little else but masses of cancer-cells. These parts of the tumour are prone to ulceration; the characteristic appearances are then lost, and an extensive zone of round-celled infiltration is found around them (*see* Fig. 299). The surface of a squamous-celled cancer usually displays these modifications, except at the edges, where the appearances remain characteristic. Here it is often seen that the cancer has penetrated the stroma beyond the apparent edge of the growth, passing into parts which are still covered by normal epithelium (*see* Fig. 299).

Squamous-celled cancer may originate in a cervical erosion. It will be remembered that an erosion is either simple, papillary or follicular in type.

The follicular form is the result of tubular downgrowths from the basal layer of the surface-epithelium. In some cases malignant metaplasia of the latter takes place and the downgrowing processes therefrom are malignant likewise. The histological appearances superficially resemble those of a true adeno-carcinoma, but the difference between the malignant follicles of the squamous-celled cancer and the processes of a tubular adeno-carcinoma is that the former are composed of non-secreting squamous epithelium and the latter of columnar cells which are capable of filling the gland-spaces with their secretion.

Adeno-carcinoma of the Cervix is rare, and, like the squamous-celled growth, it arises from the cervical endometrium, either from the columnar epithelium of the surface or from that deeper down in the gland

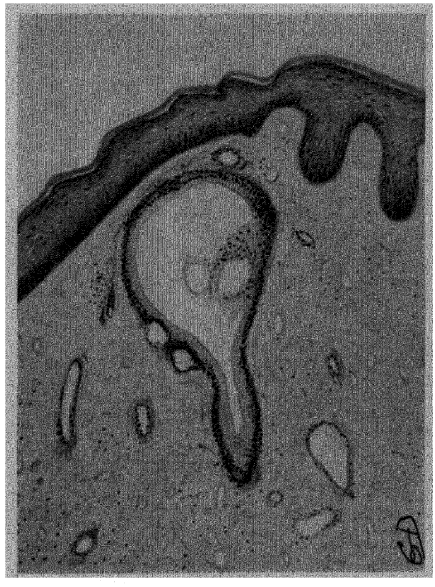


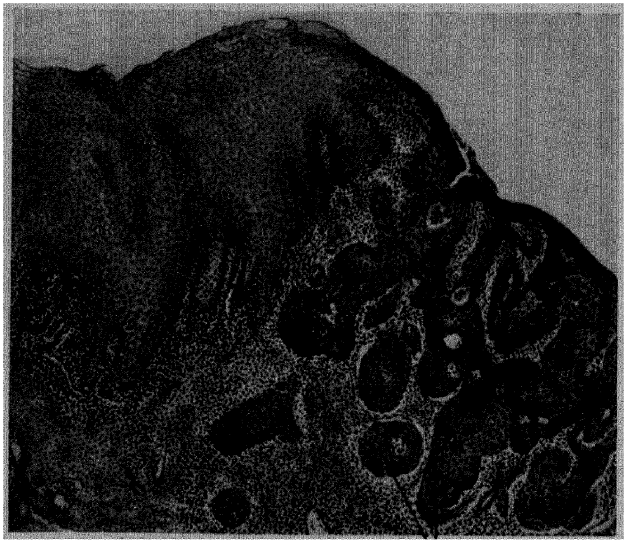
FIG. 297. VERTICAL SECTION THROUGH THE VAGINAL SURFACE OF THE CERVIX UTERI, showing digitate processes of surface-epithelium projecting into the subjacent fibromuscular tissue.

tubules, the latter source being the commoner site of origin. The cancer starts by the formation of tubular projections from the lumina of the glands. These crypts, communicating with the lumen of an original tubule, begin to branch and elongate, and may join up with others which have arisen from another site; hence a complex adenomatous formation is produced. Some of the secondary tubules may project into the lumina (*inverting type*), but for the most part they spread outwards in the fibromuscular stroma, which becomes gradually diminished by the invasion of these ramifying tubules. There is no pronounced tendency to multiplication of layers, so that for the most part the lumina possess only a single layer of cubical epithelium (*see* Fig. 300). This type of cancer is rare in the cervix; it resembles in its histology the so-called *adenoma malignum* (tubular carcinoma) of the uterine body. The histological evidence of malignancy consists, mainly, in the invasion and destruction

of the stroma by the proliferating tubules. This growth has, however, but little tendency to invade the parametrium and the adjacent viscera; it is therefore far less malignant than the squamous-celled cancer.

In a few cases adeno-carcinoma of the cervix shows the same colloid degeneration of cells as is seen in cancer of the bowel.

Macroscopic Appearances of Cancer of the Cervix. The naked-eye appearances of cancer of the cervix are very variable. The younger the subject, the softer, and more brain-like, is the growth liable to be. Roughly speaking, cancers of the cervix uteri may be divided into those which show, from the first, a tendency to *erode* or *ulcerate*, and those which are characterized by a marked degree of *new formation* or *proliferation*. Such a division into types—(1) ulcerative, and (2)



A

FIG. 298. SQUAMOUS-CELLED CANCER OF THE CERVIX. Multipara, aged 27. The section is made through the edge of the growth. At A are seen two epithelial processes, one in cross-section, the other running up to the surface.

proliferative—is, however, not wholly satisfactory, because the deepest cervical excavations are those which are caused by the necrosis of a certain type of *proliferative* cancer to which we shall again refer.

(1) *Formative or Proliferative Type.* One of the most frequent forms of this type is the so-called *cauliflower* carcinoma of the portio vaginalis. This type arises in one or other lip of the cervix and may form a huge mass of new tissue with a warty or nodular surface (*see* Fig. 301). This projects into the vagina, but shows a lesser tendency to spread into the deep tissues. Such a growth may reach the size of a fist and appear at the vulva, whilst its attachment to the portio may be by a relatively thin base. The surface may be furrowed and lobulated, and is often deeply fissured (*see* Fig. 301). The largest growths are extensively degenerated and covered with a greyish-green necrotic layer. Generally such large growths as these are not formed, because the new tissue rapidly necroses.

This kind of growth is very prone to spread along the surface of the vagina, by direct continuity or by contact-implantation. When this happens the cancer-cells may penetrate the vaginal mucous membrane and involve the para-vaginal tissues; the growth may then break through into the vaginal wall and appear at another spot.

Another equally if not more frequent form of the proliferative type is the *endocervical cancer*, which arises from the deep layers of the epithelium of the portio vaginalis or from the epithelium of the cervical endometrium. Even when it arises from the deep layers of the squamous



FIG. 299. SQUAMOUS-CELLED CANCER OF THE CERVIX. Nullipara, aged 40. The growth had formed a small ulcer on the posterior lip of the external os. The section is taken through the edge of the ulcer and shows that the growth has penetrated into parts still covered by normal squamous epithelium. A good deal of round-celled infiltration is seen both in the superficial and deep parts.

epithelium of the portio, it spreads, from the first, into the depths of the cervix, and is therefore endocervical in position. These proliferative growths at first form spherical, nodal masses of cancer (*see* Figs. 293 and 294, p. 467) in the tissues of the portio and supra-vaginal cervix. The cervix as a whole is much enlarged circumferentially and rendered irregular in shape (*see* Fig. 291, p. 466). At first the epithelium covering the *portio vaginalis* is intact (*see* Fig. 292), but later on the growth makes its appearance both externally (Fig. 302), and towards the cervical canal (Fig. 303). By the time ulceration has appeared on the external surface of the portio vaginalis, the proliferation of the growth within the cervix has often extended as far as the internal os in an upward direction, and laterally it may have

reduced the cervix to a mere shell and involved the lymphatics in the loose cellular tissues. By the breaking down of the endocervical proliferative cancer, a very deep crateriform ulcer is produced. The condition is then that of a somewhat cone-shaped excavation, with its apex near the internal os, and its base where the external os was originally situated, but often the portio, as such, has disappeared, and the walls of the ulcer are flush with the vaginal fornices (*see* Fig. 303). The walls of the conical crateriform ulcer thus formed, consist of sloughy, crumbling, hæmorrhagic masses of growth (*see* Pl. XXVII), which on examination may come away by contact with the examining finger. With this form of cancer, infiltration of the parametrium is most rapid, metastases are most common, and often it establishes

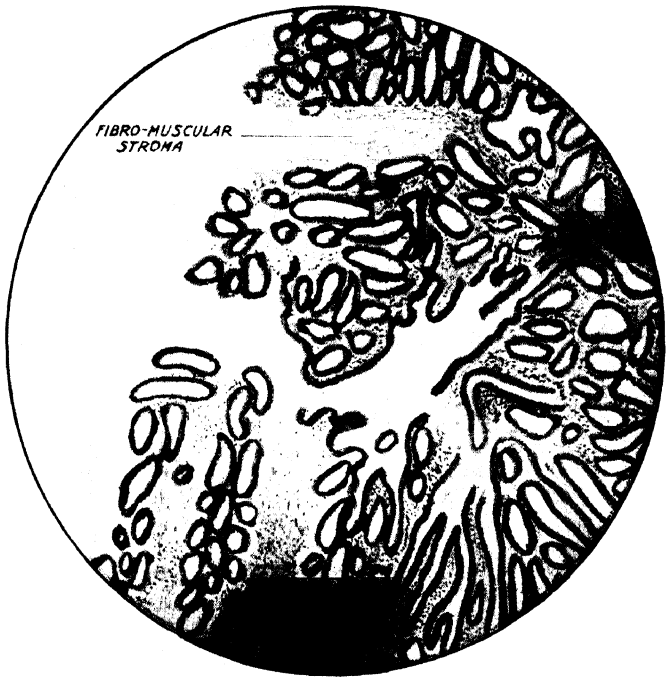


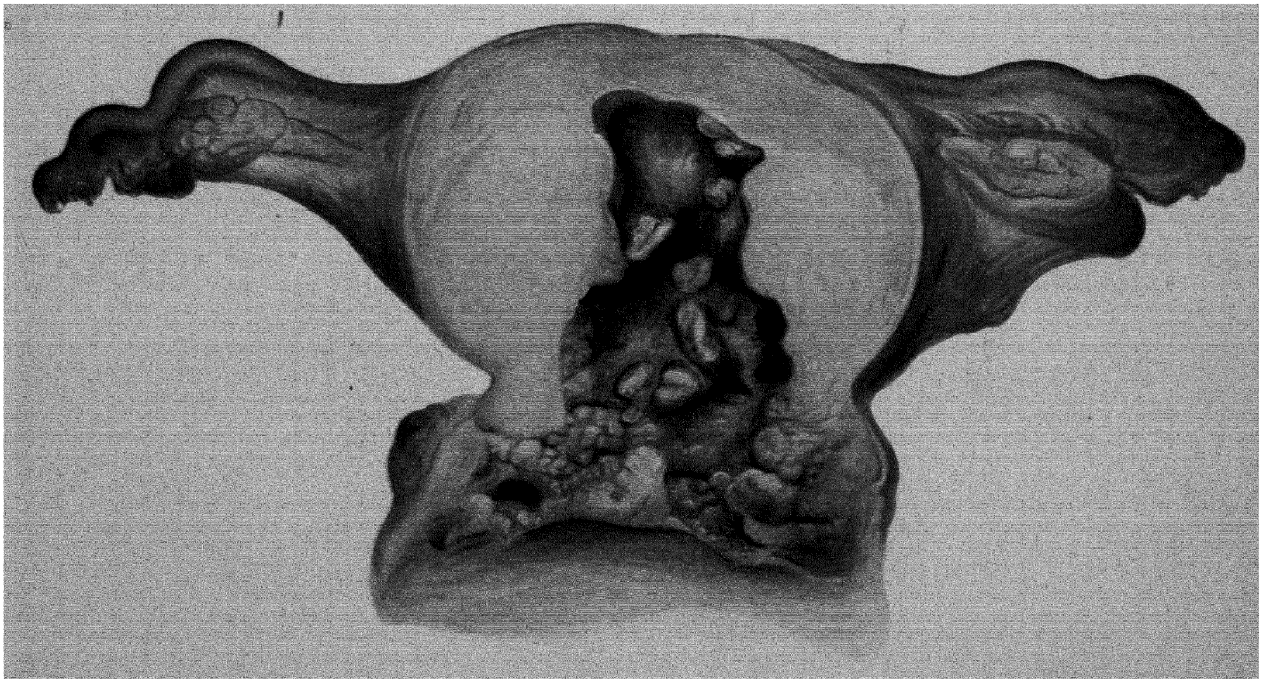
FIG. 300. ADENO-CARCINOMA OF CERVIX, TUBULAR FORM. Multipara, aged 37.

fistulous communications with the bladder and rectum. It may safely be said that of all types of cervical cancer, the endocervical (excavating) type is the most destructive.

(2) *The Ulcerative Type.* Far less frequent than either of the preceding is the cancer which produces a flat sore with a shallow, hard edge. It probably starts in an *erosion* (*see* p. 470). There is relatively little tendency for this type of growth to penetrate deeply; it spreads very gradually, and somewhat resembles the rodent ulcer of the external skin. It is found especially in elderly subjects, and at its onset is difficult to diagnose from an *erosion*, or from simple ulceration.

A still rarer form of cancer is met with also in old subjects in which the tendency to ulceration is very slight. It consists of a hard puckered induration of one or other lip of the *portio vaginalis*. It bleeds but slightly on

PLATE XXVII



ENDOCERVICAL CANCER COMBINED WITH CANCER OF THE BODY. The cervix is expanded by a crumbling necrotic growth which is continuous with the carcinomatous condition involving the greater part of the uterine walls. Necrotic particles of growth, green in colour, lay loose in the cavity of the uterus.

To face page 474.

contact and shows little tendency to disintegration. Microscopically the marked feature is the comparatively small size of the cancerous processes and the relatively large amount of the stroma. The cancer-cells run in small lymph-spaces, almost in single or double file, with a large amount

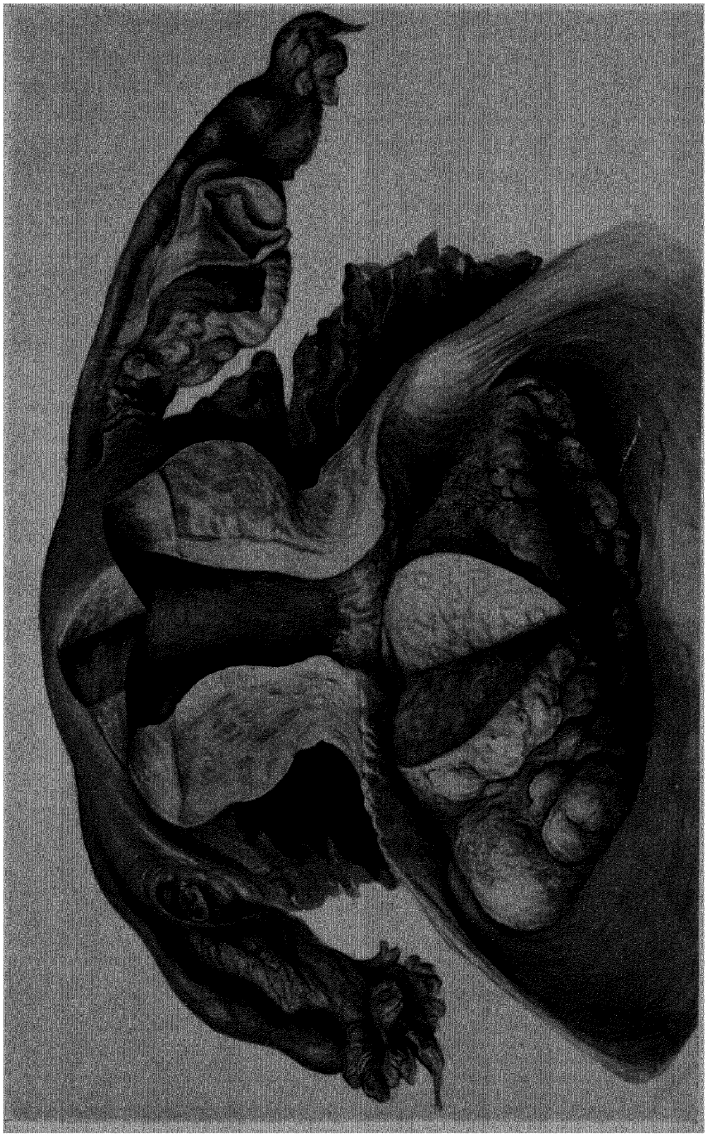


FIG. 301. PROLIFERATIVE TYPE OF SQUAMOUS-CELLED CARCINOMA OF CERVIX LYING IN A PORTION OF THE VAGINA. Removed from patient *æt.* 48 in August, 1908. Recurrence 1925, which disappeared under treatment by radium. Further recurrence in floor of urethra 1927.

of fibro-muscular tissue between them; there is probably an overgrowth of connective tissue taking place simultaneously with the slow cancerous growth. The cancer-cells are small in size but stain deeply. The microscopic appearances are those of a very chronic scirrhus of the breast, or of a rodent ulcer.

In concluding our observations on the pathology of cancer of the cervix three further points may be mentioned respecting the sites of origin of the disease. (1) A rare form of cervical cancer, the so-called *central node*, has been described as springing from fœtal relics. It is said to reach ultimately to the surface, but whilst the cervical canal and the surface of the *portio* remain normal, it will give rise to no symptoms, and it may reach an inoperable stage before being discovered. This may of course be the case with the ordinary endocervical type already referred to, and, as we have stated already, the origin of cancer from fœtal relics must be very difficult to prove. (2) Cervical polypi may become cancerous (*see* Fig. 259, p. 435) and the disease may then secondarily involve the cervix. (3) Lastly, we have attached no importance, as a mode of classification, to a distinction between cancer of the *portio vaginalis* and cancer arising from the cervical endometrium because we find that it is often impossible to be sure of the site of origin of these growths, even after careful macroscopic and microscopic examination. Only the cauliflower excrescence and the flat ulcer can be regarded as surface-carcinomata with any degree of probability, and it may be repeated that these types are relatively benign as compared with the endocervical cancer, *i.e.* their tendency to invade extra-uterine tissues is less than that shown by the latter variety.

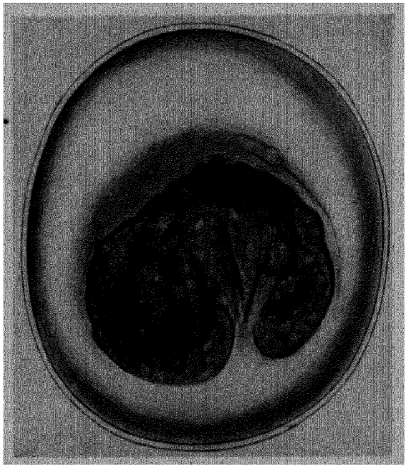


FIG. 302. ENDOCERVICAL CARCINOMA OF CERVIX SHOWING EARLY ULCERATION.

Spread of Cancer of the Cervix. The first invasion is one of continuity, the cancer-cells forming solid outrunners which proceed from the original focus into the adjacent cervical tissues. From thence the cells enter the connective tissues and are taken up by the lymph-stream, whereby a continuous efferent spread of cancer is rendered possible. It is a notable fact that in the spread of cervical cancer the neighbouring glands frequently escape invasion even in cases where metastases are found as remote as in the liver.

The malignity of cervical cancer is due to the complex lymph-system in and around the cervix. The lymph-channels lead direct to the parametrium, also to the cellular tissue of the utero-sacral ligaments and sides of the rectum. From the cellular tissue, extension anteriorly to the bladder occurs with relative frequency, and in an endocervical cancer this takes place both earlier and with greater frequency than in the other forms. As a result of necrosis or sloughing of the tissues, a zone of cellulitic inflammation may be formed, which cannot be distinguished *clinically* from malignant infiltration. The terminal portions of the ureters may become obstructed in advanced cases, either by compression from infiltration of the surrounding cellular tissue, or by direct extension of the growth to their walls. Dilatation of the ureter (hydro-ureter) above the obstructed portion may then occur.

When the lymphatic glands become involved the invasion follows a definite order from its starting-point in the cervix. The first gland to be implicated is found at the crossing of the ureter by the uterine artery in the base of the broad ligament. Then follow both iliac sets and also the sacral glands on the posterior pelvic wall, by the side of the rectum; still more remote are the superficial and deep lumbar glands, the inguinal glands, and also the colic set. Generally speaking the glands nearest to the uterus are the first to be involved, but not infrequently the proximal group escapes whilst the more distant ones become involved.

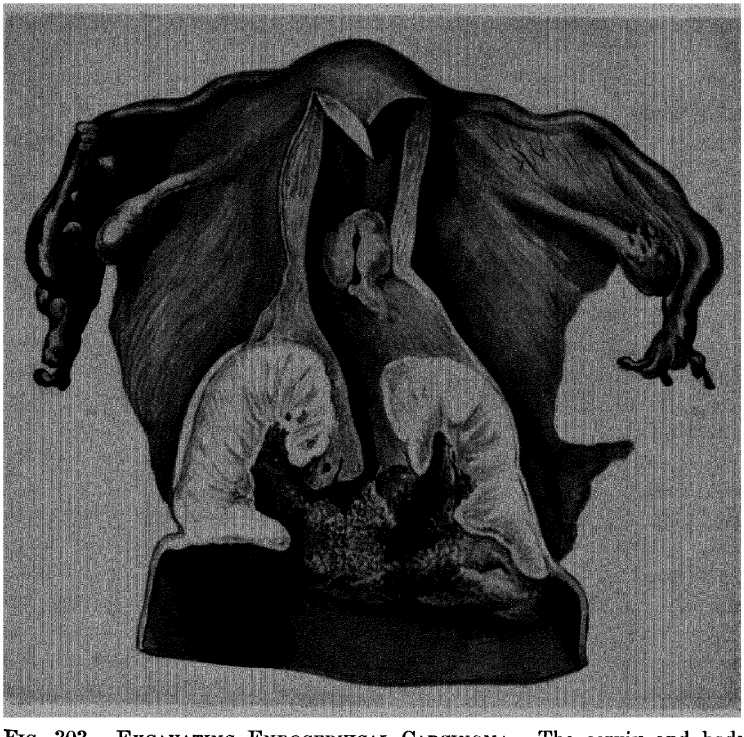


FIG. 303. EXCAVATING ENDOCERVICAL CARCINOMA. The cervix and body have been opened up posteriorly. The cervix is enlarged to three times the size of the body by a carcinoma which arose in the cervical glands. The anterior cervical wall is thinned out by ulceration and necrosis. The polypus in the body was innocent.

It is assumed that the earlier the cancer, the less likelihood is there to find lymph-metastases, and conversely the more advanced the cancer, the more likely is it to find glands involved. Investigations of late years have proved this assumption to be wrong. There is no rule as to the lymphatic spread of the disease. All that can be said is, in about one-third of the cases of extensive inoperable cancer, the glands are free from deposit. Also, that in operable cases one-third show gland-metastases and two-thirds do not. The cancerous glands are often not much enlarged but are firmer than normal, and they may be quite hard. It is not uncommon, however, to find glands which are much enlarged and of soft consistence; these are septic glands, and on microscopic examination they show inflammatory but

not cancerous changes. Since carcinoma-cells can penetrate blood-vessels they may spread *viâ* the blood-stream, but this is less frequent with cancer than with sarcoma.

Metastases in distant organs occur only in the most advanced stages of the disease, and are relatively rare. According to the statistics of the Middlesex Hospital (MacCormac), in 109 autopsies for cancer of the cervix, visceral metastases were only found in 20 *per cent.*, the organs most prone to these deposits being the liver and the spleen. The upper part of the urinary tract is frequently affected from direct extension of the disease to the bladder and ureters, and MacCormac reports that kidney lesions—usually hydro- or pyonephrosis—were present in 43·5 *per cent.* of his series of autopsies.

CANCER OF THE BODY OF THE UTERUS

Pathological Anatomy. Cancer of the uterine body arises in the endometrium, from the epithelium of the surface, or from that of the glands. It may attack an otherwise healthy uterus or one which is already the seat of a fibroid tumour. The upper part of the uterine cavity is first affected (*see* Fig. 305 and Pl. XXV, p. 410) in the great majority of cases. As the disease advances it tends to overrun the whole of the mucous membrane, and may then appear to naked-eye examination in one or two different forms. In the commoner *tuberous* type large, projecting, sessile masses of new growth are formed which more or less completely fill up the enlarged uterine cavity (*see* Fig. 304). In the rarer *papillary* form the new growth consists of large numbers of delicate polypoid processes, sometimes branching, sometimes merely divided by sulci on their surface (*see* Figs. 290, p. 465, and 306). In some cases this rapid diffusion of the disease over the whole uterine surface is not seen, but instead, a mass of growth is found upon a single spot, and the form then assumed by the disease is *polypoidal* (*see* Fig. 305).

The disease rarely passes through the internal os to attack the cervical endometrium, and invasion of the fibromuscular wall of the uterus occurs later than in cancer of the cervix, but can always be seen by the naked eye in advanced cases. Formative processes are commonly in the ascendant, and ulceration of the growth, so common in cancer of the cervix, is much rarer; the greater freedom of the uterine cavity from infection from without perhaps explains this difference. Enlargement of the body of the uterus, as a rule, is only of moderate extent; it is rare for these tumours to attain a large size, but Spencer has recorded an exceptional instance in which the uterus weighed 1 lb. 1½ oz. and measured 5¼ inches in length. The normal contour of the uterus is, as a rule, preserved, for the growth invades the uterine wall very slowly, and seldom reaches the peritoneal coat except in advanced stages (*see* Figs. 288, p. 463, and 290, p. 465). From the upper angle of the uterine cavity the growth frequently extends to the interstitial portion of the Fallopian tube.

Microscopic Appearances. In contradistinction to cervical cancer, carcinoma of the uterine body is almost always of the glandular variety, but a few rare instances (including a case published by one of us,) of primary squamous-celled cancer of the corporeal endometrium have been described.

Adeno-carcinoma may assume two different forms: (1) the tubular, and (2) the alveolar. Opinions differ as to which is the more common.

(1) The *tubular* form consists of an irregular and very free proliferation of gland-tubules of varied shape and size, which lie in contact with one another, the stroma being scanty. The tubules are lined with high columnar epithelium, which differs from that of the normal uterine glands in the situation and character of the cell-nuclei. The latter are placed at irregular levels; they are variable in shape and present karyokinetic figures; and they do not stain with the same uniform intensity as do the nuclei of benign epithelium. The growing tubules may bud outwards (*everting type*) (*see* Figs. 307 and 308), or they may produce a number of

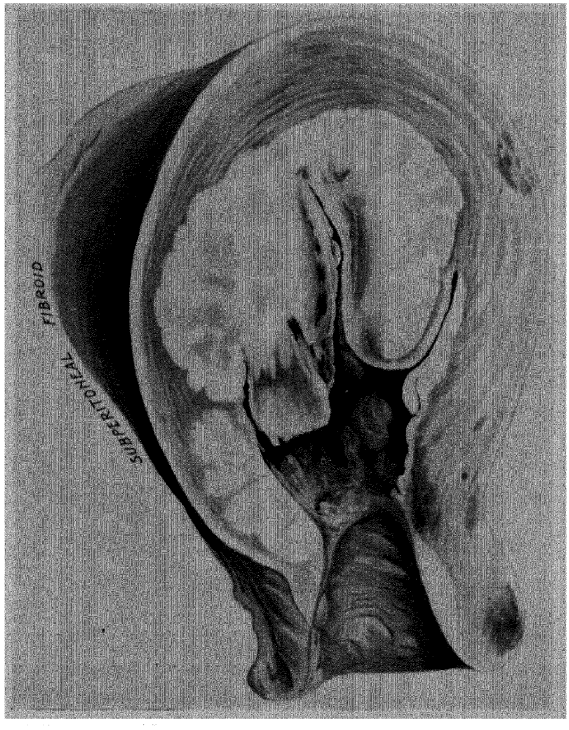


FIG. 304. CARCINOMA OF THE BODY OF THE UTERUS. A small subperitoneal fibroid was also present. Multipara, aged 49. The growth consists of tuberous masses arising at the fundus and projecting into the uterine cavity. The growth has extended under the endometrium to the internal os. Invasion of the fibromuscular tissue is clearly seen.

papillary processes within their own lumina (*inverting type*) (*see* Fig. 309). Both the inverting and everting forms occur together and have no pathognomonic significance. At the growing edge the tubules may be seen to invade and destroy the tissues of the uterine wall. The epithelium of individual tubules does not proliferate so as to fill up the lumen. In some parts the growth often consists of masses of delicate, compound, branching papillæ, consisting of a slender and very vascular connective-tissue core, covered with two or three layers of columnar epithelium. The surface-cells of the papillæ proliferate freely and irregularly, and islets of cells, detached from the papillæ, are frequently seen in the microscopic field.

In some cases tubular cancer of the uterine body presents somewhat different features; the growth consists of an aggregation of tubules, of perfectly regular and uniform characters, lined with a single layer of regular epithelium. The stroma is scanty, the tubules invade and destroy the fibromuscular wall, and if the growth is removed by scraping it recurs. The name of *adenoma malignum* was applied to this form by C. Ruge, and it deserves special mention because the differentiation of *adenoma malignum* from the benign form of gland-proliferation seen in the early decidua, and also that seen in benign papilloma (*see* Fig. 273, p. 449) may sometimes present difficulties, to overcome which many sections of curettings may have to be made before the signs of malignancy in the cell-nuclei (which have already been enumerated, p. 479) can be found.

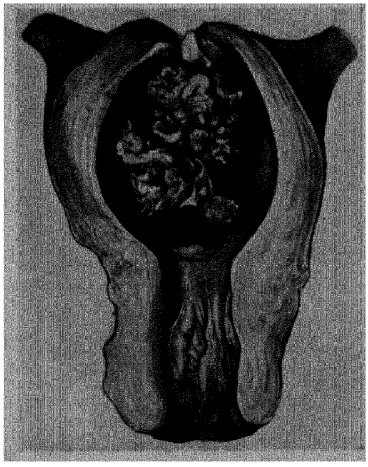


FIG. 305. EARLY CARCINOMA OF THE BODY OF THE UTERUS. Patient aged 53. The growth formed a papillary polypoidal mass which was attached to the right cornu by a comparatively narrow base.

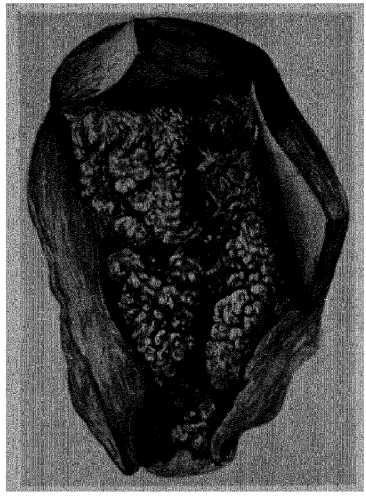


FIG. 306. CARCINOMA OF THE BODY OF A SENILE UTERUS. The growth is composed of papillary or villous masses which have protruded through the internal os and dilated the cervix.

(2) *Alveolar Form.* This form of cancer of the body of the uterus is stated by some observers to be more common than the tubular variety. This is because some pathologists only designate as *tubular* those rare cases in which the epithelium is represented by a single layer of cubical cells, *i.e.* the *adenoma malignum* of Ruge. In alveolar carcinoma the predominant histological feature consists in the glands containing many layers of cells, irregular in shape and size; gland-lumina become rapidly filled up, so as to form solid branching columns of cells, which join up with one another to form still larger, solid, epithelial masses (*see* Fig. 310). The central cells of the latter break down, and thus the alveoli are produced from which the term 'alveolar' carcinoma is derived. This central degeneration is produced in the same way as that seen in the solid masses of squamous-celled carcinoma of the cervix, and this similitude has led to the error of certain squamous-celled cancers being regarded as adeno-carcinomata.

In Figure 310 the free cell-proliferation of adeno-carcinoma is seen to have obliterated and to have filled up the gland-spaces, and the central alveolation is well shown. It is obvious that the malignancy of such a growth is of

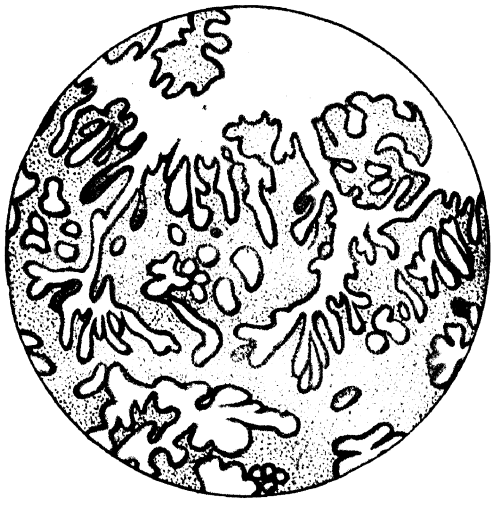


FIG. 307. ADENO-CARCINOMA OF THE BODY OF THE UTERUS. × 30. Showing the *everting* form of tubular carcinoma in its early stage.



FIG. 308. ADENO-CARCINOMA OF THE BODY OF THE UTERUS. × 30. Showing the *everting* form of tubular carcinoma in its advanced stage. Note that the tubular processes are more complicated than those in the incipient stage seen in Figure 307.

greater degree than that of the tubular form of adeno-carcinoma (*see* Figs. 307 and 309).

The histological differentiation into tubular and alveolar carcinoma is quite independent of, and bears no definite relation to, the macro-

scopical varieties of cancer of the uterine body, so that in the earlier stages of the disease at any rate, it is impossible to tell by the naked eye which form of cancer is present; it can only be said that the deeper and more extensive the destruction of the muscular wall, the more likely is the case to be one of alveolar cancer.

Squamous-celled Cancer. In a small proportion of cases of chronic endometritis it has been observed that the normal columnar epithelium on the surface has been replaced in isolated patches by stratified squamous epithelium, and prolonged irritation resulting in cell-metaplasia, has been assumed to be the cause of this so-called *leucoplakia*. A very few cases of primary squamous-celled cancer have also been described in the body of the uterus; in some of these the whole of the growth was of this nature, in others, parts were squamous-celled, and parts adeno-carcinomatous. It can only be recognized by microscopic examination, when epithelial

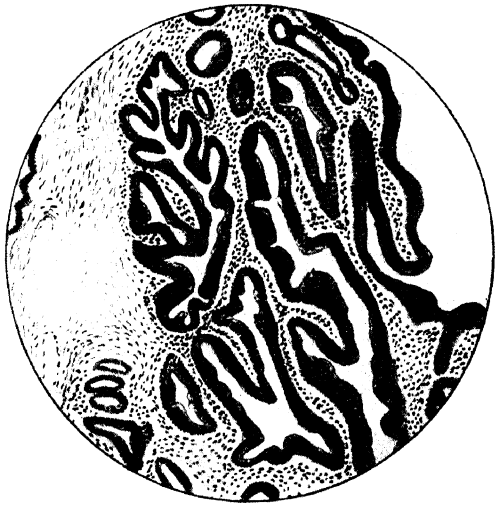


FIG. 309. ADENO-CARCINOMA OF THE BODY OF THE UTERUS. × 30. Showing the *inverting* type of tubular carcinoma. The tubules form processes within their own lumina.

pearls and the general appearances described in connection with the same type of growth in the cervix will be met with.

Spread of Cancer of the Uterine Body. Cancer remains limited to the affected organ much longer when occurring in the body than when arising in the cervix. It tends less rapidly to infiltrate the uterine wall, and lymphatic infection also proceeds more slowly. Glandular enlargements are therefore less often met with in operable cases of cancer of the body than in those of cancer of the cervix. The lymphatics which drain the uterine body run along the upper border of the broad ligament in close relation with the ovary and Fallopian tube (*see* Fig. 51, p. 64), and then accompany the ovarian vessels over the brim of the pelvis to reach the lateral chains of lumbar glands lying at each side of the spinal column. A lymphatic vessel also runs from the fundus to the inguinal chain of glands in company with the round ligament. None of these glands, however, becomes enlarged except in very advanced stages of the disease. Secondary

growths sometimes occur in the vagina from direct implantation of cancer-cells carried down from the uterus in the discharge. Ultimately the peritoneum and pelvic cellular tissue become infiltrated in the same manner as in cancer of the cervix, but not until the disease has advanced much further. The results are, however, much the same, and in fatal cases metastases have been discovered in the liver, omentum, adrenals, etc.

Pyometra is a common complication of the advanced stages of both cancer of the cervix (*see* Fig. 139, p. 213) and cancer of the body. Hæmatometra may also be met with, although more rarely (*see* Fig. 288, p. 463).

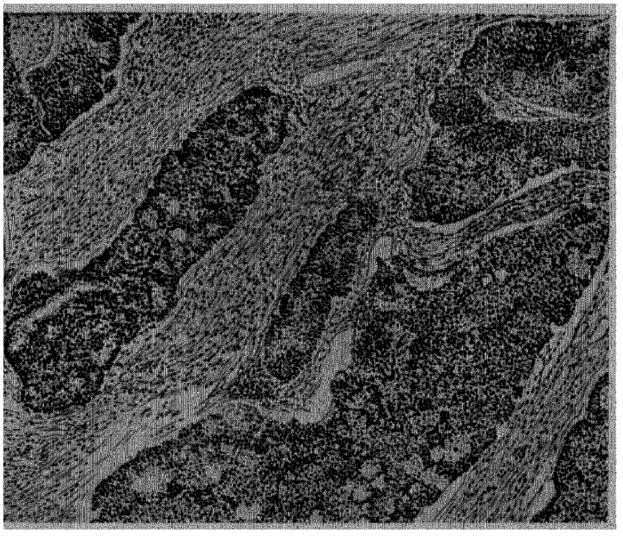


FIG. 310. ADENO-CARCINOMA OF THE BODY OF THE UTERUS: ALVEOLAR FORM. The cancer-cells are arranged in closely packed spaces limited by well-preserved fibromuscular tissue. The "alveoli" are produced by the breaking down of cells in the centre of these spaces.

CLINICAL FEATURES OF CANCER OF THE CERVIX

Incidence. Two factors must be considered in relation to the incidence of the disease, viz. age and child-bearing.

Age. As is the case with cancer of other organs, the age of appearance of this disease is subject to very wide variations. The extremes are represented by a case in a child of two and a half years, recorded by Adams, and one in a woman of ninety-three recorded by Findley. Under the age of twenty it is extremely rare, although two cases at the age of eighteen have been recorded, one by Cragin, the other by de Rouville, and one by Schauta at seventeen years. The recent study of massed statistics published by the Ministry of Health [1] have shown that there is no special age predisposition to cancer of the uterus; the liability to the disease appears to increase steadily with each lustrum until 60 has been

[1] "Reports on Public Health and Medical Subjects" (Ministry of Health), No. 40, 1927.

reached, after which there is a small decrease. It does not appear from these statistics that there is any clearly defined tendency for the disease to occur at the menopause.

Child-bearing. Cancer of the cervix is rarely seen in childless women. The most careful statistics show that not more than 4 *per cent.* of recorded cases have occurred in nulliparous women, *i.e.* in women who have not borne children. A certain number of nulliparæ, however, have had miscarriages, but no children, and this point should also be taken into consideration. For a precise estimation the figures should be corrected by comparing the relative numbers of parous (including abortion) to nulliparous women in the general population ; but no such statistics are available.

A further interesting point has also been established, viz. that the subjects of cancer of the uterus have shown a fairly high degree of fertility. Lewers placed the average number of pregnancies in his series at five ; in Wilson's series the average number of pregnancies (including abortion) was six and a half. There can be no doubt that parturient lacerations and the chronic inflammatory conditions which so frequently follow them, form the connecting link between child-bearing and the development of cancer. These conditions are described in connection with *lacerations of the cervix* (p. 504) and *cervical erosion* (p. 364), to which the reader may be referred. As already stated (on pp. 470–471), the direct transition from an ' erosion ' to a cancer can be at times observed. Wilson believes that precancerous conditions may sometimes be found in an ' erosion ' similar to those observed in the tongue and in lymphatic glands.

Diagnosis of the Early Stages of the Disease. It must be understood that the first observed symptoms of cancer of the cervix represent, not the onset, but a comparatively advanced stage of the disease. *There are no initial signs or symptoms.* Until the growth has attained a considerable size, and until the necrotic changes to which it is so liable have set in, there may be a complete absence of symptoms, and it will remain therefore undiscovered, except by a chance examination. This only repeats what is almost a constant feature of cancer when it affects parts other than exposed epithelial surfaces, such as the lip and the tongue. Since the first symptoms to be observed do not by any means correspond with the onset of the disease, its duration cannot be reckoned from them. In point of fact the time of actual onset is in almost every case unknown, and therefore the rate at which cancer of the cervix advances in the early stages is also unknown.

The earliest symptom met with is almost invariably *haemorrhage*, slight in amount, irregular in occurrence, and as is most characteristic of all—often produced by coitus. Coitional hæmorrhage may, however, sometimes occur from other causes such as an ' erosion,' or a mucous polypus, so that this symptom cannot be regarded as distinctive of cancer. Sometimes the bleeding is excited by straining at stool, by unaccustomed exertion, or by jolting, as during a railway journey. Menstruation is not necessarily increased in amount or disturbed in rhythm, and there may be no other symptoms whatever at this time. Women who have reached the age at which the disease is most likely to occur, attach little importance to slight bleeding of this kind, which they attribute traditionally to the approach of the change of life. The absence of other symptoms, such as *discharge* or *pain*, is regarded as an indication that nothing can be wrong.

Yet the disease may have been in existence for some months before there is even a trace of hæmorrhage, for this does not occur until there has been damage to superficial vessels from necrotic changes in the tumour tissues.

The next symptom to appear is a *discharge;* sometimes its appearance precedes the bleeding, but this is not usual. The discharge at this stage is usually thin, yellowish, or brownish in colour, nearly constant, slight in amount, and has no offensive odour. It results from the necrotic changes which occur in the tumour-tissues. Sometimes it is profuse in amount, and this appears to be especially likely in cases where the predominance of formative processes leads to the production of a large mass of neoplasm.

No other symptoms than these are to be anticipated until the disease has reached an even more advanced stage; there is no ill-effect upon the general health, and in most cases there is no pain. The hæmorrhage tends, however, in time to appear more frequently and to become more severe in character; this is especially the case when ulcerative processes predominate. In some cases, especially in women of advanced age, the amount of hæmorrhage is trivial throughout the whole course of the disease.

Pain is never an early symptom, but it may be met with in association with hæmorrhage or discharge. This symptom may probably be taken to indicate that the cellular tissue around the cervix is already to some extent involved. The cellular tissues may be involved in two ways, as has been already pointed out: (*a*) by cancerous infiltration; (*b*) by inflammation due to infection by organisms which have attacked the necrotic tumour-tissues. Cancerous infiltration probably at first produces pain by blocking the lymphatic circulation in the affected areas. Clinically, the pain associated with cancer of the cervix is felt chiefly in the lower part of the back; it is subject to exacerbations; it is not relieved by lying down, and is often worse at night than during the day time.

An interesting observation has been made by Wilson as to the character of the first-observed symptoms. In a series of 328 cases he found that hæmorrhage *alone* was the first symptom in 41 *per cent.* In a number of other cases discharge or pain appeared at about the same time as the hæmorrhage; if these cases are included it appears that hæmorrhage, either alone, or in company with discharge or pain, was the earliest symptom in 65 *per cent.* of cases.

From what has been said it is obvious that the onset of cancer of the cervix is insidious, and the initial symptoms to which it gives rise are apparently trivial in character and comparatively late in appearance. The disease can be recognized at this stage only by careful physical examination, supplemented in some instances by the aid of the microscope. The urgent necessity of making such an examination at the first moment that the case comes under observation must always be borne in mind. Patients are sometimes unwilling to submit to the necessary examination, but we are not justified in deferring to objections of this kind, and our duty is, first to explain the necessity of an examination, and then to decline absolutely the responsibility of treatment until an examination has been made. To prescribe, for instance, a drug such as ergot, and the use of a vaginal douche, to a middle-aged woman who complains of intermenstrual hæmorrhage, even though inconsiderable in amount, is to lose time, upon which the patient's chances of relief solely

depend, in the event of these symptoms being due, as is quite possible, to cancer.

Diagnosis of Cancer of the Portio Vaginalis. On examining the cervix with the finger the conditions found will depend upon the form the disease has assumed. Often extensive changes will be found in a case in which the duration of the symptoms has been brief and their severity inconsiderable. In the rare instances when the earliest stages of the disease can be observed it will be seen that the growth forms a firm, but not densely hard, nodular, elevated patch, or sometimes a shallow ulcer, involving some part of the *os externum* and extending over the adjacent surface of the cervix. Almost invariably the growth is sessile, and when of large size it causes well-marked alterations in the contour of the cervix. The position of the external os can be defined by touch, as it is not entirely involved in the disease at the stage under consideration. If the surface of the growth is lightly scraped with the gloved finger-nail, it breaks down, being *friable* in consistence, and portions of it come away with a certain amount of bleeding.

The cervix should next be exposed with a speculum and examined in a good light. The part affected by the growth will be found darker in colour than normal, and dull instead of polished in appearance. Its surface is irregular, and in parts, where ulceration has occurred, it is worm-eaten in appearance; this is usually found at the parts near the *os externum* which represent the oldest portions of the growth. The outlying parts may be smooth and still covered with polished, intact, stratified epithelium. The ulcerated parts bleed when lightly swabbed with cotton-wool. In cases such as this, the diagnosis of a malignant new growth is not for a moment in doubt, the following points being amply sufficient to decide that the disease is malignant: (1) The area of firm nodular induration; (2) the ulceration of portions of this area; (3) the friability of the tissues as indicated by lightly scraping with the finger-nail; (4) the bleeding thus excited.

Bimanual examination is useful in estimating the total extent of the swelling formed by the growth plus the surrounding induration, and the general mobility of this mass. The latter point will be referred to again below. Lastly, *a rectal* or a *combined rectal and vaginal examination* should be made in every case of cancer of the cervix; thickening of the utero-sacral folds and of the bases of the broad ligaments can be more clearly perceived, and its extent estimated, than by the vagina. The posterior surface of the supra-vaginal portion of the cervix is also accessible to touch from the rectum, and often a better estimate of the extent of the disease in this position can be obtained.

Occasionally, when the disease comes under observation *before surface-ulceration* has occurred, diagnosis may present considerable difficulty. A small, slightly elevated, dull red patch involving a portion of the external os may then be seen. Spiegelberg has pointed out that while the mucous membrane is slightly movable over the surface of the cervix in health, it becomes adherent at a very early stage to a subjacent malignant growth, imparting to the cervical tissues a firm, slippery consistence like that of wet rubber. This sign is, however, not of much service, except in cases of endocervical cancer where the surface of the *portio vaginalis* is not yet encroached on. Non-ulcerated patches of cancer bear a certain resemblance

to a *cervical 'erosion,'* but this resemblance is not close enough to mislead any but an inexperienced observer. To the touch the 'erosion' feels smooth and soft like velvet, while the cancer is slightly roughened or distinctly nodular; the tissues of the 'erosion' are firm and non-friable to the finger-nail; the erosion is bright red in colour when seen through a speculum (Pl. XVII, p. 366), while cancer is dark and often dirty looking from superficial necrosis; although an 'erosion' sometimes bleeds *from one or two points* after swabbing with cotton-wool, the amount is small, and the oozing is not general as in the patch of cancer. Actually, 'erosions' show little tendency to become malignant, but in all cases in which the least doubt exists a section should be taken for microscopic examination. This must be done with care, a piece about a third to a half inch in diameter being cut out of the edge so as to include a definite area of outlying healthy tissue, and the excised piece dropped immediately into spirit before being sent to the histologist.

The early malignant *ulcer* may be confused with *tuberculous disease* or with a *chancre*. Tuberculous disease of the cervix is rarely primary (*see* p. 274), and accordingly the presence of signs of tubercle in other organs may direct attention to the possibility of the cervical lesion being of the same nature. The local appearances are not dissimilar to those of cancer (*see* Fig. 157, p. 274), and cases have occurred in which the uterus has been removed on account of cervical disease, which has been subsequently proved to be tuberculous, not malignant. Tuberculous disease of the cervix gives rise to free muco-purulent discharge, but not usually to spontaneous bleeding, and the tissues are not friable like those of the malignant ulcer. However, microscopic examination must, as a rule, be resorted to before malignant disease can be excluded.

Cervical chancre is not uncommon, but its nature is soon revealed by the appearance of the early constitutional signs of syphilitic infection. The specific organism may usually be detected by the method mentioned on page 286. If this is negative, microscopic examination will reveal the absence of malignant changes.

Diagnosis of Endocervical Cancer. Cancer in its endocervical form is less easily recognized by physical examination than when the vaginal portion is attacked. Beginning within the cervical canal the growth shows less tendency to spread in the direction of the external os than in other directions (*see* Fig. 293, p. 467), at any rate until an advanced stage is reached (*see* Fig. 303). The disease first infiltrates the fibro-muscular tissues, leading to broadening and induration of the cervix, while the *os externum* and the vaginal surface remain unaffected (*see* Fig. 292). A general increase in the bulk of the cervix results (*see* Fig. 311), and it becomes densely hard; the growth may sometimes be located in the supravaginal cervix, upon upward pressure with the finger through the vaginal fornices. Usually this increase in density and in bulk will be detected better by rectal examination; indeed, only rectal examination can reveal the true extent of the disease when situated in the upper part of the cervix. A densely hard enlargement of the deeply lying parts of the cervix, associated with hæmorrhage, and without involvement of the os, should always suggest endocervical cancer. A scraping taken with a small sharp spoon from the interior of the canal will be required for a definite diagnosis. When the disease is fairly advanced it reaches the *os externum;* this becomes enlarged by ulceration (*see* Fig. 302), exposing the lower part of the growth, which

then presents as a nodular friable mass. At a still later stage an extensive crateriform cavity continuous with the vagina may be formed by ulceration (*see* Fig. 303).

Diagnosis in Advanced Stages of the Disease. The advanced stages of cervical cancer are characterized by free putrid discharges with hæmorrhage, at times constant and slight, at times irregular and profuse, at times quite uncontrollable. In rare cases there is little or no bleeding even in the advanced stages. In the excavating form the cervix has disappeared, and in its place is found a large crateriform or cup-shaped cavity, with indurated ragged walls, extending upwards to the lower part of the body-cavity, and also involving the vaginal fornices to a greater or less extent (*see* Fig. 303). The disease may indeed advance upon the vaginal walls, especially the anterior wall, nearly as far as the ostium vaginæ. In

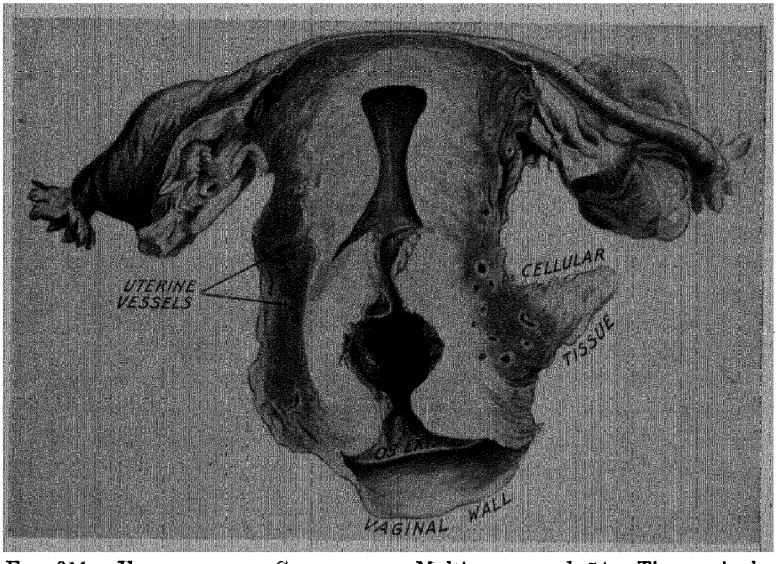


FIG. 311. ENDOCERVICAL CARCINOMA. Multipara, aged 54. The vaginal portion of the cervix is atrophied; the supra-vaginal cervix is the seat of the disease, the central cavity representing the oldest part. The disease has not spread visibly beyond the limits of the cervix.

all such cases the pelvic cellular tissue has also been invaded, and this will be perceived much more clearly by rectal than by vaginal examination. By vaginal examination the limits of the growth on its deeper aspects cannot be defined, but only the limits of the cavity formed by ulceration. By rectal or recto-vaginal examination the mass of new growth will often be found surprisingly large, extending forwards and on each side to the bony pelvic walls, and backwards so as to encroach upon the lumen of the bowel. The mass feels densely hard and often tender, and is almost, if not entirely, immovable.

In the advanced stages of the *formative* type a large mass of new growth is formed, occupying the upper part of the vaginal canal (*see* Fig. 301, p. 475). This mass is attached to, or has replaced, the cervix; sometimes its surface is divided up by sulci into a complex papillary arrangement resembling a cauliflower; sometimes the surface is uniform and rounded.

In both cases the growth is dark coloured, and shows superficial sloughing. Sometimes the mass of cancer is so large as to fill the whole of the vagina, and present at the *ostium vaginae*, coming into view when the labia are held apart by the fingers. The position of the external os can seldom be defined in stages so advanced as this. In this form also, the extent to which the disease has spread deeply can best be defined by rectal examination. Such cases must be carefully distinguished from large sloughing polypi, and this can invariably be done by recognizing, in the case of a fibroid polypus, the stalk which attaches it to the uterus. An anæsthetic will be necessary if the growth is very large, in order to allow the finger to be passed up far enough to reach the pedicle. In both cases the hæmorrhage is often very free during examination. In these advanced stages of the disease putrid discharges are met with which often have an appallingly offensive odour. This may not be observed by the patient herself, but the discharges are very irritating, and cause vulvitis with ulceration and extensive intertrigo.

In the advanced stages of cancer of the cervix the *general symptoms* become prominent. Loss of flesh occurs comparatively late, and in elderly women, at any rate, it progresses very slowly. Anæmia is always present as an element in the cancerous cachexia, but sometimes, as the result of profuse losses of blood, profound anæmia occurs at an earlier period than this. In other cases cachexia ensues somewhat rapidly, being in all probability accelerated by absorption of toxic products from large ulcerating or necrotic growths. Loss of appetite, and want of sleep due to nocturnal pain, further aggravate the general ill-health.

As the local disease comes to involve *other pelvic organs*, a fresh train of symptoms appears. The tendency of the disease to spread to the bladder has been already referred to, but a considerable area of the muscular wall of the bladder may be involved without giving rise to hæmaturia, if the mucosa escapes; consequently it may not be until ulceration occurs and a vesico-vaginal fistula is about to be formed that the extension is revealed. The urinary incontinence and cystitis which result from this fistula add greatly to the patient's distress, and it is hardly possible to conceive anything more pitiable than the condition of the patient at this stage. Occasionally one of the ureters becomes partially blocked by new growth which has invaded it; then the proximal part of the ureter becomes dilated and the functional activity of the corresponding kidney is consequently impaired. By ulceration, a ureteric fistula in the vaginal roof may be formed. Ascending infection of the kidneys from cystitis, or from ulceration of the pelvic portion of the ureters, may occur, and lead speedily to a fatal termination.

A different train of symptoms may arise from infection of the uterine cavity, which, aided by obstruction to the escape of discharges into the vagina, leads to the formation of a *pyometra* (*see* p. 213). By direct extension from an infected endometrium a pyosalpinx may be formed on one or both sides, and from this again septic peritonitis may arise, which of necessity proves rapidly fatal. Pyrexia and abdominal distension in the late stages of cancer of the cervix may usually be taken to indicate the presence of these complications.

Diagnosis of Operability. A case is said to be operable when there appears to be a reasonable chance of removing the *whole of the disease by a radical operation.* In the case of the uterus, the difficulties of forming a clinical estimate of the extent of the disease are peculiarly great; con-

sequently the diagnosis of operability is to be regarded as approximate only, and when an operation is undertaken, the first step in the procedure should be to revise the clinical estimate, by a careful exploration of the disease *in situ*, before its actual removal is begun. The value of this procedure is very great, and in doubtful or border-line cases we need not hesitate to open the abdomen for purposes of diagnostic exploration. Laparotomy *per se* is attended with little or no risk, and whenever the operator is in doubt as to whether a case is operable or not, the hope of removing the disease should not be abandoned until an abdominal exploration has been made. In many cases, however, the clinical findings make it certain that the disease is inoperable, and it is then unnecessary to subject the patient to the discomfort and distress of an abdominal operation. Abdominal exploration has largely taken the place of preliminary examination under anæsthesia, as being much more exact.

The lymphatic glands which drain the cervix are so situated as to be inaccessible to clinical examination, and in consequence the question of operability has to be considered without reference to their condition. The question must be decided mainly by the local conditions, but the general state of the patient must also be taken into consideration. There are two points only, in regard to the *local conditions*, upon which reliance can be placed, viz. the degree of mobility of the uterus, and the extent to which the surrounding structures have been involved.

Mobility may be tested with the fingers during bimanual examination, the extent to which the cervix can be moved in all directions being carefully observed. Sometimes it may be possible to seize a healthy portion of the cervix with a volsella and gently pull it down towards the vulva; in the case of a parous woman the normal mobility allows of the os externum being thus drawn down to the vulva. Slight impairment of mobility does not by any means negative the operation. More marked degrees of fixation must be considered in connection with the extent of the surrounding induration. When the mobility of the cervix has been much impaired, the evidence of surrounding infiltration is usually pronounced.

A certain amount of caution is, however, necessary in the interpretation of the *condition of the surrounding tissues*. Inflammatory thickening due to chronic infection of the adnexa can only be definitely distinguished when the characteristic outlines of a dilated tube can be made out. Sometimes a layer of induration can be felt beneath the upper part of the anterior vaginal wall. In such cases the floor of the bladder is almost certainly involved, and cystoscopic examination may yield definite indications of this. The condition of the utero-sacral folds, and the bases of the broad ligaments, can be made out much better by recto-vaginal than simply by vaginal examination, so that the importance of an examination *per rectum* must again be insisted upon. In advanced cases the mass of induration can be felt to extend outwards to the bony pelvic wall on one side, or it may be on both sides. In such a case radical operation is of course impossible.

Along with these local conditions the *general state* of the patient must be considered. The radical operation for cancer of the cervix is one of great severity, and cannot be borne by enfeebled subjects. Women of advanced age, *e.g.* over sixty, are seldom fit to bear it. In addition, if there has been much wasting, if there is great anæmia, or if the temperature shows irregular fever, the operation should be postponed or abandoned.

Cases are *certainly inoperable* when profound anæmia from bleeding, or signs of cachexia are present, when the cervix is completely fixed, and there is a great amount of surrounding induration, or when fistulous communications have been formed with other organs. Cases are *certainly operable* in which the cervix has retained much of its mobility, the ligaments are little if at all thickened, and the general condition of the patient is unaffected, or at any rate little impaired. Between these limits lie a large number of cases which are doubtful, and in which it is right that the surgeon should face serious operative risks.

Duration and Prognosis. It has been already pointed out that the actual onset of the disease antedates the onset of symptoms by a variable but considerable interval. The rate at which the disease progresses and the expectation of life of those affected by it are, therefore, very difficult to estimate. Two observers, MacCormac and Leitch, have independently worked out, over a large series of cases, the time which elapsed between the first appearance of symptoms and the death of the patient. Their results were remarkably alike, the interval being 1 $\frac{6}{12}$ year, and 1 $\frac{9}{12}$ year, respectively, for the two series. The view expressed in the previous edition that the prognosis was relatively unfavourable in young women is not borne out by the statistics of the Ministry of Health, which show that the survival rate differs very little at different ages; if anything, the advantage appears to be with the younger women. Pregnancy sometimes occurs in young subjects, and rapid advance of the growth must then be anticipated, especially during the puerperium. In such cases there is grave risk of puerperal infection if delivery *per vias naturales* takes place, in consequence of injury and subsequent sloughing of the cancerous tissues. The rate of advance does not appear to be affected by the histological variety of the growth.

The causes of death are frequently to be found in the complications which accompany the later stages of the disease. Those most frequently met with are the spread of septic infection to the peritoneum and to the kidneys.

CLINICAL FEATURES OF CANCER OF THE UTERINE BODY

Cancer is rarer in the body than in the neck of the uterus, the proportion being about 1 to 10. About 20 *per cent.* of the recorded cases of cancer of the body occur in nulliparous women, and the parous women affected show a relatively low degree of fertility, averaging two to three children each. It occurs with greatest frequency at a somewhat later age than cancer of the cervix, viz. between fifty and sixty; women are therefore more likely to be attacked by this disease after the climacteric has been passed than before it. The statistics of the Ministry of Health show the average age to be about eight years higher than that at which cancer of the cervix occurs.

Early Stages. The *symptoms* of corporeal cancer closely resemble those of cervical cancer, but they are later in appearing and are less conspicuous in character. Necrotic changes do not occur to anything like the same extent, because the corporeal growth is better protected from invasion by bacteria; the uterine cavity in health is sterile, while the vagina always contains numerous saprophytic organisms. Therefore, the discharges from corporeal cancer do not become putrid so early, nor do they become so

extremely offensive as those of cervical cancer. Again, the amount of bleeding is less, indeed it is seldom if ever profuse, and the usual form in which it appears is as a *bloodstained discharge,* which is the first symptom. In many cases this is so slight that it has been present for several months before the patient is led to seek advice.

From this it follows that the early recognition of corporeal cancer is even more difficult than that of cervical cancer, and the necessity of insisting upon a complete local examination, whenever irregular bleeding, however trivial, occurs in elderly women, must once more be pointed out. Owing to the fact that the disease is in a situation inaccessible to direct examination, the physical signs are much less definite, even in advanced stages, than those of cancer of the cervix. Before the local examination is made the symptoms, though suggestive of cancer, give no indication of its location, and it may in fact be found in the vaginal wall, the cervix or the uterine body. If the two first-named parts are found to be healthy, attention is next directed to the body. In the great majority of cases of the disease this will be found, on bimanual examination, to be enlarged, although to this rule there are definite exceptions (*see* Fig. 305, p. 480). And it is important to recollect that enlargement must be considered in relation to the age of the patient; a size which would be normal to a multiparous woman in the sexually active period, will be abnormally large in one who has passed the climacteric. If the disease should attack the atrophied uterus of a woman long past the climacteric age, an advanced stage may be reached while the organ is still under the normal size (*see* Fig. 306, p. 480). The important point to bear in mind is that cancer cannot be excluded because the uterus is atrophied.

The enlargement due to cancer is moderate in extent and uniform in character. The question of enlargement is complicated by the fact that fibroids are found in company with corporeal cancer with exceptional frequency, with the result that the uterus may be of irregular shape as well as of abnormally large size (*see* Pl. XXV, p. 410). Mobility remains unimpaired until a much more advanced stage than is the case with cervical cancer.

It will be obvious from these considerations that something more than a bimanual examination is required for the recognition of the disease, and in fact a definite diagnosis, except in advanced stages, can only be made by exploration of the uterine cavity. This simple procedure is by no means unattended with danger in the case of corporeal cancer. If the disease is advanced, perforation of the uterine wall with the sound, a dilator, or even the curette, may readily occur, an accident which calls for the immediate removal of the uterus. Casual exploration with the sound cannot be too strongly condemned; the exploration should be carried out carefully with all the antiseptic and other precautions set forth in connection with vaginal operations (*see* p. 721), such as curetting. The cervix should, as a rule, be dilated sufficiently to admit the curette freely and allow free uterine drainage afterwards, *i.e.* up to No. 10 dilator. Often during dilatation fragments of tissue detached by the instrument will escape from the cervix: they consist of pale greyish or discoloured portions of friable tissue, and their appearance may be sufficient to settle the diagnosis. In less advanced cases the curette must be used carefully and gently, and this instrument will bring away more of the same friable material. If the use of the

curette is negative, the dilatation may be carried further until the cavity can be explored with the *little finger*.

The conditions which have to be distinguished from cancer of the body are *senile endometritis*, *papilliferous adenoma* and an *interstitial fibroid* which is causing hæmorrhage owing to some degenerative change. The distinction from the two former is made by an exploratory curetting; the presence of a fibroid may usually be determined by careful bimanual examination, and curetting will show whether or not endometrial cancer has also developed.

The differential diagnosis by histological examination of senile endometritis and villous papilloma of the body from corporeal cancer is important.

In *senile endometritis* the endometrium is thin and the surface-epithelium replaced, to a large extent, by granulation tissue; the glands are few and shrunken, and those which remain run a horizontal or oblique course through the stroma (*see* Fig. 212, p. 362), which is fibrotic and dense. No muscle-fibres will be seen in the scrapings.

In *papilliferous adenoma* (*see* Fig. 273, p. 449) the processes are exuberant and branching; they are covered with fairly regular columnar epithelium with basal nuclei; the stroma consists of fibrous tissue only, no muscle fibres being present in the curettings.

In *cancer of the body* the appearances vary according to whether the growth belongs to the *tubular* or to the *alveolar* type. In the *tubular* form there is a mimicry of gland-tissue, but the tubules are lined by *many* layers of cubical epithelial cells with nuclei at various levels; this helps to distinguish a tubular cancer from a villous papilloma. In the *alveolar* type, there is no attempt at gland-formation, the cells are neither columnar nor cubical, but vary in shape, being often quite atypical; they aggregate in densely packed columns and masses, which by breaking down in the centre give an alveolar appearance to the growth (see Fig. 310, p. 483).

With either of the above forms the curettings will show some portion of the muscular wall of the uterus to be invaded by the cancerous tissue. The stroma will therefore contain both muscle and fibrous tissue, and it may be œdematous and infiltrated with round cells. Masses of cancer-cells or malignant gland-tubules will be found among the muscle-bundles.

Advanced Stages. In the advanced stages offensive discharges due to ulceration of the growth are met with and pyometra frequently forms; the latter condition may result in very considerable enlargement of the uterus from dilatation of its cavity. Fixation occurs and is often due to direct transperitoneal extension of the growth to the omentum, to the wall of the rectum, pelvic colon or cæcum; the cellular tissue also becomes infiltrated, but this occurs at a much later period than in cancer of the cervix. Fistulous communication with the bladder or the bowel are rare, but in other respects the final stages of the disease are similar to those already described in cancer of the cervix.

TREATMENT OF UTERINE CANCER

The methods of hysterectomy suitable for these cases are described in a later section (*see* p. 680).

Symptomatic Treatment. In advanced cases it may be necessary to adopt measures which are designed to palliate symptoms, rather than cure

the disease. The practice of a partial operation for removal of necrotic masses of growth by the sharp spoon and cautery is not to be recommended except under one condition, *i.e.* severe hæmorrhage. It is only occasionally that severe bleeding occurs in cancer of the uterus; it is due to deep-spreading ulceration having laid open blood-vessels of more than capillary size. Such hæmorrhages aggravated with profuse putrid discharges can only be controlled by the removal of the superficial layers of the necrotic tissue and the application of the actual cautery or of styptic solutions to the site of bleeding. Scraping must not be carried beyond the limits of friability as recognized by the gloved finger. The use of the actual cautery usually results in subsequent extensive sloughing of the devitalized tissues, and it is preferable to soak the exposed tissues in a strong styptic solution which can be poured into the vagina in quantity sufficient to fill it. Suitable solutions are a mixture of acetone and tincture of iodine in equal parts, or a 1 *per cent.* solution of formalin. The solution should be left in contact with the cervix for 5 minutes, and the application can be repeated as required.

Treatment of Cancer of the Cervix. "When the uterus is attacked by cancer in any part, extirpation of the organ with its appendages, and, in the case of cervical cancer, the surrounding cellular tissue and lymphatics, offers the sole chance of cure." This statement made in the first two editions of this work now requires some modification. The advances which have been made in radium-therapy are very striking, and the results achieved in different clinics call for careful consideration. A considerable number of gynæcological authorities have reported results from radium treatment alone which bear comparison with those obtained by operation, and it is therefore necessary to state briefly the relative facts.

The radical operation for cancer of the cervix introduced by Wertheim, has now been on trial for 25 years. In the hands of men of the largest experience of its technique, the case-mortality of the operation is not less than 16 *per cent.* Victor Bonney, in this country, reported in 1925 a series of 192 cases with an operation-mortality of 16 *per cent.*

In the Chelsea Hospital for Women, Wertheim's operation was performed in 113 cases during the years 1922 to 1925, by the various members of the staff with an operation-mortality of 17·7 *per cent.* In the hands of the average surgeon the mortality of the operation is very much higher than in the case of a surgeon with great experience of the operation. If the operation were performed only in early cases the mortality would not be much more than one-third of the above figures, for the operative risks are directly proportional to the extent of the disease. The tendency with operators is to deal with more advanced cases as their experience widens, *i.e.* to increase their "operability" rate, and there appears to be no hope of further reduction of the mortality of the operation without greatly restricting its application.

As regards the late results the most successful operators can claim that about 50 *per cent.* of the cases operated upon live for 5 years without recurrence; the average results are between 35 and 40 *per cent.* Into the question of how far such cases can be said to be "cured" we cannot enter, but experience shows that although recurrence, if it takes place, will occur within 5 years in 90 % of cases, yet no case of cancer is safe from risks of recurrence for much longer periods. The unsatisfactory

character of these results called for the exploration of the possibilities of treatment by radium and X-rays, either alone or as an adjunct to operation. We will first consider the results which have been reported with radium.

Treatment by Radium.—Two recent American writers have presented results which can with confidence be quoted (Gray Ward[1] and Schmitz[2]). They have treated in all 35 cases of *operable* cancer of the cervix by a uniform technique with radium alone (Gray Ward) or with radium and X-rays (Schmitz), and of these 21, or 60 *per cent.*, were alive and free from recurrence after 5 years. The number of cases is too small to allow of generalization, but these results have never been excelled by surgery, so far as can be judged from published statistics.

Large numbers of cases have now been treated by radium alone or by radium combined with X-rays in Germany, America and Sweden; these cases, all of the "operable" class, yielded a Nett-Survival Rate[3] which varied from 20 *per cent.* in some clinics to 50·0 *per cent.* in others, the average being between 35 and 40 *per cent.* It must, accordingly, be admitted that when judged by the test of the 5-years' survival, the results now obtained by radiation are not appreciably less favourable than those obtained by abdominal hysterectomy in the most experienced hands.

In advanced cases such results as these cannot be anticipated, but life can be prolonged and symptoms relieved to an extent which is not practicable by any other means than radium. Thus Gray Ward reports that of 102 advanced cases, 35 were alive and free from recurrence three years later, that is, a survival rate of 36 *per cent.*; and of the 55 advanced cases treated, 8 were alive and free from recurrence 5 years later, *i.e.* a survival rate of 14·5 *per cent.*

In the meantime it is probable that the interests of patients will be most adequately met by radical operation in early cases. Advanced cases should not be operated on for two reasons, firstly, the high operation mortality; secondly, the slender prospects of a five years' "cure."

All who have used radium in cancer of the cervix are agreed that a local cure can be obtained in all but the more advanced cases, and those with long established necrotic changes in the growth. In early and moderately advanced cases, complete local healing of the cancer can be obtained, with cessation of hæmorrhage and discharge. Subsequent histological examination may show a complete disappearance of cancer cells from the cervical tissues; this has been repeatedly observed in cases where the uterus has been removed subsequent to radium treatment. The action of the radium is however restricted to a narrow area around the tissues of the cervix, and if the cancer cells have reached the parametrium or the glands, the progress of the growth in these situations will not be permanently arrested.

The value of this local healing is however very great. It may, in some instances, convert a case which appeared to be clinically inoperable into an operable one. And even if this result is not achieved, the patient benefits very greatly in health from cessation of hæmorrhage and discharge, and of absorption from septic areas. The advance of the cancer in the

[1] "Report of Women's Hosp. of State of New York," 1923-24.

[2] *Jl. of Amer. Med. Assoc.*, Jan. 10th, 1925.

[3] The "Nett-Survival Rate" is obtained by deducting from the total number of patients operated upon those who could not be traced and those who had died from some other cause. The remainder represent those who were known to be alive five years after operation (see also "Reports on Public Health and Medical Subjects" (Ministry of Health), No. 40).

pelvis may be very slow, and accordingly these patients may enjoy several years of comparatively good health before the occurrence of metastases in the final stages of the disease. It must further be borne in mind that there is no risk, or only a minimal risk, associated with the radium treatment, while radical operation in advanced cases is attended by a mortality of probably 25 to 30 *per cent.*

Attempts are being made to apply radium treatment to extensions of the disease beyond the limits of the uterus. Thus the abdomen may be opened and radium needles (*see* below) introduced into the thickened cellular tissues around the uterus, or into the enlarged glands, or alternatively the radium needles may be introduced from below through the vaginal fornices. The latter method is clearly attended by risks of injury to the ureters and the uterine vessels, if the needles are inserted outside the lateral border of the cervix. Another alternative is to attack the extrauterine extensions by deep X-ray therapy, after the method introduced at Erlangen. At present no definite opinion can be expressed upon the value of irradiation by radium or X-rays in these conditions.

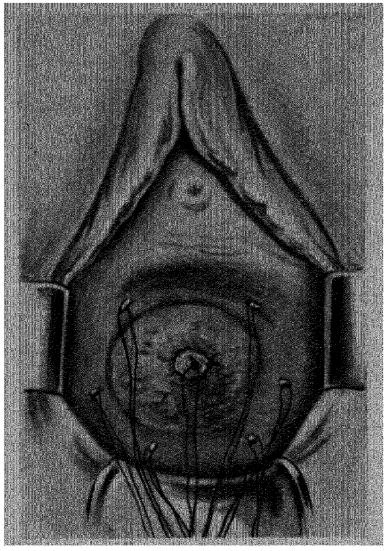
Radium and X-rays as Adjuncts to Operations.

It has already been pointed out that the local action of radium upon cervical cancer sometimes converts an inoperable or a doubtful case into one which can be operated upon with confidence. Even if this result is not fully obtained, operative risks are greatly lowered when an ulcerating and discharging area of cancer has first been dealt with by radium. The use of radium as a preliminary measure has, therefore, definite advantages. Certain disadvantages must, however, be pointed out, the most obvious of which is the expense. Also time is lost, for at least four weeks is required for local healing to occur. Again, it is said that the technical difficulties of the operation are increased by the preliminary use of radium, which may result in the formation of dense fibrous tissue around the cervix. This result has, however, only been observed when a prolonged interval had elapsed before operation, or when repeated applications had been employed. It is hardly possible that dense fibrous tissue can be formed in such a brief period as three to six weeks.

It would appear therefore that the advantages of preliminary treatment with radium greatly outweigh the possible disadvantages.

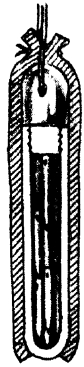
Subsequent to operation all cases should be treated with X-rays, the pelvis being subjected to cross-fire, so that the lateral areas, which may be the seat of disease, may be reached. This treatment is invariably made use of by general surgeons after operations for cancer of the breast, and its use in cases of cancer of the cervix is very clearly indicated. The first application should be made as soon as the wound has healed, and the applications should be repeated at intervals over a period of several months. The Erlangen technique is unnecessary unless areas of suspicious disease have been left behind in the pelvis.

The Technique of Radium treatment of Cancer of the Cervix. In an early case of cancer of the cervix the initial dose should be 100 to 150 mg. of radium bromide. The radium salt contained in a glass capsule is further enclosed in a tube of aluminium 2 mm. in thickness, which acts as a filter in preventing the transit of all radiations except those known as the gamma rays. The alpha and beta rays should be excluded on account of the surface irritation which they cause. The aluminium tube is further encased in a



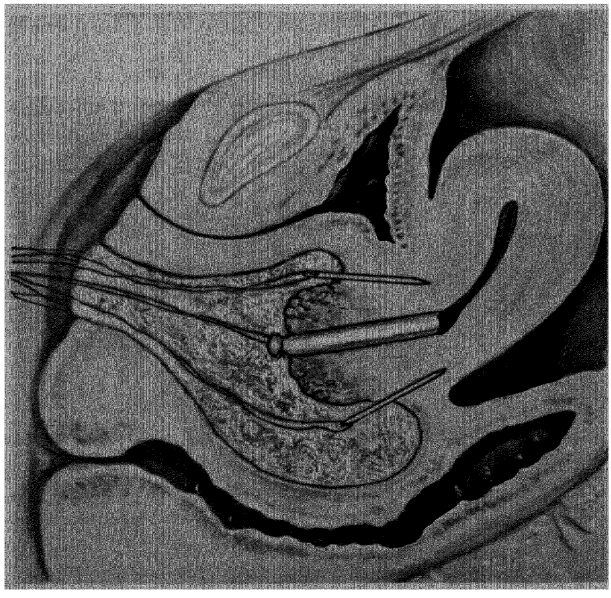
I.

(I) FRONT VIEW OF CERVIX TO SHOW RADIUM TUBE IN CERVICAL CANAL AND RADIUM NEEDLES AROUND THE MARGINS OF THE GROWTH. Note the latter are inserted in front of and behind the coronal plane to avoid the ureters.



II.

(II) SECTION TO SHOW THE RADIUM WITH ITS FILTER. The radium is contained in a series of small needles.



III.

(III) DIAGRAM OF SAGITTAL PLANE TO SHOW RELATIONS OF RADIUM TUBES AND VAGINAL PACKING. (After Lillian Farrar.)

FIG. 311A.

piece of rubber tubing 1 to 2 mm. in thickness, and this is tied at each end to secure the radium container. The radium thus enclosed, is to be placed in the cervical canal and retained in position by careful packing with gauze. In more advanced cases hollow aluminium " needles " containing 10 mg. of radium bromide are employed in addition to the tube in the cervix. These needles are buried in the outlying portions of the cervix near the visible edge of the disease (*see* Fig. 311A), and from four to six may be made use of in this way. The zone of effective radiation of a maximum dose of radium is about 2 inches deep, and if the disease has reached the margin of the cervix or has spread to the vaginal vault, the use of these needles is essential.

The needles and tube are left *in situ* for 24 hours, and the dose thus administered may be expressed *e.g.* as $140 \times 24 = 3{,}360$ milligram-hours. Each needle or tube has attached to it a stout silk thread several inches long; this allows of easy withdrawal when the gauze packing is removed.

The first application of radium is best made under anæsthesia; this will also allow of a complete bimanual examination being made, and a more exact estimate formed of the extent of the disease and the mobility of the uterus. The radium tubes may be sterilized by boiling, and the vaginal canal must be carefully prepared by first cleansing the passage with a sterilized swab, and then swabbing the walls with tincture of iodine. If the cervical canal will not admit at least half an inch of the radium tube, it can be enlarged by further scraping, but it is better to avoid all interference with the cancer if possible. The tube and needles having been introduced, the vagina is tightly packed in such a manner as to retain them in position; the lower part of the vagina need only be loosely filled with gauze.

Evacuation of the bladder is sometimes rendered difficult by the presence of the packing, and the catheter may consequently be required. Most patients exhibit a definite reaction to radium, which appears within 24 hours. Headache and nausea are the commonest symptoms, and there may also be definite soreness and redness of the gums. The patient should consequently be kept in bed while the radium is *in situ*, and for 24 hours subsequently.

A fair amount of watery discoloured discharge usually occurs after the radium treatment and may last for several weeks. Douching with a non-irritant antiseptic should therefore be advised.

The action of radium is slow, and no great change will be observed in the growth until a month has elapsed. Definite local healing will then be clearly seen if the patient is examined *per speculum*. The size of the cervix has diminished, its surface has become smoother and notably paler. To touch, the cervical tissues have lost their friability and feel firm or even hard.

Ward and Farrar rightly lay stress upon the importance of repeating this examination every month in order that early signs of recurrence of the local disease may not be overlooked. The reappearance of a reddish friable area on the lips of the external os, or the formation of nodules in outlying parts of the portio vaginalis, call for repetition of the treatment. The condition of the pelvic cellular tissue must also be carefully observed, for, as has been said above, it may happen that progress of the disease in this situation may proceed concurrently with healing of the cancer in the cervix. The invasion of the cellular tissue may be treated either by deep X-ray therapy, or by the use of radium needles, as previously described.

Cases unsuitable for radium. When the disease has reached an advanced stage care must be exercised in the use of radium. The presence of advanced necrotic changes resulting in the formation of large cavities with hæmorrhage and free putrid discharges, are not suitable; in such cases pyometra is often also present, and an acute infection may have spread to the tubes or the pelvic peritoneum. Such patients are very ill from sepsis, and often show a high degree of fever. Acutely inflamed tissues are unsuited to the action of radium, and its use will almost certainly aggravate the condition. If a fistulous communication has formed with the bladder or bowel, it is useless to attempt to promote their healing with radium.

Treatment by X-rays. The introduction of the Erlangen method gave a great stimulus to the employment of X-rays for cancer of the uterus, and in Germany a great deal of work has been reported. The technique of X-ray treatment of cancer of the cervix uteri which has been adopted at Erlangen is the application of rays which have been generated at over 200,000 volts, and which have passed through filters of 0·5 mm. of zinc and 3·0 mm. of aluminium. The object of filtering the rays through these metals is to remove as far as possible those rays which have harmful effects on the skin; those rays which pass through the filter have a high penetrative power, and the amount of these rays which will, under certain fixed physical conditions, produce a slight transient erythema of the skin three days after the exposure has been made is designated the "skin-erythema dose," and is often expressed as 100 *per cent.* As the rays pass through the tissues of the body they are absorbed or scattered, with the result that approximately only 20 *per cent.* of the skin-dose reaches a depth of 10 cm. from the surface.

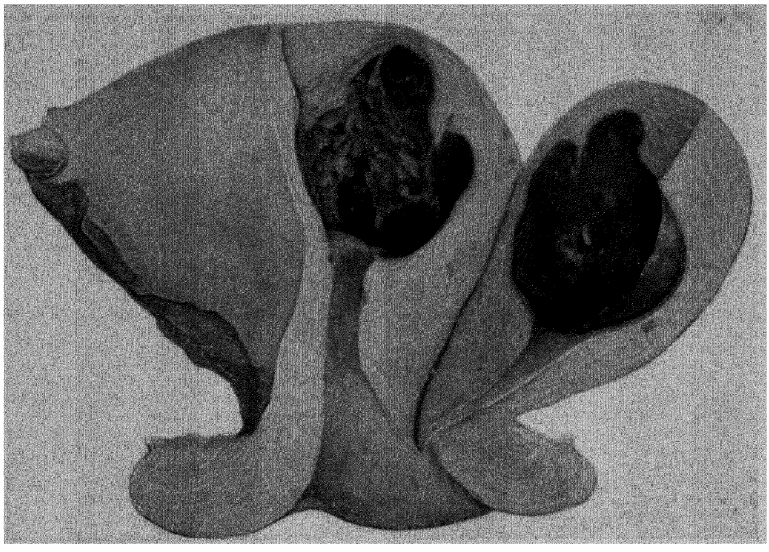
By applying a method of cross-fire through five or six portals of entry, experience shows that the best results in carcinoma of the cervix are obtained when the total amount of rays at the site of the tumour was equivalent to 120 *per cent.* of the skin-erythema dose.

Wintz[1] has treated 612 cases of cancer of the cervix and 88 cases of cancer of the body between the years 1915 and 1920. The percentage of five-year "cures" for the whole series was 38·3 *per cent.* The percentage of "cures" is calculated by this author upon the total number of cancer cases seen, including those not treated by X-rays, *i.e.* the "gross survival rate." There were deaths attributable to the treatment amounting to 1 *per cent.*, but these casualties were probably due to imperfect technique.

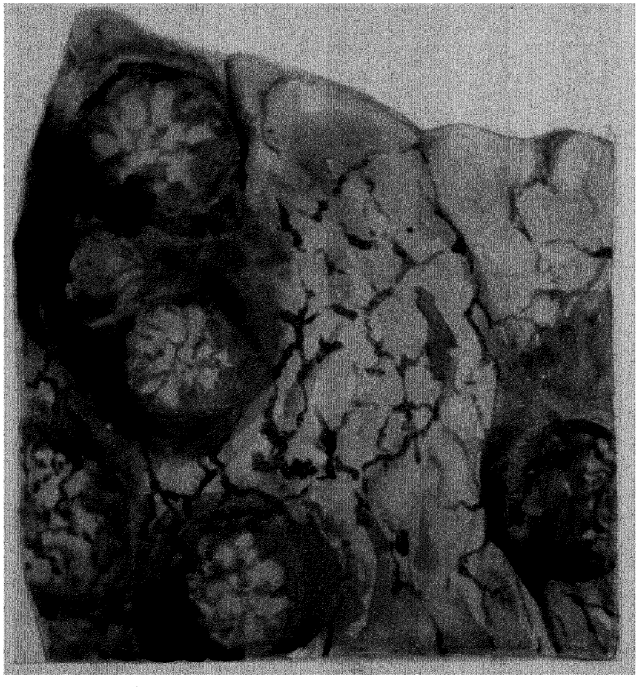
It would appear that radium gives better results and is attended by less risk than deep X-ray therapy; the technique of the latter is much more complicated and requires the special training and experience of a radiologist.

Treatment of Cancer of the Uterine Body. Radical operation holds the field for this condition for the following reasons: (1) the operation is simpler and is attended by a case-mortality little higher than that of hysterectomy for fibroids; (2) the disease remains localized to the uterus for much longer than is the case with cancer of the cervix, and in consequence there is less risk of injury to neighbouring organs during the operation; (3) the percentage of five-year cures from operation is higher than is the case with cancer of the cervix. The statistics of corporeal cancer are much less abundant than those of cervical cancer, but a series of 507 operations collected

[1] *Deutsche-Med. Woch.*, 1925, Nos. 15 and 17.



A.—Uterus showing Chorionic Carcinoma (M. Handfield-Jones). Note the hæmorrhagic character of the growth and its limitation to the uterine body.



B.—Portion of Lung showing Secondary Deposits of Chorionic Carcinoma (Cuthbert Lockyer). The hæmorrhagic character of the metastases is well seen.

To face page 499.

from various sources yielded a "nett survival rate" of 60 *per cent.*[1] If post-operation prophylaxis with X-rays were practised, there is no doubt that these results could be still further improved.

CHORIONIC CARCINOMA

It is convenient to consider this unusually interesting form of malignant tumour in connection with the uterus; but although, in the great majority of cases, the uterus is the organ primarily attacked, exceptions sometimes occur, the primary growth being found in the vagina, the labium, the Fallopian tube, or the ovary.

Its special histogenetic feature is that it arises from certain embryonic tissues, viz. the epithelial and connective-tissue elements of the chorion. It is accordingly a disease which affects women who have at some time or other been pregnant; apparent exceptions to this statement will be mentioned later. The connection with pregnancy may be quite remote, several years having elapsed before the appearance of the tumour; on the other hand, it may make itself manifest during the puerperal period following an abortion or a confinement. In approximately one out of every three cases it has been found that the immediately preceding pregnancy terminated as a hydatidiform mole; when the rarity of the latter condition is borne in mind the significance of its frequent association with chorionic carcinoma will be apparent.

In cases in which the primary growth was found in the Fallopian tube or ovary, it may be presumed that these organs had been the seat of an early ectopic gestation. When the primary growth is vulval or vaginal, it may be supposed that implantation of placental tissue has occurred, perhaps, upon an abrasion, which has subsequently given origin to the malignant growth.

Pathological Anatomy. In the uterus the growth usually arises in the fundus and the adjacent parts of the anterior and posterior walls, *i.e.* in the normal position of the placental site (*see* Fig. 312). Three very early cases examined by one of us all show that the growth starts deeply in the uterine muscle, the mucous membrane being intact and not involved in the malignant process. In these cases it was only by sections made through the musculature of the uteri, that the foci of new growth were discovered (*see* Fig. 314). Later on the tumour presents in the uterine cavity, causing a symmetrical enlargement of the organ (*see* Pl. XXVIII.); more rarely it produces a nodular subserous mass by projecting beneath the peritoneal surface (*see* Fig. 313), and in a case recorded by one of us the peritoneal coat had given way, causing fatal peritonitis. The growth itself is soft, dark in colour, and freely hæmorrhagic (*see* Pl. XXVIII.); its tissues are of especially low vitality, and therefore very prone to break down; consequently the older parts are generally found to consist of *débris* and blood-clot, the characteristic elements being found only at the growing edge. These changes in the base and central parts of the tumour are well seen in Fig. 313. Invasion of the fibromuscular wall is usually visible, and isolated implantation-nodules are often found in the lower part of the uterine cavity. Similar nodules, formed in the same manner, may be found in the vaginal walls and the vulva. These nodules are of a deep plum colour, soft and friable; they bleed readily when handled. The uterine

[1] *System of Gynaecology.* Eden & Lockyer. Vol. III.

growth does not attain large size, in this respect resembling corporeal carcinoma. In a few cases grape-like bodies, resembling the vesicles of a hydatidiform mole, have been seen in these tumours. No matter what may be the location of the primary growth, its structure and characters are uniform.

The cell-elements which are typical of this tumour are the following (*see* Fig. 316): (1) large irregular multinucleated masses of protoplasm

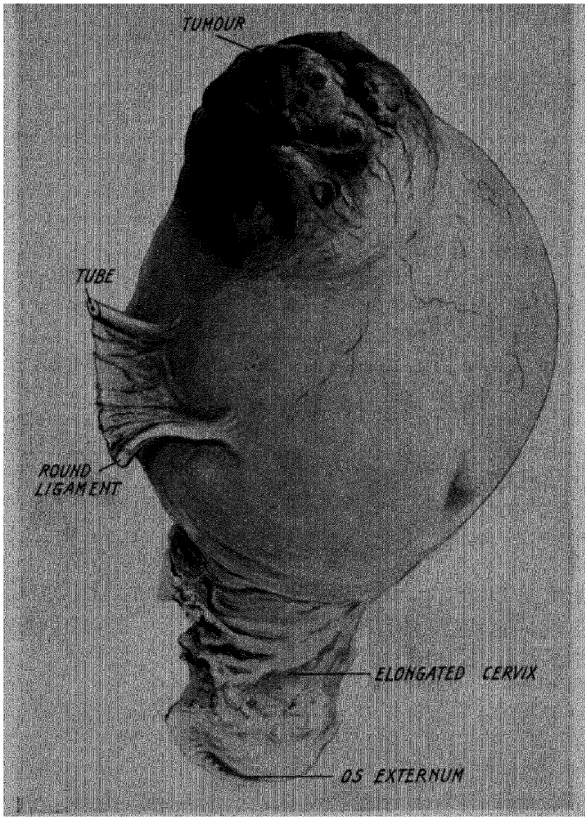


FIG. 312. CHORIONIC CARCINOMA OF THE UTERUS. Multipara, aged 26. The uterus is enlarged, but its surface is smooth, except at the fundus. Here a nodular mass of dark-coloured growth is seen, the peritoneal covering being still intact. There is also well-marked elongation of the supra-vaginal portion of the cervix.

(plasmodia) in which cell-boundaries cannot be recognized; these are derived from the outer layer of the chorionic epithelium or syncytium; (2) small polyhedral cells, with large nuclei, lying in closely packed masses; these are derived from the inner or Langhans' layer of the chorionic epithelium; (3) large mononucleated cells, and multinucleated giant cells, collected in masses, or invading the stroma of the uterine tissues; these are probably derived from both (1) and (2). In addition to these elements, definitely recognizable chorionic villi are sometimes present, either of normal appearance or in a condition of vesicular degeneration; the origin from the

epithelium of the villi of the three varieties of cells just described has been traced by a number of different observers.

The tumour-elements show no definite arrangement, but are mingled with one another in irregular clusters and masses, and are sufficiently characteristic to establish the microscopical diagnosis of chorionic carcinoma.

Chorionic carcinoma may occur at any age within the limits of possible pregnancy, a case having been recorded at seventeen and one at fifty-five. A high degree of fertility appears to entail a certain predisposition to the

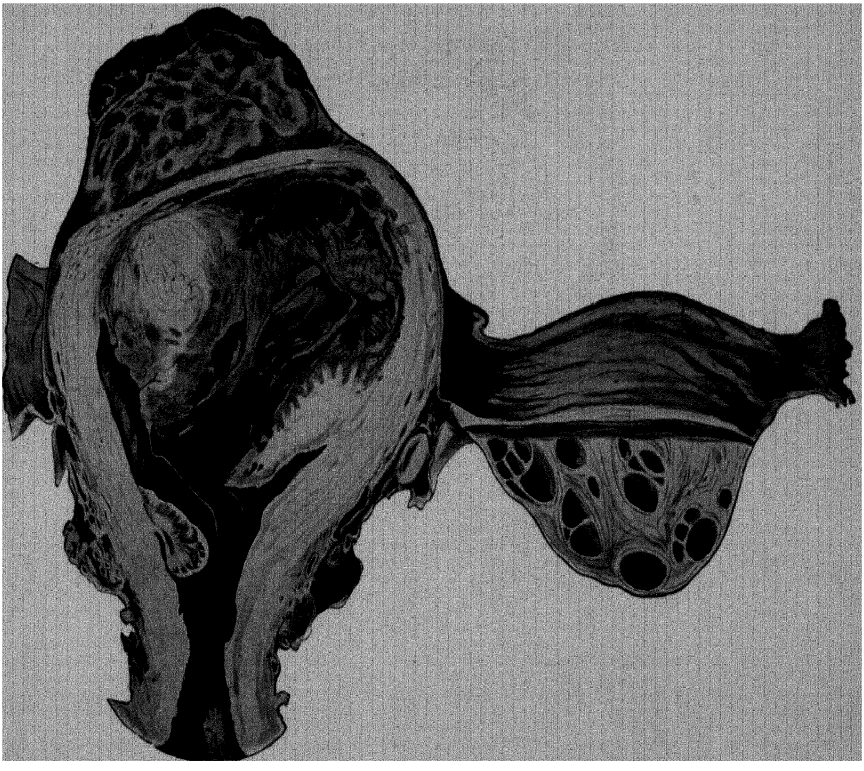


FIG. 313. CHORIONIC CARCINOMA OF THE UTERUS. The same specimen as Figure 312. The nodular projection on the fundus probably represents an intramural metastasis, being separated from the rest of the growth by a layer of fibromuscular tissue. An isolated polypoid metastasis is also seen in the lower part of the uterine cavity.

disease, for a relatively large proportion of cases has occurred in women who have had five or more pregnancies. In two out of every three cases, the immediately preceding pregnancy terminated in abortion.

As in the case of all other varieties of malignant disease of the uterus, the earliest symptom is *haemorrhage*. Usually it is severe from the first, and in this respect differs greatly from that met with in adeno-carcinoma. Not infrequently the patient also notices the passage of 'shreds' or 'pieces' in the discharge. In exceptional cases the amount of bleeding is not at any

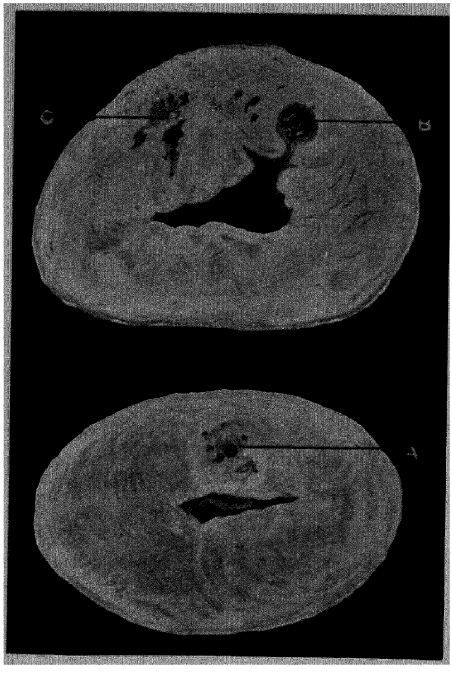


FIG. 314. TRANSVERSE SECTION THROUGH THE UTERINE BODY, showing early chorionic carcinoma arising in the muscularis, *i.e.* beneath the mucous membrane (Malcolm, Bell and Lockyer).

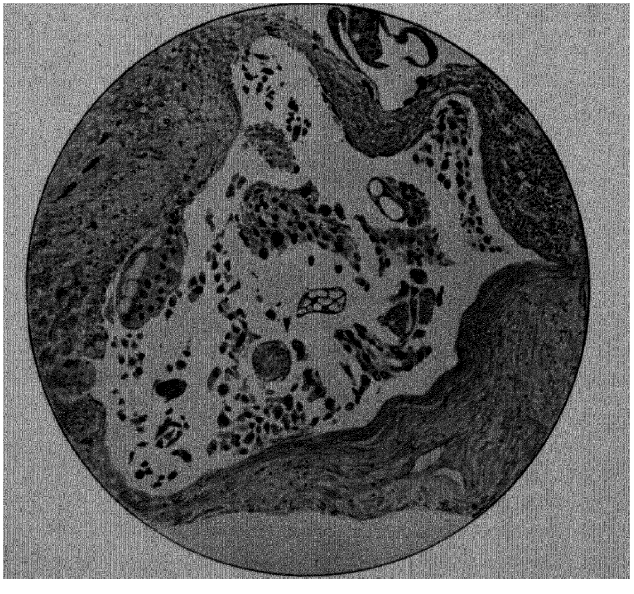


FIG. 315. MICROSCOPIC SECTION OF TISSUE REMOVED FROM THE FOCUS OF GROWTH MARKED A IN FIGURE 314. The intramuscular space contains solid and vacuolated masses of syncytium. *Cf.* Figure 316. (Malcolm, Bell and Lockyer.)

time considerable. More often profound anæmia results from profuse and repeated hæmorrhages. Ulceration of the growth and decomposition of the discharges, indicated by an offensive odour, occur earlier than with ordinary cancer and form a striking feature of the condition. To this is usually added

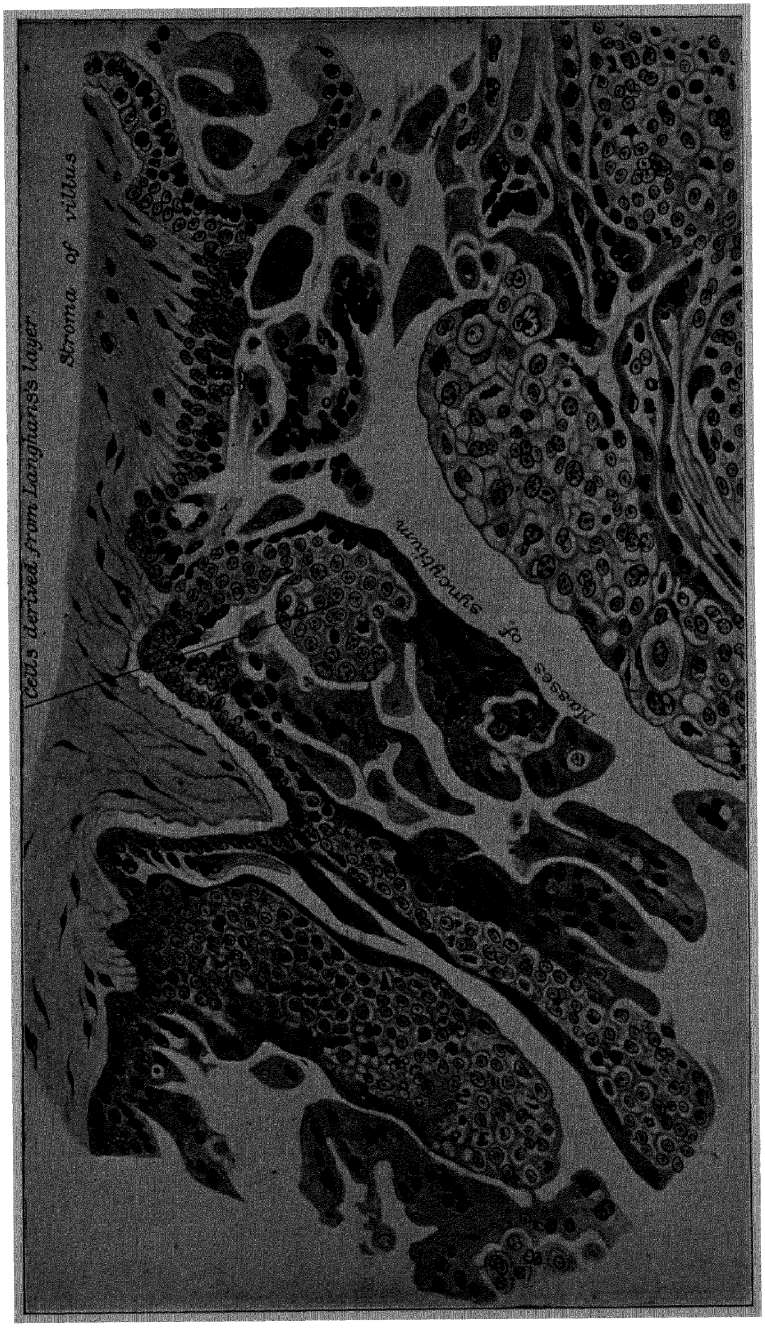


FIG. 316. CHORIONIC CARCINOMA OF THE UTERUS (Teacher). This section shows the characters of the essential cellular elements of the tumour.

a certain amount of fever; as a rule it is moderate, but severe rigors and other evidences of acute sepsis sometimes occur.

The degree of malignancy of the growth is variable, even more than is the case with other varieties of malignant tumour. Sometimes it destroys life in a few weeks by the formation of widely diffused metastases; at other times its virulence is decidedly moderate, and radical operation has proved successful a year or eighteen months after the appearance of the first symptoms. Dissemination occurs through the blood-vessels, the cell-elements of the growth having been traced into efferent veins, and found in the venous channels of distant parts. The cells of this tumour possess an unusual power of eroding the walls of the vessels and so reaching the blood-stream. One of the commonest positions for metastases is the lung (*see* Pl. XXVIII.), hæmoptysis and sometimes pleural effusion furnishing clinical evidence of the occurrence. The brain, the liver, the spleen, and the pancreas may also be attacked; in the brain metastases are relatively frequent.

Diagnosis. Cases of chorionic carcinoma may follow quickly upon an abortion, and have been accordingly mistaken for sapræmia with retention of placental tissue, and treated as such. Both conditions are attended with hæmorrhage, a foul uterine discharge, fever, enlargement of the uterus, and the presence within it of decomposing *débris* of tissue or blood-clot. Clearing out the uterus brings a temporary improvement, but after an interval the symptoms all recur with severity, and the uterus is again found to contain considerable masses of *débris* although completely evacuated at the first operation. The rapid reproduction of decomposing tissue in the uterus under such circumstances is strongly suggestive of chorionic carcinoma. Cases in which the connection with pregnancy is more remote than this may arouse no suspicion of the real nature of the condition. An enlarged uterus, giving rise to hæmorrhage and, possibly, a foul discharge, is naturally treated, in the first place, by exploration and scraping, which will result in free bleeding and in the removal of a quantity of *débris*. The ultimate diagnosis can then only be made by a skilled microscopist, and the whole of the tissue removed from the uterus should be sent to the pathologist with as little delay as possible.

The *treatment* is extirpation of the uterus. Owing to the serious condition in which so many of these cases come first under observation, the primary mortality of the operation has been unusually high. In several cases removal of the primary growth has been followed by complete disappearance of metastases in parts, such as the vaginal wall, where they could be directly observed. Radium has been employed for advanced cases unsuited for laparotomy. In a case recorded by T. B. Sellors no trace of the previous growth could be found when the uterus was removed two months after the insertion of radium.[1]

C. LACERATIONS AND DISPLACEMENTS OF THE UTERUS

LACERATIONS OF THE CERVIX

Laceration of the cervix is so common in labour that signs of this injury are regarded as the commonest indication of child-bearing.

Such lacerations, as a rule, are of only moderate degree; they do not give

[1] T. B. Sellors, *Am. Jl. Obst. & Gyn.*, 10, 1925, 741.

rise to any considerable bleeding after labour, and consequently they are not repaired. They result in visible scarring of the cervix, and often lead to marked deformity which takes the form of a gap in the continuity of the cervical wall, which may involve only the cervical lip, or may run up into the vaginal roof, or even into the base of the broad ligament, according to the extent of the original injury. The left lateral wall of the cervix is the commonest seat of these lacerations (*see* Fig. 317); sometimes there is one on each lateral wall; occasionally there are three or more dividing the cervix up into irregular segments. Considerable puckering may then occur which completely alters the shape and appearance of the cervix. When a deep tear has run up into the vaginal vault, an irregular scar may be traced from the base of the cervical injury across the lateral vaginal fornix.

A deep bilateral laceration splits the cervix into two halves, which are roughly anterior and posterior (*see* Fig. 318). A certain amount of infection of a mild type takes place, resulting in thickening of all the cervical tissues (chronic cervicitis). As a consequence each lip becomes *everted*, *i.e.* rolled outwards upon its vaginal aspect; this exposes a large area of mucosa, which becomes thickened and congested from chronic irritation, a condition usually spoken of as 'erosion' (*see* p. 364). This combination of 'eversion' with 'erosion' is frequently seen in multiparæ.

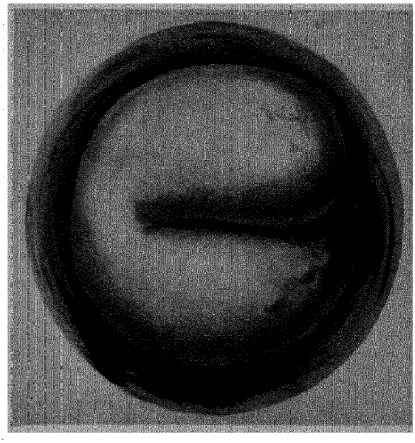


FIG. 317. OBSTETRIC LACERATION OF THE CERVIX WITH EVERSION AND THICKENING OF THE LIPS OF THE OS.

Other morbid conditions attributable originally to the same cause are often present. Thus prolapse from lacerations and over-stretching may occur, or from infection through the lacerations chronic inflammation of the pelvic cellular tissue, or of the tubes and ovaries, may occur. Consequently these patients often present a series of lesions, of which the cervical laceration may form the least important feature.

Clinical Features. Cervical lacerations give rise to no symptoms unless they have produced 'eversion' and the chronic inflammatory changes in the cervical tissues which accompany it. The symptoms are therefore only the indirect result of the injury. They are identical with those described on page 369 as the symptoms of 'erosion,' and accordingly they need not be repeated here. Frequently the clinical features are rendered more complex and more severe by the association of prolapse or chronic pelvic inflammation with the cervical lesions.

It has long been held that cervical lacerations are a powerful predisposing cause of cancer. This view is based *first* upon the general principle that injury predisposes to cancer in all organs, the predisposition being explained by the chronic irritation which scar-tissue produces in the healthy tissues around it. *Secondly*, it is established that cervical cancer is mainly a disease of parous women. *Thirdly*, as we have seen, an *everted*

cervix is also the seat of chronic inflammation, and this condition predisposes to cancer in the same way as scar-tissue.

It is, however, difficult to obtain direct proof, for cases of cervical cancer can seldom be shown to have arisen in relation to scar-tissue, although occasionally it may be traced to an erosion. At the same time the reasonable probability of these views gives to cervical injuries an

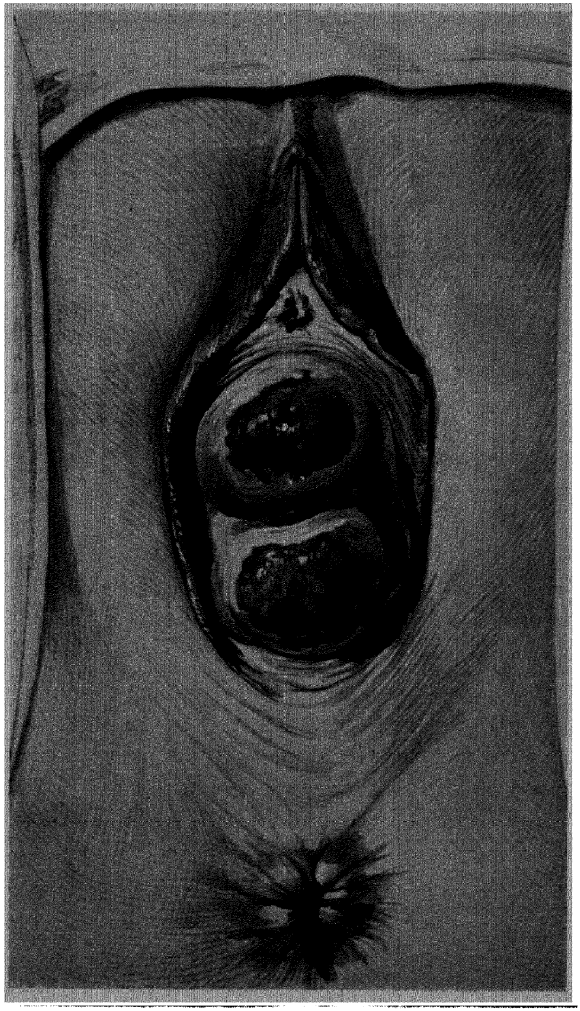


FIG. 318. DEEP BILATERAL LACERATION OF CERVIX WITH ECTROPION (EVERSION) OF THE LIPS, in a case of the second degree of prolapse.

importance considerably greater than the comparatively trivial nature of their immediate effects.

Cervical lacerations of unusual depth sometimes do harm in a different direction, viz. they impair the retentive capacity of the uterus in pregnancy and thus lead to abortion. If the laceration has run up into the vaginal fornix, almost the entire length of the cervix from internal os to external os may have been involved, impairing the capacity of the lower uterine seg-

ment to support the ovum as the uterus undergoes active dilatation during pregnancy.

The *diagnosis* of the condition is very simple when the cervix is exposed with a speculum in a good light. By hooking a tenaculum into each cervical lip the eversion can be unrolled and the cervix reconstructed. The depth and position of the lacerations can then be exactly made out. The exposed cervical surfaces are bright red in colour and present the appearances characteristic of an ' erosion ' (*see* p. 364). If traction on the cervix is made it will sometimes be found that there is loss of mobility from old-standing scar-tissue immobilizing the cervix more or less completely. The condition of the uterine body and the adnexa should always be carefully explored by bimanual examination.

Treatment. The only possible treatment of cervical lacerations is operative ; the object of the operation is not only to restore the integrity of the cervical wall but also to deal with the associated conditions of ' eversion ' and formation of scar-tissue. It is not necessary to treat all cases of laceration of the cervix. Generally speaking, those which are not associated with ' eversion,' and those which do not extend to the vaginal roof, do not require treatment. It is only bilateral lacerations of some depth which lead to ' eversion ' of the cervical lips.

The condition of the other pelvic organs should be carefully examined before an operation is undertaken. On account of the frequency with which multiple lesions are present, other operations such as curetting or perineorrhaphy may be required as well as that for repair of the cervix, which will be described on page 727.

DISPLACEMENTS OF THE UTERUS

Before entering upon this subject, we must first consider the means by which the normal position of the uterus and of the other pelvic viscera is maintained. It is important to remember that when the uterus is displaced, other organs are often affected as well. In the case of downward displacement (*prolapse*) the alterations induced in the position of other pelvic organs are so extensive that the condition cannot be strictly regarded as a *displacement of the uterus ;* it must be viewed as a complex condition affecting many structures besides the uterus. It will therefore be treated as a separate condition.

THE SUPPORTS OF THE UTERUS

The uterus is an organ which, on account of its anatomical relations, and on account of the remarkable enlargement which it undergoes during pregnancy, requires loose attachments and a correspondingly wide range of normal mobility. The frequent changes in volume of the bladder, as this organ undergoes its alternating diastole and systole, produce marked changes in the position of the uterus : the normal degree of anteversion is only possible when the bladder is empty ; as this organ fills up, the uterus is gradually pushed backwards, becoming first erect and then displaced upwards and backwards towards the sacral promontory. From this position retroversion may readily occur from further distension, or some accidental cause. The influence of the volume of the rectum upon the uterus is less marked ; but distension of the rectal ampulla probably elevates the uterus to

some extent. During pregnancy the uterus increases enormously in size, and in consequence produces well-marked alterations in the position and relations of adjacent viscera, notably the tubes and ovaries, the bladder and portions of the pelvic peritoneum. In order to allow of these changes, all of which are physiological, the uterine attachments must give the organ freedom to accommodate its position to the varying conditions of the adjacent viscera, and also to undergo enlargement without causing undue strain upon its anatomical attachments.

The uterus is structurally continuous with the vagina, the vault of which is reflected over the vaginal portion of the cervix; this is its most unyielding attachment. The peritoneal 'ligaments,' which have been already described, are morphologically of the nature of a *mesentery;* they carry the blood-vessels, lymphatics and nerves of the organ, which are invested with a sheath of fibrous tissue of some strength forming one of the principal supports of the uterus, although leaving it a wide range of mobility. When observed from within the abdomen during operative work, the broad ligaments, utero-sacral ligaments and utero-vesical ligaments, all appear as lax folds, which under normal conditions will allow of the uterus being drawn up to, or through, the abdominal incision without the use of force (*see* Fig. 19, p. 25). They can by no means be regarded as *supports* which sustain the uterus at a constant level.

The round ligaments are not homologous with the mesentery. Developmentally the round ligament is the adult form of the structure which corresponds to the gubernaculum testis of the male (*see* Fig. 55, p. 68). The function of this structure is developmental only, and the portion which becomes the round ligament may perhaps be regarded as a vestigial structure which serves no definite purpose in the adult. Its laxity, its variability in size, and its curved course through the pelvis negative the idea that it can exert any notable influence upon the position of the uterus. It is very doubtful whether it can even oppose any effective resistance to forces tending to retrovert the uterus into the pouch of Douglas. It can, however, be made serviceable by the surgeon, who constructs from it a useful artificial uterine support (*see* p. 699).

The deep group of musculo-fascial structures which constitute the *pelvic diaphragm* are those which chiefly maintain the horizontal level of the uterus. This diaphragm is a funnel-shaped structure, oval in shape, with the long axis antero-posterior. It consists of the levator ani and coccygeus muscles on each side, with the visceral layer of the pelvic fascia, which forms their aponeurosis.

Anatomists describe the levator ani as comprising two muscles, which have been named from their attachments, the *pubo-coccygeus*, and *ilio-coccygeus* muscles. The *pubo-coccygeus* arises from the back of the pubic symphysis and body, and from the pelvic wall along an oblique line which is continued upwards and outwards towards the obturator canal, and also in part from the triangular ligament (*see* Fig. 319). The muscle passes backwards and inwards and is inserted partly into the last sacral vertebra, and partly into a tendinous median raphé situated behind the rectum, where it unites with its fellow from the opposite side (Thompson). These muscles partly ensheath the vagina and rectum, and exert to some extent a supplementary sphincteric function. The *ilio-coccygeus* arises sometimes from the ilio-pectineal line, and sometimes from a fibrous arch

passing from the pubes to the ischial spine, the 'white line of the pelvic fascia' (Thompson). It has an aponeurotic insertion into the two last coccygeal vertebræ and into the ano-coccygeal median raphé. The coccygeus or *ischio-coccygeus* muscle arises from the ischial spine, and is inserted into the lateral aspects of the lower sacral vertebræ and the coccyx.

Another musculo-fascial layer has recently been described by Victor Bonney, which he has named the pubo-cervical muscle.[1] It is said to contain unstriped muscle, and it lies at the same level as the transverse ligaments of the cervix, that is, above the level of the muscles composing the pelvic diaphragm. It is described as spreading from the back of the symphysis pubis to the front and sides of the cervix and vaginal vault; it therefore forms the floor upon which the bladder directly rests. The muscular elements are regarded by Bonney as being continuous with the

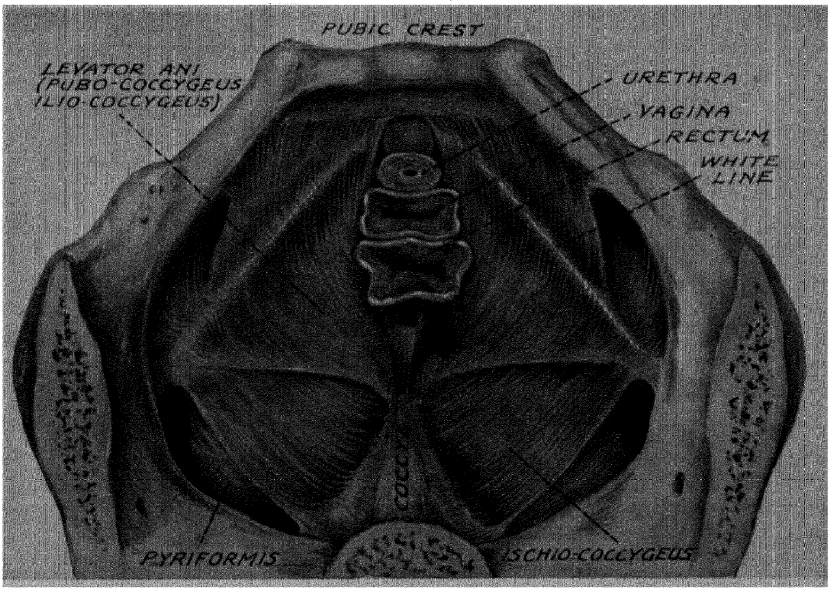


FIG. 319. THE PELVIC DIAPHRAGM AS SEEN FROM ABOVE (Deaver).

superficial longitudinal fibres of the uterine musculature. Its function would appear to be to support the bladder and the upper part of the vagina.

Morphologically the pubo-coccygeus, ilio-coccygeus and ischio-coccygeus muscles represent the powerful tail-muscles of apes and lower mammals; the two former are the depressors of the tail; the last-named are the tail-wagging muscles. In man, owing to the disappearance of the tail, these muscles have lost their original function, and are of course much less powerfully developed than in tailed animals. Considerable difference of opinion has been expressed as to their function in man. By some writers they are regarded as vestigial structures which are too feeble to be of much practical value (Fothergill). Others consider that they have an important function which has developed in consequence of the assumption of the erect attitude by man. This function is to support sudden increases in intra-abdominal pressure, such as frequently occur from violent muscular effort in coughing, sneezing, and in the act of defæcation (Paramore). But for the presence

[1] *See* also pages 59, 537, 736.

of structures in the pelvic floor capable of effectively counteracting such increases in pressure from above, hernial protrusion of the pelvic viscera would no doubt occur with greater frequency. The latter view appears to be the true one, and if this is accepted, it follows that the muscles, closing the pelvic cavity below, which by their contraction are capable of increasing the resistance of the pelvic diaphragm as and when required, are structures of great physiological importance.

It must be borne in mind, however, that the pelvic diaphragm is weakened by being pierced by the urethra and vagina; in women who have borne children, the aperture representing the latter is of large size. The rectum should not be regarded as piercing the pelvic diaphragm; it lies entirely free in a compartment of its own, and has a much wider range of normal

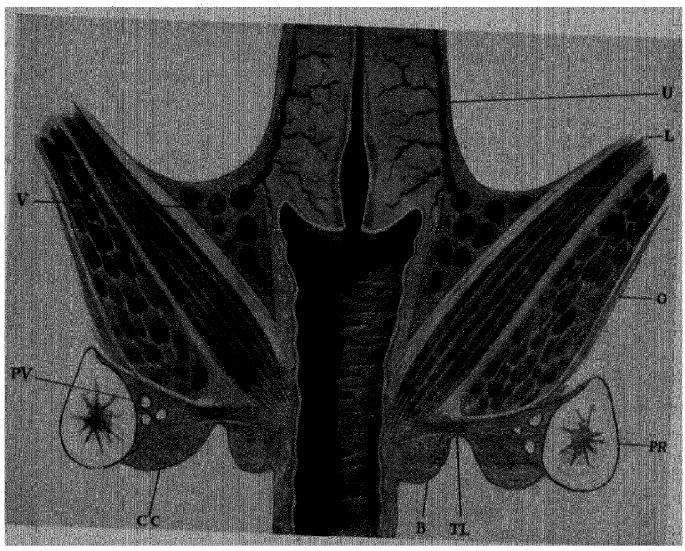


FIG. 320. CORONAL SECTION THROUGH THE PELVIC FLOOR. *L.* Levator ani; *O.* Obturator internus; *PR.* Pubic ramus; *TL* Triangular ligament; *B.* Bulb of vagina; *CC.* Crus clitoridis; *PV.* Internal pudic vessels and nerve; *U.* Uterine artery; *V.* Veins of the parametrium (after Elliott Smith and Stopford).

mobility than the two other canals. An element of weakness is thus evident in the pelvic diaphragm, which owing to the accidents of child-birth is capable of greatly impairing its functional efficiency.

Certain other arrangements exist which counterbalance this element of weakness to a great extent. In the first place the vagina and urethra are attached to the sloping sides of the pelvic diaphragm by the layer of pelvic fascia which invests them, and which is continuous with the other divisions of the pelvic fascia at the white line. In the second place the cervix and vaginal vault have a specialized support of their own. It will be recollected that the uterine vessels reach the uterus at the level of the internal os; as they cross the pelvis from the neighbourhood of the sacro-iliac joint, they carry with them an investment of strong fibrous tissue (*see* Fig. 320). These vessels with their sheaths form an important lateral attachment, which will oppose descent of the uterus. Further, at this

level is to be found a well-formed band of fibrous tissue which has been named the " transverse ligament of the cervix " (Paterson), or the ' cardinal ligament.' It follows the line of the uterine vessels, but at a lower level, and is continuous with their fibrous investment; it is continuous externally with the fibrous sheath of the iliac vessels, and with strong fibrous bands which enter the pelvis through the sciatic notch; internally it is attached to the sides of the uterus, to the sides of the vaginal vault and to the sides of the urethra and bladder. It has been frequently pointed out that in removing the uterus *per vaginam* the cervix cannot be pulled down much below its normal level until the structures at its sides, including the vessels, have been divided, when it can easily be drawn outside the vulva. It is the division of the uterine vessels and the transverse ligaments which liberates the cervix.

It appears, therefore, that the uterus is maintained at its normal level by the pelvic diaphragm, the fibrous sheaths of the blood-vessels, and by the supplementary transverse fascial bands attached to the cervix and vaginal vault. The continual changes in intra-abdominal pressure which result from respiration, changes of posture, coughing, sneezing, and general muscular effort are opposed by the contraction of the muscles of the pelvic diaphragm, which are therefore in constant functional activity. It is possible that abnormal increases in intra-abdominal pressure may lead to compensatory hypertrophy of these muscles. On the other hand, injury to these structures or to the transverse fascial bands from overstretching, or from laceration in child-birth, will seriously impair their efficiency, causing them to yield before the forces of intra-abdominal pressure, and thus to allow the occurrence of prolapse.

DISPLACEMENTS

The following displacements of the uterus may be met with:

(*a*) Forward—anteversion, anteflexion.
(*b*) Backward—retroversion, retroflexion.
(*c*) Inversion—turning inside out.
(*d*) Downward—prolapse.

The term displacement of the uterus is understood to include some departure from the normal *position* of the organ, and also in most cases an alteration in the *curve of its axis*.

The simplest form of displacement is that in which an alteration of position occurs without marked alteration in the uterine axis. Thus the uterus may be pushed bodily forwards against the pubes (*ante-position*) by some tumour or collection of encysted fluid in the pouch of Douglas (*see* Fig. 136, p. 199); a little straightening of the uterine axis may result, but the organ remains anteverted. Similarly the uterus may be pushed back into the sacral hollow (*retro-position*) (*see* Fig. 321) by a tumour in the utero-vesical pouch, or may more rarely be drawn there by contraction of old inflammatory adhesions in the pouch of Douglas. Or it may be pushed over to one side of the pelvis by a laterally situated swelling, *e.g.* a cyst developing between the layers of the broad ligament on the opposite side (*sinistro-* or *dextro-position—see* Fig. 461, p. 688) or more rarely drawn over by contraction of the cellular tissue upon the same side. Again, the uterus may be raised above the level of the pelvic brim (*elevation*) by a

collection of retained menstrual fluid in the vagina (*see* Fig. 104, p. 153), or may sink below its normal level, either from failure of its proper supports, or from increase of intra-abdominal pressure above it, produced by abdominal tumours or collections of fluid. Occasionally the uterus undergoes *rotation* on its long axis when enlarged by the presence of fibroid tumours (*see* Fig. 228, p. 385).

It will be obvious that such displacements as these, though of anatomical interest, in reality are only mechanical results of other morbid conditions which are of far greater importance, and are only capable of correction by

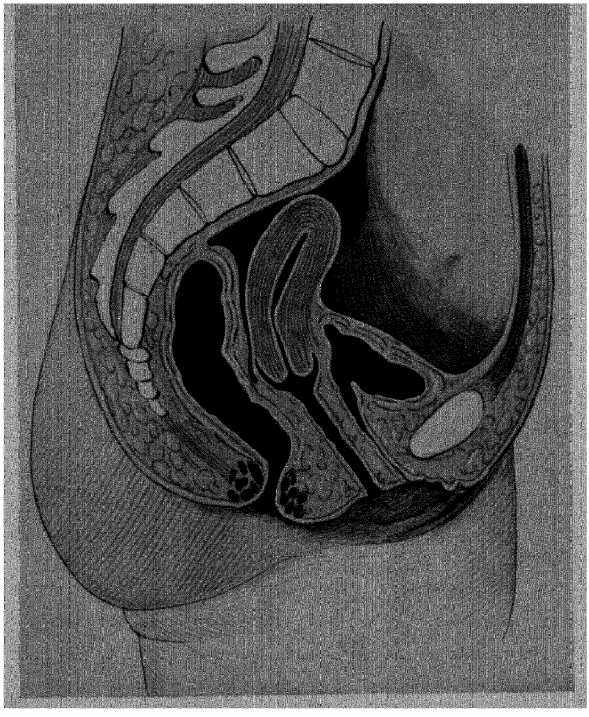


FIG. 321. RETROPOSITION OF THE UTERUS.

removal of these conditions. Such displacements only become of practical importance when the displaced uterus becomes gravid. Displacement downwards belongs to a special category; it induces secondary displacement of other organs and leads to a definite train of clinical results. It is known as *Prolapse*, and will be considered in a later section (*see* p. 530).

Displacements are usually accompanied by an alteration in the uterine axis, which may be of two kinds—*version* or *flexion*. In the former case the width of the angle between the body and the cervix is not much altered. In the latter case the width of this angle is diminished until it becomes acute, when the uterus is said to be *flexed;* if the uterine body remains directed forwards the condition is called *anteflexion;* if occurring in connection with displacement backwards, *retroflexion*. For practical purposes no distinction need be made between versions and flexions, and they will be considered together in the succeeding paragraphs.

Forward Displacement of the Uterus

Anteversion is the normal position of the uterus; it varies continually with the filling and emptying of the bladder, and is usually exaggerated in early pregnancy. While the width of the corporeo-cervical angle remains normal, the condition is not to be regarded as pathological.

Anteflexion occurs under two different conditions; in some cases it is congenital, and is then generally associated with deficiency in size and development of the whole organ (*see* p. 135); in other cases, which, however, are rare, the displacement is acquired, being brought about by contraction of the utero-sacral ligaments (chronic utero-sacral cellulitis) pulling the isthmus upwards and backwards, and thus increasing the acuteness of the uterine angle. The same result may ensue from adhesions in the lower part of the pouch of Douglas, pulling back the cervix and posterior vaginal wall. The uterine angle may then be reduced below a right angle, with a consequent abrupt bend in the curve of the uterine cavity. Both the congenital and the acquired types are rare, the latter being especially uncommon. The reduction in the width of the corporeo-cervical angle may be due, either to an altered direction of the cervix, the position of the body being nearly normal, or to a forward bending of the body, the direction of the cervix being normal; in the most marked instances it is (Fig. 322) due to both conditions. The congenital form of small anteflexed uterus is often called the 'cochleate uterus.'

Diagnosis is easy by bimanual examination. In the congenital type both cervix and body are usually unduly small, while in the acquired type they are of normal size. The degree of flexion can be estimated by the index finger placed in the anterior fornix. It must be borne in mind that the uterine angle is subject to considerable variation in size under normal conditions, and slight degrees of anteflexion, therefore, sometimes occur in health. Certainly not all cases are pathological; only those should be so regarded in which either deficiency in the size of the uterus, or chronic inflammatory changes are found in connection with it. In the latter condition the mobility of the uterus is always diminished, which forms a useful aid to the diagnosis of the acquired form. Under all other conditions anteflexion is not pathological and does not require treatment.

The two main *symptoms* of pathological anteflexion are *spasmodic dysmenorrhœa* and *sterility*. The bend in the uterus is not, however, directly responsible for either of these symptoms; in the congenital type both may be due to the deficient development of the organ; in the chronic inflammatory type the associated inflammatory lesions are the cause of the principal symptoms.

It follows from what has previously been said that the *treatment* of these cases is to be directed not solely to the correction of the abnormal uterine angle, but to the alleviation of the causal conditions when practicable. In the congenital type dilatation of the cervix, when performed, is of only temporary benefit; in a few fortunate cases pregnancy may follow this operation and a permanent cure may then result. It is possible that if these cases could be recognized during adolescence, endocrine therapy might promote the secondary development of the uterus (*see* p. 89). Attempts to stimulate the development of the uterus by the electric current have been made, and have generally proved unsuccessful. In the chronic

inflammatory type the treatment is that of chronic pelvic inflammation (*see* p. 235).

Backward Displacement of the Uterus

Although the usual position of the uterus is one of anteversion, it will be understood, from what has been said about the supports of the uterus, that a narrow interpretation of what is normal cannot be upheld. Owing to anatomical dispositions it is possible for the uterus to be displaced backwards without interfering in any way with the position or function of any other organ. In other cases, the tubes and ovaries are also dragged out of position, but these are the only organs which can in any way be displaced.

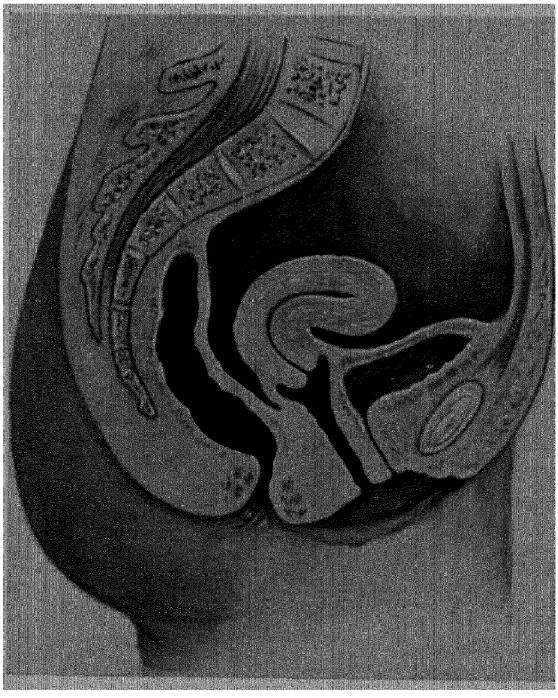


FIG. 322. ANTEFLEXION OF THE UTERUS (Diagrammatic).

Clinical experience has indubitably proved that it is possible for a uterus 'displaced' backwards to perform all its functions, including that of gestation, normally. There is, therefore, not the slightest justification for regarding every case of backward displacement as pathological or as requiring treatment. Often the condition is seen in women with perfectly normal health.

There are, however, certain respects in which a backward-lying uterus is to some extent at a disadvantage, especially in relation to the functions of *insemination and menstruation*. The former may be affected by the coincident forward displacement of the external os. Coitus in the dorsal position deposits semen in the posterior vaginal fornix; if the uterus is retroverted, the external os is directed away from the posterior fornix, and the entrance of spermatozoa into the cervical canal is possibly rendered

more difficult. That this difficulty may be readily overcome is shown by the numerous cases in which repeated pregnancy has occurred in women with a retroverted uterus.

With regard to menstruation, it must be recollected that a uterus fully retroverted or retroflexed is so placed that the fundus is on a lower level than the internal os; consequently the force by which the menstrual fluid is expelled has to overcome a certain amount of resistance from gravity. To a uterus on the border-line of muscular inefficiency, this slight obstacle may be sufficient to induce muscular spasm and its attendant severe menstrual pains. In most cases, menstruation occurs without any abnormal pain.

It is obvious, in addition, that backward displacement renders drainage

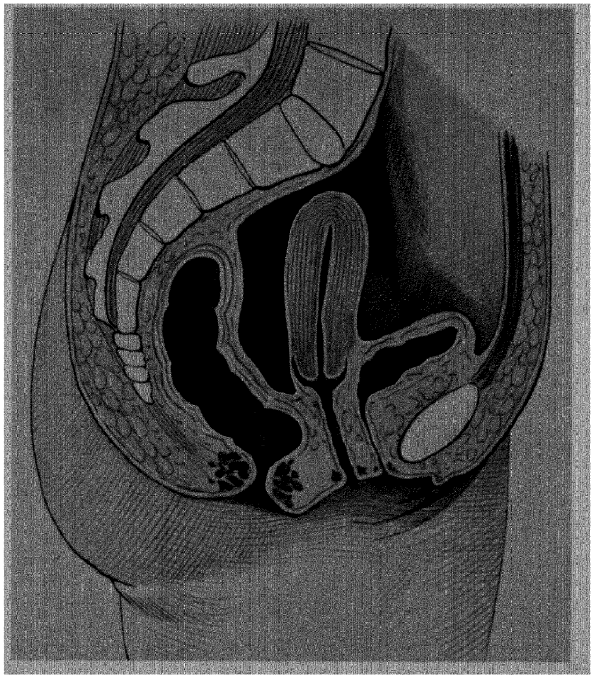


FIG. 323. RETROVERSION OF THE UTERUS (First Stage).

of the uterine cavity more difficult. In health this is unimportant, as the uterine secretions are scanty. If the uterus becomes infected in the puerperium, the backward displacement forms a complication of real practical importance.

It is open to question whether backward displacement has any influence upon the *uterine circulation*. Some writers believe that as the broad ligaments become folded over the edges of the utero-sacral ligaments, pressure is exerted upon the walls of the veins of the pampiniform plexus to an extent sufficient to cause stasis. In this way a broad-ligament varix may result, but it is probably very rare, and its clinical significance when present is doubtful.

The foregoing considerations serve to explain the fact that a large

number of instances of retroversion are encountered on routine gynæcological examination, where the 'displacement' gives rise to no ill effects whatever. Retroversion has been observed in the fœtus, and it is probable that many cases in adults are congenital. Other minor abnormalities may be associated with it in congenital cases, such as a shortness and narrowness of the vaginal canal, or an undersized *portio vaginalis*. In other instances the 'displacement' is fortuitous, and may be found spontaneously corrected on a later examination.

Great care is accordingly required in deciding what view to take of a case of backward displacement. To treat all cases is clearly improper, and a careful consideration of the associated symptoms is required. No

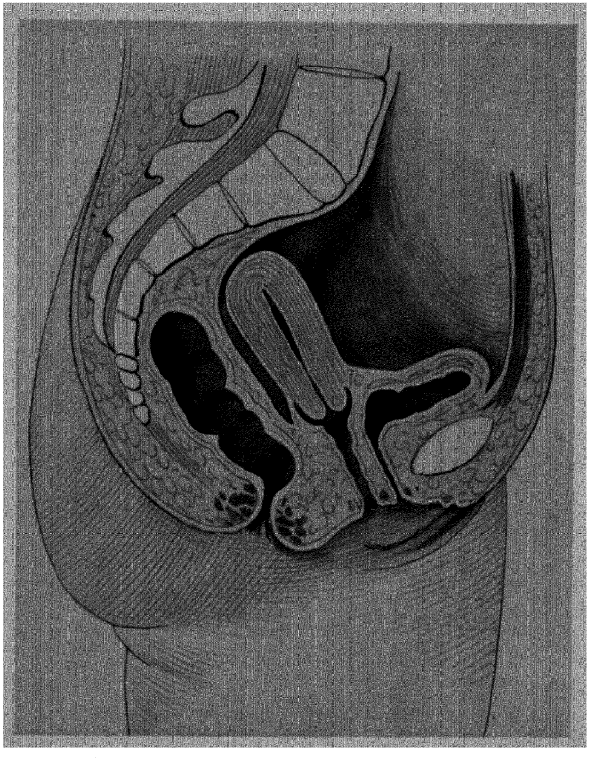


FIG. 324. RETROVERSION OF THE UTERUS (Second Stage).

distinction need be made between retroflexion and retroversion; the extent to which the uterus bends at the isthmus depends upon the tone of the uterine wall, and except that a marked flexion aggravates the mechanical impediments already referred to, it is of no importance. While retroversion is often congenital, retroflexion is usually an acquired condition.

Apart from the degree of flexion at the isthmus, cases of backward displacement vary in regard to the extent to which the uterus is deflected from its normal position. In its simplest form the uterus is drawn backwards towards the sacral hollow, occupying much the same position as it would naturally fall into during extreme distension of the bladder (*see* Fig. 4, p. 7, and Fig. 321). This may be conveniently distinguished as *retroposition*. The stages of a true retroversion are represented in Figures 323,

324, and 325 ; from these it will be seen that the uterus rotates in a backward direction upon a transverse axis passing through the isthmus, the result being that the fundus describes an arc which ends below upon the floor of the pouch of Douglas, while the external os describes a much smaller arc directed towards the pubes. The three stages represented are not definite degrees of retroversion, but it is convenient for clinical description to recognize these steps of the process of displacement.

Apart from the congenital cases the commonest cause of backward displacement is a general lax condition of the uterine supports, due usually to child-bearing but often also occurring in nulliparous women.

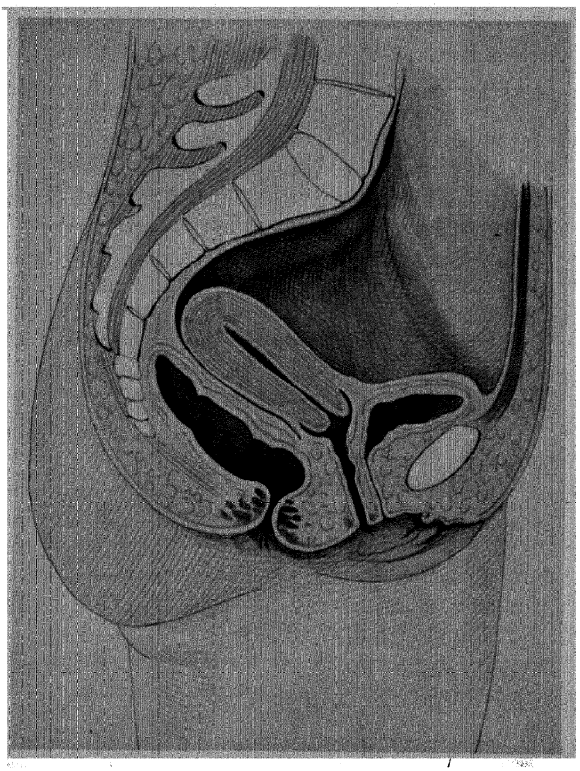


FIG. 325. RETROVERSION OF THE UTERUS (Third Stage).

Many cases of retroflexion first come under observation after child-birth, and are no doubt brought about by two factors : (*a*) relaxation of the uterine supports, and (*b*) the abnormal size and weight of the uterus. In these circumstances the uterine body may be readily displaced backwards by a fall or by overdistension of the bladder. Such a result is obviously more likely to occur if the uterus is heavy, as from early pregnancy, or from sub-involution, or from enlargement due to a small fibroid tumour. Backward displacement is also a secondary result of prolapse (*see* Fig. 334, p. 532). Sometimes it occurs in consequence of great increase in intra-abdominal pressure from the presence of a large tumour or of a large amount of fluid in the peritoneal cavity. Lastly, it may be brought about by pelvic peritonitis affecting the pouch of Douglas, and resulting in the formation of adhesions,

the gradual contraction of which draws the uterus down to the floor of the pouch.

Sometimes an enlarged and retroverted uterus, when examined during an abdominal operation, shows signs of having been exposed to friction in its abnormal position. Thus the peritoneal surface may be darker than normal, with irregular areas of pale mottling upon the posterior wall; in a case seen by one of us there was a distinct shallow ridge upon the fundus where it lay in contact with the rectum. When adhesions have formed the uterine surface will be roughened and shaggy.

Complications. Simple cases of backward displacement, *i.e.* those in which there is no other morbid condition present, rarely give rise to symptoms and accordingly seldom require treatment. Only when some other condition is superadded do symptoms arise. Perhaps the commonest complication is sinking of the whole organ below its proper level (*descent*). When multiparæ are affected, general relaxation of the supporting structures tends to produce both displacements. These cases cannot, however, be considered as instances of prolapse, for they do not show the tendency to progress in the direction which is characteristic of 'falling' of the womb. Retroversion with descent is, however, always of greater import than when the normal level is maintained. Next in frequency and importance comes *prolapse of the ovaries.* The tubes and ovaries are frequently dragged downwards and backwards until they lie in the pouch of Douglas; often one ovary or both may be found upon the floor underneath the retroverted fundus. The clinical features of the case are undoubtedly intensified when prolapsed ovaries are also present.

These two conditions are, strictly speaking, the only *complications* of backward displacement.

Three other morbid conditions, although independent in origin, are, however, so frequently found in association with it, that mention must be made of them here. The first of these is *pelvic inflammation,* the commonest form being bilateral chronic salpingitis. With this condition, more or less widespread peritonitic adhesions are usually found, the result of which is loss of mobility of the uterus and the adnexa. Reposition of the organ, except by operative measures, is impossible, and the mass of inflamed structures filling the posterior pelvic compartment may be the cause of severe suffering.

The second is *an interstitial fibroid tumour* which has enlarged the uterus to a size sufficient to fill the sacral hollow and crowd the other pelvic organs. In many such cases the fibroid has developed in the posterior uterine wall, and the uterus is not, strictly speaking, retroverted at all. When the tumour is situated in the posterior wall, the direction of the uterine cavity may not be much affected, and reposition is usually impossible in such cases.

The third is the condition already described as *chronic interstitial endometritis* (*see* p. 351), which is especially frequent in cases of backward displacement of puerperal origin.

When a fibroid tumour or salpingitis is present, these conditions so much outweigh in importance the abnormal position of the uterus, that they are to be regarded as the determining factors in treatment, and the principles upon which they are to be dealt with have been considered elsewhere.

Symptoms. It has been mentioned already that, in a certain proportion of cases, backward displacement gives rise to no symptoms and

requires no treatment. In the majority, however, the following symptoms, or some of them, will be met with: *pain* in the lower abdomen and sacral region; *menorrhagia, dysmenorrhœa and leucorrhœa;* and married women may complain, in addition, of *dyspareunia* and *sterility*. It must, however, be borne in mind that a similar symptom-complex, due to other causes, may be met with when the position of the uterus is normal; accordingly, the dependence of the symptoms in a given case on the malposition of the uterus cannot always be postulated with certainty.

Pain is never acute, but is usually of a dull aching or dragging character and is relieved by lying down; it most commonly takes the form of backache, or sometimes of a dragging pain in one or both iliac regions. Pain is usually most severe in cases where the uterus is adherent, or the ovaries are prolapsed. *Menorrhagia* and *leucorrhœa* are the result of accompanying endometritis. *Dysmenorrhœa* may be due in part to congestion, in part to the increased difficulty which the uterus meets with in expelling the menstrual blood, when the uterine body lies below the level of the internal os, as in cases of extreme backward displacement. *Dyspareunia* is seldom present, except in cases where recent adhesions exist, or where the ovary is completely prolapsed, *i.e.* lies on the floor of the pouch of Douglas. Women with a backward displacement are by no means necessarily *sterile*, but it has been frequently observed that after several years of non-fertile marriage, cure of a backward displacement has been followed by conception. This displacement is therefore a possible factor in the causation of sterility.

It has been frequently asserted that backward displacement is a cause of constipation or intestinal stasis, and so may become indirectly the cause of general ill-health. The evidence in favour of this view is not convincing.

These are the only symptoms which can be directly attributed to the displacement, and it will be apparent that they are neither important nor characteristic. Backache is the commonest of all the ailments of which women in indifferent health complain; and especially is this the case in the large class of ailments described as 'functional.' The discovery that a woman complaining of backache has a retroverted uterus is no justification for attributing the pain to the displacement; care should be exercised in accepting this apparently easy explanation, for the treatment appropriate to the displacement will be unsuccessful. Another equally unfortunate error is to attribute to the displacement symptoms for which it could *under no circumstances* be responsible. The commonest instance of this misjudgment of a symptom is irritability of the bladder, or urinary incontinence, neither of which can possibly be caused by backward displacement of a uterus of approximately normal size.

A further source of error lies in the fact that retrodisplacement may be found in women who present the well-known picture of complex *functional disturbances* of the pelvic type. The greatest difficulty lies in estimating at their true value the dependence of such symptoms upon the malposition of the uterus. No clinical problem taxes the patience and the judgment of the conscientious gynæcologist more than this. If the simple rule, followed apparently by some, is observed, of correcting every case of backward displacement, it may be safely said that only a small proportion of the patients treated will derive benefit.

Diagnosis. The diagnosis of backward displacement can be made only by internal examination. *Per vaginam* the examining finger first

notes the forward displacement or inclination of the cervix; this is most marked in cases of retroversion (*see* Fig. 325). Owing to the frequency with which slight degrees of prolapse are associated with backward displacement, the uterus is often found at a lower level in the vagina than normal. The anterior fornix is found empty on bimanual examination, *i.e.* the uterine body cannot be felt there. Exploring the posterior fornix, a body will be found which, in favourable cases, can at once be shown to be the uterus. The following three points suffice for this diagnosis: (*a*) the body found in the pouch of Douglas can be felt to be continuous with the cervix, no sulcus or interval being recognizable between them; (*b*) on moving the cervix from side to side with the finger, the body in the pouch of Douglas will be felt to move with it; (*c*) the characteristic pyriform shape of the uterus may be recognized, the broad end lying below and behind the cervix. The latter point can often be more readily made out by rectal than by vaginal examination. It may be difficult to make a bimanual examination of a retroverted uterus except under anæsthesia. Confirmation of diagnosis may be made in a difficult case by the passage of the sound, which must be carried out under strict antiseptic precautions. The ovaries, if simply prolapsed, will be found at the sides of the uterine body in the pouch of Douglas; their shape, mobility and sensitiveness assist greatly in recognizing them. Sometimes, however, they may be found adherent either to the back of the uterus or to the floor of the pouch of Douglas. In cases where the retroversion is unaccompanied by prolapse, the normal position of the ovaries may be preserved. Finally, an attempt should be made to push the body of the uterus upwards and forwards in the axis of the pelvic brim, when an estimate of its degree of freedom from adhesions may be formed. Adhesions often, however, permit a considerable degree of mobility, and can sometimes be felt by the finger as tense bands; recent adhesions when stretched cause pain. The presence of adhesions must not be inferred from a failure to replace the uterus, unless the attempt has been made under anæsthesia.

Difficulty will in some cases be met with from extreme tenderness of the uterus, in others from loading of the rectum with scybala. Detailed diagnosis must then be deferred until the appropriate preparatory treatment has been carried out.

Treatment. From what has been already said it will be clear that a difficult preliminary question may have to be decided, viz. is the case one which requires treatment at all? No absolute rules can be formulated, but the problem can be narrowed down to some extent by defining certain classes of cases as follows: (1) in young unmarried women, and in women who have long passed the climacteric, treatment of an *uncomplicated case* is never required; (2) in sterile married women the displacement should be corrected even if no pelvic symptoms are present at all; (3) cases occurring in married women in which the ovaries are prolapsed usually require treatment. With regard to all others careful judgment and selection are called for.

The object of treatment is to replace the uterus and *maintain it in its normal position*, and to do this in the simplest possible manner. In recent puerperal cases a period of rest in bed, the patient lying in the prone position for several hours each day, and combined with massage and passive muscular exercises, may both relieve the symptoms and spontaneously restore the

uterus to its normal position. The treatment is, however, tedious and seldom applicable except in the well-to-do classes. Digital reposition is the alternative method.

When reposition of the uterus has been decided upon, two methods are available, viz. (*a*) the operative method, the object of which is to maintain the uterus permanently in a position of anteversion, and (*b*) the instrumental method, the object of which is to keep the uterus anteverted by means of a mechanical support (pessary) placed in the vagina. There is at present no uniformity of opinion as to the special indications for each method, but one or two guiding principles may be stated thus: (1) The use of a pessary should always be regarded as a temporary expedient only; its prolonged use is objectionable from the point of view of cleanliness, and sometimes causes serious trouble from ulceration. (2) A pessary rarely *cures* a displacement, *i.e.* its use cannot be discontinued without recurrence taking place. (3) An operation suitably planned, involves but slight surgical risks, and is almost invariably successful in preventing recurrence. It follows that the field of application of a pessary is limited; a typical instance in which it may be used is a puerperal backward displacement associated with sub-involution. Here the use of a pessary for three months may permanently cure the displacement, for in that time the uterus may be restored to its normal size and the cause of the displacement is thus removed. When the surgeon is in doubt as to whether the symptoms are due to the malposition or not, the pessary affords an experimental test of the relation of the symptoms to the lesion.

It must be borne in mind that unless the pessary retains the uterus in a satisfactory position, it has failed in its purpose, and must be discontinued. Failure of the pessary forms one of the strongest indications for operation.

Before attempting to replace the uterus *preparatory treatment* is sometimes necessary. It is essential that the lower bowel should be empty, and in patients habitually constipated a course of aperients may be necessary; if the uterus is very tender, replacement without an anæsthetic cannot be carried out, owing to the pain which the manipulation causes. The patient may then be sent to bed for a week, and treated with hot vaginal douches twice or three times a day, vaginal pessaries or tampons of glycerine, or of glycerine and ichthyol (10 per cent. of the latter), a daily saline aperient before breakfast, and a light diet without alcohol. The employment of general anæsthesia, although it allows of the uterus being replaced, does not obviate the necessity for these preparatory measures, for a pessary cannot be supported in comfort by the patient when great tenderness of the pelvic organs is present.

The displaced uterus may be reduced with the fingers, either alone or aided by the uterine sound; if anæsthesia is not employed the Sims's position is the most useful (*see* Fig. 81, p. 106). The index and middle fingers of one hand are first passed into the posterior vaginal fornix, and with them pressure is made upon the fundus of the uterus in an upward and forward direction towards the pelvic brim. With the assistance which the Sims's position lends to this manœuvre, the fundus can easily be raised to the level of the sacral promontory; but the most difficult part of the reduction remains. If the abdominal walls are thin and lax, they can now be depressed by the fingers of the other hand until these pass behind the uterine fundus, which is then gently directed forwards towards

the symphysis, while the internal fingers push the cervix upwards and backwards towards the sacral hollow.

The second and third stages can often be best carried out after getting the patient to turn over on her back, while the operator keeps the uterus in the position to which he has raised it. With the complete muscular relaxation of general anæsthesia, the aid of Sims's position is not required, and the whole procedure can be carried out with the patient on her back.

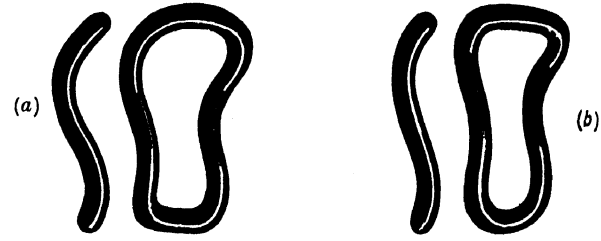


FIG. 326. PESSARIES FOR BACKWARD DISPLACEMENT. (*a*) Hodge Pessary; (*b*) Albert Smith Pessary. Note that the lower end of (*a*) is square, and the profile-curve is more pronounced than in (*b*).

If the uterus cannot be replaced by the fingers alone in this manner, an anæsthetic should be given. Digital manipulations may then succeed, and if not, the sound may be employed as well; owing to the importance of observing strict asepsis in the use of this instrument it is better not to use it except under anæsthesia, when the requisite disinfection of the passages can be properly carried out. In very stout women reposition may be impracticable without the use of the sound. Before using the sound the uterus should be raised as far as possible with the fingers; then the cervix

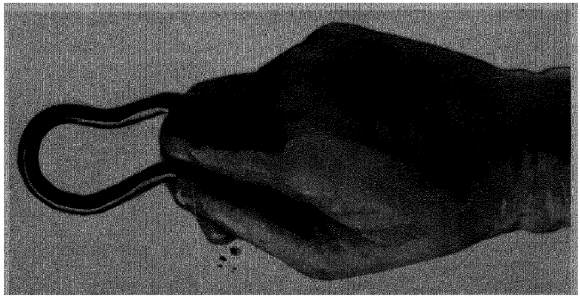


FIG. 327. HOW TO HOLD THE HODGE PESSARY.

should be exposed with a speculum and grasped with volsellum forceps. If the cervical canal contains purulent secretion, the sound must never be introduced. Even if the conditions appear to be healthy prior to its introduction, the cervical canal should be disinfected by a 3 *per cent.* picric acid or 2 *per cent.* iodine solution. After the sound has been introduced up to the fundus the handle is carried well back over the perineum and the fundus will then be directed towards the pubes, whence it can be pushed still further forwards by the fingers of the external hand.

The manipulations with the sound must be very gently carried out; in attempting to raise an adherent uterus the sound may be pushed through

the uterine wall. Unless the fundus can be readily brought forwards to the pubes, the attempt should be at once discontinued.

In some cases after the uterus has been apparently replaced without much difficulty, the faulty position recurs as soon as the retaining finger or the sound is removed. Lax adhesions are sometimes present in such cases; in others the immediate recurrence of the malposition is due to rigidity of the uterine wall, which prevents the slight forward bending of the body on the cervix, which is necessary if the position of anteversion is to be retained. In all such cases pessaries will prove unsuccessful. Prolapsed ovaries, if not adherent, will be carried up into an approximately normal position when the uterus is anteverted. Tubo-ovarian adhesions may

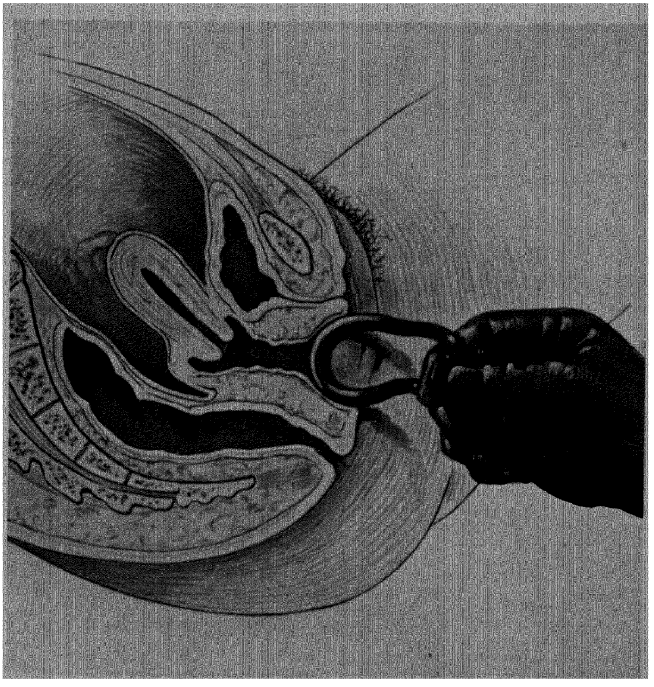


FIG. 328. HOW TO INTRODUCE THE HODGE PESSARY. First step, the instrument passing through the ostium vaginæ.

prevent replacement; they can often be felt through the posterior fornix when the body of the uterus is elevated or held forwards.

When the uterus has been satisfactorily reduced, a suitable pessary should at once be introduced to retain it in position. The most convenient pessary for general use in these cases is the Hodge or Albert Smith pattern, shown in Figure 326, or one of the various modifications of these patterns. The surgically clean instrument is held in the fingers of the right hand, as in Figures 327 and 328, and introduced in the antero-posterior diameter of the vulva. If the uterus has been replaced with the sound, the pessary may be introduced by passing it over the handle of the sound, the latter keeping the uterus in position. It is then pushed on gently in an upward and backward direction, until about one half of the instrument is within the vagina. The right index finger is then directed along the posterior vaginal

wall to the upper bar of the pessary, which can be pushed up until it lies behind the cervix in the posterior fornix (*see* Fig. 329); the pessary will of itself rotate into the transverse diameter of the vagina as this is being done. The lower end of the instrument should now lie just within the ostium vaginæ and in contact with the anterior vaginal wall, well above the urinary meatus; it thus rests against, and is supported by, the thick soft tissues which lie behind the lower end of the symphysis pubis, and which serve as its *point d'appui*, the pessary acting as a long vaginal splint. The upper end carries the posterior fornix upwards and backwards, and thus prevents forward

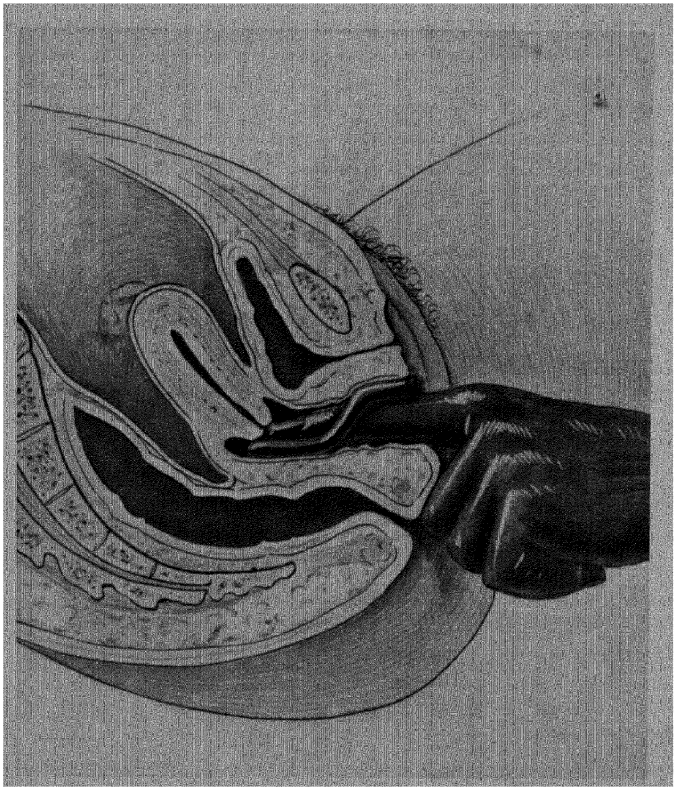


FIG. 329. HOW TO INTRODUCE THE HODGE PESSARY. Second step, the instrument being pushed up into the posterior fornix.

displacement of the cervix. If, however, the vaginal walls and uterine supports are very lax, or if the pessary is too short, the body of the uterus will fall backwards over the top of the instrument.

The instrument should be carefully adjusted to the length and capacity of the canal in which it is to lie. It should cause no discomfort to the patient, who should indeed be unconscious of its presence after introduction. Vulcanite instruments can be moulded to any required shape after immersion in boiling water.

The patient should be directed to use a vaginal douche daily while wearing the pessary, and not to allow it to remain longer than three months without being changed. Neglect of these precautions may lead to vaginal

infection or ulceration. If these precautions are omitted, superficial excoriations may be formed which bleed when wiped with cotton-wool. They are more likely to form in the case of nulliparous women with narrow vaginæ than in parous women in whom the vaginal walls are more lax.

It is often useful to perform a preliminary curetting of the uterus before pessary-treatment is begun, especially in cases of sub-involution and chronic endometritis.

Cases in which the displacement is irreducible, or cannot be corrected by pessaries, can be dealt with only by operation. It must not be forgotten, however, that tubo-ovarian inflammation, when present, takes the case out of the class of displacements altogether, and the treatment should then be considered from a different point of view.

The operation of choice in backward displacements is intra-peritoneal shortening and interposition of the round ligaments, known as Gilliam's operation. Other methods of shortening the round ligaments are practised, or as an alternative, the uterus itself may be stitched to the abdominal parietes. These procedures cannot be usefully discussed without describing them in full, and the reader is referred to the later section dealing with operations for backward displacements (*see* p. 699).

CHRONIC INVERSION OF THE UTERUS

This condition is rare. In the majority of cases it is puerperal in origin and begins as an *acute* inversion. In the remainder it is non-puerperal and associated with the presence of a tumour, most commonly a submucous fibroid, growing from the fundus or upper part of the body of the uterus (*see* Fig. 330). Sarcoma appears to produce this result with relatively greater frequency than a fibroid (*see* p. 453); a small number of cases associated with carcinoma have also been described. The inversion is seldom complete in these cases, but may be so in rare instances, as in that recorded by Schäfer where a fibroid of the fundus produced a puerperal inversion. Puerperal cases, on the other hand, are usually complete; the cervical canal may be partially retained, as in Figure 331, or the whole of the cervix together with the upper part of the vagina may also become inverted.

The *causation* of puerperal inversion need not be here considered. In non-puerperal cases, due to an intra-uterine tumour, the two factors which predispose to the occurrence of the displacement are, the weight of the tumour and the dilatation of the cervix which an intra-uterine growth usually produces. These two conditions allow of the portion of the uterine wall which forms the base of the tumour dropping into the cavity of the uterus; when this process has once been begun its progress is probably effected by contractions of the surrounding muscular wall, which tend still further to dilate the cervix and expel the mass.

Anatomy. In non-puerperal cases the size of the inverted uterus is never very large; cases are not classed as 'chronic inversion' until from four to six weeks have elapsed since delivery, and during this period involution proceeds with approximate regularity. The peritoneal surface of the uterus forms the cavity or *cup* of the inversion, and this seldom exceeds 2½ inches in depth. The edges of the cup form a prominent ring which is palpable by abdominal examination and is of great service in the diagnosis of the condition. Usually the cup is empty, but sometimes it

contains the Fallopian tubes and ovaries; in recent puerperal cases a coil of intestine may be contained in it. Not infrequently the cup becomes obliterated by adhesion of the peritoneal surfaces, resulting probably from infection which has gained entrance through the mucous surface exposed in the vagina. Obliteration of the inversion-cup greatly increases the difficulty of replacing the uterus.

The mucous surface in the earlier stages is much altered in appearance

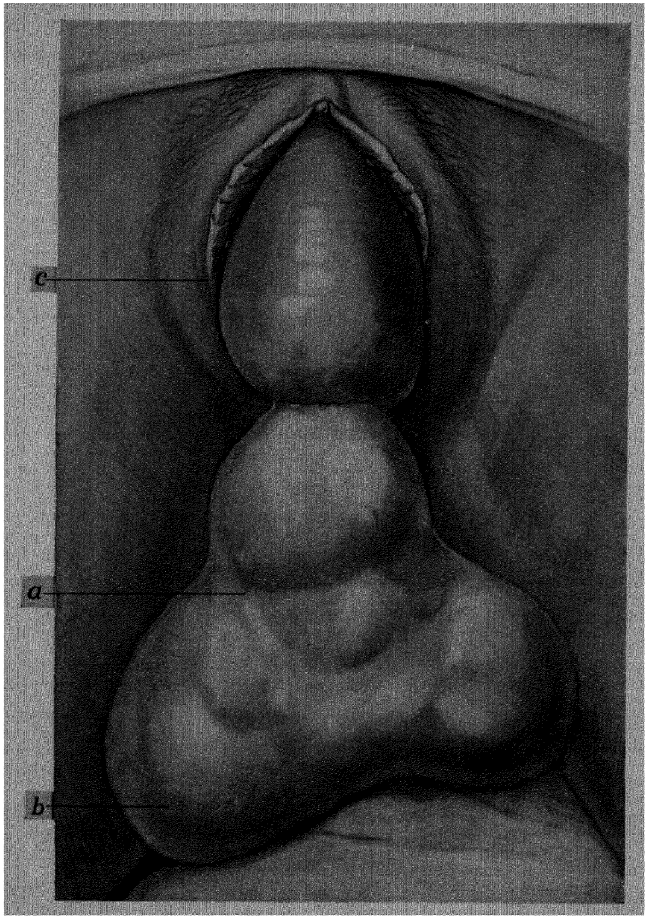


FIG. 330. COMPLETE INVERSION OF THE UTERUS AND VAGINA DUE TO A SUBMUCOUS FIBROID (after Barnes). *a*. Uterine fundus. *b*. Tumour. *c*. Inverted vagina.

by congestion and œdema; the openings of the Fallopian tubes are thus obscured. Later on, patches of superficial ulceration from traumatism or infection may be found. Occasionally, in long-standing cases, cell-metaplasia from friction occurs, and the epithelium becomes stratified, taking on the external characters of vaginal mucous membrane.

While puerperal inversion is nearly always complete, non-puerperal inversion is usually incomplete, and varies in extent from a mere depression corresponding to the base of the tumour, up to the expulsion of the fundus

into the vagina. In rare instances (*see* Fig. 330) complete inversion both of the uterus and the vagina may, however, take place. The attachment of the tumour is usually fundal, but it may be either sessile or polypoid.

Clinical Features. The prominent *symptom* of chronic inversion is irregular hæmorrhage, dating in puerperal cases from the confinement; the bleeding may be very severe and has sometimes proved fatal. In addition, the patient may complain of the presence of a tumour, or of the womb 'coming down.' The diagnosis can only be made by physical examination, and while, in complete puerperal cases, this is very easy, in partial cases, associated with a tumour, great care is required to avoid mistakes.

The completely inverted uterus forms an inverted pyriform swelling

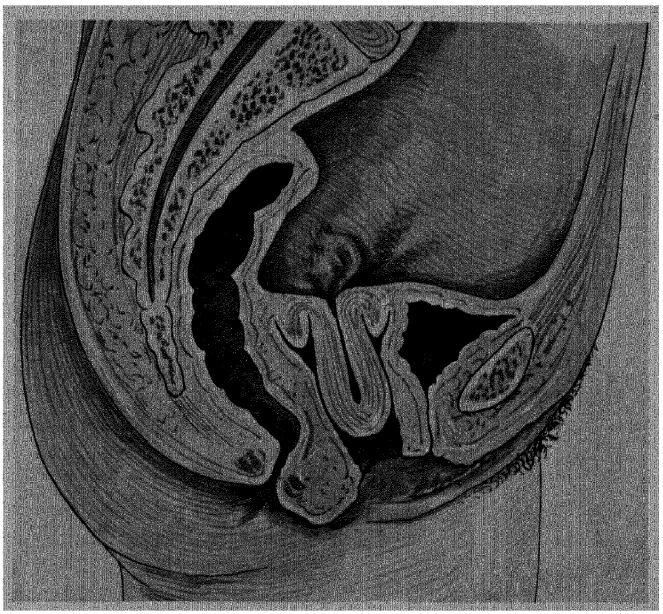


FIG. 331. INCOMPLETE CHRONIC INVERSION OF THE UTERUS (diagrammatic, after Haultain). The tube and ovary are seen lying above the inverted uterus.

occupying the upper part of the vaginal canal. It is smooth, dark red in colour, and usually bleeds readily on being handled. The orifices of the Fallopian tubes can seldom be distinguished. On passing the examining finger upwards, a constricting ring may be felt surrounding the neck of the swelling (*see* Fig. 331); this represents the external os, and shows that the cervical canal is not completely inverted. If the cervix has been completely inverted, no constricting ring is felt, and the finger passes on to the smooth surface of the vaginal *cul-de-sac* all round. Bimanual examination will reveal the absence of the uterine body from its normal position; the recto-abdominal method is the most suitable, as the vagina is occupied by the inverted uterus. The sound, if used, cannot be passed higher than the top of the vagina. Next to the absence of the uterus, the most important point is the recognition by abdominal examination of the edge of the

inversion-cup; under anæsthesia this can always be felt, and its recognition is also an important point in regard to the reduction of the displacement.

Differential Diagnosis. There are two other conditions in which a large bleeding swelling may be found occupying the vagina, and their differential diagnosis from inversion is a matter of considerable importance. These conditions are: (1) a large fibroid polypus; (2) carcinoma of the cervix. In both of these cases, when a careful bimanual examination is made, if necessary under anæsthesia, the body of the uterus will be found to occupy its normal position. In the case of the *polypus*, its stalk can generally be felt *per vaginam*, but this may conceivably be mistaken for the neck of the inverted uterus; the uterine cavity is, however, open, and a sound may be passed into it along the neck of the polypus. In cases of *carcinoma of the cervix* with formation of large masses of new growth (*see* p. 475) the cervical canal cannot be identified, but a careful bimanual examination will reveal the presence of the body of the uterus lying above the swelling in the vagina.

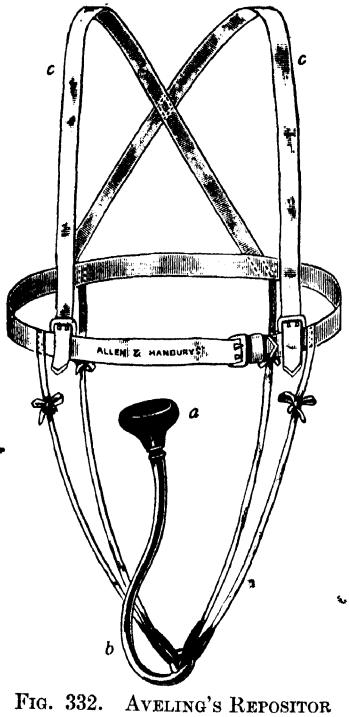


FIG. 332. AVELING'S REPOSITOR FOR CHRONIC INVERSION.

In incomplete cases, which are usually associated with the presence of a uterine tumour, the diagnosis is less easy; while the tumour is readily recognized, the fact that the uterus is also inverted may escape notice altogether, unless the points just mentioned with regard to a recto-abdominal examination are borne in mind. A mistake of this kind may lead to serious operative mishaps and is only to be avoided by remembering its possibility and by making, as a matter of routine in all cases of vaginal tumour, a careful examination to locate the body of the uterus.

Treatment. Cases of inversion when recent are to be treated by manual reduction; this procedure is described in text-books of midwifery. After some time has elapsed the inversion is much more difficult to reduce, and continuous elastic pressure is required to overcome the resistance offered by the inversion ring. The best method of applying this pressure is by the *repositor* of Aveling shown in Figure 332. The vulcanite cup (*a*) fits over the fundus of the uterus; the cup is continued below into a rigid curved stem (*b*), to which four strong rubber bands are attached; these are in turn fixed by tapes to an abdominal girdle with shoulder straps (*c*); the vulcanite cup is thus held in contact with the fundus, and the rubber bands being stretched, continuous elastic pressure in an upward direction is applied through the stem to the inverted uterus. Considerable pain attends the use of the repositor. The process of replacement must be carefully watched, and the cup may be removed before reduction is quite completed, for the last part of the process will occur spontaneously. If this precaution is not adopted, the cup may be carried inside the replaced uterus, and

great difficulty may be encountered in extracting it through the narrow cervix.

Failure may, however, occur from two causes: (1) obliteration of the peritoneal cup by adhesions; (2) rigidity of the uterine tissues, a considerable amount of elasticity being clearly required to allow the uterus to be re-inverted. If the first application of the repositor should fail, an interval of some days should be allowed during which an attempt may be made to improve the local conditions. Thus the patient may be kept in bed with the foot of the bed raised, and hot vaginal douches alternating with glycerine tampons employed. The second attempt may then succeed.

When attempts at reposition fail, which is very seldom, operative measures must be adopted, and some form of operation is, of course, always required in cases of non-puerperal inversion.

Operative Treatment. This may be radical or conservative. *Conservative* operations are designed to overcome difficulties which have prevented reposition. Many methods have been advocated; that which has best stood the test of experience is to overcome the difficulty by means of an incision through the uterine and the vaginal walls (*see* p. 764). By means of these incisions difficulties such as peritonitic obliteration of the inversion-cup can be dealt with, and room obtained for the manipulation of the uterine walls. The mortality of the operation is low, and the permanent results appear to be good.

Radical operation consists in removing the uterus by vaginal hysterectomy; it is indicated in most cases of non-puerperal inversion. Puerperal cases in young women should if possible be treated by conservative methods only.

When a tumour is present the question of its possible malignancy should first receive consideration. Fibroid tumours are usually encapsulated, and can be shelled out after the capsule has been freely incised. Non-encapsulated growths may be malignant and should be treated as such. In some instances preliminary microscopic examination of a portion of the growth may be desirable. If the case is regarded as malignant, an extended vaginal hysterectomy, after the method of Schuchardt, should be practised (*see* p. 777).

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PART II: SECTION IV

PROLAPSE; HYPERTROPHIC ELONGATION OF THE CERVIX

As already mentioned, prolapse is a complex condition affecting the uterus and many other pelvic organs and structures.

There are four common clinical varieties of prolapse, viz. (1) prolapse of the anterior vaginal wall (*cystocele*); (2) prolapse of the anterior vaginal wall and the uterus; (3) prolapse of both anterior and posterior vaginal walls (*cystocele* and *rectocele*); (4) complete prolapse of the uterus with inversion of the vagina, *i.e. procidentia;* (5) prolapse of the posterior vaginal wall alone (*rectocele*). With these conditions must be classed another, viz. *hypertrophic elongation of the cervix.* This condition is frequently met with as a complication of prolapse, although in one of its forms (*vide infra*) it is primary and occurs alone.

The frequency with which these different forms are met with is variable; the commonest combination is uterine prolapse with cystocele; then, combined cystocele and rectocele; with uterine prolapse cervical elongation and hypertrophy are frequently combined; the rarest conditions are simple cystocele and simple rectocele, the latter being the rarest of all.

It is therefore clear that *prolapse* is not a displacement of the uterus alone, the vagina being usually involved as well, and in some cases also, as will be seen later, the bladder and urethra, the rectum, the Fallopian tubes and ovaries, the broad ligaments, and even coils of intestine or a portion of the omentum, may form a part of the prolapsed structures.

Prolapse may be likened to hernia, inasmuch as it consists in the protrusion of a portion of the abdominal contents through an aperture in the supporting structures. Procidentia further resembles hernia in the presence of *coverings*, the vagina, a *sac*, consisting of the utero-vesical and utero-rectal peritoneal pouches, and *contents* consisting of different structures which have been drawn into it. The hernial aperture through which prolapse occurs is formed internally by the interval between the *levatores ani* muscles, and externally by the ostium vaginae.

All varieties of prolapse, except that due to elongation of the cervix, are met with much more frequently in parous than in nulliparous women, and there can be no doubt that obstetric laceration, and relaxation of supporting structures are powerful predisposing causes. In a few cases it may be that the walls of the hernial aperture are congenitally weak, and the internal organs indifferently supported; prolapse may then occur without any actual injury having taken place. On the other hand, stretching of the hernial aperture, when once begun, may be continuously increased by abnormal intra-abdominal pressure, as when a large abdominal tumour is present, or when the patient follows some laborious occupation involving muscular effort, or suffers from a chronic cough, or from attacks of violent sneezing as

in hay-fever. Constipation, and the straining it entails, may in the same way become contributory causes.

ANATOMY OF PROLAPSE

In all but very early cases of prolapse there is a protrusion from the vulva, but its extent is very variable. The protrusion may be only apparent after the patient has been up and about for some hours; when resting it again retreats within the vulva. In all forms of prolapse the degree of protrusion is increased by contraction of the diaphragm and abdominal muscles, *e.g.* in 'straining.'

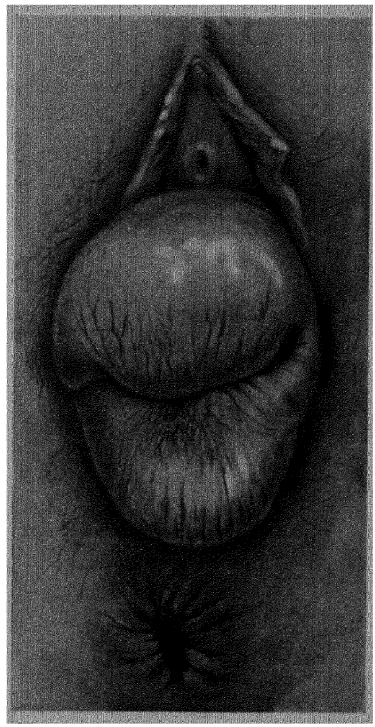


FIG. 333. PROLAPSE OF SECOND DEGREE, showing protrusion of the cervix, the lips of which are thickened and everted.

Prolapse of the Uterus. This is described as occurring in three degrees. In the *first*, often called *descent*, the uterus lies below its normal level, but the cervix does not protrude from the vulva; it *may or may not* be accompanied by backward displacement. In the *second* degree the cervix protrudes, in part or wholly, from the vulva (Fig. 333), and the body *is always* directed backwards. In the *third* degree, distinguished as *procidentia* (Fig. 336), the whole uterus is expelled through the vulva, and in consequence the vagina is almost completely inverted.

The first stage of the process consists essentially in dropping of the uterus; backward displacement is only incidental and is explained by the fact that the uterus cannot fall through the pelvic outlet unless it lies in the axis of the outlet. The vagina is not prolapsed at this stage to an appreciable extent. The second and third stages consist essentially in inversion of the vagina, and this process usually takes place from below upwards, *i.e.* the vagina is not inverted by the traction exerted upon it by the falling uterus; on the contrary, the latter is drawn out of the pelvic outlet by the inversion of the anterior wall of the vagina. That this is the true sequence may be demonstrated in a case of procidentia by watching the reappearance of the prolapsed parts after they have been reduced. If the patient is directed to strain, the lower part of the anterior vaginal wall first appears, then the remainder of this wall bringing with it the cervix, and lastly the posterior wall appears, being inverted in the reverse direction, viz. from above downwards. Procidentia is accordingly a combination of cystocele with *prolapsus uteri;* the inversion of the posterior vaginal wall, as will be seen later, is not a true rectocele, but the mechanical result of the uterus being driven out of the pelvis.

The structure of the hernial protrusion in cases of *procidentia* is shown

in Figures 334 and 335 in sagittal mesial section. The protrusion takes the form of an inverted cone, the apex of which is formed by the *portio vaginalis* with the external os; the outer coat or covering of the hernia is formed by the wall of the vagina, which is completely inverted, and can be traced forwards to the urinary meatus and backwards to the perineal body. At the base of the hernia lie the *mons Veneris* in front and the anus behind. The sections show that the whole of the bladder and the whole of the uterus lie within the hernia. The posterior vaginal wall has been completely separated from the rectum; only a small portion of the anterior rectal wall is seen in Figure 335, while in Figure 334 it is seen that no part of the rectum has been drawn into the protrusion. The urethra runs almost vertically upwards from the bladder to the meatus. The anterior and posterior

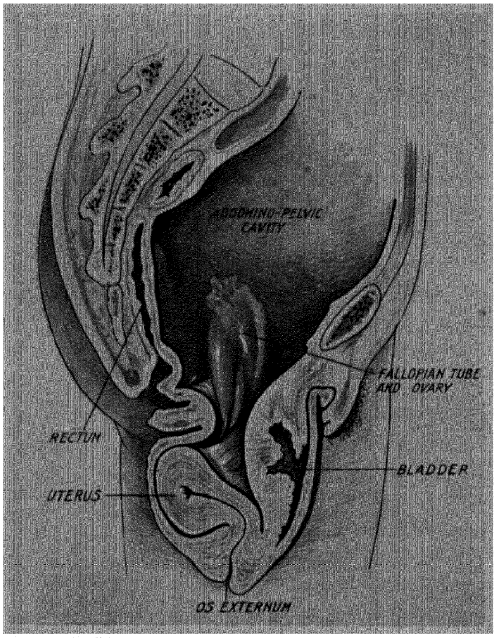


FIG. 334. PROCIDENTIA UTERI, as seen in mesial sagittal section of the pelvis; the cervix is somewhat elongated (Berry Hart).

peritoneal pouches lie outside the pelvis; the Fallopian tube and ovary lie at a much higher level than the uterus. It would obviously be possible, during life, for coils of intestine or portions of omentum also to find their way into the peritoneal pouches.

It is not in all cases that the whole of the bladder passes into the hernia; in less advanced instances it is the base of the bladder only, the herniated portion forming a sac in which urine is liable to become stagnant. It is obvious from the marked displacement that considerable mechanical difficulty must arise in evacuating the bladder.

Cases of total prolapse of the uterus such as those just described are rare; instances are much more common in which, although almost the whole of the vagina is inverted, a portion of the uterus is retained within the pelvis owing to the accompanying elongation of the supra-vaginal cervix. These

are not, strictly speaking, cases of *procidentia*, but are extreme examples of the second degree of prolapse. When the *base* of a true procidentia is pinched up with the fingers the uterus is felt to lie entirely below the base.

In long-standing cases of the second and third degrees, certain *secondary* changes occur in the prolapsed parts. The anterior vaginal wall loses its transverse folds and becomes smooth from stretching; next the epithelial covering dries and takes on the appearance of skin. In chronic cases great

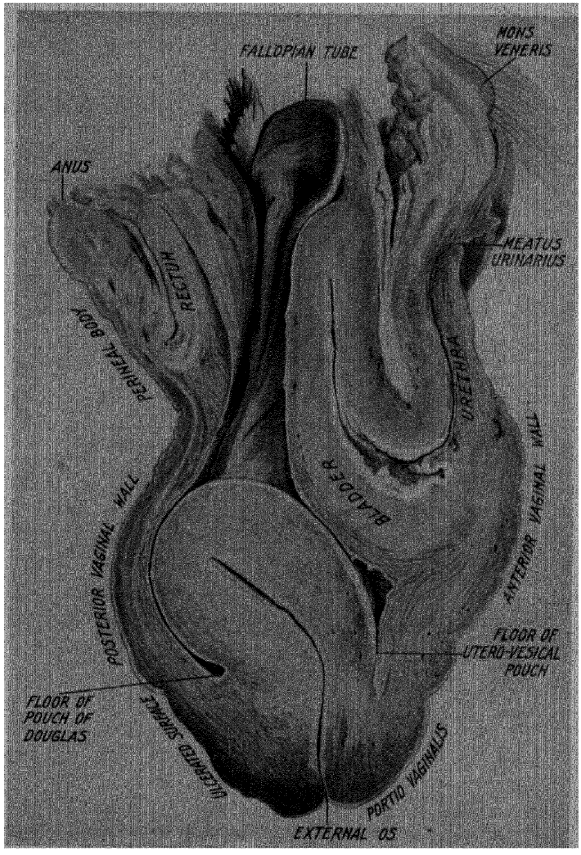


FIG. 335. PROCIDENTIA UTERI FROM A DISSECTION. A sagittal mesial section has been made through the hernial protrusion to show its component parts. The general thickening of the bladder wall is probably due to chronic cystitis (Charing Cross Hospital Museum).

thickening of the vaginal wall occurs from congestion and œdema, and the tissues lose their pliability and become hard and rigid. The anterior wall shows these changes much more markedly than the posterior, and may be found one-third to half an inch thick in chronic cases which have been long unreduced (Fig. 335). As a result of these changes, ulceration is not infrequently found on some part of the prolapsed mass, usually near the external os (*see* Fig. 336). Usually it is callous in type and is due to defective circulation, malnutrition of the tissues, and chronic irritation from friction, urinary contamination, *etc.* Occasionally infection spreads from the ulcer

to the deeper tissues, and may lead to local peritonitis and the formation of adhesions.

Elongation of the cervix is frequently found in cases of procidentia, usually affecting the supra-vaginal portion, but sometimes affecting the vaginal portion also. As a rule this condition results from the prolapse, but it may be a pre-existing abnormality, and possibly a contributory cause. The body of the uterus is always retroverted in procidentia (*see* Figs. 334 and 335), and in old women it may be atrophied from post-climacteric changes. In long-standing cases of *true* procidentia, in which there is no elongation of the cervix, the whole uterus shrinks, and may become abnormally small.

As a rule, the hernia is reducible without difficulty; occasionally it

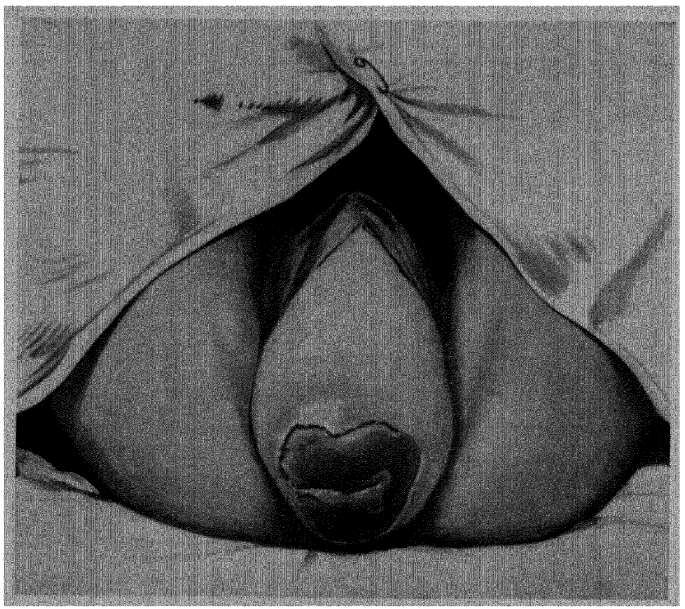


FIG. 336. THE CLINICAL APPEARANCES OF PROCIDENTIA AND ALSO OF AN EXTENSIVE DEGREE OF THE SECOND STAGE OF PROLAPSE. Note the anterior vaginal wall is completely inverted and smooth, the rugae being obliterated, and there is extensive ulceration of the cervix.

becomes temporarily irreducible from œdematous swelling of the parts; after a few days' rest in bed, however, reduction can usually be effected in these cases. Very rarely, cases of completely irreducible procidentia are met with, failure to return the prolapsed parts being due, either to rigidity of the vaginal walls, or to the formation of peritonitic adhesions involving the prolapsed uterine body.

The condition of the *perineal body* is an important clinical point in connection with prolapse, although, as has been already pointed out, it is not an etiological factor of much importance. Three degrees of perineal laceration are usually described. In the first the anterior half of the perineal body is involved; in the second the tear has extended up to, but has not included, the external *sphincter ani* muscle; in the third this muscle has been involved, the anus is wholly or partly incompetent, and a portion of the rectal mucous

membrane often protrudes (*see* Fig. 530, p. 750). In rare cases of prolapse, *e.g.* in nulliparæ, the perineal body may be found uninjured. Although loss of the tissues of the perineal body does not necessarily cause prolapse of the uterus, one of its functions is to assist in closing the vaginal orifice, and the destruction of this function is certainly a predisposing cause of prolapse of the vaginal walls. Not infrequently the perineal body is injured on its deep (vaginal) aspect without much external sign of injury. On picking up its tissues between the thumb externally and the finger in the vagina, it will be found that the anterior part of the perineal body has been greatly reduced,

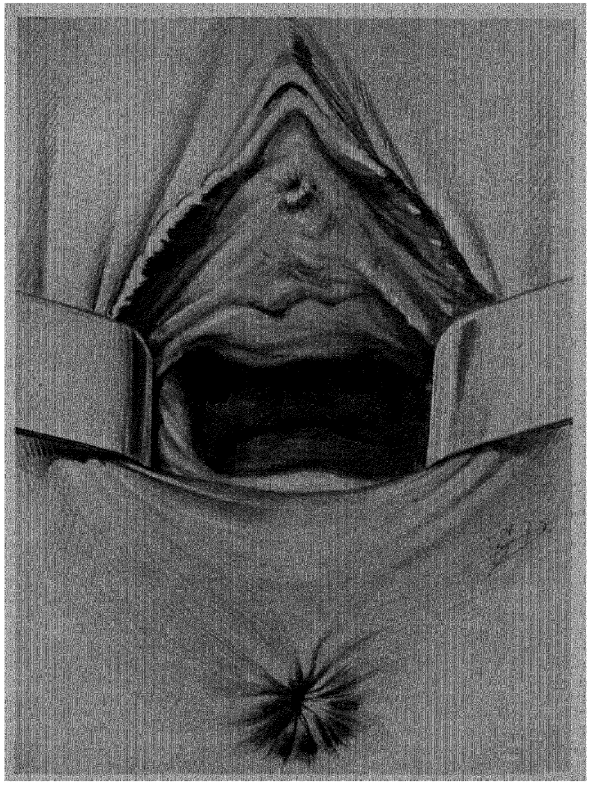


FIG. 337. RELAXATION OF THE OSTIUM VAGINÆ IN A PAROUS WOMAN, due to laceration of the posterior vaginal wall. The skin-surface of the perineal body is uninjured. (From a photograph.)

often to the thickness of stout paper. If the vaginal orifice is now opened up by the fingers, a deep sulcus will be found in the posterior vaginal wall running upwards and to one side ; sometimes there are two sulci of unequal depth, one on each side. On the floor of the sulcus an irregular line of cicatricial tissue will be found. The deep part of the perineal body has been destroyed by an obstetric laceration extending into it from the posterior vaginal wall, and this internal injury weakens the vaginal orifice as much as, or even more than, an external one. In such cases very marked *relaxation* of the orifice may be present, so that it may be stretched sufficiently to admit three or even four fingers without giving the patient pain (*see* Fig. 337).

Incompetence of the anus is one of the most distressing complications of perineal injuries, and careful attention should always be paid to the condition of the external sphincter. In its normal condition, the presence of shallow radial folds of skin around the anus indicates its functional activity (*see* Fig. 338); when the anterior part of the muscle has been involved in a perineal laceration these radial folds, though still seen at the sides and posteriorly, are absent in front, the anterior wall of the anus being represented by a band of smooth cicatricial tissue. The ends of the torn muscle have retracted so that it is now horseshoe shaped, and the position of the

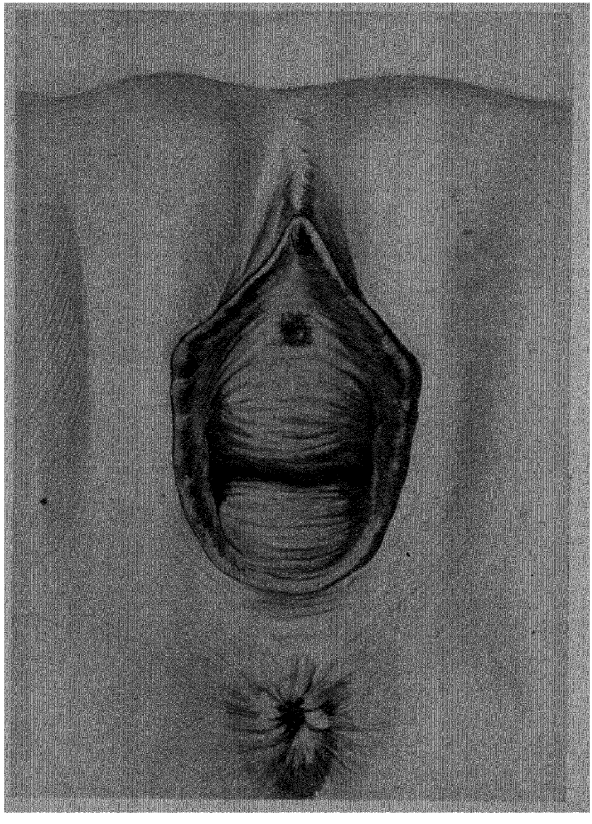


FIG. 338. CYSTOCELE (early stage), with slight prolapse of the posterior vaginal wall.

retracted ends is often indicated by a shallow pucker or dimple in the skin on each side. As a rule the retracted ends are not precisely opposite one another (*see* Fig. 520, p. 749).

Cystocele. In this condition the anterior vaginal wall, and with it the base of the bladder and the urethra, protrude from the vulva (*see* Fig. 338). The vaginal wall becomes stretched, and loses the characteristic transverse folds, except in its lower part, where they persist. The lowest part of the anterior vaginal wall is the part first involved, but in extreme cases the whole of this wall may protrude, dragging the external os down to the vulva. A certain amount of descent of the uterus accompanies it,

but well-marked cystocele may exist with only a slight degree of uterine prolapse, and this form may be met with in both parous and nulliparous women. Cystocele is a protrusion of the bladder through the interval between the two pubo-coccygeus muscles; the pubo-cervical muscle described by Bonney (*see* p. 509) must first yield, and the bladder is then free to descend to the lower level at which the pubo-coccygei muscles lie. Laceration or overstretching of these muscles during child-birth, or possibly in some cases congenital weakness, predisposes to the occurrence of this form of prolapse.

The protrusion is soft and elastic in consistence owing to the participation

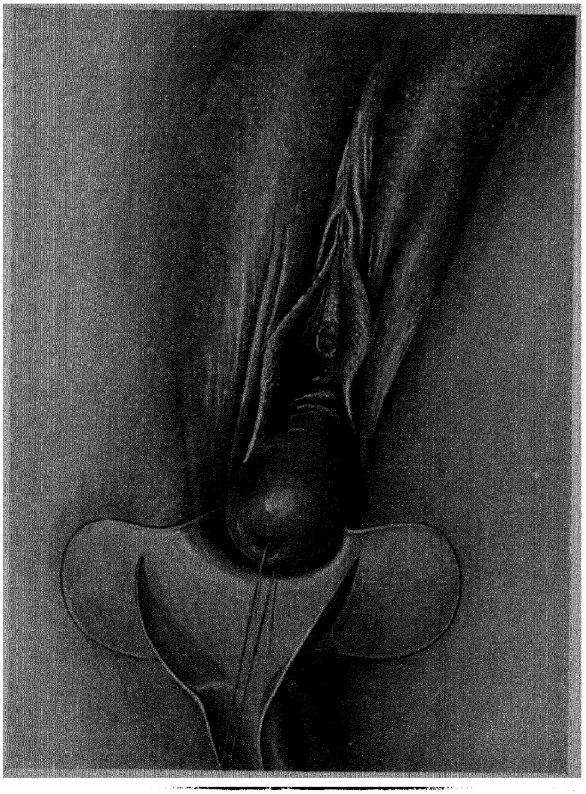


FIG. 339. HYPERTROPHIC ELONGATION OF THE VAGINAL PORTION OF THE CERVIX.

of the bladder. At the anterior extremity, underneath the pubes, the orifice of the urethra will be observed; it is displaced forwards and directed more or less upwards, consequently it is more prominent than under normal conditions. The vertical course of the urethra may be demonstrated by passing a catheter into the bladder. In the recumbent position cystocele may not be obvious until the patient strains, when the protrusion at the vulva will at once appear. On vaginal examination, with the parts in their natural position, the anterior vaginal wall will be felt to be relaxed and elongated.

Rectocele is a protrusion of the lower part of the posterior vaginal wall which has carried with it a corresponding portion of the anterior rectal

wall; the swelling, therefore, contains part of the lumen of the rectum. This is the rarest of all the forms of prolapse. When, in procidentia, the

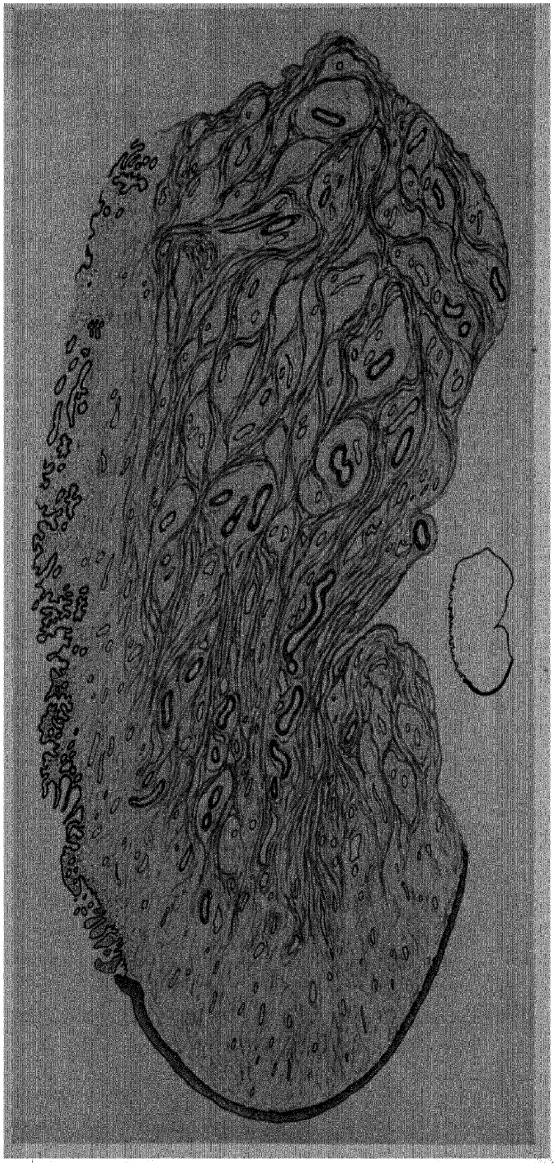


FIG. 340. A SAGITTAL SECTION THROUGH THE CERVIX OF A YOUNG VIRGIN IN A CASE OF HYPERTROPHIC ELONGATION. The os presented nearly at the vulva. There is hypertrophy of the fibro-muscular tissue, but the glands are few and small, and the squamous epithelium is relatively thin.

posterior vaginal wall becomes inverted, it separates from the rectum so that the latter does not enter into the hernial protrusion at all (*see* Figs. 334 and 335). The loose cellular tissue of the recto-vaginal septum allows the

rectal and vaginal walls to be thus separated from one another. In such circumstances a rectocele is not formed, although the posterior vaginal wall is prolapsed. For the production of a rectocele it is necessary that firm union should exist between the rectal and vaginal walls, and inflammation of the cellular-tissue plane following upon a puerperal laceration is the usual antecedent. In such cases the perineal body does not necessarily show traces of injury, the laceration may have been above it. Occasionally, however, rectocele is seen as a primary condition in a nulliparous woman; the mechanism of its production in such cases is not clear.

Hypertrophic Elongation of the Cervix. The cervix may become elongated in either its *vaginal* or its *supra-vaginal* portion (*see* Fig. 7, p. 12); the change is not due to stretching, but to new formation of tissue, *i.e.* the elongation is hypertrophic. Elongation of the *vaginal portion* is usually congenital. Elongation of the *supra-vaginal cervix* is frequently, but not always, acquired; in the great majority of cases it is associated with prolapse of the uterus.

(*a*) *Elongation of the Vaginal Cervix* (*Portio Vaginalis*). The cervix presents at, or protrudes from the vulva, and the condition may therefore be mistaken for prolapse of the uterus (*see* Fig. 339). It is, however, most commonly seen in virgins or nulliparous women, in whom prolapse is uncommon. On bimanual examination the fundus of the uterus will be found at its usual level, *i.e.* the organ is not prolapsed; also the vaginal fornices are not depressed; the vaginal canal is occupied by a long cylindrical body, at the free end of which is found the os externum; and the length of the uterine cavity, as determined by the sound, may be increased up to four or four and a half inches. In procidentia the protrusion of the cervix is due to the low level of the organ; in cervical elongation it is pushed out on account of its extreme length. The diagnosis is accordingly a matter of great simplicity, for the clinical resemblance of this condition to prolapse is only superficial.

In *congenital* elongation of the *portio vaginalis* the vaginal cervix presents points of histological interest (*see* Fig. 340). The hypertrophy affects the fibro-muscular stroma only, the gland-elements of the endometrium and the squamous epithelium of the *portio vaginalis* showing neither hypertrophy nor hyperplasia; in fact, the epithelial structures, both columnar and squamous, appear to be comparatively poorly developed (*cf.* Fig. 14, p. 17):

(*b*) *Elongation of the Supra-vaginal Cervix.* This condition is seldom if ever met with apart from uterine descent or prolapse.

Occasionally cases of complete cystocele with elongation of the supra-vaginal cervix are met with, in which little or no change has occurred in the *posterior vaginal wall.* In such cases the elongation presumably affects the intermediate portion of the cervix; the intermediate portion is described as that comprised between the level of the peritoneal reflection on the anterior and that on the posterior wall (*see* Fig. 7, p. 12). Combined elongation and hypertrophy of both the vaginal and supra-vaginal portions are also commonly met with in marked cases of prolapse of the uterus. Whether the elongation is a sequence of the prolapse or a cause of it is uncertain.

SYMPTOMS OF PROLAPSE

The symptoms to which prolapse gives rise are variable, and often inconsiderable. In slight cases a feeling of weight or 'bearing down' is

usually the only symptom present. In other cases, even moderate degrees of prolapse give rise to constant dragging pain; this is aggravated by standing or walking, or by muscular effort of any other kind, and may become insupportable to women who lead an active life. Rest in the horizontal position will usually relieve this pain by correcting the displacement. Persistent pain is only met with in cases of temporarily or permanently irreducible procidentia. On the other hand, in some cases of complete procidentia, the inconvenience caused by the bulk of the hernial protrusion is the only thing the patient complains of. Hypertrophic elongation of the vaginal cervix causes a certain amount of discomfort from the mechanical effects of the protrusion, and in unmarried women often a good deal of mental distress. It also offers an obstacle to coitus. In other respects it is of little importance.

Prolapse is a displacement of slow and gradual formation; it is during the early stages that pain is most prominent; when the displacement ceases to advance, pain diminishes or disappears. The menstrual function is not affected, nor is the reproductive capacity much impaired, except in cases of procidentia. Leucorrhœal discharge is commonly met with, and slight bleeding may occur from ulceration of the protruding parts. In cases of cystocele, irritability of the bladder and frequency of micturition are often, but not always, complained of; sometimes the bladder is incompletely evacuated, and cystitis from decomposition of residual urine may then occur. In almost all marked cases of cystocele the sphincter of the bladder is weakened, and slight dribbling incontinence occurs on coughing or muscular exertion.

When the *sphincter ani* muscle has been extensively injured, a greater or lesser degree of rectal incontinence results, and this when present forms the most distressing symptom of all. While control of flatus and liquid contents may be lost, total incontinence is seldom or never seen. The injury does not involve the deep sphincter except in very extensive lacerations, and the competence of this muscle helps to make up for the loss of the external sphincter.

The most important clinical symptom of prolapse, in the majority of cases, is that it incapacitates the patient from leading an active life, and from most kinds of manual labour.

Diagnosis. In all cases of prolapse the condition of the perineal body should be ascertained by careful inspection in a good light, noting the extent of the deficiency, if any, and the condition of the sphincter ani muscle. If the postero-lateral wall of the perineum on each side is taken between the fingers and the patient directed to cough, the levatores ani muscles can be felt to contract strongly in normal conditions. If they have been seriously injured, it may be impossible to feel them contract.

The patient should then be asked to strain, gently at first and then strongly. If the protruded parts do not include the cervix, the finger should be passed into the vagina, and the horizontal level of the external os carefully noted during straining and when at rest. Finally, the routine bimanual examination should be made, noting the position of the uterus, the fundus, the condition of the tubes and ovaries, and the pelvic contents generally.

It must be recollected that, except in extreme cases, prolapse disappears in the recumbent position, and in that position will only become evident

when the patient strains; in order to observe the full extent of the displacement it is in some cases desirable to examine the patient in the standing position. Well-marked instances of cystocele may be observable only when the patient stands up and strains; if the examination is confined to the recumbent position, the condition may be overlooked. In most cases the full extent of the displacement will only appear in the erect position, and allowance must be made for this in estimating the degree of displacement which is apparent when the patient is examined lying down.

Protrusion of the cervix at the vulva is due either to prolapse, or to hypertrophic elongation of the cervix; not infrequently both conditions are present. Elongation of the vaginal portion of the cervix is easily recognized, as it can be both seen and felt. The protruding cervix cannot well be mistaken for any other structure, the presence of the external os at the lower end, and the normal position of the fundus, being distinctive. Elongation of the supra-vaginal cervix can also be recognized by palpation, the long, slender, cylindrical outline being easily felt through the vaginal walls in a case of procidentia. The use of the uterine sound is usually unnecessary.

The only condition which can be mistaken for cystocele is a *cyst of the anterior vaginal wall* (*see* Fig. 201, p. 344); such cysts often become prolapsed and then form a vulval protrusion resembling a cystocele. On replacing the cyst within the vagina, its presence in the anterior wall will be detected by careful bimanual palpation; in cystocele when the vaginal wall has been replaced and the bladder is empty, nothing but the general lax condition of the vaginal wall is observed. The use of a bladder-sound will, of course, clear up any doubt that may remain. Similarly a rectocele may be distinguished from a prolapsed cyst of the posterior vaginal wall by rectal examination.

TREATMENT OF PROLAPSE

There are three possible lines of treatment for cases of prolapse: (1) Rest and general massage; (2) pessaries; (3) operative measures.

(1) Slight cases of prolapse occurring in young women, detected soon after confinement and associated as they often are with 'sub-involution,' are often curable by putting the patient to bed for three or four weeks, and taking measures to improve the general muscular condition. Daily massage by a skilled person, with muscular exercises, attention to the daily evacuation of the bowels, and the administration of such tonic remedies as strychnine and iron, are the points of greatest importance. As the weight of the uterus diminishes, and the general muscular condition improves, the prolapse may be permanently cured; or alternatively the advance of the displacement may be arrested, and the symptoms permanently relieved. This method is not applicable to old-standing cases or to those of the second and third degrees.

(2) *Pessaries.* Gynæcologists of an earlier generation devised vaginal pessaries which are capable of keeping the uterus within the body under almost all circumstances, if their presence can be tolerated by the patient. In the case of some of them, the discomfort of the pessary is greater than that of the prolapse, and in addition, their continued use is liable to cause serious ulceration, leading sometimes to perforation of the vaginal walls, opening up the bladder, the rectum, or the peritoneal cavity. No useful

purpose would be served by describing these obsolete instruments; the conditions under which they were formerly resorted to are now dealt with more satisfactorily by operative measures.

Prolapse can never be *cured* by wearing a support, as is the case with some instances of backward displacement (*see* p. 520). The pessary is

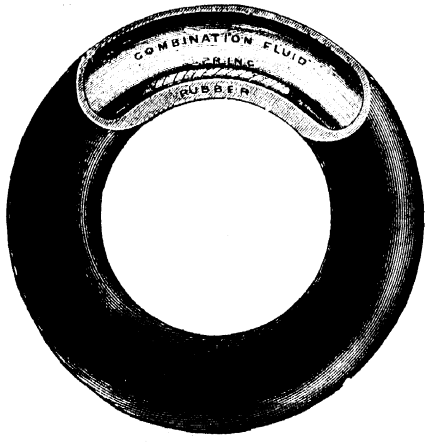


FIG. 341. THE WATCH-SPRING RING PESSARY.

used to relieve symptoms, and to check the natural tendency to increase of the condition. It is only in cases of prolapse of the uterus of the first and second degrees that a pessary will be found useful, and the elastic (watch-spring) rubber-covered ring is the most suitable instrument (*see* Fig. 341). It must be recollected that pessaries are useless when the retentive power of the vagina has been completely lost through extensive laceration

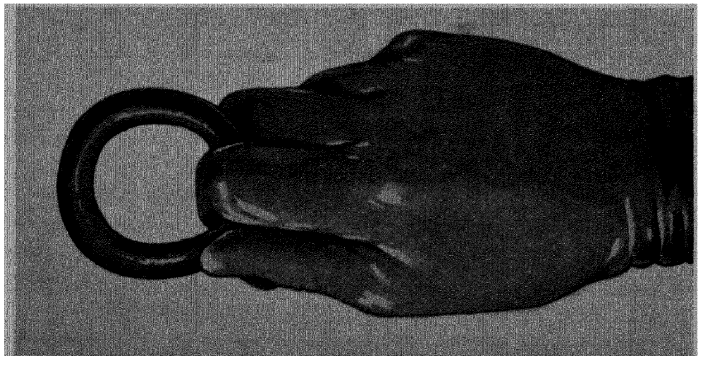


FIG. 342. HOW TO HOLD THE RING PESSARY FOR INTRODUCTION.

of the perineal body, or through relaxation of the *ostium vaginae*. Unless the structures which close the vaginal aperture retain much of their natural competence, the pessary will be expelled by muscular efforts such as coughing or straining at stool. And further, a pessary cannot be worn in comfort if such conditions as inflammation or ulceration of the vaginal walls are present.

In selecting a ring pessary, it is important to use the largest size which can be retained without discomfort, the action of the pessary being slightly to stretch the vaginal canal in its transverse diameter. While the upper

parts of the vaginal walls remain in their normal position only slight descent of the uterus is possible. Its action in supporting the uterus is thus mainly indirect. If the pessary is large enough to exert too much tension upon the vaginal walls, its effect will be still further to stretch these already relaxed structures, and thus actually to aggravate the condition.

To introduce the ring pessary, the patient should lie upon her side or on her back with the thighs flexed; the *clean* instrument is then held in the right hand, the index finger being passed through the ring in the manner shown in Figure 342. The ring, thus compressed to an oval shape, is introduced in the antero-posterior diameter of the ostium vaginae, being directed at first backwards towards the sacral hollow. When rather more than one half of the instrument is inside, it may be allowed to expand, and then be pushed gently upwards; rotation into the transverse diameter now occurs spontaneously, and the index finger should be slipped up the posterior vaginal wall so as to guide the upper part into position *behind* the cervix. The lower part should now lie behind the lower border of the symphysis pubis, and the instrument should be of a size which does not allow the

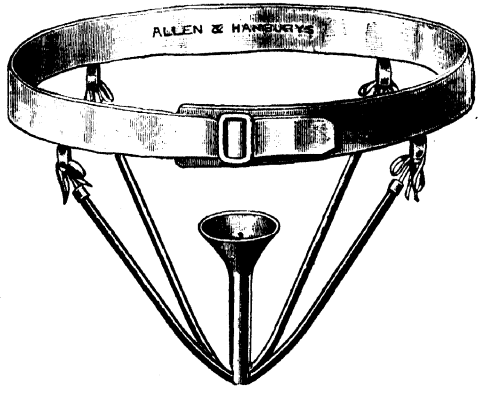


FIG. 343. NAPIER'S PESSARY FOR PROLAPSE.

anterior vaginal wall to sag through it. This instrument does not interfere with marital intercourse.

In cases of cystocele a ring pessary is seldom successful, for the anterior vaginal wall and bladder will protrude through it if the cystocele is of considerable size. Ring pessaries with a perforated rubber diaphragm are sometimes used in these cases, but this device is objectionable, as it prevents the free escape of the uterine and vaginal secretions. For slight cases of cystocele a Hodge pessary, to the lower end of which a transverse bar has been added, is useful; severe cases of cystocele can only be dealt with efficiently by operation (*see* p. 733).

Cases of prolapse in which the retentive power of the vagina has been lost are, generally speaking, unsuitable for treatment by pessaries, and in almost all cases operative measures should be advised. Sometimes, however, the patient may decline to submit to operation, or operation may be undesirable on account of advanced age or for some other reason. In these circumstances mechanical support may be afforded by the Napier pessary, or some of the many modifications which are obtainable.

The Napier pessary (*see* Fig. 343) consists of a thick but flexible stem

terminating above in a shallow rubber cup; when introduced the cervix rests upon the cup, which is perforated to allow of the escape of discharges. The stem is of sufficient length to allow the lower end to lie outside the vulva. Through this end are threaded two rubber bands, and to each end of the bands tapes are attached. The tapes are passed, two forwards over the pubes and two backwards over the buttocks, to be fixed to a belt round the waist. By adjusting the tension of the tapes, elastic pressure in an upward direction is exerted upon the instrument through the rubber bands, and in this way the descent of the uterus or the vaginal walls is prevented. This instrument should be worn only in the day, and removed each night and a vaginal douche used; before re-introducing it the instrument should be thoroughly cleansed by boiling, or by immersion in 5 *per cent.* carbolic acid solution. Neglect of these precautions may lead to serious ulceration of the vagina.

(3) *Operative measures* for prolapse include the following procedures: (1) Perineorrhaphy; (2) radical cure of cystocele; (3) amputation of the cervix; (4) Le Fort's operation; (5) ventrisuspension and ventrifixation.

The description of these operations will be given in a later section, but the indications for each may here be briefly mentioned. *Perineorrhaphy* is indicated when the perineal body has been considerably injured, or when the *ostium vaginae* has become relaxed so that its retentive capacity is diminished or lost. The object of the operation is to restore the vaginal outlet, including the levator ani muscles, and in addition, when necessary, to repair the anal sphincter. In cases where the posterior vaginal wall is prolapsed, the dissection may be extended upwards until rectum and vagina have been sufficiently separated from one another; this is sometimes called *colpoperineorrhaphy*. A special operation is practised for the radical cure of cystocele (*see* p. 733). In cases of extensive uterine prolapse it is desirable to perform ventri-suspension or ventrifixation of the uterus as well, and thus support the prolapsed organs from above. Indeed, in such cases an extensive operative procedure may be necessary, including amputation of the elongated cervix, radical cure of cystocele, perineorrhaphy and ventrisuspension. In women who have passed the menopause, an alternative to these measures may be found in Le Fort's operation (*see* p. 753). For elongation of the vaginal cervix amputation is all that is required: elongation of the supra-vaginal cervix is dealt with as a constituent feature of prolapse.

The permanent results of these operative measures for prolapse are good, if primary union is secured. There is, of course, a certain tendency to stretching of the cicatrices, and in anticipation of this the constricting plastic operations should be carried to a point of slight exaggeration. The part most likely to suffer stretching is the anterior vaginal wall; plastic operations on the anterior vaginal wall should therefore in all cases be supplemented by perineorrhaphy in order to afford support from below the repaired anterior wall. Ventrisuspension alone is useless for prolapse.

PART II: SECTION V

MORBID CONDITIONS OF THE FALLOPIAN TUBES

(1) TUBAL CYSTS (2) TUBAL INFLAMMATION
(3) TUBAL NEW GROWTHS

CONGENITAL Defects of the Fallopian tubes and Tubal Pregnancy have been already considered; we have here to deal with (1) Tubal Cysts; (2) Inflammatory affections; and (3) New growths.

TUBAL CYSTS

Cysts of the Fallopian tube may be classified as follows:—

I. Serosal 'cysts' formed as the result of obstruction, or due to a low type of chronic inflammation.
  (*a*) Pseudo-cysts or dilated lymphatics.
  (*b*) Peritoneal cysts.

II. Mucosal cysts: Paratubal cysts derived from follicles formed from displaced mucosal epithelium.

III. Cysts of congenital origin.
  (*a*) Hydroparasalpinx.
  (*b*) Accessory hydrosalpinx.
  (*c*) Homologues of accessory hydrosalpinx (? pronephric).
  (*d*) Fimbrial cysts (rete-testis cysts).

IV. Degeneration cysts.
  (*a*) Hydatid of Morgagni (dropsical fimbria).
  (*b*) Cystic fibromyxoma.

V. Cysts of parasitic origin.
  (*a*) Echinococcal cysts.

I. **Serosal Cysts.** (*a*) *Pseudo-cysts.* Small irregular bullæ may form on the tubes as the result of lymphatic obstruction in cases of large pelvic tumours. When the parts are resected they subside and the lymph drains away; they are not true cysts.

(*b*) *Peritoneal Cysts.* Small subserous vesicles the size of shot, pearly-white and glistening, are sometimes present; they persist after the tube has been removed. They are thought to be due to cystic changes in down-growths from the peritoneal coat of the tube produced by a low form of inflammation (peritonitis) (*see* Fig. 303, p. 477; *also* P″, Fig. 344).

II. **Mucosal Cysts: Paratubal Cysts.** (*See* Fig. 344.) In chronic tubal inflammation, especially in the type known as chronic nodular salpingitis, portions of the tubal mucosa may be squeezed out from the lumen into the muscularis, and there form epithelial follicles. These follicles may undergo cystic distension, and when their connection with the tube-lumen is maintained

these intramuscular cystic spaces will be filled with the same fluid-contents as are to be found in the tube-lumen. Such cysts are lined with a cubical

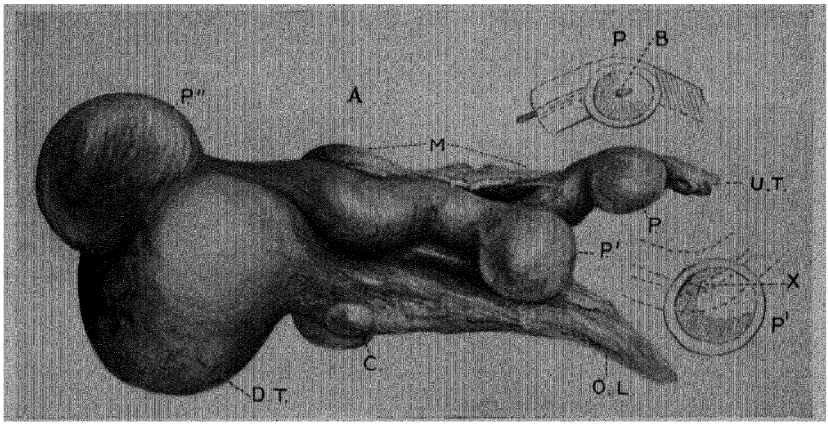


FIG. 344. MUCOSAL CYSTS: RIGHT-SIDED PYOSALPINX, showing two *Mucosal* or *Paratubal Cysts*, P and P'. The upper inset shows a bristle (B) passing from cyst (P) into the tube-lumen. The lower inset shows, at point X, the site of a scar in cyst (P'), where it formerly communicated with the lumen of the tube. U.T., Uterine end of tube; O.L., Ovarian ligament; M., Mesosalpinx; P'', Serous cyst; D.T., Distal end of tube.

epithelium, but the latter is often replaced by granulation tissue. In the case of a paratubal *cyst*, it is the *mucosal* epithelium which excavates a portion of the tube-wall, whilst in the case of a paratubal *haematocele* it is the

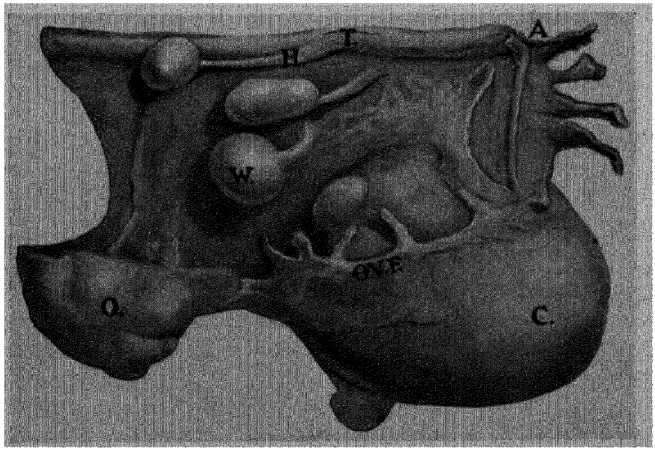


FIG. 345. HYDROPARASALPINX: RIGHT APPENDAGES, showing T., Fallopian tube. A., Abdominal ostium. H., Hydroparasalpinx. W., Pedunculated epoöphoritic cyst. OV.F., Ovarian fimbria. O., Portion of Ovary. C., Fimbrial cyst (rete-testis cyst).

fœtal epithelium (trophoblast) which erodes the wall of the tube and forms a blood cyst.

III. (*a*) **Hydroparasalpinx.** This is the name given to small cysts which have a solid pedicle uniting them to the tube (*see* Fig. 345, H). Whilst

definitely Müllerian in origin, the character of their lining membrane is similar to that of the commoner pedunculated cysts which arise from the Wolffian system (*see* Fig. 345, W).

(*b*) **Accessory Hydrosalpinx.** (*See* Fig. 346.) Handley has shown that an accessory tube may become cystic by closure of its abdominal ostium and by torsion of its connection with the main tube. Bell further showed that such a cyst may attain dimensions sufficient to render it clinically important. These structures are probably identical with the *antrum tubae* described by Rœderer and by Montgomery.

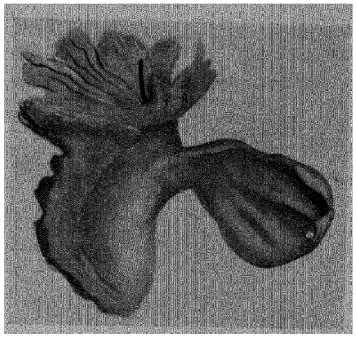


Fig. 346. Hydrosalpinx of Accessory Tube (Mus. R.C.S. Path. Series, 4582.)

(*c*) **Homologues of Accessory Hydrosalpinx.** These are single cysts found in the same situation as accessory tubes, viz. the upper surface of the ampulla (Fig. 347). In position they occupy the spot where the pronephric (terminal) segment unites with the rest of the tube. They differ from a hydrosalpinx of an accessory tube (1) in never having had any communication with the tube-lumen; (2) in having no plicated mucous folds, their lining consisting in a single layer of cubical epithelium; (3) in being far more common than their homologue of more advanced development, the true accessory hydrosalpinx.

At the site of junction of the outer pronephric segment with the

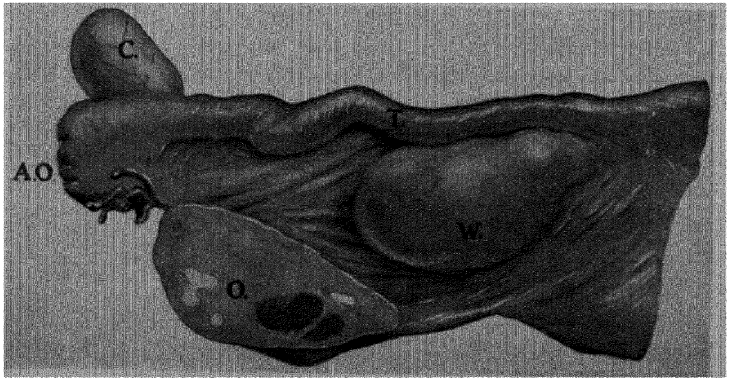


Fig. 347. Left Appendages, Posterior View. A.O., Abdominal ostium. C., Cyst on the ampullary portion of the tube. T., Tube. O., Ovary. W., Epoöphoritic cyst. The cyst C. is *homologous with an accessory hydrosalpinx* (*see* text).

remainder of the tube the following developmental defects are liable to occur:

(1) The formation of an accessory tube with an ostium of its own.

(2) The formation of a sessile ostium.

(3) The subsequent formation of a hydrosalpinx of the accessory tube.

(4) The formation of a simple cyst lined by low cubical epithelium and

never communicating with the tube-lumen—homologue of accessory hydrosalpinx (*see* Fig. 347).

(*d*) **Fimbrial Cysts: Rete-testis Cysts.** In young subjects a collection of minute tubules may be traced from the hilum of the ovary upwards and outwards along the course of the ovarian fimbria of the Fallopian tube. These tubules are the homologues in the female of the *rete-testis* of the male. From these tubules cysts may develop, which, from their close proximity to the ovarian fimbria, are termed *fimbrial cysts*. They do not develop *from* the fimbria of the tube, but it is convenient to include them in a classification of tubal cysts. Fimbrial cysts, like those of the epoöphoron and of the paroöphoron, are situated in the broad ligament; they lie in the outermost part of that ligament and the ovarian fimbria stretches over them (*see* Fig. 348). They will be referred to again in the section dealing with cysts of the ovary (*see* p. 632).

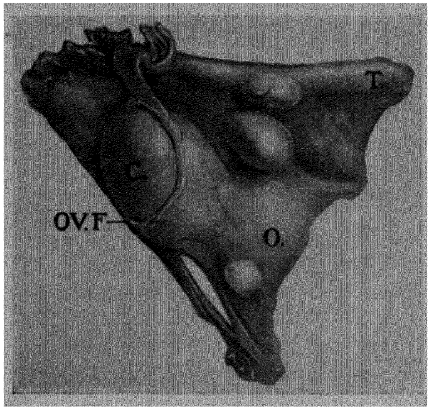


FIG. 348. FIMBRIAL CYST. LEFT APPENDAGES, POSTERIOR VIEW. C., Fimbrial cyst (rete-testis cyst). T., tube. OV.F., Ovarian fimbria. O., Ovary.

IV. (*a*) **Degeneration Cysts.** The hydatid of Morgagni is a modified tubal fimbria. This structure may become dropsical, forming a cyst of variable size: small cysts are very common, larger ones are rare. Cysts of the hydatid of Morgagni, since they arise from tubal fimbriæ, must be regarded as *pronephric* in origin, as the fimbriated extremity of the tubes arises from the pronephros.

(*b*) **Cystic Fibromyxoma.** This is a very rare condition in which a collection of fibrocystic growths arises from the fimbriæ, or pronephric portion of the tube.

V. **Echinococcal Cysts** have been found in the Fallopian tubes on very rare occasions; they have been already described in the section on parasites (*see* p. 293).

INFLAMMATION OF THE FALLOPIAN TUBE

Owing to their protected situation, the tubes are but rarely the seat of *primary infection*, which can only occur through the blood-stream, but when inflamed, the symptoms are so pronounced that the primary source of the disease becomes of secondary importance and is often difficult to locate. Infection of the tubes may occur by four routes: (1) By spread of inflammation from the uterine mucosa; (2) from the peritoneal cavity through the *ostium abdominale*; (3) through the lymphatics, *indirectly* from the parametrium, and less often from the vermiform appendix (*see* Fig. 349) and the sigmoid flexure (*viâ* their mesenteries), or *directly* from any part of the bowel by adhesions of the apposing serous surfaces; (4) by the blood-stream.

The gonococcus of Neisser is the most frequent cause of salpingitis, accounting as it does for about 75 *per cent.* of all cases. Gonococcal sal-

pingitis is due to an ascending inflammation of the genital tract. The same may be said of streptococcal salpingitis. In tubal infection the streptococcus is next in importance to the gonococcus, and as both these organisms reach the tube *viâ* the uterus, it is clear that most cases of salpingitis are the result of an ascending infection. Pyogenic bacteria may also enter the tube in the three other ways mentioned above. The tubercle bacillus, which stands third in order of importance as a source of salpingitis, probably gains access most often by the blood-stream, but not infrequently it enters by the *ostium abdominale* in cases of tuberculous peritonitis. It is also known that the bacillus of tubercle may reach the tube by a circuitous route, by entering through an abrasion in the vaginal or uterine mucosa; thence it will pass into the lymph-vessels of the parametrium, and from there, directly enter the tube and ovary. As the tubercle bacillus may set up no local irritation at its point of entrance, the above method of invasion

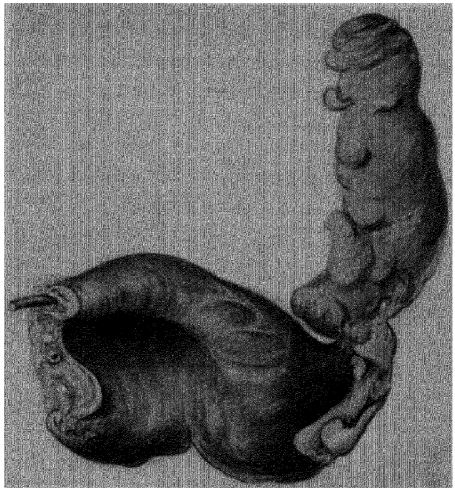


FIG. 349. RIGHT-SIDED SALPINGITIS, with inflamed appendix vermiformis adherent by its tip to the tube. A bristle is placed in the uterine end of the tube.

is difficult to prove clinically, but it has been demonstrated experimentally. Of other organisms which have occasionally been known to cause salpingitis may be mentioned the *bacterium coli commune, actinomyces, typhoid bacillus, diplococcus pneumoniae,* and the *pneumobacillus of Friedlander.*

The advance of non-mobile germs is effected by their power of continuous surface-growth. Want of cleanliness during a menstrual period will allow bacteria to spread from the vulva to the tube by direct surface-infection.

Catarrhal Salpingitis

In simple catarrhal inflammation the organisms are of low virulence and are few in numbers. The muscularis is not affected and the mucosa is but little changed. The stroma of the plicæ is not infiltrated, but the folds

are separated from one another by exudation, and in this exudation are found many desquamated, swollen epithelial cells, a few leucocytes, and perhaps a little blood. For the most part the epithelium of the mucosa is intact, the ciliæ have in part disappeared, but are often still distinguishable. This stage of slight salpingitis is relatively seldom seen since it quickly subsides. But with repeated attacks permanent changes are wrought, the most important being a closure of the ends of the tube. This results in the retention of secretion and a gradual expansion of the tube, *i.e.* in the formation of a *hydrosalpinx* (*sactosalpinx serosa*). For the formation of a tubal sac, the sole essential is a closure of both extremities.

Hydrosalpinx. The usual mode of closure of the abdominal ostium is that the fimbriæ are drawn into the lumen of the tube, and their surfaces then fuse together (*see* Fig. 350). Thus a closure of the outer end of the tube is brought about by a plug, consisting of the swollen fused fimbriæ, which are suffering compression by the unyielding peritoneal investment of the tube.

Previous to this, there has been a closure of the *uterine* end of the tube, caused by catarrhal swelling of its mucous membrane. When it is remembered that the lumen of the intersititial part of the tube is only 0·5 to 1 mm. in diameter, it will be understood that a slight turgescence is sufficient to effect its occlusion. There is now no chance of escape for the secretion of the tubal mucous membrane, and a collection of fluid in the lumen results. By intratubal fluid-pressure the tube is both elongated and expanded. When the indrawn plicæ are completely welded or fused together, the closure of the tube becomes permanent. It is obvious that in this mode of occlusion the fimbriæ will have disappeared externally, and nothing will remain to mark the site of the ostium but a small cicatrix (*see* Fig. 352).



Fig. 350. Closure of the Abdominal Ostium. First stage, showing retraction (indrawing) and swelling of the fimbriæ. (Sitzenfrey.)

Another method of closure is that which arises from peritonitis, and results in adhesion of the open ostium to adjacent surfaces. In the absence of catarrh the uterine ostium of the tube may be still open, in which case no hydrosalpinx will result. Such a closure is seen for example in cases of appendicitis in which the serosa of the tube is implicated. This mode of closure will be again referred to in the description of pyosalpinx and tubo-ovarian cysts.

Macroscopic Appearance of Hydrosalpinx. The distension of the tube begins, and is always most marked, at the ampulla, whence it diminishes gradually towards the uterine end. The early distal enlargement is accounted for by the facts that the muscle is thinner at the ampullary end of the tube, and the secreting epithelial surface is much more extensive. Thus a hydrosalpinx of typical shape possesses a pedicle, consisting of the relatively small, and but little altered, uterine end of the tube, which connects the more or less distended ampulla to the cornu. The entire tube may now resemble in shape an Indian club, or a retort, or a post-horn.

Kinking of a hydrosalpinx is apt to occur because the inelastic peritoneal

coat cannot share in the elongation of the muscle; coiling or winding of the tube takes place, especially if the peritoneum is adherent (*see* Fig. 351). The kinks produce spurs or projections of the muscle and mucosa, which form false septa in the dilated lumen.

Whatever the shape of a hydrosalpinx may be, its walls are always thin and may be semi-transparent; when opened up, the mucosa may be found to be as flat as a serous membrane, with here and there a slight fold or projection, representing the remains of the original plicæ. As already stated, the fundamental lesion which leads to hydrosalpinx is repeated attacks of *catarrh* of the mucous membrane; this does not induce thickening of the muscle, so that the latter is not prepared to cope with the raised intratubal pressure exerted by the accumulation of fluid; this accounts for the thin wall of a hydrosalpinx. There may, or may not be, signs of inflammation externally. In addition to the cicatrix at the site of the ab-

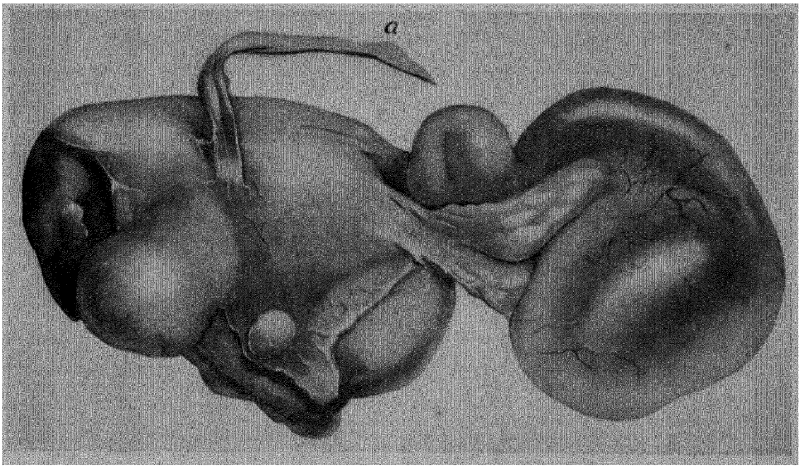


FIG. 351. UTERUS WITH FIBROIDS; RIGHT HYDROSALPINX. *a*, Elongated band of adhesion from an old ventrifixation. The ovary is seen below the inner half of the dilated tube.

dominal ostium, there may be nothing to show the inflammatory nature of the lesion; on the other hand, extensive peri-salpingitis is not uncommon (*see* Fig. 352), and the sac may even be invested and fixed by membranous adhesions. The contents of a hydrosalpinx generally consist of a clear or slightly clouded, thin, serous, albuminous, or mucoid fluid.

Microscopically, in early cases of hydrosalpinx evidences of inflammation can be traced in the mucosa, *e.g.* round-celled infiltration in the folds, fusion of the tips, and resulting pseudo-follicles at the bases, of the plicæ. Even in the otherwise unaltered muscle there may be tracts of round-celled infiltration. In the walls of larger sacs all traces of inflammation are often lost. In the sac itself the flattened epithelium lies immediately upon a fibrous wall, from which the muscle-bundles have often completely disappeared. Microscopic examination of the contents will reveal the presence of leucocytes, epithelial cells, and perhaps a few red discs. In a large sac the contents are always sterile, for the causal bacteria of low virulence are soon destroyed (*see also* p. 559). Whether a hydro- or a pyosalpinx will form after

closure of a tube is solely a question of the number and virulence of the invading organisms. It is stated that the contents of a hydrosalpinx may be ejected into the uterus and escape *per vaginam*. In these cases the terms *hydrops tubae profluens* and *hydrorrhœa tubae intermittens* are used to describe this process; its occurrence in cases of tubal papilloma has been established; with hydrosalpinx it is entirely hypothetical.

Occasionally axial rotation of a hydrosalpinx occurs, resulting in the effusion of blood into the tube. This condition may resemble that next to be described, viz. hæmatosalpinx, but it is more accurately described as a *blood-stained hydrosalpinx*.

Hæmatosalpinx. This is a condition in which the tube becomes distended with blood, and is an occasional result of catarrhal salpingitis. The infection is more acute than in cases of *hydrosalpinx* and results in an effusion of blood from engorged capillaries. Closure of the abdominal ostium, in

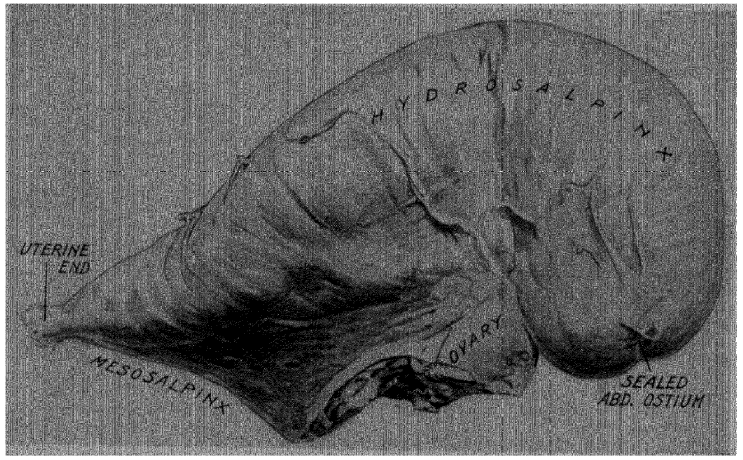


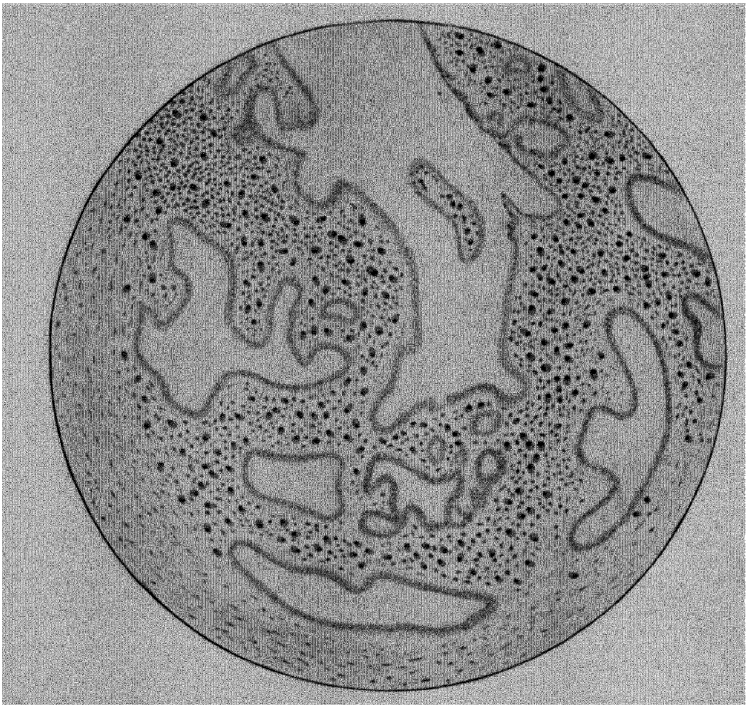
FIG. 352. HYDROSALPINX (Royal College of Surgeons Museum). The specimen shows the characteristic retort-shaped dilatation, and at the outer end a puckered depression indicating the position of the abdominal ostium. The ovary has been partly cut away. There are numerous peri-salpingitic adhesions.

this case, is effected by the escape of blood, which sets up perisalpingitis and causes adhesion of the ostium to neighbouring surfaces. Two other varieties, non-inflammatory in character, are met with, viz. that due to tubal pregnancy and that associated with cryptomenorrhœa (*see* p. 150).

It is in ectopic gestation that true hæmatosalpinx is most commonly seen, and this occurs mechanically, not as the result of inflammation. Non-inflammatory hæmatosalpinx is also on rare occasions secondary to hæmatocolpos and hæmatometra in cases of imperforate hymen (*see* p. 151). Hæmorrhage into the lumen of the tube occasionally occurs in axial rotation of a mobile tubal swelling, and this gives rise to the same type of acute abdominal symptoms as are associated with torsion of the pedicle of an ovarian cyst (*see* p. 636).

Suppurative Salpingitis

Suppurative inflammation of the tube is usually due to an acute ascending infection which has reached the tube from without. The organisms are



PURULENT SALPINGITIS (SUBACUTE), showing an abundance of plasma-cells in the inflammatory infiltration. Note the fusion of the plical tips which has produced *pseudo-follicles*. There is no invasion of the muscularis by the mucosa such as is seen in chronic interstitial salpingitis.

To face page 553.

virulent and invade (1) the connective-tissue elements of the mucosa, and (2) the entire tube-wall as far as its peritoneal coat. There is first seen a very pronounced thickening of the plicæ (*see* Fig. 353); this is due in part to the dilatation of the blood- and lymph-vessels, and in part to an inflammatory infiltration of the stroma with polymorphonuclear pus-cells and mononuclear round cells, the latter being derived from the proliferation of the fixed connective-tissue cells. Numerous lymphocytes are also seen both in the swollen plicæ and in the purulent secretion which occupies the tube-lumen (*see* Fig. 354). Later on when the condition is subacute the character of the infiltration changes, and plasma-cells take the place of the polymorphonuclear and mononuclear cells (*see* Pl. XXIX). In the acute stage



FIG. 353. SUPPURATIVE SALPINGITIS; FROM THE AMPULLA OF THE TUBE. The plicæ of the tubal mucosa are swollen by infiltration of pus-cells and mononuclear round cells. The latter are derived from proliferation of the fixed connective-tissue cells. The above is an early stage of salpingitis purulenta.

of suppurative salpingitis the tube is increased in size, and is soft, this change being due to œdema of the muscularis and of the subserosa. If healing occurs this thickening may subside, and the subsidence of a tubal swelling may sometimes be noted clinically. If the acute inflammation does not soon subside, the mouth of the tube becomes closed, pus collects in the lumen, and the muscular and subserous layers, which are already softened and swollen by œdema, yield to the pressure exerted by the contained purulent secretion; thus the tube-wall becomes stretched and relatively thinned out, but never to the same degree as seen in hydrosalpinx. The final result is a *pyosalpinx*. On the other hand, the initial inflammatory attack may be followed by a relapse or by repeated recurrences of subacute and chronic inflammation. Instead of a pus-sac forming, the tube-wall then becomes thickened, and a state of *interstitial suppurative salpingitis*

is produced. The result of suppurative salpingitis on the tube is, therefore, twofold. The tube may become chronically thickened, forming a pus-tube (*interstitial salpingitis*), or it may become distended and dilated to form a pus-sac (*pyosalpinx*). It is common to find that the isthmic portion shows interstitial changes while the ampullary portion is distended with pus, so that both varieties of suppurative salpingitis may occur in the same tube. The formation of a pyosalpinx will be considered first.

Pyosalpinx (*Sactosalpinx Purulenta*). The mechanism by which retention of pus produces a pyosalpinx is in many respects similar to that by which the fluid of a hydrosalpinx is confined within the lumen of the tube. The fimbriæ are indrawn to a certain extent, but closure is aided by more rapid



FIG. 354. SUPPURATIVE SALPINGITIS (Early Stage). Under a high power the round-celled infiltration of the stroma is seen; pus cells and lymphocytes are present in the lumen.

fusion of the fimbriæ owing to destruction of the surface-epithelium. Closure is often effected by the formation of an external pseudo-membrane, or through the fusion of the abdominal ostium to neighbouring organs. In such cases, after the separation of the adhesions the abdominal ostium may be found to be still open, and the plicæ still visible, so that indrawing of the plicæ is not so essential to the formation of a pyosalpinx as it is to the formation of a hydrosalpinx. In fact, retention of pus may occur through the swelling of the mucosa alone. Of importance to operators is the fact that through an open abdominal ostium, a pus-tube may communicate with a collection of pus enclosed in a false membrane around the mouth of the tube (*peritubal pyocele*), just as in tubal pregnancy the lumen of the tube may communicate with a peritubal hæmatocele (*see* Fig. 122, p. 182). A *peritubal pyocele* is

far more liable to rupture during salpingectomy than is a true pyosalpinx, so that there is invariably an escape of pus during its removal, an accident which may be attended with serious consequences (*see* p. 233).

The formation of a tubal pus-sac may be rapid or slow; in the former case the walls will, as already stated, be relatively thin; in the latter event, the muscularis at first shows signs of a work-hypertrophy, but even here the subsequent deposition of fibrous tissue causes muscular atrophy, and thus an old pus-sac may consist of a thick wall, composed entirely of connective tissue without a trace of muscle. The peritoneum is generally overlain by fibrinous adhesions, granulations, and finally by thick connective-tissue laminæ. Generally there is also extensive pelvic peritonitis, with adhesions to the ovary, to the back of the uterus, to the broad ligament,

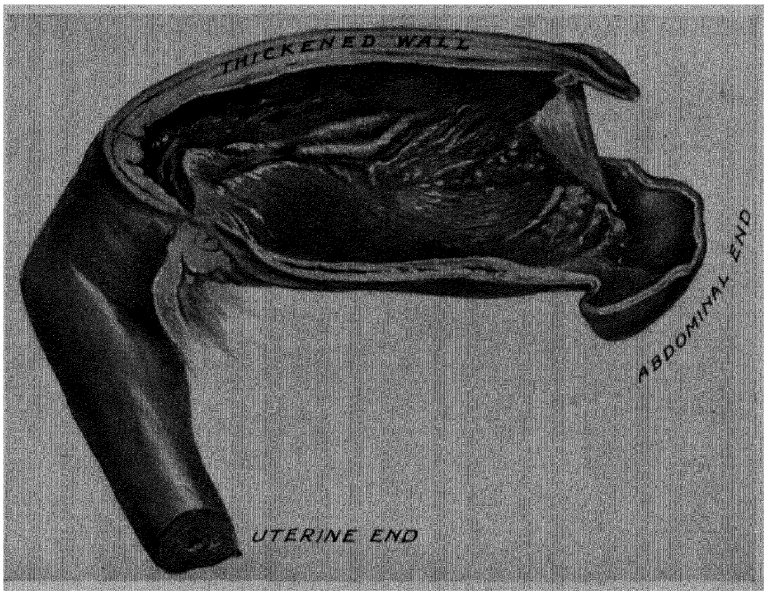


FIG. 355. CHRONIC PYOSALPINX (Charing Cross Hospital Museum). The tube is bent at a right angle, the outer part alone being dilated. The tube-wall is thickened throughout. From the same case as Figure 359.

and to the rectum. Tubal pus-sacs may communicate with each other or with an ovarian abscess (*see* Fig. 357), in fact the adnexal structures may be so welded together by peritonitis as to render it impossible to distinguish tubal from ovarian tissues. When the abdomen is opened, in such a case, access to the pelvic organs may be entirely prevented by a roof of densely adherent structures which has been formed by fusion of omentum, coils of small intestine and loops of pelvic colon over the inflamed organs. These adhesions are protective, and serve the useful purpose of limiting the infective process to the pelvis. On the other hand, there are exceptions, and a pyosalpinx may be freely mobile and hard, giving the clinical signs of a pedunculated fibroid.

On section, the mucous membrane of a pyosalpinx is seen to be bright red, yellow, or grey. Microscopically, there is seen to be much desquama-

tion of the surface-epithelium; it may be shed entirely, but where epithelium persists, it becomes many-layered, and thickened; the individual cells,

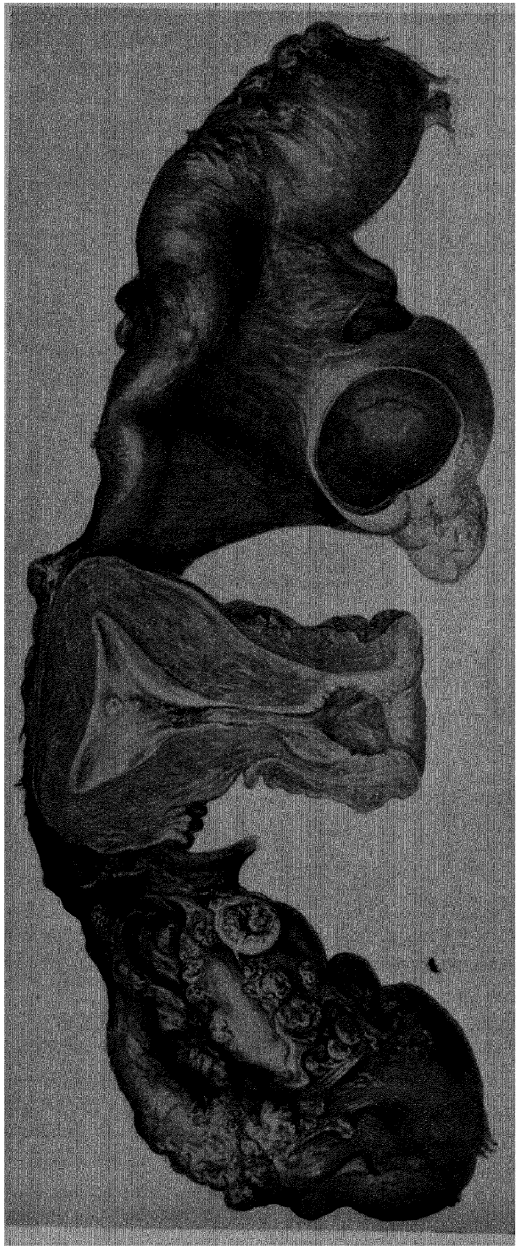


FIG. 356. BILATERAL PYOSALPINX OF GONORRHŒAL ORIGIN. Note the extensive tubal adhesions.

instead of being cubical, become round or irregular and may even resemble the squamous or transitional type seen in the urinary tract.

With acute suppuration the epithelium first disappears at the summits of the main plicæ and of their branches. The raw extremities then adhere—

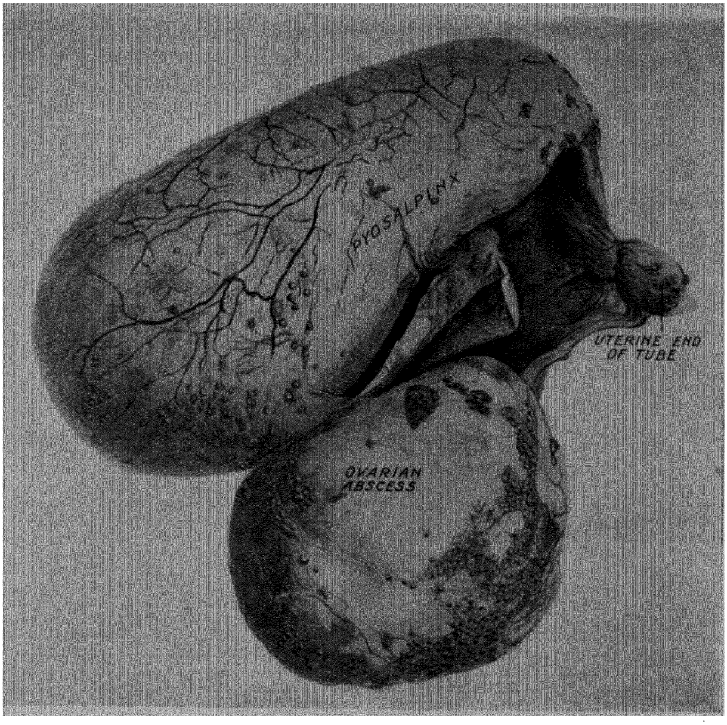


FIG. 357. TUBERCULOUS PYOSALPINX AND OVARIAN ABSCESS. Nullipara, aged 21. The dilated tube shows the characteristic retort shape. Both tube and ovary are studded with tubercles; they are almost entirely free from adhesions.

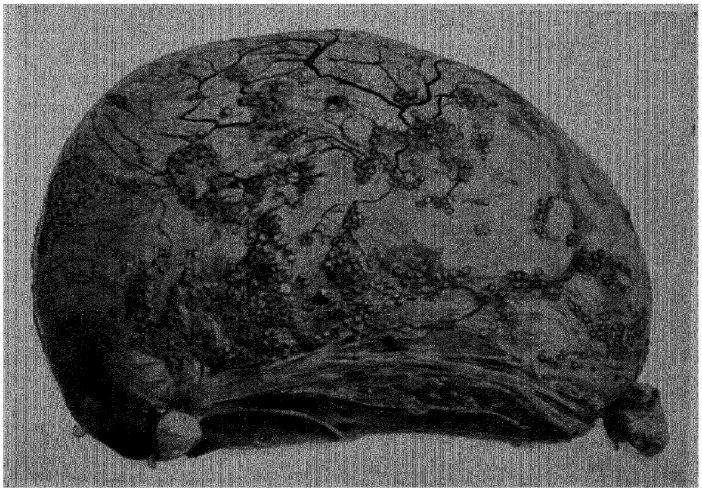


FIG. 358. TUBERCULOUS PYOSALPINX. From the same case as Figure 357 The dilatation is roughly cylindrical or sausage-shaped and the tube wall is studded with tubercles.

and organic union occurs producing pseudo-follicles (*see* Pl. XXIX, p. 553) which may persist and can be found in the thicker parts of the wall of a pyosalpinx. In large pus-sacs the entire mucous membrane may have disappeared, leaving nothing but a lining of granulations; but even here

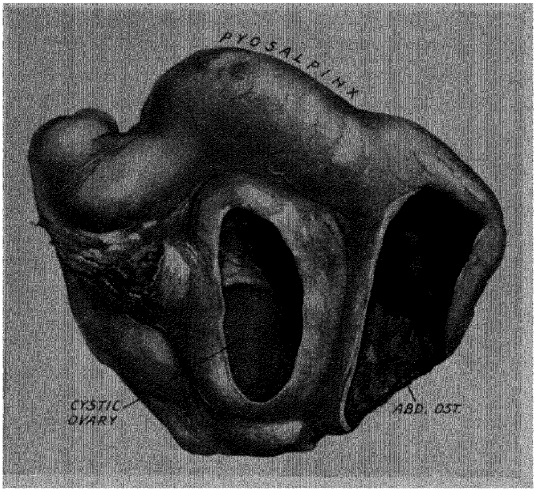


FIG. 359. CHRONIC PYOSALPINX. The tube is not much dilated, its outline is convoluted and its walls are thickened. The ovary is enlarged, cystic, and firmly adherent to the tube.

traces of the mucosa, in the form of displaced follicles, may be found in the fibrous tissue of which the sac-wall is composed (*salpingitis follicularis*).

Contents of a Pyosalpinx. The contents of a pyosalpinx are very variable

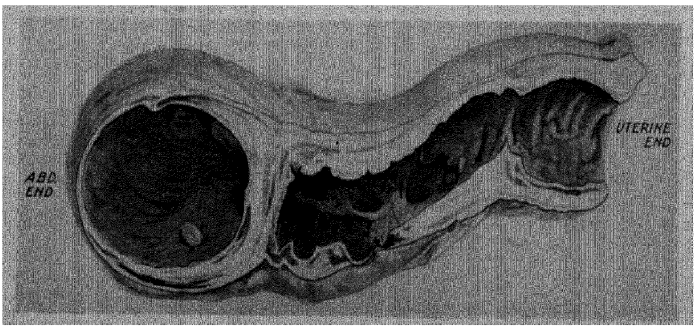


FIG. 360. CHRONIC PYOSALPINX (Charing Cross Hospital Museum). The dilatation is fairly uniform, the tube-wall is thickened, and a septum is formed near the abdominal end.

When of *tuberculous* origin the pus may be fluid or semi-solid, consisting of caseous *débris* and devoid of odour unless secondarily infected with the colon bacillus or with saprophytic organisms. Sometimes the caseous material becomes inspissated, dry hard nodules being found, and not infrequently calcareous changes occur in the lining of a tuberculous pyo

salpinx. It is very rare to find the tubercle bacillus, but it has occasionally been discovered in the sac-wall. In pyosalpinx due to *gonorrhœa* or to *puerperal sepsis*, the pus may be thick or thin, yellow or bloodstained, uniformly creamy, or flocculent from flakes of necrotic lymph. In the absence of B. coli and of saprophytes there will be no odour, but after the death of the exciting pathogenic bacteria, it is common to find a secondary invasion by putrefactive germs. The character of the contents is then totally changed and offensive pus results.

Bacteriological examination of the pus from forty-three cases of pyosalpinx revealed the fact that in thirty-three instances it was sterile, *i.e.* the organisms had died; in seven the gonococcus was found (Howard Kelly).

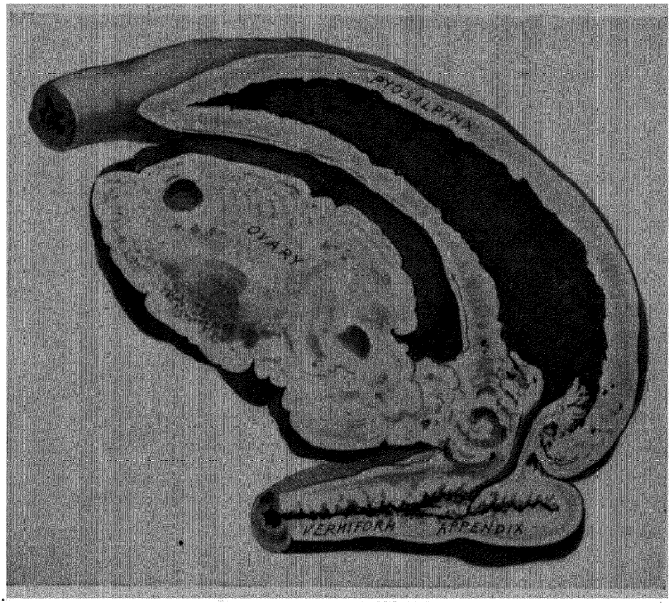


FIG. 361. TUBO-APPENDICULAR FISTULA (Bland-Sutton). The appendix has become adherent by its tip to the abdominal ostium, and a fistulous communication has been formed in that position. Infolded relics of the tubal fimbriæ are seen.

In one case there was a mixed infection by staphylococci and streptococci. In two, the organisms were undiagnosed. In none was the B. coli discovered. Among the rarer organisms found are the *bacillus aerogenes capsulatus*, the *micrococcus lancelolatus*, and the *proteus bacillus*.

From the above we may conclude that there is a tendency for pus in pyosalpinx to become sterile and that mixed infections are rare, but it must also be remembered that infection by an organism of one type paves the way for a secondary invasion by bacteria of another form, and when offensive pus is discovered, in most cases, this is what has happened. It is important to bear in mind that while the contents of a *chronic* pyosalpinx are sterile in three-fourths of the cases, the contents of an *acute* pyosalpinx are highly infective; the same may be said of the peritonitic abscesses which often occur in the neighbourhood of the affected tube.

Rupture of a Sactosalpinx. Rupture occurs not infrequently with a

hæmatosalpinx resulting from tubal pregnancy. It is probable that a hydrosalpinx may rupture spontaneously, without giving rise to any clinical phenomena whatever, and there is accordingly no means of estimating its frequency. Spontaneous rupture of a pyosalpinx into the peritoneal cavity is very rare, owing to the fact that, as a rule, the tube-wall is too much thickened and too densely adherent to surrounding structures to permit of this accident. Nevertheless forty-eight cases have been collated by Bonney (1909), and the grave nature of the occurrence is made clear by the fact that 48 *per cent.* of these cases terminated fatally.

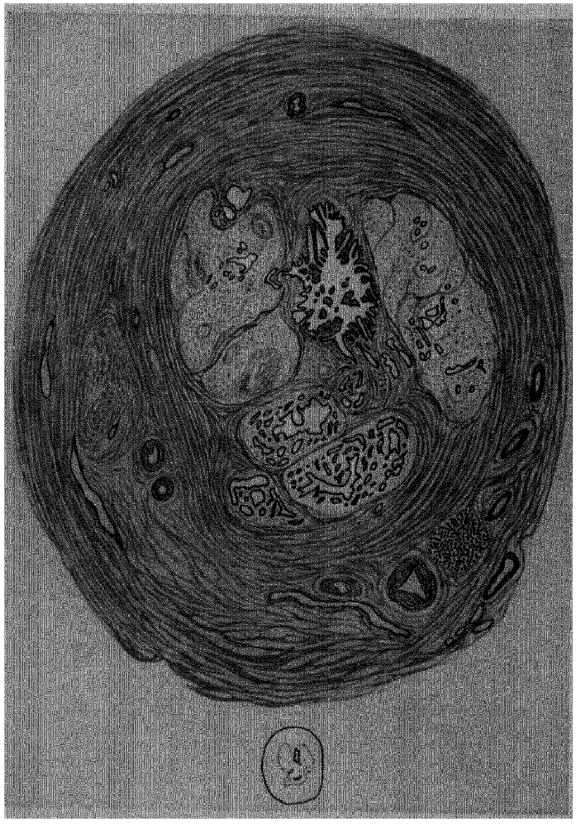


FIG. 362. TRANSVERSE SECTION OF TUBE THROUGH AN AREA OF *salpingitis isthmica nodosa*. Note that the mucosal epithelium has penetrated the muscular strata, and appears as branching adenomatous follicles (*salpingitis follicularis*).

Tubal Fistulae. In chronic cases of pyosalpinx fistulous communications may be formed between the tube and its fellow or with one of the hollow viscera, by gradual destruction, through ulceration, of the septum formed by the adherent walls. Most commonly the communication is formed with the intestine—the upper part of the rectum, the pelvic colon, or a coil of ileum being the parts usually implicated. In rare cases a fistulous communication may be formed between the vermiform appendix and the tube (*see* Fig. 361). Next in frequency to the intestine comes the vaginal

vault; a pyosalpinx commonly occupies the pouch of Douglas and is therefore adjacent to the vagina, but the intervening tissues are thicker and denser than in the case of the intestine. Lastly, and least frequently, the pyosalpinx may discharge into the bladder; the infrequency with which a dilated tube is found in the utero-vesical pouch explains the rarity of this form of tubal fistula.

The formation of a tubal fistula is a curative process and may be followed, in some cases, by obliteration of the canal of the tube, and permanent cure. More frequently drainage is inadequate, reaccumulation occurs, and the fistula simply persists. Cystitis does not necessarily follow the formation of a tubo-vesical fistula, for the pus may be destitute of living organisms.

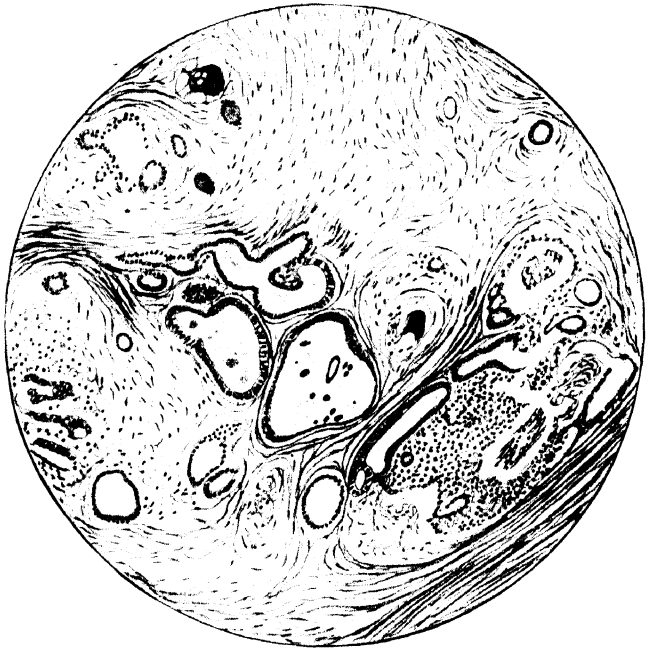


FIG. 363. PORTION OF FIGURE 362 UNDER A HIGH POWER. Note the distended follicles and numerous giant cells lying in the muscularis. The lumen of the tube is not seen.

Tubo-ovarian fistulæ will be referred to under *Tubo-ovarian Cyst and Abscess* (*see* p. 563).

Interstitial Salpingitis. This is the result of repeated attacks of sub-acute inflammation. There is pus-formation in these cases, but not to the same extent as is seen in tubal pus-sacs. The ostium of the tube is sealed and is generally found fused with the ovary, the only notable exception being in tuberculous cases, where extensive interstitial salpingitis may exist with an open abdominal end, the swollen fimbriæ remaining non-adherent and free (*see* Fig. 159, p. 277).

Although in some cases tubes are found which show interstitial salpingitic changes throughout their whole length, it is more common to find considerable collections of pus in the ampullary segment. In such cases the isthmic portion may be thickened by hypertrophy of muscle, and by

young fibrous tissue, so that the transverse diameter of the tube measures 2 cm. or more. Figure 355 illustrates the effect of interstitial salpingitis at the uterine end of the tube produced by chronic inflammation which has allowed sufficient time for the tube-wall to become thickened. Figure 360 shows that with chronic interstitial salpingitis the entire lumen may be distended with pus; the wall is everywhere thickened except the part formed of false membrane at the abdominal ostium. This is a rarer type than that seen in Figure 355.

The thickening of the tube-wall in interstitial salpingitis may be uni-

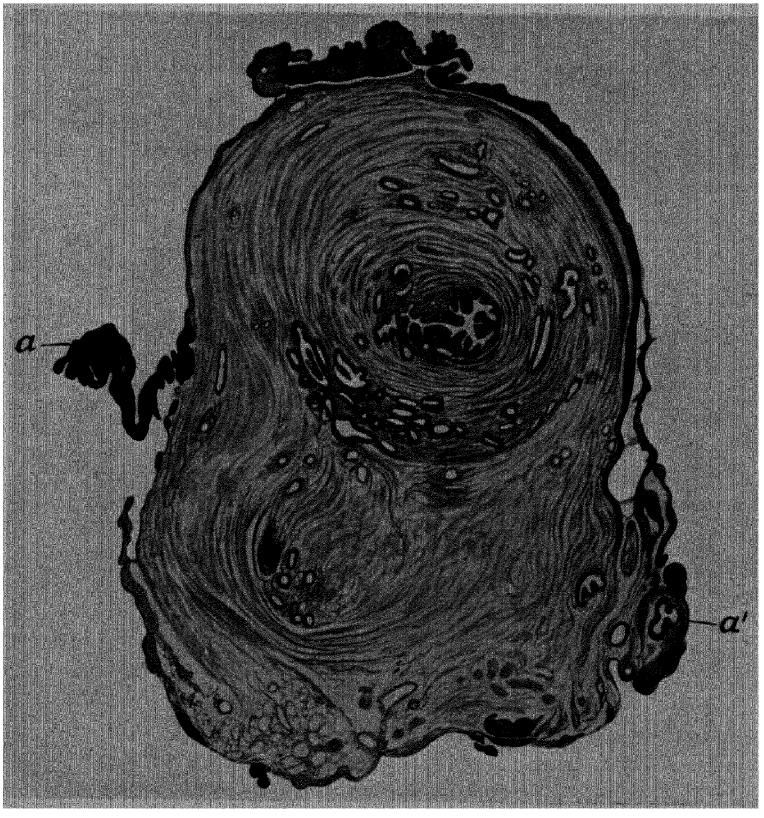


FIG. 364. SALPINGITIS ISTHMICA NODOSA. Showing extension into the broad ligament (von Franqué). *a—a'* = peritoneal coat of tube.

form (*see* Fig. 355), but often it is irregular and definite nodes are produced; this nodular condition is most marked at the isthmic or uterine end, where the tube joins the cornu uteri (*salpingitis isthmica nodosa*). This localized enlargement is generally found in cases of tuberculous salpingitis (*see* Fig. 159, p. 277), but it is also produced to a less marked degree in gonorrhœal and septic cases. The characteristic behaviour of the mucosa in chronic interstitial salpingitis is best illustrated by the study of these nodes.

The striking feature of *salpingitis nodosa* is the presence in the thickened fibromuscular wall of displaced or ectopic epithelium, which is derived from the mucous membrane of the tube. When, by progress of the infection,

the muscularis becomes infiltrated by round cells and softened by œdema, the epithelial cells of the mucosa, or perhaps portions of the entire mucosa, become squeezed (by intratubal pressure) into the substance of the muscular wall, producing true follicles, *i.e.* gland-spaces lined by cubical epithelium. Owing to the presence of these follicles this variety is called by some pathologists *salpingitis follicularis* (*see* Figs. 362, 363, 364). The displaced epithelium actively proliferates in its new situation, and produces an intramural, complex, pseudo-glandular structure. Simultaneously, the fibrous and muscular elements undergo active hyperplasia in response to the irritation produced by the growing glandular tissue, and the result is a well-defined nodule. This process may spread into the interstitial part of the tube, and may expand the tubal isthmus, so that at the cornu, the mesosalpinx becomes opened up by a solid tubal mass the size of a walnut or larger (*see* Fig. 364). The connection between the gland-follicles and the lumen may ultimately be cut off, but often pervious crypts or *culs-de-sac* persist so that the follicles lying in the muscle-wall may be injected from the lumen of the tube. The epithelial lining of the displaced follicles may be composed of columnar, cubical, or flattened cells and their lumina may be filled with secretion, or old blood, or pigment-laden cells. The clinical significance of the mucosal diverticula above referred to is, that they may perhaps become the seat of tubal pregnancy.

The changes described as nodular salpingitis are best seen in tuberculous tubes, but may be found in lesser degree in all cases of chronic salpingitis independent of their etiology.

Chronic Salpingo-oöphoritis

Many cases of chronic salpingitis are non-suppurative and not accompanied by dilatation of the tube. There is marked perisalpingitis accompanied by peri-oöphoritis, and a moderate degree of thickening of all the layers of the wall of the tube (*see* Fig. 366). From the fact that almost without exception the ovary shares in the inflammatory process, the term *chronic salpingo-oöphoritis* is correctly applied to this condition. The abdominal ostium remains patent for much longer than in the other varieties of salpingitis, but ultimately it becomes sealed. An extensive pelvic peritonitis may also be present.

It must be assumed that in this condition *repeated* catarrhal attacks have led to a certain degree of thickening of the middle coat of the tube. There being no suppuration, the epithelium on the plicæ remains intact and varies exceedingly in character. Marked proliferation and also metaplasia of cells are seen. Papillary and tufted masses of epithelial elements may abound to such a degree as to give the appearance of papilloma and carcinoma. These mucosal changes have in fact given rise to the view that cancer of the Fallopian tube is the outcome of chronic salpingitis.

Tubo-ovarian abscess: **Tubo-ovarian cyst.** The fusion between tube and ovary produced by inflammation may lead to a communication between a pyo- or hydrosalpinx on the one hand, and an ovarian abscess or cyst on the other. This results in the formation of a cyst the wall of which belongs in part to the tube, and in part to the ovary. The point of communication is usually a small aperture, but this may be of considerable size. Around this aperture, the spread-out fimbriæ of the tube can be seen,

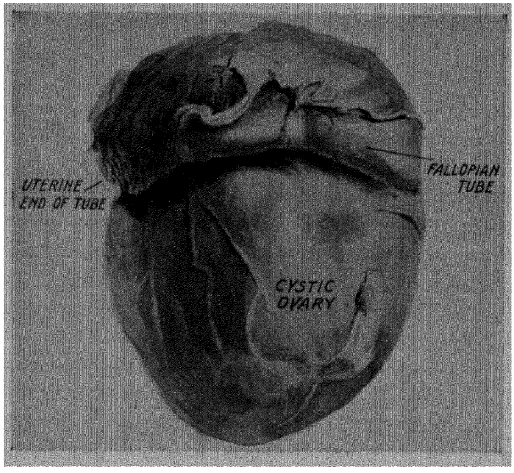


FIG. 365. CHRONIC SALPINGO-OÖPHORITIS. Multipara, aged 43. The ovary is enlarged by cystic formation; the tube is not dilated, but closely adherent to the upper part of the ovary, the mesosalpinx being concealed by the adhesions.

radiating over the adjacent surface of the ovarian portion of the wall of the cavity. This shows that the aperture is a patent tubal ostium.

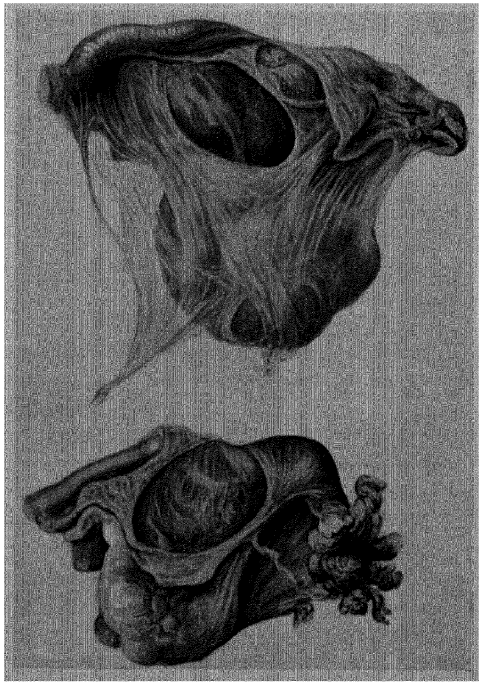


FIG. 366. BILATERAL CHRONIC SALPINGO-OÖPHORITIS. Showing extensive peritonitic adhesions.

Clinical Features of Inflammation of the Tubes and Ovaries

The symptoms of inflammation of the tubes and ovaries resemble those of pelvic peritonitis already described (p. 233). Exact diagnosis is much more difficult in acute than in chronic cases, for lapse of time, and the progress of the physical signs of the disease, are often of great service in determining the position and nature of the principal lesions in a given case.

General Symptoms in Acute Cases. In acute cases which develop rapidly grave symptoms indistinguishable from those of other forms of the 'acute abdomen' may develop without any localizing signs being discovered in the pelvis. More frequently the onset is less severe and two main symptoms then manifest themselves, viz. fever and pain; vomiting, except

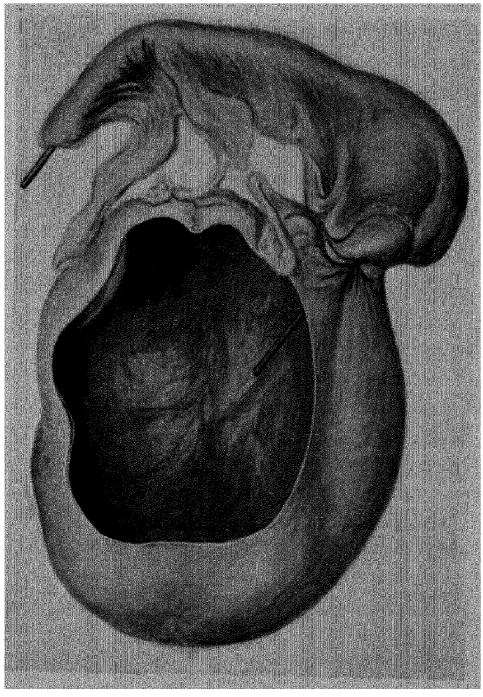


FIG. 367. TUBO-OVARIAN CYST. Showing a bristle passed through the length of the tube and projecting into the cavity of the ovarian cyst.

during the first few hours, is rare. The fever is usually severe, running up to 103° or 104° F., and may be associated at its onset with a definite rigor, or with attacks of chilliness. Thereafter the temperature runs an irregularly intermittent course, similar to that of septicæmia. The fever in some cases subsides rapidly, and in a few days the temperature becomes normal; this indicates that the inflammatory focus has been isolated by adhesions. In other cases recurrences of high fever occur with intervals of abatement; this is seen when a salpingitic inflammation succeeds in passing the barrier and invading fresh regions of the peritoneum, or when suppuration occurs.

In a case of ascending infection recently seen by one of us (T. W. E.) the right tube was first attacked, giving rise to acute abdominal symptoms,

but distinguished from appendicitis by the presence of a purulent vaginal discharge of recent origin. The symptoms gradually abated, and after an interval of three weeks a second acute attack occurred exactly similar to the first except that the symptoms were referred to the left side. Apparently the left tube was not involved so early as the right, and leakage did not occur from it until nearly three weeks after the original onset. The second attack gradually abated and the patient completely recovered her health.

The pulse-rate is quickened, as a rule, proportionately to the temperature. When the pulse-rate is disproportionately rapid, generalized infection is probably occurring.

Abdominal pain and distension, both at first limited to the hypogastric zone, and sometimes to one or other side, are commonly met with; they are in a special sense indications of localized peritonitis. Great tenderness on abdominal pressure is also present, and defæcation and micturition may become painful. The general condition of the patient, as indicated by the tongue, and the ability to take nourishment, is fairly good.

The symptoms indicative of pus-formation are not in all cases clear. Rigors may be absent, and the fever is not invariably exacerbated. After a time the general condition of the patient deteriorates, the pulse quickens, and sweating occurs; rapid emaciation, and the appearance of a peculiar earthy tint of the skin, may be seen in prolonged cases. Abscess-formation may occur in a few days in cases of acute infection; in chronic infections its occurrence may be much delayed.

Assistance in the diagnosis of pus-formation may be sometimes obtained by making a differential blood-count, and repeating it on one or more occasions, a single estimation being unreliable. (1) A total of 20,000 to 25,000 leucocytes per cubic millimetre, with from 80 *per cent.* to 85 *per cent.* of polymorphonuclear cells, indicates the presence of pus or other infective fluid, which is imperfectly isolated and from which absorption of toxins is occurring rapidly. (2) A total count of from 10,000 to 15,000 leucocytes indicates either the absence of pus, or if pus be present, the loss of its infectivity. A high and increasing leucocyte-count, obtained on several occasions, is the clearest indication of active suppuration (Topley).

More recently the sedimentation test has been applied in cases of pelvic infection, and according to Baer [1] and others it is very helpful when used in association with the leucocyte-count. By "sedimentation" is meant the settling of the red cells in a graduated column of citrated blood-plasma. The "sedimentation time" in health is about two hours, in acute infection it may be reduced to 30 minutes. When it falls below 45 minutes there is active infection, and the level to which it falls below this point is taken as a rough index of the virulence of the infection. It is recommended that cases of pelvic infection should not be submitted to operation until the sedimentation time has risen above 60 minutes.

Reduction of the "sedimentation time" is not confined to infective processes; it may also occur in carcinoma in any part of the body.

General Symptoms in Chronic Cases. In the great majority of cases of chronic tubo-ovarian inflammation there is a prolonged history of pain and general ill-health, which can be traced to a confinement or an abortion, or to an attack of gonorrhœal infection. In puerperal cases there may be no definite history of septic infection, but merely a retarded convalescence;

[1] *Amer. Jl. Obst. and Gyn.*, 1925, p. 397.

or the onset of symptoms may be delayed for a period of several weeks or months after the occurrence of the confinement or abortion. In gonorrhœal cases an interval even more prolonged may elapse between the original infection and the appearance of symptoms of pelvic inflammation. It will be found on inquiry that during this interval the general health has been unsatisfactory, and that the symptoms of gonorrhœa have not been entirely relieved. Sterility also almost always characterizes this interval. In some instances, however, the tubes may be attacked within a few days of the appearance of the gonorrhœal discharge.

In women who are virgins bowel-infection and tubercle are the commonest antecedents, while in parous women any of the possible causes, or a combination of them, may be met with.

An important feature of cases of chronic tubo-ovarian inflammation, and one which is frequently present, is the occurrence of intercurrent acute attacks, or exacerbations, at irregular intervals. These intercurrent attacks reproduce the general features of acute pelvic inflammation, and are usually attended by abdominal pain and fever, slight or moderate in degree. Often they are sufficiently severe to necessitate confinement to bed for several days, but the attacks are not necessarily so severe as this. Their onset is frequently synchronous with a menstrual period. They do not, of necessity, indicate the presence of suppuration, but they do imply that the infective agent is still active in the inflammatory focus. In time these relapses cease, as the virulence of the infecting agent becomes exhausted.

In the quiet phases chronic inflammatory lesions give rise to few symptoms, the most troublesome being pain, which is felt chiefly in the lumbar and iliac regions, and is aggravated to so marked an extent by exertion that the patient becomes disinclined to effort of any description and falls into a state of chronic invalidism. Dysmenorrhœa of the secondary extrinsic type, menorrhagia, and leucorrhœa are nearly always present, and probably arise in part from associated chronic infection of the endometrium or the vagina. Dyspareunia and sterility are common, and, sooner or later, a train of hysterical symptoms often becomes superimposed, which may distract attention from the true cause of the illness. Occasionally gross pelvic lesions, such as pyosalpinx, come in time to be tolerated extraordinarily well and give rise to little or no trouble, the probable explanation being that the infective agent has entirely lost its virulence. Thus a tubal abscess of considerable size may be discovered in cases where no indication of its presence was afforded by the temperature or the general condition of the patient; in such cases the organisms have probably all perished and the pus will be found sterile (*see* p. 559).

Diagnosis of Tubo-ovarian Inflammatory Swellings. The swelling formed by *inflamed adnexa* almost invariably lies in the posterior compartment of the pelvic cavity (*see* Figs. 368 and 369), although occasional exceptions have been recognized. As a rule the swelling is not mesial but postero-lateral in position, and in something like 75 *per cent.* of cases both sides can be felt to be involved, either in the form of a single mass of large size, or of two distinct swellings, that on one side being often appreciably larger than that on the other. In other cases, while a definite swelling is formed upon one side, only an ill-defined thickening of the tube and ovary is to be felt upon the other. The actual characters of the swelling itself are varied. The outline of the affected tube and ovary is often obscured by the presence

of surrounding exudative or plastic peritonitis; the result is the formation of a firm, fixed, tender mass in the position indicated, the nature of which can only be inferred. In other cases more detail can be recognized; thus a pediculated attachment of the swelling to the uterine cornu of the same side may be felt (*see* Fig. 368), or the outline of a curved structure like the crooked finger may be made out representing the tube, and a globular or oval portion representing the ovary. When suppuration has occurred, details of this kind can rarely be recognized owing to the amount of surrounding peritonitic thickening which is present. The rectal-bimanual examination should always be practised in these cases, for it will show the close relation of the swelling, when large, to the anterior rectal wall; the finger in the rectum is able to reach the lower and posterior surfaces of a swelling in the pouch of Douglas, while from the vagina, only the anterior surface can be felt. Rectal

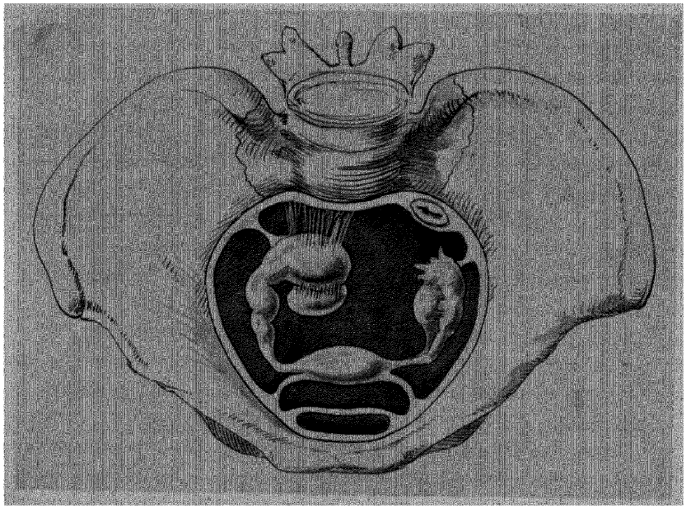


FIG. 368. TUBO-OVARIAN INFLAMMATORY SWELLINGS (Martin). Representing diagrammatically the position and character of the swellings. The right tube is sealed and dilated, and adhesions have been formed with the ovary and the peritoneum of Douglas's pouch. The left tube is thickened but not sealed.

examination is therefore of great value in the diagnosis of cases of inflamed adnexa.

Occasionally, swellings of this nature are large enough to extend above the pelvic brim and to be felt on abdominal palpation; more rarely still cases occur in which a pyosalpinx or hydrosalpinx has been found drawn up into the abdominal cavity proper, so as to lie entirely above the pelvic brim. When a large amount of surrounding thickening and fixation is present, suppuration has probably occurred; when there is little thickening, and the affected tube and ovary are comparatively soft and not entirely fixed, the presence of pus is improbable. Even when the appendages of one side appear on examination to be but slightly, if at all, affected, operation may reveal extensive changes in them; prognosis in this respect must therefore be cautious. A general anæsthetic is of course a great aid to accurate diagnosis in all cases, and is indispensable when the conditions are very unfavourable to a satisfactory bimanual examination.

The definite recognition of suppuration in these cases is often a matter of great difficulty. Pointing can rarely be recognized except when it involves the rectum; there it may sometimes be detected by the finger high up in the anterior wall, by the formation of a soft, highly sensitive spot upon the swelling. As a rule, it is unsuspected until a discharge of pus reveals its occurrence. Densely hard, fixed swellings, with much surrounding induration, usually contain a focus of pus, albeit often a small one.

In all chronic cases the condition of the *uterus* must not be overlooked; frequently laceration and erosion of the lips of the cervix will be found, and frequently also the body of the uterus is enlarged and tender. These conditions indicate the presence of a chronic endometritis, which was probably originally septic, and may still be a focus of infection from which the tubal

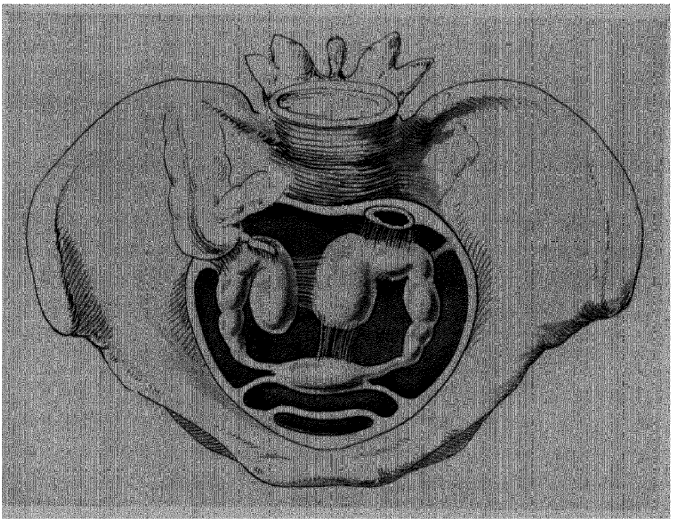


FIG. 369. TUBO-OVARIAN INFLAMMATORY SWELLINGS (Martin). Representing a more advanced stage than that shown in Figure 368. The cæcum and vermiform appendix are adherent to the right tube. Both tubes are sealed and dilated; there are adhesions of the other tube to the rectum and to the uterus.

or ovarian inflammation may from time to time be reinforced. In such cases the uterus requires treatment, as well as the more deeply seated inflammation.

Differential Diagnosis. In the *acute* stages the differentiation of pelvic inflammatory swellings from one another is not a matter of great practical importance, for all are, as a rule, to be treated by palliative methods unless suppuration has occurred. In *chronic* cases a detailed diagnosis of the parts affected should, however, be attempted.

Of all the varieties of pelvic inflammatory swelling the tubo-ovarian is by far the commonest. Chronic cellulitic deposits are very rare, as the experience gained by the operative treatment of cases of pelvic inflammation has clearly shown. Chronic peritonitic effusions, small in extent and often multiple, are not uncommonly found in association with inflamed tubes and ovaries; they hardly ever occur alone, and their importance is quite secondary to the changes in the adnexa. As has been already mentioned, the commonest result of pelvic peritonitis is the formation of adhesions, leading

subsequently to displacement and loss of mobility of the uterus and its appendages.

Tubo-ovarian swellings large enough to be felt above the pelvic brim are often found to include a small ovarian cyst, which has become infected from the Fallopian tube, and to which the bulk of the swelling is due. There are no physical signs by which a large pyosalpinx can be distinguished from an infected ovarian cyst. Small tubo-ovarian swellings, on the other hand, are usually posterior or postero-lateral in position, of more elastic consistence, and are, as a rule, very sensitive when touched; they also give rise to pain when the cervix is moved forward by the finger in the vagina. Often the characteristic outline of a convoluted and thickened tube can be made out in some part of the swelling.

Difficulty often arises from the association of a fibroid tumour with a case of chronic tubo-ovarian inflammation. Usually it can be distinguished by the closeness of its relation to the uterus, but in chronic nodular salpingitis, which chiefly affects the isthmus, the swelling closely resembles a nodular fibroid both in its position and relations. Although a tubo-ovarian swelling is often closely adherent to the back of the uterus, a sulcus between them can usually be felt on vaginal or rectal palpation, which indicates the line of cleavage. In the case of the inflamed fibroid, the swelling appears to be completely incorporated with the uterus. In the case of an obese patient, a large inflammatory mass may often be diagnosed as a fibroid; through the thick abdominal wall the mass appears to be solid, and inseparable from the uterus, while the associated menorrhagia lends support to this view.

Treatment of Tubo-Ovarian Inflammation

Acute Cases. All acute cases, whether in the initial stage or during a recurrence, are to be treated in the first place by expectant or palliative measures. When, however, in such cases there is evidence of diffused peritonitis, or of the formation of pus, the treatment necessarily becomes surgical.

During the stage of fever, severe pain, and tenderness, all local interference should as far as possible be avoided, the patient being kept in bed, the diet limited to fluids, the bowels kept open, and simple measures for the relief of pain adopted, such as the application of hot fomentations to the abdomen. At this early stage the employment of what is called protein therapy may be useful. It is known that the number of leucocytes in the blood can be raised by intra-muscular injection of a non-specific protein, *e.g.* milk deprived of its fat (Graves and Polak) is used and 5 c.c. is injected into the muscles of the buttock just beneath the iliac crest. It is claimed that large tubo-ovarian masses, extensive pelvic exudates, and even collections of pus clear up under this treatment.[1] We have had no personal experience of it. In all prolonged cases, whether accompanied by much fever or not, a careful watch should be kept for local signs of suppuration, the importance of rectal examination for this purpose being borne in mind.

Chronic Cases. In such cases it is often a matter of some difficulty to decide whether medical or surgical treatment will give the patient the better chance of recovery. Generally speaking it may be said that medical treatment may be preferred when there has been only a single acute attack, when

[1] Gellhorn, Schmitt, Graves, quoted by Polak in Gynæcological Monographs, Appendix, 1925, p. 3.

the tubo-ovarian enlargement is not great, or when there is no evidence of suppuration. As a general rule it may also be said that surgical treatment is indicated when there have been repeated acute attacks, when the tube is distinctly dilated, or when there is evidence of suppuration; repeated acute recurrences generally signify the presence of an imperfectly isolated collection of pus.

Medical or palliative treatment. Sexual intercourse, and the use of alcohol, must be forbidden during the treatment. Attention should be paid to the condition of the alimentary canal; anæmia, when present, should be energetically treated with suitable preparations of iron, or of hæmoglobin and bone marrow. The local measures consist of vaginal douching, hot hip-baths, and medicated vaginal tampons and pessaries, the usual remedial agent being a 10 *per cent.* solution of ichthyol in glycerine. Hot-air, or electric light baths, applied to the whole of the trunk and limbs also promote the absorption of inflammatory exudates. Drugs are of little use, but small doses of mercury and iodide of potassium sometimes appear to do good even in cases not obviously specific. Courses of treatment of ten to fourteen days' duration may be repeated at intervals, as long as there is evidence of progressive improvement in the local and general conditions. The value of vaccine treatment in cases where the infecting organism can be isolated must not be forgotten.

It is clear that palliative treatment, to be successful, must be prolonged, and the social conditions of the patient often form a factor of importance in deciding between palliative and surgical treatment.

Surgical Treatment: (*a*) *Suppurative Cases.* Collections of pus, wherever they may be formed, must be evacuated as soon as they are recognized. *Peritonitic abscesses* are most conveniently reached, as a rule, through the posterior vaginal fornix, by the procedure known as *posterior colpotomy* (*see* p. 704). When the pus has been reached, the finger should be passed into the cavity for exploration, and any septa felt may then be broken down so that free drainage may be obtained, but the limiting wall of the abscess-cavity should not be disturbed. A large, flanged rubber drainage-tube is then introduced and the case treated on ordinary surgical lines.

An *acute pyosalpinx* attended with fever and with abdominal pain and distension should also, if possible, be evacuated and drained by posterior colpotomy. In such cases the pus is certainly infective, and fouling of the general peritoneal cavity is difficult to avoid when the operation is performed by the abdominal route. The disadvantage of the vaginal operation is that secondary peritonitic or ovarian abscesses may remain undetected; when therefore the operation fails to give complete relief, a fuller exploration from above must be undertaken. Dilated tubes, when drained vaginally, may entirely close without any further operation being required, but when other inflammatory foci, not necessarily suppurative, remain, a cure cannot be obtained.

Chronic pyosalpinx, whether unilateral or bilateral, is best dealt with by extirpation of the affected tubes by the abdominal route. The ovaries are often infected as well, and the uterus is probably in similar state. When the disease is bilateral, a radical operation, including complete removal of the tubes and ovaries, and of the uterus (*see* Fig. 342, p. 629), is therefore the best operation to perform. The removal of the uterus does not appreciably increase the severity of the operation, and allows of more efficient drainage being obtained.

(*b*) *Non-suppurative Cases.* When an operation is decided upon in these cases radical procedures should, if possible, be avoided. The ovary is not necessarily infected, and should be carefully examined and inspected after the abdomen has been opened, to see if it cannot be wholly or partially conserved upon one side or the other. It may not be necessary to remove both tubes in these cases, and a sealed but only slightly thickened tube may be restored to functional competence by *salpingostomy* (*see* p. 696). Conservative procedures are clearly to be preferred in young women, whenever the local conditions warrant an attempt being made to save the damaged organs.

Inasmuch as the clinical recognition of the extent of the disease is difficult, it is wise to secure the patient's consent to whatever procedure the operator may subsequently find it desirable to adopt.

NEW GROWTHS OF THE TUBES

The majority of new growths of the tube—fibro-myoma, lymphangioma (7 cases), teratoma (7 cases), papilloma, sarcoma, and carcinoma—are very rare, and their nature will not be diagnosed before operation. About 140 primary adeno-carcinomata and 18 cases of chorionic carcinoma have been recorded. Of these papilloma, carcinoma, and chorionic carcinoma are most important clinically.

Primary Tubal Papilloma. The term *papilloma* was first applied by Doran in 1879 to an exuberant morbid growth arising from the mucosa of the Fallopian tube. Sixteen cases of benign papilloma have been recorded. It arises in the form of numerous villous processes or papillæ (*see* Fig. 370). These papillæ possess a central core of connective tissue, from which proceed multiple branches, which in their turn may again divide so that a racemose villous growth (*see* Fig. 371) is produced which eventually fills and distends the tube without invading its walls. As a result of distension by the growth the tube-walls are ultimately thinned (*see* Fig. 370). The tube may attain a large size without closure of the abdominal ostium taking place. The branching processes are invested by columnar ciliated epithelium and by columnar cells devoid of cilia; the latter secrete a thin watery mucoid fluid. In the case shown in Figure 370 the fluid escaped from the patent abdominal ostium and gave rise to ascitic effusion, but the innocence of the case was proved by the absence of secondary deposits, and by the fact that the patient was known to remain well for twenty-three years after the removal of the growth. On the other hand cases are recorded in which the abdominal ostium was sealed by inflammation whilst the uterine end remained patent, allowing of the escape of great quantities of sero-sanguineous fluid *per vaginam*.

Etiology. In many cases the history of previous inflammation is quite clear; on the other hand it is not always evident that a pre-existing salpingitis was present.

Signs and Symptoms. Papilloma of the tube gives rise to a tumour which can be felt on bimanual examination upon one or other side of the uterus. From the presence of fluid in the tube the swelling may have the consistence of a tense cyst. It may be accompanied by free fluid in the peritoneal cavity even in the absence of malignancy. There may be a history of sudden escape of pink watery discharge which comes away in

gushes drenching the patient's clothes (*hydrops tubae profluens*). Such an event may be preceded by pain of a crampy character, caused by tubal contractions.

Diagnosis. Recognition of the condition will depend upon the detection of a swelling clinically recognizable as an enlarged tube. The diagnosis of simple from malignant papilloma and from adeno-carcinoma (*vide infra*), cannot be made by clinical means in the absence of evidence of metastases.

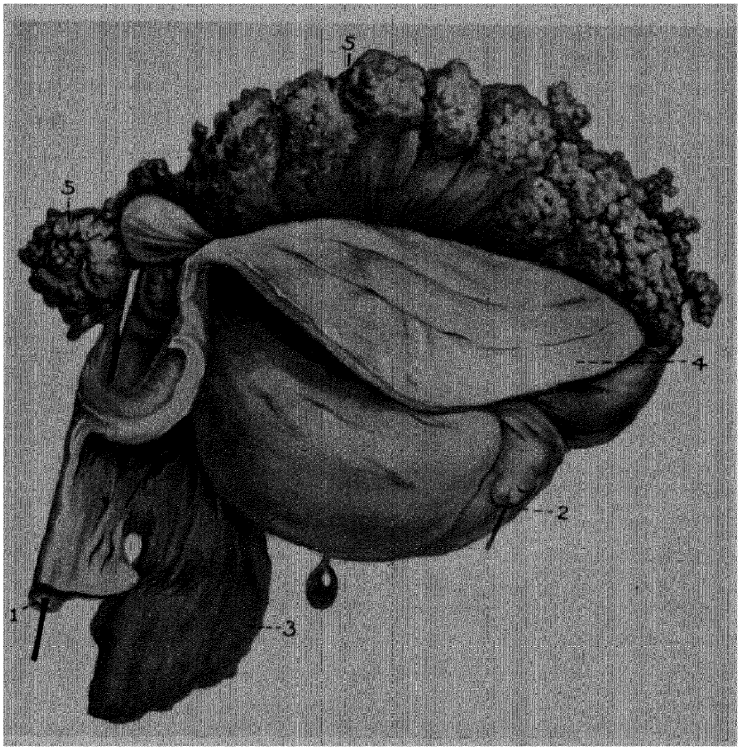


FIG 370. A FALLOPIAN TUBE ENLARGED AND DILATED BY MASSES OF PAPILLOMATOUS GROWTHS, WHICH SPRING FROM THE MUCOUS MEMBRANE (Hubert Roberts). They have not rendered the tube impervious, and a bristle is passed completely through it from the uterine end to the fimbriated extremity. No secondary deposits were found, and the patient was known to be alive twenty-three years after the operation. (1) Uterine end of tube. A bristle is passed through this to the fimbriated extremity. (2) Bristle issuing from fimbriated extremity of tube. (3) Ovary, which is healthy. A small pedunculated cyst is seen below the tube near the ovary. (4) Wall of tube, turned down to show growth occupying the lumen. (5, 5) Masses of papillomatous growth filling the tube.

Prognosis. Simple papilloma may become malignant (*see* Fig. 372), and in this respect it shows a close analogy to the ciliated papilliferous cyst of the ovary (p. 604). The evidence of malignancy rests upon finding deposits of the growth in the muscularis of the tube by microscopical examination and also, to a certain degree, upon the formation of masses of epithelial cells produced by proliferation and metaplasia of the epithelium investing the papillæ (*see* Fig. 372).

The *treatment* is complete removal of the affected tube, and if the opposite tube shows evidence of disease it should be resected also.

Secondary Papilloma occurs as a surface-growth, *i.e.* on the *peritoneal* aspect of the tube. It is met with as an extension from papillomatous growths of the ovary; the symptoms will therefore be referable to the primary growth (*see* p. 608).

Adeno-carcinoma. As with papilloma, cancer of the Fallopian tube may be primary or secondary. In its *secondary* form the disease may be due to direct extension by continuity of tissues from cancer of the ovary, or more rarely of the body of the uterus. In ovarian cancer microscopic deposits have been observed by one of us in the perivascular lymphatics of the tubes

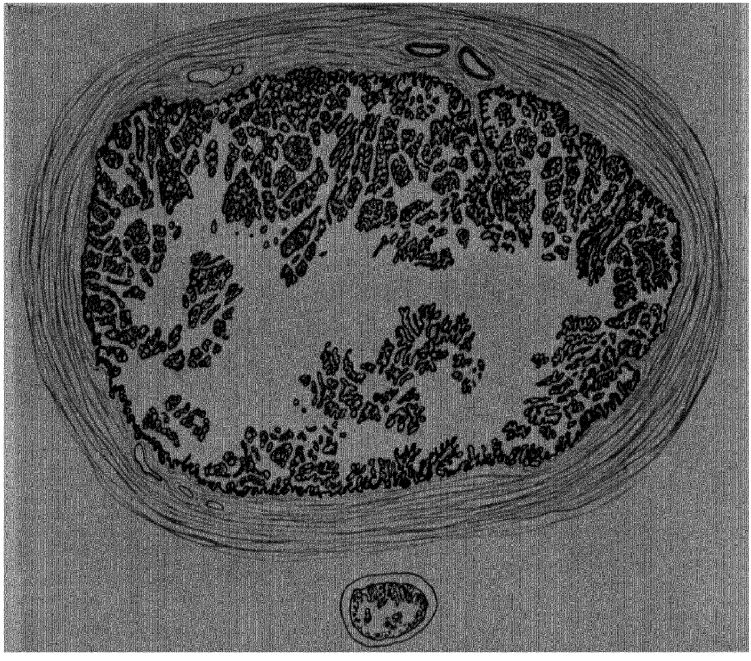


FIG. 371. PRIMARY PAPILLOMA OF FALLOPIAN TUBE. Inset, natural size. This part of the tube shows no invasion of its walls by the new growths, but further sections proved that this had occurred (*see* Fig. 372).

even when the latter showed no naked-eye changes. Cancer-cells may also make their way into the lumen of the tube through a patent abdominal ostium. Secondary cancer in the tube may occur with a primary growth situated in the alimentary tract; it is probable therefore that many of the cases presumed to be primarily tubal are in reality secondary to an undiscovered cancer in some other organ.

Primary Cancer of the tube is a rare disease, but not so rare as is simple papilloma, of which, according to Doran, only sixteen cases are recorded. Orthmann reported the first authentic case of cancer of the tube in 1888, and in 1910 Doran brought the number of his collated cases to 100, since when about forty more cases have been recorded.

Clinical Features. Adeno-carcinoma is more frequently bilateral than is

simple papilloma. It especially affects women at or about the time of the climacteric. The age of the patient from whom the specimen shown in Figure 373 was removed was 58 years. Doran states that parous women are the most subject to this disease.

Pain is very common but is not an invariable symptom. It appears to be due to increased tension produced by retained secretion and is worse in cases

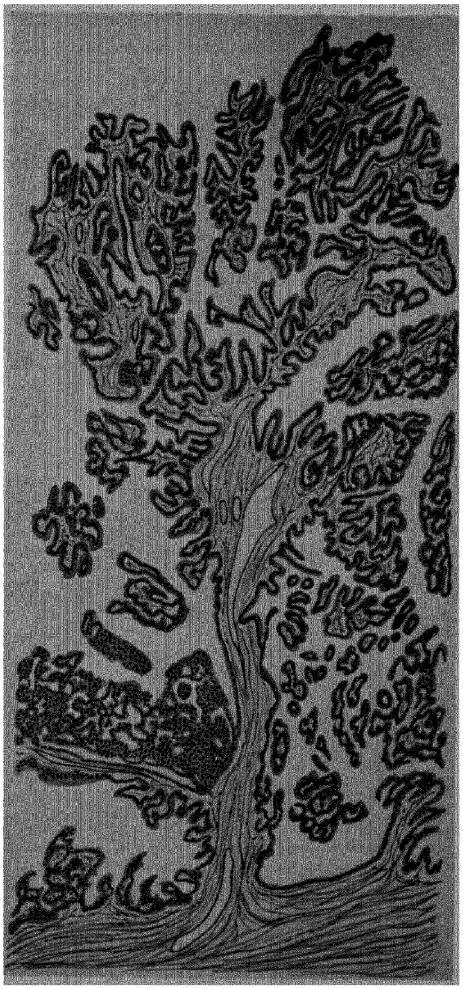


FIG. 372. PORTION OF FIGURE 371 × 45, showing that Primary Tubal Papilloma may become malignant (*see* p. 573).

where there is no discharge. The presence of a *swelling* is noticeable in most cases; in size this may vary from a small mass in the lateral fornix to an abdominal tumour of considerable dimensions. In some cases a uterine or ovarian tumour may be present as well.

Discharge is the most important of all the symptoms, being present in more than 27 *per cent.* of cases; it is usually thin, watery, and sanious, as in papilloma.

Ascites may be present and is an indication of metastatic implantation, and not of patency of the abdominal ostium as in the case of simple papilloma. There is a distinct history of pelvic inflammation, either gonorrhœal or puerperal, in a large number of cases, and in several the tubes have previously undergone gross inflammatory changes, such as hydrosalpinx, pyosalpinx, and tubo-ovarian cystic disease.

Pathology. In 36 *per cent.* of cases the disease is bilateral. The tumours which have been examined after removal have varied in dimensions from the size of a pigeon's egg to that of a mass, examined by one of us, which measured 10 inches in its greatest, by 8 inches in its least circumference. The shape of the tube is maintained until the walls are ruptured by the intratubal masses (*see* Fig. 373). On section, the lumen is seen to be occupied by a yellowish-white growth of either soft or firm consistence, which resembles

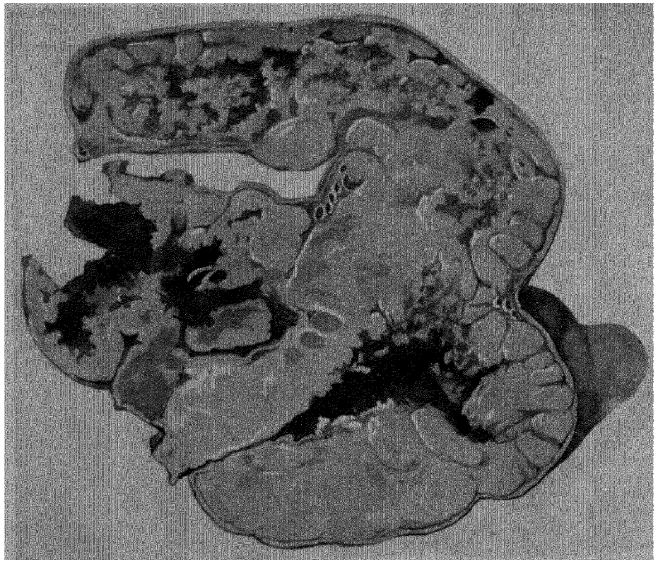


FIG. 373. PRIMARY ADENO-CARCINOMA OF THE FALLOPIAN TUBE, patient aged 58 (Herbert Spencer). The growth has considerably distended the outer part of the tube, the wall of which is intact except at the abdominal ostium. (From the *Journal of Obstetrics and Gynaecology of the British Empire*, vol. xvii., p. 33.)

the cut surface of a sarcoma in its central and more compressed parts, whilst externally are seen the coarse papillary masses characteristic of a carcinoma. The thin tube-wall forms a sac for the growth, between which and the latter may be found hæmorrhagic or mucoid fluid pent up in cyst-like spaces. The abdominal ostium is generally closed by pre-existing inflammation, and the outer surface of the delicate sac is often densely adherent to adjacent structures.

Histologically, cancer of the tube varies within wide limits, from adenocarcinoma of *tubular* type, such as that seen in Figures 374 and 375, to a diffuse *spheroidal-celled* growth with cells densely packed within large alveolar spaces (*alveolar carcinoma*). It may here be mentioned that the malignant papilloma already referred to is often included in the records of *cancer* of the tube; this is quite admissible so long as it is remembered that the growth

started as a benign tumour and not as a cancer. The histological features assumed by a papilloma after it has undergone malignant epithelial metaplasia have already been described (*see* Fig. 372).

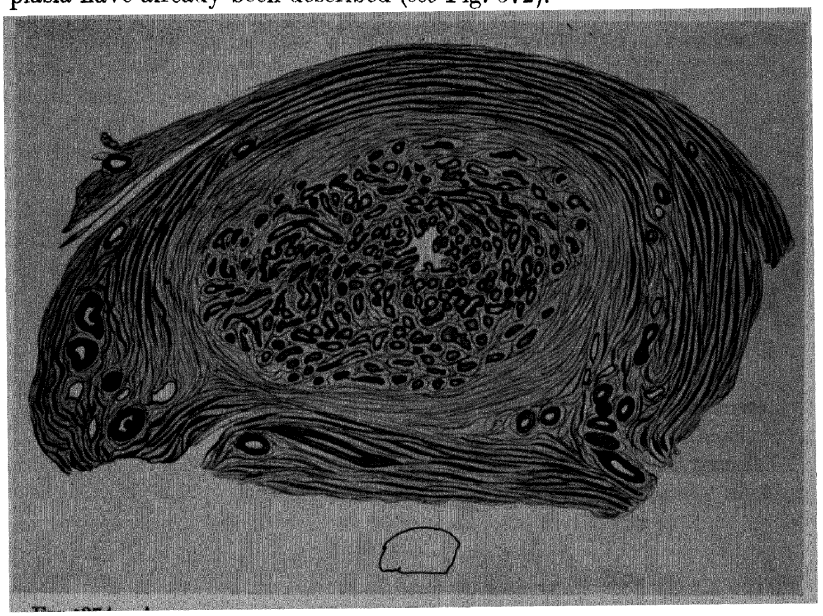


FIG. 374. ADENO-CARCINOMA OF THE FALLOPIAN TUBE. Inset, natural size.



FIG. 375. ADENO-CARCINOMA OF THE FALLOPIAN TUBE.
Portion of Figure 374. × 65.

Diagnosis. The disease is seldom detected at an early date. "A watery sanious discharge in a woman between 45 and 55, associated with a distinct and usually tender swelling in one lateral fornix, without clear evidence of uterine cancer or of a movable ovarian tumour, are indications of the existence of primary cancer of the Fallopian tube" (Doran).

Prognosis. Carcinoma of the tube is extremely malignant. The tube-wall offers but a slight resistance, and there is only the thinnest possible layer left, which easily ruptures. The proximity to large lymphatics, and the possible patency of the abdominal ostium, are among the factors which make dissemination easy. Again, rupture during operation may lead to implantation, or particles may escape through the ostium during operative manipulations. The operation for removal may entail many difficulties, so that there is an operation-mortality of 7 *per cent.* More than 25 *per cent.* of patients die of recurrence between six months and one year after removal of the affected parts (Doran).

Treatment. This consists in the free removal of the tube or tubes, and owing to the extreme malignancy of the disease it is better to perform hysterectomy at the same time, so that the tubes, ovaries, and uterus may be extirpated *en masse.*

Primary Chorionic Carcinoma. This disease of the tube has been recorded eighteen times, and, as when found in other situations, the growth may be extremely malignant (*see* p. 499).

PART II: SECTION VI

MORBID CONDITIONS OF THE OVARIES

(1) CHRONIC OVARIAN PAIN
(2) DISPLACEMENTS
(3) INFLAMMATION
(4) NEW GROWTHS

CHRONIC OVARIAN PAIN

WOMEN not infrequently complain of chronic pain referred to the iliac region on one side or the other, or sometimes on both sides; this area is often loosely styled the 'ovarian region.' The left side is much more frequently affected than the right, and in the majority of cases the subjects of this pain are women of more or less pronounced nervous temperament. The ovary may be found somewhat enlarged and more sensitive than usual to pressure in the bimanual examination, but without restriction of its mobility. Such ovaries are often said to be 'congested.' In other cases the ovary may be felt to be of abnormally small size. If signs of inflammation, affecting the Fallopian tube and ovary on the same side as the pain, are found, the pain is to be attributed to the inflammatory process.

An *enlarged* painful ovary, when examined after opening the peritoneal cavity, is often found to contain a number of small follicular cysts (*see* p. 585), and, as will be explained later on, this condition is of inflammatory origin. The *small* painful ovary is usually found to be of abnormally dense consistence, with numerous deep puckerings such as are commonly found in the ovaries of women who are approaching the close of the fertile period of life. These ovaries have been called 'cirrhotic,' since they contain relatively few Gräafian follicles and a large proportion of well-formed fibrous tissue; the pain is attributed in some way to the pressure-effects on nerves of this excess of fibrous tissue. But it must be recollected that analogous changes occur in the ovary under normal conditions in connection with the menopause, and at such times ovarian pain is not a marked or constant symptom.

But while it is doubtful whether premature fibrotic changes in the ovary are a source of pain, there is no doubt that the association of slight inflammatory changes in the ovarian cortex with the formation of small retention cysts is a frequent source of pain. Such ovaries are not only enlarged and tender when examined clinically, but are also, almost always, of abnormally large size.

In many cases, however, no definite abnormality can be detected, and such are regarded as instances of ovarian 'neuralgia.' It is therefore necessary to distinguish four groups of cases of chronic ovarian pain: (*a*) those in which the ovary is enlarged, tender, and limited in mobility; these are *inflammatory*, and often there is also evidence of thickening of the Fallopian

tube; not infrequently the changes are bilateral; (*b*) those in which the ovary is enlarged, and tender but freely movable; these are examples of what will be described later as *small-cystic degeneration;* (*c*) those in which the ovary is abnormally small; (*d*) those in which no abnormality can be detected. The last named is probably a neurosis; the others are associated with recognizable changes in the affected organ. Care must be exercised in diagnosis, and examination made under anæsthesia, in order to determine the local conditions with as much precision as possible.

Treatment. The fact that an ovary is the seat of pain is not a sufficient reason for removing it. An organ of such physiological importance is not to be lightly sacrificed during the years of its functional activity. Ovarian pain without definite organic changes is to be regarded and treated as a neurosis, and all local treatment is to be avoided; removal is never justified, for it is useless, inasmuch as it does not relieve the pain; in some cases it is positively harmful. The removal of both ovaries for such a condition is a surgical blunder of the greatest gravity.

When local changes have occurred, the treatment depends upon their nature and extent. When definitely inflammatory, the palliative treatment indicated on page 571 may be applied with benefit, and often, if persevered in, with complete success. Cystic changes are, however, uninfluenced, so far as we know, by all therapeutic measures. Partial resection, with conservation of as much healthy tissue as possible, is the operation of choice. The limitations of usefulness of ovarian transplantation have been already discussed (p. 46).

DISPLACEMENTS OF THE OVARY

Congenital *non-descent* of the ovary is a very rare anomaly, but a few cases have been recorded in which the ovary has been detained above the pelvic brim in the neighbourhood of the ureter (Bland-Sutton).

As a result of pelvic peritonitis, ovaries may be found displaced and adherent to the fundus or back of the uterus, to the ovary or Fallopian tube of the opposite side, to the abdominal wall, the omentum, or in rare cases even to the floor of the utero-vesical pouch.

Prolapse of the Ovary. In this condition one or both of the ovaries lie in the para-rectal pouch or in the pouch of Douglas. It is a common result of backward displacement of the uterus (*see* p. 514), but also often occurs as an independent condition. In the latter case there are two determining causes, viz. relaxation of the ovarian supports (usually the result of pregnancy), and enlargement with increase in weight of the ovary. These conditions lead the ovary first to sink into the para-rectal pouch, and later, slipping over the edge of the utero-sacral fold, to fall into the pouch of Douglas. At first the ovary, though usually enlarged, is not otherwise abnormal; after a time it may become adherent in its faulty position. Except in cases of backward displacement the condition is usually unilateral, or if bilateral one ovary is affected to a much greater extent than the other.

The main *symptom* of a prolapsed ovary is a dull aching pain felt in the back or in the hypogastric zone of the abdomen, and when the condition is associated with backward displacement of the uterus, other symptoms may be present (*see* p. 518).

In its abnormal position in the pouch of Douglas the ovary is subject to disturbance from the filling and emptying of the rectum, from straining

during defæcation, or from coitus. In its normal position it is free almost entirely from disturbances of this kind. These considerations probably account for the fact that the majority of prolapsed ovaries are very sensitive to touch *per vaginam* or *per rectum*, and to this abnormal sensitiveness the pain so often experienced is due. The pain is increased during menstruation, but beyond being unusually painful this function is not otherwise disturbed. Married women sometimes complain of dyspareunia, the pain in some cases being described as severe and sickening in character. Yet cases are not very infrequent in which prolapsed ovaries are not unduly sensitive, and do not give rise to pain, but are discovered, as it were, by accident during clinical examination.

As is the case with many other gynæcological ailments, neurasthenia and hysteria are frequently found in association with prolapsed ovaries. Care must be exercised in avoiding the error of attributing all the patient's alleged sufferings to the displaced ovary.

The *treatment* of a prolapsed ovary is a subject which calls for the exercise of discretion, especially if complicated by obvious neurosis. *Relief* of pain can sometimes be secured by a course of local treatment, such as rest, vaginal douching and vaginal tamponade; rest in such cases should be enforced in the prone position. These measures may temporarily relieve the embarrassed circulation through the ovary. A ring pessary will limit the descent of the ovary, although it is powerless to restore it to its normal position. Only a certain amount of relief can be anticipated from the use of this instrument. Cure can be obtained by stitching up the ovary in its proper position by shortening the ovarian ligament (*ligamentum ovarii proprium*).

In cases dependent upon backward displacement of the uterus, the treatment is that suited to the displacement.

Hernia of the Ovary. This condition may be *congenital* when the ovary occupies the canal of Nuck (*see* Fig. 86, p. 134); in many reputed cases, however, the body found in this canal has proved on microscopic examination to be a testis, or a combined gland—ovo-testis (*see* p. 147). The *acquired* form is much commoner than the congenital; the ovary has been found in every variety of hernia, but more commonly in the inguinal, than in any other. It is usually accompanied by its companion Fallopian tube, and sometimes by a knuckle of bowel or a piece of omentum. Ovaries displaced in this way are usually functionally active. The gland often becomes swollen and unusually tender during menstruation, and in rare instances axial rotation has occurred, giving rise to acute symptoms and to a diagnosis of strangulation of the hernia. When the ovary cannot be reduced, the case should be treated surgically upon the lines suited to the variety of hernia which it represents.

INFLAMMATION OF THE OVARY

Oöphoritis is due to the same causes as inflammation of the tubes, but the ovary is less often infected than the tube. Extension of inflammation from the tube to the ovary may occur in two different ways, (1) by a spread to the *surface of the ovary* directly from the tube or adjacent peritoneal surfaces; this results in the formation of ovarian adhesions and a thickening of the superficial layers of the cortex (*peri-oöphoritis*); (2) bacteria may

penetrate the ovarian tissues through a ruptured Gräafian follicle, or may be deposited in them by the blood- and lymph-streams (*interstitial oöphoritis*).

Peri-oöphoritis

Peri-oöphoritis is of frequent occurrence, the commonest precedent conditions being salpingitis (*see* Fig. 365, p. 564) and pelvic peritonitis. The adhesions may bind the ovary firmly to the tube, to the back of the broad ligament, or to the floor of the pouch of Douglas. In a large proportion of cases the ovary, in addition to being adherent, is also enlarged from the formation of numerous small unilocular cysts, resulting from the non-dehiscence and cystic degeneration of Gräafian follicles. The frequency with which adherent ovaries are cystic, points to the conclusion that inflammatory changes lead directly to this condition, which is known as the 'small-cystic' ovary (*see* Fig. 379, p. 585).

In the acute stage of peri-oöphoritis the ovary can be easily separated from the adherent tube and neighbouring peritoneum. It is swollen, as a rule, and œdematous. In chronic peri-oöphoritis it is usual to find the ovary enveloped by fibrous webs and intimately bound to the tube (*see* Fig. 366, p. 564), sometimes along the whole length of the latter, sometimes to its abdominal ostium, the fimbriæ of which are obscured by the adhesions. Inflammatory peritoneal cysts often overlie both tube and ovary and the mesosalpinx intervening between tube and ovary may have disappeared, or if present may be thickened by inflammatory new formation (*see* Fig. 365, p. 564.)

Acute Interstitial Oöphoritis

This condition is usually due to a streptococcal infection spreading from a septic endometrium during the puerperium or after abortion, or it may be caused by a direct blood-infection during one of the acute fevers. Thus acute interstitial oöphoritis is liable to occur in typhoid, cholera, and scarlet fever; it also occurs in poisoning by phosphorus and arsenic. In *acute oöphoritis* resulting from septic endometritis, the ovary is soft and swollen, in colour it may be yellowish, deep-red, or dirty grey, sometimes it may be nearly black. The surface is covered with thick fibrinous flakes. On section the stroma is œdematous, and small interstitial abscesses are found. The follicles may also contain pus. The condition is accompanied with acute peritonitis, which is often fatal before a clinical diagnosis of acute oöphoritis can be made.

In cases of *subacute* infection (1) the damage to the ovary may be repaired to some extent, but many follicles become atresic, (2) the subacute stage may pass into a chronic oöphoritis (*see* Fig. 379), or (3) abscesses may form which run a subacute or a chronic course.

Ovarian Abscess. Abscesses are found in two situations within the ovary: (1) in the stroma, (2) within either a follicle or a corpus luteum. The latter situation is by far the more usual.

In an ovarian abscess the specific organism may exist for a longer time than it does in a pyosalpinx. Many months after abortion one of us was able to grow pure cultures of a streptococcus after twelve hours' incubation, from pus aspirated from an ovarian abscess. Dudgeon has also found the staphylococcus albus in the blood of an ovarian hæmatoma (Hedley).

(1) An abscess in the stroma is the result of a direct blood-infection and

may arise in the course of enteric fever or other specific fever, or of puerperal sepsis. It is therefore an embolic or pyæmic lesion. Many foci of suppuration may be found and they are usually small, with ragged walls, and are devoid of a lining of granulations.

(2) *Corpus Luteum Abscess.* The usual site for an ovarian abscess is the mature Gräafian follicle or corpus luteum, and the usual mode of infection is not through the blood-stream, but by the progress of an ascending infection along the mucous membrane of the tube. The organisms enter through the tear in the follicle caused by dehiscence in ovulation, the process of infection being analogous to the transference of a spermatozoon to a follicle, such as is known to occur in ovarian gestation. This kind of abscess is therefore one of the final results of an ascending infection from the lower genital tract, and the commonest cause is gonorrhœa. Since the pus is formed from the infection and breaking down of the blood-clot within a corpus luteum, the lining of the abscess will, in the first instance, be composed of the convolu-

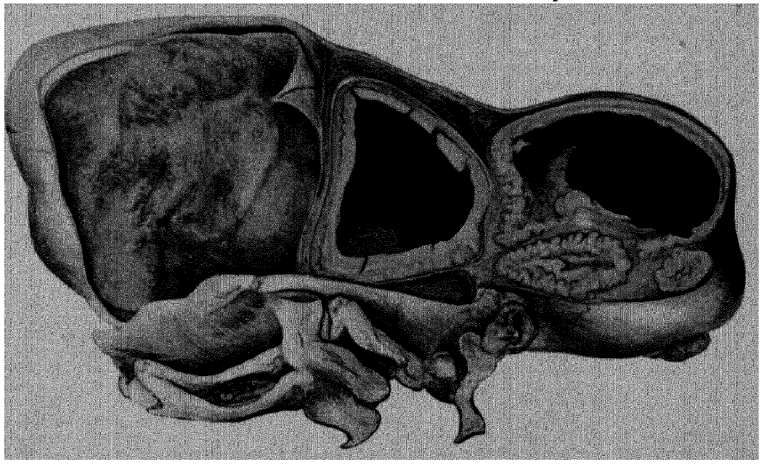


FIG. 376. TWO LUTEIN ABSCESSES IN A CYSTIC OVARY. Note the convoluted yellow lutein tissue.

tions of lutein tissue. Later on, when the abscess has become chronic, the lutein cells are in part replaced by granulations, but it is generally possible to distinguish their presence microscopically. In a recently formed lutein abscess the characteristic yellow lining is very obvious, and its folded appearance is maintained in those of small dimensions. When granulations intermingle with lutein cells, the lining becomes coarsely granular, giving an appearance which has been likened to frog's spawn. Figures 376 and 377 represent the average sizes of lutein abscesses. The largest which we have encountered was the size of a fœtal skull, and was densely embedded in the left side of the pelvis. Lutein abscesses run a very chronic course, become densely adherent (*see* Fig. 377), and as there is frequently no rise of temperature, they are rarely diagnosed before operation, but when opened up after removal, the tufted or papillary character (*see* Fig. 377), and yellow-ochre colour, of their inner wall is diagnostic.

Follicular Abscess. An unripe or atresic follicle, or what will later be described as a *theca-lutein cyst*, may become infected *viâ* the blood-stream, as we have already seen in acute oöphoritis. It is quite possible that this

may also occur in subacute and chronic oöphoritis. In such cases, we must assume that the infection occurs through actual penetration of the thin walls

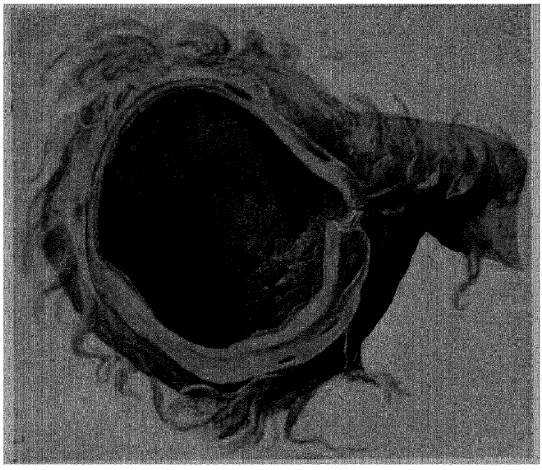


FIG. 377. LUTEIN ABSCESS FROM A CASE OF DOUBLE SALPINGO-OÖPHORITIS. Note the 'frog-spawn' lining, and the adhesions on tube and ovary.

of such cysts as project on the surface of the ovary. It is a well-known fact that although the gonococcus usually produces a surface-inflammation, it,

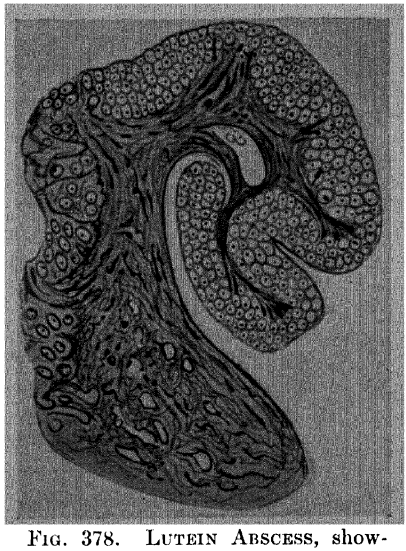


FIG. 378. LUTEIN ABSCESS, showing one of the tufts which give the papilliferous or 'frog spawn' appearance to the yellow abscess-wall. The section was taken from specimen shown in Figure 377.

nevertheless, is capable of penetrating into cellular tissues. In suppuration of unripe follicles, the theca-lutein cells are often seen as a flattened lamina

lining the cavities, but the papillary or tufted appearance of the lining membrane of a corpus-luteum abscess is never seen.

Chronic Interstitial Oöphoritis

This condition is generally bilateral, but it is not invariably so. There is almost always enlargement of the ovary and fixation of the organ to the pelvic wall, or in the pouch of Douglas, where it is prone to gravitate by reason of increase in weight and size.

Causation. *Gonorrhœa* is the most frequent cause of chronic oöphoritis. It is therefore most common in young women between twenty and thirty years of age. In children and virgins a latent *appendicitis* may be the cause, or an acute *puerperal* oöphoritis may, as already stated, pass into a chronic stage. It may be that *circulatory disturbances*, of a non-inflammatory nature, produce the same histological changes in the ovary as those caused by infection; so that all sources of irritation leading to increased blood-supply to the ovaries must be considered in the etiology of this form of oöphoritis.

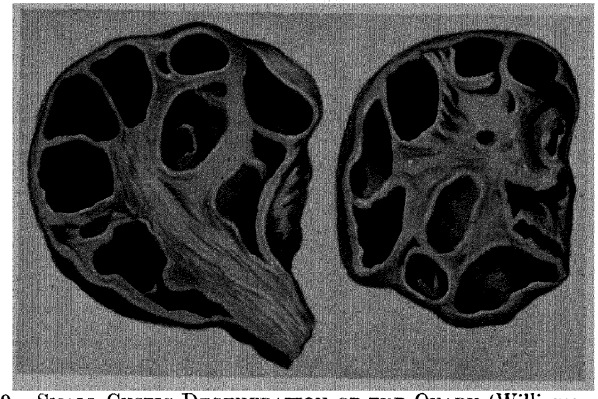


FIG. 379. SMALL CYSTIC DEGENERATION OF THE OVARY (Williamson). The cysts are atresic follicles.

Such sources of irritation are uterine fibroids, ovarian tumours of the opposite side, sexual excitement (masturbation, *coitus interruptus*, etc.). The patient herself will often give as a cause, *chill*, *e.g.* getting wet during a period, and this cannot be excluded, as it may lead to a determination of blood to the inner genital organs sufficient to produce an extension of a pre-existing inflammation.

Macroscopically, the ovary is almost always enlarged. The surface is frequently covered by adhesions; it is uneven and lobulated, partly from an unusual number of distended follicles, partly in consequence of deep depressions and folds of the cortex itself (*ovarium gyratum*). Sometimes, on the other hand, it becomes reduced in size and very hard.

Microscopically, are found (1) a more or less uniform thickening of the tunica albuginea, visible as white spots similar to the tendinous spots of the cardiac ventricle; (2) an increase of the connective tissue of the stroma accompanied by a definite numerical reduction or total disappearance of the primordial follicles; (3) the walls of the blood-vessels in the hilum are thickened; (4) the corpora albicantia, corpora fibrosa, and cystic follicles are increased in numbers, due sometimes to impairment in the retrogression

and absorption of the lutein tissue, the latter remaining as compact hyaline masses; (5) in other cases the ovary is converted into a mass of fibrillary connective tissue.

"Small-cystic Degeneration of the Ovary." Sclerocystic Disease. In this condition the number of visible follicles may be increased to twenty or more; they vary in size from that of a pea or bean to that of a pigeon's egg, whilst the stroma is diminished in amount (*see* Fig. 379). In many of the cysts the egg-cell is still visible, but often it is degenerated or has disappeared, together with the granulosa-layer. These cysts are *atresic follicles*. Some possess a lutein lamina. The failure of these follicles to ripen and rupture is due in part to the thickened tunica albuginea, and may be dependent also upon the fact that the egg-cell has degenerated, which in its turn may be a result of inflammation. When a follicle has lost its egg-cell, one of two alternatives

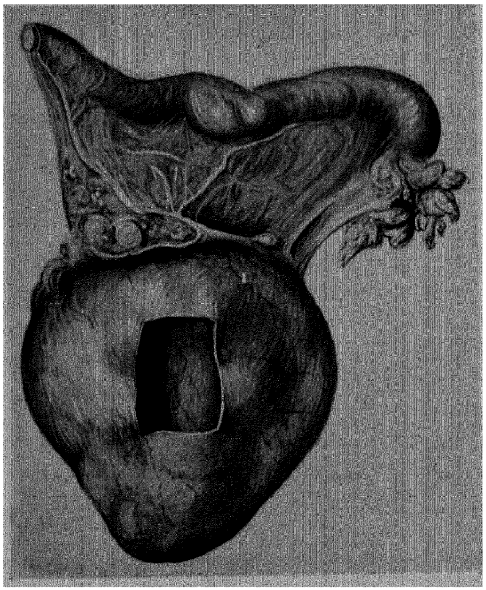


FIG. 380. LARGE HYDROPS FOLLICULI OR SIMPLE SEROUS CYST.

will happen, according to the stage of development which the follicle has reached; these are (1) the formation of a hydrops folliculi, or (2) the formation of a theca-lutein cyst.

Hydrops Folliculorum. This condition is not regarded by all writers as inflammatory in origin, but in our opinion this is the correct view to take of its causation.

In small-cystic degeneration, or sclero-cystic disease, we have the initial stages of the formation of dropsical follicles. In a variable structure like a Gräafian follicle, it is difficult to say where physiological enlargement ends and where pathological distension begins. We must therefore take the degenerated condition of the egg-cell and stratum granulosum as evidence that the distension is pathological, and we must find collateral evidences of chronic oöphoritis, before drawing the conclusion that the latter is the cause of the distension of the follicle.

Round-celled infiltration which appears in the early stages of oöphoritis is not seen in the chronic stage. The signs of chronic inflammation in the ovary have already been described on the last page. Such changes as are there mentioned are often met with in association with hydrops folliculorum, and when present they justify the conclusion that the follicular distension is the outcome of chronic oöphoritis.

Macroscopically, these distension-cysts appear as thin-walled, translucent vesicles on the surface of the ovary. There may be many such, but generally only one enlarges to a considerable size; the remainder, succumbing to the pressure of the largest cyst, finally disappear. Very rarely a number of cysts enlarge simultaneously, producing a multi-locular tumour, the septa of which consist of thinned-out ovarian stroma dividing the individual cysts one from another. This is the so-called 'Rokitansky's tumour,' or *compound hydrops folliculorum*. By the breaking-down of septa between dropsical follicles, a cyst composed of two or three conjoined loculi may be formed, but again, this is exceptional, it being usual to find a single unilocular cyst.

Microscopically, the cyst-wall is composed of connective tissue, the outer layer being fibrous, the inner cellular and containing vessels. The innermost layer consists of the basal cells of the stratum granulosum; the more superficial cells, together with the ovum and discus proligerus, have been shed (*see* Figs. 381 and 382). The cells of the basal layer are seen to have changed their shape and become cubical. As the cyst enlarges these cells become flattened out, and eventually they are destroyed by the pressure of the cystic fluid. In colour this fluid is pale yellow; it contains albumen, salts, and nitrogenous extractives. It has a low specific gravity.

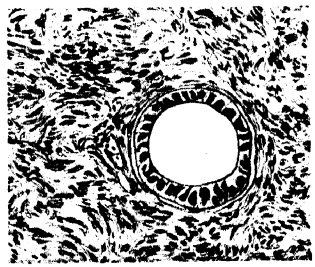


FIG. 381. ATRESIC GRAAFIAN FOLLICLE FROM AN ADULT OVARY (early stage). The egg-cell is lost, only the membrana granulosa remains, and its cells have changed their form and become cubical instead of spherical.

Hydrops folliculi *per se* causes no characteristic symptoms. It appears at every period of life up to the menopause. The cysts may rupture and undergo spontaneous cure.

Simple Serous Cysts. Some authorities regard the cyst described by this title as the simplest form of an ovarian adenoma, but we consider it to be an exaggerated form of hydrops folliculorum and therefore include its description under inflammatory changes of the ovary and not under the section dealing with new growths.

Simple serous cysts are seldom sufficiently large to cause symptoms, they may attain the size of an orange, and in exceptional cases reach large dimensions. Usually they are unilocular, but one or two septa may be present. They have thin walls, and contain clear albuminous fluid of low specific gravity. They grow slowly, and may rupture, but the contents set up no irritation of the peritoneum; and there is clinical evidence to suggest, that without rupture, the contents may be absorbed and the cyst subside. The fluid is a secretion from the epithelium lining the cyst. As the cyst enlarges the epithelial lining becomes flattened out, and shows a certain tendency to proliferate. The increase of epithelium and the correspondingly large size

of the cyst is no reason for regarding a simple serous cyst as a new growth, the same epithelial increase is seen in a large hydrosalpinx; also it is to be remembered that in salpingitis the epithelium (in response to inflammation) behaves in an adenomatous manner, *i.e.* it proliferates and forms cystic follicles in the wall of the tube (*see* Fig. 363, p. 561), but the adenomatous formation thus produced is not regarded as a new growth.

Proliferative processes such as are characteristic of neoplasms are entirely wanting in the walls of a large hydrops folliculi (simple serous cyst). It is true that small dense wart-like projections are sometimes seen as papillæ upon the otherwise flat surface of the cyst; these, however, show no epithelial overgrowth, but are generally covered by a flat layer of endothelioid cells.

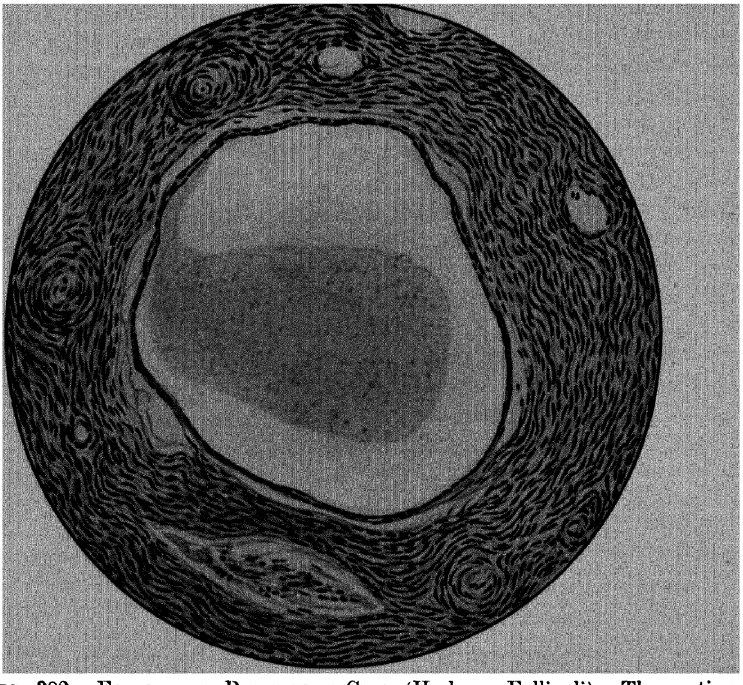


FIG. 382. FOLLICULAR RETENTION CYST (Hydrops Folliculi). The section shows an irregular dilated follicle with its epithelial lining flattened and atrophied by pressure.

These projections may be explained by regarding them as due to an *inflammatory* hyperplasia of the connective tissue in the wall of the cyst, *i.e.* of the nature of condylomata acuminata (*see* Fig. 152, p. 261), especially as they resemble these structures histologically.

Theca-lutein cysts are a very common accompaniment of chronic oöphoritis. The characteristic feature of these cysts is that theca-lutein cells are present in their wall. They are formed from follicles in which the ripening process has begun, that is, after the development of the lutein cells in the theca interna, and sometimes after the disappearance of the membrana granulosa. Many theca-lutein cysts, however, still retain an epithelial lining (membrana granulosa) internal to the lutein lamina, and are consequently termed *epithelial-lined lutein cysts*. Those which are non-epithelial, possess a

lamina of fibrinous material covering the lutein layer. This is probably the representative of the unaltered part of the theca interna of the follicle (*see* Fig. 383); it may be smooth, tufted or wavy in outline. The lutein cells which are found in the theca-lutein cysts are much smaller than those seen in the yellow convoluted lutein-layers of a ripe corpus luteum (*cf.* Figs. 384 and 385, also Plate IV., p. 39). The latter have an origin in the granulosa-cells, and thus we may divide lutein cysts into two varieties, the theca-lutein cyst and the granulosa-lutein cyst.

It will be seen that while theca-lutein cysts and hydrops folliculorum are

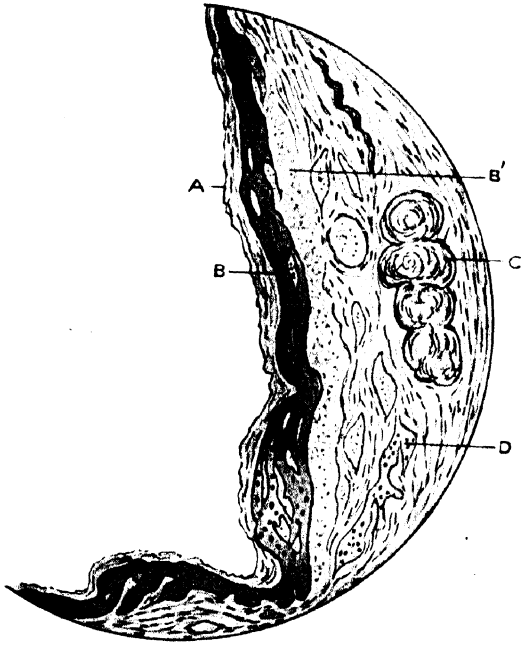


FIG. 383. WALL OF A LARGE THECA-LUTEIN CYST. The lutein cells have become compressed by tension of the cyst contents so that the outline of the cells is lost. A, Internal layer of fibrin. B, Lamellar arrangement of compressed lutein cells. B′, Layer of blood-clot within theca interna. C, Corpus albicans. D, Displaced lutein tissue lying in ovarian stroma.

both due to chronic oöphoritis, they differ in one essential particular, viz. that only the former shows the presence of lutein cells. In the latter condition the cystic changes occur before these theca-lutein cells have developed. There is no evidence to show that once a follicle has become dropsical, it can proceed to the normal development of lutein cells from its theca interna. Absence of the egg-cell, and the gradually increasing intracystic pressure, prevent further progress towards maturity.

Theca-lutein cysts are usually unilocular and single, but many such cysts are to be found in a single ovary which has suffered from chronic interstitial oöphoritis. Occasionally these small cysts may be bilocular (*see* Fig. 384).

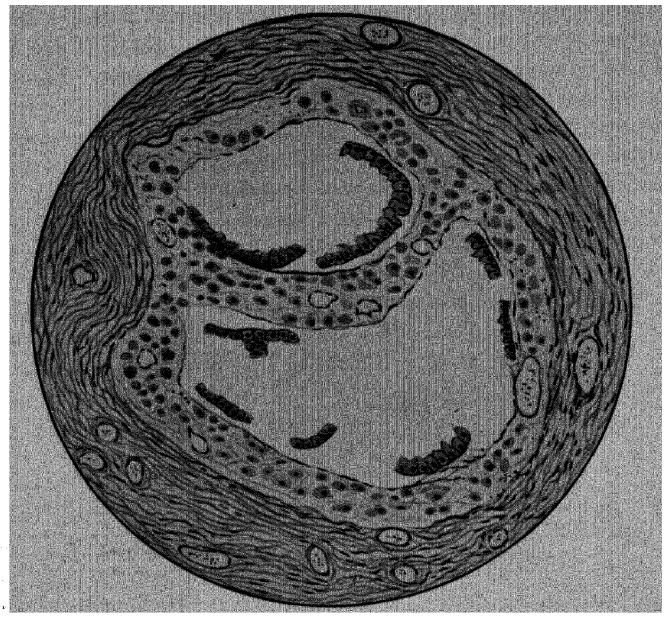


FIG. 384. BILOCULAR THECA-LUTEIN CYST. The theca-lutein cells are smaller than those seen in the convolutions of a ripe corpus luteum (*cf.* Fig. 385). The granulosa-layer still persists in detached fragments.



FIG. 385. MICROSCOPIC SECTION OF NORMAL CORPUS LUTEUM, such as those seen in Plates IV. and V. (*see* pp. 39—40). The large mono-nuclear lutein cells, rich in cytoplasm, make up the yellow convolutions. They are derived from the stratum granulosum.

The contents consist of an albuminous, clear, straw-coloured fluid, which is derived mainly by transudation from the vascular theca interna. When an epithelial lining persists (*see* Fig. 384), it will contribute by its secretion to the fluid contained in the cyst.

Compound Theca-lutein Cysts are bilateral, thin-walled, multilocular ovarian cysts found in association with vesicular mole and with chorionic carcinoma. The average size of such cysts is that of a fœtal skull. In general appearance a compound theca-lutein cyst resembles a compound hydrops folliculorum or large Rokitansky's tumour. The loculi possess extremely thin, tense walls, looking like bubbles about to burst. Through the thin walls may be seen yellow patches of the lutein lamina which forms the lining of the cysts. On section, the cysts can be seen to arise from the oöphoritic or cortical part of the ovary, the hilum and adjacent medulla being the last

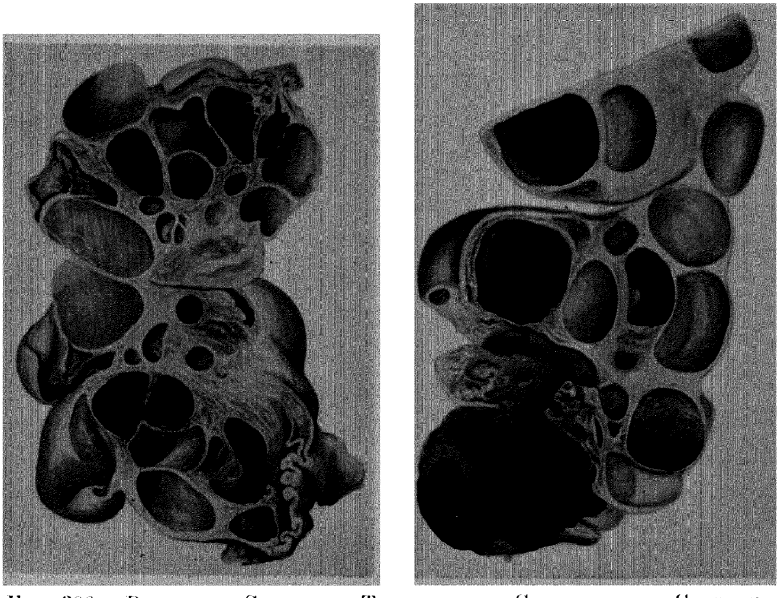


FIG. 386. BILATERAL COMPOUND THECA-LUTEIN CYSTS FROM A CASE OF VESICULAR MOLE, which was followed by chorionic carcinoma.

part to be invaded (*see* Fig. 386). A ripe corpus luteum may sometimes be detected in the remaining solid portion of the ovary. Even in the largest cysts a considerable part of the ovary may remain intact. The contents of the loculi are a clear, straw-coloured, highly albuminous fluid which solidifies in formalin solution (*see* Fig. 387). Islands of solid lutein tissue may be found in what remains of the solid part of the ovary. In the largest loculi of these compound cysts the lutein lamina is very compressed and flattened out (*see* Fig. 383); it is often found to be displaced within the fibrous tissue composing the thin cyst-wall. The innermost lining is composed of fibrinous material (*see* Fig. 383).

The excess of lutein tissue in a compound theca-lutein cyst was thought to provide a stimulus which resulted in the abnormal trophoblastic proliferation seen in vesicular mole and chorionic cancer. This hypothesis has, however, never been proved.

Compound theca-lutein cysts are of considerable clinical importance, since, like other cysts, they are liable to axial torsion of their pedicle (*see* Fig. 388 ; Malcolm, Bell and Lockyer), and there is considerable clinical evidence that they may shrink spontaneously until the ovaries assume their normal size.

Cysts of the Corpus Luteum. This term has erroneously been used to describe theca-lutein cysts which arise from atresic follicles. It must be clearly understood that theca-lutein cysts arise from abnormalities (the result of inflammation) produced during the *maturation* stage of a Gräafian follicle. Such cysts, therefore, form a variety of atresic follicles, follicles, that is, which have received a check in their development, preventing further maturation along normal lines to dehiscence, and to the formation of a corpus luteum. The question arises, Can cysts ever develop from a ripe corpus luteum during its *retrogression* and before its normal disappearance ?

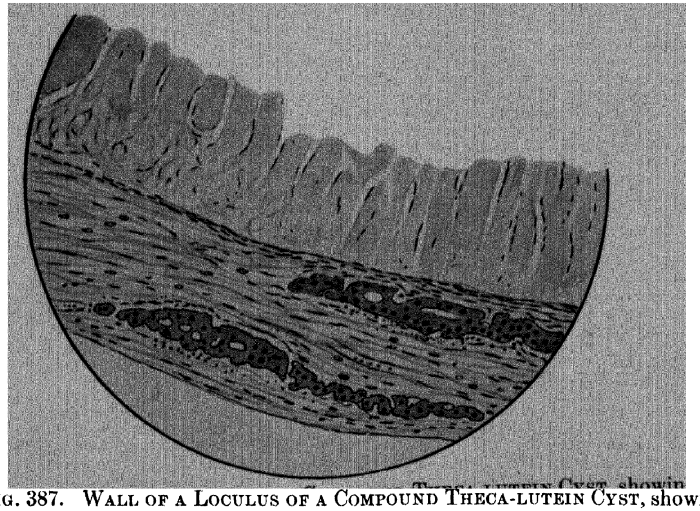


FIG. 387. WALL OF A LOCULUS OF A COMPOUND THECA-LUTEIN CYST, showing the albuminous fluid-contents hardened by formalin solution. The lutein tissue is represented by two laminæ which have been displaced from the inner surface and lie in the fibrous tissue composing the cyst-wall.

We have found evidence to show that a few cysts do develop in this way : (1) by liquefaction starting in the central blood-clot, and (2) by cystic spaces forming in displaced masses of lutein cells. Such cysts are, however, only interesting from the histological standpoint ; they are probably of no clinical importance.

After rupture, the ripe follicle, on rare occasions, does, however, provide one pathological condition of great clinical significance, viz. the corpus-luteum hæmatoma (*vide infra*). This leads to a continuance of hæmorrhage after dehiscense, which may be sufficiently excessive to simulate a ruptured ectopic pregnancy, and from which it can only be distinguished by microscopic examination of the hæmatoma, proving the absence of chorionic villi in the clot.

Ovarian Hæmatomata. The following varieties of hæmatoma are met with in the ovary :

I. Hæmatoma of the Gräafian Follicle { (*a*) Immature. (*b*) Mature.

II. Endometrial Hæmatoma.

I. (*a*) Of the two varieties of *follicular hæmatoma* the one which arises from a follicle *before* its rupture is by far the most common of all ovarian

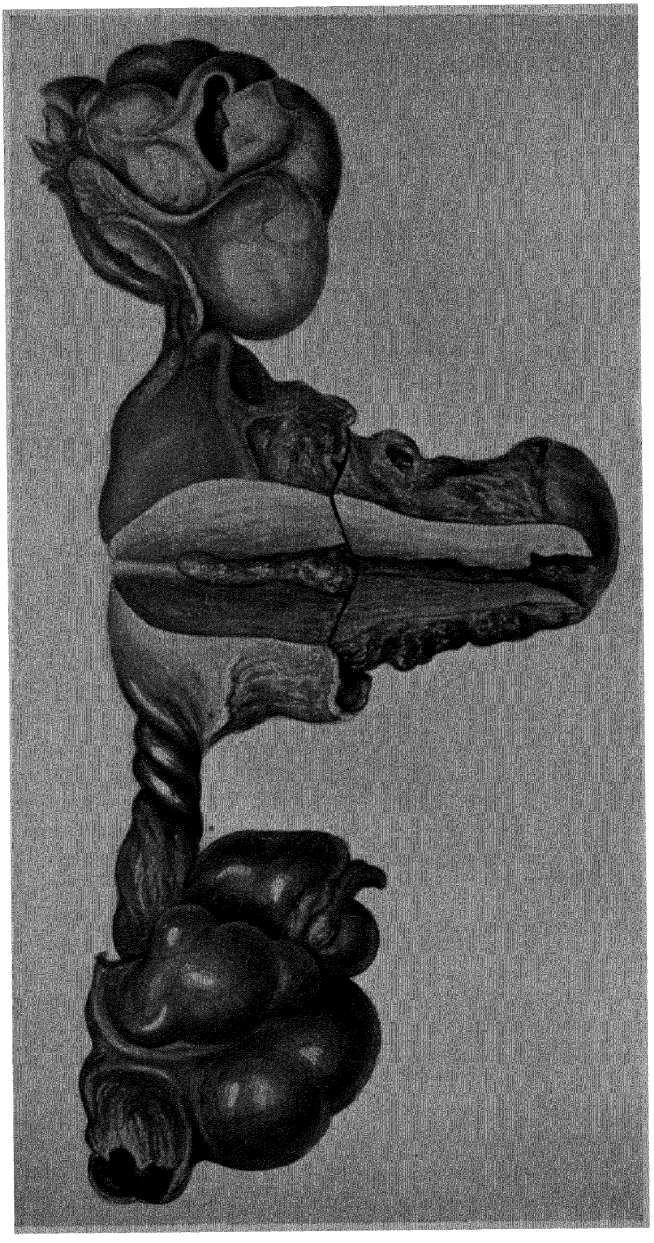


FIG. 388. AXIAL TORSION OF A COMPOUND LUTEIN CYST, in a case of vesicular mole followed by chorionic carcinoma (Malcolm, Bell and Lockyer).

hæmatomata. It is the outcome of a chronic oöphoritis which produces an excessive congestion of the theca interna; from this hæmorrhage into the cavity of the follicle results. The bleeding inverts and rup-

tures the inner lining of the follicle, and the cavity soon becomes greatly distended with blood. This lesion, known as a *theca-lutein haematoma*, is frequently *bilateral*, which is not surprising when it is remembered that it is caused by chronic oöphoritis; moreover, theca-lutein hæmatomata are often densely adherent and accompanied by chronically thickened tubes. They are liable to secondary infection, and form one of the precursors of ovarian abscess (*see* Figs. 377 and 378, p. 584).

Theca-lutein hæmatomata have thick walls; they may attain the size of an orange (*see* Fig. 389); the contained blood may be inspissated and resemble anchovy paste, or it may form a thick black fluid of the consistence of tar or golden syrup. Except in the largest hæmatomata theca-lutein tissue, as a flat lamina, may be made out underneath an inner fibrous lining by microscopic examination.

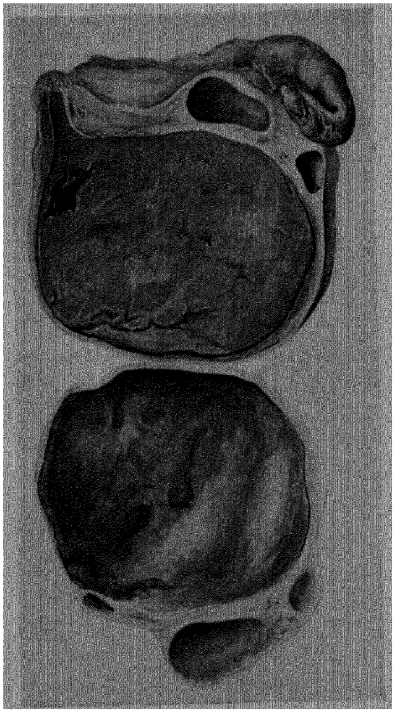
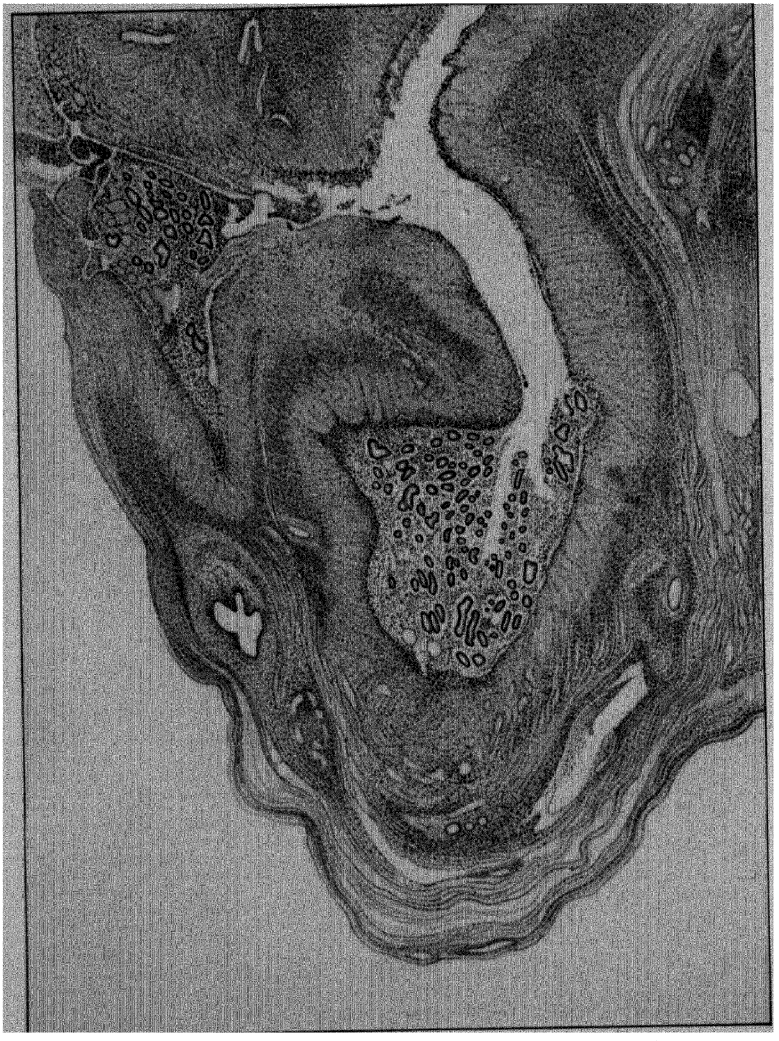


FIG. 389. THECA-LUTEIN HÆMATOMA. Bisected in its transverse axis.

(*b*) The hæmatoma which is produced *after*, or rather synchronously with, the rupture of a *mature* follicle (*corpus luteum haematoma*) is a rare lesion, but many such have been recorded, including three cases published by one of us. It has, in fact, been clearly demonstrated that from certain causes, of which chronic oöphoritis may be one, a *mature* follicle (ripe corpus luteum) may become abnormally distended with blood and after what appears to be a normal dehiscence may continue to bleed to such an extent as to cause symptoms of internal hæmorrhage. The hæmatoma in the ovary in such cases maintains the appearance of a corpus luteum in that it has a thick lining of yellow cells (granulosa-lutein cells) arranged in the well-recognized convolutions. Whilst there is enough blood in its cavity to justify the term "*haematoma*" the *excess* of blood has escaped, and the convolutions of lutein tissue have not been subjected to enough pressure from contained blood to cause them to be flattened out, as happens with the *theca-lutein* hæmatoma described above.

Under normal conditions, as soon as a ripe follicle dehisces and the ovum escapes, the vascularity of the theca interna subsides, and blood escapes only in sufficient amount to take the place of the liquor folliculi. In chronic oöphoritis the congestive state of the theca interna is not thus easily relieved, but may lead to ovulation being accompanied with severe hæmorrhage. In such cases, it should be clearly understood that the blood comes from the periphery of the corpus luteum (theca interna) and not from the ovarian cortex lacerated by dehiscence.

The follicular ovarian hæmatomata have to be diagnosed from ovarian



OVARY INVADED BY ENDOMETRIAL TISSUE.
(After Vernon Bayley.)

To face page 595.

gestation ; this especially applies to the hæmatoma derived from a mature follicle.

II. *Endometrial Haematoma.*—American investigators, notably Sampson,[1] Cullen and others, have drawn attention to the presence in the ovary and other pelvic structures of tissue indistinguishable from the corporeal endometrium. This tissue is found on the surface of the ovary and also in the depths of the gland. It possesses the power of invasion by a process of erosion ; it responds to the stimulus of menstruation, and by the outpouring of blood into the stroma of the ovary it produces an ovarian hæmatoma. The so-called ' tarry cysts ' of the ovary are said by some observers always to be caused in this way. We are prepared to admit that many, and perhaps most, of the " tarry " or " chocolate " cysts are thus to be accounted for, but we are convinced that theca-lutein hæmatomata may assume the same characters, so that only by the microscope can the origin of these hæmatomata be determined, *i.e.* whether the collection of blood proceeds from invading endometrial tissue or from the inflamed theca of an atresic follicle.

In many cases where the ovary has been extensively destroyed by the pressure of blood from within, it is impossible to detect either endometrial tissue or lutein tissue, and the origin of such hæmatomata as these must remain in doubt.

In ovarian hæmatomata of endometrial type, speculation as to how the invading tissue reached the ovary favours the view originally expressed by Sampson, viz., that during menstruation there has been a back flow along the tubes leading to a ' cellular spill,' and implantation. Bailey accepts this view and suggests that in cases of retroversion it is more likely to occur than when the uterus is forwardly placed. It is very obvious that menstrual regurgitation does not occur in all women, so the question to be answered is, Why does it ever occur ? Serial sections prepared by Sampson and by Bailey show blood and cells in the lumina of the tubes ; therefore regurgitation as a fact may be said to be established. It has been suggested by Everard Williams that intra-abdominal pressure exerts a suction action upon the contents of the tube and thus favours the regurgitation of the blood.

Not only does the endometrial tissue in and on the ovary bleed during menstruation, but it undergoes decidual reaction during pregnancy.

Morbid Anatomy of Endometrial Haematoma.—These blood-cysts resemble theca-lutein hæmatoma in being densely adherent and they are usually ruptured on removal. In the adhesions to the cortex, endometrial tissue may be found, and from this the same tissue may be shown microscopically to invade the ovary leading to other deposits which appear to be able to develop *in situ*. The lesion is described by Bailey as one of active local invasion (*see* Pl. XXX.).

Clinical Features.—Endometrial hæmatomata occur during the fertile period, both in unmarried and married women, and are the cause of absolute or relative sterility. Pain is the most prominent symptom ; menstrual disturbances are common, dysmenorrhœa and menorrhagia being marked features. Some few cases, according to Hedley, have an intermenstrual coloured discharge and also intermenstrual pain. The endometrial tissue has been known to invade an adherent bladder, thus adding vesical symptoms to the clinical features.

[1] *Am. Jl. Obs. Gyn.*, vol. x., 1925.

A summary of the pathological changes which may occur as the result of chronic ovarian inflammation and death of the egg-cell, or of endometrial invasion may prove useful.

Changes in the unripened follicle.

1. Small cystic disease.
2. Hydrops folliculorum.
3. Simple serous cysts.
4. Theca-lutein cysts.
   - (*a*) single small.
   - (*b*) compound theca-lutein cysts.
5. Theca-lutein hæmatoma.
6. Theca-lutein abscess.

Changes in the ripened follicle (corpus luteum)

1. Incomplete absorption of the lutein convolutions leading to:
   - (*a*) Islands of lutein cells being distributed in the ovarian stroma.
   - (*b*) In these scattered areas of lutein cells small cysts form which have only a pathological interest.
2. Corpus luteum hæmatoma, a rare condition which may cause severe internal hæmorrhage.
3. Corpus luteum abscess.

Endometrial invasion of the ovary causing hæmatomata.

It will thus be seen that all the important follicular changes wrought by chronic inflammation (save two) concern the unripened follicle, and not the corpus luteum.

NEW GROWTHS OF THE OVARY AND CYSTS OF THE BROAD LIGAMENT

In this section only true neoplasms will be described. Cysts arising as the result of inflammatory changes and the conditions brought about by endometrial invasion have been already dealt with in the preceding pages. Owing to their clinical resemblances it is convenient to consider broad-ligament cysts in conjunction with ovarian tumours although they do not arise in ovarian tissue.

Etiology. On the subject of the etiology of ovarian neoplasms nothing is known, and on the question of the histological derivation difficulties arise, because in the case of ovarian growths of epithelial origin the cells do not correspond to any pre-existing type of cell peculiar to the ovary. It may be recalled that in the ovary epithelium exists in three situations, viz. (1) on the surface of the organ (*germ-epithelium*); (2) the epithelial lining of the follicles (*membrana granulosa*); (3) the epithelial tubules which are found in the hilum and considered to be Wolffian or mesonephric derivatives. Until within the last seven years the origin of epithelial new growths from each of these three sources was accepted. More recently Goodall,[1] by extensive

[1] *The Origin of Tumours of the Ovary*, by J. R. Goodall, McGill University, Montreal. (*Proc. Roy. Soc. Med.*, 1920, vol. xiii., pp. 63-95.)

research in comparative histology, has simplified our conception as to the derivation of these neoplasms. He describes an epithelial tubular system in the embryonic ovary as running from the germ-epithelium on the surface of the cortex through the ovary and into the mesosalpinx, where it joins up with the Wolffian duct (Fig. 26, p. 33). This tubular system is of oöphoronic (ovarian) origin. It is, to start with, ovulogenetic, capable of producing egg-cells throughout its whole course from cortex to hilum. From it are derived the Gräafian follicles, and after their formation the remainder of the tubules disappear in the human subject, but portions may remain as the remnants of medullary rays and rete-ovarii. It is, according to Goodall, from such

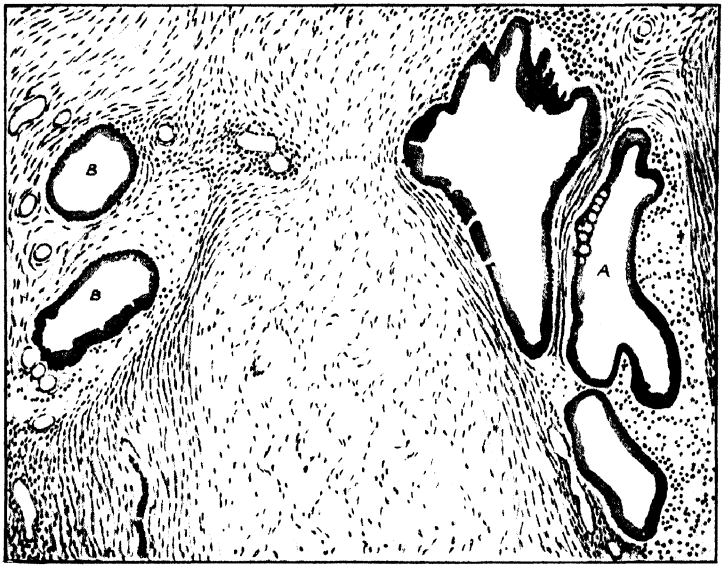


FIG. 390. HEALTHY OVARY OF AN ADULT WOMAN. Multipara, aged 40. The epithelial-lined spaces (A and B) illustrate the origin of the cyst-adenoma; their connection with the germinal epithelium was traced in serial sections. The epithelium is columnar, and in the space marked (A) contains a number of goblet cells.

remnants that all the epithelial new growths of the ovary arise. None proceed from the Gräafian follicles, none are of mesonephric, epoöphoronic or Wolffian origin as, according to Goodall, no epoöphoronic tubules penetrate into the ovarian substance. This statement is based by Goodall on his finding that the epithelial tubules in the ovary are all ovulogenetic or egg-bearing, whilst those of the mesonephros or epoöphoron are not. The tubules found in the hilum and originally called Wolffian are, according to Goodall, remnants of the rete-ovarii (*see* Fig. 26, p. 33).

Goodall has also found that the adult germinal epithelium may send down-growths into the subjacent cortex and stroma, and from these new growths may arise. This we have been able to verify in sections prepared of ovaries removed by ourselves.

Classification. The following classification is based upon the histological

characters as presented at the time of investigation ; it will include all but a very few clinically undiagnosable tumours :

A. Tumours arising in the ovary.

I. *Epithelial Tumours.*

Oöphoronic.
1. Benign : Adenoma.
   (*a*) Cyst-adenoma pseudomucinosum.
   (*b*) Cyst-adenoma serosum (ciliatum, papillare).
2. Malignant : Carcinoma.
   (*a*) Primary.
   (*b*) Secondary.

II. *Connective-tissue Tumours—Desmoids.*
1. Benign : Fibroma. Fibromyoma.
2. Malignant : Sarcoma. Endothelioma. Periendothelioma.

III. *Tumours arising from Egg-cells.* Tridermoid embryoma. Teratoma (in the wide sense).
1. Innocent : Cystic Teratoma (' Dermoid ').
2. Malignant : Teratoma in the narrow sense (blastomatous teratoma).

IV. *Compound Ovarian Tumours.*

B. Cysts arising in the broad ligament.
(*a*) Fimbrial : Rete-testis Cysts.
(*b*) Epoöphoronic (parovarian).
(*c*) Cysts of Kobelt's tubes.
(*d*) Cysts of the hydatid of Morgagni.

BENIGN EPITHELIAL TUMOURS

Eighty *per cent.* of all ovarian growths are adenomatous, and show a tubular gland-formation. Solid adenomata are rare ; the tubules of an adenoma very rapidly develop into cysts. The chief feature of a cyst-adenoma is the more or less rapid and unlimited enlargement of the cystic spaces, produced by the continuous secretion and rapid proliferation of their lining-epithelium. The proliferation of the epithelium and sub-epithelial connective tissue seen in ovarian cysts is of two types, according to whether the branching of the adenoma takes an outward direction (into the cyst-wall) or an inward direction—into the lumen. The former is called the *everting* and the latter the *inverting* type. The everting type of adenomatous proliferation is present in every ovarian cyst ; the inverting type is less common, but it is a constant feature of the rarer variety known as the *cystoma serosum papillare* to which we shall refer later.

The epithelium sends out multiple glandular projections ; these produce daughter-cysts in the connective tissue of the cyst-wall, which likewise increases. By proliferation, these cysts in their turn originate another generation of daughter-cysts, the process continuing until a multilocular cystic tumour is produced. We must imagine this process as taking place simultaneously at many points in an ovary. In further growth, one or more cysts predominate in size ; the smaller ones bulge into the walls of the larger, and ultimately fuse with the latter by the rupture of partition-walls.

The remains of the broken septa then appear as bands or elevated rings on the inner surface of the larger cysts. By repeated fusion of small cysts a large loculus is produced (*see* Fig. 391); but it is still possible to find in its wall many 'daughter-cysts,' and also when examined microscopically the glandular remains of tiny cysts. Hence arose the old term *Cystoma proliferans glandulare.*

The epithelium of an ovarian cyst is supported on a richly cellular sub-epithelial connective-tissue basis (*see* Fig. 392). This cellular connective tissue, in order to accommodate the rapidly growing epithelium, projects into the cyst as a spur (*see* Figs. 393 and 394); these spurs or processes are

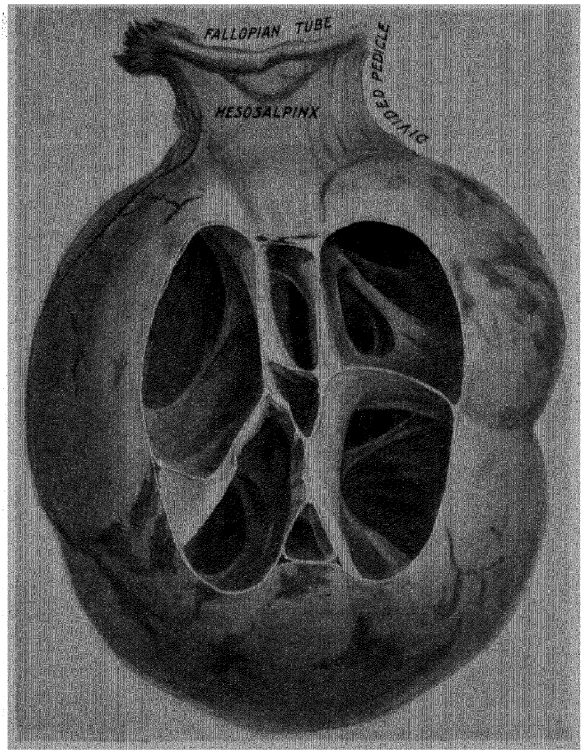


FIG. 391. CYST-ADENOMA PSEUDOMUCINOSUM OF THE OVARY (Charing Cross Hospital Museum). A portion of the cyst-wall has been removed to show the multilocular character of the tumour. The ridges seen in the interior are traces of broken-down septa.

very numerous, and they throw out secondary spurs or branches, which in their turn form tertiary twigs, and so on. The whole of this racemose arrangement carries a surface-epithelium composed of tall columnar cells with small basal nuclei. This arrangement is strikingly similar to the branching of chorionic villi.

(*a*) **Cyst-adenoma Pseudomucinosum.** This variety constitutes *two-thirds of all ovarian growths.* It is characterized by the high palisade character of its epithelium. The cytoplasm is strikingly clear, the cell-bodies are full of secretion and are therefore often of the goblet or beaker-variety; the nuclei lie at their base and are very small in comparison to the size of the cell. The

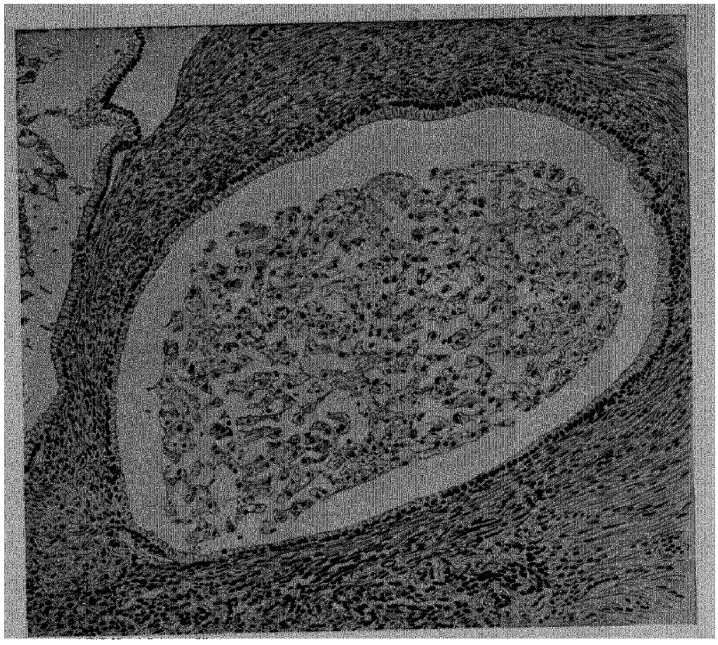


FIG. 392. CYST-ADENOMA PSEUDOMUCINOSUM OF THE OVARY. Showing a loculus with its epithelial lining and the septa composed of well-formed fibrous tissue.

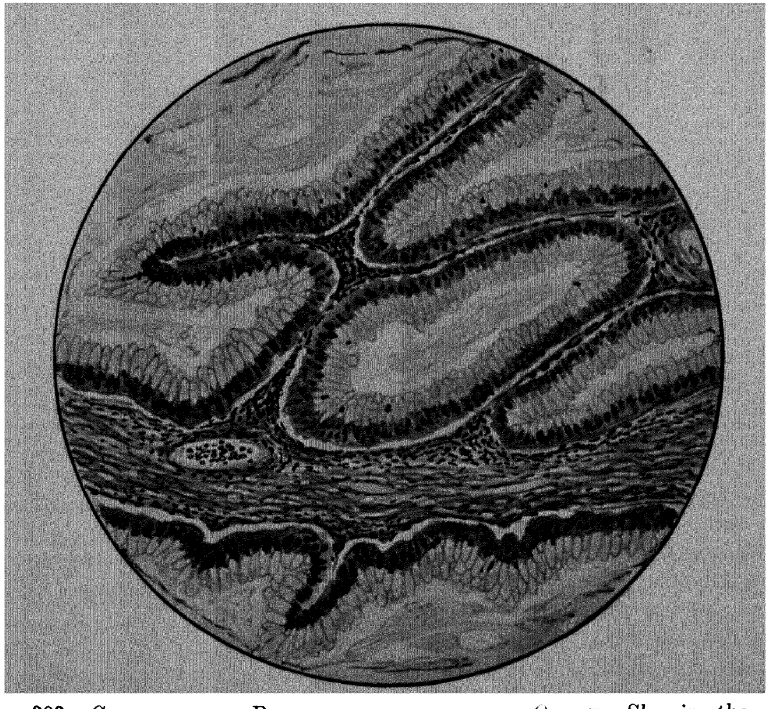


FIG. 393. CYST-ADENOMA PSEUDOMUCINOSUM OF THE OVARY. Showing the high columnar epithelium found in the smallest loculi. Inverting type of proliferation.

cells contain *pseudomucin*, a mucoid substance produced by cell-degeneration or secretion which is not precipitated by acetic acid and which contains a glycoproteid, *i.e.* a body which on boiling with a mineral acid is split up into albumen and COH. In the pure state pseudomucin is a stiff jelly; it can be cut by a knife, and is opalescent. As seen in the smaller cysts, the fluid is more or less thick or thin, but is always stringy or *colloidal*. Its specific gravity varies between 1010–1030, according to the degree with which it is mixed with serous exudation, blood, and degenerated thrown-off epithelium. The colour ranges from yellow or greenish-grey to a dirty red-brown or

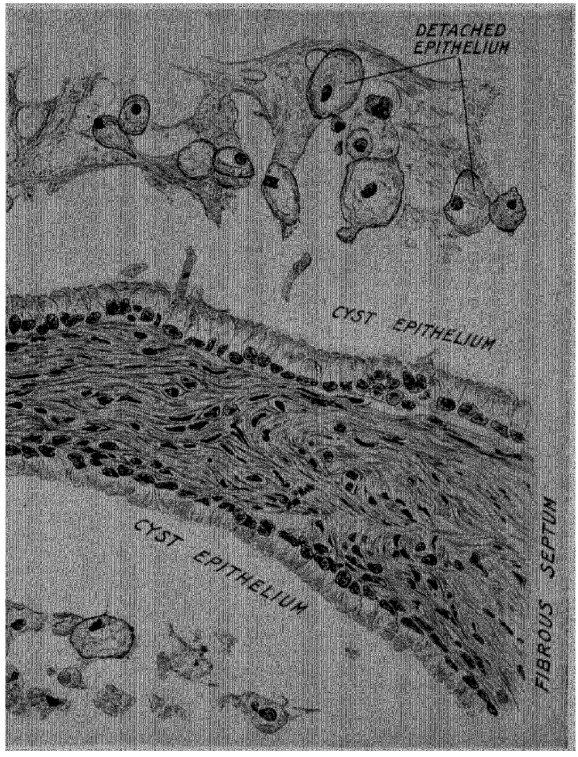


FIG. 394. CYST-ADENOMA PSEUDOMUCINOSUM OF THE OVARY. The section shows a septum between two compartments, both surfaces being covered with a single layer of high columnar epithelium. The detached epithelial cells are swollen and distorted. (A portion of Figure 392 more highly magnified.)

blackish tint; sometimes the presence of cholesterin gives a glistening appearance to pseudomucin. The reaction is alkaline.

Pseudomucinous cysts are, as a rule, unilateral. They are coarsely nodular or lobulated, and are multilocular (*see* Fig. 391). The term *multilocular cyst* is therefore the most appropriate for the description of its naked-eye characters. They may attain an enormous size, representing the largest tumours ever met with in the body. The amount of fluid which they may contain is sometimes very great; it has been known to exceed 16 gallons. As these tumours are now usually removed as soon as they are recognized, they are not allowed time to attain their full size. They may form

adhesions to the anterior abdominal wall, to the omentum, to intestines, to the under-surface of the liver, and to the diaphragm. Adhesions are especially common if the pedicle undergoes gradual torsion, or if one or more of the

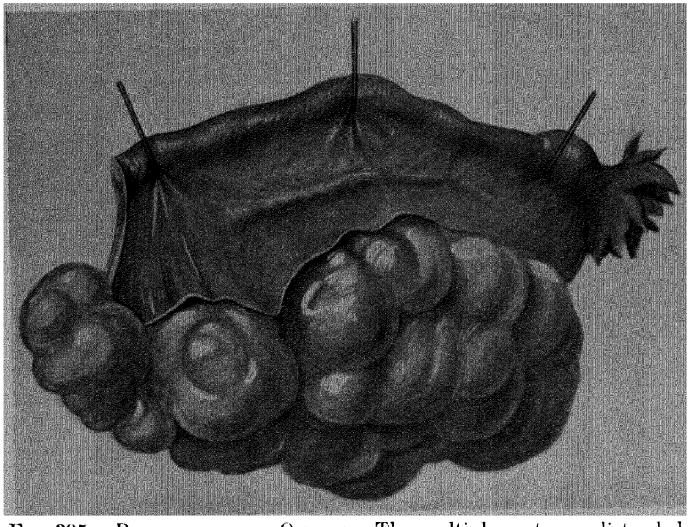


FIG. 395. PSEUDOMYXOMA OVARII. The multiple cysts are distended by jelly-like pure pseudomucin.

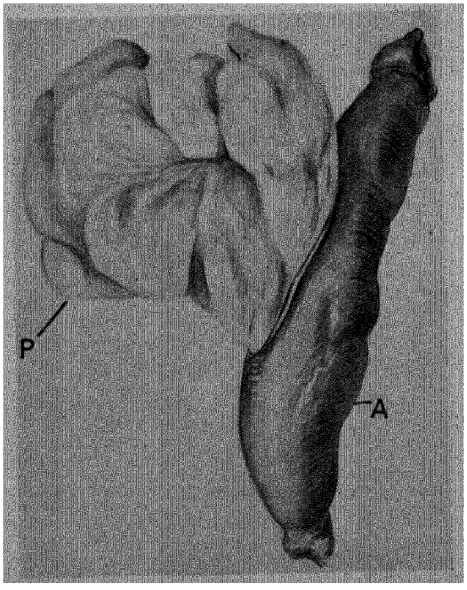


FIG. 396. APPENDIX VERMIFORMIS DISTENDED WITH PSEUDOMUCIN. From the same case as shown in preceding Figure 395. On incising the appendix, A, the viscid, jelly-like pseudomucin, P, escaped and remained adherent.

surface-cysts become ruptured. The pedicle consists of the infundibulo-pelvic fold containing the ovarian vessels, the *ligamentum proprium ovarii*, the Fallopian tube, and the stretched mesovarium.

Pseudomyxoma ovarii (*see* Figs. 395 and 396). This is the name given to a variety of the pseudomucinous cyst, in which the contents consist of *pure* pseudomucin and the walls of the cyst are very thin and transparent. On microscopic section the high palisade epithelium, which is so characteristic a feature of the pseudomucinous cyst, is seen to have largely disappeared, often only the basal parts of the cells remaining. The cytoplasm is replaced by a structureless substance which stains very faintly with eosin (*see* Fig. 397). This material is pure pseudomucin which, as stated previously, is a resultant product of cell-degeneration or secretion. The pro-

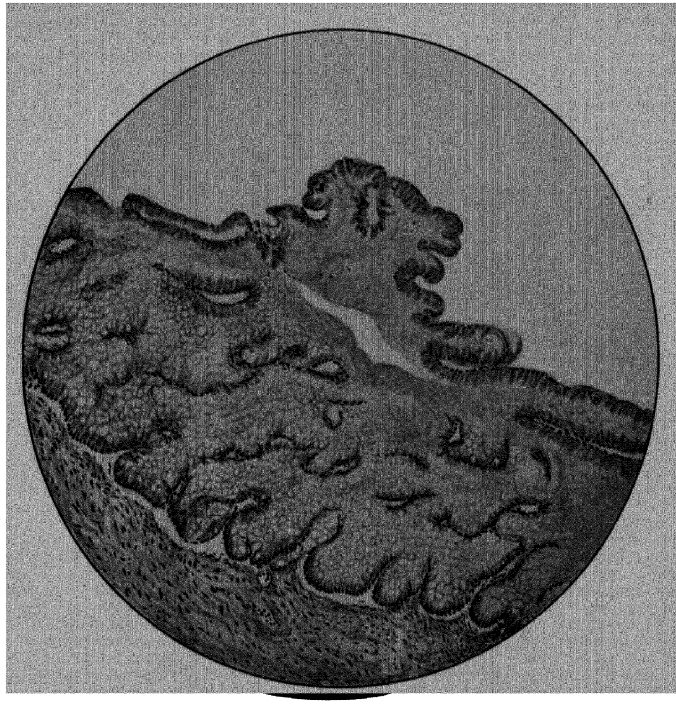


FIG. 397. PSEUDOMYXOMA OVARII. The gland-elements of the cyst are transformed into jelly-like pure pseudomucin. In many places the basal nuclei represent all that remains of the original cells.

found structural alteration produced by its presence is best appreciated by comparing Figure 393 with Figure 397.

Rupture of the cyst-wall frequently occurs and masses of jelly-like pseudomucin (*see* Fig. 396, P) are constantly poured on to the peritoneum, which it is difficult, if not impossible, for the latter to absorb, the result being that the material is distributed over the whole abdomen by the peristalsis of the bowel. Thus an irritative chronic peritonitis is set up, with the development of young connective tissue between adherent peritoneal surfaces; a complete clearance by operation is impossible, and the condition is now described as *pseudomyxoma peritonei*.

This condition is, nearly always, a secondary result of *pseudomyxoma ovarii*, but a similar affection has, in about twelve instances, been recorded as starting in the vermiform appendix, in which the appendix was involved

as well as the ovary. These appendix-cases have mostly occurred in males, but two in women have been noted by Wilson and one by Eden (*see* Fig. 395). Even when the primary source of the disease (ovary or appendix) is removed, it frequently happens that fresh pseudomucinous masses develop. Then, in consequence of the destroyed vitality of the peritoneum, the gland-cells are able to become implanted upon it and to proliferate, and finally to continue their secretion of pseudomucin. Extension to the pleura may occur, and some cases terminate fatally as if the condition were truly malignant.

(*b*) **Cyst-adenoma Serosum Papillare (Papilliferous Cyst).** This variety of

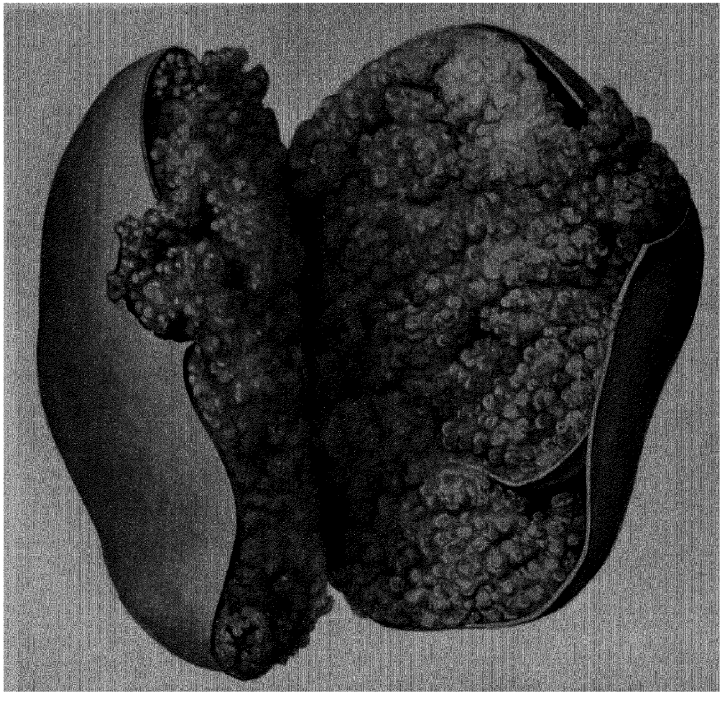


FIG. 398. CYST-ADENOMA SEROSUM PAPILLARE (after von Franqué). The papilliferous processes have broken through the capsule of the growth and have also entirely filled its cavity. A very rare type.

ovarian cyst is nearly always papilliferous and is characterized by its low epithelium, which is mostly ciliated and less actively secreting than is the epithelium in the pseudomucinous cyst. The *inverting* type of epithelial proliferation is illustrated by this variety of cyst.

This type of cyst has thin walls (*see* Fig. 398) and the intracystic papillomata consist essentially of a delicate connective-tissue core with an epithelial covering; they are formed by direct outgrowth from the cyst-wall. To the naked eye they appear individually as small wart-like projections with an irregular surface (*see* Fig. 399). They may be diffused widely, in small clusters, over the cyst-wall, or, being collected in larger groups, they may form tuberous masses resembling a cauliflower. Sometimes they thickly

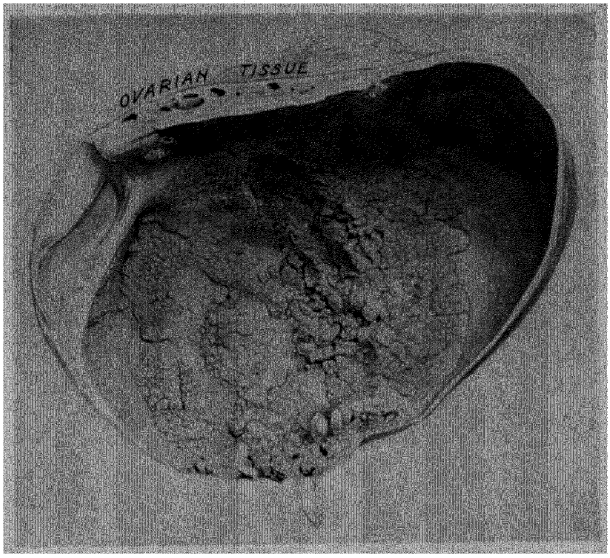


FIG. 399. PAPILLIFEROUS CYST OF THE OVARY (Roya College of Surgeons Museum). The cyst is unilocular, and its inner surface is thickly studded with warty masses. A certain amount of ovarian tissue, bearing Gräafian follicles, has persisted.

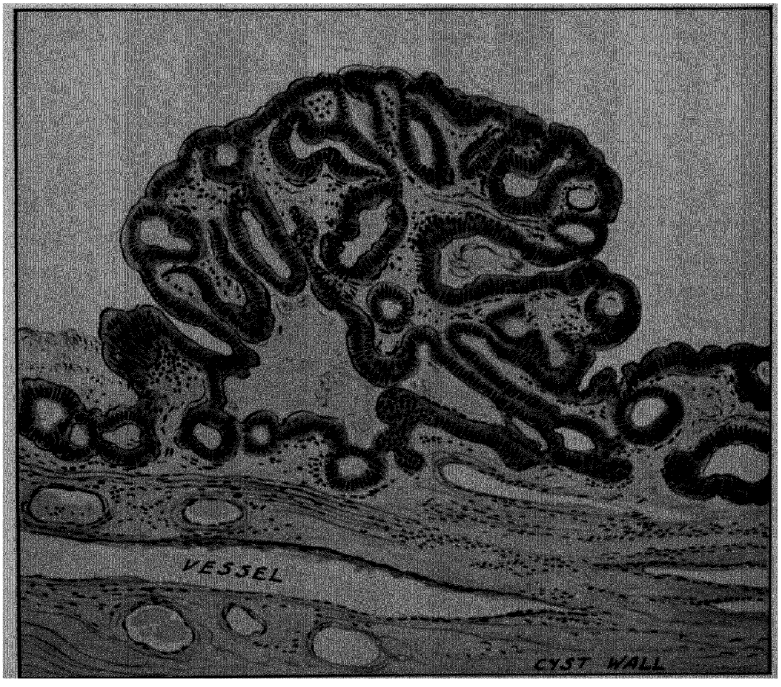


FIG. 400. PAPILLIFEROUS CYST OF THE OVARY. A simple papilla showing the connective-tissue core, the epithelial covering, and the numerous epithelial invaginations.

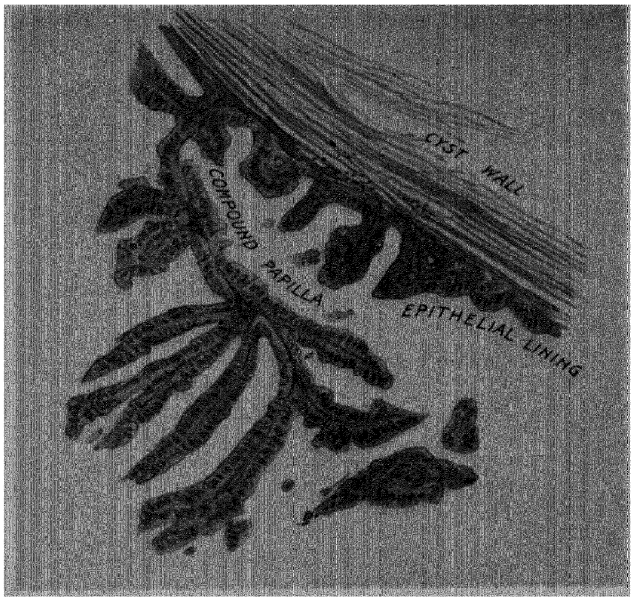


FIG. 401. PAPILLIFEROUS OVARIAN CYST. Showing the origin of the papillæ from the cyst-wall. Numerous buds and processes are thrown out by the epithelium. (Semi-diagrammatic.)

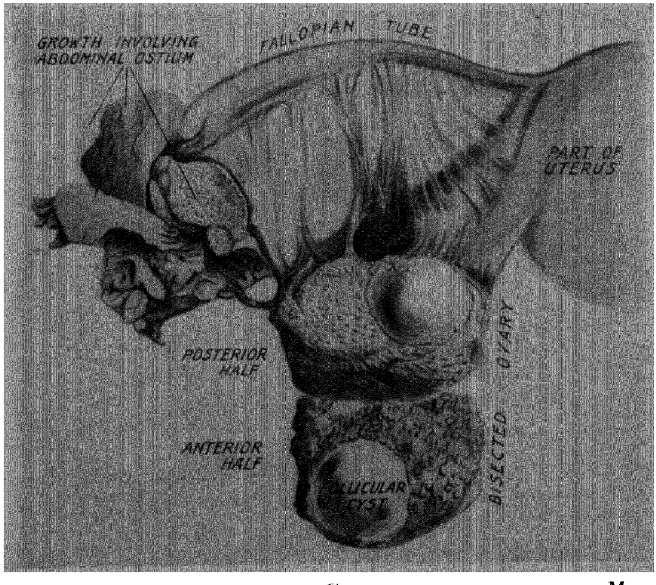


FIG. 402. PAPILLIFEROUS OVARIAN CYST WHICH HAS BECOME MALIGNANT. Multipara, aged 68. The growth has spread from a malignant papilliferous ovarian cyst of the opposite side. The ovary has been bisected so as to show both external surfaces, which are nearly covered with delicate papillary growth. A cluster of similar growth is seen upon the mesosalpinx and upon the abdominal ostium of the tube.

cover nearly the whole wall of the cyst and entirely fill up its cavity (*see* Fig. 398), but this is very rare, the contents of the cyst being usually fluid. Structually they present two types. In the first type (simple papillæ) the papillæ are inactive; they form shallow rounded projections, and consist of a delicate fibrous-tissue core, with an epithelial covering showing numerous shallow invaginations, composed of a single layer of cells (*see* Fig. 400).

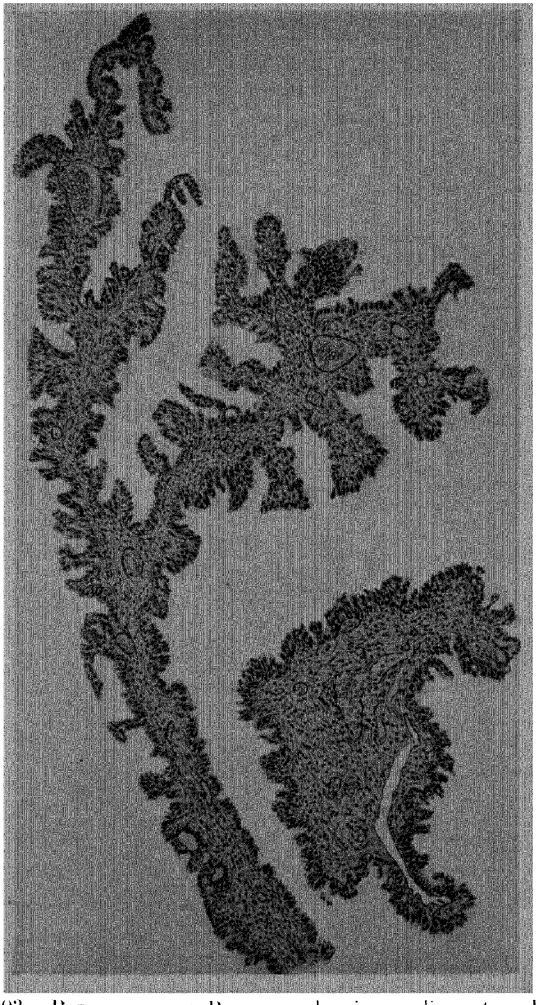


FIG. 403. PAPILLIFEROUS PROCESS, showing malignant proliferation of the epithelium. From the same specimen as Figure 402.

In the second (compound papillæ) the papillæ are very active; they consist of an aggregation of compound sinuous, branching processes, composed of a core of delicate connective tissue and an epithelial covering of a single layer of low columnar cells (*see* Figs. 401 and 403).

The contents of the cyst are thin and watery, scarcely at all stringy, and contain but little albumen and no pseudomucin. A papilliferous cyst is frequently bilateral and intraligamentary in situation, that is to say,

it travels out from the follicle-zone through the medulla and hilum of the ovary into the mesosalpinx, which it opens up. It will then lie within the folds of the broad ligament and will *possess no pedicle;* it is only slightly mobile, being far less so than the pseudomucinous variety, which is but rarely found in the intraligamentary situation. It is much slower in its growth than the latter, and is seldom larger in size than a man's head, and it contains but few loculi (*see* Figs. 398 and 399).

Clinically this variety of ovarian cyst is of extreme importance since it has a great tendency to become malignant, this change being much more pronounced in the serous (papilliferous) than in the pseudomucinous cyst. Moreover, without becoming structurally malignant, the solid papillary growths are liable to produce rupture of the cyst-wall leading to implantation of tumour-cells upon the surface of the ovary (*see* Fig. 402) and also upon the peritoneum.

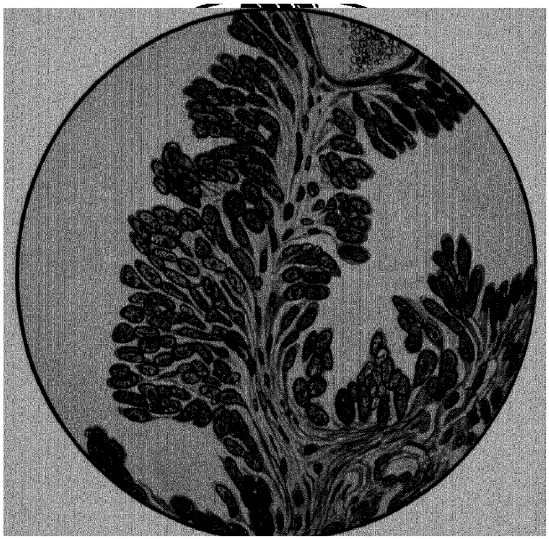


FIG. 404. PORTION OF PAPILLIFEROUS PROCESS SEEN IN FIGURE 403 under a higher power, showing definite malignant proliferation of the epithelium.

Papillæ, which are structurally malignant, are much softer and more vascular than the benign ones, and on microscopic examination they show remarkably active growth, forming long compound processes branching freely, and demonstrating irregular epithelial proliferation (*see* Figs. 403 and 404). Once the papillæ escape from the cyst-wall there is no limit to their dissemination. Rapid ascites and injury to health follow. Even metastases in lymph-glands and on the pleural aspect of the diaphragm have been noted, in cases of dissemination of microscopically innocent papilliferous serous cysts. The secondary peritoneal growths tend to disappear after the removal of the principal tumour, but they may remain and subsequently assume a true carcinomatous character.

MALIGNANT EPITHELIAL TUMOURS

Carcinoma of the Ovary. Cancer may occur in the ovary under conditions which may be stated as follows:

I. As a primary growth.
II. As a secondary growth arising either by direct extension, or more often by metastasis.

I. **Primary Ovarian Cancer.** This is a comparatively rare form of tumour: it is generally agreed that among the organs liable to be attacked by primary cancer in women, the ovary stands low in order of frequency; its occurrence

is certainly very much less frequent than that of uterine cancer. Its age incidence is wide; about 68 *per cent.* of cases occur in women between the ages of forty-five and fifty-five (Glendinning), *i.e.* in the climacteric decennium, but it may also occur in adolescents and in children. It is frequently bilateral, but a simultaneous onset of the disease in both ovaries is unlikely;

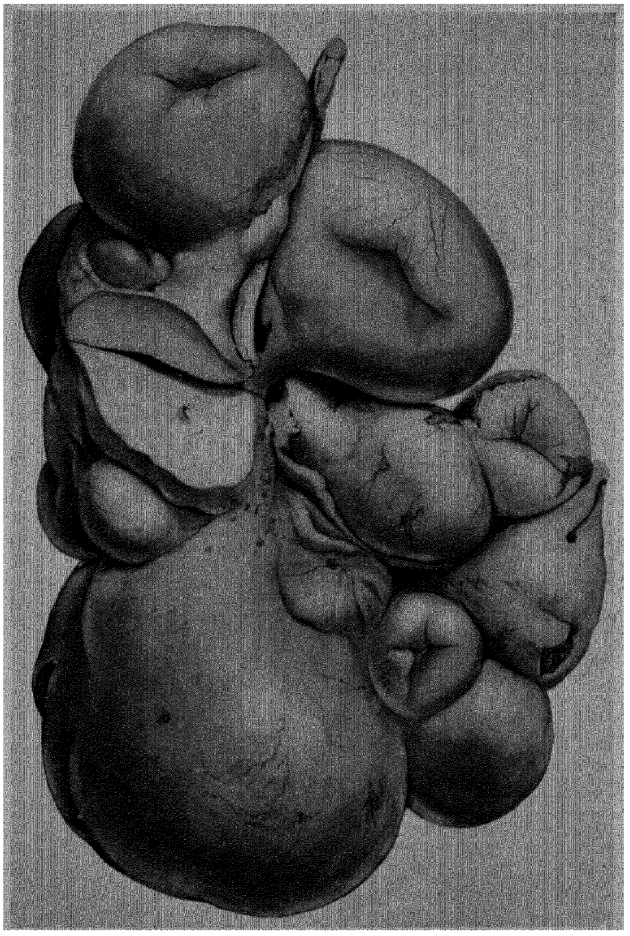


FIG. 405. CYSTIC ADENO-CARCINOMA OF THE OVARY (Charing Cross Hospital Museum). The large tumour is partly cystic, and partly solid; one of the solid portions has been laid open. A similar growth of somewhat smaller size was present in the other ovary. The microscopic appearances were those of the diffused form of carcinoma (*see* Fig. 409).

it is more probable that one ovary is attacked by metastasis or by direct extension. This view receives some support from the fact that, at the somewhat advanced period when these tumours commonly come under observation, one is usually considerably larger than the other. They are frequently, but not invariably, accompanied by ascites.

The growth is usually smooth, of irregular shape and moderate size,

but specimens weighing upwards of fifteen pounds have been described. Its consistence is usually that of a soft solid tumour, but not infrequently some parts are solid and other parts cystic (*see* Fig. 405), and the latter may form irregular protuberances on its surface. It usually has at first a well-formed fibrous-tissue capsule derived from the tunica albuginea; but this may sometimes be invaded and destroyed in places by the cancer-cells, which then become free to disseminate themselves in the peritoneal cavity. On section its substance is seen to be fairly homogeneous, and of friable consistence; numerous cystic spaces may be seen, some of which represent cavities formed by degeneration, others are lined with epithelium. Not infrequently these cavities are formed in superficial parts of the tumour,

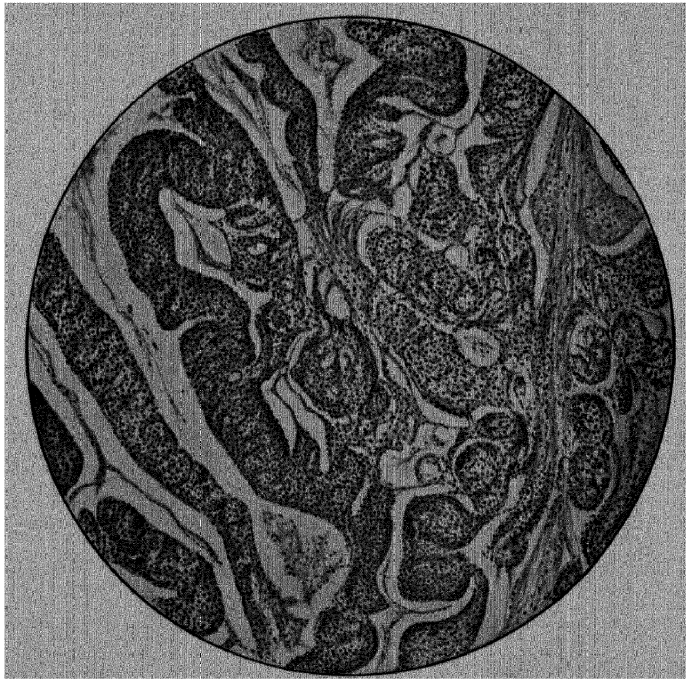


FIG. 406. CYSTIC ADENO-CARCINOMA OF THE OVARY. The single layer of columnar epithelium of a benign adenoma is replaced by many layers of cancerous cells.

where they give rise to projecting bosses which render the shape and outline of the tumour very irregular. Areas of interstitial hæmorrhage of reddish, brownish, or yellowish colour, according to their age, are also often seen. A diagnosis can only be made with certainty by means of the microscope.

Carcinoma of the ovary is very variable in its *histological* structure. Macroscopically two principal groups are distinguishable: (1) the cystic adeno-carcinoma, and (2) the solid carcinoma.

(1) *The cystic adeno-carcinoma* corresponds in its naked-eye characters to a benign cystic adenoma, and it is often necessary to make a most careful histological investigation before its malignancy is discovered. It occurs as a multilocular cystic tumour (*see* Fig. 405), containing, as a rule, inverting papillary growths and a fluid which varies within very wide limits, but

which frequently consists largely of pseudomucin. When apparently solid, very soft, brain-like, white or yellowish areas appear in a multilocular cyst; the latter should be regarded with suspicion, and should be examined microscopically for evidence of malignancy.

Cystic adeno-carcinoma can occur primarily, or may be the result of

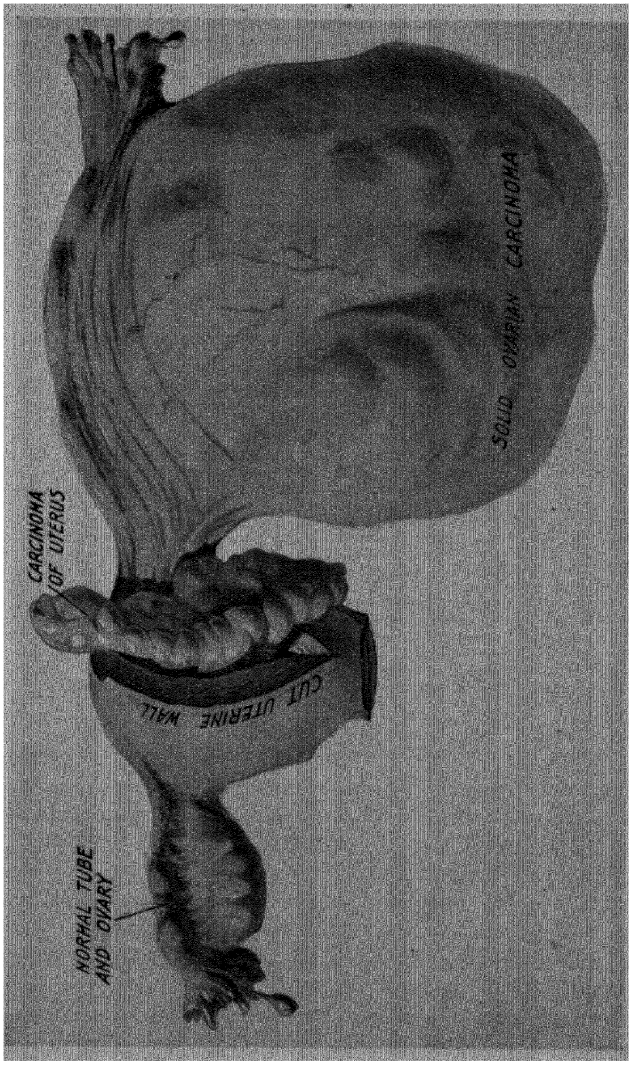


FIG. 407. SOLID CARCINOMA OF THE OVARY AND CANCER OF THE UTERUS. Multipara, aged 60. Both uterine and ovarian growths were adeno-carcinomata of somewhat different characters. There was no growth in either of the tubes. The uterine cancer is polypoid, and is shown through an incision in the posterior wall. The ovarian growth is probably secondary, the uterine growth primary.

a malignant change in a hitherto benign cyst. In either case there may be numerous cysts lined by a single layer of columnar epithelium, lying in proximity to other cysts in which are seen many layers of irregularly shaped epithelial cells, filling up the lumina in characteristic malignant fashion (*see* Fig. 406). In the metastases also, simple and malignant glandular structures exist side by side, while the benign elements continue the function of secretion.

The type of *papillary cancer* derived from a papilliferous serous cyst was shown in Figures 402, 403, 404 (pp. 606–608).

(2) *The solid carcinoma.* In the second group, the carcinomata form solid coarsely lobulated tumours with a well-formed pedicle (*see* Fig. 407). The normal shape of the ovary is more or less preserved. The structure is that of an ordinary carcinoma, *i.e.* the growth is made up of solid strands and nests of epithelial cells running in a fibrous stroma (alveolar type) (*see* Fig. 408), or the entire ovarian substance may be so uniformly invaded by the epithelial cells that the differentiation between carcinoma and sarcoma may be difficult or impossible (diffuse type) (*see* Fig. 409).

Carcinoma of the ovary is liable to break through the tunica albuginea and by proliferation to produce papillary processes or nodes

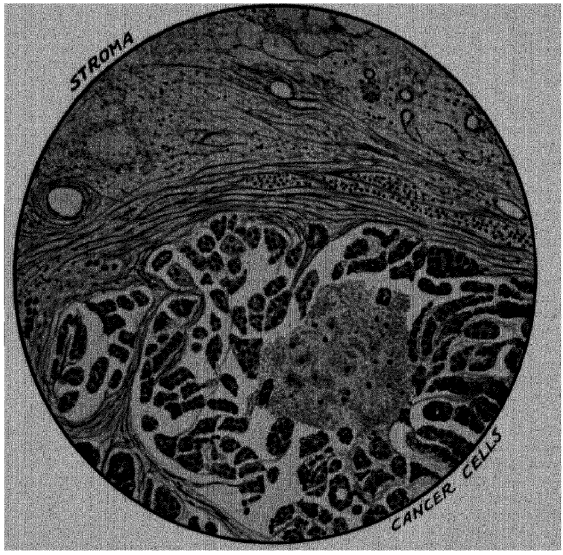


FIG. 408. ALVEOLAR CARCINOMA OF THE OVARY. Multipara, aged 48. The cancer-cells are arranged in irregular columns and masses. The stroma in the upper part of the figure is abundant and degenerated.

on the peritoneum (*see* Fig. 402), and especially so in Douglas's pouch, where the tiny particles sink by gravity. Hæmorrhagic ascites occurs in consequence of such dissemination. A spread along the tube is common; we have shown that this may occur along the perivascular lymphatics of tubes which have a normal appearance externally; other observers have shown the cancer-cells being carried towards the uterus by the ciliary action of the tubal mucosa. In either case the cancer cells have been traced into the uterine wall, where we have found deposits lying in the uterine muscle beneath a healthy endometrium. The regional glands, *i.e.* the retroperitoneal, lumbar and prevertebral sets, do not, as a rule, become invaded. As soon as the carcinoma reaches the surface of the ovary, dense adhesions unite the organ to neighbouring viscera, especially to bowel, leading not infrequently to the necessity for performing enterectomy during the removal of the growth. Carcinoma of the ovary of whatever variety is

usually bilateral; this applies not only to primary, but also to secondary growths.

Secondary Ovarian Cancer. When the ovary becomes cancerous secondarily the primary growth may be found (*a*) in the pylorus, the colon, or more rarely, some other part of the intestine; (*b*) in the liver; (*c*) in the mamma; (*d*) in the uterine body. Not infrequently secondary growths in the ovary attain considerable size, while the primary growth in another organ remains small and gives rise to no conspicuous symptoms (*see* Figs. 407 and 410). It is the presence of the ovarian tumour, and often of the accompanying ascites, which attracts attention, not the primary disease. Both ovaries are commonly, but not invariably, affected, and usually to an unequal degree; indeed, there may be great discrepancy in the sizes of the

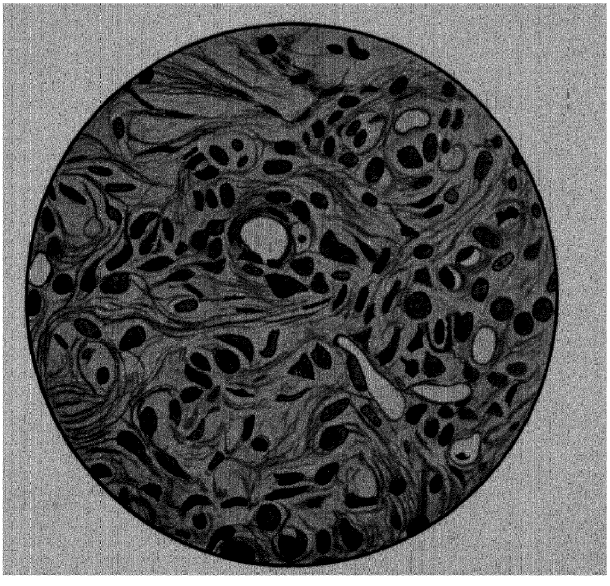


FIG. 409. DIFFUSE CARCINOMA OF THE OVARY. Multipara, aged 30. The cancer-cells are of varied shapes and sizes, and the stroma is relatively abundant.

two tumours. Microscopically both the alveolar and diffused types of cancer may be met with (*see* Figs. 408, 409), or there may be little in their histological features to distinguish the secondary from the primary growth. In some instances the amount of connective-tissue stroma found in secondary growths is abnormally large and ill-formed, and shows an unusually definite liability to undergo myxomatous degeneration, and to become altered by interstitial hæmorrhage.

There is great difficulty in determining the relative frequency of the varieties of ovarian cancer just described. Cancerous changes in originally benign cysts are much commoner than was formerly supposed, as the result of systematic microscopic examination of these tumours has clearly shown. As a strictly primary disease ovarian cancer is rare, many instances originally regarded as primary being shown subsequently to be secondary to cancer of some other viscus. The obtrusive size of the secondary growth directs attention to it, while the primary growth being small, and giving rise to no

urgent symptoms, remains unrecognized. Post-mortem statistics of cancer show that secondary growths are frequently found in the ovary

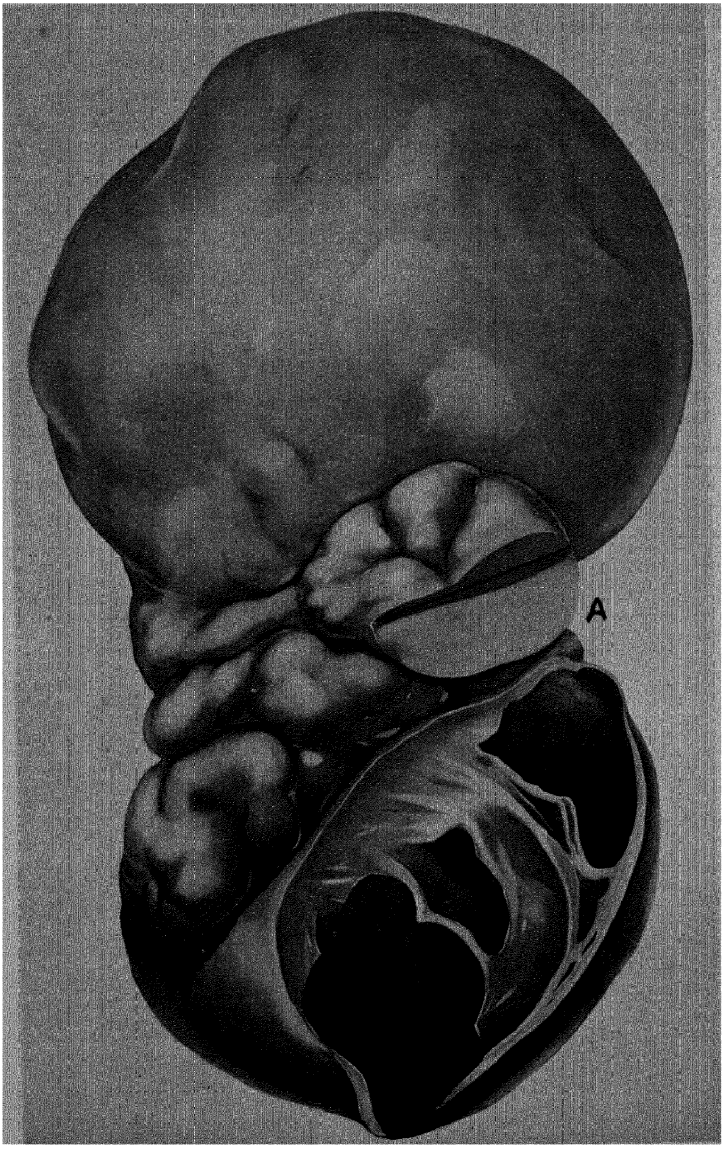


FIG. 410. SECONDARY OVARIAN CARCINOMA. The primary growth was situated in the pelvic colon. The microscopic appearances are shown in Figure 411. A, Site of section shown in succeeding figure.

after death from mammary cancer, stomach-cancer, and cancer of the intestine. But it must be recollected that in such cases the affection of the ovary is not recognized during life unless the tumour is of large size; consequently the frequency of secondary ovarian cancer, as clinically met

with, is probably considerably underestimated. It is probable that from a clinical standpoint cancerous changes in an ovarian cyst are the most frequent, secondary cancerous tumours coming next, and the true primary growth last in order of frequency.

The transference of cancer-cells to the ovaries in secondary ovarian carcinoma may be *viâ* the lymphatics, or by an adherent omentum; or it may occur by direct implantation of cells which, passing through the bowel-wall and escaping into the peritoneal cavity, gravitate to the ovaries, where they lie in the most dependent part of the peritoneal sac. Such implanted cells have been actually found on the surface of normal ovaries.

Secondary carcinoma of the ovaries appears in both the afore-mentioned types, *i.e.* the cystic and the solid. The most common form is that of a solid tumour, resembling a fibroma which has been invaded by columns and masses of cancer-cells; when secondary to a bowel-carcinoma, the growth is a columnar-celled cancer (tubular carcinoma) (*see* Fig. 411).

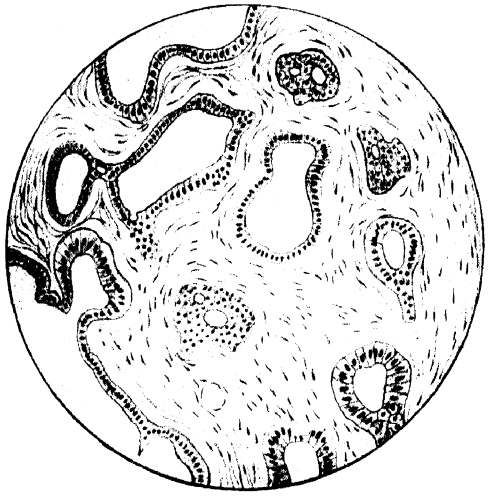


FIG. 411. SECONDARY OVARIAN CARCINOMA. The malignant tubules in a dense fibrous stroma resemble those of the primary growth, which was a columnar-celled carcinoma of the colon (*see* Fig. 410).

Inoperable carcinomata of the ovaries soon become fatal, and only 10–20 *per cent.* of cases operated upon remain free from recurrence. With *bilateral* malignant disease only a few isolated cases finally escape recurrence.

In order to improve the prognosis in all cases of ovarian cancer, both ovaries, both tubes, and the uterus should be removed *en masse*, together with any palpably enlarged glands.

KRUKENBERG TUMOURS OF THE OVARIES

Under this heading is included a type of bilateral solid ovarian tumours which is commonly regarded as secondary to cancer of the stomach. These growths form solid smooth non-adherent tumours of only moderate size (*e.g.* 10 × 10·3 cm.) (*see* Fig. 412). They may contain cyst-like spaces from degeneration, and are almost always accompanied by ascites. Histologically they were first regarded as sarcomata by Krukenberg and also by

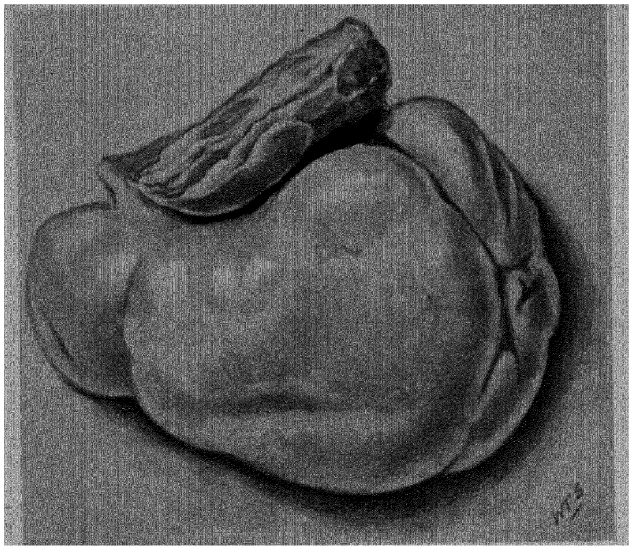


FIG. 412. KRUKENBERG TUMOUR. Illustrating the shape of the tumour and the smooth surface. (Wilfred Shaw.)

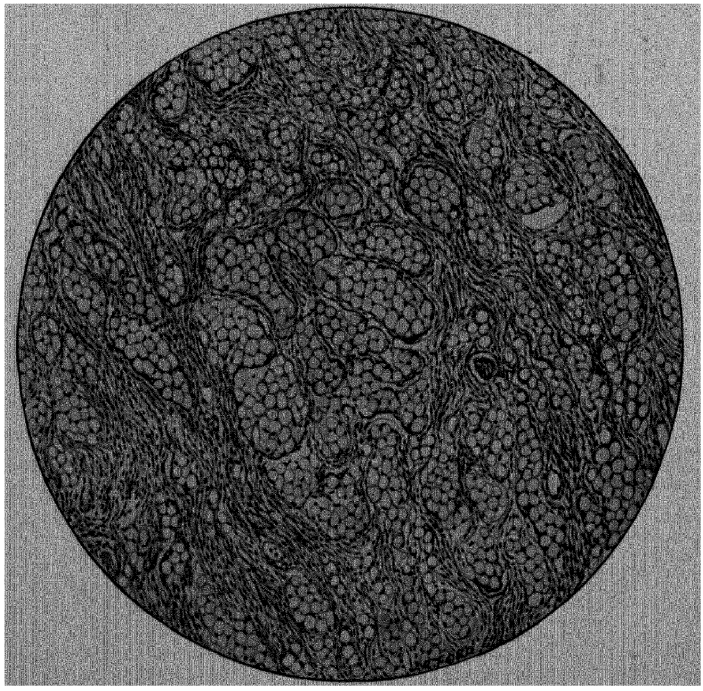


FIG. 413. The signet-ring cells are shown in a fibrosarcomatous stroma. They are collected together in bunches. (Low power.) (Wilfred Shaw.)

Marchand. In a very cellular stroma lie large cells with clear protoplasm and an eccentric flattened nucleus; these signet-ring cells set in a "sarcomatous" stroma form the chief histological feature of the growth (*see*

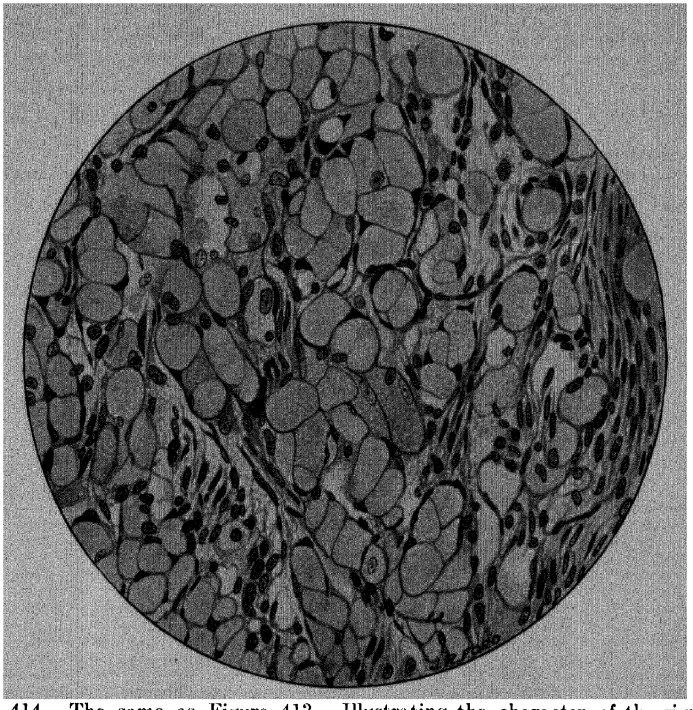


FIG. 414. The same as Figure 413. Illustrating the character of the signet rings. (High power.) (Wilfred Shaw.) [1]

Figs. 413 and 414). The mode of transference of cancer-cells from the stomach, or bowel, to the ovaries was discussed on page 615.

BENIGN CONNECTIVE-TISSUE TUMOURS OF THE OVARY

Fibromata. Apart from the frequent small fibrous outgrowths (*corpora fibrosa*), which arise from ruptured and unruptured follicles, and which some regard as true surface-fibromata, connective-tissue tumours are uncommon, comprising only about 5 *per cent.* of all ovarian tumours. Excluding the small debatable surface-fibromata, there still remain two fairly distinct types of fibromata of the ovary to be described. The common variety is that in which the entire organ is replaced by the new growth, but there is a less frequent form (*encapsulated fibroma*) in which the growth is invested by a capsule consisting of the tunica albuginea, and of a variable amount of ovarian cortical tissue, which occasionally permits the tumour to be shelled out in a manner somewhat similar to the enucleation of a fibroid from its bed in the uterine wall. This latter class is rare and is invariably benign.

[1] "Krukenberg Tumours of the Ovaries," Wilfred Shaw, F.R.C.S., *Proc. Roy. Soc. Med.*, 1926, vol. xix., Sect. Obst. and Gyn., pp. 49–55.

The characters of the commoner variety (*diffused fibromata*) are as follows: they are frequently bilateral with one tumour much larger than the other. In size, they may become as large as a man's head. The general shape of the ovary is usually preserved. The surface is smooth and shiny; shallow sulci, separating large, smooth lobes, are present. On section, the colour of the interior is dull white. Adhesions are rare. These tumours do not open up the layers of the broad ligaments; they possess a pedicle which allows of free movement and which, as three examples in the Charing Cross Hospital Museum show, may become twisted, leading to intense congestion of the tumours. In consistence ovarian fibromata are, as a rule, extremely hard, but hyaline degenerative changes are common, leading to the formation of liquefactive areas and cystic cavities. Œdema may also occur, but less frequently than hyaline liquefaction. Small hæmorrhages in cyst-like cavities are occasionally observed.

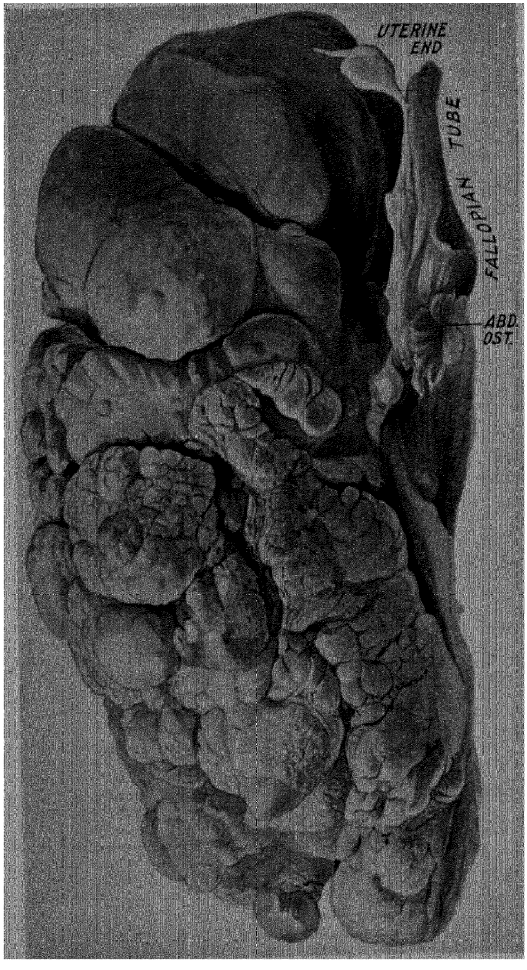


FIG. 415. SARCOMA OF THE OVARY (Charing Cross Hospital Museum). Multipara, aged 43.

Histologically, an ovarian fibroma is composed of groups of irregular spindle-cells packed into areas separated by bands of coarser fibrous tissue. The cellular areas are by no means of uniform appearance. In some, the new cells are seen to have developed into mature fibrillary tissue with scanty nuclei, and in which hyaline degeneration has already set in. In ~~others, the area~~ consists of young fibroblasts of typical spindle shape, the latter frequently giving rise to the impression that the growth is a spindle-celled sarcoma. The clinical history of non-recurrence after many years proves that such tumours are no more dangerous than those composed entirely of dense non-nucleated, and perhaps hyaline, fibrous tissue. On the other hand, this type of apparently simple fibroma, with a structure indistinguishable from that of ovarian stroma, may prove to be extremely malignant and lead to rapid dissemination, so that a prog-

nosis based upon histology alone may prove to be quite misleading (*see* Sarcoma of the Ovary).

One notable clinical feature of these growths, even when quite innocent, is that they are frequently associated with hydroperitoneum, and more rarely with hydrothorax. Ovarian fibromata are found at all periods of life. Our youngest case was in a child of twelve years, and our oldest an adult of seventy. In both the pedicles were twisted.

Adenofibromata. Very exceptionally ovarian fibromata contain cystic gland-spaces, lined by cubical or columnar epithelium. Giles has recorded a case of this type; the tumour was larger than an adult's head, and in some of the spaces, the epithelium was thought to show malignant proliferation, but clinically the tumour proved to be benign. Spencer has met with a similar case, but these tumours are very rare. The adenomatous formation leads to pseudomyxomatous degeneration, and these tumours are softer than are pure fibromata. Although they may become cancerous, this is exceptional.

Myofibromata and myomata have been described, but are very rare.

All the above connective-tissue tumours grow very slowly, have a well-formed pedicle, and are hence very mobile. Owing to their hardness and free mobility, they cause pain on bodily movement, and lead to ascites through mechanical irritation to the peritoneum.

MALIGNANT CONNECTIVE-TISSUE TUMOURS OF THE OVARY

Sarcomata. These rare tumours occur in every period of life and are often found at *an earlier age than carcinoma*, in fact the majority are found at about the age of puberty, and after the menopause. When found in young girls these growths are usually of the round-celled type and are extremely malignant. In about half the number of recorded cases the growths were bilateral, and as in the case of fibromata, one tumour may be much larger than the other. In size, ovarian sarcomata may attain enormous dimensions; they are usually pediculated, and oval in shape; their surface presents a certain degree of lobulation (*see* Fig. 415), and large veins may be seen under the stretched tunica albuginea. Some sarcomata are composed of spindle-cells; these are hard tumours, difficult to distinguish from fibromata. Others are made up of round embryonic cells and have a softer consistence; they may even be brain-like in their softness. Cystic cavities are common, and the cysts may be filled with blood (*see* Fig. 416). Finally both the spindle-celled and the soft forms may be found in one and the same tumour. Microscopically the hard variety is found to contain a large amount of innocent-looking fibrous tissue arranged in strands which enclose groups of spindle-cells with large nuclei. The latter show multiple chromatin granules, and vary in size and shape.

In endeavouring to decide whether a *hard* cellular connective-tissue tumour of the ovary is an innocent fibroma or a malignant sarcoma, stress must be laid upon the characters of the nuclei of the cellular elements; variation in shape and size, a rich supply of chromatin, and evidence of mitosis, are all points in favour of malignancy. But, as we have stated in connection with fibroma, there is room for error in attempting to form an opinion as to malignancy solely from the microscopic examination of these connective-tissue growths.

The microscopic characters of the *soft* or round-celled sarcoma are much more distinctive.

The small round cells have a deeply staining, relatively large nucleus, centrally situated in a clear cytoplasm. Multinucleated giant-cells are common amidst the small round cells. There is an intercellular stroma which ramifies between the individual cells, and by which the latter are often arranged in an alveolar pattern. The vessels are embryonic, having only an endothelial coat; their lumina may be seen to be filled with sarcoma-cells. Free hæmorrhages are often seen surrounded by areas of

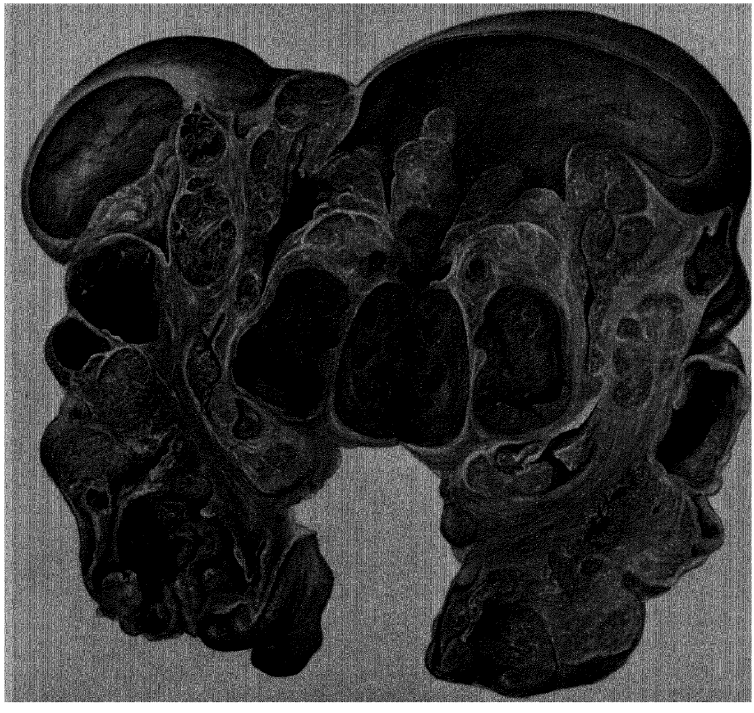


FIG. 416. SARCOMA OF THE OVARY. Both ovaries were the seat of sarcoma, and secondary deposits were removed from the peritoneum of the utero-vesical pouch. The dark areas are cysts filled with blood-coagula. The microscopic characters are seen in Figure 417.

degeneration. The round-celled sarcoma is very malignant; metastases are found early, and masses of sarcomatous growth occur on the peritoneum together with ascites.

Melanosarcoma occurs both primarily and secondarily in the ovary.

Endothelioma. This is a type of sarcoma in which the origin of the proliferating cells can be traced to the *endothelial* lining of lymphatics and blood-vessels. These growths are frequently bilateral. They resemble carcinomata of the ovary so closely in every clinical detail (occurrence in youth, shape, rapid growth, ascites, dissemination and cachexia) that a differentiation before operation is impossible.

Histologically it is often extremely difficult to decide between an

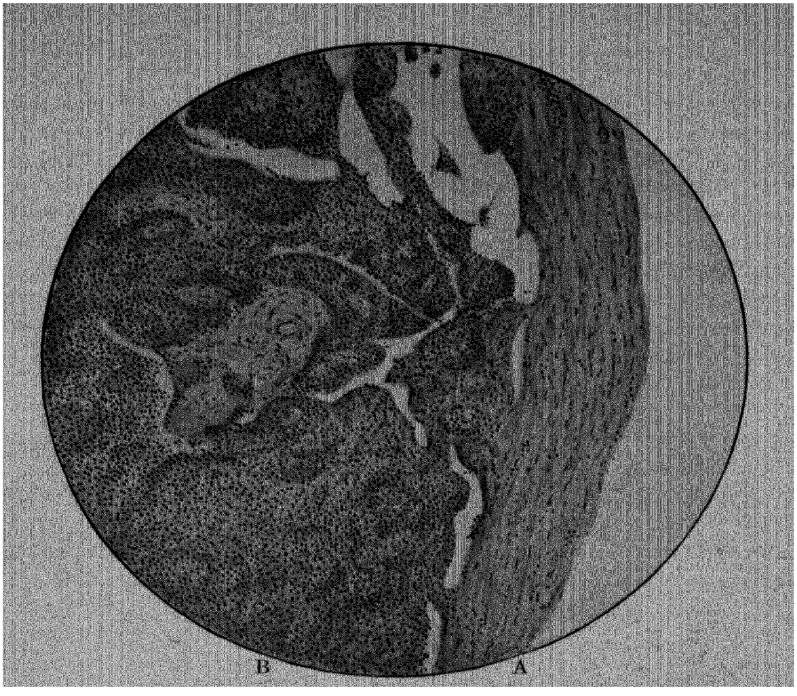


FIG. 417. SMALL ROUND-CELLED SARCOMA OF THE OVARY. Section from specimen shown in Figure 416. × 105. A, Ovarian cortex. B, Sarcomatous growth; the latter was very soft and degenerate.



FIG. 418. SOLID ENDOTHELIOMA OF THE OVARY (× 80). The cells filled up the lymphatic channels, from the endothelial linings of which they arose. There is an abundance of dense fibrous-tissue stroma which is unusual with ovarian endotheliomata.

endothelioma or a round-celled sarcoma, and a growth of epithelial origin. The case of endothelioma can only be decided by demonstrating the transformation of the normal endothelial cells into the cells of the tumour (*see* Figs. 418, 419), and when cysts are present they are lined by typical flattened endothelium, composed of cells variable in shape and arranged in many layers. Generally speaking, the cells and their nuclei are polymorphic; syncytial masses exist, and wandering cells are present. Hyaline and mucoid degeneration makes its appearance in the stroma, just as in epithelial growths. Sometimes endotheliomata are cystic and papillary, and then they are difficult to distinguish from either primary or secondary adenocarcinomata.



FIG. 419. SOLID ENDOTHELIOMA OF THE OVARY (× 278). Same section as that in preceding figure under a higher power.

Macroscopically, sarcoma and endothelioma are softer than fibromata. Their section is brain-like and white; areas of hæmorrhage, fatty degeneration, and necrosis are common. The contents of the cystic endotheliomata are thin and serous, not pseudomucinous. The cystic growths are always solid in parts, and the solid areas are soft and brain-like.

Periendothelioma. The relative incidence of periendothelioma in the ovary is given by Goodall as eight periendotheliomata to one sarcoma, whereas in the rest of the body this proportion is reversed. This fact and the behaviour of the growth, *i.e.* its tendency to metaplasia (which makes it difficult at times to distinguish it from a carcinoma or a sarcoma), has caused Goodall to conclude that the interstitial cells of the ovary, and not the connective tissue, form its source of origin. The new cells are small, round and epithelioid in appearance (*see* Fig. 420). The collections of epithelioid cells are seen to

surround the lumen of the particular vessel from which they arose, and from whence, spreading radially, they invade adjacent tissues for a variable distance. Large strands of fibrous tissue intervene between one cellular area and another, so that periendothelioma can be demonstrated as starting from multiple foci. This type of growth is firmer than a round-celled sarcoma, but, like the latter, it has a smooth, homogeneous cut-surface. In our own experience this type of sarcoma is the least malignant of all; in Doran and Lockyer's case of periendothelioma of uterus, tube and ovary, the patient was

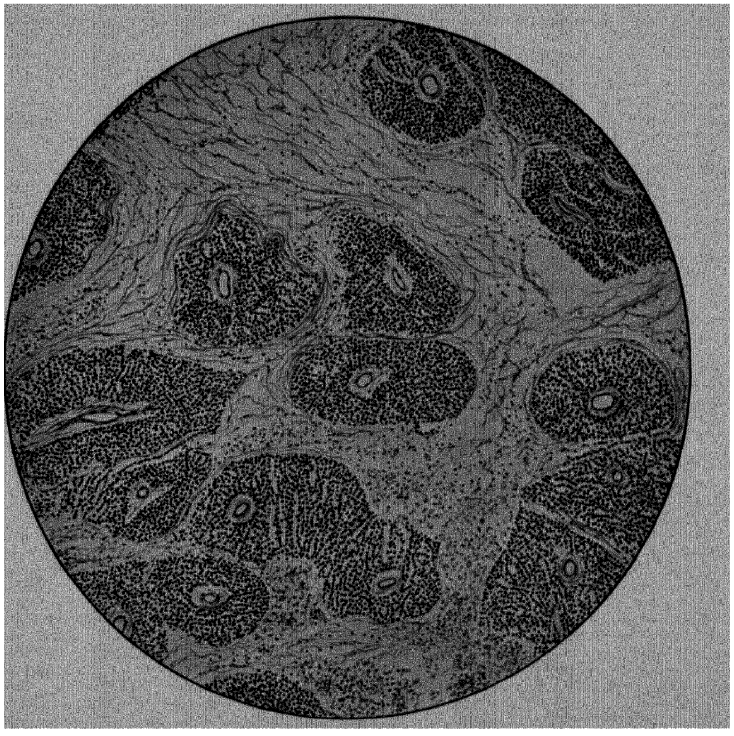


FIG. 420. PERIENDOTHELIOMA OF THE OVARY (× 80). The growth consisted of solid masses in the wall of a teratomatous ovarian cyst.

well after five years, although it was reasonably certain that all the growth had not been removed.

OVARIAN TERATOMATA

Teratomatous Cysts: Ovarian Dermoids. Teratomatous ovarian cysts are usually termed *dermoids* of the ovary, but this is not strictly accurate. A *dermoid* is a cyst produced by the inclusion of ectodermal structures only; its cavity is lined with skin and skin-appendages, it contains no hypoblastic elements like mucous membrane, and no mesoblastic structures such as muscle, cartilage or bone. On the other hand, we usually find all three embryonic layers, epi-, meso-, and hypoblast, represented in an ovarian *dermoid*. The student should bear in mind, therefore, that an ovarian dermoid is a *teratomatous* growth within an ovarian cyst. Whether the

cyst-formation is secondary to, and caused by, the teratomatous growth is a matter which is unsettled.

Teratomatous ovarian cysts are usually pediculated (*see* Fig. 421). They make up about 10 *per cent.* of all ovarian tumours (von Franqué); as a rule they occur singly but are often bilateral (14 *per cent.* Olshausen). They have been met with at all ages from the eighth month of intra-uterine existence (Reissman), to the eighty-third year of life (Potter). They are slow of growth and when small give rise to no symptoms; they may, therefore, have been in existence for long periods before being clinically recognized.

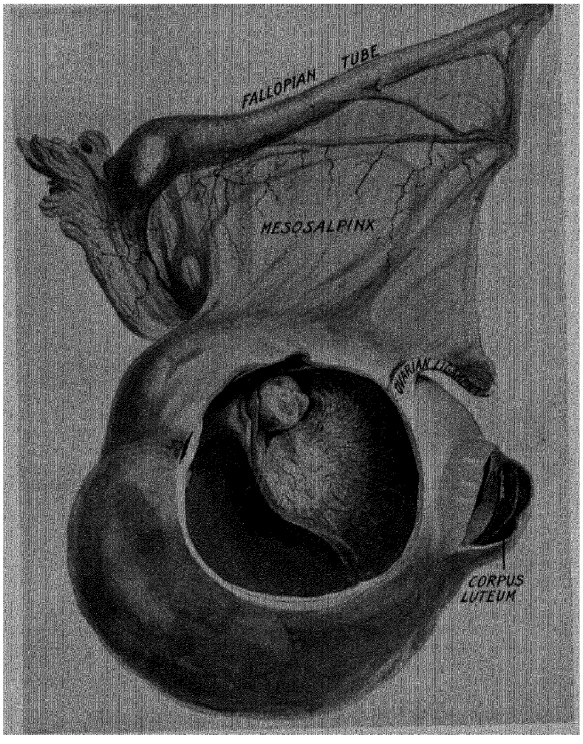


FIG. 421. TERATOMATOUS OVARIAN CYST (DERMOID). In the interior of the cyst are seen a patch of skin furnished with hairs, and a well-formed tooth resembling a premolar. The whole of the ovarian tissue is not destroyed, as is shown by the presence of a recent corpus luteum.

Many teratomatous cysts may occur in one and the same ovary. A teratomatous ovarian cyst never reaches the dimensions which can be assumed by a pseudomucinous cyst; it is not often larger than a man's fist, and at the most is not bigger than an adult's head. In shape they are generally spherical (*see* Fig. 421); the surface is smooth and glistening; the yellow colour of the contents is often seen through the thin membranous cyst-wall.

If the cyst be regarded as an essential part of the tumour we may say that an ovarian 'dermoid' consists (i) of a cyst, and (ii) of a teratomatous prominence projecting from its inner wall into the cavity of the cyst. The relationship of the cyst or cysts to the normal ovarian tissue is of importance.

It is usually found that the ovary is flattened and incorporated with one part of the cyst-wall to such a degree as to escape detection by the naked eye; less frequently it may form a projection on the *outer surface* of the cyst-wall. Exceptionally, the cystic teratoma may possess a pedicle of its own which attaches it to the ovary. In many cases ovarian tissue bearing follicles or corpora lutea can be detected in the neighbourhood of the ovarian ligament. This tissue is functionally active and should be retained if possible, when the cyst is removed by operation. Figure 422 shows the presence of a *dermoid* prominence in a lutein cyst. This is probably the result of fusion of a *dermoid* cyst with a lutein cyst.

The contents of a teratomatous cyst are fluid at body-temperature but become semi-solid and granular on cooling. The teratomatous prominence is covered by epidermis from which long slender hairs grow out.

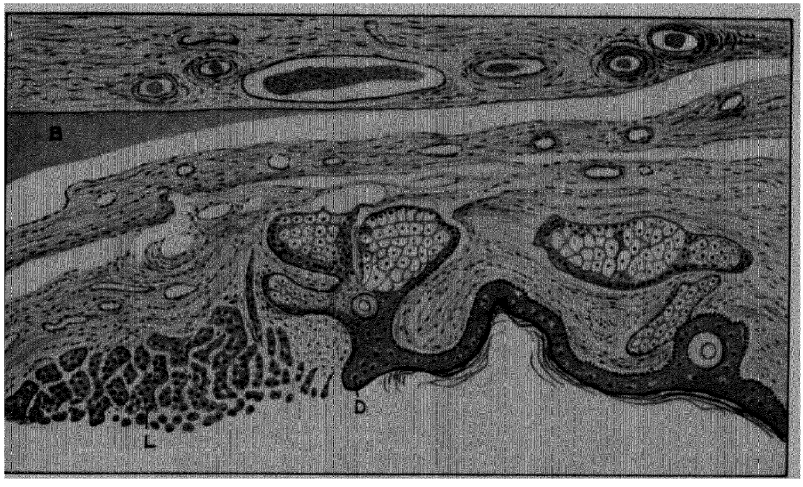


FIG. 422. TERATOMATOUS PROCESS (DERMOID) IN THE WALL OF A LUTEIN CYST. B, Dilated blood-vessels. D, 'Dermoid' process. L, Lutein lamina, which lined the greater part of the cyst-wall.

The skin-elements do not line the whole cyst, but are found on the so-called *dermoid processes* and on the adjacent part of the cyst-wall. The *dermoid process* projects from the wall into the lumen of the cyst. It is a solid mass of tissue, often shaped somewhat like a nipple, invested with hair and containing sebaceous glands and various bony constituents such as teeth (*see* Fig. 425), portions of the lower jaw, flat skull bones, long bones, etc.

After removal, when the cyst-contents have had time to solidify, the cyst-wall looks dry and shrunken, and crackles when handled; it then pits on pressure and has a doughy consistence. The contents consist of sebaceous material, coils of long hair, granular *débris*, fat-globules, and crystals of cholesterin. In this material are sometimes seen small solid balls composed of a fatty substance with a nucleus of hair; more rarely whitish balls of harder consistence are found. These consist of agglomerations of shed epidermal cells (epithelial balls). Sometimes balls consisting entirely of shed intertwined hairs are found loose in the cyst-cavity.

The *dermoid process*, already referred to, represents an attempt at the formation of the cephalic extremity of an embryo, and in a favourable case the following structures, occurring in superimposed layers, may be detected: (1) cutaneous tissues representing the scalp (*see* Fig. 423); (2) bone representing the cranium; (3) an epidermal sulcus in which may be found teeth and bone representing the mouth; (4) neuroglia representing the brain; (5) tubes and depressions, some of which are lined by ciliated epithelium, representing the upper extremities of the respiratory and alimentary tracts. In some teratomatous cysts the nipple-shaped prominences mentioned do not occur at all, so that the arrangement here described



FIG. 423. SECTION THROUGH A DERMOID PROCESS OF A TERATOMATOUS OVARIAN CYST. The section shows a patch of skin with a hair-follicle surrounded by abundant sebaceous glands. The tubules, *a*, *a*, represent rudimentary sweat-glands.

is not of universal occurrence in these tumours. The significance of these findings will be referred to again in connection with the histogenesis of ovarian dermoids.

It will thus be seen that a variety of tissues of ectodermal and mesodermal origin occur in these tumours, and some of them deserve more particular mention.

Skin only occurs in patches; it resembles its normal prototype in consisting of a cuticle resting upon a *cutis vera*, and in being furnished with hair-follicles and abundant sebaceous glands (*see* Fig. 423), and occasionally with a few ill-developed, spiral sweat-glands. Fatty tissue is often found beneath it, and sometimes striped muscle-fibres. Imperfectly formed nails are also sometimes found. *Hair* in ovarian 'dermoids' may be either dark or light in

colour; individual hairs may attain the length of many inches, and sometimes they grow through the cyst-wall so that their free ends appear upon the outer surface. The interesting statement is made by Bland-Sutton that as age advances, hair in ovarian dermoids becomes grey, or may be shed, rendering the dermoid tumour 'bald.' *Sebaceous glands* are active and abundant, and form the source of the characteristic fatty contents of the cyst. *Epithelial balls* have received special attention from Bland-Sutton. They are described as about the size of pills, and are composed of masses of shed epidermal scales, aggregated around a rolled-up hair. They are not often seen, but may occur in very large numbers, so as practically to fill up the cyst-cavity.

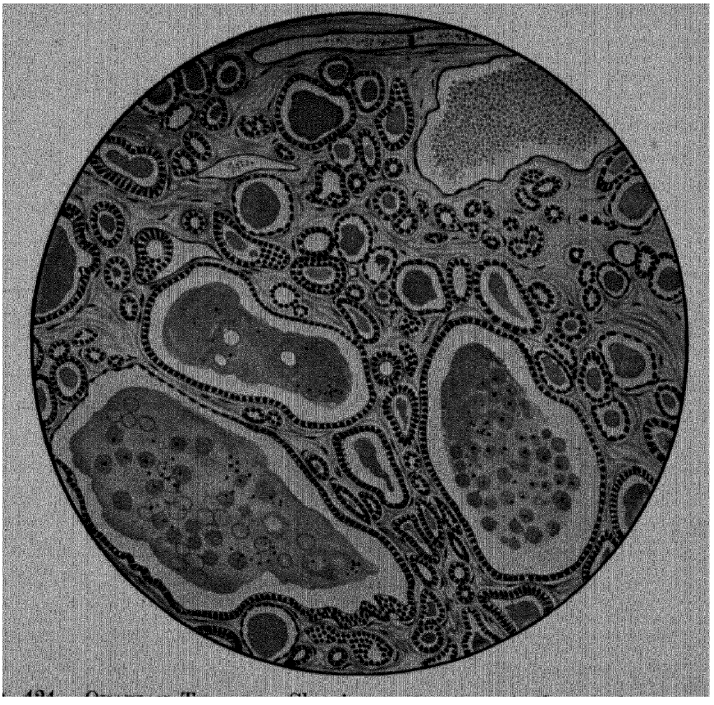


FIG. 424. OVARIAN TUMOUR. Showing a structure similar to that of the thyroid gland; such a structure is sometimes seen in teratomata. × 150.

Teeth are found in upwards of 50 *per cent.* of ovarian dermoids. They are for the most part of the canine or incisor type, and consist of enamel and dentine. They may be very numerous, and as many as three hundred have been found in a single specimen. They are often partly embedded in bone, and in such cases unerupted teeth may also be found buried in the bony tissue. *Bone* is a frequent constituent. Usually it occurs in plates and masses of quite irregular conformation. Instances have, however, been described of imitations of various normal bones of the skeleton; thus an imperfectly formed digit furnished with a nail has been seen, and bony masses resembling certain bones of the face or cranium have also been met with. *Cartilage* of the hyaline variety in the form of flat plates is not infrequently found in dermoids.

In a few rare instances certain structures of *entodermal* origin have been

found, such as patches of thyroid-gland tissue (*see* Fig. 424), portions of intestinal wall consisting of plain muscle and a mucosa furnished with Lieberkühn's glands, and epithelial tubes lined with ciliated cells which have been held to represent the respiratory tract.

The structures found in cystic ovarian teratomata (ovarian dermoids) may accordingly be summarized thus :

1. *Ectodermal :* Skin, hair, sebaceous glands, sweat-glands, teeth, nails, neuroglia.
2. *Mesodermal :* Bone, fatty tissue, fibrous tissue, muscle.
3. *Entodermal :* Thyroid (*see* Fig. 424), mucosa of small intestine and air-passages.
4. *Granulation-tissue* containing phagocytes.

The inner surface of the wall of an ovarian teratomatous cyst is composed for the most part of granulation-tissue, with patches of skin or mucous membrane here and there. It is probable that the granulation-tissue results from the chronic irritation caused by the peculiar nature of the cyst-contents. Phagocytes in the act of destroying fragments of hair are to be seen in the granulation-tissue.

Occasionally *teratomatous* cysts unconnected with the ovary have been found in the abdominal or pelvic cavity. These, when pelvic, may arise from accessory ovarian tissue ; when abdominal, through the escape of some active elements of an ovarian teratoma.

As stated before, the origin of the *cyst* in which a *dermoid process* or teratoma is found is uncertain ; possibly it is the result of distension of the ovarian stroma by the sebaceous contents thrown out by the *dermoid process ;* it may represent a follicular cyst, a lutein cyst (*see* Fig. 422), or even a lymph-space. It is not infrequently a loculus of a pseudomucinous cyst into which a *dermoid process* has penetrated (*see* Fig. 425). The teratomatous ovarian cyst is not a proliferating tumour but an example of a retention cyst ; its enlargement is very slow and is not due to growth of new tissue, but only to gradual distension of the cyst by the sebaceous secretion.

The epithelial elements of a teratomatous cyst may become malignant ; this occurs in about 3 *per cent.* of cases. Most frequently seen is the epithelioma of squamous type, more rarely the sebaceous glands become malignant. We have met with one case of secondary periendotheliomatous change occurring in a teratoma (*see* Fig. 420, p. 623). It may be said that a *dermoid* is essentially an innocent growth, and even when malignant areas appear in it, the prognosis is good, but, on account of its slow growth and duration, it is frequently a source of clinical disturbances, such as pressure, axial torsion, suppuration, and complications during pregnancy, labour, and the puerperium. Rupture is less frequent than with the proliferating cystomata, and it occurs nearly always as a result of trauma, *e.g.* during labour, but a thin-walled teratomatous cyst will rupture sometimes as the result of the internal pressure of its own contents. After rupture, adhesions and a false capsule form around the escaped contents. It is said that local peritonitis around a teratomatous cyst of the ovary may be set up by the penetration of the capsule by hairs.

Solid Ovarian Teratomata. These are the rarest of all ovarian tumours. In 1920 Frankel collected sixty cases, and two others from patients aged

12 and 30 years were reported by Black, of Memphis, in 1925.[1] As already indicated, they are clinically malignant, and tend to recur rapidly after removal. They may attain an enormous size, and in this particular they differ considerably from teratomatous cysts. Their in-

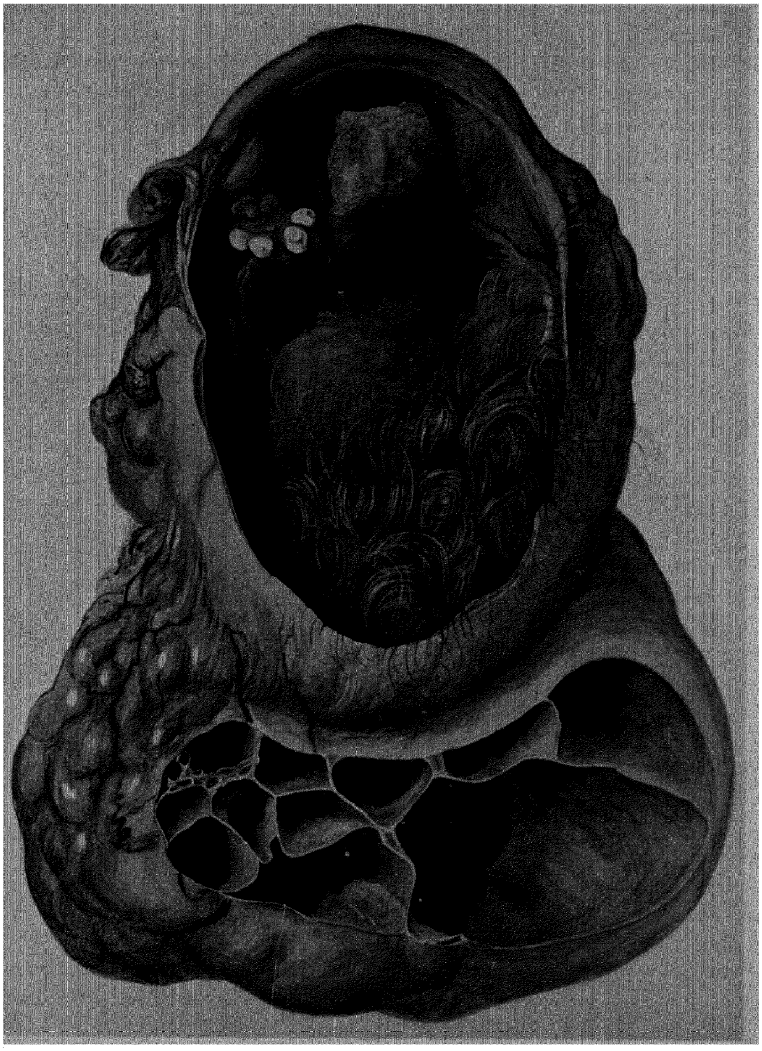


FIG. 425. COMPOUND OVARIAN CYST. The largest loculus shows a *teratomatous process* composed of a tongue-shaped solid epidermal mass and four teeth set in a bony ridge. The loculus was filled with granular sebaceous material and hair. The lower part is an adenoma pseudomucinosum.

cidence falls especially in adolescence, although a case has been reported in a woman of forty-nine. Generally speaking, they form *solid* irregularly lobulated growths, containing more or less numerous cystic spaces, some of degenerative origin, others lined with epithelium. Microscopic

[1] *Amer. Jl. Obst. and Gyn.*, vol. x., 1925, 345.

examination reveals the presence of an extraordinary variety of embryonic tissues derived from all three layers of the blastoderm, and these occur in confused association, without any attempt at the formation of *fully organized* structures, such as the teeth, skin, and bone which are characteristic of teratomatous cysts. The various elements are, for the most part, in a very embryonic state and are very irregularly arranged. In consequence of their embryonic character the fœtal constituents show a pronounced tendency to active proliferation, tissue-growth is very rapid, and not infrequently it is malignant, metastases being formed in which the embryonic

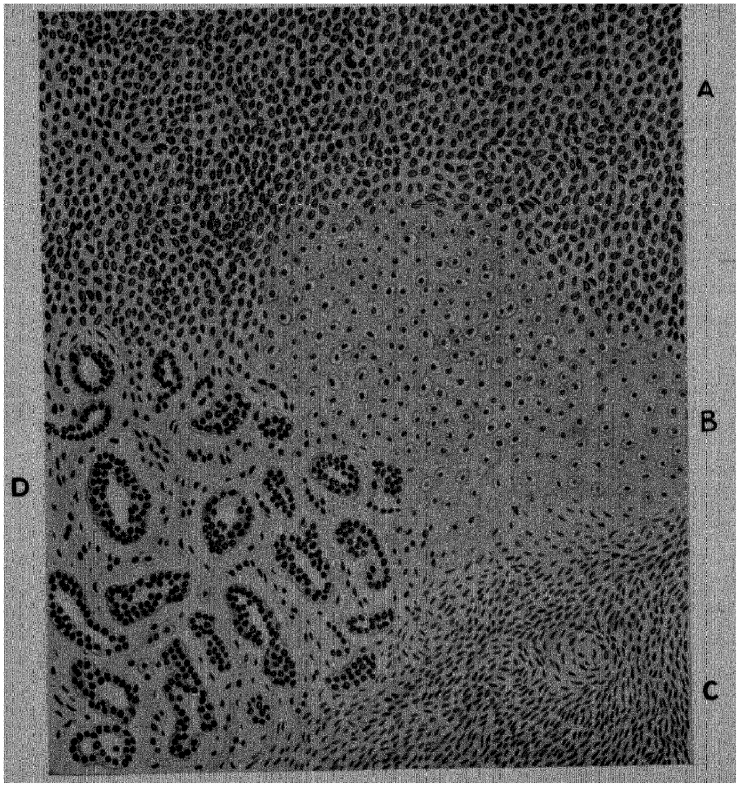


FIG. 426. SOLID OVARIAN TERATOMA. × 278. Showing areas of three distinctive types of new growth. A, Sarcoma. B, Cartilage. C, Ovarian stroma. D, Embryonic gland-tubules.

tissue is mostly of sarcomatous type (*see* Fig. 246), carcinomatous metaplasia being less frequent. On macroscopic section, soft brain-like tissue predominates, but this is often combined with numerous small and large cysts containing epidermal structures. Microscopically every tissue of the human body can be represented, the different structures being found in varying degrees of development but mostly immature. The clinical features are those of a solid ovarian growth, ascites is usually present; they are usually unilateral and occur most frequently in the young adult (33–34 years, Harris).

The prognosis is grave; the mortality given by Frank is 88·8 *per cent.*

Histogenesis. The theories that ovarian teratomata might arise from *parthenogenesis* and *sporogeny* (asexual reproduction) are deserving of serious consideration, and some authorities have no difficulty in accepting parthenogenesis as an explanation for the occurrence of ovarian teratomata. In 1911 Loeb found that it occurs in about 10 *per cent.* of guinea pigs before they are six months old. In an animal under control, and with fertilization excluded, a follicular cavity in the cortical zone of the ovary was found to contain a chorionic vesicle with trophoblast and syncytia penetrating into the neighbouring tissue. Moreover, a neural tube was thought to be present. Therefore parthenogenesis in mammalia must be accepted. No such regular development has ever been observed, to our knowledge, in ovarian teratomata. We see it imitated in chorionic cancer, and this has led some pathologists to regard that neoplasm as teratomatous. But we are still waiting for the discovery of a common cause which will explain the origin of extragenital teratomata in all localities and in both sexes, and this to our mind parthenogenesis fails to do.

Black suggests that a teratoma may result from the improper development of a uniovular twin, the error being either improper *fusion* or deficient *fission* or imperfect *segmentation* of an isolated blastomere. This theory would account for a teratoma appearing in any situation (Black).[1] The theory enunciated by Cohnheim ascribed the inception of tumours generally to misplaced embryonic rudiments, cells or aggregations of cells, which became misplaced during the complicated shiftings of the embryonic tissues during the developmental process. In this way epidermal and mesodermal cells may have become 'included' in the ovary at an early period of embryonic development, and such cells, after lying dormant, possibly for many years, may become active and give rise to growths consisting of epidermal and mesodermal structures. This was conveniently spoken of as the theory of *embryonic rests*. Again, many writers have attempted to explain the occurrence of teratomata by associating them with those aberrant forms of pregnancy which result in the production of 'conjoined twins,' or with the duplication or dichotomy of different parts of the body in the fœtus.

The theory enunciated independently by Waldeyer and by Wilms is that both cystic and solid teratomata are the result of some unknown but powerful stimulus applied to the egg-cell; in response to this stimulus proliferation occurs, and the resulting growth may contain cells representative of all the different structures which are normally produced from the egg-cell under the stimulus of fertilization. The egg-cell possesses the potential power of producing all the tissues of the body; by some unknown pathological stimulus this potential power may be partially evoked, and will naturally lead to atypical and inco-ordinate results. A similar stimulus applied to an epithelial cell may produce carcinoma; to a connective-tissue cell, sarcoma. But again we have to admit that this *ovular* theory of Wilms, whilst affording a satisfactory explanation for the formation of *ovarian* teratomata, is less helpful in the elucidation of similar growths in other parts of the body or of those found in the male sex.

COMPOUND OVARIAN TUMOURS

The varieties of ovarian tumours hitherto described may be regarded as generally recognized types; many individual instances, however, occur of

[1] W. T. Black, M.D., *Amer. Jl. Obst. and Gyn.*, vol. x., 1925, 345.

tumours which cannot conveniently be included within these types owing to some peculiarity, usually of the nature of diversity of structure, in different parts. Thus cystic tumours may be in parts pseudomucinous, in other parts papillary ; or a pseudomucinous tumour may show a single 'dermoid' loculus (*see* Fig. 425), or a circumscribed fibroma in its wall. Again, an innocent cystic tumour may show malignant metaplasia of its epithelial or connective-tissue elements, giving rise to a cancerous, or sarcomatous, or periendotheliomatous change (*see* Fig. 420). Again, a solid tumour may be in one part fibroma, in another sarcoma (*fibro-sarcoma*) ; or a fibroma may show collections of epithelial tubules in some part of its mass (*fibro-adenoma*). The occurrence of plain muscle-fibre in an ovarian fibroma has also been described (*fibro-myoma*) ; rare instances of *fibro-myosarcoma* have also been recorded. These compound types, though of great interest to the pathologist, possess no practical importance beyond the additional difficulty which they may introduce into the histological determination of the innocence or malignancy of individual growths.

CYSTS ARISING IN THE BROAD LIGAMENT

Under this heading we may conveniently consider the following varieties of cystic tumours :

Fimbrial cysts.
Epoöphoronic cysts.
Cysts of Kobelt's tubes.
Cysts of the hydatid of Morgagni.

Fimbrial Cysts. The view was once commonly held that all broad-ligament cysts which reach a size sufficiently large to render them clinically

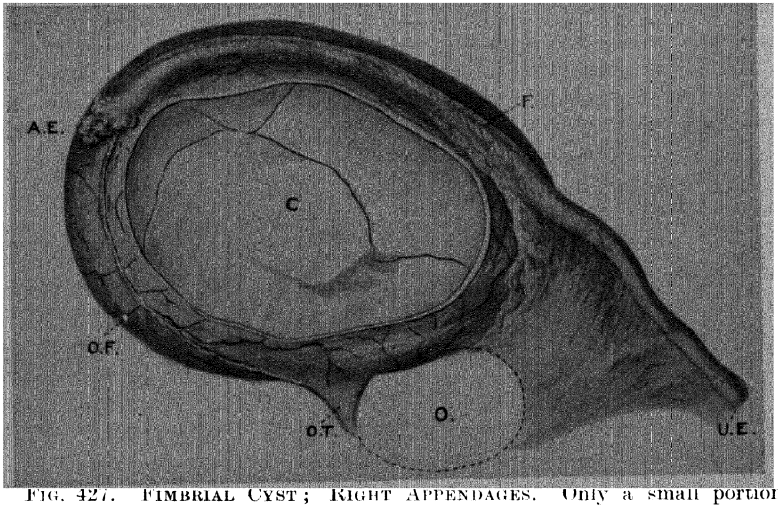


FIG. 427. FIMBRIAL CYST ; RIGHT APPENDAGES. Only a small portion of the ovary (O.T.) was removed with the cyst. F., Fallopian Tube. A.E., Abdominal end of Tube. U.E., Uterine end of Tube. O.F., Ovarian fimbria. O.T., Ovarian Tissue. O., Ovary (site of). C., Cyst opened to show contents solidified by formalin solution.

important were parovarian, *i.e.* that they arise from the epoöphoron, or organ of Rosenmüller. Keith has shown that this view is wrong, and that such cysts have their origin from developmental remains in the neighbourhood of the ovarian fimbria of the Fallopian tube. The term *fimbrial cyst* is therefore here used as the title of those cysts which have previously been described as *parovarian*.

Origin. The ovarian fimbria of the tube has been shown by Keith to be formed in part from the genital ridge, and to contain (in the new-born child) a portion of ovarian tissue continuous with the hilum.

In a large percentage of subjects, one or more tiny cysts will be found close to the ovarian fimbria; such structures are developed in the homologues of the *rete testis* of the male (Keith). Keith, in a series of preparations,

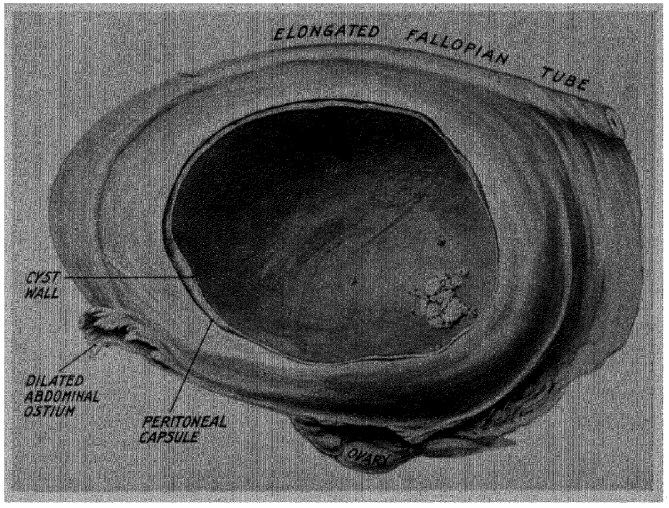


FIG. 428. FIMBRIAL CYST (Royal College of Surgeons Museum). The Fallopian tube is stretched over the summit of the cyst which occupies the mesosalpinx. The ovary is seen on the side opposite to the tube. The ovarian fimbria is much elongated. A cluster of papillomata is seen on the inner surface of the cyst-wall.

has shown all the stages of development from these minute fimbrial cysts into large tumours. A similar development from small parovarian cysts into large tumours has never been demonstrated.

Characters. Fimbrial cysts vary in size from minute dimensions to very large tumours. As they grow they develop between the layers of the broad ligament and open up its peritoneal folds. Thus the Fallopian tube becomes arched and elongated over the upper surface. The ostium of the tube is attached to the outer surface of the cyst, and the ovarian fimbria, which runs from the tubal ostium to the ovary, is stretched out over the cyst-wall. The ovary is generally quite separate and distinct, but in the case of very large cysts it may become greatly thinned and flattened out, and incorporated in their walls.

The pedicle of a fimbrial cyst is composed of that portion of the broad ligament which is not occupied by the cyst. It follows that only cysts of comparatively small size can be said to possess a pedicle (*see* Fig. 427). When

large enough to occupy all the space between the peritoneal folds of the broad ligament the cyst becomes sessile.

The cyst is unilocular and has a very thin, but comparatively strong, wall which is loosely attached to the investing peritoneum. The inner surface is smooth excepting for the occasional presence of a few warty growths (*see* Fig. 428). Microscopically the wall is seen to contain connective tissue and muscle-fibres, and the lining consists of columnar ciliated epithelium. The contents consist of a limpid alkaline fluid, nearly or quite as colourless as water, and having a low specific gravity (1004–1006); it contains a faint trace of albumen and very rarely pseudomucin. It is solidified by immersion in formalin solution (*see* Fig. 427).

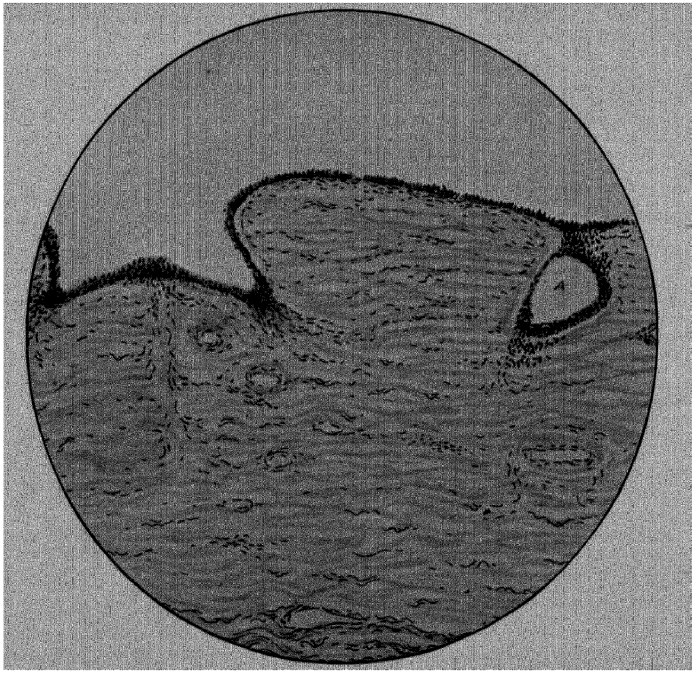


FIG. 429. FIMBRIAL CYST. The section shows the scanty epithelial lining consisting of imperfectly preserved cubical cells. *A* is merely an inclusion of lining-epithelium due to the fusion of two fibrous papillomata.

Clinical Features. Fimbrial cysts probably never develop before puberty, they grow very slowly, and may exist for many years without causing serious symptoms.

Large cysts, after opening up the broad ligament, may burrow downwards into the paravaginal and pararectal connective tissues, displacing the uterus upwards and forwards or to one or other side. They may also elevate the peritoneum and open up the mesosigmoid or mesocæcum, reaching by this retroperitoneal route high up into the abdomen.

As both fimbrial cysts and papilliferous ovarian cysts are found in the broad ligament these growths may be confused one with the other, especially as fimbrial cysts may contain papillomatous growths (*see* Fig. 427). Fimbrial cysts with their intracystic papillomata are, however, essentially innocent, whilst papilliferous ovarian cysts often present malignant characters.

Epoöphoronic Cysts (Parovarian Cysts). The canals of the epoöphoron are formed of circular muscle-fibres and an epithelium provided with cilia (Fig. 39, p. 44). One, or occasionally several, of these develop into cysts,

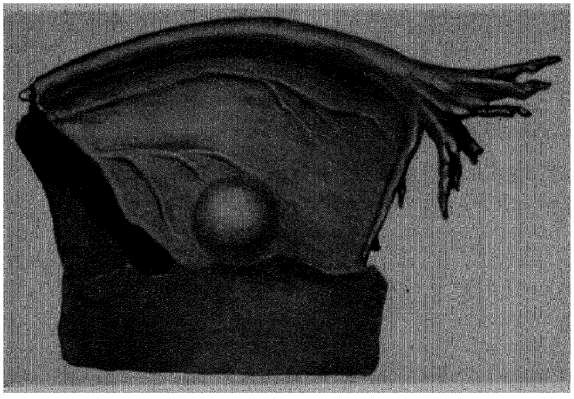


FIG. 430. PAROVARIAN CYST ARISING IN THE EPOÖPHORON, OTHERWISE CALLED THE PAROVARIUM OR ORGAN OF ROSENMÜLLER (*see* p. 67). (Doran.)

which are generally quite small (*see* Fig. 430); they may, however, attain a size equal to that of a large fimbrial cyst. Such cysts generally arise in the

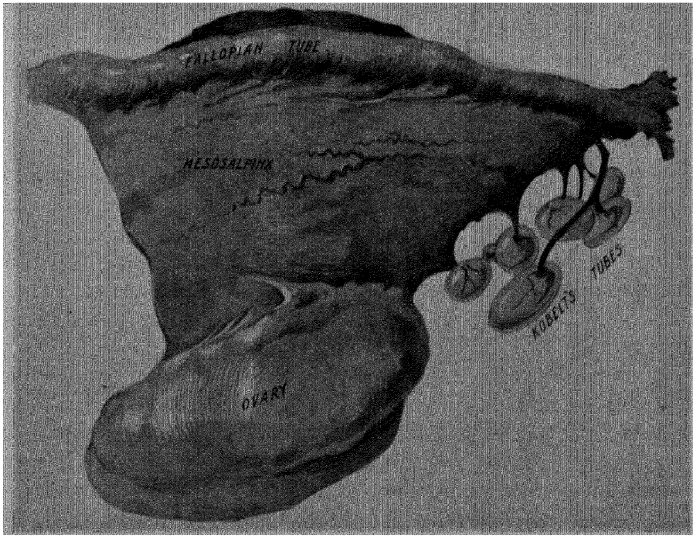


FIG. 431. THE FALLOPIAN TUBE, OVARY, AND MESOSALPINX OF THE LEFT SIDE (Charing Cross Hospital Museum). On the free edge of the mesosalpinx is seen a cluster of small pediculated cysts, probably derived from Kobelt's tubes.

vertical tubules of the epoöphoron, more rarely they originate in the duct of Gartner. They are small translucent structures with a thin capsule containing connective tissue and muscle-fibres. Their contents consist of colourless fluid of low specific gravity containing salts and a trace of albumen.

Cysts arising in the lower segment of Gartner's duct have been described in the section dealing with the vagina (p. 343).

Cysts of Kobelt's tubes never attain a large size (*see* Fig. 431) and never cause clinical symptoms. They are probably pronephric in origin.

Cysts of the Hydatid of Morgagni.* These structures have already been described on page 548.

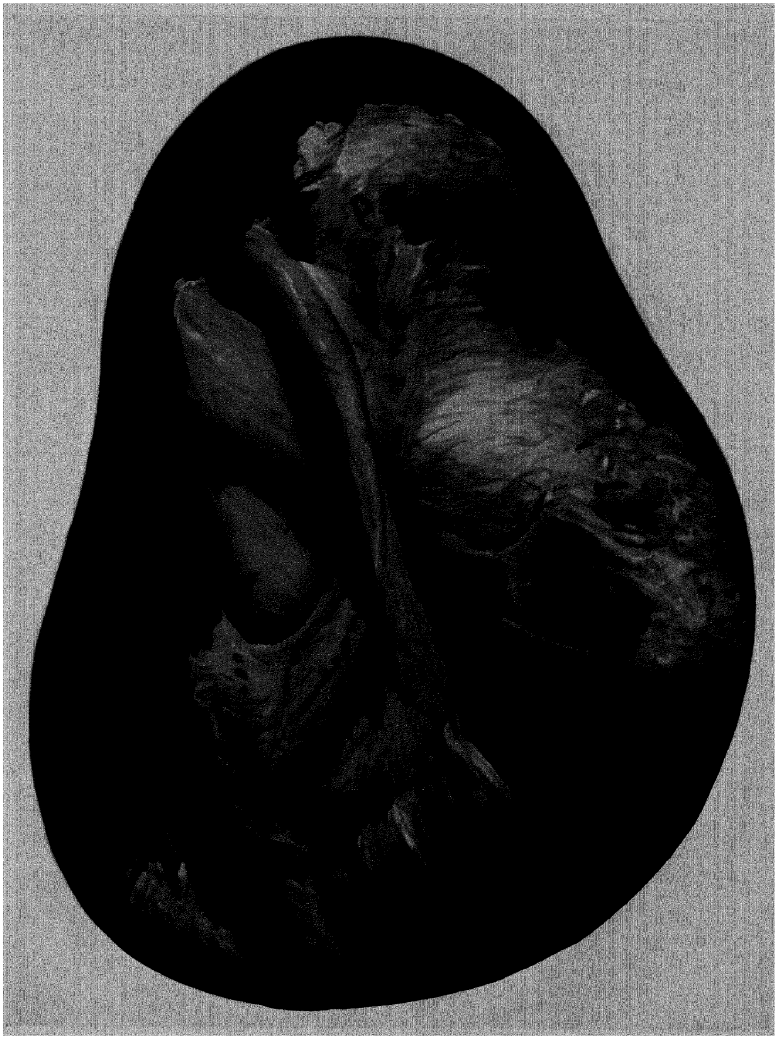
SECONDARY CHANGES IN OVARIAN TUMOURS

(1) **Axial Rotation : Torsion of the Pedicle.** This accident is found to have occurred in about 2 *per cent.* of cases submitted to operation. The tumours which are most likely to undergo this change are cysts of moderate size with a fairly long thin pedicle which allows them to rise above the pelvic brim. It occurs more rarely with solid [1] than with cystic tumours, and those of very large size are usually prevented by their bulk from rotating. The extent of the torsion varies from one half-turn to twelve complete turns ; a twist of less than one half-circle probably does not affect the circulation in the tumour at all. The effects produced upon the tumour vary with the extent of the torsion, and probably with the rapidity of its production ; these effects may be described in three stages.

(*a*) *Congestion.* A moderate twist is sufficient to compress the thin-walled veins of the pedicle, and arrest the venous return from the tumour without greatly reducing its arterial supply. The vessels subjected to compression are the ovarian vessels, which reach the tumour through the infundibulo-pelvic fold. The uterine artery is not affected, but since the uterine veins communicate freely with the pampiniform plexus in the broad ligament, the uterine circulation is also disturbed. On the distal side of the twist it is accordingly found that the Fallopian tube, broad ligament, and cyst-wall are greatly swollen. On the proximal side of the twist swelling also takes place, but to a less marked extent ; this is to be explained by the fact just mentioned that twisting of the broad ligament interferes to some extent with the venous outflow from the uterus itself. Both the pedicle and the tumour become engorged with venous blood, extensive interstitial hæmorrhage occurs, and, in addition, bleeding takes place into the loculi of the cyst. As a result, enlargement of the tumour takes place, and in some cases spontaneous rupture, from increased tension due to intracystic effusion of blood, has been observed. Tumours in this condition are usually of a dark plum colour (Pl. XXXI.), and dull, having lost the polished appearance characteristic of the unaltered cyst-wall. In this condition the tumour is liable to become infected from the bowel. Adhesive peritonitis is frequently found around it, causing adhesions to neighbouring intestinal coils, to the omentum, and the abdominal wall ; adhesions are not, however, invariably present. Extensive thrombosis is often observed in the veins of the pedicle on both sides of the twist, and it may spread far into the large veins of the broad ligament.

(*b*) *Necrosis* may take place from sudden arrest of the arterial supply or, more gradually, as the result of extreme congestion. The tumour in this condition is very liable to become infected from adherent coils of intestine,

[1] An instance of solid ovarian carcinoma with twisted pedicle and consequent fatal intraperitoneal hæmorrhage is recorded by Schumann, *Amer. Jl. Obst. and Gyn.*, vol. x., 1925, 273.



OVARIAN CYST DRAWN IMMEDIATELY AFTER REMOVAL, showing the effects of acute torsion of the pedicle.

To face page 636.

giving rise to suppuration or gangrene. But even when the twist is sufficient completely to kink the arteries, necrosis may not occur if the change has been a gradual one and the tumour is small; the omental and other adhesions, which rapidly form, become vascularized and are able to furnish sufficient blood to maintain the vitality of the tumour. If the twist is too rapidly produced to allow time for adhesions to form and become vascularized, this alternative source of blood-supply will not be available and necrosis will then ensue.

(*c*) *Detachment* may occur, from atrophy of the tissues of the twisted portion of the pedicle. Fresh connections having been formed during the process, the tumour not only maintains its existence but may actually increase in size, and appear to be growing from some other abdominal organ.

Causation. Not much is known about the causes of axial rotation. The conditions which predispose to its occurrence are, small size and free mobility of the tumour, and laxity of the abdominal wall. It is therefore not uncommonly met with in pregnancy and the puerperium. Trauma or muscular strain may in some cases actually initiate the rotation, and once started the movement may, perhaps, continue spontaneously. There has been great discussion as to the *direction* of the movement of rotation. It appears that the movement may occur in either of the two possible directions, and that in the majority of cases it follows the direction of the movement of supination of the forearm on the affected side, *i.e.* the tumour rotates towards the side to which it belongs. An instance of axial rotation of an ovarian cyst in the fœtus has been recorded.

(2) **Infection.** Ovarian and fimbrial cysts are much more prone to infection than are uterine fibroids. They may become involved in the spread of septic or gonorrhœal infection from the uterus and the Fallopian tubes, or by the passage of organisms into them from the bowel through adherent coils of intestine. In pre-antiseptic times, infection often followed the operation of tapping a large cyst through the abdominal parietes. Infection is, however, much commoner in the case of small pelvic cysts than in the larger abdominal ones. As already mentioned, axial rotation is a powerful predisposing cause of bowel adhesions, and consequently of infection also. It is stated that 'dermoid' cysts are especially prone to become infected, but the evidence upon which this statement is based is inconclusive; probably, in many cystic teratomata described as containing pus, the characteristic sebaceous contents were mistaken for purulent fluid, owing to the resemblance of their naked-eye characters to pus. It is not uncommon to find certain loculi of an infected cyst containing pus, while the contents of the others are non-purulent. The infective process is clinically found to be much more often chronic than acute; not infrequently, the pus is sterile at the time of operation.

A suppurating ovarian cyst becomes closely adherent to neighbouring viscera, and, after destroying the intervening walls, may discharge spontaneously by perforation into the rectum, the bladder, or the vagina. If the cyst contains a teratomatous (*dermoid*) process, hair and teeth may then be passed per rectum or through the urinary passages. It would seem that suppurating teratomatous cysts are more liable to perforate the bladder than other varieties of ovarian cysts, a point which is no doubt explained by their being more frequently found in the utero-vesical pouch. It is a possible, but extremely rare, occurrence for a suppurating ovarian cyst to rupture into

the peritoneal cavity. When a pyosalpinx is also present a communication may be established between them, forming a *tubo-ovarian* abscess.

(3) **Rupture.** Three conditions may lead to rupture of an ovarian cyst: (1) traumatism; (2) sudden increase of intracystic tension from hæmorrhage or suppuration; (3) morbid changes in the cyst-wall. Spencer Wells stated that rupture had occurred in 2·4 *per cent.* of his series of 1000 ovariotomies.

(1) Thin-walled cysts can sometimes be felt to rupture during a bimanual examination; this is especially liable to occur under anæsthesia with complete muscular relaxation. During labour, an ovarian cyst in the pouch of Douglas may rupture from the pressure exerted upon it during the delivery of the fœtus. A large cyst may no doubt be ruptured by direct abdominal violence such as a blow or a fall.

(2) Axial rotation is by far the commonest cause of any considerable hæmorrhage into an ovarian cyst. The spontaneous rupture of suppurating cysts has already been mentioned.

(3) In the colloid cysts (pseudo-myxoma) the wall is unusually friable, and spontaneous rupture may occur from mere inability of the tissues to support the normal amount of intracystic tension. Papillary growths, either innocent or malignant, may actually perforate the cyst-wall, or by weakening it, lead to spontaneous rupture. Cystic carcinomata of the ovary not infrequently undergo spontaneous perforation into the peritoneal cavity, owing to the friability of the cancerous tissues.

Results of Rupture. These depend entirely upon the nature of the cyst-contents which are effused into the peritoneal cavity. Serous fluids of low specific gravity and scanty albuminous contents, such as those found in fimbrial and follicular cysts, are readily absorbed by the peritoneum, without any local inflammatory reaction taking place. No serious consequences need therefore be anticipated from such an accident as the bursting of a small cyst during clinical examination. Thick fluids containing large quantities of albuminous material, such as those found in pseudomucinous cysts, or thick fluids containing fat, loose hair, and other solid materials, such as are found in cystic teratomata, do invariably produce a local peritonitic reaction. Small quantities of such fluids sometimes become completely encysted by adhesive peritonitis, but more commonly the fluid escapes in large amount and becomes diffused over the peritoneal cavity; it then tends to accumulate in certain positions, viz. in the pouch of Douglas and in the renal pouches, as is the case with all free fluids in the peritoneal cavity. It resists absorption, and the adhesive inflammation which is set up is a protective process, which has the effect of isolating and imprisoning the foreign material. Unless the cyst-contents were infected at the time, general peritonitis does not supervene.

In the case of teratomatous and papillary cysts a further result ensues, viz. the active epithelial elements which these tumours contain become engrafted upon the peritoneal membrane and grow there. Thus a crop of peritoneal warts may be found, after rupture of a papillary cyst, not only in the neighbourhood of the tumour but also in distant parts. Cases have been described in which, after rupture of a teratomatous cyst, numbers of small epithelial growths with hairs have formed upon the peritoneal membrane. It is probable also that in some instances non-ovarian abdominal teratomata have been formed by peritoneal implantation from ruptured cystic ovarian

teratomata. The rupture of a malignant ovarian cyst is followed by rapid spread of the growth to the surrounding peritoneum. It is now well established that in non-malignant cases of peritoneal implantation, spontaneous disappearance of the peritoneal growths occurs after removal of the primary tumour.

(4) **Adhesions.** Plastic peritonitis may occur around an ovarian tumour in consequence of axial rotation or infection, as has been already mentioned. Many tumours become adherent, however, in which these changes have not occurred. Small growths lying in the pouch of Douglas are more often found to be adherent than larger ones occupying the abdominal cavity. Coincident disease, such as appendicitis, salpingitis or pelvic peritonitis from uterine

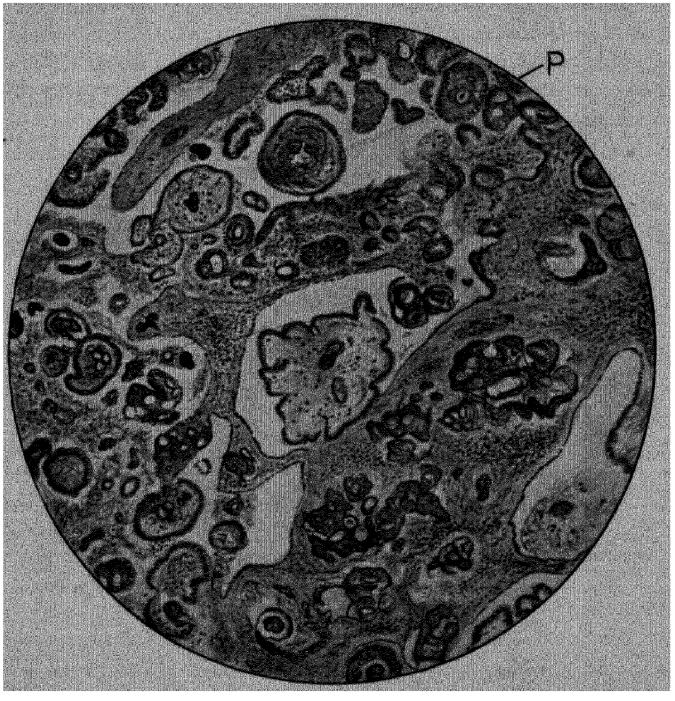


FIG. 432. PAPILLIFEROUS OVARIAN CYST (× 105), which has undergone psammomatous change. P, Psammoma-body.

infection, is the usual explanation of the formation of the adhesions. In some instances the unaltered tumour may itself cause sufficient peritoneal irritation to produce the same result without the aid of bacterial infection; cystic-teratomata are believed to be especially liable to form adhesions in this way. On the other hand, solid tumours, such as fibromata, become adherent more rarely than cystic tumours, though the amount of peritoneal irritation which they cause must be greater.

Adhesions result in more or less complete fixation of the tumour; when thus confined in the pouch of Douglas it is often spoken of as 'incarcerated.' Adherent pelvic tumours cause pain and usually menorrhagia; and there can be no doubt that the formation of adhesions increases the urgency of the other symptoms to which these tumours give rise. Operative difficulties may also arise from adhesion of coils of intestine to the growth.

(5) **Malignant Degeneration.** The occurrence of carcinomatous or sarcomatous changes in the wall of an innocent ovarian cyst has been described in another place.

(6) **Degeneration-Cysts in Solid Tumours.** Cystic cavities are frequently met with in the interior of both innocent and malignant solid tumours. They result from myxomatous degeneration or coagulation-necrosis; their walls are ragged and irregular, their fluids contain altered blood and tissue-débris, and they possess no epithelial lining. It will be recollected that similar cysts, due to hyaline liquefaction, are frequently found in fibroid tumours of the uterus (*see* p. 397).

(7) **Psammomatous Degeneration.** The occurrence of this curious change is rare in ovarian cysts. Globular bodies composed (according to the analysis of Lassaigne) of cholesterin, albuminous matter, and sub-phosphate of lime, may be formed in the stroma of papilliferous cysts. These bodies may be hard or soft, according to the amount of earthy deposit they contain. On section they show a laminated structure (*see* Fig. 432).

CLINICAL FEATURES OF OVARIAN TUMOURS

Exact pathological diagnosis by clinical methods is at present impossible, but careful consideration of each case will usually admit of its being allotted to one of three classes, viz.: (*a*) *Benign cystic tumours;* (*b*) *Benign solid tumours;* (*c*) *Malignant tumours.* The clinical features will therefore be considered in relation to each of these three classes in turn.

The age-incidence of ovarian tumours generally is very wide; they may occur in the fœtus, or they may first be recognized in extreme old age. Operations for their removal have been undertaken with comparative frequency in children under twelve years of age, and in a few cases infants under two years of age have been surgically relieved of these growths. Sir John Williams showed from a study of statistics, now over forty years old, that ovarian tumours occurred with decidedly greater relative frequency in unmarried than in married women.

Benign Cystic Tumours

Symptoms. Innocent ovarian cysts produce few symptoms, those met with being mainly due to their *size*, their *position*, or to *secondary changes* which have occurred in them. Their presence does not necessarily affect any of the ovarian functions, as, even when they are bilateral, a certain amount of active ovarian tissue persists. They do not as a rule cause pain, nor do they affect the general health. As a rule their rate of growth is comparatively slow, although more rapid than that of fibroids. An ovarian cyst may accordingly attain a large size before the patient's attention is attracted to it, and then it may be only the abdominal enlargement of which she complains.

As a result of secondary changes they may, however, rapidly increase in size. Teratomatous cysts often remain stationary for long periods.

The *position* occupied by the tumour is, however, an important factor in the case. Small tumours not exceeding the size of a cricket ball usually lie *in the pouch of Douglas*, into which they sink by gravity. When exceeding this size they generally rise above the pelvic brim into the abdominal cavity,

where they ride free among the viscera. If the ascent of such a tumour is prevented by absence of a pedicle, or by any other cause, pain usually supervenes, being due in part to crowding of the pelvic viscera proper, in part to disturbance of the pelvic circulation, and sometimes to direct pressure upon the nerves which pass out through the sacro-sciatic and obturator foramina. It is very uncommon for ovarian cystic tumours in the pelvis to cause retention of urine from pressure on the urethra or the neck of the bladder, but frequency of micturition is commonly observed in such cases. The rectal functions are not disturbed, but menstruation may become more painful and more profuse than usual, probably as a result of obstruction to the venous return from the uterus by pressure on the bases of the broad ligaments. If adhesions are formed, the tumour may become a source of pain, which is aggravated by menstruation, by exertion, jolting, coitus, and constipation.

Ovarian cysts which have risen into the *abdominal cavity* proper cause far less trouble than those detained in the pelvis. They do not give rise to pressure-symptoms until they are large enough to fill the greater part of the abdomen and stretch the abdominal walls; in extreme cases they may, however, displace the diaphragm upwards and embarrass the action of the heart and the respiratory movements, and also obstruct the circulation through the great abdominal veins, thus leading to hæmorrhoids, and to œdema of the lower extremities. Even in the case of the largest cysts the amount of œdema is not extreme, but enormous varices of the superficial veins of the lower abdominal wall may occur from pressure on the pelvic brim obstructing the venous return through the parietal veins (Fig. 434). In cases such as these, the general health may become profoundly deteriorated; emaciation may be extreme, resembling that found in the late stages of cancer, and clinical observers of fifty years ago were accustomed to describe an 'ovarian facies' in such cases—a peculiar sallow tint of the skin, with an expression of weariness and suffering. Owing to the popularization of the operation for removal of ovarian tumours, cases are now very rarely allowed to reach this advanced stage before surgical relief is obtained.

Physical Signs. When *pelvic* in position a small ovarian cyst is inaccessible from the abdomen, but is recognized on bimanual examination as an oval or globular, tense, elastic swelling lying as a rule behind the uterus, which it displaces forwards. When uncomplicated, it is movable and not sensitive to touch. Its position is rarely exactly median, but it does not necessarily lie upon the side from which it grows. The pedicle may be palpated bimanually when the local conditions are favourable; this is made easier by anæsthesia, or by pulling down the cervix with a volsella to put the pedicle on the stretch. Non-adherent cysts are movable independently of the uterus; adherent cysts are not, and care is then required in distinguishing them from uterine fibroids. The posterior surface of the cyst can be felt best from the rectum. Usually, cysts of this size are regular in contour and uniform in consistence. Rounded tense projections due to the presence of daughter-cysts on the surface may, however, be found; sometimes a densely hard area may be felt at some part of the surface, suggesting that the tumour is a teratomatous cyst containing a bony or cartilaginous area in its wall. This diagnosis can sometimes be confirmed by X-ray examination revealing the presence of bone or of teeth.

Small ovarian cysts are occasionally found in the utero-vesical pouch instead of in the pouch of Douglas, in which case the uterus becomes partially

or entirely retroverted. It is a curious and interesting point that an unusually large proportion of the small tumours found in this situation are teratomatous ovarian cysts.

A *medium-sized cyst*, when *abdominal* in position or when extending from the pelvis into the abdomen, forms a well-defined, elastic swelling, with a surface generally smooth, but sometimes broken by rounded projections representing external clusters of daughter-cysts. It usually lies more to one side than the other, but it may be exactly mesial in position. It is freely movable and insensitive to touch; when the pedicle is long, the fingers can be passed below the tumour into the pelvic brim; usually, however, the tumour can be felt to pass deeply into the pelvis, the lower border being inaccessible. On percussion it is dull, except near the borders where the intestine usually overlaps it, giving a subresonant note. Tumours large enough to extend above the umbilicus may yield a fluid thrill, but this is not always the case; the detection of a thrill depends upon the presence of a large cavity in the anterior part of the tumour; if no such large cavity is formed, a definite thrill cannot be obtained. Ovarian tumours are all dumb on auscultation. Bimanual examination will show that the uterus is distinct from the tumour; its position may be normal, but frequently it lies retroverted.

The flanks will usually be found resonant in uncomplicated cases, but when present, free fluid in the peritoneal cavity is significant, and the exclusion of ascitic fluid should always receive attention in examining a case of ovarian tumour. It must be recollected that free fluid may occur with papillary or teratomatous cysts, or any malignant tumour, or it may result from leakage from a pseudomucinous cyst.

Very large cysts which greatly distend the abdominal cavity are comparatively rare; they may, however, attain a size such as that shown in Figures 433 and 434. In such a case as this the entire abdomen, including the flanks, is protuberant, the two sides being usually unequal; the belly is pendulous (*see also* Fig. 435), the umbilicus is everted, the skin tense, and the subcutaneous veins distended. A fluid thrill will be readily obtained in all directions; the greater part of the abdomen is quite dull to percussion, the exceptions being the subcostal angle, where stomach-resonance persists, and the outlying portions of the flanks, where a muffled colon-note can nearly always be obtained. When the patient lies on her side, the upper flank may become slightly more resonant, owing to sinking of the heavy tumour towards the dependent flank. The peri-umbilical area is always completely dull. On vaginal examination the uterus is usually found either retroverted or prolapsed; it is very rare to find its position normal in the case of very large tumours. In these cases it is often very difficult to locate the body of the uterus by digital examination, but this point is not of great practical importance.

The diagnosis of the *side* from which the tumour arises is also a matter of small importance; three points serve as guides, viz. the lateral inclination of the tumour (which, however, is sometimes misleading), the position of the pedicle, and the palpation of a normal ovary upon the unaffected side, which, however, is rarely practicable without anæsthesia.

Sometimes the *intraligamentary situation* of the tumour can be recognized; but when, as occasionally happens, such tumours have a pedicle, they cannot be distinguished from others. An intraligamentary growth tends to displace the uterus to the opposite side of the pelvis (*see* Fig. 461, p. 688);

this displacement chiefly affects the body, but the cervix is also to some extent affected. Further, intraligamentary tumours are less freely movable than others, and often they tend to burrow, so that their deepest part lies unusually low down, and may pass behind the cervix under the floor of the pouch of Douglas.

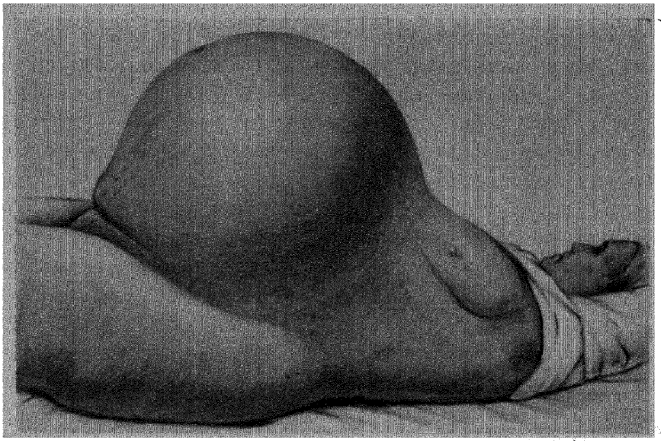


FIG. 433. LARGE OVARIAN CYST, SEEN IN PROFILE. The maximum girth-measurement was 65 inches.

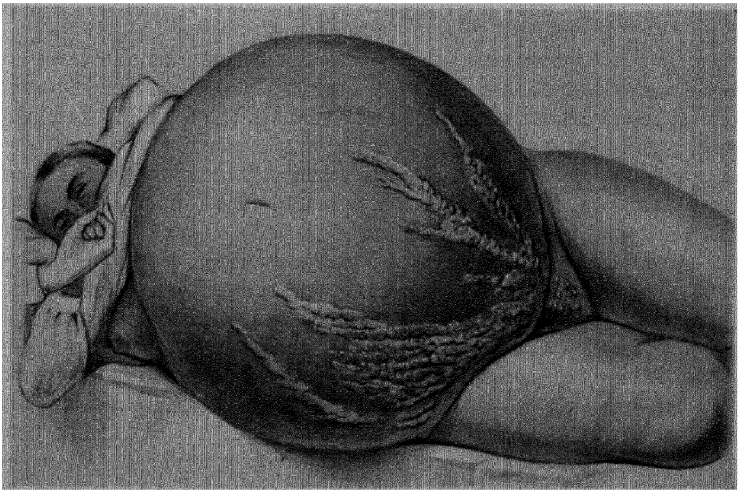


FIG. 434. LARGE OVARIAN CYST. FRONT VIEW, showing lymphatic and venous varices. The same case as that seen in Figure 433.

Differential Diagnosis of a Benign Ovarian Cyst. Differential diagnosis of an abdominal tumour is always a matter of difficulty and uncertainty, and many mistakes are made by the most careful diagnostician. Too many operators in the present day are ready to leave the question entirely until the abdomen has been opened. If a 'lump' can be felt, it is regarded as a sufficient reason for operation, and the nature of the lump can be inquired into by the pathologist after its removal. Such an attitude, if prevalent,

would soon be fatal to the art of clinical diagnosis, and would reduce the surgeon to the intellectual level of a skilled artisan. Differential diagnosis is well worthy of careful study, not only because knowledge is an end in itself, but because it is in the patient's interest that the surgeon should fully understand her case. The preparations for an operation, the question of operability, and the prognosis, are points which require as full knowledge as possible of the condition to be dealt with.

(1) *Small cysts*, situated in the pelvis, may be confused on physical examination with (*a*) a *pediculated subperitoneal fibroid*; (*b*) an *inflammatory effusion*; (*c*) a *hydrosalpinx*, or *gravid tube*; (*d*) a *retroverted gravid uterus*.

(*a*) Careful examination should, in the case of the *fibroid*, demonstrate the immediate attachment of the tumour to the uterus, its well-defined outlines, and its solid consistence. It is very rare, although possible, for a subperitoneal fibroid to possess a pedicle long enough to be clinically recognized. Softening is very rarely met with in small fibroid tumours, except in pregnancy, so that the difference in consistence is a point of great practical importance. As fibroids are usually multiple, and interstitial or submucous growths usually accompany subperitoneal ones, menorrhagia may be a prominent symptom. Fibroids may, however, be found along with an ovarian cyst.

(*b*) A small ovarian cyst, when inflamed and adherent in the pouch of Douglas, may be difficult to differentiate from an effusion in the pouch, or from a swelling formed by inflammation of the tubes and ovaries. The special characters of these latter swellings have already been described (*see* p. 567).

(*c*) A *hydrosalpinx* can often be distinguished from a small ovarian cyst by its elongated or tortuous shape (*see* Fig. 351, p. 551). It must be recollected that rectal examination is of great value in the detailed examination of swellings occupying the pouch of Douglas.

A *gravid Fallopian tube* has been frequently confused with a small ovarian cyst. The chief guides in distinguishing the former are the coincident signs of pregnancy—amenorrhœa, breast changes, and softening of the cervix; except in a primigravida the two latter are not easy to recognize in the early weeks of pregnancy. The shape and consistence of the swelling is similar in the two cases; usually a pulsating vessel can be felt in the lateral vaginal fornix below a gravid tube, but this is not invariably found, and is sometimes felt under other conditions, especially when inflammatory changes are present.

(*d*) A *retroverted gravid uterus* is also most readily distinguished by the recognition of the accompanying signs of pregnancy. The consistence of the swelling in the pouch of Douglas is not unlike that of an ovarian cyst, and owing to the softening of the tissues of the isthmus, the cervix may appear to be movable independently of the swelling behind it. Attention should be paid to the position of the cervix, which is always *displaced upwards* and *directed forwards* to a greater or less extent. On the other hand, although a tumour in the pouch of Douglas may displace the whole uterus forwards, it does not alter the direction of the cervix; therefore forward marked inclination of the cervix indicates that the swelling in the pouch of Douglas is uterine. In all cases of doubt examination under anæsthesia will be helpful in demonstrating the continuity of the cervix with the swelling. This is easier when the swelling can be pushed up out of the pouch of Douglas.

(2) When the ovarian cyst is larger and lies in the *abdominal* cavity it offers an easier diagnostic problem, if the abdominal walls are thin, for the fluid consistence of the swelling, and the independence of the uterus can be easily recognized. In corpulent women it sometimes requires care to decide whether, or not, there is a tumour present, and many mistakes have been made, from an abnormal amount of fat in the abdominal wall and in the omentum.

(*a*) An *obese abdomen* is uniformly enlarged especially below the level of the umbilicus. The navel is deeply depressed, while all large intra-abdominal tumours tend to evert it. On palpation the definite outlines of a tumour are missing, and the observer must not be misled by what is called 'increased resistance.' The extreme thickness of the subcutaneous fat-layer can be demonstrated by pinching it up with the fingers of the two hands, and when this is present great care in diagnosis is obviously called for. A certain amount of general loss of resonance results from the thickness of the fat-layers, but on deep percussion a resonant note can be elicited. Examination under anæsthesia greatly assists the deep palpation of an obese abdomen in a woman who from nervousness fails to relax her muscles.

(*b*) *Phantom* abdominal tumours are produced partly by a more or less involuntary depression of the diaphragm, and partly by gaseous distension of the intestines. Sometimes it is associated with amenorrhœa and other symptoms suggestive of pregnancy, when the name of *pseudocyesis* is applied to it. Unless associated with corpulency the abdomen remains resonant on percussion, and there is no excuse for the observer being deceived by this condition. Under anæsthesia it wholly or partly subsides, allowing the abdominal organs to be satisfactorily examined. Women of nervous temperament are more likely than others to present this form of abdominal enlargement.

(*c*) *Pregnancy.* If amenorrhœa from some intercurrent cause is present, the differential diagnosis from *pregnancy* may present difficulties. The chief reliance will then be placed upon the condition of the mammæ and the cervix, and the results of auscultation. Total absence of breast-changes, and of cervical softening, in connection with an abdominal tumour exceeding the height of the umbilicus, will serve to exclude pregnancy with practical certainty. The fœtal heart-sounds, if recognized, offer the most certain positive sign of pregnancy. If any doubt exists a second observation after a fortnight's interval will demonstrate a definite increase in size of the gravid uterus. Such rapid increase is quite unusual with ovarian cysts, except from axial rotation, or from intra-cystic hæmorrhage.

(*d*) On the other hand, the presence of menorrhagia from an intercurrent cause may suggest that the tumour is a *fibroid.* As a rule, the dense solid consistence and sharply defined margins of a fibroid tumour are easily distinguished from the elastic resistance and less sharply defined outlines of an ovarian cyst. Felt through a very thick abdomen they are difficult to distinguish from one another by palpation; it is, however, rare for the mobility of fibroids to be so free as that of uncomplicated ovarian tumours. Chief reliance may be placed in such cases upon recognizing, by the bimanual examination, that in the case of the ovarian cyst the uterus is independent of the tumour. Difficulty may arise in the case of fibroids which have been softened by extensive degenerative changes, for their consistence may approximate to that of an ovarian or other cyst. But even fibro-cystic

tumours of the uterus seldom have walls thin enough to allow a fluid thrill to be felt, and the detection of the thrill in a doubtful case is decidedly in favour of the ovarian origin of the tumour. A *souffle* can often be heard over a fibroid tumour (*see* p. 422), but ovarian tumours are always silent on auscultation. Additional difficulties may arise from the co-existence of ovarian and fibroid tumours. When one or other tumour is of predominant size, the smaller is obscured and is often overlooked; the most important point is the want of uniformity in the consistence and character of the whole tumour, when carefully examined in detail. This should always suggest the possibility of the double nature of the condition.

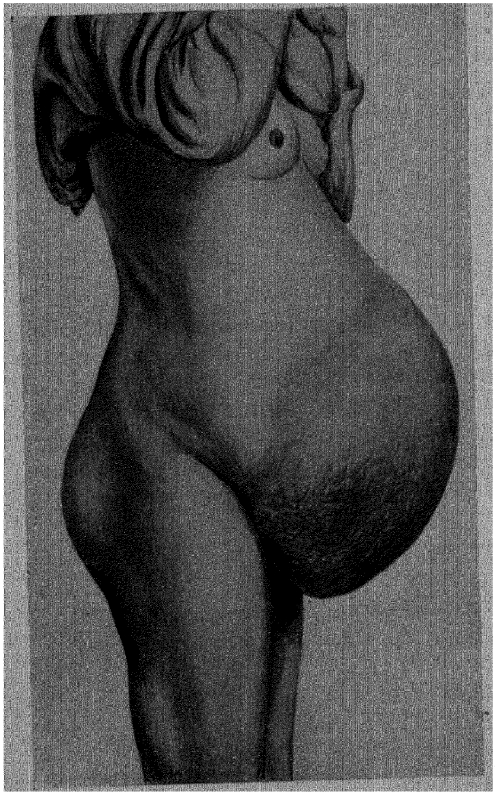


FIG. 435. LARGE CYSTIC KIDNEY SIMULATING AN OVARIAN CYST. Patient erect.

Certain general considerations may assist the differential diagnosis of fibroid and ovarian tumours. Fibroids are of slower growth, and accordingly present a long clinical history of menorrhagia, and possibly of other symptoms before they attain large size. Ovarian tumours are of more rapid growth, the duration of the symptoms is relatively short, and menorrhagia is quite an unusual result of their formation.

It is very uncommon for fibro-cystic tumours of the uterus to attain the enormous size of the largest ovarian cysts, and if it has been determined that the fluid is encysted and not free, the probability that it is ovarian is very high. Nevertheless numerous instances have been recorded in which a tumour of this character revealed itself as a fibro-cystic uterine tumour on opening the abdomen (*see* Fig. 436). Occasionally a renal cystic tumour may attain the size of a very large ovarian cyst, even to the extent of producing 'pendulous belly' (*see* Fig. 435); pre-operative diagnosis is then very difficult. It may, however, be possible in the former to demonstrate the presence of a band of resonance crossing the tumour and corresponding to the position of the colon.

Many other forms of cystic tumours may occur in the abdomen, although much more rarely than cysts of the ovary; the more important are *mesenteric* cysts, *pancreatic* cysts, *renal* cysts (*see* Fig. 435), including hydronephrosis, *encysted peritonitic accumulations*, and *hydatid* cysts. These tumours

are slow of growth and do not give rise to pain, as a rule, until they attain considerable size.

(*e*) *Mesenteric* and *pancreatic* cysts arise in the umbilical or subcostal zones of the abdomen (*see* Fig. 73, p. 96); when they have attained a large size they may extend downwards to the pelvic brim. They are often freely movable, but usually it is possible to make out that their point of attachment is in the abdomen, not in the pelvis. An ovarian cyst with a long pedicle, although it may be found in the umbilical zone, can be pushed down into the pelvis, unless it has become adherent in its altered position. Mesenteric and pancreatic cysts, even when freely movable, are tethered in the abdomen proper. On percussion, irregularly distributed areas of subresonance are

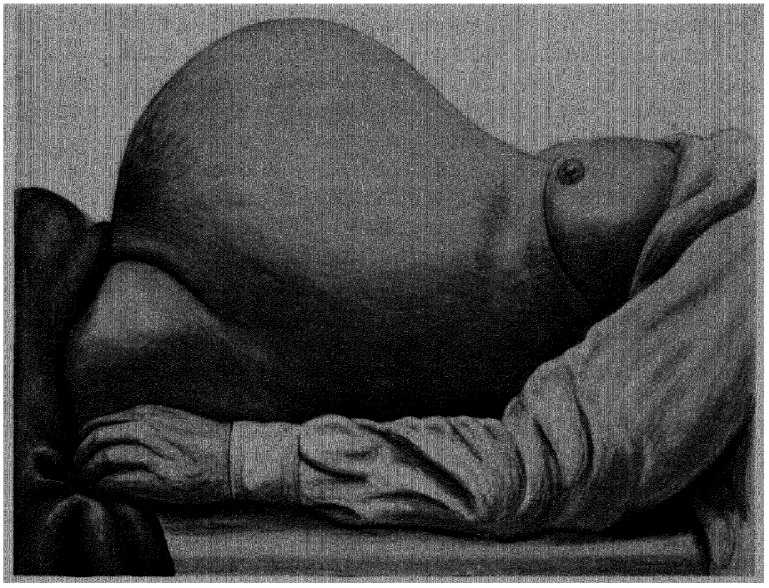


FIG. 436. LARGE FIBRO-CYSTIC TUMOUR OF THE UTERUS. Patient recumbent.

found over these tumours, owing to loops of intestine crossing in front of them.

(*f*) *Renal* cystic tumours, when of small size, may be found in the pouch of Douglas, having been completely dislocated from their normal position, or possibly congenitally misplaced. When of larger size they may extend from the costal margin to the pelvis (*see* Fig. 435), and though definitely lateral in position, they may extend across the middle line to the opposite side. Usually large renal tumours pass deeply into the flank, and can be felt posteriorly upon one side or the other between the last two ribs and the iliac crest; this is quite unusual in the case of an ovarian cyst. As a rule the renal tumour is oval in shape, the long axis being usually oblique, and a band of partial resonance, corresponding to the colon, can usually be made out on its anterior surface. The affected kidney may be functionally inactive, secreting no urine, a point which can be determined by cystoscopic examination of the bladder or catheterization of the ureters.

Occasionally a healthy kidney, or the healthy spleen, may occupy the

pouch of Douglas; the nature of such cases can seldom be cleared up except by opening the abdomen.

(*g*) *Encysted collections of peritonitic* fluid are often tuberculous in origin. Signs of tubercle in other organs may then be present, suggesting that the abdominal condition is also of that nature. The other organs may, however, be free from disease, but irregular fever, wasting, and night-sweats may accompany the abdominal enlargement, when tubercle will naturally be thought of. In some cases the abdominal enlargement is almost the only symptom present; amenorrhœa, however, occurs much more frequently than with ovarian cysts. In other cases the condition is septic in origin and may have followed labour or miscarriage (*see* p. 231).

The abdominal swelling is usually situated in the umbilical and hypogastric zones. It is ill-defined and only slightly movable, and is not entirely dull on percussion. These points are explained by the fact that the enclosing wall is composed of adherent viscera, of which a considerable part always consists of intestine. If it extends into the pouch of Douglas, the lower pole can be felt *per vaginam;* the body of the uterus has no independent mobility, being involved in the surrounding adhesions.

(*h*) *Hydatid* cysts may occur in the ovary, or the Fallopian tube, or in any part of the subperitoneal tissue of the pelvis. In the latter position they form fixed, ill-defined swellings which may attain large size and extend into the abdomen. Their nature may sometimes be surmised from a history of the previous occurrence of hydatids in the same subject; or they may discharge spontaneously through the bladder or bowel, when daughter-cysts and hooklets will be discoverable in the discharges. Apart from this, the specific serum-reaction is the only possible means of pre-operative diagnosis (*see* p. 292).

(3) *Very large abdominal* cysts must be distinguished from extreme degrees of *ascites*, whether simple or associated with intra-abdominal malignant disease, and from *fibro-cystic tumours* of the *uterus*. With the patient lying on her back, in ascites the clearest note on percussion is obtained around the umbilicus, the dullest note in the flanks; in ovarian cysts the converse is the case. In cases of ascites the distribution of dulness shifts readily with changes of posture, but with ovarian cysts dulness does not shift except to a very slight extent. In ascites some causal condition, such as cirrhosis of the liver, may be detected, or the presence of hard nodular masses in the abdomen may suggest advanced malignant disease with secondary deposits.

Benign Solid Tumours

Like cysts, the innocent solid tumours of the ovary seldom give rise to direct symptoms until secondary changes occur in them. There is a somewhat greater tendency for bilateral fibromata to cause amenorrhœa by complete destruction of the ovarian substance than is the case with the cysts. They attract attention earlier than the cysts, from the inconvenience caused by their bulk and weight, and the amount of abdominal distension produced is frequently aggravated by the occurrence of ascites. Axial rotation occurs, but with less relative frequency than in the case of cysts.

On examination these tumours form oval, firm, insensitive swellings which have the same relations to the uterus as the cysts. Their dense consistence and sharply defined outlines are usually appreciable without diffi-

culty, except in obese women. But generally speaking, these tumours are not so hard as fibroids of the uterus, and in some cases, from the occurrence in them of cystic degeneration, they may feel elastic or doughy on palpation. Free ascitic fluid can be detected clinically in a considerable proportion—probably one-third to one-half—of all cases; in addition, fluid may be found, on operation, in quantity too small for clinical recognition. The clinical results of axial rotation and infection are much the same as in the case of cysts.

Differential Diagnosis. A solitary, pediculated, subperitoneal, fibroid tumour may be difficult to distinguish from an ovarian fibroma. If, however, the uterus is movable independently of the tumour, the latter is in all probability ovarian; and if the presence of ascitic fluid can also be made out, it becomes practically certain that the tumour is ovarian. An ovarian fibroma may induce amenorrhœa when bilateral, but has no tendency to increase the menstrual flow. It is, however, quite possible in subjects of an ovarian fibroma also to find fibroid tumours in the uterus, when no assistance can be obtained in diagnosis from analysis of the symptoms. In the case of the fibroid tumour it may be possible, with the assistance of general anæsthesia, to recognize that both the ovaries are present and distinct from the tumour, when its ovarian origin can be definitely excluded.

Malignant Ovarian Tumours

Ovarian tumours are more frequently discovered to be malignant after removal than recognized as such clinically. In the early stages, malignant disease gives rise to no characteristic symptoms or clinical appearances; a tumour which on naked-eye examination after removal appears to be innocent, may be demonstrated by the microscope to be malignant (*see* p. 610). in parts.

It is not too much to say that the absolute exclusion of malignancy is impossible before operation, for unilateral cystic growths of small size may be cancerous, and even cysts of large size which readily yield the signs of fluid contents, sometimes show limited areas of malignant change. The frequency with which ovarian tumours, removed by operation, are found to be malignant, therefore, becomes a point of considerable practical importance. It appears from the records of cliniques that from *eight to ten per cent. are malignant*, and that in the case of solid or semi-solid growths the proportion is considerably higher than for the whole. In any case this relatively high malignancy-rate justifies the rule, that the prompt removal of all ovarian tumours should be advised, quite independently of their clinical characters. At the same time, certain conditions may be recognized as indicating an increased probability of malignancy, and therefore as constituting *urgent indications for immediate operation.*

A solid ovarian tumour, associated with ascites and giving rise to considerable pain, may justly be suspected of being malignant, but from what has been said above with regard to pain and ascites, it will be seen that these points are by no means characteristic of malignant disease. Free fluid in company with a cyst may be due to leakage of simple cyst-contents, or to the dissemination of a papillary growth over the peritoneum. Ascites occurs in only about *fifty per cent.* of cases of ovarian cancer (Glendinning) and probably somewhat less frequently than this in sarcoma. In women over

forty years of age, the significance of pain and ascites as indications of malignancy is greatly increased. Amenorrhœa is often, but not always, present, and indicates that the disease is bilateral. Tumours of large size are, however, not infrequently accompanied by irregular bleeding from the uterus.

In cases of *secondary* ovarian cancer, and in the advanced stages of the *primary* disease, great and rapidly increasing abdominal enlargement is met with due in part to ascites, in part to the size of the ovarian growth, and in part to the formation of numerous visceral metastases. Pain, which is comparatively early in its appearance, grows severe as the enlargement of the abdomen becomes pronounced. Later still, general wasting, and swelling of the feet occur, which appear the more striking as they are associated with great abdominal enlargement. These features are, however, common to the advanced stages of other forms of intra-abdominal malignant disease, and are not specially characteristic of ovarian cancer.

It must be recollected that in cases of secondary ovarian cancer the tumour often greatly exceeds the primary growth in size, and may be met with at a time when few, if any, indications of the existence of the primary growth are to be found. Particular attention should, therefore, be paid, in cases of suspected malignant ovarian tumours, to the possibility of the presence of a primary growth in the stomach or intestine, or in the mamma.

Solid malignant tumours may arise in the omentum, the mesentery, or the pelvic cellular tissue, which closely resemble those of ovarian origin; all are usually secondary, not primary. Owing to their anatomical relations these growths rapidly infiltrate surrounding structures, and therefore tend to become fixed when comparatively small. Ovarian malignant growths, as has been explained, are at first encapsuled, and local infiltration cannot be observed clinically, until the capsule has been broken through; they therefore retain their mobility much longer than those of the mesentery or the omentum.

The Diagnosis of Secondary Changes in Ovarian Tumours

When an ovarian tumour becomes troublesome by increasing rapidly in size, or by giving rise to pain, or when it first reveals its presence by the sudden onset of acute abdominal symptoms, it is certain that some degenerative change has set in, or that the growth is malignant. The clinical features of secondary changes are therefore of great interest and importance.

Axial Rotation. The clinical results of axial rotation depend in the main upon the rapidity with which rotation occurs, and upon its extent. Rotation not exceeding one-half of a circle, found upon operation, has often been unsuspected clinically, and probably gives rise to no symptoms. When exceeding half a circle, severe symptoms are not in all cases produced, but the tumour may increase rapidly in size and become sensitive to touch, and may give rise to pain. These symptoms in the case of a presumptively innocent cyst always suggest axial rotation. It is probable that only an extensive twist, rapidly produced, gives rise to *acute abdominal symptoms*. Sometimes these are sudden in onset, the patient being unexpectedly seized with severe abdominal pain and vomiting; more often the onset is gradual and the symptoms are increasing abdominal pain, with distension and tenderness, and usually a moderate amount of fever. The acute symptoms

may last for several days, during which the abdominal distension increases, mainly owing to the progressive increase in size of the tumour, which is caused by the rotation (*see* p. 636). In the majority of cases the acute symptoms subside spontaneously, but, as has been pointed out elsewhere, very serious results, such as rupture or gangrene of the cyst, may ensue.

The *diagnosis* in acute cases is made by discovering the tumour; owing to the distension and tenderness this may be difficult, and even when a tumour has been known to exist and can be felt, detailed examination may be impracticable. But the association of an abdominal or pelvic tumour with the symptoms just described is, of itself, almost a sufficient warrant for the diagnosis of axial rotation; rotation of a fibroid tumour may also produce acute symptoms of a similar nature, but this accident is very much more frequent with ovarian than with uterine tumours. It will be recollected, also, that ovarian tumours are especially prone to this accident during pregnancy or the puerperium.

Treatment. Ovarian tumours which have become twisted should be removed without unnecessary delay. It is not, however, necessary to operate during the stage of acute pain and fever, for these symptoms almost invariably subside spontaneously, and the operation can than be performed with less risk to the patient. If the symptoms do not subside in two or three days, further delay is, however, inadvisable.

Inflammation and Infection. Ovarian tumours which become inflamed are usually of small size, and situated in the pelvic cavity, the two chief sources of infection being the bowel and the Fallopian tubes. The formation of adhesions around such tumours necessarily follows. They then invariably give rise to pain aggravated by exertion, by jolting, and sometimes by coitus. The adhesions may be gradually produced without any acute attack of pain or illness; sometimes, however, the onset is acute, the patient being confined to bed for a few days, and thereafter complaining more or less constantly of pain. It will be recollected that the blood cysts of the ovary, of the variety known as endometrial (*see* p. 594), are almost invariably found to be densely adherent to surrounding structures from the occurrence of peri-ovarian inflammation. The clinical features accordingly closely resemble those of a case of inflammation of the uterine adnexa (*see* p. 565). On examination, tumours thus affected are sensitive, unusually tense, and their mobility is more or less completely lost.

When small cysts of this kind undergo *suppuration*, a dense inflammatory reaction occurs around them, which results in absolute fixation of the swelling, and obscures its outlines and characters. There is no means of distinguishing, in such cases, a pyosalpinx from a small, suppurating ovarian cyst (*cf.* Figs. 359 and 377). Large cysts are less often the seat of suppuration than are small ones. Well-marked constitutional disturbance, with rise of temperature, results from suppuration when the infective process is acute; this is, however, relatively rare, the infective process being much more often chronic. In cases of the latter class, the tumour is usually so effectually isolated by plastic peritonitis that absorption from it is more or less completely prevented, and constitutional symptoms are accordingly slight in extent or entirely absent. The pus from such tumours may prove to be sterile on bacteriological examination.

As felt through the abdominal or vaginal wall, the swelling is densely hard and quite fixed; its cystic nature may be by no means evident. It is

then difficult to differentiate it from other forms of *pelvic abscess;* this point has already been referred to on page 567.

Ovarian Tumours and Pregnancy. The association of pregnancy with a single ovarian cyst of moderate size is so frequently observed, that the conclusion may be drawn that the presence of such a tumour offers little hindrance to conception. Bilateral tumours form a more serious obstacle to pregnancy, and are therefore seldom observed with it. Solid ovarian tumours being of much rarer occurrence than cysts are much less frequently met with in pregnancy, but the presence even of a malignant ovarian tumour does not necessarily prevent the occurrence of conception. An interesting and important point in connection with the *character* of the ovarian growth complicating pregnancy is the frequency with which teratomatous cysts are found. Of 862 cases collated by McKerron 204 (23·5 *per cent.*) were of this nature. McKerron's estimate has more recently received confirmation by the publication of forty-one cases operated upon by H. R. Spencer. Of these twelve (29·25 *per cent.*) were teratomatous cysts. This frequency is explained by the fact that this type of cyst is usually small and gives rise to no, or to few, symptoms; they therefore remain long unobserved in the pelvis. When pregnancy occurs teratomatous cysts are more likely to cause trouble than simple cystomata.

Ovarian tumours do not unfavourably affect the course of pregnancy or tend to induce abortion. When of small size their presence may be completely overlooked until labour is over, and even in the puerperium they may not be detected unless some secondary change such as axial rotation occurs in them. When lodged in the pelvis, they cause pressure-symptoms during the latter months of gestation, and this leads to their discovery; but not uncommonly it is the obstruction offered by such tumours to delivery which first reveal their presence.

When a large ovarian cyst lying in the abdomen is associated with a gravid uterus of similar size, the diagnostic problem is often somewhat difficult of solution. The abdomen is much larger than is appropriate to the period of amenorrhœa; usually the uterus and the tumour lie side by side, and the presence of an oblique sulcus, or depression, indicates that the swelling consists of two parts; in one half of the swelling the signs of pregnancy appropriate to the period of gestation will be found, in the other half these will be absent. When the gravid uterus is much larger than the cyst the latter may escape recognition. Great difficulty will be often experienced in distinguishing an ovarian cyst from a subperitoneal fibroid under these circumstances, as the latter may become so much softened during pregnancy as closely to resemble the former in consistence.

Pregnancy does not affect the rate of growth of ovarian tumours, but definitely increases the risk of occurrence of certain secondary changes in them. Thus *axial rotation* is found to have occurred in about 6 *per cent.* of ovarian tumours removed during pregnancy (Sir John Williams), as compared with a general incidence of 2 *per cent.* In the puerperium there is also the increased risk of suppuration from spread of infection from the uterus.

TREATMENT OF OVARIAN TUMOURS

Treatment is entirely surgical. No means are known by which the growth of these tumours can be in any way influenced, nor do they atrophy

after the climacteric, as is sometimes the case with uterine fibroids. Inasmuch as exact diagnosis of the pathological nature of any tumour is impossible, there should be no delay in its removal. Tumours which give rise to no clinical suspicion of malignancy may prove to be malignant on microscopic examination. Their liability to become twisted, or infected, supplies a further reason for their prompt removal. Ovariotomy is one of the most successful of abdominal operations, and may be undertaken with confidence, even in childhood, or in advanced age; the co-existence of pregnancy scarcely, if at all, affects the prognosis of recovery from the operation. The tapping of any large ovarian cyst is not generally advisable. This procedure may, however, be desirable in cases of extreme cardiac embarrassment, as a means of temporary relief to the circulation, and should be followed as soon as may be by removal of the tumour.

Ovariotomy during pregnancy is no more serious than in non-pregnant women; there is, however, considerable risk of abortion following the operation. This risk is greatest in the first two and in the last two months of pregnancy; during the latter period it has been estimated by some observers at 20 *per cent.* to 25 *per cent.* Cases diagnosed during the first two months should therefore not be operated upon until the fourth or fifth month has been reached. If premature labour should occur after an operation in the last two months of pregnancy, the obstetric risks are not appreciably increased.

Ovarian tumours which cause obstruction during labour by lying below the presenting part of the fœtus may often be pushed up above the pelvic brim, if labour has not advanced too far. The attempt should be made under anæsthesia, and great assistance can be obtained by placing the patient in the Trendelenberg position. The child is then delivered as soon as possible with forceps. Bruising of the cyst-wall almost inevitably occurs under these circumstances, and the tumour should therefore be removed within forty-eight hours of delivery.

If during labour the ovarian tumour is found to be immovably fixed in the pelvis, immediate removal by abdominal operation is indicated. It will be necessary to turn the gravid uterus out of the abdomen in order to obtain access to the tumour in the pouch of Douglas, and accordingly it is best to deliver the child by Cæsarean section before dealing with the tumour.

RETROPERITONEAL TUMOURS [1]

Tumours of connective tissue origin are occasionally found occupying a retroperitoneal situation. As they come within the purview of the gynæcologist it is our duty to draw the attention of the student to their existence. From the strictly anatomical and pathological points of view, the term 'retroperitoneal' includes the prevertebral area, the renal areas, the broad ligaments and the omentum, *i.e.* a tumour lying in the omentum or in the broad ligament is strictly extra- or retroperitoneal. From the surgical aspect, which is the one from which retroperitoneal tumours are practically regarded, the omentum and the broad ligaments are excluded, so that the majority of retroperitoneal tumours which have come to operation have been situated behind the peritoneum of the posterior abdominal wall,

[1] J. George Adami. *Montreal Med. Jl.*, Jan.-Feb. 1897; Terrillon, *Archiv. Général de Med.*, 1886, p. 257; Doran, *Jl. Obst. Gyn. Brit. Emp.*, vol. ii., 1902, p. 244.

viz. in the prevertebral and renal areas. Connective-tissue neoplasms here situated are usually composed, in the main, of fat, and there is no doubt that these tumours start, primarily, as lipomata. Later on they may acquire an admixture, variable in amount, of fibrous, cartilaginous, osteoid, mucoid and embryomatous tissues. This is not surprising when it is remembered that a connective-tissue tumour of any one type is prone to develop within itself areas of connective tissue of the other fully-formed types.

The result is that these retroperitoneal lipomata are found in the records under various names, such as fibro-lipoma, fibro-chondro-osteo-lipoma, lipoma myxomatodes, lipo-sarcoma, etc. Speaking generally, the commonest change is one of myxomatous degeneration, so that the tumour comes to be a myxolipoma or, as some term it, lipoma myxomatodes.

The fact that embryonic tissue may develop in a prevertebral lipoma is of considerable clinical importance, as such growths must be regarded as sarcomatous. The latter tend to become very adherent, in spite of the fact that there is never any evidence of inflammation, such as peritonitis, found associated with them, nor as sarcomata are they wont to produce metastases. They are, however, extremely difficult to remove, owing to their close connection with important structures, such as the pancreas, liver, and blood-vessels. The naked-eye appearance of the growth varies according to the presence or absence of other tissues besides fat in its composition. Pure lipomata are of a deep yellow colour; lipoma myxomatodes is of a dull grey colour and is frequently blood-stained; lipo-sarcomata are dull red in colour. The general surface of these tumours is smooth and lobulated, and outlying lobules may be present attached to the main mass by a pedicle. Many vessels may be seen in or on the thin capsule, portions of which may be roughened by adhesions.

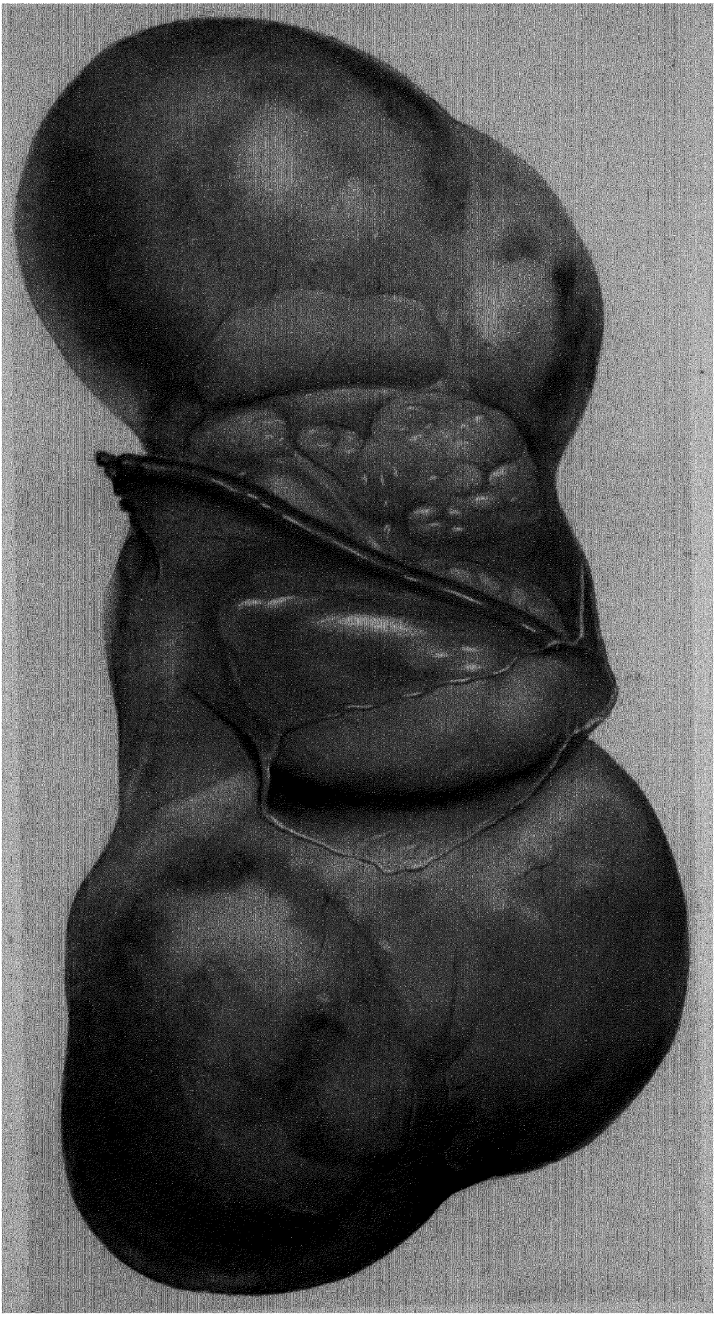
Causation. Nothing definite is known as to the ætiology of these fatty tumours. Adami found that in forty-two cases, fourteen (one-third) were of perirenal origin; the large amount of fat in this region may be held to explain this fact; on the other hand, the appendices epiploicæ never give rise to lipomata. As regards sex, the same author found that these fatty growths are commoner in women than in men, the proportion being as 25 to 16.

Perirenal lipomata are as common on the left side as on the right.

Retroperitoneal lipoma is a tumour of middle or latter life. We have only discovered one case arising in childhood, *i.e.* that of Lauwers, in which the tumour was recognized in a baby fourteen days old. It was removed seven years later, when it weighed six pounds, the child weighing only twenty pounds.

Below thirty years only two cases are mentioned by Adami, whereas in his series seventeen occurred between the ages of 30–50 years.

Clinical Features. The rate of growth is very slow indeed. There is a gradual, though very slow, enlargement of the abdomen unaccompanied, for years, by any disturbance of the general health. These tumours by their gradual growth attain to a great size, the majority of those in Adami's series weighing more than twenty pounds. In Waldeyer's case (which was sarcomatous) the tumour weighed sixty pounds. After reaching a great size symptoms referable to pressure supervene; these take the form of dyspnœa, and œdema of the lower extremities. Extreme emaciation is also commonly associated with the later stages of the growth.



LIPOMA OF THE BROAD LIGAMENT. The lipoma occupies the folds of the mesosalpinx with the Fallopian tube stretched over it. The fatty lobules lie upon a teratomatous cyst of the ovary, which forms the greater part of the mass.

To face page 655.

Diagnosis. On examination, a large prevertebral lipoma may be definitely fluctuant. A line of resonance is to be felt over the front of the tumour. Its outlines are often indefinite ; it lies above the pelvic brim, and when of large size occupies both sides of the midline and is more or less fixed. Adami points out that the fluid nature of fat in the living body accounts for the false diagnoses which have been made. These tumours have been wrongly diagnosed as multilocular ovarian cysts, echinococcal cysts, and even ascites.

Treatment. Owing to the slow rate of growth and to the absence of symptoms for a long period, these cases are often not seen until a very large tumour with consequent pressure-symptoms exists. Nothing but operative interference, *i.e.* attempt at removal, is of any service. Adami says, " In general the huge mass peels out with fair ease." In his series of forty-two cases, twelve were successfully operated upon. Doran speaks very despondently on the results of operation, and so do other surgeons. The great danger lies in the risk of subsequent gangrene of intestine from the tying off of many mesenteric vessels ; also in injury to viscera, such as the pancreas (Doran). Gangrene of the bowel, according to Adami, seems to have been the cause of most of the fatalities.

LIPOMA OF THE BROAD LIGAMENT [1]

We have already stated that a sharp distinction is to be drawn, from a surgical point of view, between prevertebral lipomata and those found in the broad ligament. In both situations lipomata are rare, but their occurrence in the broad ligament is so infrequent that we can find only eight cases on record, making, with the one illustrated on Plate XXXII, nine in all.[2] Six of these were quite small and had caused no symptoms ; only two were large, one weighing over thirty pounds and one seventy-two ounces. Contrasted therefore with lipoma of the prevertebral space, those in the broad ligament are, generally, smaller in size, they are of simpler structure, no complex connective-tissue elements or sarcoma-charge has ever been found. They are therefore easily shelled out, and never present the surgical difficulties and dangers of those higher up.

Clinical Features and Diagnosis. No symptoms appear unless the tumour is large. In Treves' case, in which the growth reached to the umbilicus, there was pain in the back. The uterus may be displaced laterally, as in a case recorded by Campbell. On examination the growth will feel soft and semi-fluctuating, and it will probably be diagnosed as an ovarian or broad-ligament cyst.

Treatment. The treatment is removal, and the tumour will be found to shell out with ease.

LIPOMA OF THE OMENTUM

Fatty tumours of large size may arise in the epiploön. Such cases have been recorded by Lennander and by Meredith. They possess more mobility and lack the band of interstitial resonance found over large prevertebral lipomata. They are pure lipomata and are easily removed.

[1] For literature see Lockyer, *Proc. Roy. Soc. Med.*, Aug. 1919.
[2] The last case put on record is one published in *Amer. Jl. Obst. and Gyn.*, June, 1926.

PART III

SECTION I: TECHNIQUE; SECTION II: OPERATIONS; SECTION III: AFTER-TREATMENT

TECHNIQUE

OPENING the peritoneal cavity by incision of the abdominal wall (*abdominal section, laparotomy, cœliotomy*) or of the vaginal fornices (*colpotomy*) is the first step in the performance of a number of operations to be described in the succeeding pages. It will be convenient, and will serve to avoid repetition, if certain points in the technique, and in the general management, of all operations which involve a preliminary opening of the peritoneal cavity are considered together.

PREPARATION OF THE PATIENT

Except in surgical emergencies, from thirty-six to forty-eight hours' rest in bed before operation has many advantages; this interval may be used for the examination of the urine, and of the digestive system, the lungs and circulatory system. The presence of a moderate amount of albumen or sugar does not form a contra-indication to abdominal operation; advanced Bright's disease or advanced diabetes do so, however, as a rule. Urinary infections should be carefully treated before all pelvic operations; operative disturbance of the bladder may lead to an outbreak of acute cystitis in such cases.

One of the first requisites is careful preparation of the alimentary canal. In this connection, the importance of oral sepsis must not be overlooked, for this condition increases the severity of post-anæsthetic vomiting by producing chronic irritation of the gastric mucous membrane, and it also increases the difficulty of feeding; further, it may become the cause of septic pneumonia if infective material is drawn into the air-passages during anæsthesia. Carious teeth, and suppurative conditions of the gums, should therefore be first attended to, if the operative conditions are not urgent. The diet should be simple and non-stimulating in character and restricted in amount. Purgation *immediately before operation* is to be avoided; it is better to give a mild aperient on two occasions three and two days before the operation; an enema on the night preceding the operation will then suffice to clear the colon. A drastic purge given the night before the operation produces marked depression, at a moment when the vitality should be conserved. The advantages of these careful preparations are: (1) distended coils of intestine are less likely to be found at the operation; (2) accumulations in the large bowel are removed which might be a source of trouble during convalescence.

In the case of patients of low vitality the administration of strychnine, either hypodermically or by the mouth, for several days before operation is of distinct prophylactic advantage in diminishing post-operative shock.

In the case of an operation which it is anticipated may be prolonged or severe, a hypodermic injection of hyoscine and morphine, morphine and atropine, or of all three, may be given three-quarters of an hour before the operation. The doses given of these combinations are hyoscine gr. $\frac{1}{100}$, morphine gr. $\frac{1}{6}$ to $\frac{1}{4}$, and atropine gr. $\frac{1}{120}$. A comfortable drowsiness is thereby induced which obviates the extreme apprehension with which many nervous women await the commencement of an operation. Further, it diminishes the amount of anæsthetic which is required, reduces post-operative vomiting and pain, and greatly reduces the frequency of post-anæsthetic bronchitis and pneumonia, the latter results being probably explained by the diminution which these drugs produce in the secretions of the respiratory mucous membranes.

The conventional view that abdominal operations upon the pelvic organs should not be performed during a menstrual period is a concession to sentiment, and not the expression of a surgical necessity. The presence of menstruation does not in any way complicate the operative procedure or disturb the convalescence ; it is therefore unnecessary to postpone a proposed operation on account of the unexpected appearance of menstruation.

GENERAL CONDUCT OF THE OPERATION

The operator is personally responsible for everything connected with the operation, although much of the work is actually delegated to his assistants. Apart from the primary object of the operation, there are certain matters of the highest importance which must always be kept in view: (1) the prevention of infection ; (2) the safe conduct of anæsthesia; (3) the prevention of post-operative shock. Upon due attention to each of these matters will often depend both the immediate success of the operation, and the favourable progress of convalescence.

The Prevention of Infection. This is in many respects the surgeon's chief concern, and that which involves the greatest responsibility, for failure may be attended with fatal consequences. Within the limits of this chapter it is impossible to discuss the general bearings of bacterial infection, and the principles underlying antiseptic and aseptic methods. It is now generally agreed that absolute asepsis, *i.e.* a bacteria-free operative environment, is practically impossible of attainment. Fortunately it is not essential to success, as all healthy tissues have the power of disposing of a certain number of organisms which may obtain access to them. The peritoneum probably possesses this power to a greater extent than any other tissue.

The atmosphere cannot be excluded, and in a room occupied by living persons it always contains suspended organisms driven from the mouth and air-passages during breathing, talking, coughing, etc. Further, the skin and all mucous membranes are to be regarded as surgically 'infected' tissues, since in health they harbour organisms capable of setting up infection when transplanted to other parts, *e.g.* the deeper layers of a wound. When, as is often the case, the tissues in the neighbourhood of the operation are infected, the difficulties are much increased.

The practical aim of the surgeon, therefore, is to sterilize the operation-area itself as far as may be, and as far as practicable to prevent any bacteria from being introduced into the wound either directly by instruments and appliances, or indirectly through the air.

The Operation-Area. The technique to be followed is somewhat different in the case of abdominal and vaginal operations.

The *abdominal wall* should be prepared twelve hours before operation by shaving the pubes down to the level of the folds of the clitoris, and thoroughly cleansing with spirit-soap and water; special attention must be paid to the umbilicus. The difficulties of sterilizing skin are well recognized, and some surgeons have abandoned the attempt to do so, relying solely upon simple cleansing of the abdominal wall; they regard antiseptic solutions as being ineffective for sterilization, and objectionable from diminishing the vitality of the tissues. The majority of surgeons, however, are of opinion that the risks of skin-suppuration cannot be met except by the use of antiseptics. Our practice is, after the preliminary cleansing just described, to

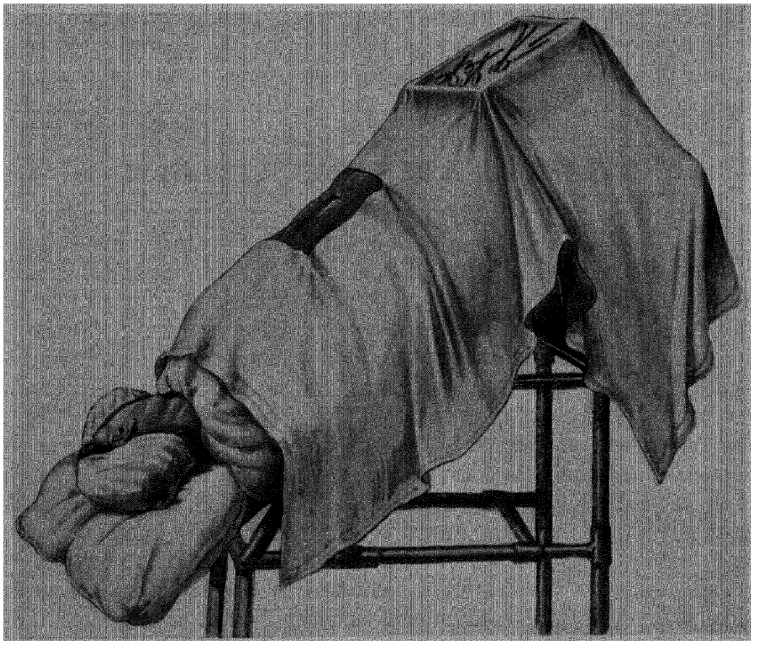


FIG. 437. THE TRENDELENBERG POSITION; patient ready for operation.

have the skin carefully dried with sterilized swabs, and then to paint the whole abdominal surface freely with a 2 *per cent.* watery solution of iodine, or with tincture of iodine. A 3 *per cent.* solution of picric acid forms a useful substitute for iodine and produces less irritation of the skin. The whole abdominal area, including the groins and the flanks, should be dealt with in this way. A sterile dressing is then applied and the painting repeated after the patient has been anæsthetized.

The *vulva* and *vagina* present unusual difficulties to efficient sterilization, owing to the constant presence of secretions, and the proximity of the urinary and anal apertures. The bacterial flora of the vulva are abundant and varied (*see* p. 206); the dense hairy covering, and the abundance of sweat and sebaceous glands, place further difficulties in the way of effective sterilization. If healthy conditions prevail, the bacteria present are probably

not of great pathological significance, but if the conditions are diseased, pathogenic organisms of high virulence may be present, the destruction of which will be very difficult.

In the case of abdominal operations preparation of the vulva and vagina is not, as a rule, necessary. In some, *e.g.* in panhysterectomy when the vagina is laid open from above, and in cases where the vagina is to be opened for drainage, the preparation of the canal is a matter of considerable



FIG. 438. THE POSITION AND COVERINGS FOR A VAGINAL OPERATION.

importance. It is better not to omit the preparation of the vagina in all circumstances in which there is the possibility of having to open the vaginal vault.

When operations upon the cervix, vagina or vulva are to be undertaken, of course the necessity of preparation is sufficiently obvious. Plastic operations such as those for prolapse, and for repair of the cervix, depend largely for a successful result upon careful preparation.

It is of especial importance, in such procedures as perineorrhaphy when the anal canal is involved, to make sure that the rectum is empty at the time of operation, and a modification of the usual procedure will be found advisable. This consists in the administration of a quarter of a grain of

opium in pill, or a full dose of the Mist. Catechu, c. Opio B.P. after the enema has been given on the night previous to the operation. This will arrest peristalsis for the time being, and thus prevent the contents of the upper part of the colon from making their way into the rectum. This is much better than repeating the enema an hour or two before the operation, which excites peristalsis in the colon at a time when it is desirable to reduce it. In this manner soiling of the field of operation can best be avoided.

Vulva and pubes should be completely shaved, and the skin prepared with spirit-soap. The vagina cannot be prepared by douching alone, although this is useful in removing secretions. Disinfection must be carried out under anæsthesia immediately before the operation is begun. The iodine method yields good results, the watery or alcoholic solution being rubbed firmly into the skin of the labia, perineum, and inner aspects of the buttocks and thighs, and then into the vaginal walls with the aid of a speculum. If cervical dilatation is to be done, the surface of the portio and the cervical canal should also be very carefully cleansed and then swabbed with the iodine solution.

It is, generally speaking, undesirable to perform plastic vaginal operations during menstruation; when the secretions are obviously unhealthy, *e.g.* purulent or offensive, such operations are absolutely contra-indicated until healthy conditions have been restored.

The Isolation of the Field of Operation. The operation-area having been thus prepared as far as possible, it is important that, during the operation, this part of the body should be so surrounded by sterile protective coverings that it is completely isolated. This is effected by covering up the entire surroundings of the 'field' with sterilized cloths and waterproofs. The general arrangements are sufficiently indicated in Figures 437 and 438, which show the patient in position for an abdominal and for a vaginal operation. In vaginal operations the anus may be covered with a waterproof-dressing fixed with stitches or clips to the surrounding skin.

PREPARATION OF INSTRUMENTS, SWABS AND LIGATURES

Swabs and compresses should be made of gauze or Gamgee tissue. In abdominal operations two large compresses (10 inches to 12 inches square), or several loosely rolled pieces of gauze 6 yards long and 4 to 6 inches wide, wrung out of warm sterile saline solution, are required for *packing*, *i.e.* for isolating the pelvic area from the upper abdomen and its contents. For taking up blood and for general cleansing, smaller gauze swabs 3 to 4 inches square are used, which must be carefully counted before and after the operation, and for this duty the operator is responsible. Some operators prefer to use long rolls of wide gauze for all purposes, in order to avoid the difficulty of keeping count when large numbers of swabs are used during a prolonged operation. A small swab may easily be overlooked and left in the abdomen when considerable numbers have been used. Supplies of swabs, dressings, towels, aprons, etc., sterilized by steam under high pressure, and preserved in hermetically sealed tins, can be obtained from surgical instrument makers, and may be used with confidence when supplied by firms of repute. Sterilization in bulk, as carried out in small nursing homes and hospitals, is not always satisfactory.

Instruments and Ligatures. Instruments should be boiled for at least ten minutes *immediately before* the operation; sharp instruments may be

immersed in 1 in 20 carbolic solution or in methylated spirit for a quarter of an hour, instead of boiling, which blunts them. If silk or linen-thread ligatures are employed, they should be *boiled for an hour* before use; a second boiling for ten minutes immediately before the operation is also desirable. It is desirable to work with ligatures as fine as is consistent with good hæmostasis.

The great majority of surgeons prefer to use an *absorbable* material for the general purposes of a ligature, and catgut is the only material of the kind which is available. The sole disadvantage of catgut is that its preparation and sterilization are difficult and complicated. The raw gut obtained from manufacturers may contain living bacteria in its substance, which being liberated when the ligature is absorbed by the tissues, may set up infection. In a few cases post-operative tetanus has in this way been caused. It is well known that the tetanus bacillus is present in the fæces of most animals. As catgut cannot be boiled in water without destroying it, chemical methods of sterilization have to be employed. Further, for many of the purposes served by a suture it is desirable that absorption should not be rapid; thus stitches placed in the aponeurosis in closing an abdominal incision should be able to resist absorption for fourteen to twenty-one days. Unless specially prepared for this purpose, catgut will not resist so long. It must, therefore, be artificially hardened. The complete process accordingly consists in first permeating the whole substance of the gut with an efficient antiseptic, and for this purpose iodine or carbolic acid is usually employed. The sterile gut is then subjected to the hardening reagent, which is either formaldehyde or bichromate of potash. Finally the prepared gut is stored in sealed tubes of alcohol.

ANÆSTHESIA

The anæsthetic most generally suitable for abdominal work is ether given by the 'open' method. The previous administration of narcotics as advised above is of great advantage for the reasons already given (p. 657). Post-operative vomiting is probably less severe after this method than any other. In patients suffering from chronic bronchitis, chloroform may be substituted. The important details of administering anæsthetics cannot be discussed in this work; it is advisable always to entrust this part of the operation to the most experienced person available.

In certain cases a general anæsthetic, even in reduced amount, is contra-indicated, and then the best method is that of intradural (spinal) anæsthesia, stovaine being the best agent to employ for this purpose. Even when a general anæsthetic is not contra-indicated spinal anæsthesia offers certain important advantages in pelvic surgery. Along with complete anæsthesia it produces also complete motor paralysis of voluntary muscle in the area involved. Injected into the spinal canal at the level of the twelfth dorsal interspace, it will produce complete anæsthesia and paralysis of voluntary movement from the toes to a variable point above the level of the umbilicus. The lower abdominal muscles are accordingly completely relaxed, and in this condition intra-pelvic manipulations are greatly facilitated and the duration of the operation appreciably shortened. There is complete absence of shock, as all nerve-impulses from the operation-area are cut off. The anæsthesia lasts from forty-five to fifty minutes, and experience has shown that the Trendelenberg position can be employed with perfect safety if an interval

of five minutes is allowed for diffusion of the solution before the operation table is tilted.

Stovaine anæsthesia leaves consciousness unimpaired, and this is an undoubted disadvantage, especially in the case of nervous women, and when the inclined position is used for the operation. A condition of "twilight sleep" may, however, be produced before the spinal injection is given, in the manner suggested by Provis and worked out in detail by him. It consists in giving a hypodermic dose of morphia gr. $\frac{1}{4}$ to gr. $\frac{1}{2}$ with scopolamine gr. $\frac{1}{200}$, an hour and a half before the operation, and following this by a second injection of scopolamine gr. $\frac{1}{200}$ without morphia an hour later. Deep drowsiness is thus induced, which renders the patient practically unconscious of her surroundings, and if the ears are filled with cotton wool so as to exclude auditory stimuli, she may sleep quietly throughout the operation, of which she will remember nothing.

The technique of the spinal injection requires careful study, and the reader is referred to special sources for the necessary information.

GENERAL MEASURES FOR THE PREVENTION OF SHOCK

It is of great importance that the atmosphere of the room in which the operation is performed should be well warmed, the temperature being about 70° F. In addition, the body-heat of the patient should be conserved as far as possible by proper coverings, by avoiding unnecessary soaking of the coverings with fluids, and by the use of an artificially warmed operating table. In prolonged operations continuous subcutaneous saline transfusion may be used in the case of specially debilitated subjects. Finally, the *method of operating* is a factor of great importance from the point of view of shock. Rapidity, gentleness in manipulation, careful protection of exposed viscera, and prompt control of hæmorrhage will often allow of the most formidable operations being carried out without any marked degree of shock.

THE OPERATOR AND ASSISTANTS

As a general rule the fewer persons concerned in the performance of an operation the better; one experienced assistant is essential, but for rapid work two or three assistants, each knowing exactly what is expected of him, are necessary. The operator is personally responsible, and one of his preoccupations is to watch the work of his assistants. The same routine of preparation should be followed by all concerned.

The sterilization of the hands of all persons actually engaged in the operation is an important detail which demands the personal attention of the operator. The following method, which has been subjected to repeated bacteriological tests by different observers, may be confidently recommended: (1) the nails must be short and the skin of the hands intact; (2) the hands and forearms should first be scrubbed with a freshly boiled nail-brush, in hot water and soap; ether-soap or spirit-soap may be employed as solvents of fatty matter; five to ten minutes are required for this stage; (3) after removing the soap with fresh water, the hands and wrists should be immersed in a watery solution of 1 in 1000 biniodide of mercury for two or three minutes, or methylated spirit may be substituted for the biniodide solution; (4) the hands thus sterilized should be immediately dried and covered with sterilized rubber gloves. It is most convenient to use dry sterilized gloves which can be readily slipped on with the aid of sterilized

French chalk. Biniodide is preferred to perchloride of mercury as being a more powerful germicide, and as penetrating the skin more readily owing to its not coagulating albumen, as is the case with the perchloride. The wearing of gloves does not obviate the necessity of careful sterilization of the hands, for gloves are sometimes punctured or torn during the operation.

Sterilized gowns or blouses, and a covering for the head which completely covers the hair, the nose, and the mouth, leaving the eyes alone free, should be worn by the operator and all his assistants.

GENERAL CONDUCT OF THE OPERATION

Position. For all operations on the pelvic organs, the inclined, or Trendelenberg position is of great assistance (*see* Fig. 437); it allows of the intestines being withdrawn from the operation-area, and kept out of the

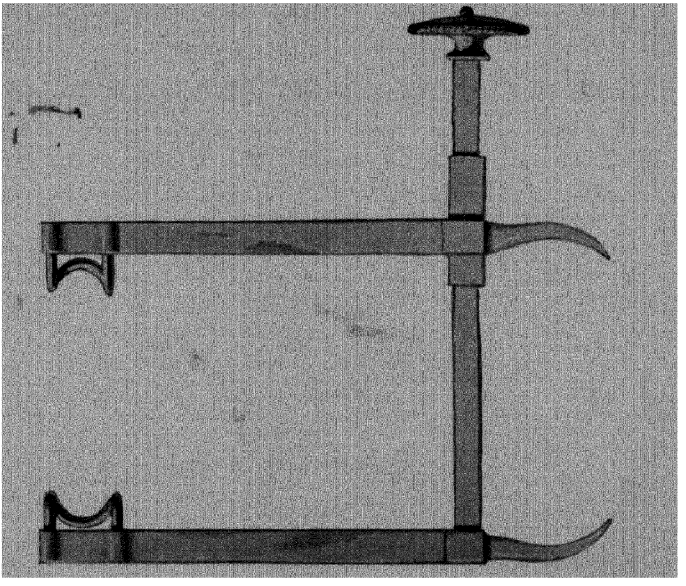


FIG. 439. GOSSET'S ABDOMINAL RETRACTOR.

way; and further, by raising the pelvis, it brings the contents of this cavity into easier reach. In the case of stout persons it somewhat embarrasses the action of the diaphragm, and so impedes aeration of the blood, with the result that marked cyanosis supervenes, but this condition when carefully watched is not of serious moment.

The *incision* which is most generally useful is the median, or paramedian, supra-pubic incision; this gives better access to the pelvic cavity than any other. The lower end should extend down to the pubic bone, due care being exercised in avoiding the bladder; freer access is thus given to the pelvic cavity than when the incision is placed higher up. Occasionally an incision through the rectus muscle will give more convenient access, as when, for example, the right adnexa and the vermiform appendix are at fault. The transverse incision of Küstner may be used when comparatively small space is required, as in operations for ventral suspension of the uterus. This incision divides the integument transversely about 1½ inches above the

pubes; the tissues superficial to the aponeurosis are then retracted up and down, and the aponeurosis muscle and peritoneum are divided in the mesial plane. The resulting skin-cicatrix is concealed by the pubic hair, but this incision offers no other advantages.

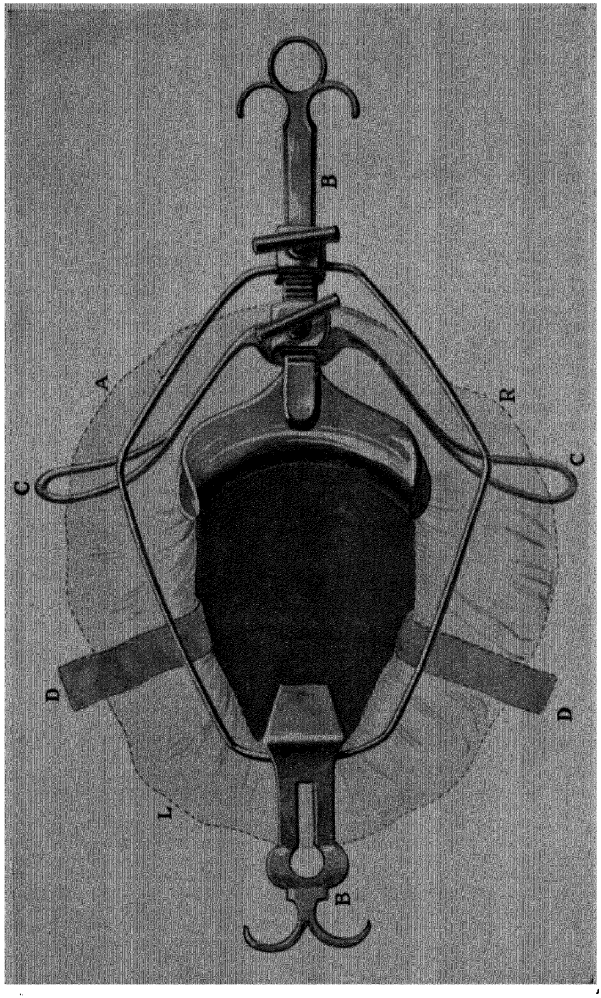


FIG. 440. FAURE'S ABDOMINAL RETRACTOR IN POSITION. A, Rubber sheeting with a broad flange tucked away and covering the deep aspect of the abdominal wall. B B, Retractors fixed in position on frame. C C, Limbs of frame which are placed between and underneath the patient's thighs. D, Pliable lead-retractors for clamping rubber-sheet in position.

Another form of transverse incision may be practised, viz., that of Pfannenstiel, in which the aponeurosis is also divided in the transverse direction. This was designed to minimize the risks of scar-hernia, the occurrence of which is presumably facilitated when all the layers of the abdominal wall are divided in the same direction. Experience has shown that, except as a sequel to the use of a drainage tube, or to suppuration in

the wound, scar-hernia is now a rare occurrence. The longitudinal incision undoubtedly allows of freer access to the abdomino-pelvic cavity than any other.

Short incisions are, as a rule, to be deprecated; the object of the incision is to provide free and easy access to the operation-area. Insufficient room prevents a proper inspection of the area of disease, prolongs the operation, often involves the use of undue force, and makes it difficult to conduct

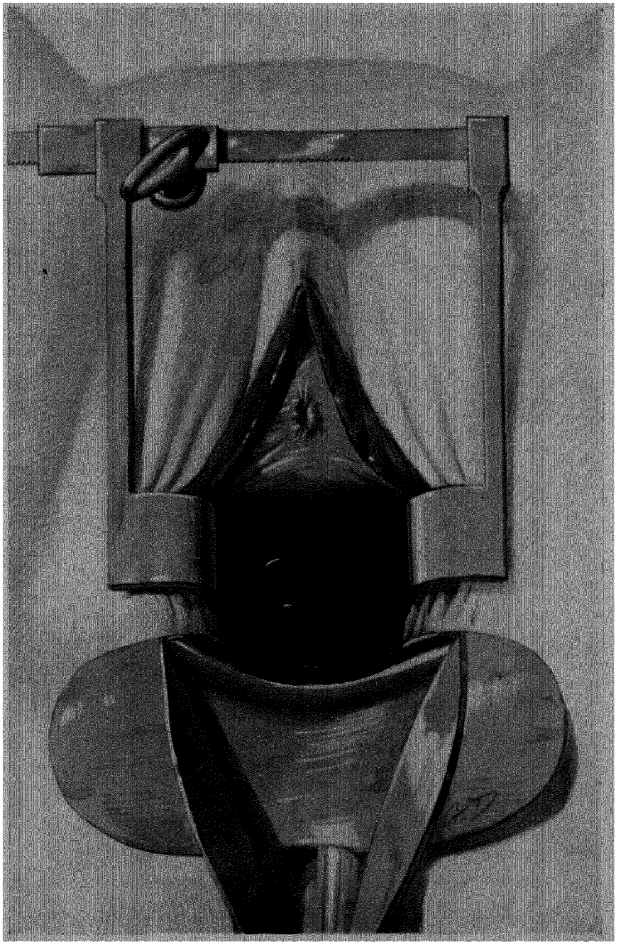


FIG. 441. JAYLE'S VAGINAL RETRACTOR AND AUVARD'S SPECULUM IN POSITION.

the satisfactory examination of other organs which may be called for. A long incision is no more likely to become the seat of hernia than a short one, and the sole argument which can be urged in favour of the latter is the so-called 'cosmetic' advantage of the inconspicuous scar.

Exposure of the Operation-Area. This is in part provided for by a suitably placed incision of adequate length, in the case of abdominal operations. Great assistance can be further obtained by the use of suitable retractors which hold apart the edges of the abdominal incision, or in the case of the

vulva, the margins of the *ostium vaginae* and the vaginal walls. Convenient retractors for abdominal work are those of Gosset and Faure. The former is shown in Figure 439 ; the latter is shown in Figure 440. Gosset's retractor has the merits of simplicity and easy adjustment ; Faure's is more complex but allows of wider separation of the edges of the wound. These are both self-retaining retractors and enable the operator to work with fewer assistants. For vaginal operations, necessitating exposure of the cervix and vaginal walls, the arrangement shown in Figure 441 is the best. The two-bladed vaginal retractor of Jayle (*see* Fig. 442) separates the lateral vaginal walls, while the self-retaining weighted speculum of Auvard (*see* Fig. 443) depresses the posterior vaginal wall and perineum. The exposure of the depths of the vaginal canal which is thus afforded, enables manipulation to be carried out with ease under direct observation, and obviates the risk of infection resulting from contact of instruments, etc., with the skin-surfaces of the vulva which are so difficult to sterilize.

Intra-abdominal technique. There are certain general principles to be borne in mind in all internal manipulations of the abdominal viscera. These

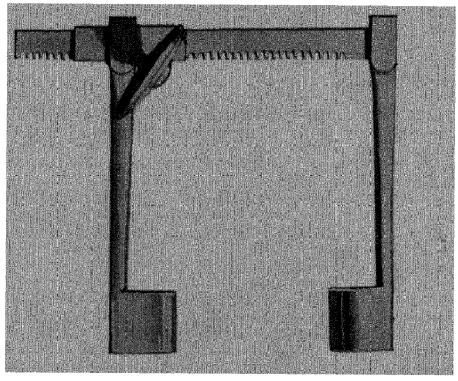


FIG. 442. JAYLE'S VAGINAL RETRACTOR.

can only be mentioned without elaboration, and their importance will, it is hoped, be sufficiently apparent. (1) All viscera should be handled as little as possible, and as gently as possible. (2) Hæmorrhage should be reduced to a minimum by securing large vessels when possible before dividing them ; it is often of advantage to secure the blood-vessels supplying an entire area before commencing to deal with that area. (3) In dealing with infective lesions, or in opening mucous tracts, the operation-area should be carefully isolated by packing, so as to protect the upper abdominal cavity, and parts of the pelvis which may not be involved. (4) Raw areas should not be left in the peritoneal cavity, as they may become the seat of adhesions, which later may cause much suffering, or even sometimes give rise to acute intestinal obstruction. Raw areas should be *peritonized*, *i.e.* covered with peritoneum drawn from neighbouring parts, or failing this with an omental graft. (5) Antiseptics should not be applied to healthy peritoneal surfaces, nor should these surfaces be subjected to damage from friction by vigorous mopping, or by the use of dry swabs and mattresses. This applies especially in general peritoneal infections, when it is of the greatest importance to avoid traumatism of the already damaged serous membrane. (6) The operator must

learn to work rapidly and not to waste time in purposeless manipulations. (7) Whenever possible, the abdomen should be closed without drainage; this point is, however, so important that special consideration must be given to it.

Drainage. Abdominal surgery is now carefully feeling its way in the limitation of drainage of the peritoneal cavity. Experience has shown that the peritoneum possesses remarkable powers of dealing with fluids, even those of an infective nature, so long as its vitality is not seriously damaged, and the original focus of infection has been removed. Blood is not easily disposed of by the peritoneum, and owing to its suitability as a nutritive medium, it is specially liable to become infected either from the bowel, or from bacteria admitted at the time of operation. The only two

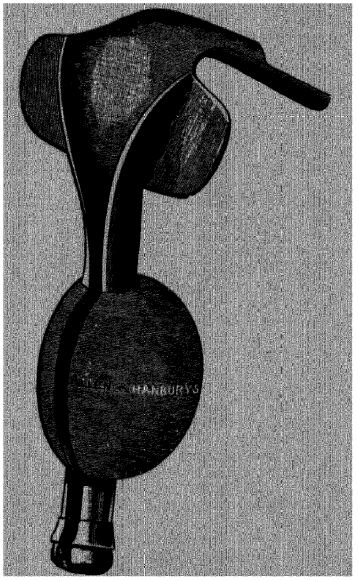


FIG. 443. AUVARD'S SELF-RETAINING VAGINAL SPECULUM. The shank of the speculum is weighted with a ball of lead, and channelled to allow of the escape of douche-fluids from the vagina.

conditions which are now generally recognized as indications for drainage are localized collections of pus, and imperfect hæmostasis in the operation area. It is impracticable to drain the whole peritoneal cavity by any method, because the drain becomes shut off by adhesions in a few hours it therefore only drains the locality in which it lies. In acute generalized peritonitis, drainage of certain selected areas may be advisable, *e.g.* the great peritoneal pouches such as the pouch of Douglas and the renal pouches The best material for drainage is rubber-tubing.

In pelvic surgery two *routes* for drainage are available, the vaginal route and the supra-pubic route. The former has certain advantages. (1) The drain-tract is the shortest possible, viz. between the pouch of Douglas, or the broad ligament, and the vaginal vault; (2) it secures the assistance of

gravity in the outflow of retained fluids; (3) it allows of the abdominal wound being completely closed, and thus obviates the risks of suppuration of the wound and later of scar-hernia which are inseparable from drainage by the supra-pubic route. The great disadvantage of the vaginal route is that we are draining into an infected canal, and the risks of secondary infection through the drain-tract are much greater than in the case of the abdominal route.

Figure 444 illustrates vaginal drainage being carried out during an abdominal operation. The vagina is opened by cutting down upon a pair of

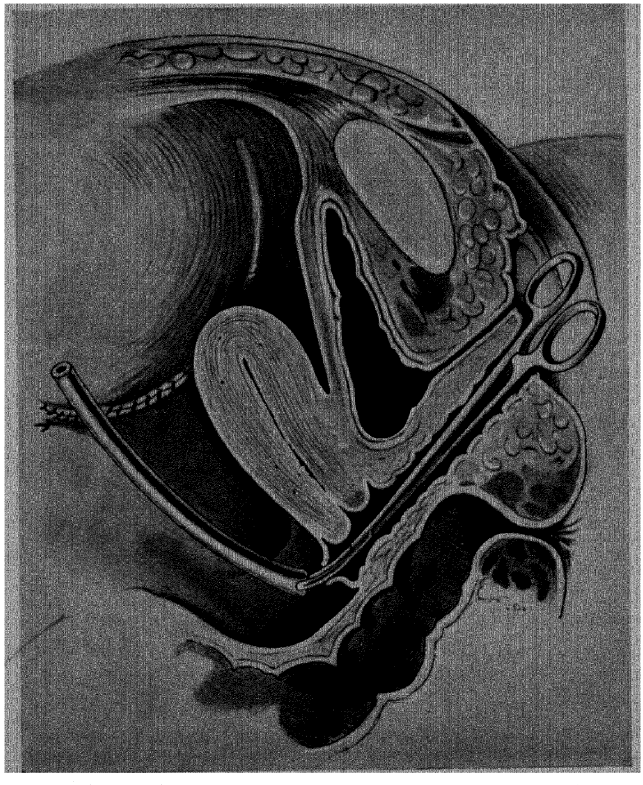


FIG. 444. VAGINAL DRAINAGE.

forceps passed into the posterior fornix and with these forceps the drain-tube is then drawn into position.

Closing the Abdomen. Before the abdomen is closed the operator must satisfy himself that all swabs, forceps, needles, etc., which have been in use during the operation are accounted for.

The parietal incision should be sewn up in layers; a fine continuous catgut suture may be used for the peritoneum, and a stouter one, or the same size doubled, which should be of hardened catgut, for the fascia; the skin and subcutaneous tissues may then be united by a continuous silk suture, or by interrupted stitches of silk or silkworm gut. When the layer of fat is of more than average thickness, a buried catgut stitch may also be

used to bring the deeper parts of this layer together, or two or three deep interrupted stitches may be introduced before stitching the fascia, to embrace all the tissues between the skin and the sub-aponeurotic layers. Many operators prefer to unite the skin with a fine *subcuticular* ligature which leaves no needle marks, or with Michel's clips. These methods give a less conspicuous cicatrix than when stitches are used.

The wound-dressings should be dry, absorbent, and aseptic; they must be retained firmly in position by a tight binder, the most convenient pattern being the "many-tail." When no drain is used, a collodion scab may be applied along the line of stitches which effectively excludes air from the wound.

ABDOMINAL OPERATIONS

MYOMECTOMY

Myomectomy *per abdomen* is an operation which embraces the removal of every type of fibroid tumour (subserous, interstitial and even submucous) without sacrificing the uterus. The technique of this operation has been so much improved in recent years that extensive enucleations which at one time would have been very dangerous are now made possible by employing the method of hæmostasis devised by Bonney. This consists in effectively controlling all the main arterial supplies (1) by ring forceps on the ovarian vessels in the infundibulo-pelvic folds, and (2) by similarly applying forceps to compress the uterine arteries against the cervix at the level of the isthmus. When arterial compression is efficient, the uterus becomes paler in colour, and even deep enucleations (see Fig. 445) and the opening up of the uterine cavity become well nigh bloodless procedures. This compression is maintained during operation until the suturing of the uterus is completed. When all the forceps are taken off, the uterus swells up, and some oozing points may be found to require additional sutures.

Bonney [1] advises the employment of a single anterior incision (Fig. 445 B) from which deep interstitial incisions are made to reach tumours in the lateral and posterior walls (Figs. 445 C, D and J). Wounds made in the posterior wall of the uterus would entail a risk of intestinal adhesions, lateral incisions would endanger the uterine vessels. On the other hand an incision in the anterior wall may be ventri-fixed if need be, and is safer in every way. When a tumour cannot be reached without opening the cavity, this is done and any abnormality of the endometrium dealt with at the same time (Figs. 445 E, H, L). Such technique entails rigid antisepsis, so that the vagina must be swabbed out with some strong antiseptic and the abdominal cavity and skin-edges protected with rubber sheeting. It is necessary to draw up and eventrate the uterus through the abdominal wound, and during the operation it should be covered with a sterile towel which has been rung out of hot saline solution.

The beds from which the growths have been removed are closed by mattress sutures of silk (Figs. 445 G and H), and for the superficial stitches a continuous catgut suture is employed (Figs. 445 F and K).

The *pros* and *cons* of myomectomy *versus* hysterectomy in the surgical treatment of fibroids have been extensively discussed in the literature. The

[1] "The Modern Scope and Technique of Myomectomy," Victor Bonney, *Jl. Obst. & Gyn. Brit. Emp.*, Vol. 29, No. 4, pp. 591–607, 1922.

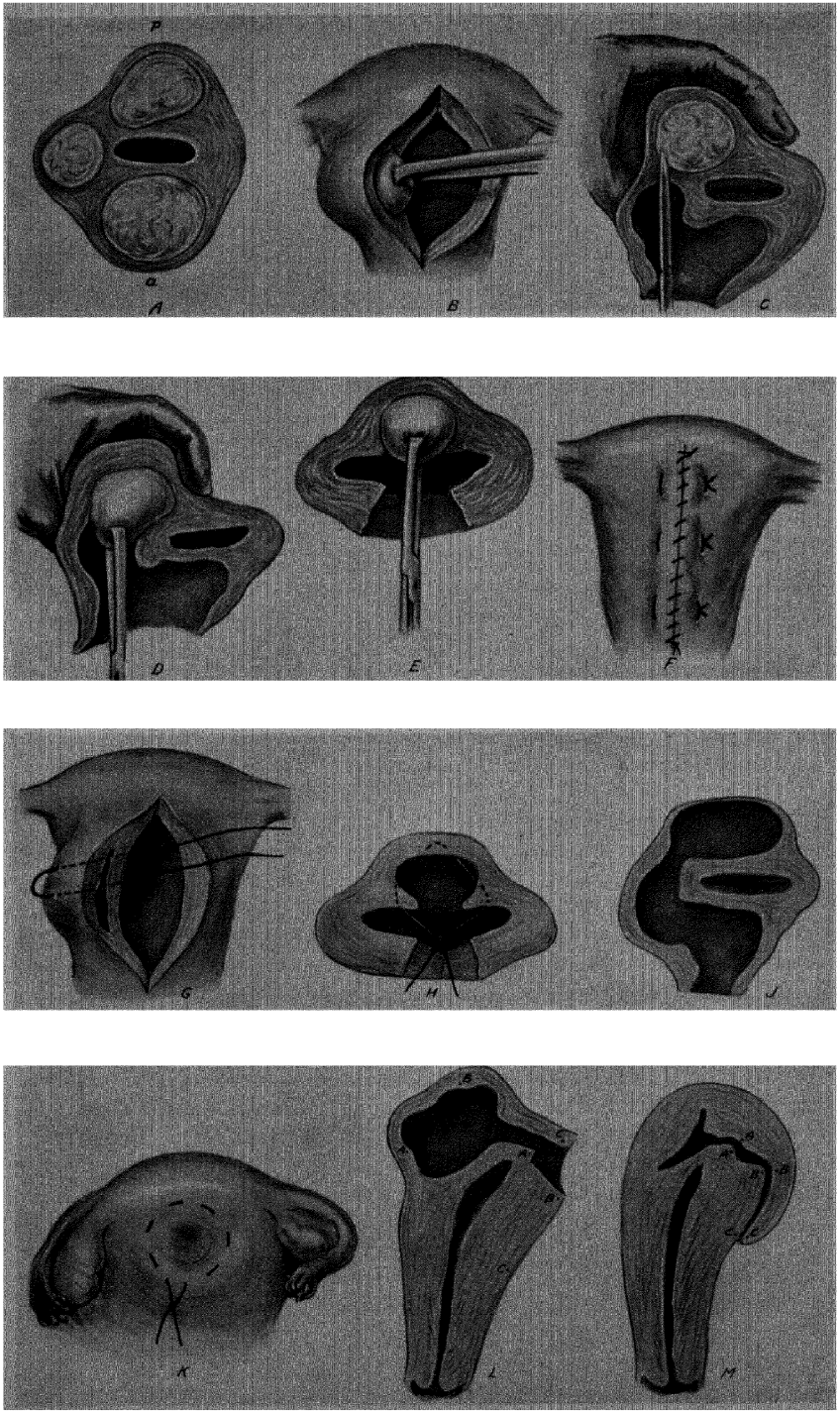


FIG. 445. MULTIPLE MYOMECTOMY through an anterior incision (after Bonney).

Figure A. Cross-section of uterus containing three fibroids. *a*. Anterior surface. *b*. Posterior surface.

Figure B. The same uterus, with the anterior fibroid already enucleated through an anterior incision; the lateral fibroid is being removed through a secondary incision.

Figure C. Scalpel attacking posterior fibroid through two former incisions.

Figure D. Index finger guiding direction of enucleation during traction by Vulsellum.

Figure E. A "trans-cavity" enucleation of a posterior fibroid.

Figure F. Anterior incision closed by sutures.

Figure G. Large anterior and small lateral enucleation-cavities: latter being closed by mattrass-sutures of silk.

Figure H. A posterior enucleation-cavity, closed by catgut sutures, passed from, and tied in, the uterine cavity.

Figure J. A posterior enucleation closely approaching the peritoneal surface of the uterine wall.

Figure K. A purse-string suture used to invaginate the thin tissue which separates a posterior enucleation cavity from the peritoneal cavity.

Figure L. The loose "hood" left after an enucleation performed through an anterior incision for a fibroid in the posterior wall of the fundus. The letters mark the points which are to be brought into apposition by mattrass-sutures

Figure M. Enucleation-cavity obliterated by the pulling forward of the "hood."

main point for the student to know is, that at the present time, there is very little difference in the mortality-risk of the two operations, it being about 1·5—2 *per cent.* for each. The choice of procedure will turn on whether the uterus can be saved as a fertile organ; a question largely determined by the patient's age, so that up to forty years of age myomectomy becomes the operation of choice. The chance of becoming pregnant has to be weighed in the balance against a 10 *per cent.* risk of fibroids subsequently developing, and a 20 *per cent.* risk of further menstrual trouble, and finally against the risk of a subsequent hysterectomy being necessary, which Giles gives as equivalent to 3 *per cent.* After the age of forty the pregnancy-factor drops out, and

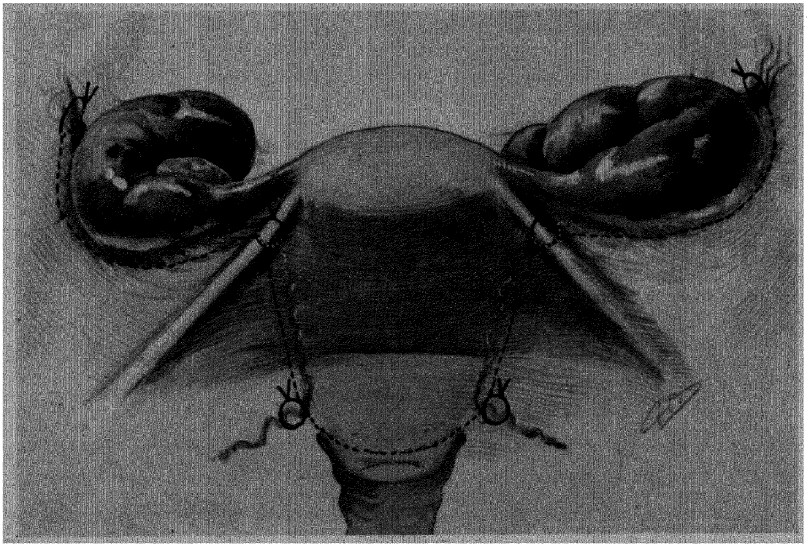


FIG. 446. SCHEME OF SUBTOTAL HYSTERECTOMY. (Supra-vaginal amputation.) In a case where both appendages are being removed.

hysterectomy becomes the operation of election, excepting for women who feel that the loss of the uterus would be a disaster.

SUBTOTAL HYSTERECTOMY: SUPRA-VAGINAL AMPUTATION

This operation consists in the removal of the uterus (with or without the appendages) by amputation through the cervix. The entire body and the greater part of the isthmus (supra-vaginal cervix) are therefore removed (*see* Fig. 446). It is extensively practised by English and American surgeons in the surgical treatment of fibroids of the body of the uterus, and some surgeons adopt this method of hysterectomy for cases of chronic metritis and also for cases of double pyosalpinx. The indications for the removal, at the same time, of one or both ovaries will depend entirely upon the state of these organs. They may be so involved in tubo-ovarian inflammation, or by co-incident new growth, as to necessitate their removal; but it should always be the aim of the surgeon to save as much ovarian tissue as possible, and when both organs are ablated a healthy portion should, if possible, be grafted within the sheath of the rectus muscle. Opinions differ widely as to the relative value of the two operations, *subtotal* and *total* hysterectomy (*vide*

infra). The preparatory steps as far as the laparotomy is concerned have already been mentioned.

With the abdomen opened, and with the operator standing on the right side of the patient, the tumour is drawn up into the wound and the intestines

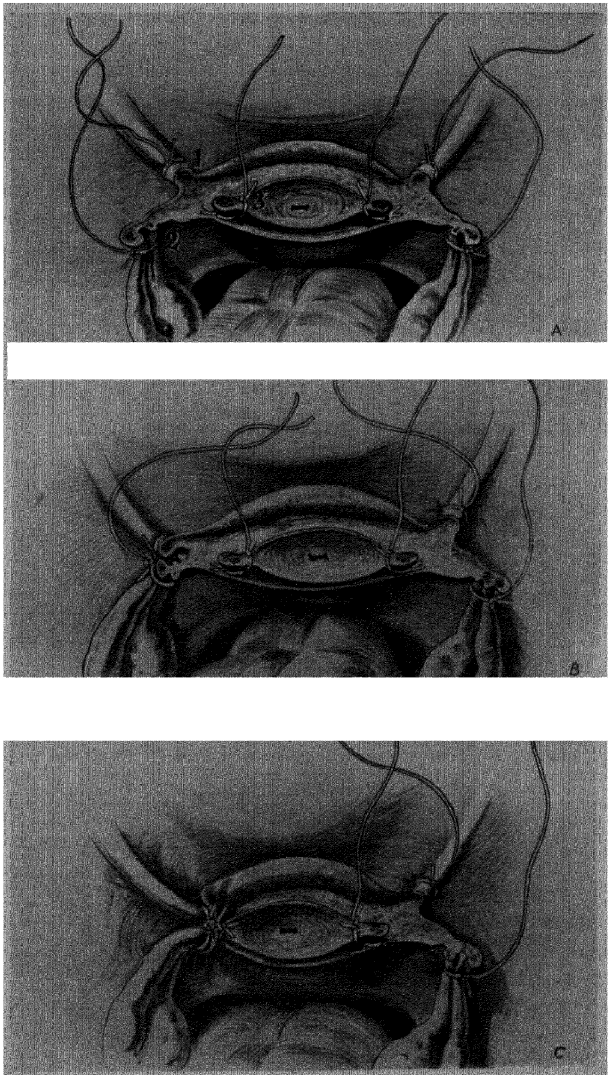


FIG. 447. Fig. A (1) Round ligament; (2) Fallopian tube and ovarian ligament; (3) corner of cervical stump. Fig. B shows (1) and (2) united. Fig. C shows (1), (2), and (3) united on the left-hand side of diagrams.

are then packed off with thin rubber-sheeting, taken out of sterile saline solution. A six-yard roll of gauze may also be used, if necessary, to assist in keeping the pelvic colon on the left and the cæcum on the right side from slipping round into the pelvic cavity should the patient strain during the operation. The advantage of applying the rubber sheeting first, is that it

does not stick to the intestines. The uterus having been drawn up, the appendages are examined, in order to decide whether it is necessary to remove one or both ovaries. In a case where both ovaries may safely be left *in situ*, the amputation of the uterus through the cervix proceeds as follows:

The operator draws the uterus and tumour to the right side. The left round ligament is divided between two clamps. Two more clamps are then applied to the remaining structures arising from the cornu, viz. to the Fallopian tube and to the ligament of the ovary, and these tissues are divided between the clamps. The assistant then raises the peritoneum of the utero-vesical pouch with toothed dissecting forceps, and the operator inserts one blade of the scissors under the peritoneum, and divides the fold from left to right, close to and across the front of the isthmus of the uterus. After division, the peritoneal flap is pushed down, together with the upper part of the bladder, by means of a swab in a holder. It will be found necessary to use a few snips with scissors in order to free the bladder in the midline.

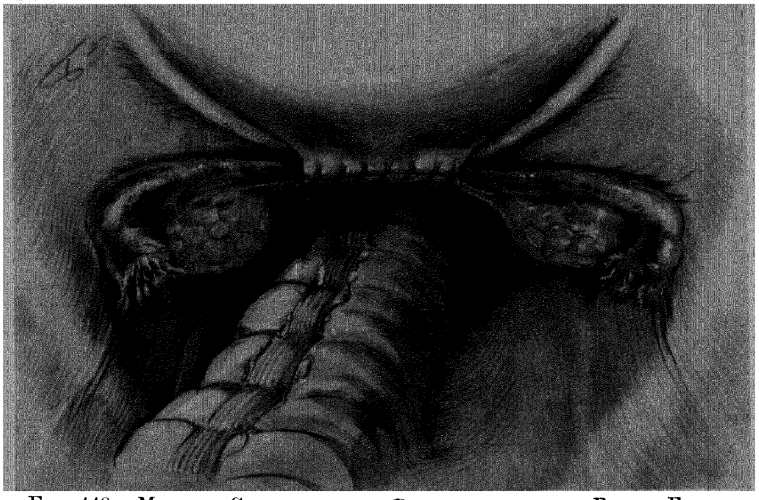


FIG. 448. MODE OF CLOSURE OF THE PERITONEUM IN THE PELVIC FLOOR.

The left uterine vessels are next exposed and isolated by passing a dissector between the vessels and the side of the cervix and running it up and down between the two. The isolated vessels are now clamped in two places about 1 inch apart with stout artery forceps, and then cut across. The appendages and vessels upon the right side are dealt with in the same manner, and when this is done the uterus is attached only by the cervix and by the peritoneum of the posterior uterine wall. The amputation through the cervix is made low down, to effect which, the uterus is drawn well up by the operator, who takes a swab in a holder and with it rolls the bladder downwards and the uterine vessels outwards. Then, with a scalpel, a V-shaped incision is made from front to back, the anterior cut running downwards and backwards through the bared cervix, and the posterior cut running downwards and forwards through peritoneum and cervix. Before the amputation is complete, the assistant grasps the cervical stump with a volsella, and when the uterus and tumour are removed, the stump is drawn up and the cervical endometrium is removed by a cone-shaped dissection of the centre of the

stump. The operator then inserts one or two mattrass-sutures of catgut through the shelving cervical flaps. When the cervical flaps are brought into apposition by suture, the latter are left long and the volsella removed. The uterine vessels are next tied off by inserting a ligature behind the clamp in each case. These ligatures are cut short as soon as they are tied, and an encircling ligature is now passed through the lateral wall of the cervix and made to include the uterine artery, thus bracing the latter to the cervical wall. Subsequently, the round ligament clamp, and those on the tubes and ovarian ligaments, are replaced by ligatures, the latter being left long for the time being. When all clamps are removed there remain three sets or pairs of long ligatures on either side of the pelvis. From above downwards they are those (1) on the tube and ovarian ligament; (2) on the round ligament; (3) on the corner of the cervical stump (*see* Fig. 447). One strand of each pair is now cut off, and of the remaining three each is united to the one lying next to it. Thus, the tubo-ovarian ligature is tied to that on the round ligament, and one of these to the ligature on the cervical stump. The tubo-ovarian ligature should be augmented by a second transfixion-ligature if there is the slightest degree of tension.

When the ligatures on either side are thus united, the cervix is held up at its corners by all the lateral structures which have thus been brought together. The peritoneal edges are finally apposed over the cervical stump by a running suture from left to right (*see* Fig. 448). The wound must be absolutely dry at the finish. The mattresses and rubber-sheet are now removed, and the abdomen closed as already described on page 668.

Figure 446, page 672, gives a scheme of subtotal hysterectomy in a case where both appendages are to be removed.

OMINAL HYSTERECTOMY: PANHYSTERECTOMY

tion the entire uterus is removed (with or without the appendages) by dividing the vagina close to its attachment to the cervix. It is definitely indicated in the surgical treatment of interstitial cervical fibroids (*see* Fig. 235, p. 391), where the cervix has been drawn up and expanded by the growth. It is the method of hysterectomy usually adopted when it is necessary to take the uterus away for cancer of the *body*, and in cases of double pyosalpinx. Many surgeons employ the *total*, to the entire exclusion of the *sub-total* method of hysterectomy. The advocates of *total* hysterectomy claim that it is the better operation (1) because carcinoma may develop in the portion of cervix which is left behind, some 300 cases having been recorded (*see* p. 410); (2) hæmostasis is better secured in the total operation. On the other hand, the total operation takes longer to complete —therefore where speed is a consideration, as in Cæsarean hysterectomy, the *subtotal* method is the best procedure. Total abdominal hysterectomy, performed as described below, was formerly employed for carcinoma of the cervix, but it has now given place to a more extensive operation introduced by Wertheim (*vide infra*). Before performing panhysterectomy it is essential that the vagina be systematically cleansed by antiseptic douches during two or three days preceding the operation. This should be supplemented by freely swabbing the *portio vaginalis* and vagina with a 2 *per cent.* solution of iodine just before the operation is begun, *i.e.* after the patient is anæsthetised.

In the description of supra-vaginal amputation both ovaries were retained. In describing panhysterectomy the removal of the adnexa will

be included. In cases of fibroid tumour the ovaries are not removed unless they are diseased, but for carcinoma of the body the tubes and ovaries are removed in the operation of panhysterectomy, as a matter of routine.

When the ovaries are to be removed, the round ligaments are tied off and divided, and the *infundibulo-pelvic folds* are then clearly defined by gentle traction on the outer half of the Fallopian tube, which can be done by the assistant. If on the left side the sigmoid is found adherent to the free edge of the broad ligament by accessory peritoneal folds, these are carefully divided with scissors and the bowel pushed back. With the left thumb and index finger the ovarian vessels are grasped whilst a ligature is passed from within outwards through the avascular thin portion of the broad ligament, which lies internal to the ovarian vessels. The latter are then tied and the ligatures cut short. This is done on both sides and then the operation proceeds as already described, excepting that it is better for a beginner to ligate, rather than clamp, the vessels at every stage, because with the increased depth of the wound it may be found that a number of large forceps will get in the way. In an easy case this exception is not

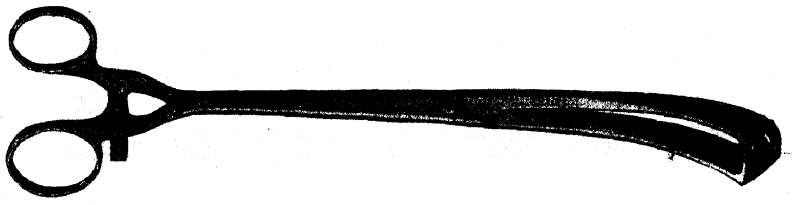


FIG. 449. STOUT VOLSELLA WITH A LATERAL CURVE.

essential, as is shown in Figure 450, where clamps are employed throughout. After ligating the left uterine vessels, the connective tissue and ureter are pushed downwards and outwards by firm pressure applied by a swab in a holder which is pressed against the lateral wall of the cervix. The uterus is now drawn forcibly upwards by means of a stout volsella with a lateral curve (*see* Fig. 449). This instrument should be applied to the lateral wall of the isthmus (supra-vaginal cervix). Traction by means of the volsella puts the parametrium on the stretch, and as the uterine vessels and ureter have already been displaced, the parametric tissues may be clamped by forceps. Two clamps grasp the utero-sacral ligament which is divided between them (*see* Fig. 450 [3]). A second pair of clamps are applied to the utero-sacral ligament on the opposite side, which is then likewise severed. The scissors are then inserted on the flat under the peritoneum at the back of the uterus and pushed across from right to left, from one cut utero-sacral ligament to the other (*see* dotted line in Figs. 450 and 451). The peritoneum thus freed is then divided, and the rectum, which is thereby exposed, is pushed down by breaking through its loose attachment to the vagina. A third and fourth clamp are now used to grasp the lateral parametric tissues on either side of the cervix. This lateral parametric tissue is then divided by keeping the scalpel close to and by

cutting on the cervix. The deep lateral dissection is carried down on either side, until the vagina is reached, a point which is easy to notice, because the vaginal walls are laxer and less resistant than the cervix. As to where the vagina is to be opened is a matter of choice; some operators open it in front, others at the side. The latter has the advantage of allowing the lateral incision to proceed until the vagina is cut into, when its vascular lateral angle can be clamped and drawn up, whilst the remainder of the

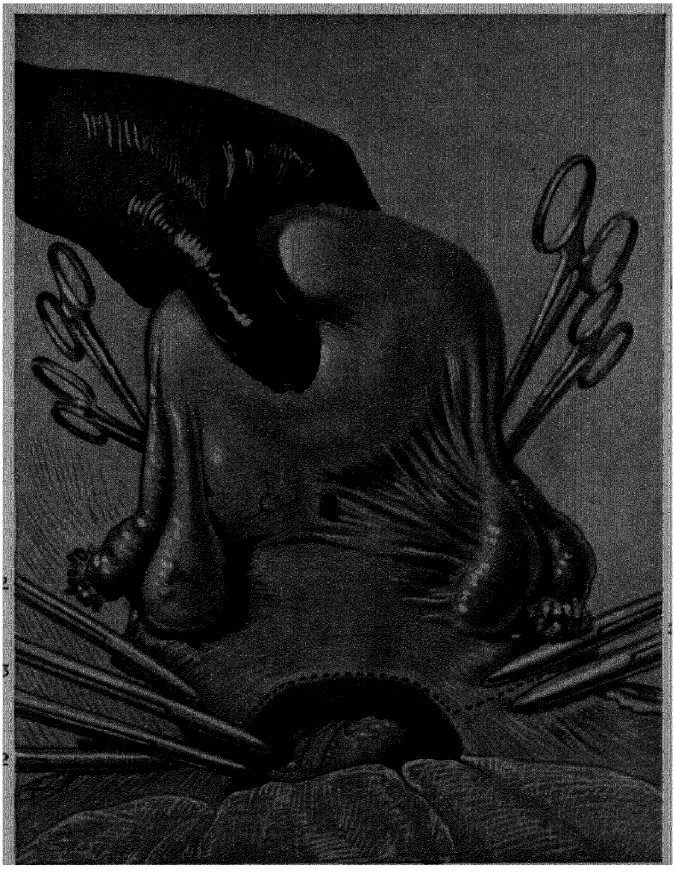


FIG. 450. TOTAL ABDOMINAL HYSTERECTOMY. On the left side the infundibulo-pelvic fold has been divided. The utero-sacral fold is clamped ready for division. 1 = Forceps on round ligament. 2 = Forceps on infundibulo-pelvic fold. 3 = Forceps on utero-sacral fold.

vagina is divided from left to right first along the anterior, and then along the posterior, walls. When the vagina is divided its edges should be caught by four clamps, one on the centre of the anterior wall, one on the posterior, and one on each lateral angle. These clamps are immediately replaced by ligatures which are left long and brought together in one pair of forceps. By leaving these ligatures long they may be used as temporary tractors, and serve to keep the walls of the patent vagina in apposition for the time being. The utero-sacral clamps, and those on the parametrium, are next

replaced by ligatures which may be transfixed in the tissues to prevent them from slipping off. The entire deep area is now carefully examined for oozing-points. When the raw surfaces are quite dry, the closure of the pelvic connective tissue is begun. The round ligaments are sewn to the corners of the vagina, and the original vaginal sutures which were in use as tractors are tied and then cut short. The peritoneum is next brought together by a running glover's stitch from left to right. When there is a good supply of peritoneum in the flaps, this membrane can be easily brought together by means of a purse-string suture, a method adopted by Spencer. It is a very rapid means of restoring the peritoneal floor of the pelvis, but when it is done, the lateral vaginal angle is tied to the parametric suture, instead of to the round

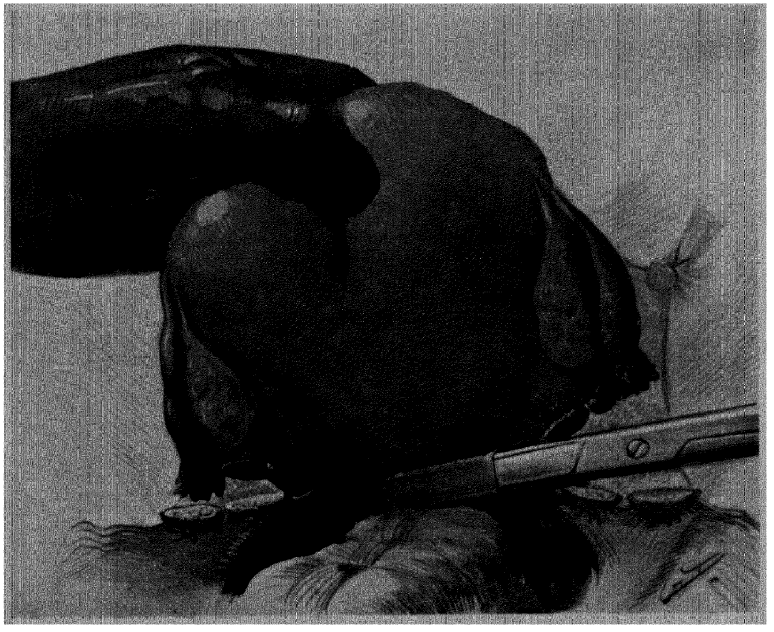


FIG. 451. TOTAL ABDOMINAL HYSTERECTOMY. The infundibulo-pelvic and the utero-sacral ligaments are ligatured on both sides; the clamps have been removed. The peritoneum is being separated from the posterior uterine wall.

ligament, as a means of support. Finally, the omentum is drawn down so as to cover the small intestines; instruments and swabs are counted, and the abdomen is then closed.

Special Methods of Hysterectomy

(*a*) **Kelly's Supra-vaginal Amputation by Continuous Incision from one side to the other.** This is the most rapid method of performing subtotal hysterectomy, and when the ovaries can be saved it can be carried out most expeditiously by the use of clamps to control the vessels, no ligature being applied until the uterus is removed. Forci-pressure is not advisable, however, for securing hæmostasis when the ovaries are to be taken away with the uterus, as they may slip off the infundibulo-pelvic fold during subsequent manipulations, especially when applied far back near the pelvic brim. In

such cases, before incising the mesosalpinx it is best to tie the ovarian vessels in the manner already described (*see* Fig. 446, p. 672).

Kelly's rapid method of continuous incision may be used for straightforward uncomplicated cases of hysterectomy, *i.e.* where the uterus can be drawn well up into the wound; it is also better adapted to meet the difficulties of dealing with an intraligamentary or retroperitoneal fibroid, than is the form of subtotal hysterectomy already described. Two clamps are applied to the left appendages at the cornu uteri, and these structures are then divided between them with a scalpel: the left round ligament is treated in the same way; the vesical peritoneum is divided and pushed down together with the fundus of the bladder. The left uterine vessels are then divided between forceps and the cervix cut straight across from left to right,

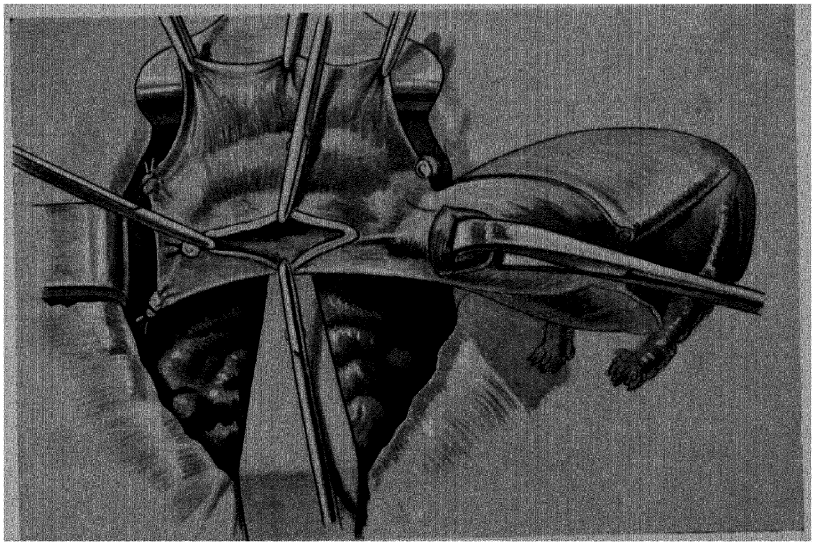


FIG. 452. TOTAL ABDOMINAL HYSTERECTOMY BY THE TRANSVERSE METHOD. The vagina has been opened and the cervix pulled up by a volsella. The clamps which are attached to the edges of the vagina are replaced by traction-ligatures as soon as the uterus is removed. The right uterine artery has not yet been severed.

until it hangs by the right broad ligament. The latter, which includes the right uterine vessels, is seized with a pair of curved museaux, or with Moynihan's cholectomy forceps (*see* Fig. 454), whilst the uterus and tumour are rolled still further to the right and dragged up (*see* Fig. 453). The only attachments still to be divided are the right appendages. These are clamped and severed from below upwards.

(*b*) **Doyen's Panhysterectomy.** This is a modification of the classical method of performing total hysterectomy. After drawing the uterus well up and packing off the intestines, the tumour and uterus are held forwards to obtain a good view of the lower part of the posterior uterine wall. The *posterior vaginal fornix* is then opened, and the cervix is thus exposed from behind. With a stout volsella the cervix is drawn through the opening in the vagina, and its attachments to the vagina, laterally, and in front, are

severed from below upwards. The utero-vesical pouch is divided, the uterine vessels are clamped and divided, and finally the appendages are treated likewise. The operation is carried out entirely from below upwards.

(*c*) **Pryor's Total Hysterectomy.** By this method the surgeon proceeds as is done in Kelly's continuous left-to-right subtotal hysterectomy, excepting that the lateral dissection is carried further down so as to allow the line of amputation to pass across the vagina instead of through the substance of the cervix. It is the most expeditious manner of performing panhysterectomy.

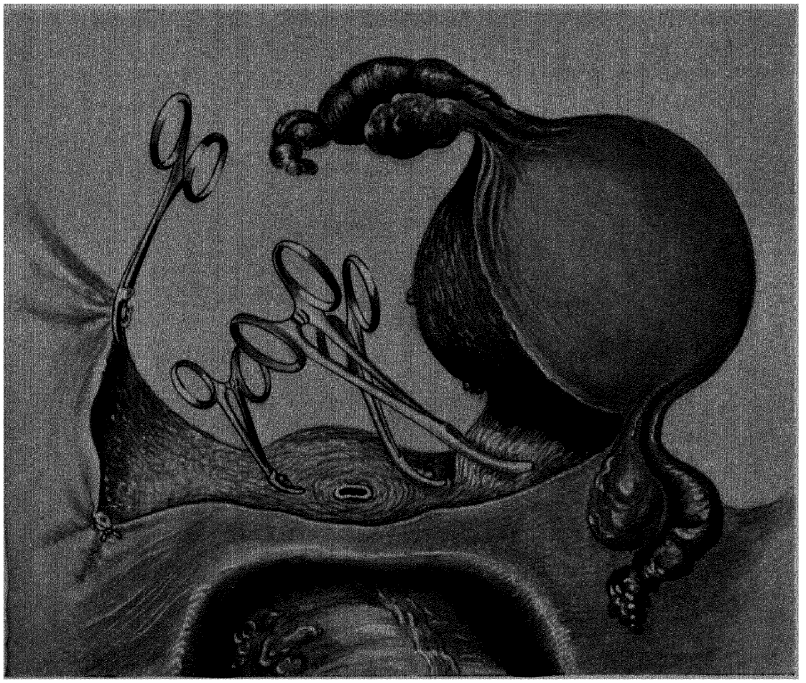


FIG. 453. ABDOMINAL SUBTOTAL HYSTERECTOMY BY KELLY'S METHOD. The left ovarian vessels and the round ligament were ligatured before division. Clamps are shown on the uterine arteries.

The Radical Abdominal Operation for Carcinoma of the Cervix: Wertheim's Operation

The principle upon which this operation is based consists in the removal of infected cellular tissue and glands, and also of *enough of the vagina to form a capsule for the enclosure of the malignant cervix*. This is effected by clamping the vagina below the level of the growth and dividing the vaginal walls at a still lower level.

Abdominal hysterectomy for cancer of the uterus has been practised since 1878. In 1896 Clark successfully carried out the operation of removal of the uterus and its appendages, with the pelvic cellular tissue, and with the lymphatic glands as high as the bifurcation of the common iliac vessels. Wertheim was the first to recognize the necessity of diminishing the *risk of cancer-implantation* on the raw surfaces, and to obviate this danger he devised the plan above mentioned, hence the operation, as now performed,

goes by his name, although many minor details in the technique have been modified from time to time.

The operation is essentially one for the specialist; this is clearly shown by the high primary mortality (deaths due to operation) as compared with that incurred in total hysterectomy performed for benign tumours.

When discussing the treatment of cancer of the cervix in the last edition of this work we instituted a comparison between the extended abdominal operation as devised by Wertheim, and the extended vaginal operation as practised by de Ott in St. Petersburg and Schauta in Vienna. During the past six years the only operation which has held the field is the one based on the principles laid down by Wertheim. Radiotherapy has now become so extensively employed that we are beginning to foresee that its claims will rival, if not actually supersede, those of surgery. An authoritative pronouncement on the relative claims of surgery and radiotherapy cannot be made at the moment, but we are fortunate in this country in being provided with a most complete record of what can be accomplished by surgery alone

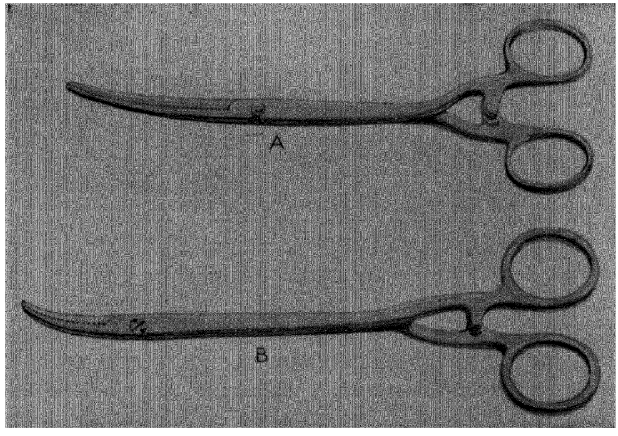


FIG. 454. A, Museaux forceps; B, Cholectomy forceps.

in the hands of the expert gynæcologists, and without invoking the aid of radium or X-rays.

Bonney's results in 214 operations show that the great drawback to the extended operation—that of high primary mortality—has not been overcome. In 1913 Wertheim's last 214 operations resulted in a 12·1 *per cent.* mortality. In a series of 214 cases published by Bonney in 1926, the operative mortality for the whole series was 15·8 *per cent.*, the first 100 cases yielding 20 *per cent.*, and the last 114 cases 12 *per cent.* mortality. In 112 cases operated on by one of us between 1905 and 1925 (C. L.), the operative mortality for the whole series amounted to 14·2 *per cent.* In Fletcher Shaw's series of 76 cases, the number of deaths due to operation was 16, or 21 *per cent.* In our opinion the performance of a thorough operation for advanced cases cannot be expected to yield a primary mortality of less than 12 *per cent.* It may be claimed with justice that if left untreated, many of the cases operated on would only live for a few months, but the main justification for taking such a big operative risk must be sought for in the late results of the operation. Tables of recurrence after operation show that if the case remains

free for two years, the risk of subsequent recurrence after this period is greatly diminished; but it seems never to be entirely excluded, since we have known freedom for fifteen years to be followed by recurrence in the vaginal vault (C. L.). Wertheim found that 41·3 *per cent.* of those who survived the operation were free from recurrence after five years, and reckoning on the same basis, Bonney's figures are 85 free in 214, or about 40 *per cent., i.e. less than one-half of the survivors are cancer-free after five years.* Carried further, the latter authority found, as did Weibel, that of those who survived five years, 7 or 8 *per cent.* recurred between the sixth and seventh years. In other words, the number of survivors after this period is roughly one-third. In Bonney's series of 214 cases there are three women known to be alive and well sixteen to nineteen years after operation. In our series of 112 cases (C. L.) one is alive and well after twenty years, one recurred in the fifteenth year but cleared up under radium, and has remained free of growth for three years[1]; three more are free after fifteen years, and one after twelve years. It may therefore safely be said that the risk of recurrence is very slight after ten years.

The student is referred to the section on Cancer of the Cervix (pp. 495–498) in order to compare the results above stated with those which have been obtained by radiotherapy alone. It is necessary to mention here that our own practice is to employ radium both before and after operation in the treatment of cervical cancer.

The Operation. When the case is advanced the patient is kept in bed for a week or ten days in order to employ means of rendering the cervix and vagina as clean as possible, and also to improve the state of health generally. With a sloughing growth accompanied by offensive discharge it is customary to apply the actual cautery under anæsthesia, and to scrape away as much of the necrotic tissue as possible. This is followed by peroxide of hydrogen (10 vols.) douches, and by the application of acetone and iodine to the raw surface. After this is done, a sound should be passed to explore for a possible pyometra, which, if present, is drained, and then 100 mg. radium bromide is introduced into the cervical canal, and also a variable number of needles of 5 mg. strength are inserted into the edges of the cancerous tissue (*see* Fig. 311A, p. 497). The irradiation is continued for twenty-four hours. The major operation should not be postponed for longer than a fortnight after the above preliminaries have been carried out. Immediately before the operation, the vagina is swabbed out with 2 *per cent.* iodine solution, and packed with sterilized gauze, an end of which is left outside the vulva.

With the patient in the high pelvic position, and the abdomen opened from above the umbilicus to the pubic bone, a careful exploration of the pelvic cellular tissue and lymphatic glands is first made. Then stout silk ligatures are passed under the adnexal structures close to the cornua uteri; these when knotted serve as tractors (*see* Fig. 458). The uterus is now drawn up and the utero-vesical pouch examined. Here the peritoneum may be found to be puckered and abnormally adherent. The first step in the operation then should be to raise the peritoneum and investigate the relation of the growth to the base of the bladder. If it is found that the growth has deeply implicated that viscus, the peritoneal wound should be closed and the operation should not be proceeded with. If this preliminary investiga-

[1] This case seen in June, 1927, was found to have some induration in the walls of the urethra, into which a needle containing 10 mg. RaB^r was inserted.

tion proves favourable, the infundibulo-pelvic and round ligaments are tied off, and the ends of the tubes are tied to the cornua so as to keep these structures folded out of the way (*see* Fig. 455). The cut edges of the broad ligament on one side are opened up by the fingers, and the ureter is sought as it runs on the posterior leaf of peritoneum between the pelvic brim and the cervix. This cord-like structure is best found by taking the sheet of peritoneum between finger and thumb, when it will be appreciated as a

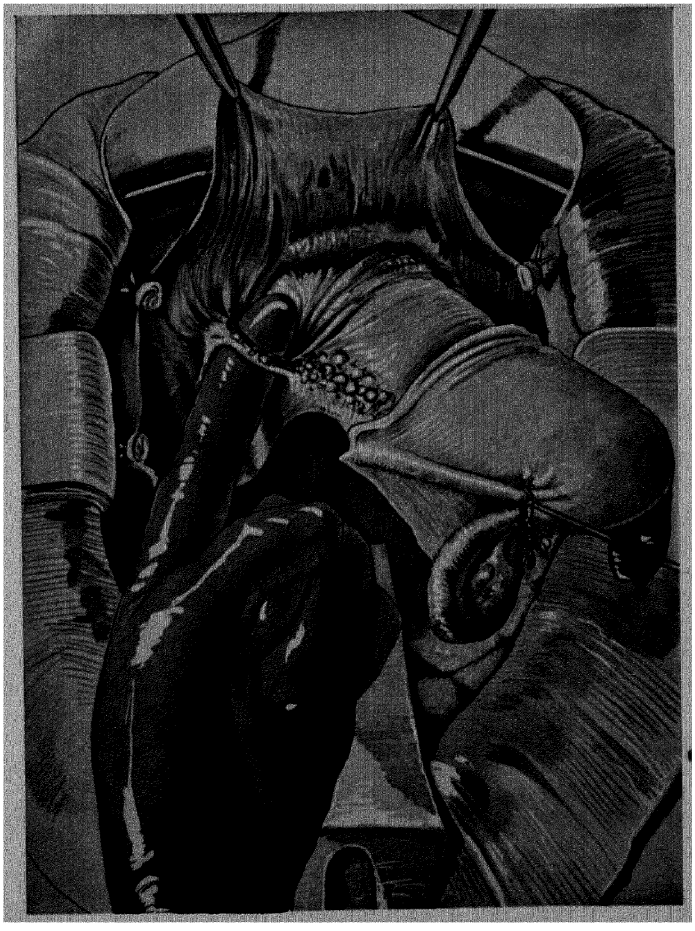


FIG. 455. ABDOMINAL TOTAL HYSTERECTOMY FOR CANCER OF THE CERVIX. Method of isolating the uterine artery.

firm cord the average size of a slate-pencil, but varying considerably in thickness. When the ureter has been identified, it is traced forwards from the brim of the pelvis behind to the cervix in front, at the side of which it enters the *ureteric canal* beneath the uterine artery. At this stage the bladder is dissected off the front of the cervix in the manner already described. When this is done, it is also necessary in many cases of advanced carcinoma to push it down from the antero-lateral aspect of the cervix; many venous points have to be caught up during this dissection. When the bladder has been displaced, its peritoneal covering may be stitched up to the lower

angle of the abdominal wound, or held forwards with forceps (*see* Fig. 455). Attention is then again directed to the ureter. The left index finger is passed through the ureteric canal and brought out in front of the uterine artery between it and the bladder (*see* Fig. 455). The finger always carries before it a thin tough sheet of cellular tissue which has to be teased apart on the apex of the finger before the latter is freed. When this is done, a ligature is passed under the uterine artery and this vessel is tied as far out towards the pelvic wall as possible. Before tying this ligature the ureter

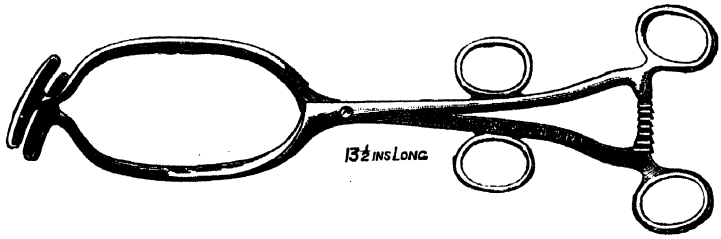


FIG. 456. Berkeley's Vaginal Clamp.

must be traced along its whole course to the bladder, in order to make sure that it is completely freed from the artery which is about to be tied. After the ligature is tied the artery is divided, and then a complete view of the exposed ureter along the whole of its pelvic course can be demonstrated (*see* Fig. 458). The ureter is now rolled off the cervix and side of the vagina with a gauze swab. The same procedure is carried out on the opposite side. (Should any glands be met with between, or overlying, the vessels, these should be removed. It is sometimes necessary to do so before the ureters can be exposed.) The uterus during the next stage of the operation is drawn

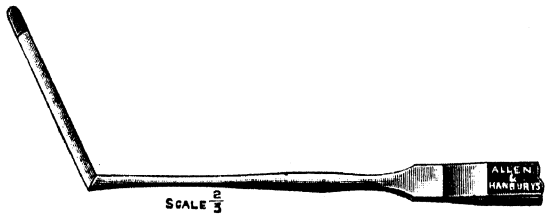


FIG. 457. Bourne's "Vaginotome."

up and carried forwards. The utero-sacral folds are clamped and divided, the peritoneum at the back of the vagina is cut across and the rectum pushed back. Next the parametric tissues on both sides are clamped with specially strong forceps devised by Wertheim for the purpose (*see* Fig. 460). When these tissues are divided, the uterus is drawn forcibly upwards in the direction of the upper angle of the wound and the T-shaped vaginal clamp devised by Berkeley applied (*see* Fig. 459). Before so doing it is necessary to raise the bladder with a wide flat retractor, and at the same time to define the ureters as they enter that viscus. They must lie well outside the curve of the clamp. After the vaginal clamp has been applied and tightly closed it is possible in some cases to place a third wide clamp on the vaginal walls lower down. The vagina is then amputated between the

clamp above and the clamp below.[1] Thus, after amputation of the vagina and removal of the uterus the vaginal passage is still closed by the lower clamp, and the closure may be made complete by oversewing the free edges which project beyond the clamp. When this is done the clamp is removed. The clamp used for closing the vagina above converts the latter into a sac, which encloses the cancerous cervix and thus prevents the dissemination

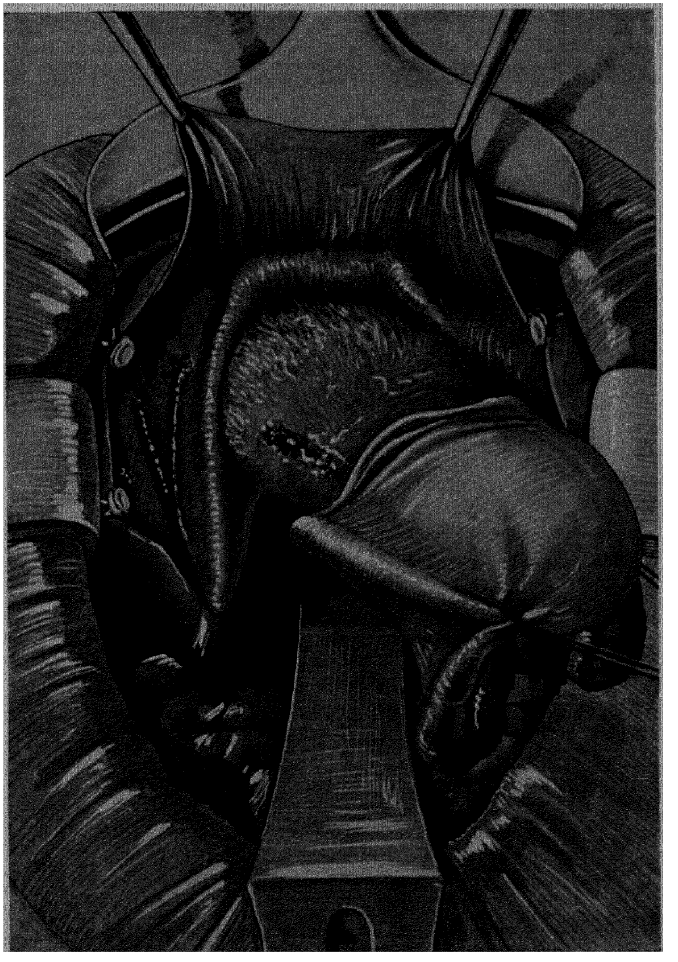


FIG. 458. ABDOMINAL TOTAL HYSTERECTOMY FOR CANCER OF CERVIX. Ureter exposed in the whole of its pelvic course.

of cancer-cells. If it is desired to leave the distal portion of the vagina open for drainage the lower clamp is not applied, but as soon as the vagina is amputated its edges are picked up and the two lateral angles which bleed freely are at once tied. The parametric tissues are transfixed and tied behind the clamps, and the latter are then removed; the same is done to the utero-sacral folds.

[1] This is most easily done by the use of a curved bistoury devised by Aleck Bourne and called by him "Vaginotome." See Figure 457.

The wound is now examined for oozing-points, which when found are caught and tied off; a further search is made for glands and then the raw surfaces are covered by closure of the peritoneum in the way already described. When the vagina is left open no gauze is inserted into the deep cellular tissues or into the vaginal canal.

OVARIOTOMY

The name *ovariotomy* is applied, by time-honoured custom, to the operation for the removal of an ovarian tumour, and must be distinguished

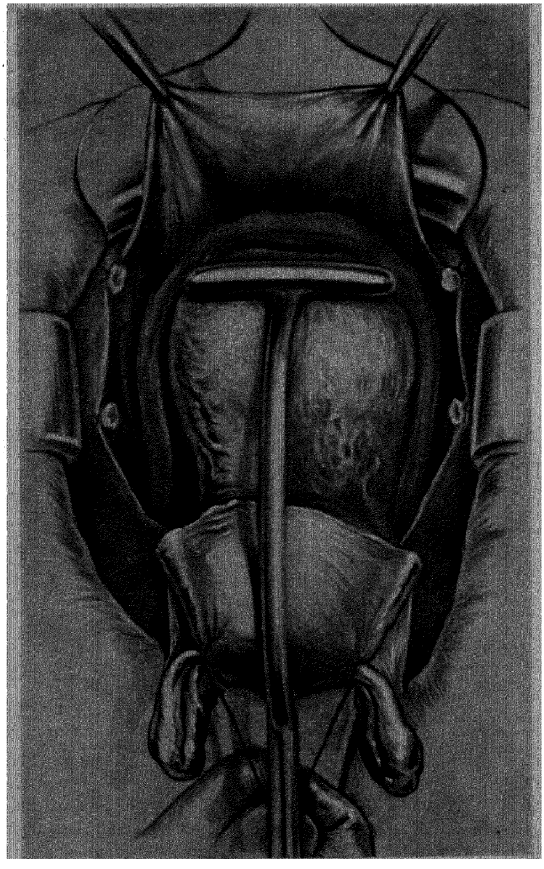


FIG. 459. ABDOMINAL TOTAL HYSTERECTOMY FOR CANCER OF CERVIX. Vaginal clamp applied. (The parametric clamps are omitted for greater clearness.)

from oöphorectomy, which is the term used for the removal of an ovary, not the seat of a new growth.

Indications. It has been already stated that all ovarian tumours should be removed as soon as the diagnosis of their presence has been made. In the case of bilateral innocent tumours a portion of follicle-bearing ovarian tissue can sometimes be conserved upon one side or the other.

Steps. The essential steps in this simple operation are the delivery of

the tumour through the incision, the division of the pedicle, the control of its vessels, and the peritonisation of the raw surface. Tumours of small size can be turned out of the abdomen entire through a median incision of four to five inches in length; the pedicle can then be examined and secured under direct observation. Should the tumour have contracted adhesions, these

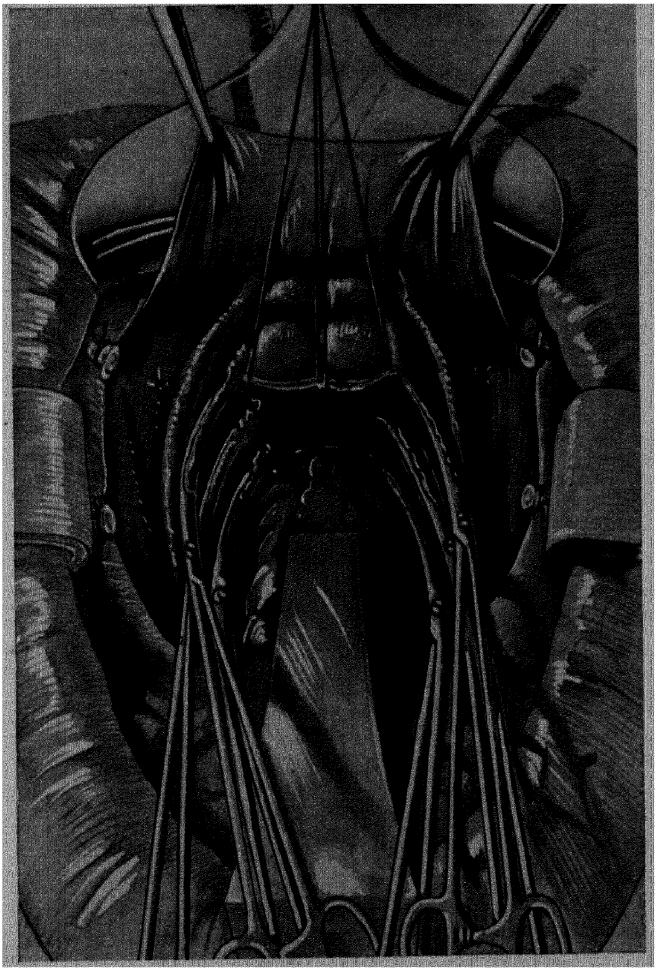


FIG. 460. ABDOMINAL TOTAL HYSTERECTOMY FOR CANCER OF CERVIX. Uterus removed. The vaginal walls are held up and brought into apposition by three long sutures, but the canal is not closed by the sutures. The posterior pair of clamps is on the utero-sacral folds. The two anterior pairs are on the parametrium.

must be divided and the growth must be completely liberated and brought out of the wound, so that the pedicle may be defined, before anything further is done. Recent adhesions to the parietal peritoneum can be readily and safely separated with the fingers. Adhesions to omentum or intestine must be carefully dealt with under direct observation and not by touch alone. Large vessels which require ligature may be found in omental adhesions;

intestinal adhesions, though they may ooze freely when torn through, seldom give rise to troublesome bleeding unless the muscular wall of the bowel has been lacerated. Infected and suppurating cysts may become so densely adherent to bowel, that separation of the two is impossible. In order to avoid injury to the gut, it is then best to cut into the cyst-wall so as to leave a thin layer of it attached to the bowel. Cystic tumours too large to be turned out through a subumbilical incision may be safely reduced in size by tapping, if the following conditions are complied with: (1) the tumour is unilocular,

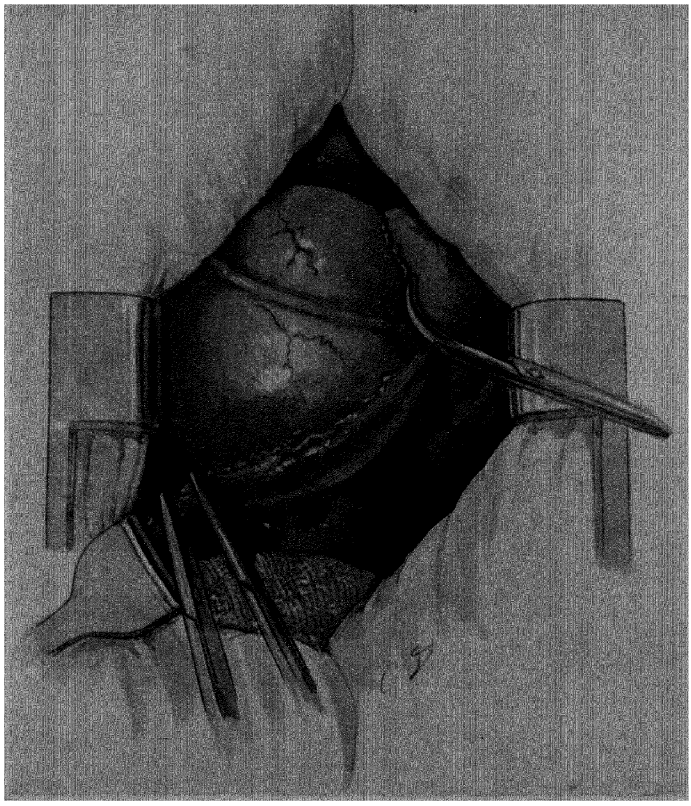


FIG. 461. CYST OF THE BROAD LIGAMENT EXPOSED *in situ*. The ovarian vessels in the infundibulo-pelvic fold have been clamped with two forceps; the anastomic artery is also clamped at the uterine cornu. The round ligament crosses the front of the cyst.

or there is a large loculus in the cyst containing a considerable amount of fluid; large tumours composed of an aggregation of small loculi cannot be tapped; (2) the pedicle is not twisted, nor is the tumour extensively adherent —conditions under which the contents may have been infected; (3) there is no clinical condition which raises a suspicion of malignancy. Alternatively, an incision must be made large enough to allow of the complete eventration of the tumour, for the reason that the escape of ovarian fluid into the peritoneal cavity, which is difficult to avoid completely during tapping, may be followed by serious results. Even in the case of innocent cysts it is

important to avoid fouling of the peritoneum and the wound-surfaces with the cyst-fluid. This may contain epithelial cells capable of becoming implanted and developing into small cysts. Such an occurrence in the abdominal wound has been recorded. In tapping, care should therefore be taken to carry off the fluid through a rubber-tube attached to the cannula, and to avoid leakage at the point of puncture.

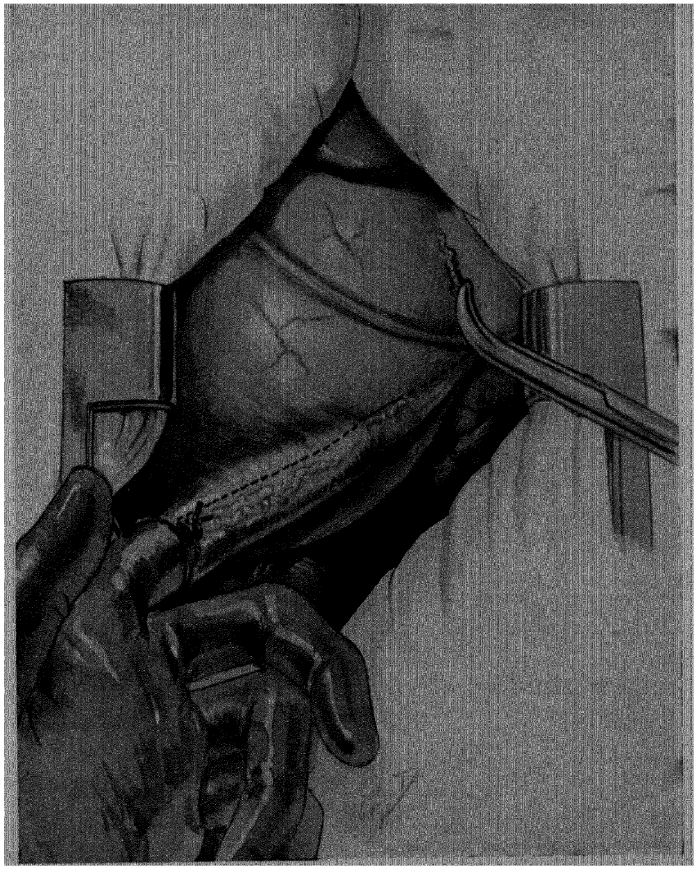


FIG. 462. CYST OF THE BROAD LIGAMENT EXPOSED *in situ*. The ovarian vessels have been divided, opening the cellular-tissue space, and the finger has been pushed towards the uterus beneath the capsule of the cyst, which is to be divided along the interrupted line.

When the collapsed tumour has been drawn out of the abdomen, the pedicle is clamped with two or three pairs of artery-forceps, and then divided between the clamps and the tumour. When long and thin, the pedicle may be transfixed with a blunt needle midway between the uterus and the infundibulo-pelvic fold where the broad ligament contains few if any vessels, and secured with a ligature tied at each side, the outer embracing the ovarian vessels, the inner the ovarian ligament and Fallopian tube. A thick broad pedicle should, however, be secured in sections, which can be transfixed

and tied off as the clamps are removed. Special attention should then be paid to the ovarian ligament, which must be under-stitched separately (*see* Fig. 466); it retracts a good deal when divided, and as a vessel of considerable size (the anastomotic branch of the uterine artery) accompanies it, dangerous hæmorrhage may occur from slipping of the ligature. Securing the pedicle in sections is preferable to embracing a considerable thickness of tissue with stout ligatures, for it gives more secure control of hæmorrhage,

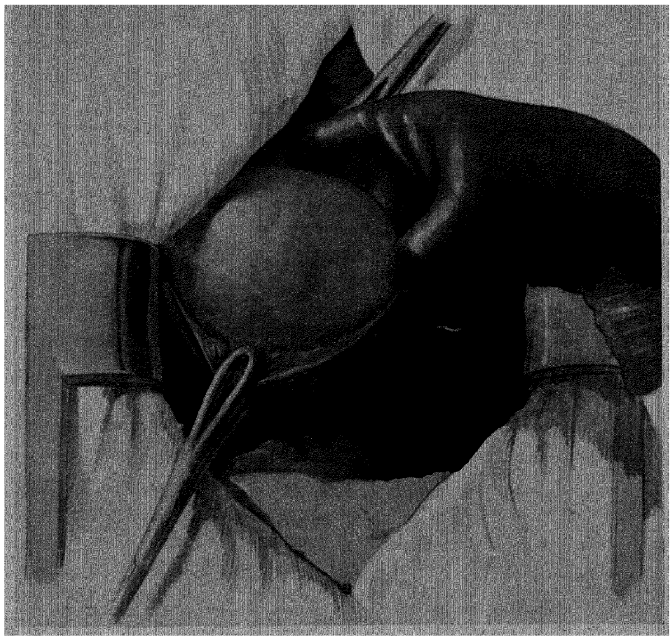


FIG. 463. SHELLING THE BROAD LIGAMENT CYST OUT OF ITS BED WITH THE FINGERS.

and does not strangulate the included tissues, or limit the future mobility of the uterus. The ovary of the opposite side should be carefully examined before the abdominal incision is closed, for in many cases a second smaller tumour is found, the existence of which was previously unsuspected.

Finally, the raw surfaces of the pedicle should be sewn over with a running stitch of fine catgut or thread, to prevent the formation of adhesions, which are so apt to result from the exposure of a raw area within the peritoneal cavity. Further, a certain amount of oozing occurs from all raw surfaces, and experience shows that a dry peritoneum is a very important factor in securing normal convalescence after an abdominal operation. When dealing with bilateral cystic tumours in young women, it is desirable to retain a portion of normal ovarian tissue if such exists. Pseudomucinous cysts and cystic teratomata may be dealt with thus, when no suspicion of infection or of malignancy is present. Follicle-bearing tissue can often be recognized near the attachment of the ovarian ligament, and this may be preserved when dividing the pedicle. All oozing from the raw ovarian tissue must then be carefully controlled with fine stitches.

Removal of Broad Ligament Cysts. Occasionally these cysts develop in an upward direction and become provided with a definite pedicle, when they can be dealt with in the same manner as an ovarian cyst. Usually, however, they develop in a downward direction, their base resting on the pelvic floor, their sides and summit being covered with the widely separated layers of the broad ligaments. Stretched over the tumour are the round ligament and the Fallopian tube with a wide interval between them (*see* Fig. 461); on the posterior aspect the ovary may sometimes be found intact, — although at other times it is unrecognizable. Such a growth is dealt with by enucleating it from its bed.

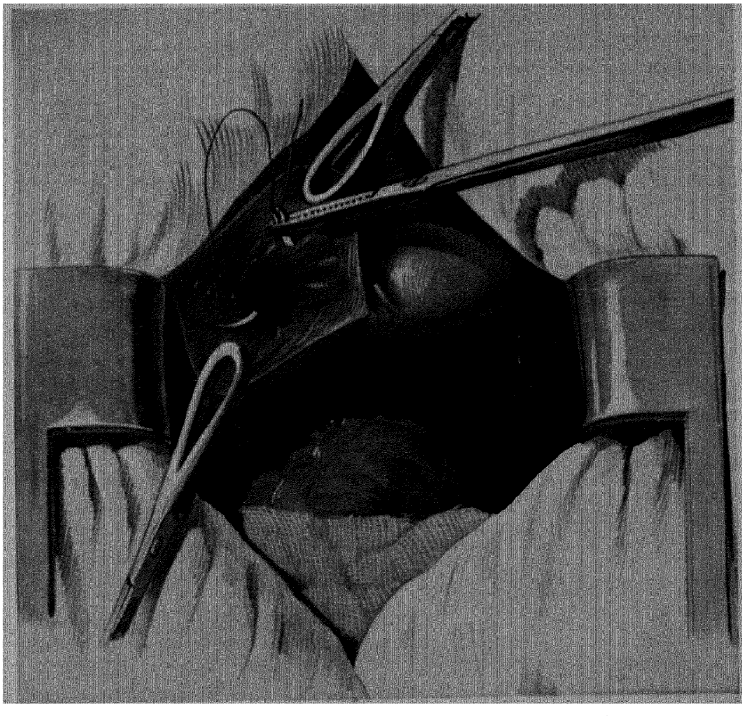


FIG. 464. CLOSING THE BED OF THE BROAD LIGAMENT CYST. RUNNING STITCH.

The ovarian artery should first be identified at the pelvic brim where it passes on to the outer and upper surfaces of the cyst (*see* Fig. 461). It is best to begin by picking up the ovarian vessels in two pairs of forceps between the pelvic brim and the tumour, thus avoiding the underlying ureter; the vessels are then divided, and each end secured by a ligature. This controls the principal blood-supply of the tumour and facilitates the further steps of the operation by diminishing bleeding. The anastomotic branch of the uterine artery reaches the cyst at its opposite (mesial) border, and this vessel may be controlled by clamping the tissues at the cornu of the uterus. These two vessels having been secured, very little trouble will be experienced from oozing when the cyst is enucleated from its bed.

It will be found that the division of the ovarian artery has opened up

the cellular tissue plane of the broad ligament, and the finger can now be passed beneath the peritoneum covering the cyst in the direction of the uterus (*see* Fig. 463); by dividing the tissues thus raised the wall of the cyst is exposed and may be freed on all sides by blunt dissection and the use of a swab, to push the cellular tissues off the cyst-wall. Usually these cysts have very thin walls and are easily ruptured; with care, small ones can be enucleated completely and removed intact (*see* Fig. 463). In the case of large ones, it is better to open the cyst after freeing the top and sides and empty it of its contents, otherwise the manipulations will be much hampered by the bulk of the tumour. In freeing the deeper parts, the walls of the detached broad ligament are picked up with ring forceps, and the deeper parts of the cyst can then be peeled off with the fingers or with a swab held in a long pair of forceps. Gentleness is here requisite or the cyst-wall will tear, leaving portions behind. The cyst-wall is most likely to be adherent in relation to its floor, and here fibrous bands may be met with which must be clamped and divided with scissors, and afterwards ligatured.

A ligature is next passed around the structures attached to the uterine cornu so as to control any vessels which may enter the cyst on that side. The bed of the cyst is next carefully examined and all oozing-points controlled; complete hæmostasis is essential to the success of the final stage. This consists in obliterating the deepest part of the bed with sutures introduced as shown in Figure 464. The redundant peritoneum which was in relation to the upper part of the tumour is then cut away, care being taken of the tube and ovary, and the peritoneal edges can then be brought together by a continuous suture. It rarely happens, if the arterial supply has been secured in the manner described, that bleeding from the bed of the tumour cannot be completely controlled; but, if necessary, an opening should be made into the posterior vaginal fornix (*see* Fig. 475, p. 705), and a rubber-tube passed into the vagina for drainage; it can be removed in forty-eight hours. Finally, the upper part of the broad-ligament cavity is closed over the drain-tube.

Infected broad-ligament cysts are very difficult to deal with; complete enucleation of the adherent cyst-wall is often impracticable. Here vaginal drainage is invaluable and should be carried out somewhat differently. The infected bed may be swabbed with tincture of iodine and the vaginal fornix opened *freely*. The end of a long strip of bismuth or iodoform gauze is then passed into the vagina, and the remainder used to pack the bed firmly. Finally, the peritoneum should, if possible, be closed over the gauze packing; if this is not practicable a second suprapubic drain must be employed as well.

Vaginal drainage calls for special precautions in after-treatment which will be mentioned later on (*see* p. 792).

OPERATIONS ON THE UTERINE ADNEXA

Indications. The following conditions may necessitate the partial or complete removal of one or both Fallopian tubes, or of the ovaries, or of portions of the ovaries, or of both tubes and ovaries: (1) pyosalpinx, or ovarian abscess, or both; (2) non-suppurative inflammation, including hydrosalpinx and cystic disease of the ovaries; (3) new growths of the tubes or ovaries; (4) extra-uterine gestation.

When the tube with its companion ovary is removed, the operation is

known as *salpingo-oöphorectomy;* it may be unilateral or bilateral. In removing an ovarian tumour, the corresponding tube is also removed, as it forms a part of the pedicle, and there is no advantage in retaining it. Removal of the tube alone, or of the ovary alone, is known as *salpingectomy* or *oöphorectomy* respectively. When a portion only of the ovary is removed the operation is called ovarian *resection*. The construction of an artificial abdominal ostium in the outer portion of the tube is called *salpingostomy*.

In Suppurative Cases. Tubes or ovaries which are the seat of suppuration cannot be dealt with on conservative lines, but must be entirely removed. After a preliminary inspection of the parts, the pelvic cavity should be isolated by careful packing with swabs and rolls of gauze, to prevent soiling of the upper peritoneal cavity. It is often impossible to avoid opening collections of pus during the manipulations.

The separation of adhesions, in suppurative cases, requires careful and delicate manipulation. Omental adhesions are usually first encountered. Tags may be simply detached, but larger portions of adherent omentum may be cut away and secured with ligatures. Bowel-adhesions should next be dealt with. In the case of the right adnexa the vermiform appendix is frequently involved, and should always be examined (*see* p. 696).

As far as possible each part should be seen as well as felt, and in dealing with adherent structures in the pelvis, the proper exposure of the parts is facilitated by the use of a double-bladed retractor such as that shown in Figure 439, page 663, which will mechanically hold the edges of the wound widely apart. Lightly adherent coils of intestine should be gently peeled off with a swab; firm bands of intestinal adhesion may be divided with blunt-pointed scissors, as far as possible away from the wall of the bowel. The peritoneal coat of the adherent intestine is frequently damaged during separation, and in difficult cases the lumen of the bowel may be actually opened. It may even occasionally be necessary to resect a length of small intestine and perform an anastomosis.

In dealing with tuberculous cases, injuries to the intestine are especially dangerous; fæcal fistulæ are very apt to result, and tuberculous fistulæ are so intractable that they must be regarded as practically incurable.

The position in which adhesions to bowel are most difficult to deal with is the neighbourhood of the rectum. The parts cannot easily be brought up into the wound or dealt with under direct observation; the sense of touch has to be largely relied upon, aided by such direct illumination of the deeper parts of the pelvic cavity as is possible. In recent cases the inflamed intestinal wall is unusually friable, and tears with unexpected ease. The injury may not be detected until the adherent structures have been removed, and the bed in which they lay has been carefully inspected. It is therefore obvious that a careful examination of the rectum should always be made when deep adhesions in its neighbourhood have been dealt with.

All injuries to bowel must be at once repaired. If the peritoneal coat only has been torn, a single row of stitches, or a running stitch reuniting the edges, will suffice. If the muscular coat has been torn or the lumen of the bowel laid open, deep stitches embracing all the coats should first be introduced, and then one or two rows of Lembert's stitches superimposed. The stitches should as far as possible be introduced in the transverse axis of the gut to avoid constriction.

Adhesions to other structures such as the uterus, the back of the broad

ligament, and the opposite tube and ovary, can be dealt with more freely than those which involve the intestine.

Collections of pus in the tube or ovary may be evacuated by aspiration or with a trochar, or by an incision, before attempting to draw the organ out of the wound; in this way the escape of pus can be controlled better than when the abscess bursts during the manipulations.

When after separation of the adhesions the pedicle has been defined, it is often found considerably thickened by inflammatory changes; ligature in bulk of such a pedicle is undesirable; it should be clamped in three or four sections, and the appendages cut away before the ligatures are passed (*see* Fig. 465). The outer ligature includes the ovarian vessels; of the inner ligatures, one embraces the uterine end of the tube, the other the ovarian ligament and its accompanying vessel (*see* Fig. 465). A separate ligature is

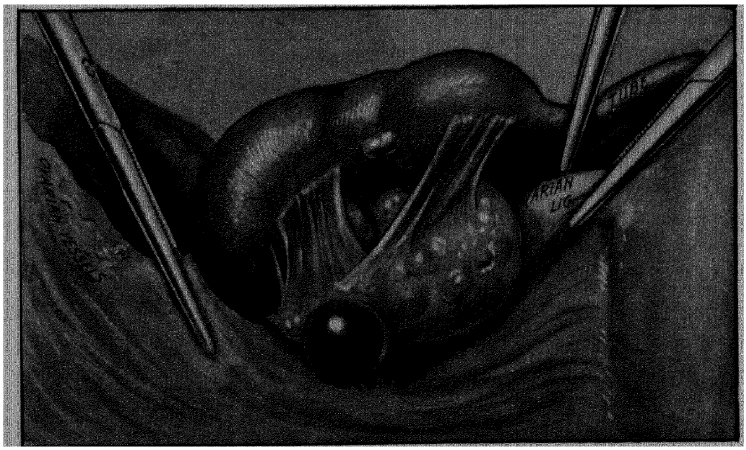


FIG. 465. TREATMENT OF THE PEDICLE IN SALPINGO-OÖPHORECTOMY (modified from Kelly and Noble). Three structures are secured with clamps: (1) the infundibulo-pelvic fold containing the ovarian vessels; (2) the uterine end of the tube; (3) the ovarian ligament. The tube and ovary are then cut away.

desirable for the latter structure, as it contains a good deal of muscular tissue which retracts, and it is usually accompanied by an artery of considerable size. The fourth ligature shown in Figure 466 is not required unless the pedicle is long or thick. If the uterine end of the tube is much thickened it should be excised along with a wedge-shaped piece of the uterine cornu, the gap thus left in the uterine wall being closed with interrupted stitches. This will obviate the risk of subsequent trouble arising from the stump of the infected tube.

In *bilateral* suppurative cases, both ovaries are frequently so closely involved, that their removal is called for as being probable foci of infection. When this is the case it is better to remove the uterus as well, for the following reasons: (*a*) the organ is functionless when both ovaries have been removed; (*b*) it is in many cases infected also, and may give rise to much subsequent trouble if not removed; (*c*) the operation-field can be much more efficiently drained when the uterus has been removed; (*d*) the severity

and duration of the operation are not appreciably increased by this procedure. The method of total hysterectomy has been described on pages 675–678.

The restoration of the peritoneal covering of the pelvic floor is often a matter of some difficulty after these operations. Usually the peritoneal covering of the bladder can be largely utilised, and raw areas of considerable extent, which cannot be covered, may be shut off from the general abdominal cavity by stitching over them a free loop of the pelvic colon; or a piece of the omentum may be grafted over such an area.

Drainage is often necessary in difficult cases although no absolute rule need be laid down (*see* p. 667). The vaginal route is the route of choice, and when the whole of the uterus (panhysterectomy) has been removed it involves no additional incision. If this has not been done, the posterior fornix can be opened by cutting down upon a pair of forceps introduced into the vagina by an assistant. When bowel has been extensively injured, or there has been escape of pus, suprapubic as well as vaginal drainage may be necessary.

In Non-suppurative Cases. In non-suppurative conditions an attempt

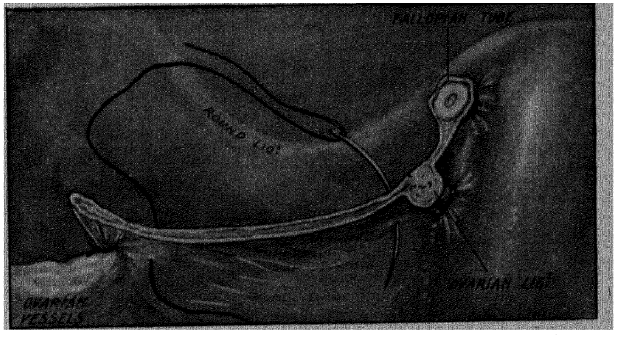


FIG. 466. LIGATURING THE PEDICLE IN SECTIONS AFTER THE TUBE AND OVARY HAVE BEEN CUT AWAY (modified from Kelly and Noble).

should always be made, in the case of women under forty years of age, to avoid the complete removal of both ovaries. In cases of bilateral hydrosalpinx, the tubes may be removed without the ovaries when the latter are unaffected, except for the presence of peri-oöphoritic adhesions; if the ovaries are also the seat of small cysts, as is frequently the case, resection of the diseased portions is usually practicable, leaving sufficient ovarian tissue to maintain the ovarian functions. Multiple small cysts may be destroyed by the actual cautery, and the ovary then dropped back into its place.

Salpingectomy. This operation consists in dividing the whole extent of the mesosalpinx, from the infundibulo-pelvic fold to the cornu of the uterus, and then cutting through the isthmus of the tube, or better by excising the interstitial portion along with the remainder of the tube. The divided mesosalpinx is secured with two or three fine ligatures, the vessels it contains being small and unimportant except near the uterine border (*see* Fig. 48, p. 60). The tissues at the angle of the uterus are very vascular, and in this position bleeding-points must be carefully controlled. If the uterine end is not excised the stump of the tube may be buried in the mesosalpinx.

This procedure forms also the operation of choice in tubal pregnancy; the ovary as a rule is healthy, and it is unnecessary to sacrifice it, if this is not necessitated by its relation to the gestation-sac.

Salpingostomy consists in constructing an artificial abdominal ostium in the ampullary portion of the tube. It is suitable for cases in which the contents are thin and serous, the walls of the tube are not thickened, and in which the patency of the tube-lumen can be demonstrated. The passing of a probe through the opened tube up to the uterine cervix is not a satisfactory test of patency. The tubal inflation apparatus described on page 109 should be used for this purpose, when the gas may be observed to be passing freely through the new opening in the tube. An incision an inch and a half long is made upon the dorsal surface of the tube, which goes through all the coats; the tubal inflation apparatus is then used by an assistant; if on either side the gas does not enter the tube there is a stricture of its inner portion; if the test is positive, the artificial ostium is completed by stitching the edge of the tubal mucosa to the peritoneal coat with a fine or continuous catgut stitch. If the obstruction has been located in the isthmus or interstitial portion of the tube, a conservative procedure is no longer practicable, and it is better to remove the damaged tube (*see also* pp. 109 and 129).

There are very few statistics available from which a prognosis can be drawn as to the prospects of pregnancy occurring after salpingostomy. A few isolated successes have been recorded, but it would appear that failure may often occur either from formation of adhesions around the new ostium, or from the tubal mucosa having been too severely damaged by preceding inflammation to fulfil its normal function.

Resection of Follicular Cysts. Small follicular cysts, not exceeding the size of a pea, are frequently found in healthy ovaries, and do not call for removal. When such cysts exceed the size of a cherry it is better to remove them by resection. A wedge-shaped piece is first cut out, including the greater portion of the cyst-wall; the base of the cyst will then be found to present a definite lining membrane which can be peeled off with forceps. The incision in the ovary may be closed with fine interrupted stitches. All bleeding must be carefully controlled before the ovary is dropped back into the pelvis.

APPENDECTOMY

The Incision. When the abdomen has been opened by a sub-umbilical incision for a pelvic operation, it is easy to explore and remove the appendix at the same time. If the operation is undertaken primarily for the appendix, the lateral incision through the linea semilunaris is often most convenient; this also allows of the pelvic organs being explored, and the right appendages can be removed conveniently through it, if the incision is extended downwards towards Poupart's ligament. The gridiron-incision parallel to Poupart's ligament has the disadvantage for the gynæcologist that access to the pelvis cannot conveniently be obtained through it.

Steps. There are three steps in the operation proper: (*a*) to find the appendix; (*b*) to isolate and excise the appendix; (*c*) to peritonize the stump.

(*a*) In a chronic case it is not always an easy matter to find the appendix, and a careful search is sometimes required. Cases reported by operators

of 'absence of the appendix' represent in reality only failures to find it, for the organ is never absent unless it has been removed by operation. The first step in a difficult case is to expose the *caput caeci* entirely, define the anterior longitudinal band and trace it to its termination; this corresponds with the base of the appendix, as some of the fibres of this band pass into the muscular coat of the appendix. If this fails to disclose the organ, the cæcum should be mobilised and displaced upwards so that its posterior surface can be examined; this is not an uncommon position in which to find the appendix. If this also fails the inner aspect of the cæcum and ascending colon must be explored upwards as far as the hepatic flexure;

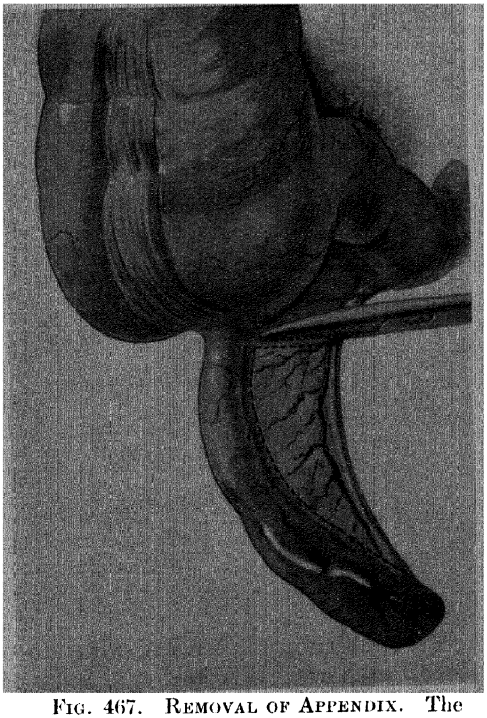


FIG. 467. REMOVAL OF APPENDIX. The organ is separated from its mesentery by an incision corresponding to the dotted line.

it is here that serious difficulties with adherent small gut may be met with. Lastly, the peritoneal pouches behind the ileo-cæcal junction should be explored; these are the most difficult situations in which to find the appendix.

(*b*) When found, the appendix must be very carefully handled whilst freeing it from its adhesions. Usually it is best to begin with the distal end and work towards the cæcum; if, however, this end is inaccessible, as may be the case when the appendix runs upwards, it is best to define the cæcal end, divide this between two ligatures passed underneath it, bury the stump, and then work towards the tip of the organ, securing the mesentery in sections at the same time. Adhesions to small bowel call for very careful

management, in order to avoid lacerating the delicate wall. When dense adhesions unite the appendix and the Fallopian tube, these adhesions need not be disturbed, for each organ can be readily removed, beginning with its point of origin and working towards the site of the adhesions.

When the appendix and its mesentery have been defined, the latter is transfixed with a needle near the wall of the cæcum, and the ligature tied upon the free margin. If the mesentery cannot be properly freed, it is best to clamp and tie it in sections up to the cæcal wall. When the appendix has been properly cleared, it should be brought up into the wound along with a portion of the cæcum, so that it can be carefully isolated from the peritoneal cavity and the edges of the wound, by packing with gauze. The base of the appendix having been thus cleared is clamped (*see* Fig. 468), and a ligature placed upon the groove left by the clamp (*see* Fig. 468, A). Excision is completed by placing another clamp on the distal side of the ligature and cutting between the two; the second clamp prevents escape of fæcal contents from the distal part of the appendix. The appendical

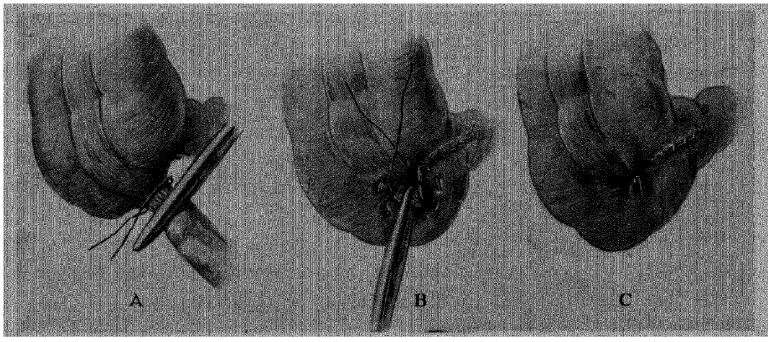


FIG. 468. APPENDECTOMY. A. Ligature applied to crushed base of appendix. B. Invagination of stump, purse-string suture placed in position. Mesentery oversewn. C. Stump peritonized by drawing tight the purse-string suture.

mucosa now exposed in the stump is touched with the actual cautery or with a strong antiseptic such as carbolic acid or tincture of iodine.

(*c*) The stump of the appendix is peritonized by burying it completely in the wall of the cæcum (*see* Fig. 468, B). In a simple case this can be done with a purse-string stitch, which should be of linen thread or silk of a medium size. This stitch is introduced about 1 inch outside the base of the appendix; it passes first through the anterior longitudinal band which is firm and comparatively avascular, then takes up the bowel-wall again, and at the opposite point takes up the mesentery of the appendix. It is desirable to introduce this stitch before amputating the appendix, so that the stump can be buried immediately, before any further manipulations are required. When the purse-string is being tied, an assistant pushes the stump inwards towards the lumen of the gut, invaginating the cæcal wall, which is thus brought together over it (*see* Fig. 468, C). If inflammatory thickening of the wall of the gut has occurred, the purse-string is unsuitable and the stump must be buried by a double row (superimposed) of Lembert's stitches. In acute cases, when the bowel-wall is inflamed, no attempt should be made to bury the stump, owing to the risk of lacerating the friable bowel-wall with the

stitches. The stump is simply cauterized and then dropped into the abdomen.

When the appendix cannot be freed from adhesions, for example to a coil of small intestine, without lacerating the bowel, it may be dealt with as follows: First, the base is defined, crushed with forceps, ligatured and divided. Then the appendix is laid open by a longitudinal incision, and the mucosa peeled off with forceps. The fibro-muscular shell remaining is then cauterized *in situ*, and a drainage-tube passed down to it, no attempt being made to remove it.

Drainage is usually necessary in acute cases, seldom necessary in chronic cases. In acute cases with localized suppuration, only the abscess-cavity requires drainage. When a good deal of free purulent, or semi-purulent, fluid is found in the general peritoneal cavity, it is usually advisable, in addition, to drain the pouch of Douglas. This can be done by the supra-pubic route, or by posterior colpotomy after closing the abdominal wound (*see* p. 704).

VENTRISUSPENSION AND VENTRIFIXATION

Definition. These names are given to operations designed to keep the uterus in a position approximating to that of normal anteversion. This may be done in three ways: (*a*) by stitching the body of the uterus directly to the abdominal parietes (*ventrifixation; hysteropexy*); (*b*) by shortening the extraperitoneal parts of the round ligaments (*Alexander-Adams operation*); (*c*) by interposing the intraperitoneal portion of the round ligaments between the layers of the abdominal parietes (*ventrisuspension*). The first method is only suitable under certain special conditions which will be indicated below. The second method has now been superseded by the third which, in one or other of its various forms, is generally applicable. The subperitoneal method of ventrisuspension described below is a modification of that published by Gilliam in 1906, and this, being in our opinion the best, will alone be fully described.

Indications. The common indication for these operations is backward displacement of the uterus (*see* p. 514); occasionally they may be useful in prolapse when combined with plastic vaginal operations.

Ventrisuspension

Gilliam's Operation by the Subperitoneal Route. The object of the surgeon is to maintain the body of the uterus in a position as nearly approximating normal anteversion as possible, and for this purpose the round ligaments are transplanted into the anterior abdominal wall in such a way as to produce a strong forward pull upon the uterus, and also to secure for it a firm anchorage in the anteverted position. The abdomen is opened by a median longitudinal incision. Full relaxation of the recti muscles must be obtained to allow of retraction and to afford a good view of the pelvis. The uterus and adnexa are carefully examined, and adhesions, if present, dealt with, because it is essential for the uterus tubes and ovaries to be freed before the subsequent steps of the operation are begun. A ligature is then placed around the round ligament halfway between the cornu and the internal abdominal ring. By traction on this ligature the round ligament is drawn up so as to form a loop. The two limbs of this loop are approximated at their base by a catgut suture in the manner shown in Figure 469. About

1½ inches above the pubic bone two clips are applied, one to the cut edge of the aponeurosis, and the other to the cut edge of the peritoneum; both these structures are separated from the intervening rectus muscle, thereby laying bare the latter for the width of 1 inch. Curved pedicle forceps are then

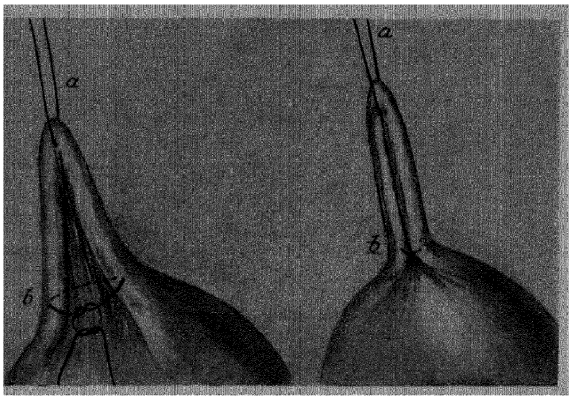


FIG. 469. THE STITCH WHICH LOOPS THE PROXIMAL END OF THE ROUND LIGAMENT. *a*, Traction-ligature. *b*, Loop-ligature.

pushed through the middle of the bared muscle (*see* Fig. 470), whence they are guided in the subperitoneal tissue towards the internal abdominal ring (Fig. 471), and then between the layers of the broad ligament until the points reach nearly to the uterine cornu (Fig. 472). Here the peritoneum is incised and the points of the forceps pushed through and opened to catch

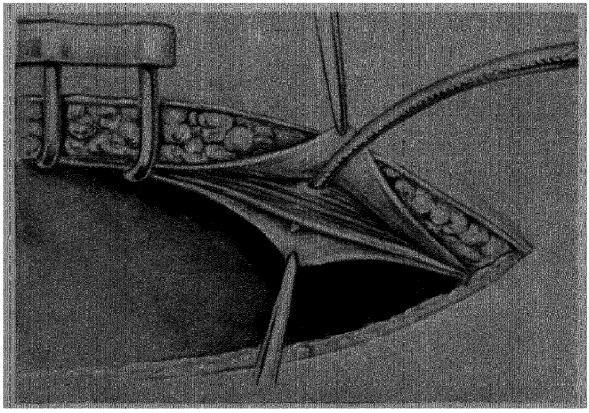


FIG. 470. CURVED FORCEPS ARE PASSED THROUGH THE MID-PLANE OF THE BARED RECTUS MUSCLE.

the traction ligature. The forceps is now withdrawn, bringing with it the ligature and the loop of the round ligament. After the loop has been drawn through the muscle it will be found on looking into the abdomen that the lateral aperture between the round ligament and the parietes is closed (Fig. 473), and thus any risk of small intestine becoming incarcerated in the utero-vesical pouch is prevented. The next step is to sew the base of the

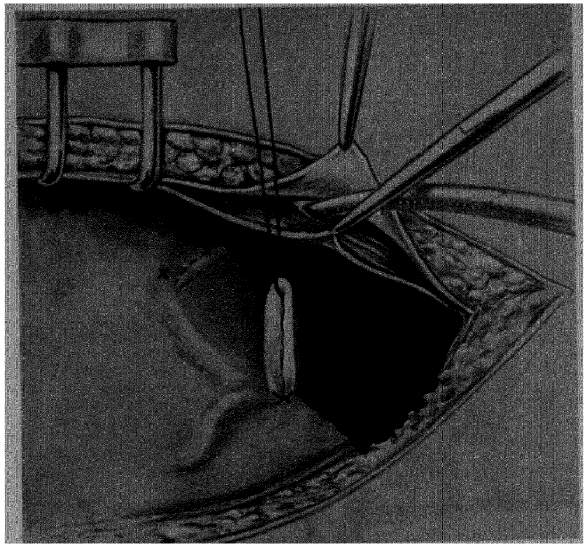


FIG. 471. THE CURVED FORCEPS HAVE BEEN PASSED OUTWARDS UNDER THE PARIETAL PERITONEUM AS FAR AS X, THE INTERNAL ABDOMINAL RING. The point is then swung round under the anterior layer of the broad ligament until it reaches the uterine cornu (*see* Fig. 472).

loop to the under aspect of the aponeurosis, and then the whole procedure is repeated on the opposite side. During the closure of the laparotomy wound the loops of the round ligaments may further be sutured across the mid line (*see* Fig. 474). Many operators use silk or thread for the fixation of the round ligament to the aponeurosis, but we have never known catgut to fail.

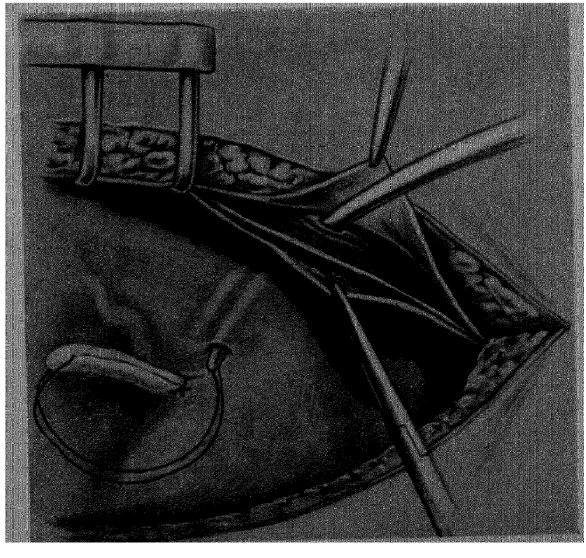


FIG. 472. THE POINT OF THE FORCEPS HAS PENETRATED THE PERITONEUM, AND IS ABOUT TO BE WITHDRAWN CARRYING THE ROUND LIGAMENT WITH IT.

There are several other intra-abdominal methods of employing the round ligaments for rectifying retro-displacement. The best known of these is the Webster-Baldy operation, in which loops of these structures are drawn

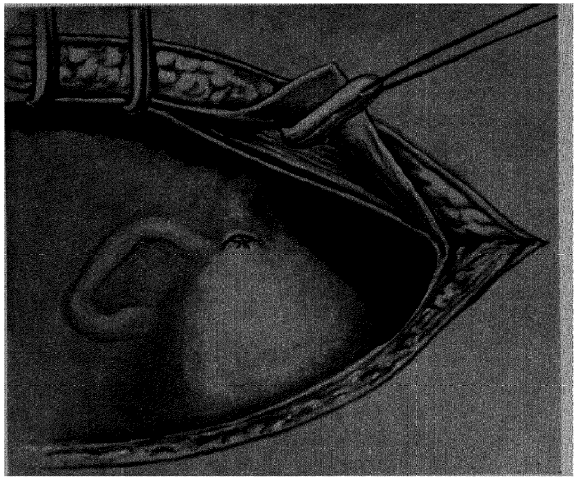


FIG. 473. THE LOOP OF ROUND LIGAMENT IS BEING DRAWN THROUGH THE OPENING IN THE MUSCLE; WHEN THIS IS COMPLETED THE LIGAMENT WILL BE SEWN TO THE APONEUROSIS (*see* Fig. 474).

backwards through the broad ligament and sewn to the back of the uterus and to each other—the so-called "posterior implantation."

Certain objections to this procedure may be raised, *e.g.*, it utilizes for

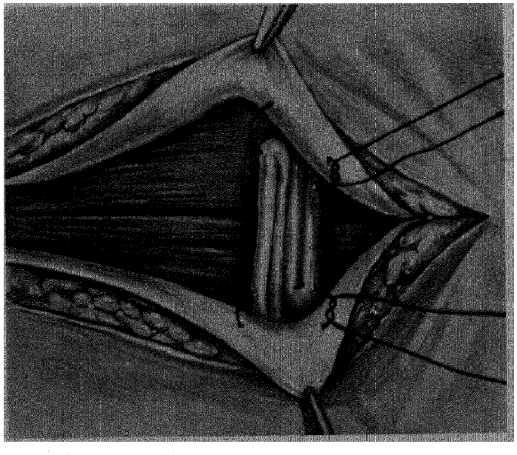


FIG. 474. THE LOOPS BEING SEWN TO THE UNDER-SURFACE OF THE APONEUROSIS.

support the outer and weaker portions of the ligaments. Recurrences occur, according to Zimmermann, in 2·5 per cent. of cases. It is liable to disturb the venous plexuses in the broad ligaments; there is, therefore, a risk of producing iliac thrombosis. Some operators rely on simple plication

of the round ligament for retroversion, combining it with a similar treatment of the utero-sacral folds to correct any forward displacement of the cervix.

Ventrifixation. Hysteropexy

In this operation the uterus is stitched directly to the anterior abdominal parietes. After the abdomen has been opened by a median incision, the uterus and adnexa, if adherent, are carefully and completely freed from adhesions, and then brought up into the wound and examined.

The introduction of the sustaining sutures is a point of great importance. The *upper part of the uterine body* must be left free, and the sutures introduced into the anterior wall as low down as possible ; the sutures must, however, in all cases be placed above the level of the peritoneal reflection on to the bladder, which should be carefully identified before they are introduced. In this way the bladder will be avoided, the fundus will be left free, and the anterior surface of the uterus will be drawn into apposition with the abdominal wall.

The stitches should be of chromicized catgut or fine silk or thread, and should be passed from side to side, first picking up the parietal tissues and then being carried deeply into the muscular layer of the uterus, finally emerging through the parietal tissues of the opposite side. The first stitch may be made to include the parietal peritoneum only, on each side of the incision ; a second pair may be made to include the peritoneum and aponeurosis, by which a firmer hold is obtained ; four sutures alternately superficial and deep will suffice in all cases. Catgut ligatures are absorbed in a few weeks, and silk ligatures probably cut their way out of the uterus in time, so that in all cases the retention of the uterus in its new position depends upon the formation of a band of adhesions in the position of the stitches. This band is often thick and strong, but it may stretch to a length of one or more inches (*see* Fig. 351, p. 551). Stitches which include the parietal fascia approximate the uterus, for the time being, more firmly to the abdominal wall while the adhesions are being formed and strengthened by organization, for which time is required. These adhesions always allow of a certain range of mobility, and it is probable that this operation seldom if ever results in *fixation*, strictly speaking, of the uterus.

Comparison of Ventrisuspension and Ventrifixation. Now that these operations have been described, the question of their relative merits must be briefly considered.

The following advantages over ventrifixation may be claimed for ventrisuspension : (*a*) the position of the uterus is much more nearly that of normal anteversion than is the position after direct fixation ; (*b*) the utero-vesical pouch is not encroached upon, and the bladder is free to expand both upwards and laterally ; (*c*) no adhesions are formed between the uterus and the abdominal wall which might give rise to intestinal obstruction ; (*d*) the entire body of the uterus is free to develop during pregnancy, and in this development it is important to remember the round ligaments participate, so that they become elongated.

It is beyond question that a considerable number of cases of acute intestinal obstruction have occurred, resulting from adhesions following direct fixation (ventrifixation), and also that in many cases serious obstetric complications in pregnancy or labour have been recorded. Under the

method of ventrifixation described above, difficulties in labour rarely occur. An older method in which the sustaining sutures were passed through the *posterior surface of the fundus*, thus producing extreme anteversion, has been responsible for nearly all the recorded instances of serious obstetric complications.

In elderly women who have passed the age of child-bearing, and in persons who, as the result of removal of both tubes or both ovaries, have been rendered sterile, the obstetric objections to direct fixation do not apply.

The only important objection to ventrisuspension is the variability of the round ligaments in thickness; sometimes they are so thin that even looping them as we do does not provide a support of adequate strength. It is possible that ligaments as weak as this may subsequently elongate sufficiently to allow of recurrence of the backward displacement. Again, in cases of chronic pelvic inflammation the round ligaments may be adherent and so thickened as to become rigid. They cannot then be utilized for interposition and Gilliam's operation becomes impracticable.

VAGINAL AND VULVAL OPERATIONS

COLPOTOMY

This operation consists in making an incision through the anterior fornix so as to open the utero-vesical pouch (anterior colpotomy), or through the posterior fornix so as to open the pouch of Douglas (posterior colpotomy). The object of the operation is to evacuate collections of blood or of inflammatory fluids in these pouches, or sometimes to remove new growths of small size such as ovarian cysts or pedunculated fibroids, or to open and drain tubal or ovarian collections of pus in acute suppurative inflammation of the uterine adnexa.

Posterior Colpotomy. The cervix is exposed as shown in Figure 475, and the posterior lip seized with a volsella and drawn forwards so as to expose the posterior fornix. A transverse incision an inch and a half long is then made about an inch above the *os externum;* this divides the vaginal mucous membrane and opens up the cellular-tissue plane in the floor of the pouch of Douglas. The finger is then passed through the incision and the tissues are picked up with forceps close to the posterior wall of the uterus, and carefully divided with scissors. In this manner the peritoneum is reached and opened at a variable depth, but by keeping close to the uterus all risk of injuring the rectum or small bowel will be avoided. The opening into the peritoneum may be enlarged by the fingers or by a pair of blunt forceps until it is as large as the incision in the vaginal wall. There is, as a rule, little hæmorrhage, but the peritoneum should be stitched to the vaginal mucous membrane by a few interrupted sutures, one being placed at each extremity of the incision.

When *collections of fluid* are present in the pouch of Douglas, they may be tapped with the trochar shown in Figure 476 as soon as the vaginal mucous membrane has been divided. This instrument consists of a strong stilette held in a special pair of forceps grooved suitably to hold it. The

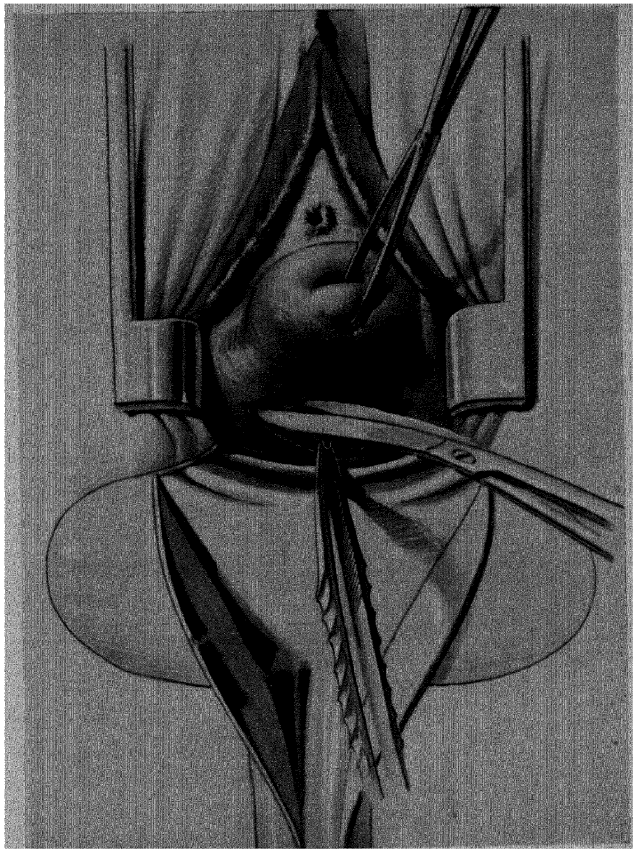


FIG. 475. POSTERIOR COLPOTOMY. The cervix has been drawn down and is being held forwards with a volsella. The mucous membrane of the posterior fornix has been divided by a transverse incision made about one inch above the external os. The peritoneum of the pouch of Douglas is caught up by dissecting forceps and is being divided transversely.

instrument is pushed through the wall of the collection of fluid, and then, upon opening the forceps, the stilette is released and can be withdrawn. By separating the blades of the forceps, the opening can now be enlarged to the desired extent. The finger is then passed into the cavity for exploration of its walls, and in chronic cases, where the fluid has been effectively isolated by adhesions, it may be douched with a sterile saline solution to wash away blood-clot or purulent material. This should not be done in recent or acute cases, lest infective material be carried upwards by the

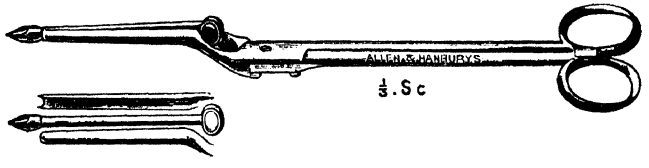


FIG. 476. MARTIN'S PELVIC TROCHAR.

fluid into parts previously unaffected. Drainage may be provided for by loosely packing the cavity with gauze, or by introducing a rubber drainage-tube provided with a flange to keep it in position.

Anterior Colpotomy. In this procedure, the preliminary steps of which are described on page 705, a transverse incision is made across the anterior fornix, just below the lower limit of the bladder (*see* Fig. 477), which corresponds to the line where the rugose mucous membrane covering the bladder merges into the smooth mucosa covering the cervix. When there is any

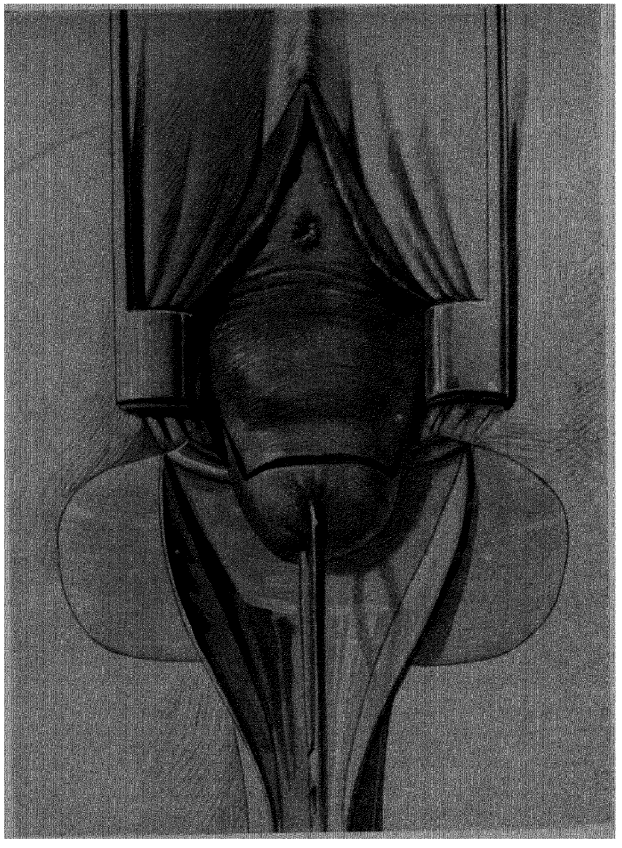


FIG. 477. INCISION PREPARATORY TO ANTERIOR COLPOTOMY AND TO SPLITTING THE CERVIX FOR THE REMOVAL OF SUBMUCOUS FIBROIDS.

doubt in determining this line, the limits of the bladder are defined with a sound. The incision is necessarily made much nearer the external os than in posterior colpotomy. The bladder is then separated from the cervix by first putting the intervening connective tissue on the stretch and dividing it with blunt-pointed scissors directed towards the cervix (*see* Fig. 478). This is done until the peritoneum is finally reached. It lies at a much deeper level than does that of the posterior pouch. With the finger in the wound and directed towards the uterus, the smooth peritoneal surfaces can be felt to slide over one another when the floor of the utero-vesical pouch

has been reached (*see* Fig. 479). The peritoneum is now picked up with forceps, and divided close to the uterine wall so as to avoid the bladder.

This operation is much less frequently performed than posterior colpotomy, since collections of blood and of inflammatory fluids are much more commonly found in the posterior than in the anterior peritoneal pouch; nevertheless inflamed adnexa, small pedunculated fibroids, and small ovarian cysts are in some cases more easily removed by this route.

INTERPOSITION OF THE UTERUS

Interposition of the Uterus. This procedure was introduced by Wertheim for severe cases of prolapse. It is a modification of the obsolete operation

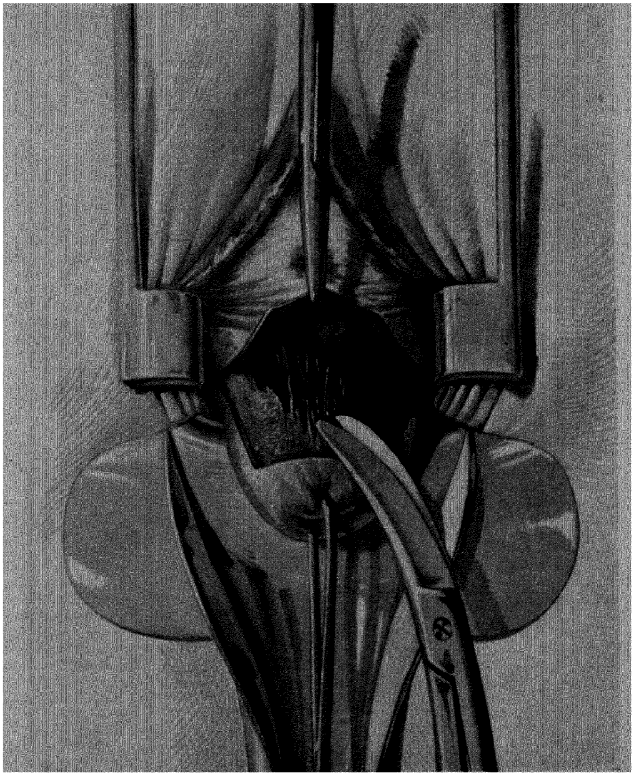


FIG. 478. METHOD OF SEPARATING THE BLADDER FROM ITS CERVICAL ATTACHMENTS.

of vaginal fixation. Briefly, it consists in separating the whole of the bladder from the anterior vaginal wall by a long median incision, extending from the cervico-vaginal reflection to a point about 1½ inches above the urinary meatus; the utero-vesical pouch is then opened as in anterior colpotomy. The fundus of the uterus is now drawn through the incision into the vagina, and the peritoneum of the utero-vesical pouch is stitched to that covering the posterior wall of the uterus, so as once more to close the

peritoneal cavity. The redundant part of the anterior vaginal wall is next cut away, and the edges are then brought together over the front of the uterus, which is finally fixed to the vaginal wall by several strong sutures. The uterine body is thus greatly anteverted, and lies interposed between the anterior vaginal wall and the bladder, which has been displaced upwards.

This operation is the method adopted by some operators for procidentia occurring in women who have passed the menopause; in its strongly

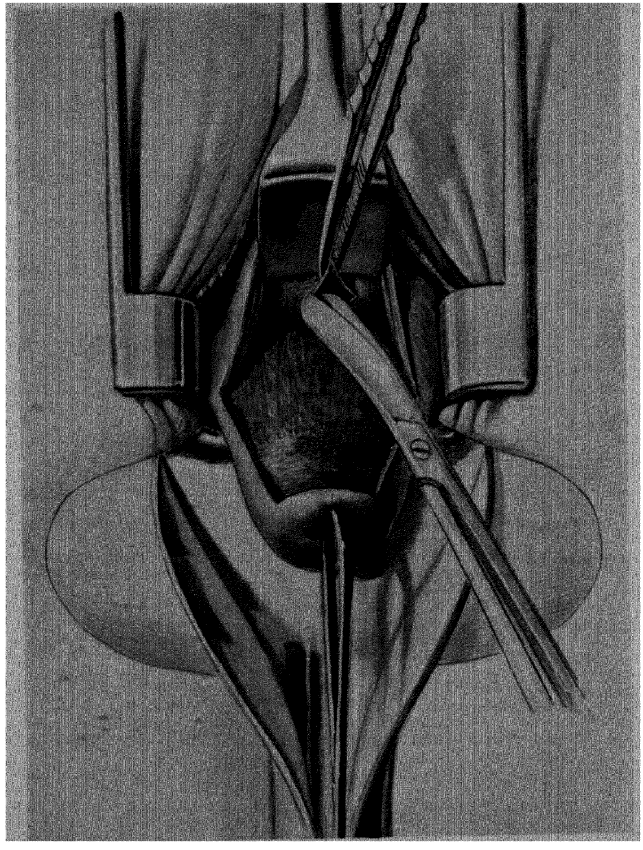


FIG. 479. ANTERIOR COLPOTOMY. The bladder is held up by a flat spatula. The peritoneum of the utero-vesical pouch is drawn down in the interval between the spatula and the uterus, where it is grasped by forceps whilst a transverse opening is made with scissors.

anteverted position prolapse of the uterus is impossible, and cystocele is equally incapable of being produced. Supplemented by perineorrhaphy when the vulva is dilated or the perineum deficient, the results are said to be good. In young women this operation is not justifiable, as pregnancy cannot be allowed to occur with the uterus in such an abnormal position.

VAGINAL HYSTERECTOMY

This operation requires a capacious vaginal outlet so that when the *introitus vaginae* is small it must be enlarged either by episiotomy or by

Schuchardt's incision (*see* p. 777). The latter was commonly employed in former years when vaginal hysterectomy was performed for cancer of the

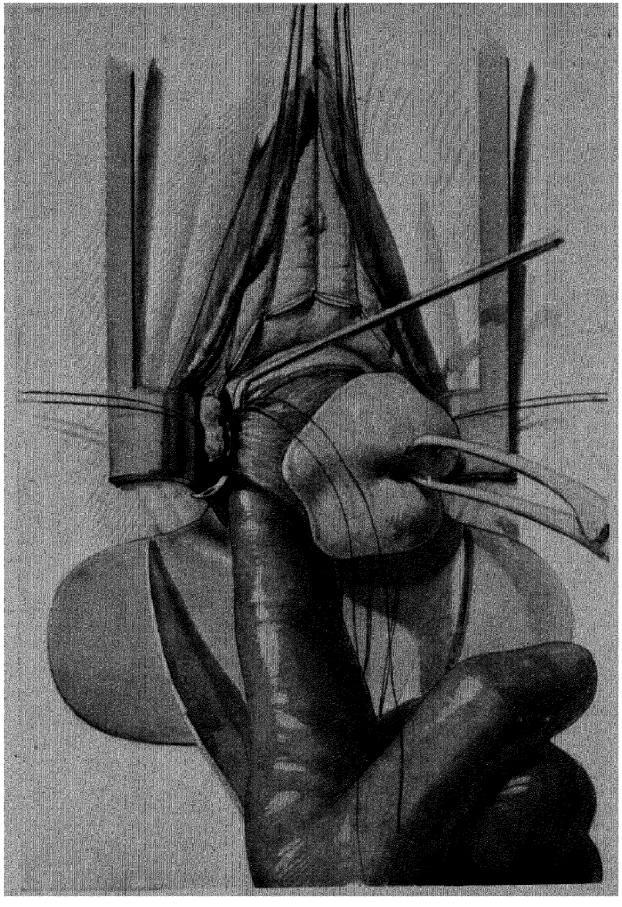


FIG. 480. VAGINAL HYSTERECTOMY. On the right side the sacro-uterine ligament and the vesico-uterine parametric tissue have been divided.

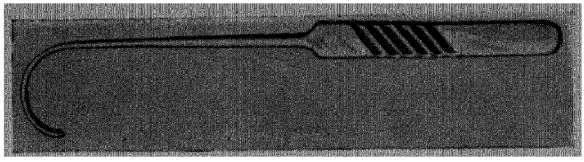
cervix. Hysterectomy *per vaginam* is carried out in two ways: (1) by extirpating the uterus from above downwards; (2) by effecting its removal



FIG. 481. WORRALL'S BROAD LIGAMENT NEEDLE FOR VAGINAL HYSTERECTOMY.

from below upwards. Only the latter, which is the method commonly employed, can here be described.

Vaginal Hysterectomy from below upwards. The cervix is seized by a volsella and drawn down. A circular incision is then made through the mucosa around the *portio vaginalis* below the level of the reflection of the



SAMARITAN HOSPITAL BROAD LIGAMENT NEEDLE.

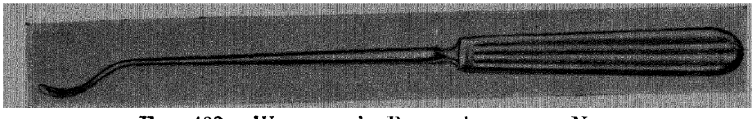


FIG. 482. WERTHEIM'S BROAD LIGAMENT NEEDLE.

bladder. Two additional antero-lateral incisions may be made as shown in Figure 477, in order to provide more room. The bladder is next dissected off the cervix (*see* Fig. 478). When this is done the cervix is drawn to one

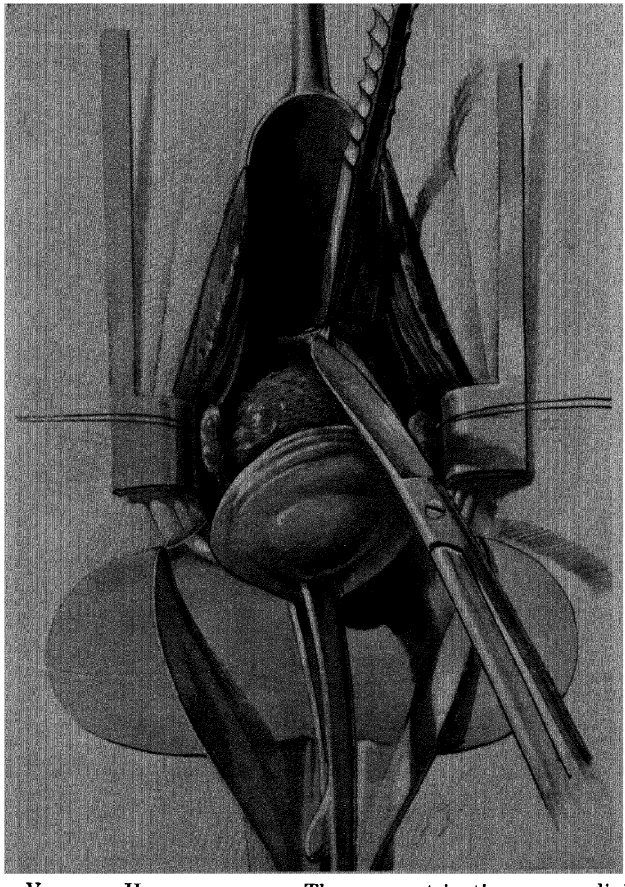


FIG. 483. VAGINAL HYSTERECTOMY. The parametric tissues are divided and the bladder is raised with a spatula. The peritoneum of the utero-vesical pouch is about to be incised with scissors.

side, and the ligation and division of the parametric tissues are commenced. These include the sacro-uterine ligament behind, and the vesico-uterine

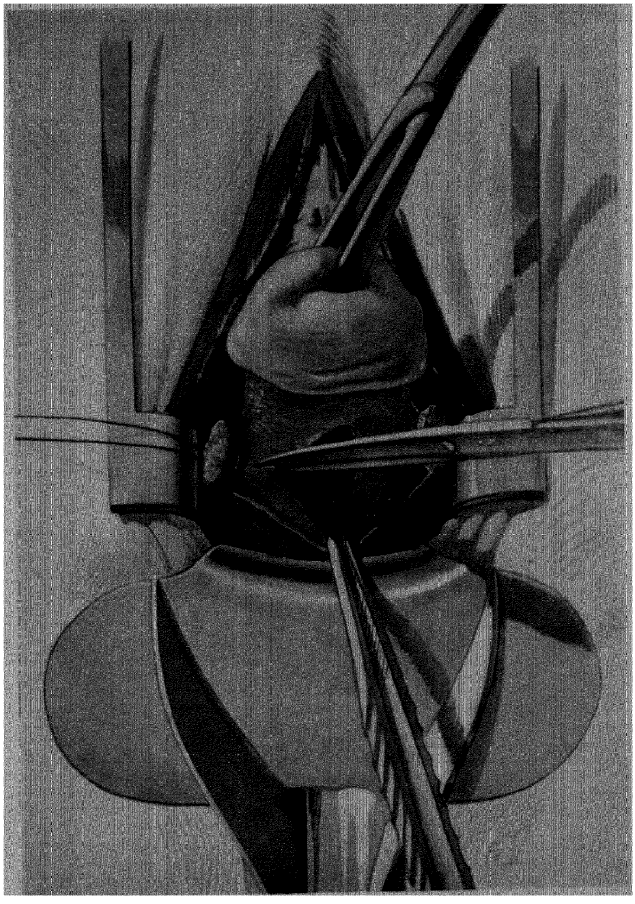


FIG. 484. VAGINAL HYSTERECTOMY. The parametric tissues are divided and the cervix is held forwards to allow of the opening of the pouch of Douglas with scissors.

parametric tissue in front, and they make up together a wide attachment of cellular tissue to the sides of the cervix. It is therefore advisable to ligate

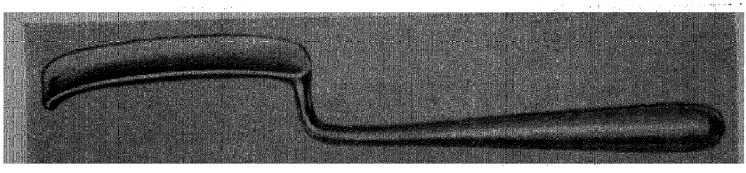


FIG. 485. BAYONET-SHAPED RETRACTOR USED FOR RAISING THE BLADDER.

them separately. The cervix should be drawn forwards during the tying of the sacro-uterine ligament, and backwards whilst ligating the vesico-

uterine parametric tissue. In Figure 483 this has been done on both sides and the ligatures are shown drawn aside. To avoid injury to the ureters, continuous retraction of the bladder is kept up by means of a spatula inserted between the cervix and that viscus (*see* Fig. 479, p. 708) : the ureters

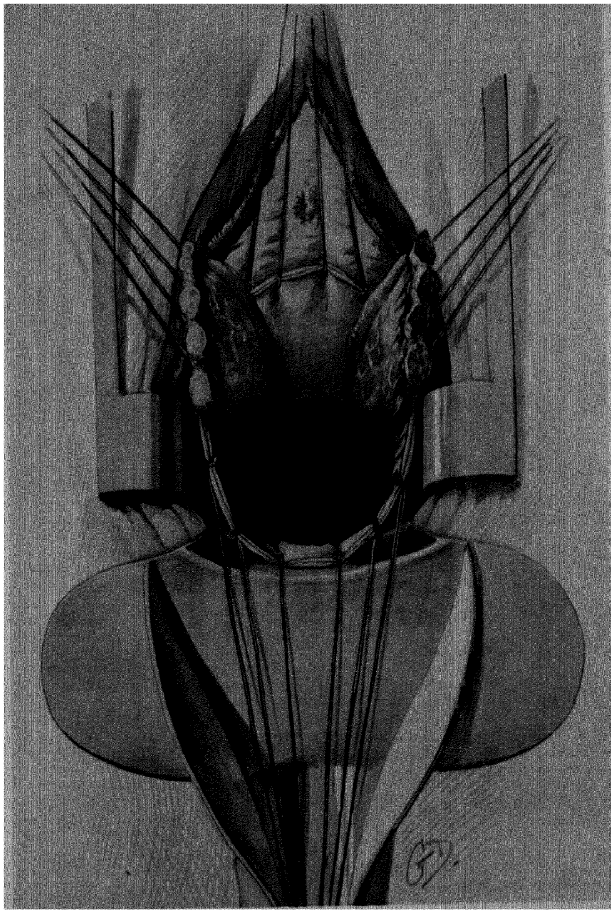


FIG. 486. THE LATER STAGE OF VAGINAL HYSTERECTOMY. The peritoneum of the utero-vesical pouch has been united to the vaginal mucosa by long interrupted sutures. The fundus is drawn outside the vagina by the index finger of the left hand. The round ligament, Fallopian tube, ovarian ligament, and the ovarian artery lie upon the finger ready for suturing.

are pushed up in this way, together with the bladder, whilst the needle carrying the ligature is passed as close to the cervix as possible.

While tying the ligatures the traction on the cervix must be relaxed. Division of the tied parts is made with scissors close to the cervix and at right angles to the direction of the tissues, in order to provide a broad flat stump from which the knot will not slip off. Figure 480 shows the method of passing sutures by means of a long curved blunt-pointed needle (*see* Figs. 481–482),

which is shown embracing tissue that includes the uterine artery. The pulsations of this vessel can be felt, but the artery is not usually seen before it is divided; after division its characteristic tortuosity is apparent.

After the parametrium of the one side has been tied and divided as high up as possible, that on the other side is dealt with in like manner. The uterus may then be drawn lower down and the peritoneal folds of the vesico-uterine pouch and the pouch of Douglas are brought within easy reach. To

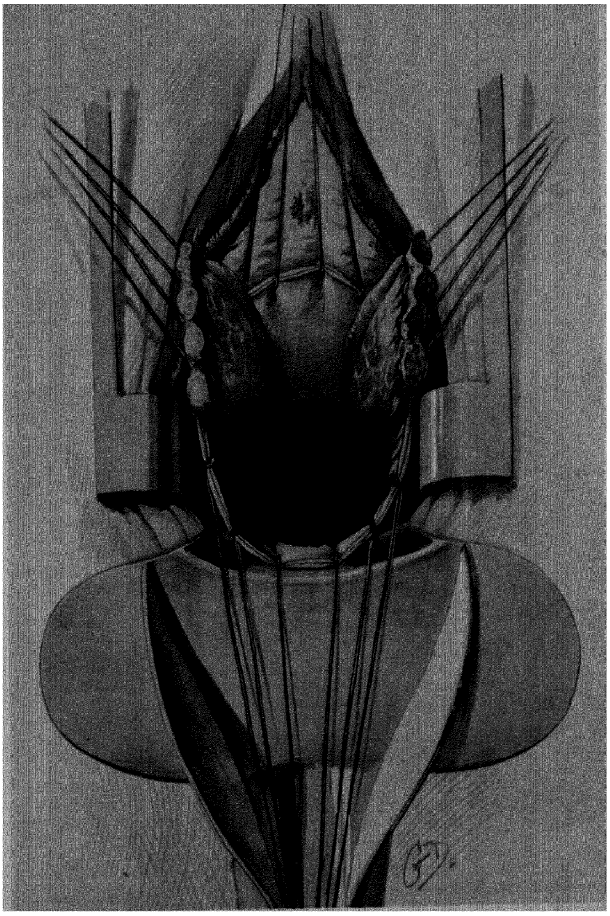


FIG. 487. VAGINAL HYSTERECTOMY, showing the parts after removal of the uterus.

open the former the cervix is drawn downwards and backwards, and the bladder is raised with a bayonet-shaped spatula. The peritoneal fold is grasped with forceps and divided in the mid line by scissors (*see* Fig. 483). The opening may be enlarged by cutting, or by stretching it to the required size by the fingers. To open the pouch of Douglas the cervix is drawn upwards and the peritoneum divided as described in posterior colpotomy (*see* Fig. 475, p. 705). The peritoneum of both pouches should now be united to the vaginal mucosa in their respective neighbourhoods

as shown in Figure 487. The remaining parts of the parametrium are now tied and divided on both sides, and when this is completed the uterus can be drawn further down until it hangs only by its adnexa. In tying the adnexal structures, which are seen lying upon the finger in Figure 486, it is usual to deal with each separately, thus the round ligament is first tied and divided, then by drawing the uterus to one side the ovary and tube can

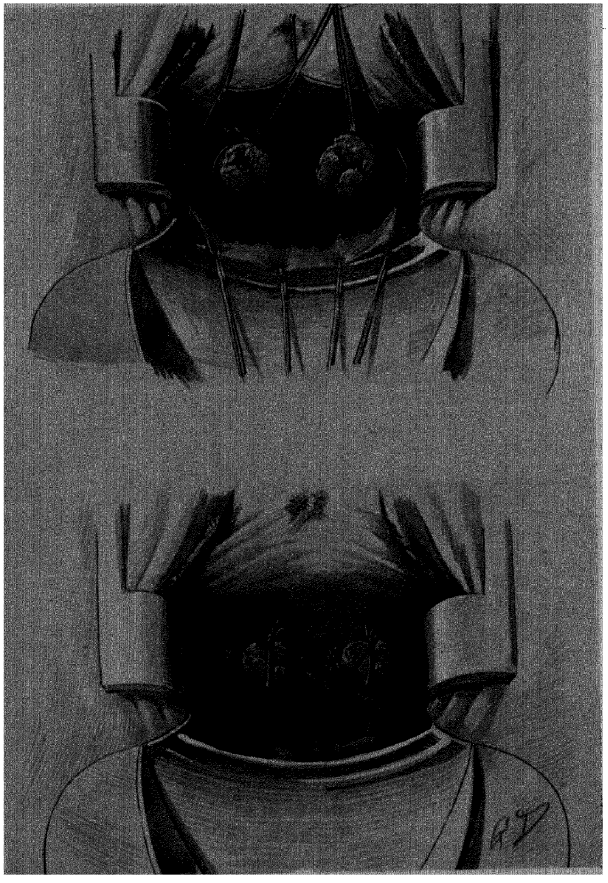


FIG. 488. VAGINAL HYSTERECTOMY. The final stage of the operation showing the method of dealing with the lateral stumps and of closing the vaginal wall. The upper figure shows the encircling ligatures left long and the former ones cut short. The lower figure shows the stumps lying in the vagina with the vaginal vault closed.

be drawn down and examined. If found to be diseased these structures should be removed; this is done by first defining the infundibulo-pelvic fold which carries the ovarian vessels. When this fold is clearly seen and put on the stretch, it is transfixed by the blunt needle (shown above), tied firmly with a stout ligature, and then divided. When the ovary and tube are left *in situ*, the tube is first transfixed, tied, and divided, and then the ovarian ligament and its vessels are dealt with by a separate ligature in the same manner.

Figure 487 shows the adnexa divided and the uterus removed. The peritoneum of the utero-vesical fold and that of the pouch of Douglas is seen united to the vaginal mucous membrane by interrupted sutures. The final steps of the hysterectomy consist in the fixation of the lateral stumps and the closure of the vaginal vault. Before the original ligatures are cut short, an encircling suture is passed around each stump, and the ends of each encircling ligature are passed through the vaginal flaps as shown in

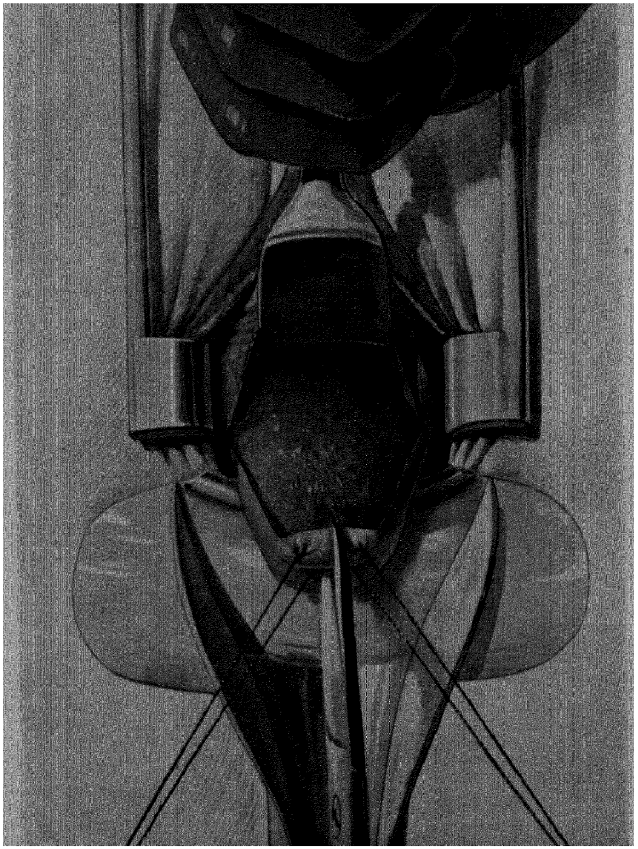


FIG. 489. VAGINAL MYOMECTOMY. The bladder has been dissected off the cervix and is being held up and protected by a flat bayonet-shaped retractor (*see* Fig. 485). The anterior lip of the cervix, steadied by long ligatures, is about to be divided in the mid line with scissors.

the lower drawing of Figure 488. Lastly, the edges of the vaginal flaps are brought together by interrupted sutures.

VAGINAL MYOMECTOMY

This operation may be extremely simple, as, for instance, when it only involves the removal of fibroid polypi from the cervix; on the other hand, it may require special skill, for example, in the removal of submucous growths, either sessile or polypoid, which are confined to the body of the

uterus. In these cases it may be necessary to raise the bladder off the cervix, to split the anterior cervical wall, and also to remove the fibroid piecemeal. The simpler operation will first be described.

Cervical Polypi. Fibroid polypi of the cervix generally have a stalked attachment to the wall of the canal, and the latter is usually dilated to some extent. The operation of removal merely consists in division of the pedicle with scissors, which may be done without fear of bleeding; or the polypus

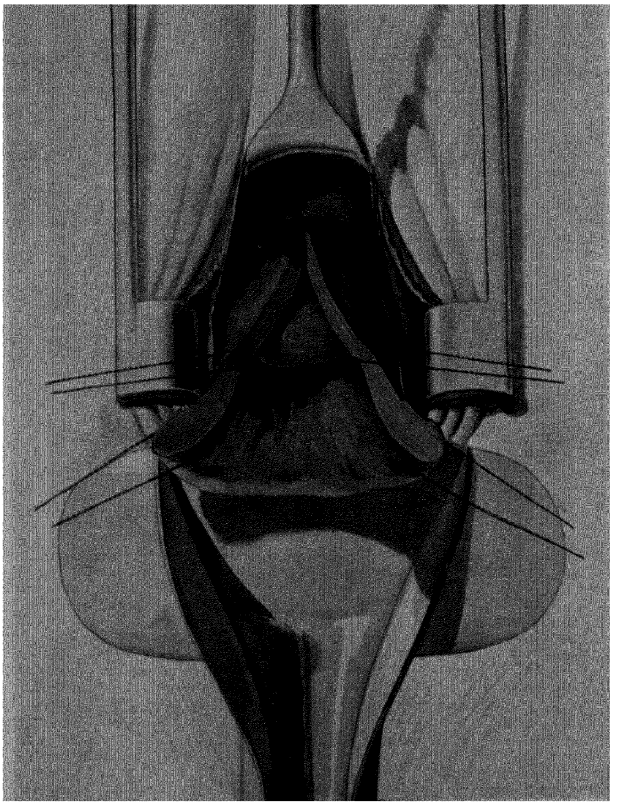


FIG. 490. VAGINAL MYOMECTOMY. The cervix has been split by a median incision in its anterior wall; the edges of the incision are transfixed and held aside by traction on long stout ligatures. The lower pole of a submucous fibroid is exposed through the upper part of the wound.

may be seized with forceps and its removal effected by twisting and snipping the stalk simultaneously.

Intrauterine Polypi. Fibroid polypi arising in the uterus may dilate the cervical canal and pass into the vagina, retaining their uterine attachment by a long pedicle, which may run up even to the fundus; as a rule, the attachment is found to be to the lower part of the uterine wall. There is no difficulty in removing growths such as these, if the pedicle is not too thick, by seizing the polypus in strong forceps and forcibly twisting it; or the stalk may be divided with curved blunt-pointed scissors passed along it into the uterus. The division should be made short of its actual base,

and only gentle traction made upon the polypus at the time, so as to avoid all risk of cutting into, or perhaps actually button-holing, the uterine wall. Very thick stalks are best dealt with by first partly dividing them with scissors, and then forcibly twisting through the remainder.

Fibroid polypi of considerable size may *remain within the uterine cavity*, and their removal is then more difficult, as the cervix cannot be sufficiently dilated to allow of their being withdrawn through it. The difficulty may be surmounted in either of two ways: (1) by reducing the size of the polypus

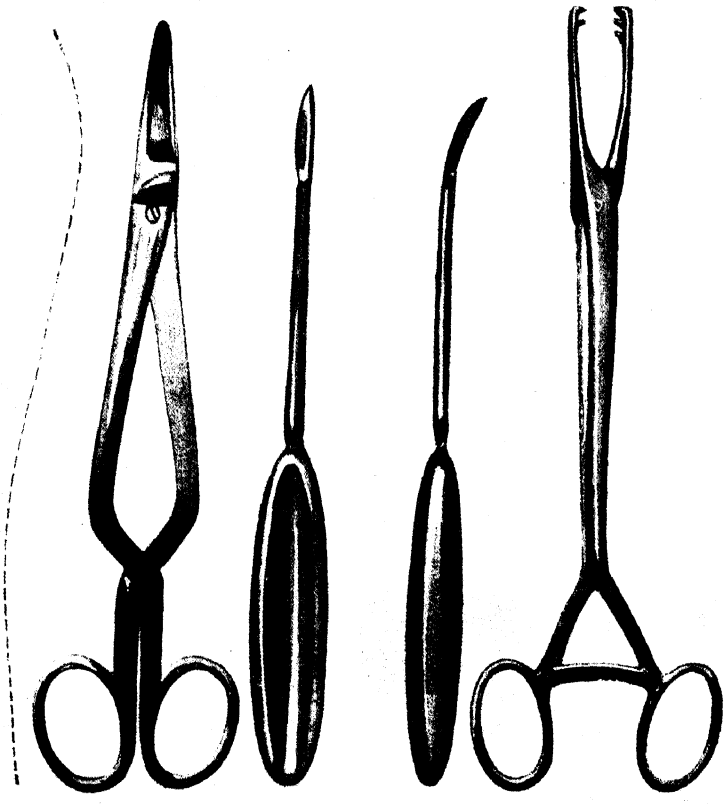


FIG. 491. INSTRUMENTS USED IN THE REMOVAL PIECEMEAL OF A LARGE SUBMUCOUS FIBROID (MORCELLEMENT).

before attempting its withdrawal; or (2) by enlarging the cervix, by incising it up to the level of the internal os; in the case of large polypi these two methods may be combined, as the cervix cannot be enlarged sufficiently to allow the polypus to pass. In either case the cervix should be first dilated to the fullest extent, and the preliminary use of a tent is helpful (*see* Fig. 498, p. 723). Then the index finger is passed into the uterus and the size and relations of the polypus are determined. Next, the polypus is detached by division and twisting of its stalk. A sessile submucous fibroid, such as that shown in Figure 232, page 388, may be dealt with by the method next to be described.

Vaginal Myomectomy by Morcellement. The foregoing description of how to deal with intra-uterine polypi embraces the main principles which underlie the operation of vaginal myomectomy. A fuller description is necessary of the method of dealing with large submucous fibroids by the vaginal route. These tumours frequently slough, and are then accompanied by a putrescent discharge, which renders any attempt to remove the uterus *per abdomen* particularly dangerous. Moreover, the cervix is frequently found to be opened up by such tumours, and their most dependent part

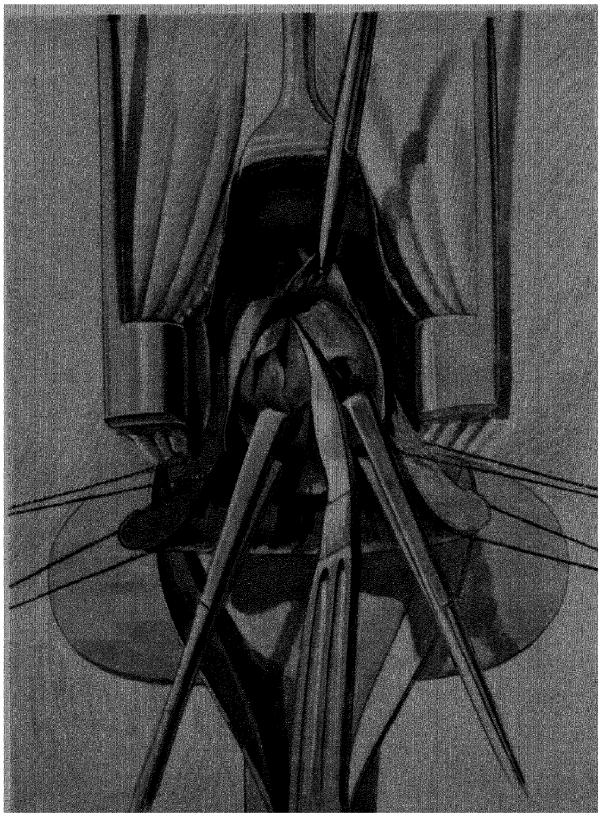


FIG. 492. MYOMECTOMY BY MORCELLEMENT. The tumour is removed piecemeal by seizing and cutting away segments of growth within its capsule.

may lie in the vagina. Taking a case where the cervix is not dilated, the operation of vaginal myomectomy is carried out in the following way: An Auvard's speculum is inserted to depress the perineum and the posterior vaginal walls. The vagina is dilated laterally by Jayle's self-retaining dilator (*see* Fig. 442, p. 666). The anterior lip of the cervix is grasped with a volsella and is drawn down. A wide crescentic incision is now made through the vaginal mucosa in front of the reflection of the bladder. When necessary two lateral incisions may also be made, passing upwards and outwards from either angle of the transverse incision, thus mapping out a tongue-shaped flap of vaginal mucous membrane (*see* Fig. 477, p. 706). The limits of the

bladder are indicated by the difference in appearance of the vaginal mucous surface in the anterior fornix, that covering the bladder being rugose, and that covering the anterior cervical wall below the bladder being smooth. The incision across the front of the cervix should therefore be made through the smooth and not through the rugose mucous membrane. The central point of the upper margin of the incision is grasped with toothed dissecting forceps and pulled vertically upwards, so as to put the connective tissue on the stretch. The vertical bands of tissue uniting bladder to cervix are then cut through with blunt-pointed scissors curved on the flat (Fig. 478, p. 707).

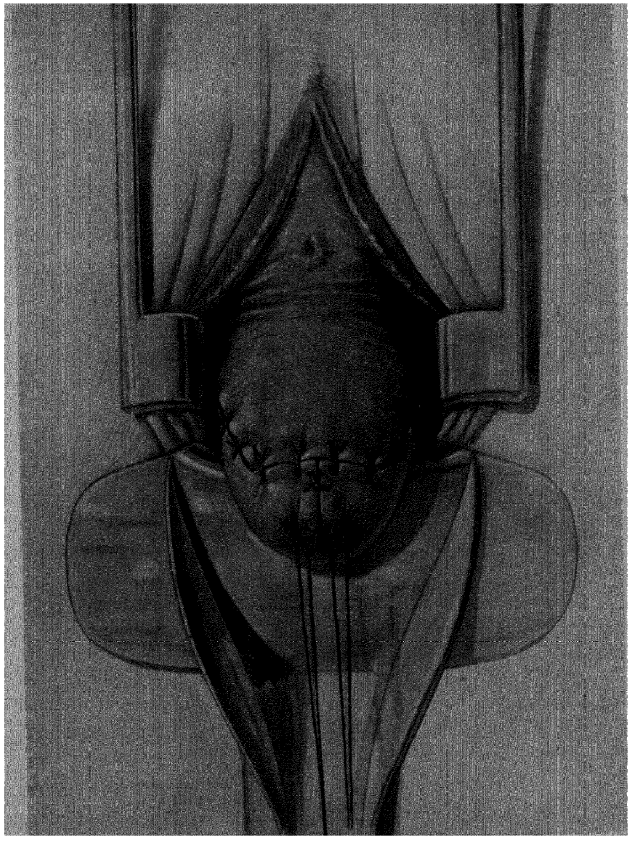


FIG. 493. VAGINAL MYOMECTOMY, showing the final stage of the operation.

When a fold of the bladder has thus been dissected off the cervix, separation may be completed by blunt dissection, *i.e.* by pushing the bladder off the cervix with a finger wrapped round with gauze. When the bladder is free it is held up by a bayonet-shaped retractor (*see* Fig. 485), or by a simple copper spatula, and the anterior wall of the cervix thus displayed is ready for splitting (*see* Fig. 490). Before the incision is made, a stout silk ligature is passed through the lips of the cervix on either side of the volsella which has already been applied to the anterior lip for the purpose of drawing it down. As soon as the ligatures are applied the volsella is removed. The cervix is now steadied by traction on the ligatures, and its anterior wall is

divided in the middle line. A second pair of ligatures may be applied to the flap of cervical tissue higher up near the internal os if required (*see* Fig. 490). With large submucous tumours arising from the fundus it is sometimes necessary to carry the median incision beyond the internal os into the lower uterine segment, in which case the utero-vesical pouch is opened up as well (a thing to avoid if the tumour is sloughing). Where it is necessary to divide a portion of the lower uterine segment the flap-incision through the vaginal mucosa (*see* Fig. 477, p. 706) is most useful as it gives a wider approach to the field of operation. With the cervix thus opened up the intrauterine tumour is grasped with a volsella whilst an incision is made into its capsule. The latter is stripped back, and a portion of the exposed growth is seized with a second volsella and *morcellement* is begun. This consists in cutting up the tumour-substance piecemeal within its capsule. In thus dealing with a large tumour special instruments are desirable, and those of Segond well serve the purpose. They consist of very strong volsellæ, short-bladed knives on long handles, and stout curved scissors also with long handles (*see* Fig. 491). Successive portions of growth are seized with a volsella, then gouged out and cut away with the knife (*see* Fig. 492). Observance of the following points is essential: (1) The growth must be kept well in view. (2) Before a piece is removed another hold must be taken by a second volsella, applied elsewhere to the tumour. (3) The process of cutting up must be carried on within the capsule. (4) The index finger of the right hand should frequently be inserted inside the capsule for the purpose of stripping it off the successively accessible portions of the tumour. (5) The fundus must be grasped by an assistant. By working inside the capsule, and by preserving its integrity, free hæmorrhage is avoided. The uterus contracts *pari passu* with the morcellement and enucleation. When the growth is removed, the capsule has to be dealt with. It may be found to be intimately adherent to the fundus, in which case it is best to cut away the freed portion, and leave the adherent part to come away during subsequent involution. When the uterine cavity is emptied, an ampoule of "Femergin" should be injected into the muscles of the buttock, and the edges of the cervical incision are then brought together by interrupted sutures of chromic gut, which are passed through the entire thickness of each wall. The uppermost stitch is placed just above the upper angle of the incision. The last suture should be so placed as to effect accurate apposition of the lips of the external os. The integrity of the cervix having been restored the bladder retractor is removed, and the crescentic or flap-incision in the vaginal mucous membrane is then closed by interrupted catgut stitches (*see* Fig. 493). A drain of bismuth gauze is inserted into the uterine cavity.



FIG. 494. AUVARD'S SELF-RETAINING VAGINAL SPECULUM. The shank of the speculum is weighted with a ball of lead, and channelled to allow of the escape of douche-fluids from the vagina.

DILATATION OF THE CERVIX AND CURETTING

Dilatation of the Cervix. Apart from pregnancy, this operation may be performed in the following conditions: (1) spasmodic dysmenorrhœa; (2) as a preliminary to curetting or other intra-uterine operations; (3) to establish drainage in pyometra or purulent endometritis.

The vulva and vagina having been thoroughly swabbed and douched under the anæsthetic, a careful bimanual examination of the pelvic organs should be made, as a routine procedure, before anything else is done. The most convenient speculum to use for depressing the perineum is that of

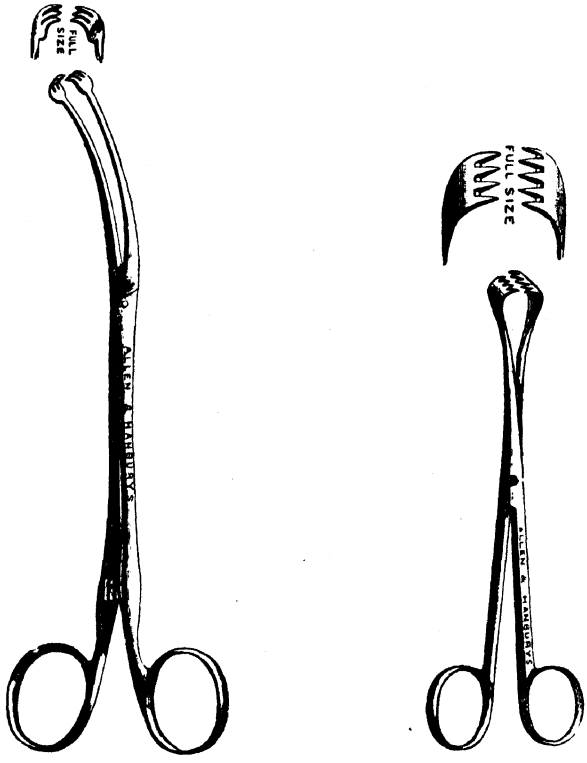


FIG. 495. VOLSELLA FORCEPS. The short pair is stronger and more generally useful for operative work than the long pair.

Auvard (*see* Fig. 494), which is self-retaining. The best lateral retractor is that of Jayle, which is also self-retaining (*see* Fig. 442, p. 666). The cervix is then seized with a volsella and its condition noted. Next, the cervical canal is swabbed out with 2 *per cent.* iodine solution and then the sound is passed to observe the length and capacity of the uterine cavity and the condition of its walls. A firm hold of the cervix is necessary in introducing the dilators, and two pairs of volsellæ such as those shown in Figure 495 may be used, placing one at each side of the anterior lip. Then the cervical canal is dilated with the graduated metal dilators shown in Figure 496, beginning with the smallest size and passing them in sequence until sufficient dilatation has been obtained. If the patient is a nullipara and the extern al os un

usually small, two lateral incisions may be made into the external os of about one-third of an inch in depth. The chief resistance to the passage of the dilators is found, however, at the internal os, the difficulty being greater

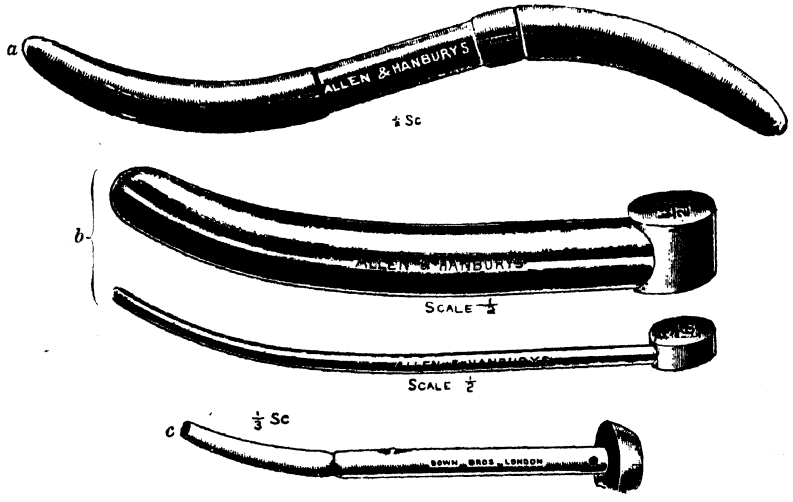


FIG. 496. UTERINE DILATORS: *a*, Fenton's; *b*, Hawkins Ambler's; *c*, Ramsay's (hollow). The instruments are made of metal, and are conical, being narrower at the point than the base. Ramsay's dilator is notched at a point two and a half inches from the tip.

in nulliparous than in parous women. The first four or five dilators usually pass easily; the sixth, seventh, and eighth encounter the greatest obstruction, and at this point a certain amount of laceration of the cervical tissues in the upper part of the canal usually occurs. The remaining dilators can then be passed without difficulty. Each should be firmly pushed in and carried right up to the fundus. The tubular dilator of Ramsay is easy to work with as it allows blood and secretion contained in the uterus to escape through the central channel. The extent to which the dilatation will be carried is determined by the purpose of the operation; for curetting it is sufficient to dilate to number ten; for spasmodic dysmenorrhœa dilatation should be carried up to number fourteen; only when it is desired to pass the finger into the uterus are the largest sizes required.

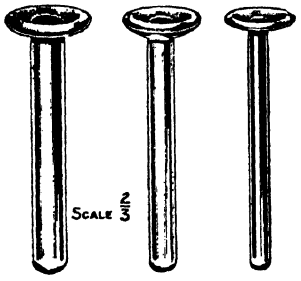


FIG. 497. INTRA-UTERINE GLASS STEMS FOR USE AFTER DILATATION OF THE CERVIX.

When full dilatation of the cervix is required the procedure may be rendered easier by the preliminary use of a laminaria tent (*see* Fig. 498), which should be introduced into the cervix at least twelve hours before the operation. The tent swells from imbibition of fluid, and not only starts the process of dilatation, but causes so much softening of the cervical tissues that subsequent dilatation with the graduated bougies is facilitated, and the risk of laceration thus diminished. It is therefore especially useful when it is desired to pass

the finger into the uterus in the case of a nulliparous woman. The disadvantages of the tent are that in an unmarried woman it is difficult to pass it without an anæsthetic, and that while it is in the cervix severe uterine colic (spasmodic contraction) is sometimes set up.

Tents may be sterilized by keeping them for a week or ten days in absolute alcohol. To pass them, a tent-forceps such as is shown in Figure 498 is useful. After preliminary swabbing of the vagina, the cervix is exposed and seized with a volsella; the tent is then passed until the upper end is well through the internal os. In a nullipara it is best to pass a small size, and if possible introduce a second beside it. In a multipara a single tent of larger size will suffice. The use of a tent is absolutely contra-indicated by the presence of purulent or offensive discharges. As an alternative, preparatory softening of the cervix may be obtained by the use of a glycerine tampon a few hours before dilatation is commenced.

Dilatation of the cervix is frequently performed as a preliminary step, to be followed by further intra-uterine procedures such as digital exploration, curetting, removal of polypi, etc. The introduction of the finger for exploration is only required in certain cases, and these may be indicated as follows: (1) when a polypus or other intra-uterine new growth is suspected; (2) in

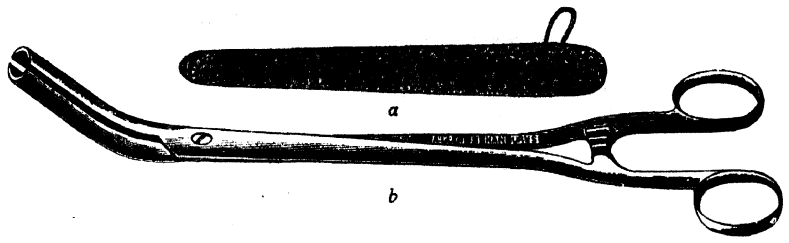


FIG. 498. *a*, LAMINARIA TENT. *b*, TENT-FORCEPS. The tent is made of compressed sea-tangle, which swells considerably from absorption of moisture.

cases of hæmorrhage following abortion or child-birth, when retained pieces of placental tissue may be found; (3) when, after curetting, hæmorrhage is profuse and difficult to control. The index finger is the most convenient one to use; traction is made with the volsella, by an assistant, upon the cervix, and, aided by the left hand placed in contact with the fundus, the right index finger is gradually pushed upwards so as to explore the walls of the uterus on both sides, and especially the tubal angles. If the uterus can be well drawn down and it is not greatly enlarged, its cavity can be explored with the little finger.

In the case of a nulliparous woman who has passed the menopause it is, however, very difficult to dilate the cervix sufficiently to admit the finger without causing severe laceration, and it is usually preferable to place reliance upon the sound and the curette.

Curetting. This operation consists in scraping away the endometrium with a sharp spoon or *curette*, after suitably dilating the cervix, and, in some cases, also exploring the uterine cavity with the finger. The indications for its performance are: (1) General enlargement of the uterus not due to a new growth, and associated with hæmorrhage or discharge, *e.g.* subinvolution, chronic endometritis, and allied conditions; (2) cases of uterine hæmorrhage for which no definite cause can be found; (3) occasionally in hæmorrhage

from small interstitial fibroids; (4) suspected malignant disease of the uterine body, for diagnosis; (5) as a preliminary to certain operations for uterine displacements; (6) cases of sterility or repeated abortions, for which no constitutional or local cause can be found.

After suitable dilatation of the cervix, the scraping is most conveniently done with a flushing curette of the patterns shown in Figure 499. The instrument is channelled to allow of sterile saline solution, or of a non-toxic

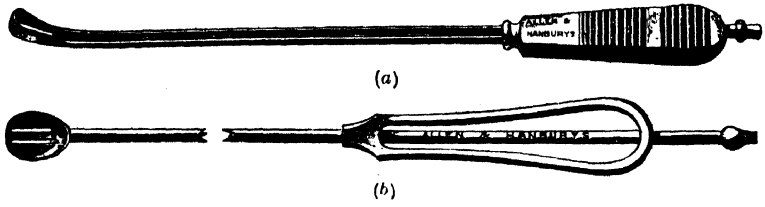


FIG. 499. THE FLUSHING UTERINE CURETTE. The stem is channelled to allow of the uterine cavity being irrigated.

antiseptic—such as iodine or lysol—being run through it, to irrigate the uterine cavity. The spoon-shaped end has a moderately sharp edge capable of removing the soft mucosa. The large size (*b*) has the advantage of being too large and blunt to be inadvertently pushed through the uterine wall; the small one (*a*) can, however, be directed more thoroughly into the uterine angles so that the endometrium of this part does not escape complete removal. The latter is therefore more efficient, and if carefully used it is not a dangerous instrument. The blunt curette made of stout wire may, however, be

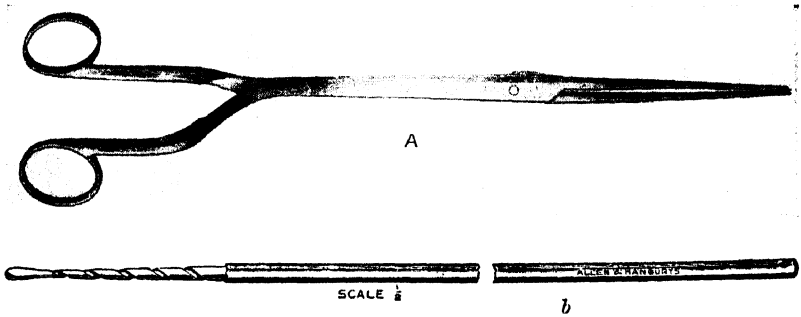


FIG. 500. (A) CERVICAL DRESSING FORCEPS AND (*b*) PROBE FOR INTRA-CERVICAL APPLICATIONS.

employed in exploratory curetting for suspected cancer of the body of the uterus, in which condition the tissues of the uterine wall are unusually friable, and perforation may readily occur.

In scraping the uterus the entire wall should be systematically dealt with, the mucosa being removed in strips by pressing the edge of the curette firmly against the uterine wall and drawing it from the fundus down to the cervix. *The uterine angles require special attention.* The detached pieces can be collected as they are washed away by the solution which pours freely out of the dilated cervix. After completing the scraping, the uterine cavity

may be dried with a probe or forceps covered with a twist of sterilized gauze. Oozing may be free, and can usually be checked by raising the temperature of the flushing solution to 118° F., or by applying upon a uterine probe (*see* Fig. 500) a strong antiseptic styptic, such as tincture of iodine, or iodised phenol (iodine, grs. 40; liquefied carbolic acid, 1 ounce). If this is not completely successful, a strip of sterile or antiseptic gauze, *e.g.* subgallate of bismuth, may be passed up to the fundus by uterine dressing forceps (*see* Fig. 500) and a tampon placed in the upper part of the vagina. The application of a strong antiseptic to the uterine walls is always desirable in cases of chronic endometritis of infective origin.

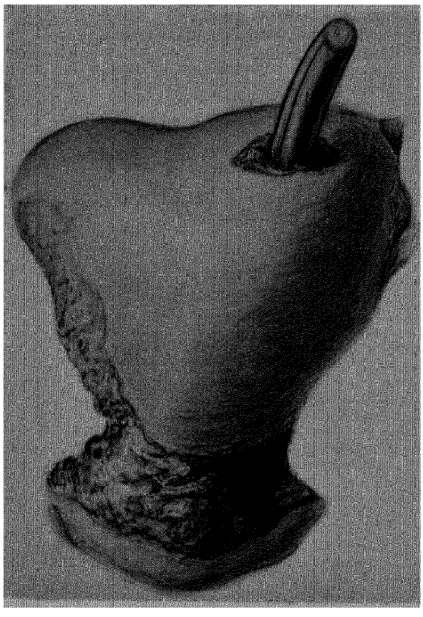


FIG. 501. PERFORATION OF THE FUNDUS UTERI BY A METAL DILATOR.

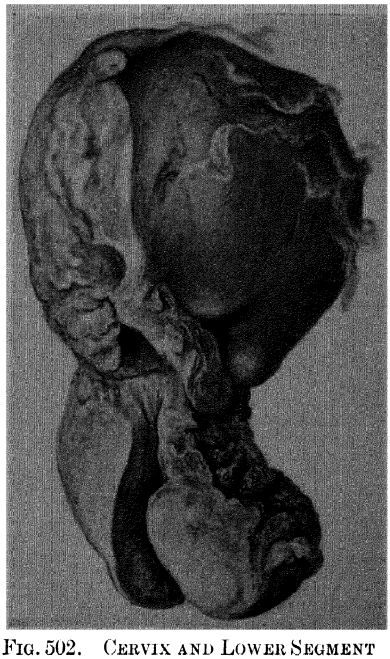


FIG. 502. CERVIX AND LOWER SEGMENT OF BODY OF UTERUS SPLIT DURING DILATATION PREPARATORY TO CURETTAGE. The uterine artery was torn across and extensive intraperitoneal hæmorrhage resulted.

The uterine wall may be *perforated* by the curette, or, as is more likely, by the dilators, especially the small sizes. This accident should be at once observed by the absence of resistance to the onward passage of the dilator after the proper limit has been reached. No bleeding results from perforation with a *small* dilator, and, if the operation has been aseptic and the uterus not previously infected, no harm follows. The operation can be completed, for the aperture is spontaneously closed by muscular contraction and by the elasticity of the tissues. This accident must not, however, be considered as of slight importance, since under certain conditions it necessitates sacrificing the uterus. If, for example, the perforation has been caused by a *large* dilator, the hæmorrhage may be so severe that it cannot be checked

satisfactorily (*see* Fig. 501), and hysterectomy is then the safest treatment. Again, if a septic uterus, the walls of which are usually softened, is thus perforated, either the uterus should be at once removed (by the vaginal route if practicable), or the posterior fornix should be opened and free drainage *per vaginam* provided. The perforation is much more likely to occur in the lateral or posterior walls than the anterior; if in the lateral wall, the peritoneal cavity is not necessarily opened, and the risks are consequently less serious. In dilating a rigid cervix a laceration at the internal os may

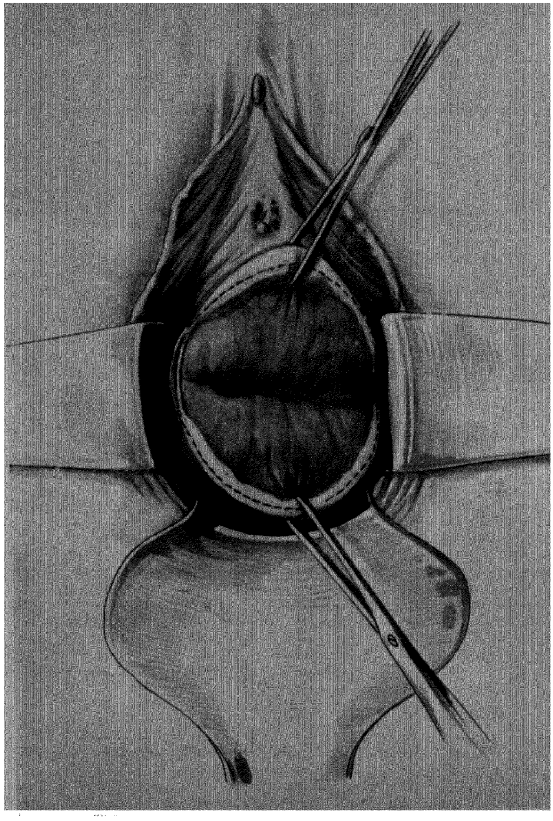


FIG. 503. EXPOSURE OF THE CERVIX FOR TRACHELORRHAPHY. The dotted lines indicate the incisions by which the flaps are raised.

occur so deep as to communicate with the broad ligament. This, again, does not, as a rule, cause severe bleeding, and is usually not observed unless the finger is introduced into the uterus. On the other hand, laceration of the lateral wall of the cervix may involve a branch of the uterine artery and cause dangerous internal hæmorrhage (*see* Fig. 502).

Free *bleeding* after curetting is usually found to be the result of incomplete detachment of some new growth, such as a polypus, the presence of which was unrecognised. The finger should always be introduced into the uterus for exploration in such cases, in order that the operation may be properly completed.

PLASTIC OPERATIONS ON THE UTERUS AND VAGINA

Trachelorrhaphy. This operation is designed for the repair of cervical lacerations; an operation planned upon similar lines may also be performed in cases of extensive cervical "erosion" without laceration, the effect being to excise the "erosion" and cover the area with the vaginal mucosa.

Cases requiring operation are almost always associated with eversion and "erosion" of the walls of the cervix. The complete procedure, therefore, consists of repair of the lacerations, and excision of the areas of "erosion,"

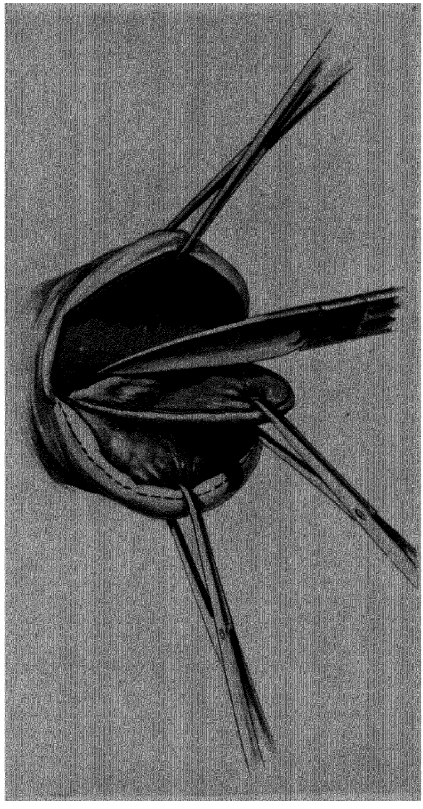


FIG. 504. TRACHELORRHAPHY. Cutting away the everted cervical lips. A vaginal flap has been raised from the cervix.

which at the same time corrects eversion. The operation can best be described in steps:

Step I. Dilatation and curetting. This is usually advisable, partly because the uterus is unhealthy, partly because dilatation facilitates the subsequent steps of the operation.

Step II. To outline the flaps. The cervix being exposed with Jayle's retractor and Auvard's speculum, is pulled down as far as possible with two pairs of volsellæ. An incision is then made in the vaginal mucosa which begins on the right side one-eighth of an inch above the apex of the triangular gap left

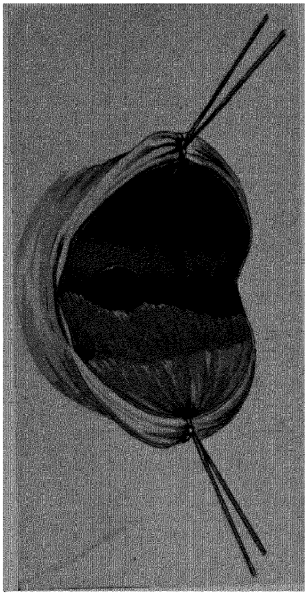


FIG. 505. TRACHELORRHAPHY. The everted lips have been cut away and the vaginal flaps are held with ligatures which transfix the apex.

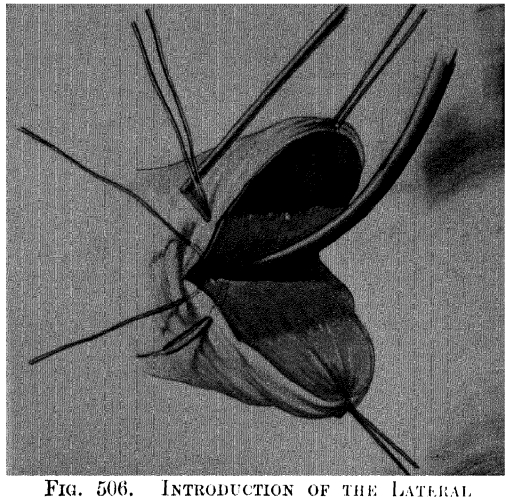


FIG. 506. INTRODUCTION OF THE LATERAL STITCHES. The sound is in the cervical canal.

by the laceration, and is continued along the edges of the "erosion," around the anterior lip, and up to a corresponding point above the apex of the laceration on the left side. This incision is about one-eighth of an inch deep, *i.e.* it divides the vaginal mucosa only (*see* Fig. 504). The cut edge is then seized with Kocher's forceps and the flap dissected upwards to the level of its base (*see* Fig. 504); this flap includes the vaginal mucous membrane only, which is thus raised from the cervical wall. The posterior lip

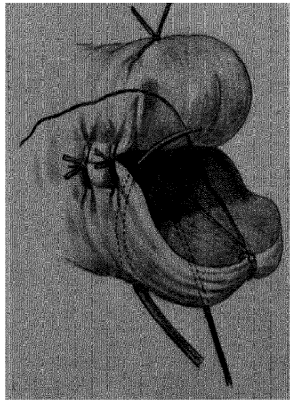


FIG. 507. THE ANTERIOR FLAP HAS BEEN ADJUSTED. One strand of the ligature on the posterior flap has been drawn through the cervical wall.

is then similarly treated, and in joining the incisions at the sides of the cervix, care must be taken to include all the cicatricial tissue which lies in the apex of the laceration.

Step III. Amputation of the everted Cervical Lips. The exposed lower part of the cervix, consisting of the everted surfaces, is now cut away.

Step IV. Reconstruction of the External Os (Bonney's Method). The manner in which the continuity of the surfaces is restored is shown in

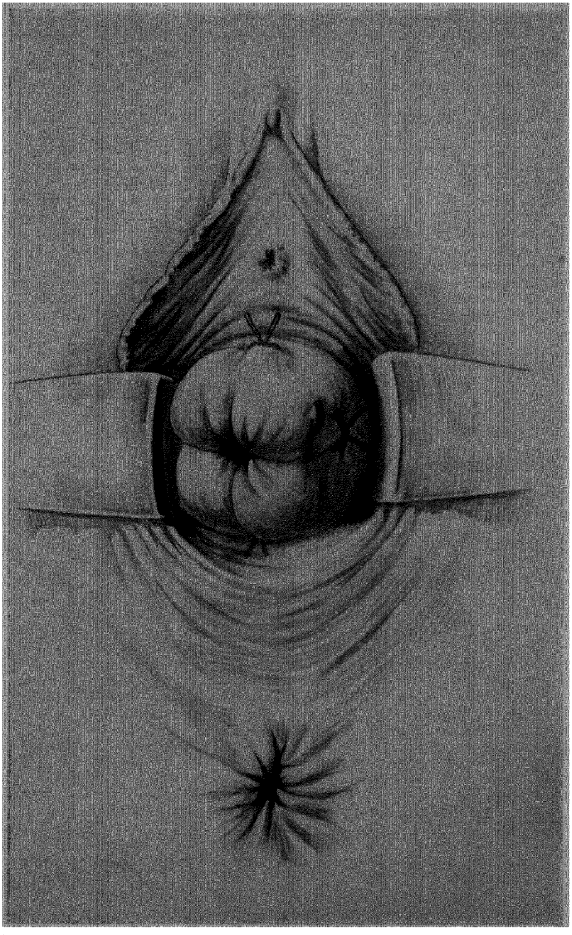


FIG. 508. TRACHELORRHAPHY. The operation completed.

Figures 505 to 508. The best material to use for the stitches is a hardened catgut of the variety sold by manufacturers as "thirty-day" catgut. A suture about 12 inches long is passed through the apex of each flap, and knotted at its middle, so as to leave two parts of equal length.

Then one or two sutures are passed deeply at the sides of the cervix, so as to close the region of the apex of the laceration. These should enter the tissues deeply and are important in the control of oozing (*see* Fig. 506), as the vessels supplying the cervix all enter at the sides.

The cervical flaps are now used to cover over the remaining raw area

as shown in Figures 507 and 508. Each end of the ligature is made to transfix the cervical wall, entering through the canal and emerging upon the vaginal surface at about the level of the base of the flap. In passing these stitches, a curved long-handled needle is often convenient. It is entered on the *vaginal surface* and made to emerge in the *cervical canal;* then the ligature is passed into the slot and pulled through. Or a fully-curved needle held in a needle-holder may be used, when the needle is entered in the cervical canal and made to emerge on the vaginal aspect. This procedure is carried out with each half of the ligature with which the flap was transfixed. When both ends of the ligature have been made to transfix the cervical wall and are knotted, the effect is to roll in the flap as shown in Figure 507 until its apex is brought up against the edge of the cervical canal. The repetition of this procedure upon the posterior flap completes the external os (*see* Fig. 508). An additional lateral ligature may be needed to unite the edges of the flaps completely; it is important that all oozing should be controlled. The cervix and vaginal roof should then be swabbed with tincture of iodine, and the vagina may be packed with bismuth gauze, which is removed twenty-four hours later.

It will be observed that the effect of this operation is to shorten slightly the vaginal portion of the cervix as well as to repair the injury.

Emmett's Trachelorrhaphy. This is the classical operation for cervical laceration. It consists in removing a narrow strip of tissue corresponding to the edges of the laceration, and including the apex of the tear in all cases. If the cicatricial tissue in the latter situation is not removed, primary union of the wound is much impeded. It is therefore well to clear the lateral aspect of the cervix by dissecting up the vaginal wall for half an inch above the apex of the laceration, in order to expose this area clearly. The cicatricial tissue can then be cut away and a stitch placed at once in the apex of the incision in the cervix. This stitch will later on be covered over by the vaginal wall when the edges of the latter are brought together. The edges of the rest of the wound are then united by stitches passed as follows: the stitch enters on the vaginal aspect of the anterior lip, and emerges upon its cervical aspect; next it passes through the posterior lip in the reverse direction and is knotted upon the vaginal surface. Three or more ligatures may be required on each side. In excising the strips, care is taken to leave untouched a bridge of tissue at the apex of each lip about one-third of an inch long, which will serve to form the margins of the external os of the reconstructed cervix.

The operation sacrifices less tissue than the procedure first described and does not shorten the cervix. But it leaves the bulk of the 'eroded' area untouched, and does not allow the eversion of the lips to be completely overcome. Except for slight cases the complete operation is therefore to be preferred.

Amputation of the Cervix (Vaginal Portion). This operation is performed for hypertrophic elongation of the *portio vaginalis.*

The operation is planned upon the same lines as those just described for trachelorrhaphy. Owing to the elongation of the lower portion of the cervix the anterior flap-incision may be placed higher up without endangering the bladder (*see* Fig. 509). The lower limit of the bladder must be defined by the sound before commencing the incision, and again before passing the deep stitches. The amount of cervical tissue removed is, however, much greater

than in trachleorrhaphy, and in delimiting the flaps due regard must be paid to the extent of tissue which it is proposed to remove. The base of the flap corresponds to the level of the amputation, and the flap should be about

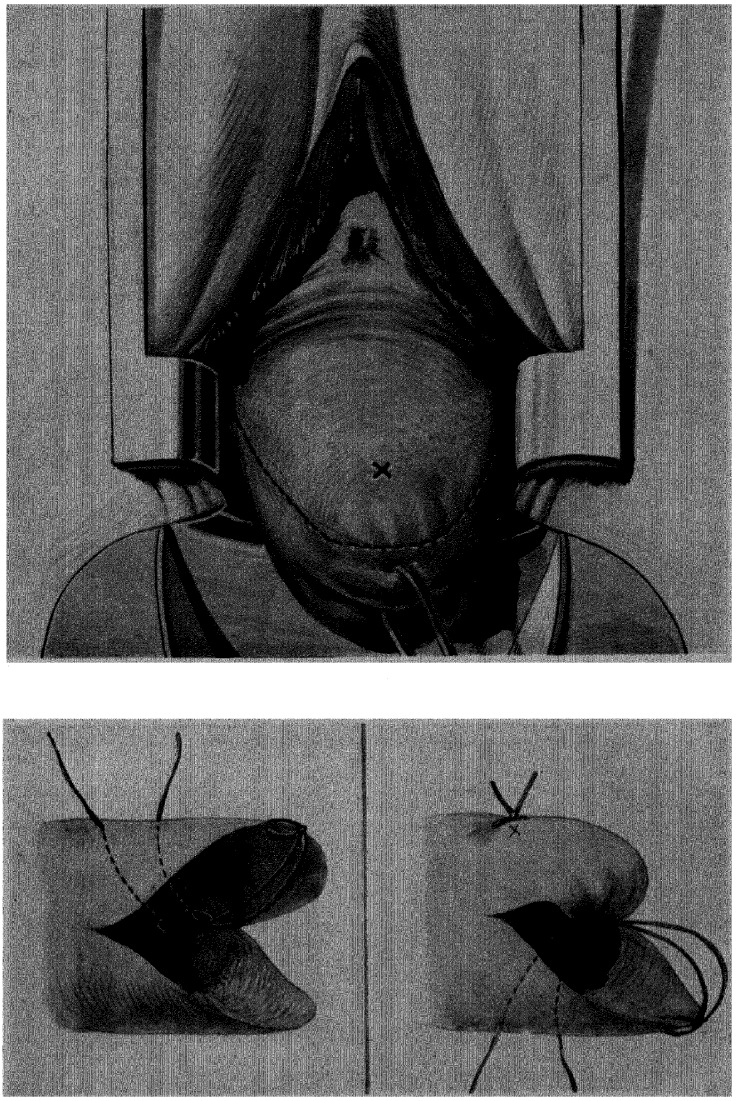


FIG. 509. AMPUTATION OF THE CERVIX. The dotted line in the upper figure indicates the extent of the anterior flap. The posterior flap is formed in the same way. The two lower figures show the shelving character of the flaps and the method of rolling them in.

three-quarters of an inch long to allow for shrinkage (*see* Fig. 509). The covering of the stump is carried out in the manner described above. The careful *understitching of the vascular areas* at the sides of the cervix is an important operative detail.

Pozzi's Operation for Sterility. The cervix is seized with a volsella on either lip and drawn down. It is then divided on each side with scalpel or scissors, the incisions extend upwards for about three-quarters of an inch to 1 inch (*see* Fig. 510). The raw surfaces thus produced are hollowed out by removing a small tongue of the fibro-muscular wall. The mucous membrane of the cervical canal is then sutured to the vaginal surface of the cervix by two or three interrupted sutures of chromic catgut (*see* Fig. 511). The union of the mucous membrane and cervical skin prevents adhesion of the cervical lips, by covering in the raw surfaces. The operation is usually

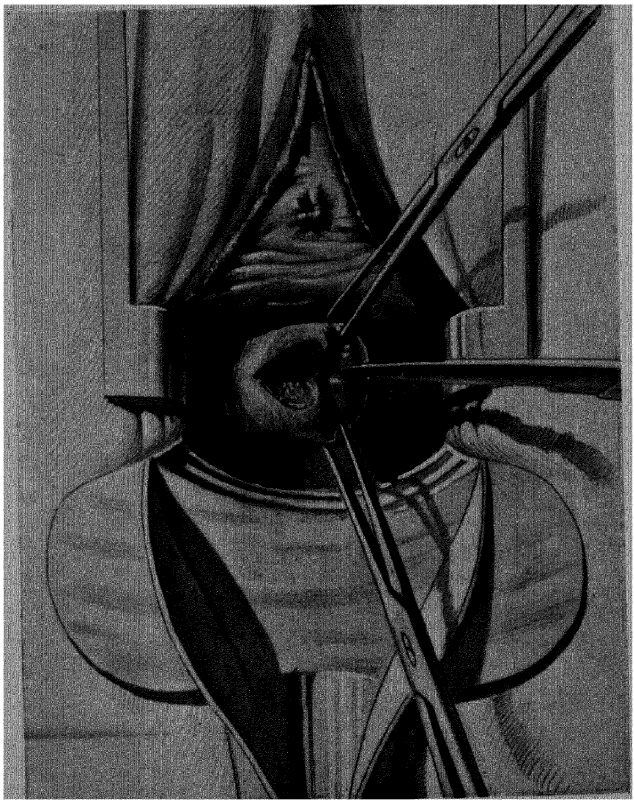


FIG. 510. POZZI'S OPERATION FOR STERILITY, showing the depth to which the incision is carried.

begun by curetting the uterus, and concluded by lightly packing the upper part of the vaginal canal with bismuth gauze, which should be removed after twenty-four hours.

Attention must be called to an important detail in the after-treatment of plastic operations on the cervix. There is considerable risk of the occurrence of secondary hæmorrhage during the second week. The patient should accordingly be kept in bed for at least fourteen days, and it is better to avoid vaginal douching and do nothing to disturb the cervical stitches. Secondary hæmorrhage can usually be stopped by careful plugging, but an anæsthetic may be necessary to carry this out effectively.

The liability to secondary hæmorrhage after plastic operations on the cervix is explained by the following consideration : it is practically impossible to sterilize the cervical endometrium on account of the depth to which the glands penetrate the wall of the cervix ; in most cases of cervical amputation there is already a mild chronic infection of the cervix, and accordingly primary healing of the wound is unusually difficult to secure. These are the conditions under which secondary hæmorrhage is most liable to occur.

It should be recollected that many cases of chronic cervical infection

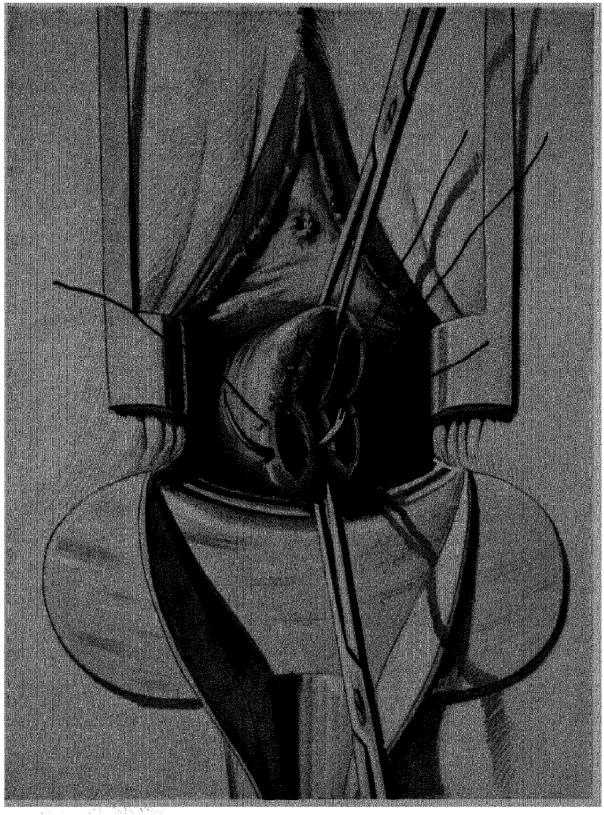


FIG. 511. POZZI'S OPERATION FOR STERILITY, showing the mode of closure of the incisions by apposition of cervical and vaginal surfaces.

can be cured by diathermy, and this method may usefully be combined with operative measures.[1]

The Radical Cure of Cystocele. This operation is designed for the radical cure of prolapse of the anterior vaginal wall and bladder. It is therefore performed in cases of simple cystocele, and also in cases of marked uterine prolapse, when it is usually combined with other procedures, such as perineorrhaphy. The aim of the operation is to restore the structures which normally form the *floor of the bladder, i.e.* the structures upon which the base of the bladder rests. This involves a deep dissection, as will be seen immediately, and the operation differs so much in character from the

[1] See remarks on the effects of diathermy, page 269.

procedure generally described as *anterior colporrhaphy*, that it is advisable to apply to it a different name. It may therefore be spoken of as the *radical cure* of cystocele, which brings it into line with the operations, similar in principle, performed for abdominal hernia.

The most careful aseptic technique is required to ensure primary union of the wound. Urinary infection, and the presence of a purulent vaginal

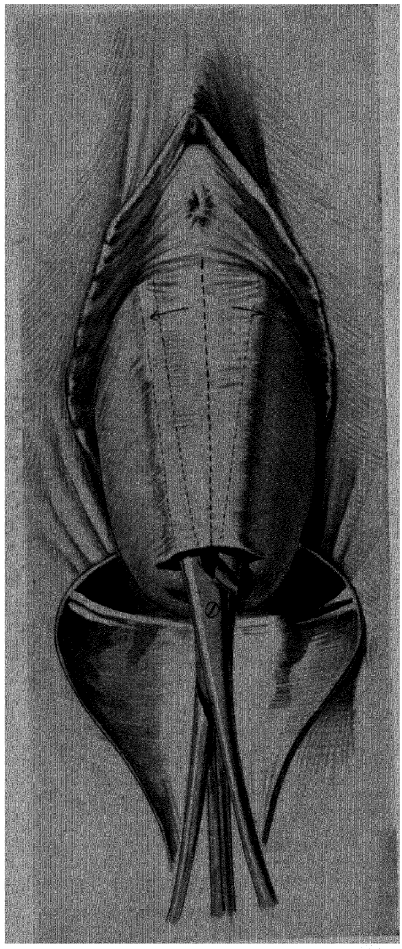


FIG. 512. RADICAL CURE OF CYSTOCELE. *Step I:* The cervix is pulled down with a volsella, which, to simplify the illustration, has not been shown.

discharge, are absolute contra-indications; the operation must be postponed until these conditions have been cured. The full preparation of the patient and of the field of operation must be carried out in the manner described on page 658. Hardened catgut (thirty-day) is the best suture material.

Steps of the Operation. In cases accompanied by marked prolapse of the uterus, good exposure of the whole length of the anterior vaginal wall can be obtained by traction on the cervix with a strong volsella, pulling the external

os as far out of the vulva as possible. In less advanced cases, adequate exposure can be obtained by the use of Jayle's retractor (*see* Fig. 442).

Step I. A transverse incision half an inch long is made on the anterior wall of the cervix half an inch above the os externum. A pair of narrow blunt-pointed scissors is then entered on the flat immediately beneath the vaginal mucosa and thrust upwards towards the urinary meatus in the manner shown in Figure 512. By opening the blades the loose cellular-tissue plane

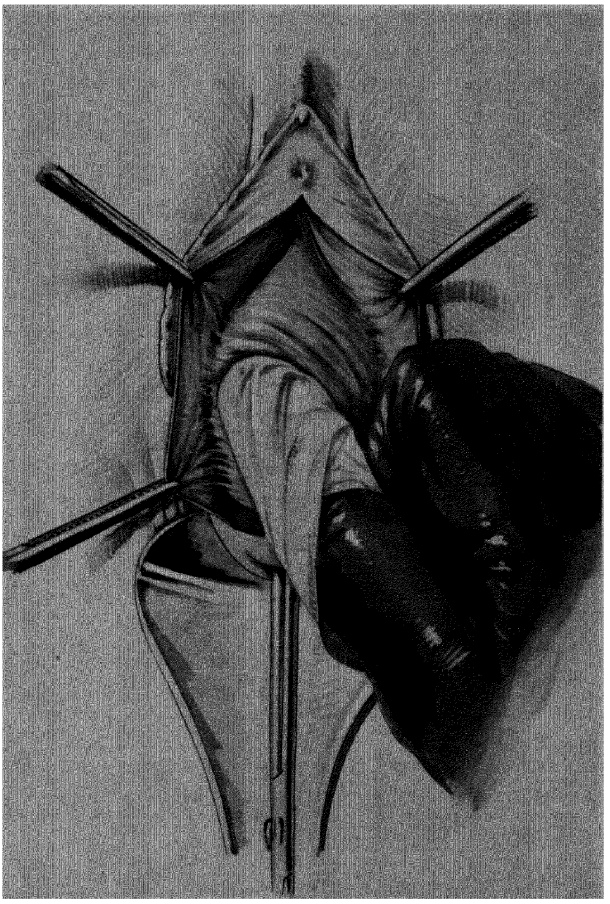


FIG. 513. RADICAL CURE OF CYSTOCELE. *Step II.* Separating the bladder by blunt dissection from the vaginal walls.

between bladder and vagina is opened up, and an extensive separation of these two structures is obtained. The anterior vaginal wall is then slit up with scissors along the mid-line, as marked in Figure 512.

Step II. The edge of the median incision is picked up on each side with two or three pairs of forceps and the separation of the bladder from the vaginal wall completed. This is done mainly by blunt dissection, with the finger and a swab (*see* Fig. 513), but here and there fibrous bands must be divided with knife or scissors. In long-standing cases of prolapse the vaginal wall may be much thickened, and inflammatory adhesion of the superficial

and deep structures may have occurred, to an extent which necessitates a good deal of cutting. The separation is carried out laterally on each side, until the finger defines the edge of the bony pubic arch ; large veins may here be met with. Next the bladder is dissected off the anterior wall of the cervix in the same manner, partly by snipping with scissors, partly by the finger and swab (*see* Fig. 514), the separation being carried up as far as the peritoneal reflection, but the peritoneum should not be opened. The whole of the base of the bladder now lies fully exposed in the wound, and all bleeding-points

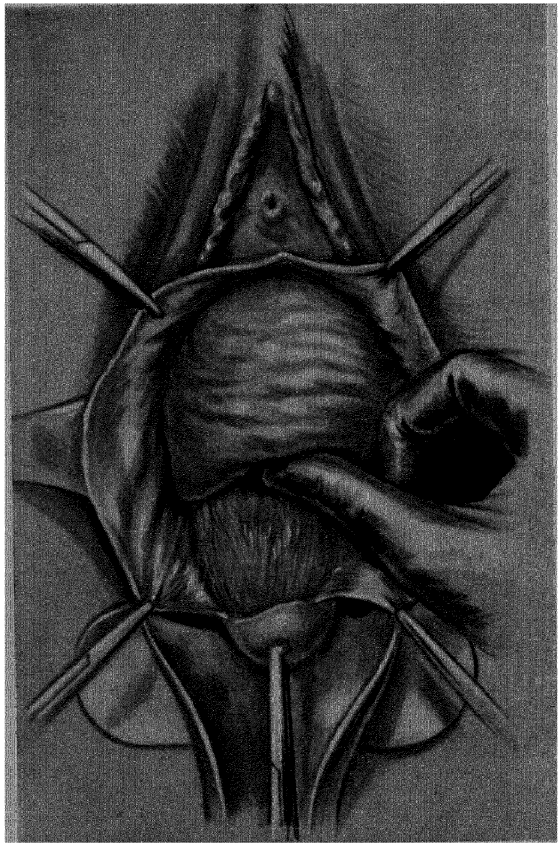


FIG. 514. RADICAL CURE OF CYSTOCELE. *Step II (continued)*: Separating the bladder from the cervix.

upon it should be carefully ligatured. It will be found that, with the finger, the bladder can now be pushed upwards behind the pubes until it is out of sight (*see* Fig. 515).

Step III. The *supports of the bladder* are next restored. On inspecting the deep surfaces of the lateral flaps which have been raised these structures can be defined, although at times they have been so far attenuated by over-stretching as to be difficult to recognize. These tissues represent the lateral portions of the pubo-coccygeus (levator ani) muscles at the sides and the pubo-cervical fascia and muscle (*see* pp. 59 and 509) in the middle. Without further

dissection they can be brought together in the middle line by interrupted sutures which are entered as far out as possible on each side (Fig. 515). In introducing these stitches, the bladder is pushed up out of the way by an assistant, and should be held there until the stitches are tied. Two stitches are passed in this way. A third stitch is passed through the muscul5-fascial layer and also made to take a deep hold of the exposed anterior cervical wall, so that when tied the edges of the tissue are held in contact with the cervix, and no interval remains through which the bladder might again become

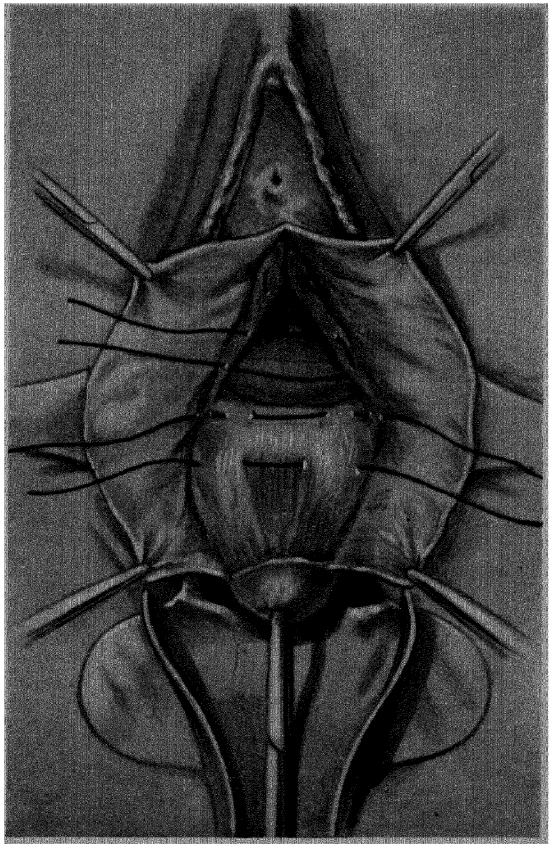


FIG. 515. RADICAL CURE OF CYSTOCELE. *Step III:* Restoration of the supports of the bladder.

pushed down. The fourth stitch (shown in Fig. 515) takes up the cellular tissues at the sides of the cervix corresponding to the lowest parts of the broad ligaments and unites them in front of the cervix.

Step IV. The redundant portions of the vaginal flaps are now cut away, and the edges united with a running stitch or with interrupted sutures, beginning at the cervix and ending just below the urinary meatus (*see* Fig. 519).

Elongation of the cervix, often accompanied by marked thickening and erosion of the cervical lips, is a not uncommon complication of prolapse, and

in such cases it is desirable to combine amputation of the cervix with the procedure just described. After Step III. has been completed an incision is carried round the lateral and posterior aspects of the cervix a little below the level at which amputation is to be done. The posterior vaginal wall is then reflected partly by cutting and partly by blunt dissection as shown in Figures 516, 517, and the sides of the cervix are cleared in the same way. The cellular tissue at the sides of the cervix is then picked up with forceps, and a ligature passed as shown in Figure 518. This will control the blood vessels which enter the cervix below the level of amputation. The cervix is now cut away at a level which removes the whole of the portio vaginalis and a portion of supra-vaginal cervix also. The cut surfaces of the cervical

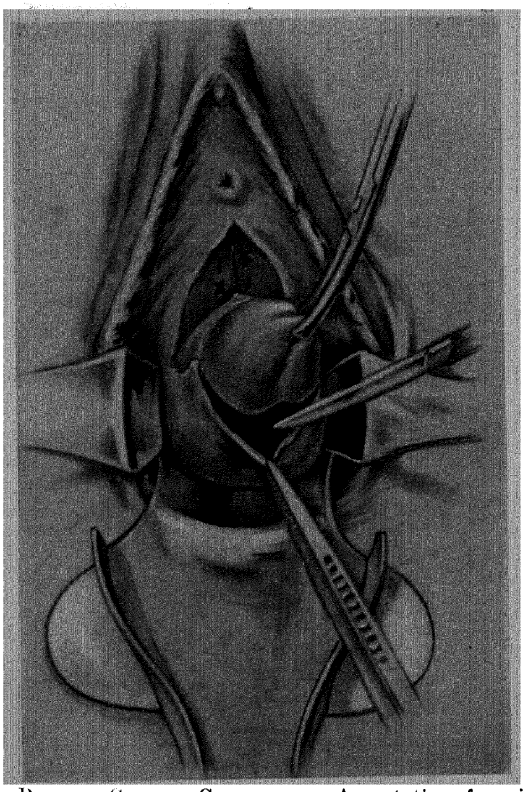


FIG. 516. RADICAL CURE OF CYSTOCELE. Amputation of cervix, 1st stage.

walls are then covered by the vaginal flaps in the manner described on a previous page. Finally the incision in the anterior wall is united as in Step IV. (*see* Fig. 519, p. 741).

The vaginal walls are finally swabbed freely with tincture of iodine, and the canal loosely packed with sterile gauze. If the perineum is deficient, perineorrhaphy should also be performed, in order to afford the bladder additional support.

Perineorrhaphy. This procedure is a plastic operation for the secondary repair of obstetric injuries of the perineum and of the posterior vaginal wall. The operation required for the primary or immediate repair of such injuries

is described in textbooks of midwifery. In cases where the primary operation has failed, secondary repair should not be undertaken for at least twelve weeks, this interval being required to allow the natural processes of involution to be completed, and any local infection which may be present to be cleared up. In many cases it is desirable to wait even longer than twelve weeks, for it is better not to undertake the secondary operation while any signs of local infection persist.

The extent of the operation varies according to the local conditions present. An extensive laceration laying open nearly the whole of the anal canal may be seen (*see* Fig. 530, p. 750), or the condition may be merely the

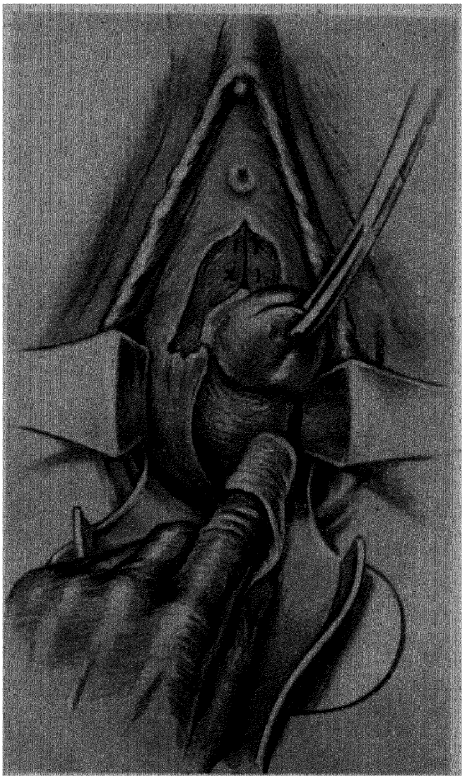


FIG. 517. RADICAL CURE OF CYSTOCELE. Amputation of cervix, continuation of 1st stage.

relaxed vaginal outlet shown in Figure 337, page 535. Between these extremes many intermediate degrees are met with, such as Figure 529, page 749, in which the anterior portion of the superficial sphincter has been injured. The objects of the operation are: (1) to restore the normal supports of the posterior vaginal wall, viz. the pubo-coccygeus muscles and perineal body; (2) to restore the continuity of the anal canal and the competence of its sphincter.

In the first place the operation will be described as practised for an incomplete laceration, *i.e.* one which does not involve the anal canal, and afterwards the modifications required for a complete laceration will be indicated.

Perineorrhaphy for incomplete laceration. The steps of this operation are illustrated in the series of Figures 520 to 528. The surroundings of the vulva, including the anus, should be carefully covered with sterilized coverings fixed in position with clips or with stitches (*see* p. 438). These coverings are not shown in the drawings illustrating the operations in order that the anatomical relations to the rectum may be clearly represented.

Step I. The operation is begun by raising a flap from the lower part of the posterior vaginal wall, and the first step consists in outlining the flap to be raised. A clip is placed upon the edge of the ostium vaginæ at a point roughly corresponding to the posterior extremity of the nympha on each

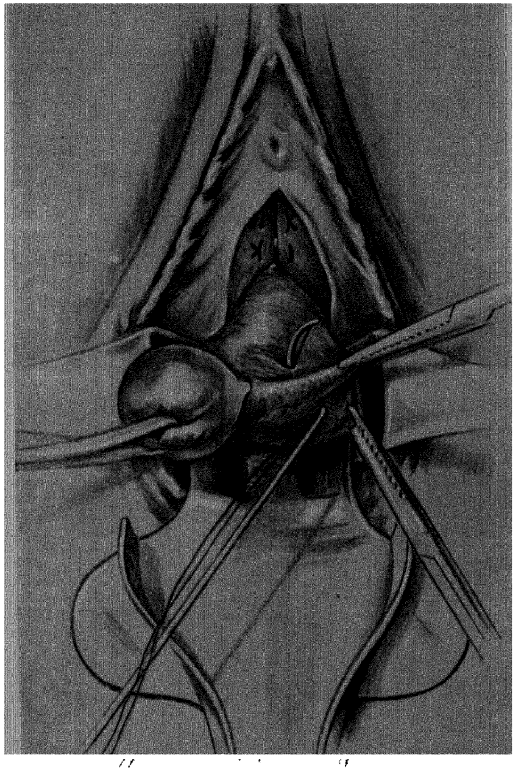


FIG. 518. RADICAL CURE OF CYSTOCELE. Amputation of cervix, 2nd stage.

side (*see* Fig. 520). By approximating these clips in the middle line, the size of the new ostium vaginæ will be indicated; it should be large enough to admit two fingers, and the points picked up in the forceps should be so adjusted as to give a space of about this extent. The extremity of the posterior vaginal wall in the mid-line is then seized with toothed dissecting forceps, and a pair of sharp pointed scissors or a sharp knife used to split the tissues from this point up to the lateral forceps on each side, as shown in Figure 521. This outlines the vaginal flap.

Step II. This consists in raising the vaginal flap. The free edge of the flap is picked up with two or three pairs of forceps, and the separation begun by snipping with sharp-pointed angled scissors (*see* Fig. 522). A good deal

of old cicatricial tissue is often encountered at this stage, which must be carefully worked through, keeping as near as possible to the vaginal mucous membrane. The dissection must be carried out on each side, to the full extent defined by the lateral pair of clips. After the cicatricial-tissue zone has been passed, the dissection can be continued upwards through the connective-tissue layer with the finger and a swab, aided by a few snips with scissors (*see* Fig. 523). Many large veins will be seen, but these are almost all connected with the rectum (*inferior haemorrhoidal plexus*) and can

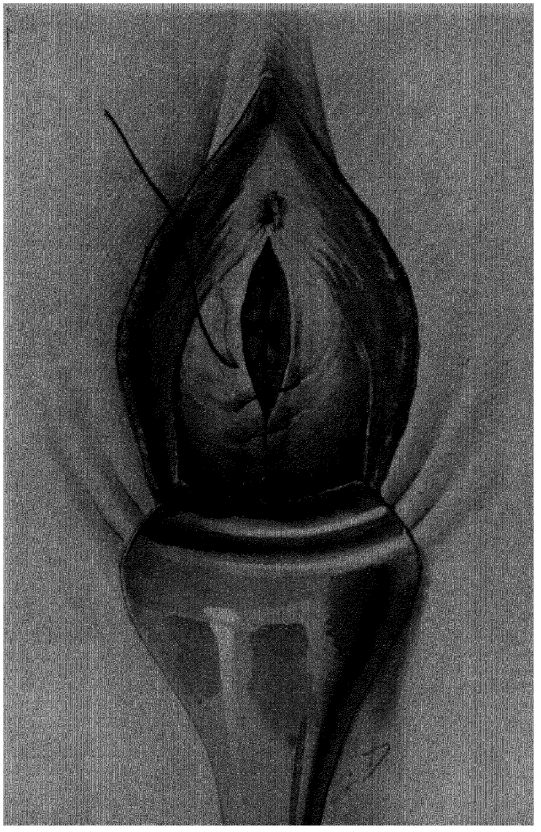


FIG. 519. RADICAL CURE OF CYSTOCELE. *Step IV:* Uniting the edges of the vaginal wall.

be peeled off the vaginal wall to a great extent uninjured. The separation of rectum and vagina can be carried upwards in this way to any required extent. A point from 2½ to 3 inches above the ostium vaginæ will usually suffice. After completing this step it is useful to commence the amputation of the vaginal flap on each side along the line indicated in Figure 524; this allows of better access to the highest part of the dissection.

All arterial hæmorrhage must be controlled by ligatures, and the largest veins should be similarly dealt with; it is not necessary, however, to arrest all oozing, as this will cease spontaneously when the tissues are brought together.

Step III. If the deep wound now produced is carefully inspected, it will be seen that the rectum occupies the deepest part, lying in the middle line; if the rectum is pressed back with the finger, it will be seen that on each side is a mass of tissue, lying in a plane superficial to it, which can be defined with finger and thumb (*see* Fig. 524). Usually these masses are of unequal thickness on the two sides, and their bulk varies in different cases; the more marked the degree of prolapse the less readily can these masses

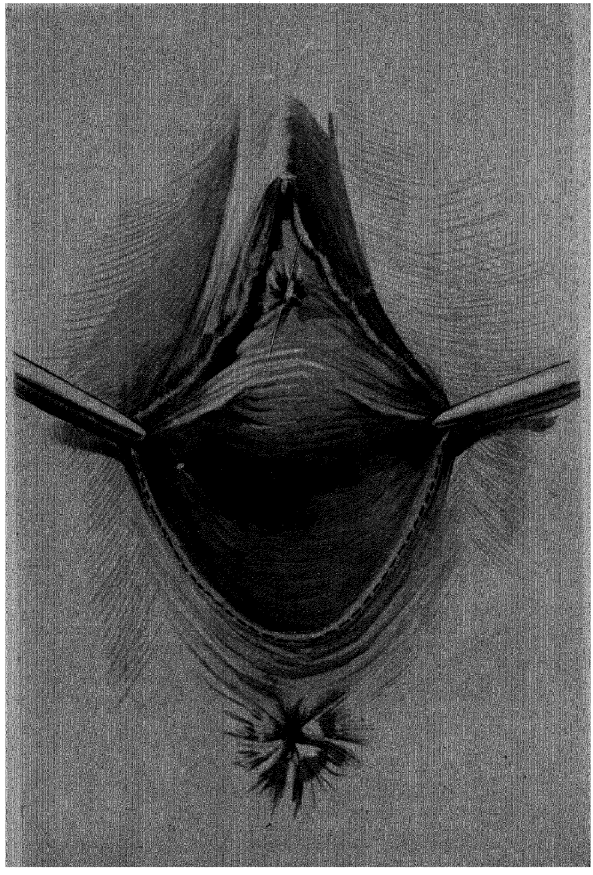


FIG. 520. PERINEORRHAPHY FOR INCOMPLETE LACERATION.
The dotted line shows the first incision.

be felt. They represent what remains of the posterior fibres of the pubo-coccygeus muscle, with its covering of pelvic fascia (*see* Fig. 525). These lateral masses are now to be brought together in the middle line in front of the rectum by interrupted stitches of stout catgut, the rectum being pushed back with the finger while they are introduced (*see* Fig. 525). Each stitch should be made to enter as far from the mid-line as possible, and then brought out at a corresponding point on the opposite side. The highest of these stitches should be made to include the deep surface of the posterior vaginal wall, so as to leave no dead space in the apex of the dissection-wound.

Upon these stitches depends the ultimate success of the operation, for they restore the natural supports of the rectum and posterior vaginal wall, and reconstitute the deep layers of the perineal body.

Step IV. The posterior vaginal flap is now entirely cut away, and one or two arterial twigs in the cut edge usually require ligature. A second row of stout catgut stitches is then introduced, bringing together the middle strata of the wound and covering in those first introduced (*see* Fig. 526). In this way the perineal body is built up over the pubo-coccygeus muscles.

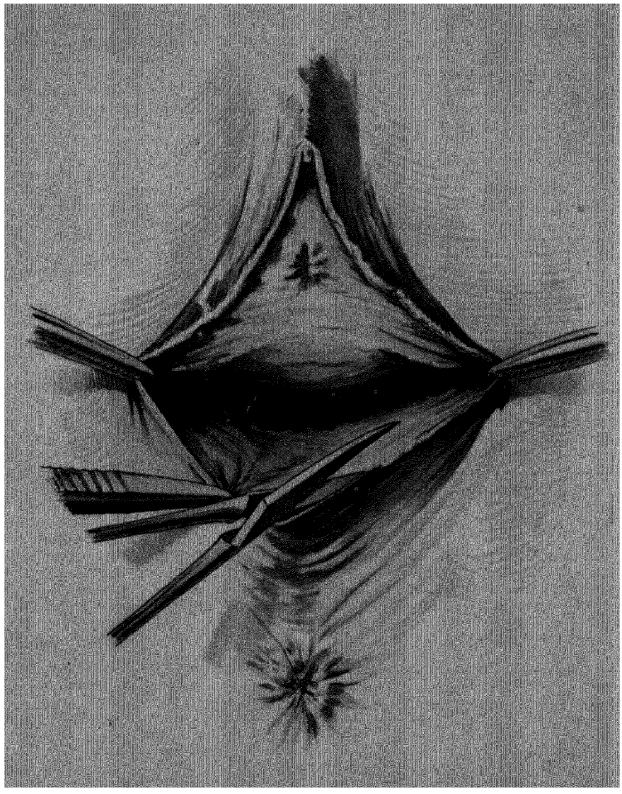


FIG. 521. PERINEORRHAPHY. *Step I:* Making the First Incision by Splitting the Tissues with Scissors.

It is important that no dead space should be left in the wound in which oozing can occur.

Step V. The edges of the posterior vaginal wall are now brought together by a running stitch; it is important to make sure that this stitch controls the actual upper limit of the incision from which free oozing may occur if it is left open (*see* Fig. 527). This stitch ends below at the points originally picked up by the lateral forceps. A double suture of No. 1 catgut is very useful for this stitch.

Step VI. Nothing now remains but to approximate the skin-edges, and thus complete the perineal body. This is best done with a subcuticular stitch of medium-sized catgut, as shown in Figure 528. This stitch adjusts

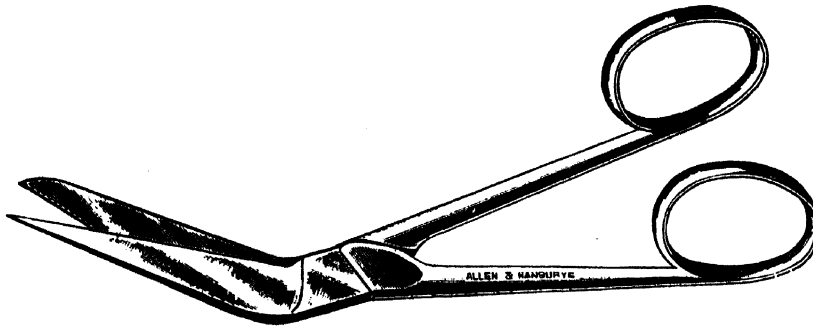


FIG. 522. ANGLED SCISSORS FOR PERINEORRHAPHY.

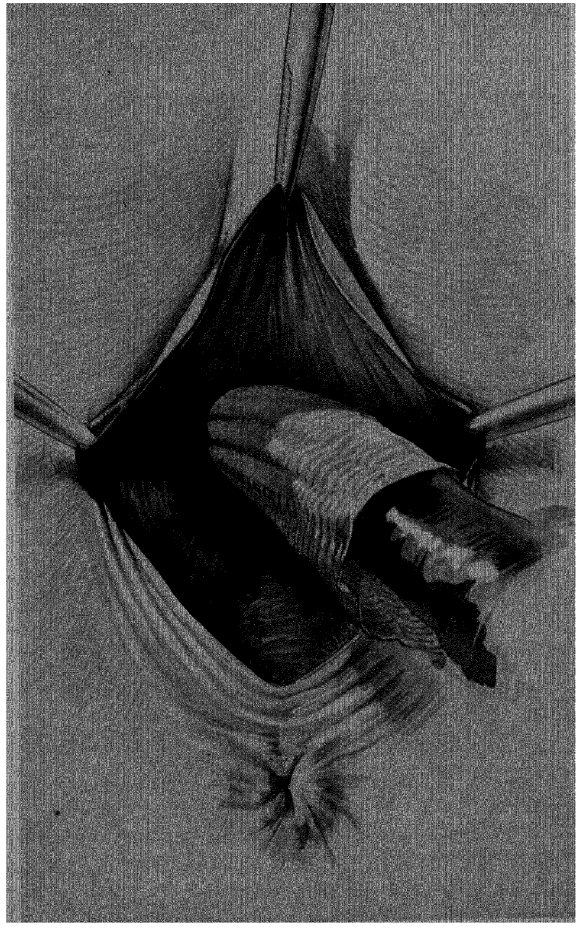


FIG. 523. PERINEORRHAPHY. *Step II :* Raising the Vaginal Flap by Blunt Dissection.

the edges without tension, and reduces the discomforts of convalescence. Finally the vaginal walls, the vulva, and the perineal region are swabbed with iodine and a sterile dressing fixed with a T bandage. This dressing should be bulky and the bandage firmly applied in order to exert pressure upon the perineum and thus assist in controlling oozing.

Perineorrhaphy for Complete Laceration. When the anal canal itself, or any part of the anal sphincter has been involved in an obstetric laceration,

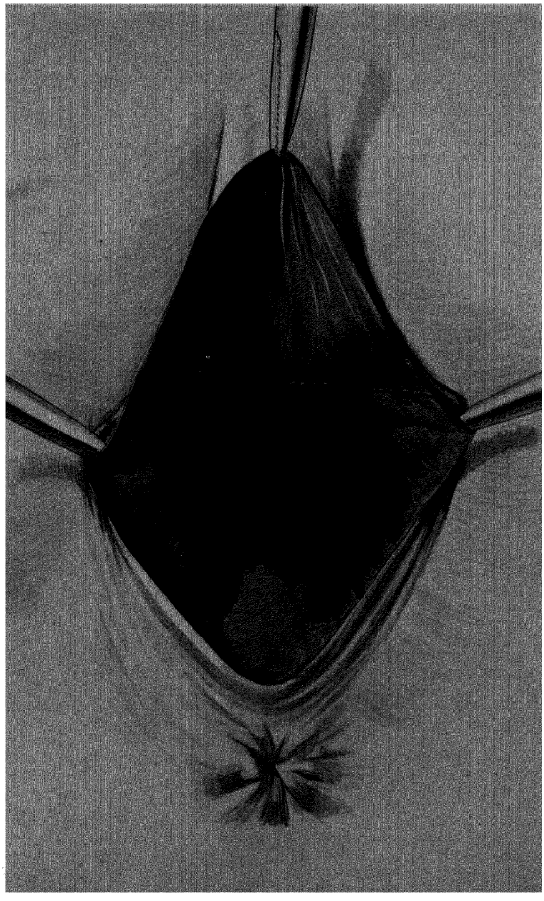


FIG. 524. PERINEORRHAPHY. *Step II.* The Vaginal Flap has been raised; in the Depths of the Wound lies the Rectum. The dotted line shows where the vaginal flap will be subsequently cut off.

the early steps of the operation are necessarily different from those just described. The importance of restoring the functional competence, as well as the actual continuity, of these parts will be readily appreciated. Figure 530 is drawn from a photograph of an extensive degree of injury to the rectum, the retentive capacity of the anal sphincter having been completely destroyed. The lower part of the rectum should be irrigated with boracic lotion before commencing the operation.

Step I. The condition shown in Figure 529 represents an incomplete

laceration of the anus, the superficial sphincter muscle having been involved, as is shown by the absence of radial grooves from the anterior half of the anus; the dotted lines indicate the incisions required to map out the flaps which it is necessary to raise. The two short posterior limbs will form the margins of the *anal flap*, the two long anterior limbs those of the *vaginal flap*. The end of the posterior limb extends half an inch behind the depressions which indicate the retracted ends of the torn superficial sphincter

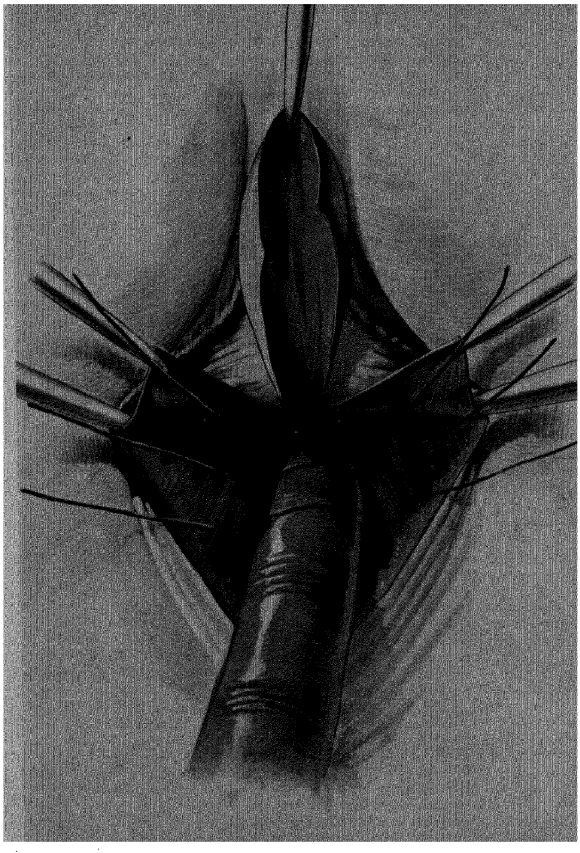


FIG. 525. PERINEORRHAPHY. *Step III*: The rectum has been pressed back by the finger; the deep sutures have been passed through the lateral musculo-fascial tissues but not tied.

ani muscle. The extremities of the anterior limbs are carried forwards to the posterior ends of the nymphæ. The anterior edge is often covered by thickened and everted rectal mucous membrane; this should be freely removed with scissors, including the cicatricial tissue which is also usually present. The recto-vaginal septum can now be split along the line already marked out, so as to separate the rectal and vaginal walls from one another (Fig. 529). Care must be taken to carry back the incision for half an inch behind the retracted end of the sphincter on each side. The direction of the anterior limbs of the incision is shown in Figure 529.

Step II. This step consists in splitting the recto-vaginal septum so as to free the anterior rectal wall not only upwards but laterally on each side as well. This must be done carefully on account of the tenuity of this septum, and it is often necessary to pass the finger into the bowel as a guide. In this case the gloved index finger is covered with a finger-stall which is thrown away as soon as used. Strict attention must be paid to the lateral dissection, which must be thoroughly carried out in cases such as Figure 530,

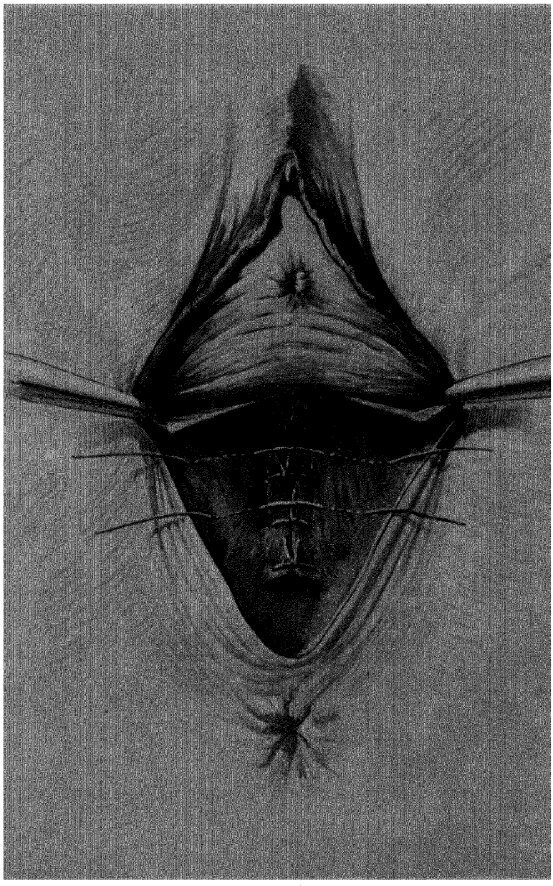


FIG. 526. PERINEORRHAPHY. *Step IV:* The deep stitches have been tied, the intermediate stitches have been introduced.

in order to allow the edges of the V-shaped gap in the anal canal to come together without tension. If the stitches are tied under tension they will inevitably give way, and the whole wound will become infected and break down. This is the commonest cause of failure with the operation. As soon as this dissection is completed the rectal stitches should be introduced. These stitches include all the tissues in the posterior flap except the rectal mucous membrane, which should be left free (Fig. 531); its edges will become approximated when the stitches are tied, and primary union will quickly follow. If the stitches are made to include the mucosa they form a channel

of communication between the rectum and the wound. Interrupted stitches of fine chromicized or iodine-formalin gut are used.

The remaining steps of the operation are the same as those described above. A fresh pair of sterilized gloves and fresh instruments should be used as soon as the rectal canal has been closed, and before commencing the

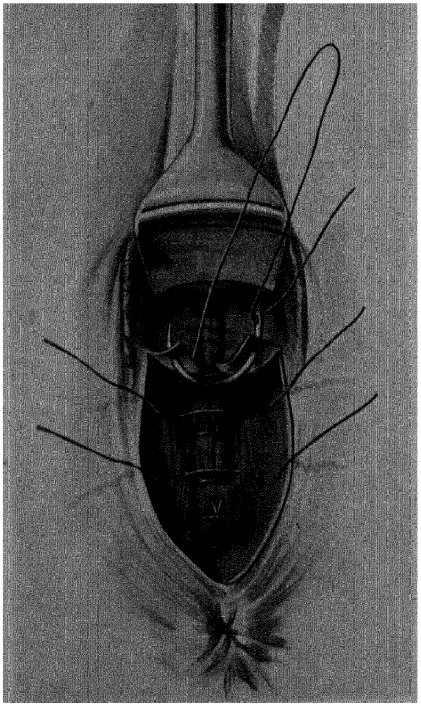


FIG. 527. PERINEORRHAPHY. *Step V:* Uniting the cut edges of the posterior vaginal wall with a running stitch.

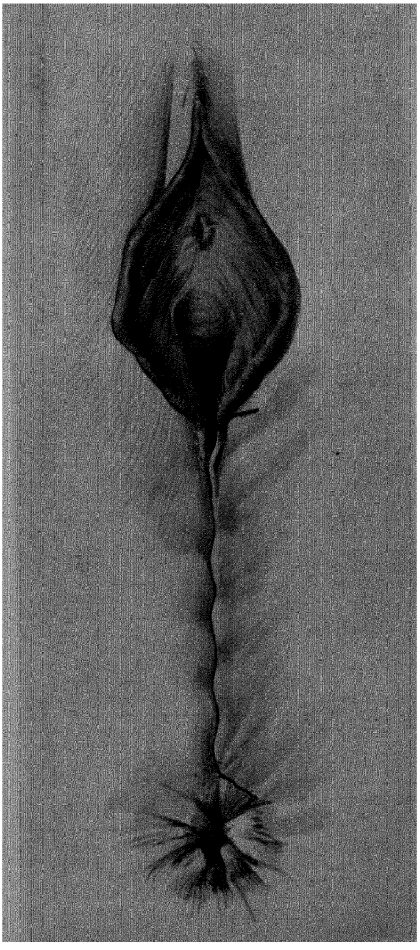


FIG. 528. PERINEORRHAPHY. *Step VI:* The skin edges of the restored perineal body have been united by a subcuticular suture.

deep dissection of the recto-vaginal space. Before closing the skin-edges, an attempt should be made to bring together the retracted ends of the superficial sphincter (*see* Fig. 532). The position of the ends of the muscle can usually be recognized, and although actual muscle-fibres can seldom be seen, a stitch passed deeply beneath them will take up the muscle along with other tissues and approximate its ends with fair accuracy.

Operation for Cure of Rectocele. Posterior Colporrhaphy. This condition

consists in prolapse of the posterior vaginal wall, which being adherent to the anterior rectal wall drags the rectum with it. It may occur in association

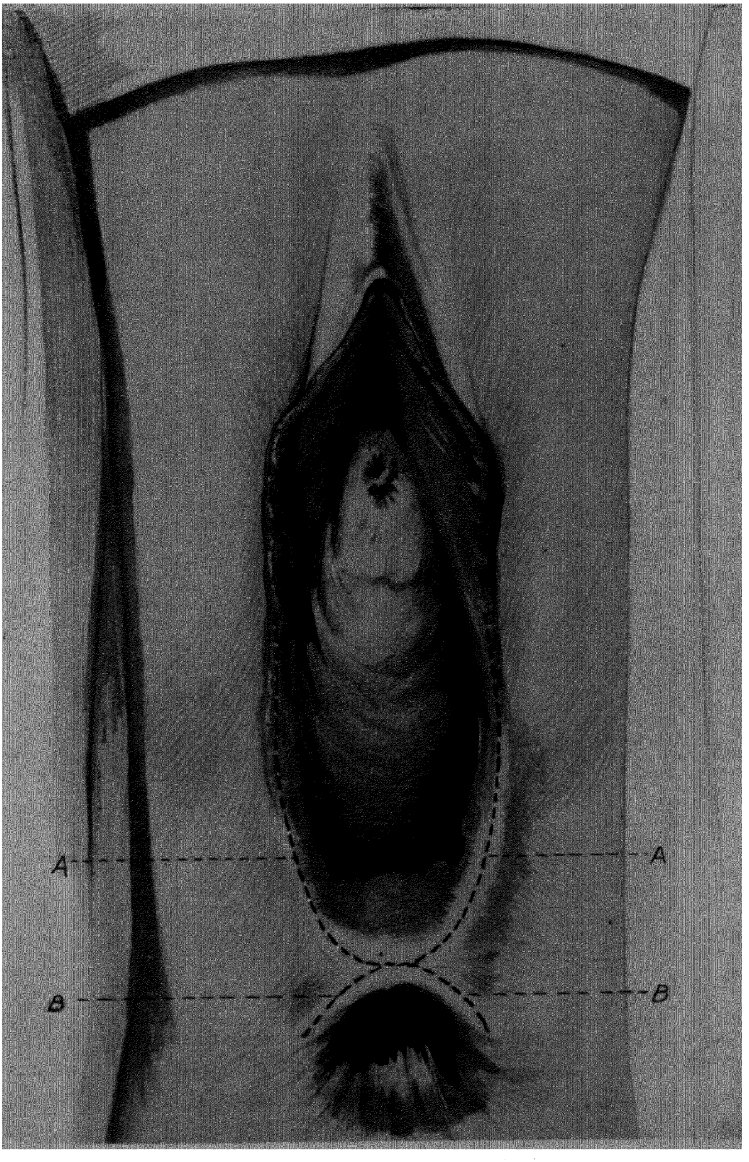


FIG. 529. COMPLETE PERINEAL LACERATION. The perineal body is absent, the vulva patulous, and the anterior vaginal wall prolapsed (cystocele). The anus is gaping, and the radial cutaneous folds are absent anteriorly. The dotted lines represent the incisions by which the vaginal and anal flaps are raised.

with cystocele, but occasionally it is met with alone (*see* p. 530). The perineum is not necessarily much lacerated, but the ostium vaginæ is always greatly relaxed.

The operation required for rectocele is similar in principle to that just described as *perineorrhaphy*, the separation of the posterior vaginal wall from the rectum being carried as high as may be required even up to the level of the posterior lip of the cervix. There are, however, certain advantages in carrying out the operation in a different manner, viz. by commencing the dissection at the highest point on the vaginal wall which it is necessary to reach, and stripping off the flap from above downwards. The steps of the operation are then as follows :—

Step I. The upper limit of the vaginal flap which is to be removed is

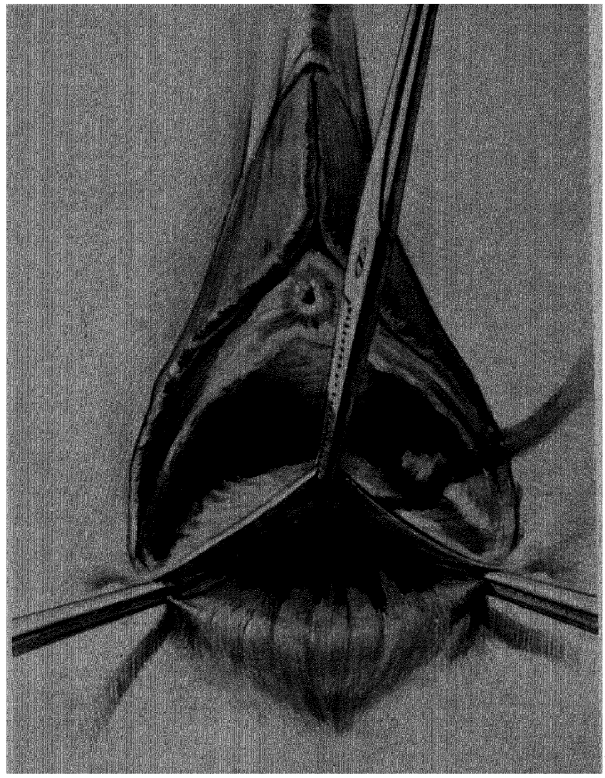


FIG. 530. COMPLETE PERINEAL LACERATION INVOLVING THE LOWER PART OF THE ANAL CANAL. The three pairs of forceps show the limits of the first incision.

outlined in the manner shown in Figure 533. A pair of volsella forceps is placed upon a point in the mid-line of the posterior vaginal wall which is estimated to be the necessary upper limit of the dissection. This part of the vaginal wall is then pulled upwards and laterally, and a pair of volsella forceps is placed on one side at a point where the lateral and posterior vaginal walls meet at the level of the ostium vaginæ. The opposite lateral limit of the incision is made next, the corresponding vaginal wall being stretched in a similar manner. In Figure 533 the point seized by the pair of volsella forceps corresponds to a level of about 1 inch below the cervix.

Step II. (Fig. 534). The triangular flap thus outlined is stripped off the subjacent rectum partly by snipping with scissors, partly by blunt dissection, and carried downwards towards the perineal body as far as possible. Progress in this direction will be arrested when the cicatricial tissue is encountered, which is usually present in the perineal body in these cases. A swab held in a pair of ring forceps and passed into the rectum is useful to push the anterior rectal wall forwards during this dissection.

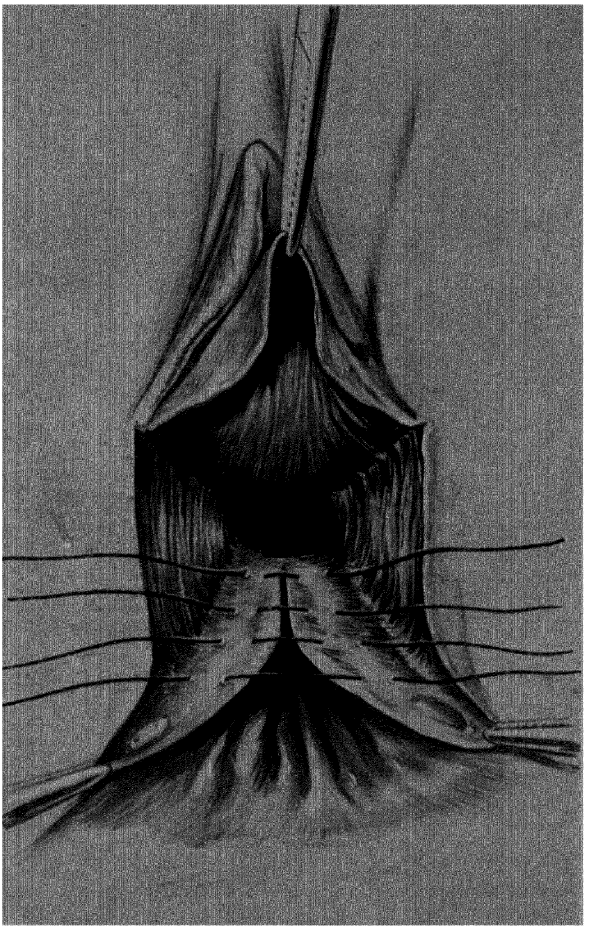


FIG. 531. COMPLETE PERINEAL LACERATION. The rectal stitches have been introduced but not tied.

Step III. The *lower part* of the rectocele is now seized with volsella forceps and pulled upwards; the incision shown in Figure 529 for perineorrhaphy is then marked out, and the posterior vaginal wall is stripped upwards until the level of the downward dissection has been reached. The whole flap is then cut away (Fig. 535).

Step IV. A layer of fascia lying in front of the rectum must now be sought for, and can usually be defined without difficulty. It is, of course,

greatly stretched by the protrusion, but it can be made use of to cover the rectum in the manner that the tissues lying under the bladder were dealt

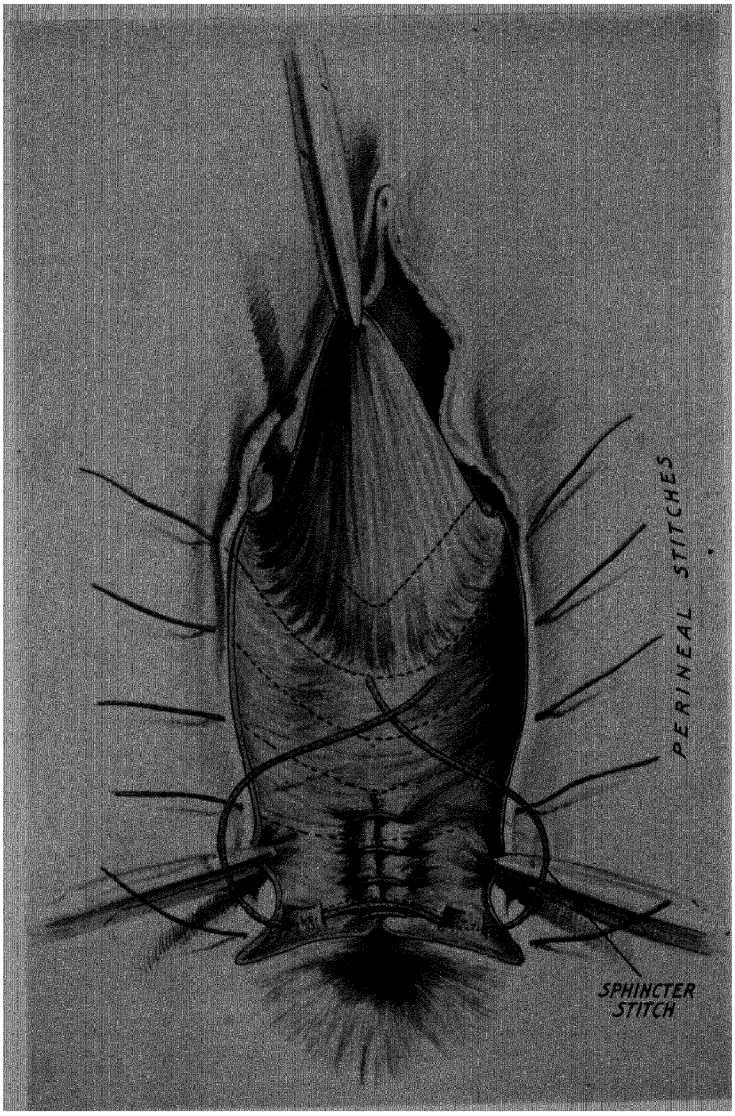


FIG. 532. PERINEORRHAPHY FOR COMPLETE LACERATION. The rectal stitches have been tied. The sphincter stitch has been introduced, but not tied. The perineal stitches also have been introduced, but not tied. The dotted V-shaped line in the base of the vaginal flap indicates where the flap is to be cut away.

with in the operation for cystocele. This is an important step in the operation inasmuch as it restores one of the natural supports of the rectum.

Step V. The perineal body is built up by layers of buried catgut sutures in the manner already shown in Figures 525 to 528.

Step VI. A continuous suture is begun at the apex of the incision in

the posterior vaginal wall above, uniting the edges throughout the whole length of the incision up to the skin margin of the perineum where it is tied, and the skin edges are united with a subcuticular suture as shown in Figure 536.

Success depends upon attention being paid especially to the following points: (1) the area of vaginal wall removed must be accurately adjusted, and particular care taken to begin the dissection sufficiently high up; (2) at each stage of the operation the most careful hæmostasis is requisite.

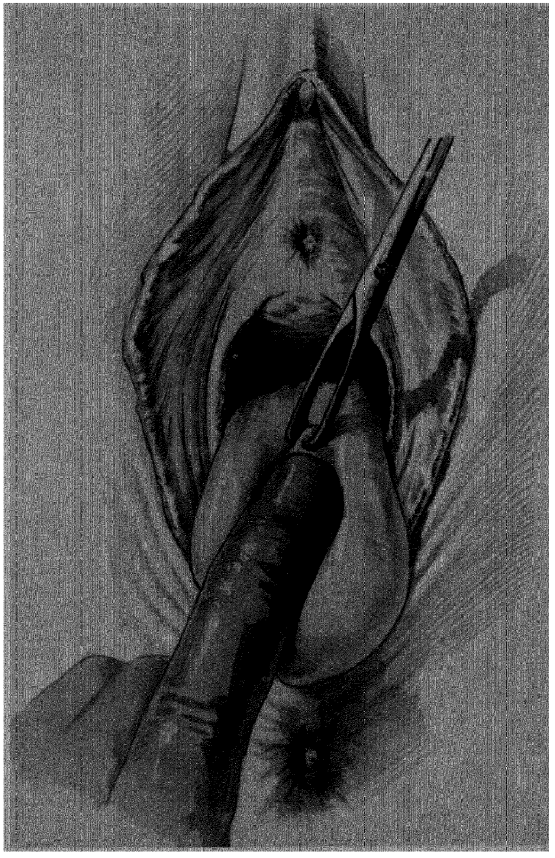


FIG. 533. OPERATION FOR RECTOCELE. The rectocele has been drawn out of the vagina and forceps applied to the point selected for the upper limit of the dissection.

If too much tissue is removed the vaginal canal may be uncomfortably narrowed.

The suture material should be chromicized, or tanned catgut, which will resist absorption for twenty-one days.

Le Fort's Operation. In elderly women in whom the question of nubility is of no importance, and who are the subjects of complete procidentia or of advanced prolapse of the second degree, this operation is suitable, and is usually successful. When efficiently performed it forms a barrier to coitus, and establishes a serious impediment to vaginal drainage. It is

therefore limited in its application, and should never be employed until after the fertile period is passed and menstruation has ceased.

The operation consists in establishing a central longitudinal partition by suturing the anterior to the posterior vaginal wall. To do this, the cervix is grasped and drawn out of the vulva by means of a volsella. Four

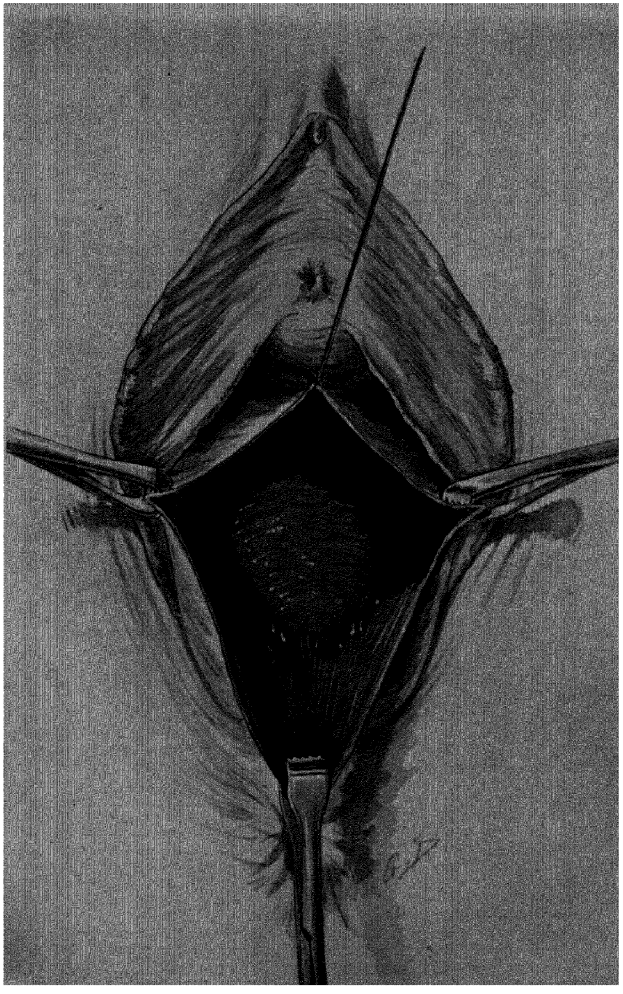


FIG. 534. OPERATION FOR RECTOCELE. The vaginal flap has been raised from the vaginal wall and turned downwards exposing the rectum. The running stitch has been introduced above.

incisions are made on the anterior surface of the vagina, enclosing a rectangular area of mucous membrane measuring some six or seven centimetres in length by two centimetres in width. The mucous membrane thus mapped out is dissected off, and an area of mucosa similar in all respects to the above is removed from the posterior vaginal wall (*see* Fig. 537). The edges of the raw surfaces on the anterior wall are then united by interrupted chromic catgut sutures to the corresponding edges on the posterior wall

(*see* Fig. 538). The effect of this is to bring two raw surfaces (the one anterior and the other posterior) into apposition. Thus a central partition is formed which effectively prevents eversion of the vaginal walls. The median partition should be long enough to reach to the vulva, and should be flush with the perineal margin behind and reach a point 1 inch above the urethral

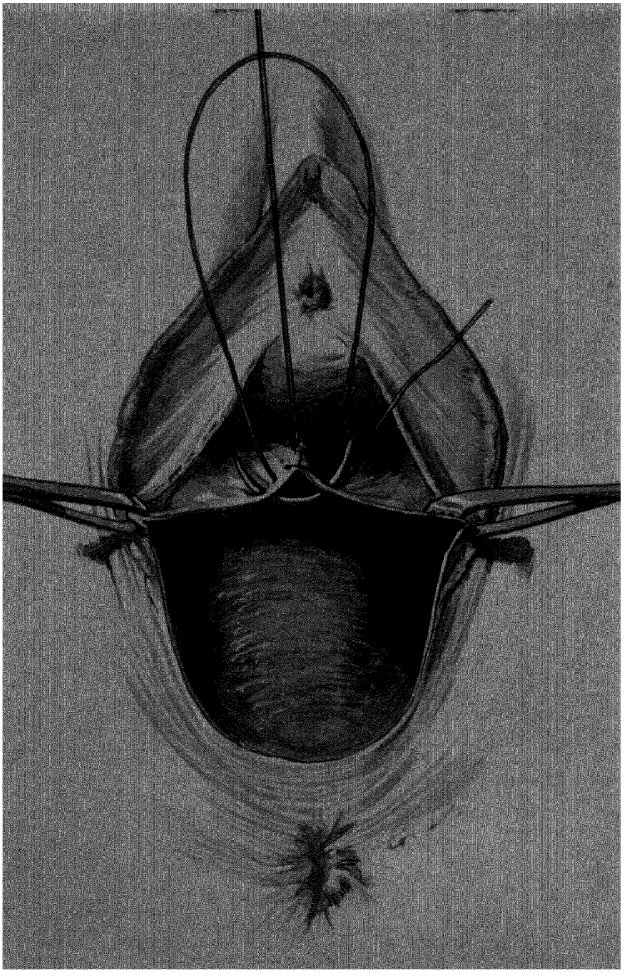


FIG. 535. OPERATION FOR RECTOCELE. The vaginal flap has been cut away. The running stitch is being continued downwards.

orifice in front. A drain of bismuth gauze should be inserted in the space left on either side of the median partition, and retained for twenty-four hours. The condition of the uterus should be observed before this operation is undertaken ; an unhealthy cervix or any kind of uterine discharge should be cleared up by suitable treatment as a preliminary procedure. Similarly there must be no ulceration of the vaginal mucous membrane. If the parts are healthy and clean, primary union occurs, leaving a partite vagina which

cannot prolapse and which thereby prevents descent of the uterus ; prolapse of the bladder and the rectum are also impossible.

Operations for Fistulæ. The following conditions may call for operative treatment by repair of the fistula or otherwise :

I. *Urinary Fistulae.* (1) Vesico-vaginal fistula ; (2) vesico-cervical fistula ; (3) uretero-vaginal fistula ; (4) vesico-abdominal fistula ; (5) uretero-

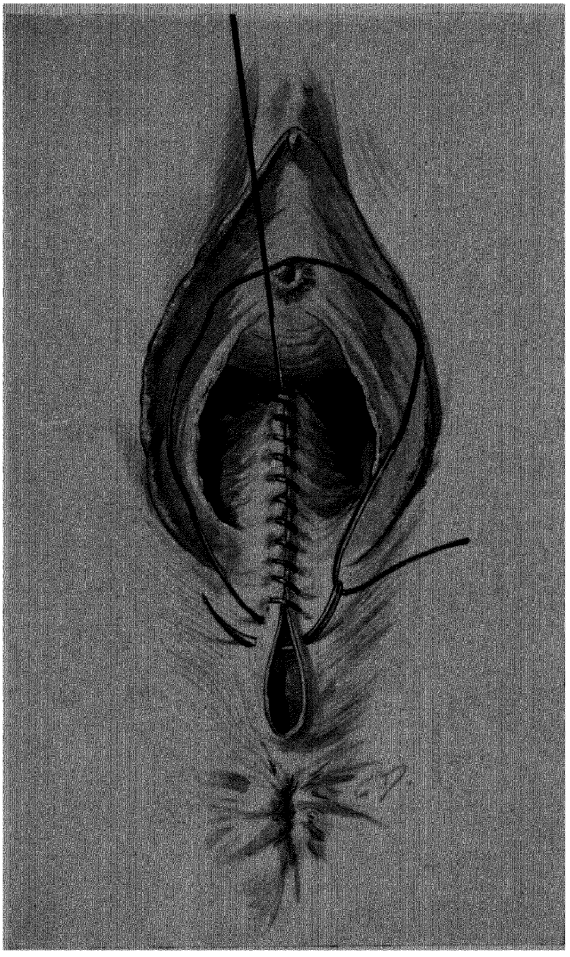


FIG. 536. OPERATION FOR RECTOCELE. Suturing the edges of the vaginal wall and the skin with a continuous stitch.

abdominal fistula. II. *Faecal Fistulae.* (6) Ano-perineal fistula ; (7) recto-vaginal fistula ; (8) abdominal fæcal fistula.

These fistulæ may be met with under three conditions : (*a*) as the result of obstetric injuries ; (*b*) as sequelæ of operative procedures involving the urinary or intestinal tract ; (*c*) as the result of malignant disease involving these parts. Those due to the last-named cause are of course incapable of operative cure ; the others can all be dealt with by suitable methods.

The operations required are in many instances complicated and cannot

here be described in detail. There are certain general principles of dealing with fistulæ which may, however, be considered.

Fistulous tracts which are lined by mucous membrane show little or no tendency to close spontaneously, while those which are lined only by granulation-tissue show a strong tendency towards repair. Vaginal fistulæ, both urinary and fæcal, belong to the former class; all the abdominal fistulæ and the ano-perineal fistulæ belong to the latter class. While operation is

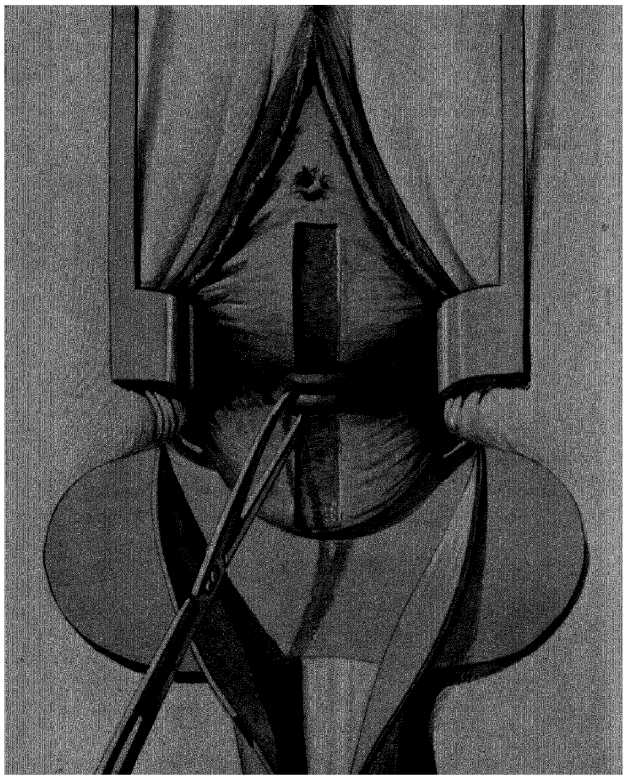


FIG. 537. LE FORT'S OPERATION FOR EXTENSIVE PROLAPSE IN ELDERLY SUBJECTS. The strips of vaginal mucous membrane have been removed.

consequently always indicated in the former class, the latter should be left alone as long as they show any tendency towards progressive repair.

In the case of urinary fistulæ the success of operative procedures is rendered exceptionally difficult by the presence of urinary infection. Consequently this condition must be carefully treated before operation is undertaken. In the case of fæcal fistulæ no such preparations are practicable.

The operations required for *abdominal faecal fistulae* are difficult and complicated procedures which cannot be described here. *Ureteral fistulae* whether vaginal or abdominal are generally dealt with either (*a*) by transplantation of the proximal end of the damaged ureter into the bladder—*uretero-vesical anastomosis*, or (*b*) by the removal of the kidney on the affected side, the other kidney having first been demonstrated to be functionally

active by catheterization of the ureter and urinary analysis, including the renal efficiency tests. Vesico-vaginal fistulæ and recto-vaginal fistulæ can usually be dealt with by plastic operations which may now be described.

Vesico-Vaginal Fistulæ. The majority of these fistulæ affect the lower and middle thirds of the anterior vaginal wall, and can be closed by an operation *per vaginam*. A small number are situated higher than this, and are accompanied by more or less destruction of the anterior cervical wall.

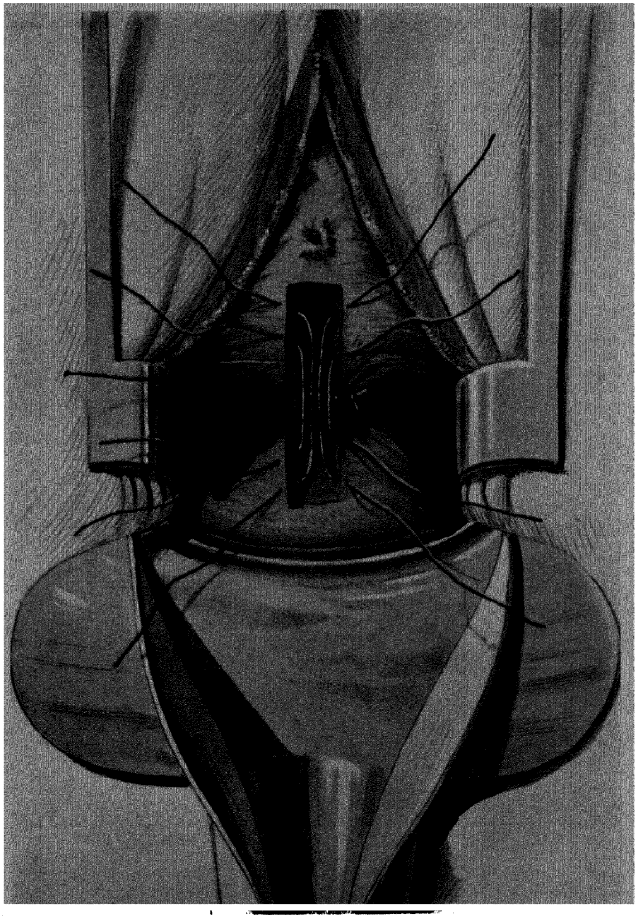


FIG. 538. LE FORT'S OPERATION, showing the method of uniting the anterior and posterior raw surfaces.

In these, the hole in the bladder may be situated so high that it can be best reached by an intra-peritoneal operation. This consists in separating the bladder from the uterus and vagina, beginning above and extending well down below the level of the lower border of the fistula; the aperture in the bladder is then closed, and afterwards that in the vagina. The operation is formidable owing to the difficulty in obtaining access to the parts.

Several different procedures may be practised for those situated in the middle or lower third (*see* Fig. 539) of the vagina.

The operation suitable for moderate-sized fistulæ, involving only the vaginal wall and bladder, is simple and easy. In order to obtain a good view of the anterior vaginal wall it is advisable to employ the elevated pelvic position shown in Figure 540. The posterior vaginal wall being then held back by a flat retractor the fistula can be well seen (Fig. 539). Two different methods of closure may be practised : (*a*) in one the edges of the fistula are simply rawed and then stitched together ; (*b*) in the other, a flap-splitting method, the bladder and vaginal walls are first widely separated from one

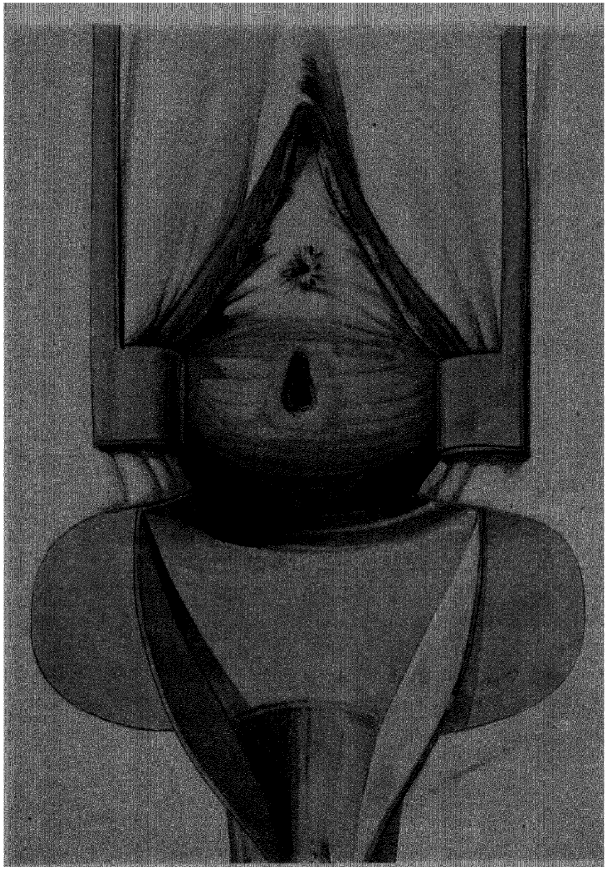


FIG. 539. VESICO-VAGINAL FISTULA EXPOSED FOR OPERATION.

another, and then separately united by distinct sets of stitches. The former method is only suitable for fistulæ of the smallest size.

(*a*) In rawing the edges of the fistula, fine, keen, angled knives like those shown in Figure 541 are employed, and a narrow strip of tissue is removed all round, which includes both bladder and vaginal wall, the latter being rather more freely removed than the former. Three strata of tissue are thus traversed, viz. vaginal wall, peri-vaginal cellular tissue, and bladder-wall. Owing to the occurrence of inflammation around the fistula, bladder and vagina usually adhere closely to one another, and the intermediate layer cannot be defined. Stout interrupted stitches are used to close the aperture,

and these should be passed through all the tissues except the vesical mucosa, a good hold of the vaginal wall being required, as there is necessarily considerable tension. All oozing from the edges of the mucosa must be care-

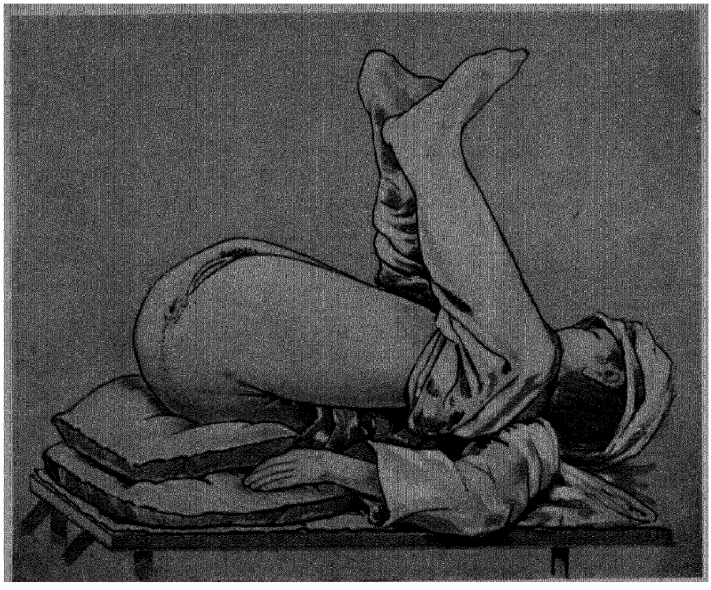


FIG. 540. ELEVATED PELVIC POSITION FOR OPERATION FOR VESICO-VAGINAL FISTULA (after Kelly).

fully controlled by hot irrigation, or by pressure, before the ligatures are tied. The rawed edges of the bladder-mucosa are thus brought into apposition but are not included in the stitches (*see* Fig. 542). Chromicized catgut is the best suture-material to employ. The disadvantage of this operation is



FIG. 541. KNIVES FOR VESICO-VAGINAL FISTULA.

that the edges of the fistula are held together under considerable tension, a condition unfavourable for healing by primary union.

(*b*) In the flap-splitting operation an incision is made all round the fistula, cutting through the vaginal wall alone; from this incision two short longitudinal incisions are carried, one upwards towards the cervix and the

other downwards towards the *meatus urinarius* (*see* Fig. 543). By means of these incisions two flaps of vaginal wall are then dissected carefully off the subjacent bladder, until the latter is exposed for half an inch all round the fistula (*see* Fig. 543). The edges of the opening in the bladder are freed from everted mucous membrane by snipping with scissors; the opening is then closed by a continuous catgut stitch passed just outside the edge through the muscular wall alone, on each side of the fistula, so as to bring muscular wall in apposition with muscular wall and invert the mucosa. The separation of the bladder from the vagina frees the former, and allows the edges of the opening to be drawn together without tension. A second series of interrupted stitches may then be similarly passed from side to side so as to bury the first stitch. The edges of the vaginal flaps are finally

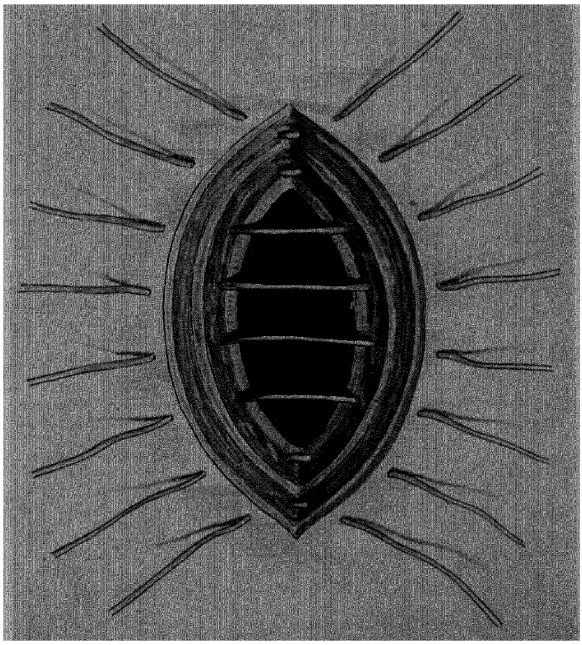


FIG. 542. OPERATION FOR VESICO-VAGINAL FISTULA. The edges have been rawed, and the sutures introduced so as to include all the tissues except the mucous membrane of the bladder.

trimmed and united accurately by interrupted catgut stitches so as completely to cover up the bladder-walls. The advantages of this method are: (1) absence of tension: (2) strengthening of the bladder-wall by superimposed layers of sutures; (3) better protection of the bladder-stitches from vaginal infection. It is essential in the after-treatment that the bladder should not be allowed to become even moderately full, and continuous drainage must be provided for.

A self-retaining rubber catheter is therefore kept in the bladder for five or six days after either operation. It should be removed daily and boiled before it is again inserted. After extensive operations for the closure of large apertures, it may be better to drain the bladder by the supra-pubic route with a large rubber tube. The resulting fistula closes spontaneously

in six weeks. Diluents should be given freely, and careful vaginal asepsis must be observed, as primary union of the vaginal stitches is an important element of success. In the presence of active urinary infection union is very difficult to achieve.

Recto-vaginal Fistulæ. In the *lower third* of the posterior vaginal wall these fistulæ are comparatively common. They result from irregular healing of obstetric lacerations of the perineum, and are of small size; in

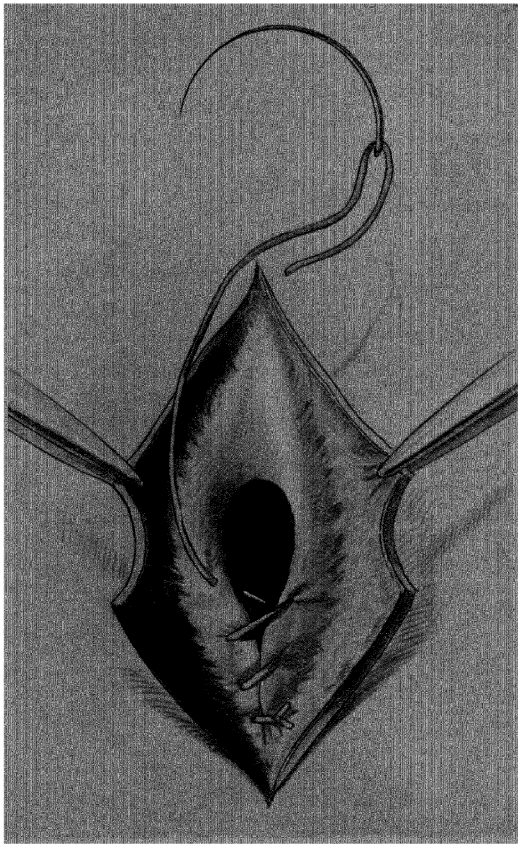


FIG. 543. FLAP-SPLITTING OPERATION FOR VESICO-VAGINAL FISTULA. The vaginal flaps have been raised and are held aside by forceps. A catgut stitch is seen, which inverts the edges of the aperture in the bladder-wall.

the operation for complete perineal rupture they can be closed without modifying the steps of the operation (*see* Figs. 530—532).

Those situated in the *middle third* can be dealt with in the manner already described for vesico-vaginal fistulæ by separating the rectum from the posterior vaginal wall, and closing the opening in the former, separately from that in the latter. Or they may be reached by an operation which, commencing as in perineorrhaphy, extends the dissection of the recto-vaginal space upwards, until a point well above the upper limit of the fistulous aperture has been reached. The opening in the rectum can then be closed with interrupted stitches and the vaginal wall united over it.

Fistulæ situated in the *upper third* of the vagina often involve the floor of Douglas's pouch and the posterior wall of the cervix. Considerable sloughing from fæcal infection often follows the injury, and this ultimately results in the formation of much cicatricial tissue, which forms an absolute bar to spontaneous healing, and adds greatly to the difficulties of operative repair. Cicatrization immobilizes the parts, and as they lie at a considerable depth the mechanical difficulties attending the operative manipulations are formidable. Fistulæ in this situation may often be best reached by an abdominal operation, and in order to obtain proper access from above, it may be necessary to remove the uterus. In exceptionally difficult cases a preliminary left inguinal colotomy may be necessary, as in a case recorded

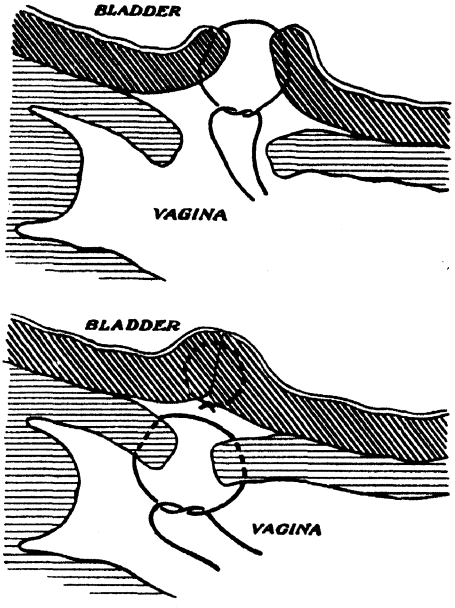


FIG. 544. FLAP-SPLITTING OPERATION FOR VESICO-VAGINAL FISTULA—DIAGRAMMATIC.

by one of us (T. W. E.): this is kept open until the fistula has been successfully dealt with, and time has been allowed for firm union to occur. The colotomy-opening is then closed. Healing is greatly aided by cutting off the fæcal stream from the affected segment of the intestine.

Operation for Restoration of an Inverted Uterus

Indications. This operation may be practised in cases of chronic puerperal inversion, in which the uterus is otherwise healthy, and attempts to reduce it by Aveling's repositor (*see* p. 528) have failed. Cases of chronic inversion due to new growths (*see* p. 526) are not suitable for this procedure, as has been already explained. The operation should not be undertaken until all signs of infection, when such have been present, have disappeared. The operation is a conservative procedure, and should be preferred to

vaginal hysterectomy in young women whenever the condition is favourable for it.

The technique here described is that of Spinelli, and the operation is known as "Spinelli's operation"; it will be best understood by describing each step in order. The most careful antiseptic preparations are called for before the operation is begun, and during its performance.

Step I. Opening the utero-vesical pouch through the anterior fornix (*see* Fig. 545, *b* and *c*). The condition shown in Figure 545, *a*, is an incomplete inversion, the cervical lips being well defined. The anterior lip is fixed with a volsella and the procedure already described as "anterior colpotomy" carried out (*see* p. 706).

Step II. The anterior wall of the uterus is split in the middle line from os externum to fundus (*see* Fig. 545, *d* and *e*). Scissors are used, and the uterus is steadied by traction upon each half of the divided cervix.

Step III. The uterus is re-inverted by the fingers, in the manner shown in Figure 545, *f* and *g*, the peritoneal surface of the organ being pressed forwards and the cut edges at the same time rolled backwards. This is the most difficult part of the operation, especially in long-standing cases, on account of the rigidity of the uterine tissues. When the inversion is corrected the uterine incision lies behind, the fundus still being the lowest part.

Step IV. The uterine incision is closed in two layers, the first including mucosa and muscular layer, the second including peritoneum and muscular layer. The fundus of the uterus is carried forwards and upwards to obtain access to the anterior uterine surface (Fig. 545, *h* and *i*).

Step V. The uterus is next returned to the pelvic cavity by pushing it up through the opening in the utero-vesical pouch; the uterus is thus rotated around a transverse axis passing through the supra-vaginal cervix. The relations are shown in Figure 545, *j*, which also indicates the line of suture in the anterior uterine wall.

Step VI. Finally the peritoneal and vaginal incisions in the utero-vesical pouch and the anterior fornix are closed. Spinelli advises that both anterior and posterior pouches should be drained.

OPERATIONS ON THE VULVA

Atresia of the Vulva. This condition has been mentioned on pages 142 and 303. It is occasionally found in adults, and is the result of membranous vulvitis due to diphtheritic or streptococcal infection during childhood. The lesion is superficial, and is remedied by the following simple operation. The bridge of scar-tissue shown in Figure 96, page 141, is divided in the middle line from one end to the other. The flaps thus formed will be seen to have an inner mucous and an outer cutaneous surface; these surfaces are united by sewing over the edges with catgut as shown in Figure 546. The great depth at which the hymen lay in this Figure (photographed immediately after the operation) became rapidly reduced by consolidation and retraction of the divided tissues.

Urethral Caruncle. Caruncles are sometimes treated by burning, a Pacquelin's cautery being used. The result of cauterization is unsatisfactory, recurrence of the growth being common after such procedure. It is far better to remove a caruncle by excision.

Excision and Suture. The growth is seized with fine forceps and drawn

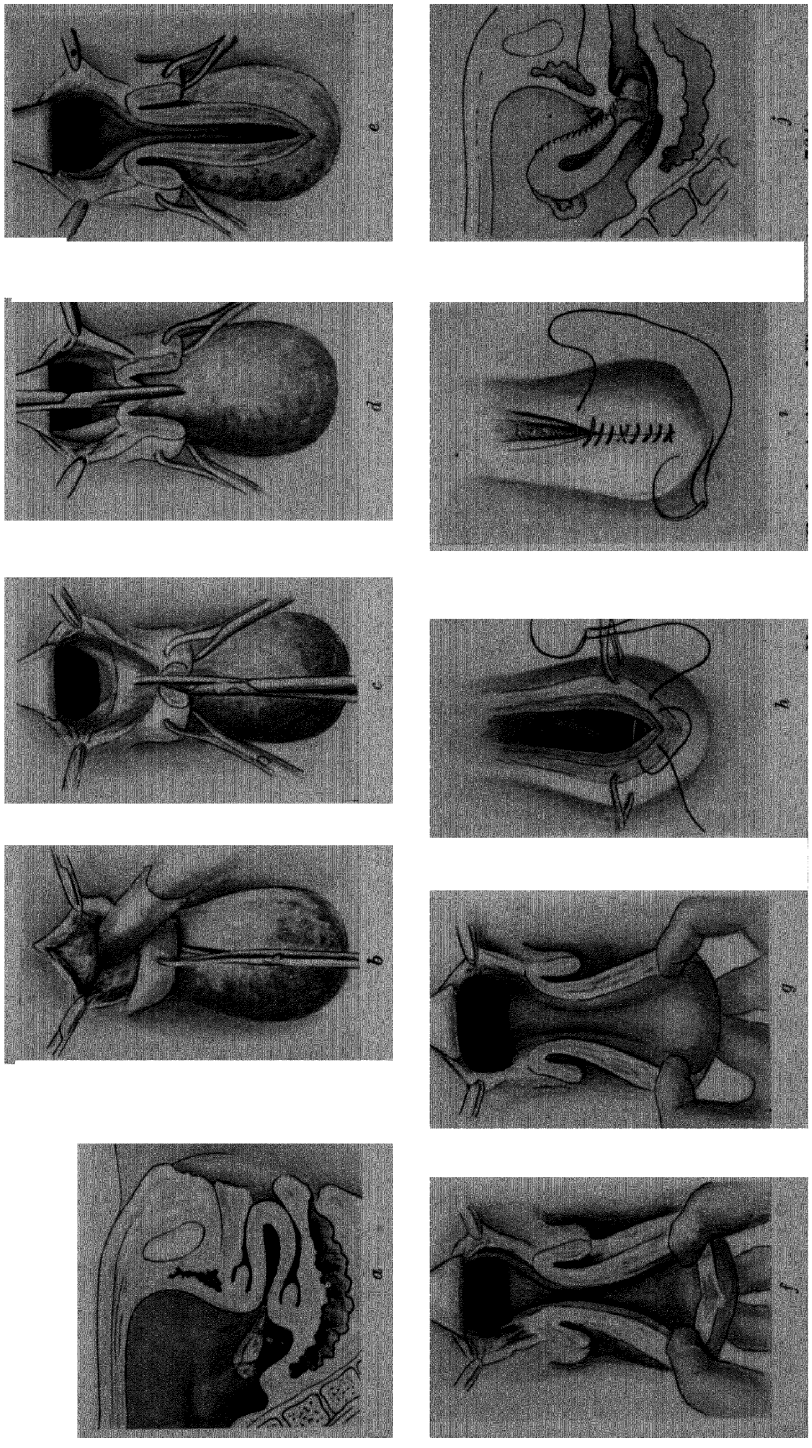


FIG. 545. SPINELLI'S OPERATION FOR CHRONIC INVERSION OF THE UTERUS. (For description of Figures *see* text, p. 764.)

down until its origin from the mucous membrane of the posterior wall is clearly defined. It is then excised with a scalpel or with fine sharp-pointed scissors. The incision is carried through the entire thickness of the mucous membrane and it leaves an oval elongated wound on the floor (posterior wall) of the urethra. The edges of this wound are brought together by one or two fine catgut sutures. If the excision is not complete there is a liability

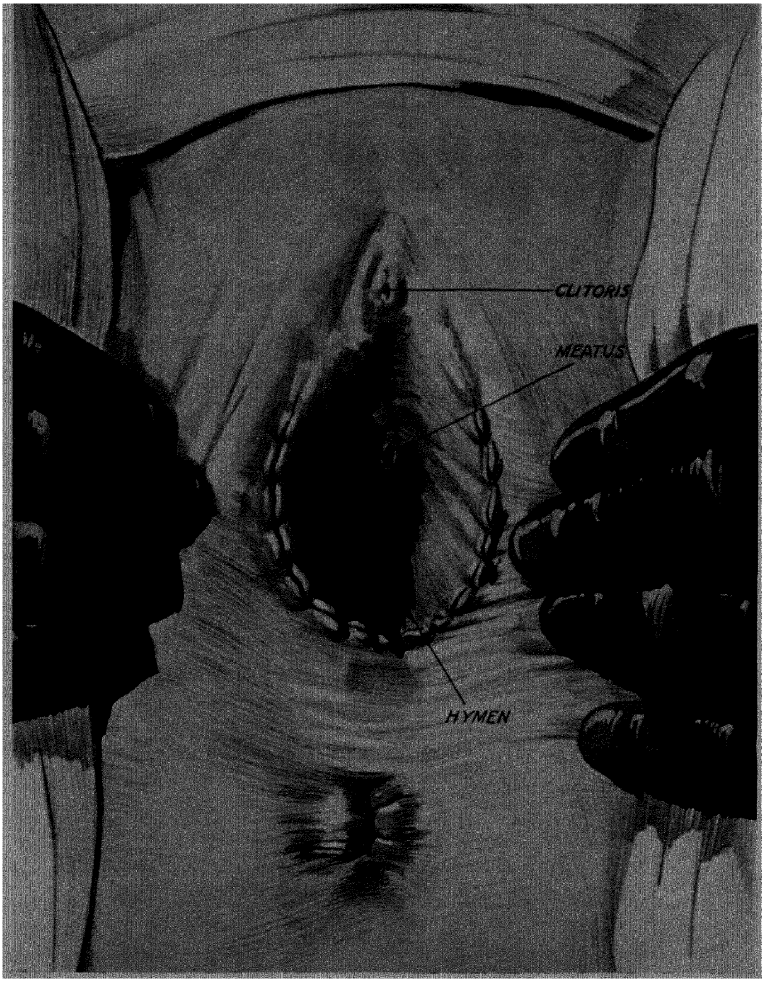


FIG. 546. THE OPERATION FOR VULVAL ATRESIA SHOWN COMPLETED.
See also Figure 96, page 141.

to recurrence, hence it may be necessary to dilate a small urethra before removal of the growth, in order to obtain a good view of the extent of its attachment to the urethral floor.

Prolapse of the Urethra. The prolapsed portion of the mucous membrane (*see* Fig. 200, p. 338) is grasped with forceps and put on the stretch. At the base of the stretched mucosa two lateral catgut sutures are passed, one on the right and the other on the left side. These sutures are to prevent

retraction of the mucosa after the prolapsed portion is removed ; the sutures include all the tissues in the urethral wall, passing (1) through the attachment of the urethra to the vestibule ; (2) through the fibro-muscular wall and the mucosa ; (3) into the lumen of the urethra and out again through the urethral walls, where, before being tied, they are held aside until the prolapsed mucosa is cut off. This is done by dividing the prolapsed collar from before back through its upper and lower surfaces until the level of the above sutures is reached ; then the two resulting lateral flaps of mucous membrane are divided flush with the ligatures. The latter are then tied, when they form the two lateral sutures of the new meatus. Similar sutures are passed above and below to bring the mucosa into union with the vestibular surface all round and thus to form the new *meatus urinarius*. An additional advantage of the method is that the undue patency of the meatus is reduced.

Urethral Diverticulum. This is a sacculated portion of the mucous membrane which projects towards the anterior vaginal wall, where it forms a small rounded reducible swelling.

Excision. The treatment of the condition consists in its removal. A sound is passed into the urethra and its tip directed into the sac. A linear incision is then made through the vaginal wall on to the tip of the sound. The vaginal wall is then dissected off the urethra, when the stretched mucous membrane forming the sacculus will appear as a thin-walled cyst. The edges of this structure are generally adherent to the urethral wall in the same way that the sac of a ventral hernia is adherent to the parietes ; it is therefore safe to cut off the sac close to the aperture through which it has prolapsed, without fear of retraction of the mucous membrane. This is next done and then the floor of the urethra is closed by interrupted catgut sutures. Finally the small vaginal skin-flaps are trimmed with scissors and brought together with catgut sutures. In cases where there is no definite "sacculus" but a general laxity of the entire length of the urethra (urethrocele) excision of any part of the urethra is unsuitable. It is then better to treat the dilated duct on the same principle as that adopted for the bladder in the radical cure of cystocele (*vide* p. 733).

Operations for Incontinence of Urine. In certain cases where there is no abnormality of the bladder or of the urine, but where the only sign to account for the troublesome symptom of incontinence is a dependent position of the urethra, an operation for the *elevation of the meatus* has been devised. A horseshoe-shaped incision is made through the vestibular mucous membrane above and to either side of the meatus. By uniting the edges of the meatus to the outer edges of the vestibular incision, the mouth of the urethra is drawn up for half an inch, or more, above its former position. Cases of incontinence occur in which an undue patency of the urethra is found, which may, or may not, be accompanied by cystocele. The treatment then consists in making a longitudinal median incision through the vaginal wall along the length of the urethra, raising two lateral vaginal flaps, then invaginating the floor of the urethra, and bringing the margins of the groove into apposition with interrupted catgut sutures. When a lax urethra accompanies a cystocele the above procedure is merely a continuation of the radical cure of cystocele (*see* p. 733), the central vaginal incision being carried as far as the *meatus urinarius*.

Operation for Epispadias. Mild cases of epispadias, in which the defect is confined to the vestibular or distal portion of the urethra (*see* p. 145),

may be dealt with successfully by plastic surgery. The area of operation is exposed by an assistant, who retracts the labia (*see* Fig. 547). The defect in the urethral roof is thus brought into view and a horseshoe-shaped incision is made through the skin around the enlarged urethral opening. From the collar of integument thus obtained, a new roof for the urethra is made. This is done by inverting the skin-flap and stitching its edges in the mid-line (*see* Fig. 548).

It may now be found that the restored canal is too patulous. To remedy this and to prevent the risk of incontinence of urine, a medium-sized glass catheter is placed in the urethra and held there by an assistant. The operator now passes two circumferential stitches around the entire urethra and ties them tight enough to cause the duct to grip the catheter. The latter is then withdrawn and the raw surface, from which the skin-flap was reflected, is now covered by bringing its lateral margins together by a few interrupted sutures (*see* Figs. 549 and 550).

By this procedure the stitches in the new urethral roof are buried, and the final result is that seen in Figures 549 and 550.

Excision of Bartholin's Cyst. A vertical linear incision is made over the vulval swelling (*see* Fig. 190, p. 326). Reference to Figure 45, page 56, will show that the gland of Bartholin lies immediately behind the bulb of the vestibule. Since the latter contains many large vessels, the anterior limit of the incision should not be made so high as to injure this structure. The incision having been made, its edges are picked up with pressure-forceps, and the mucous membrane and skin of the labium are dissected off the cyst, care being taken not to buttonhole the delicate mucosa. Strands of connective tissue carrying blood-vessels are divided between clamps, while the cyst is being shelled out of its fibro-fatty bed. It is quite possible to remove the cyst and the gland together as Figure 192, page 328, shows, but in the case of large cysts the gland will have been flattened out and will not be found. After the cyst has been removed entire, all bleeding-points are secured by catgut ligatures, and then the wound is closed by buried sutures of the same material. A pad of gauze is placed between the labia before the external dressing is applied. The patient is kept in bed for a week.

Bartholin's Abscess. Whenever possible the abscess-sac should be dissected out without rupture or perforation; the difficulty of so doing lies with the vulval mucous membrane, which soon becomes very adherent and thinned. It is worth while to sacrifice a portion of the mucosa in an attempt to secure primary union of the wound. If, therefore, two curved incisions are made so as to include a lozenge-shaped piece of the mucosa at its most adherent part, it is possible to dissect out the pus-sac entire. The wound may then be completely closed in layers with catgut sutures. The alternative plan is to lay the abscess open freely, scrape away the pyogenic membrane, swab the raw surface with 1–2000 biniodide of mercury solution and pack with bismuth gauze. The cavity then granulates up from the bottom, leaving an area of indurated tissue in the depths of the wound which can be felt for months afterwards.

Hydrocele of the Canal of Nuck. Serous peritonitic fluid sometimes collects in the *processus vaginalis peritonei* when the latter remains patent. The result is a cystic swelling at the upper part of the *labium majus* overlying the external abdominal ring. The treatment is removal, which is carried out as follows: An incision is made parallel to Poupart's ligament at a level

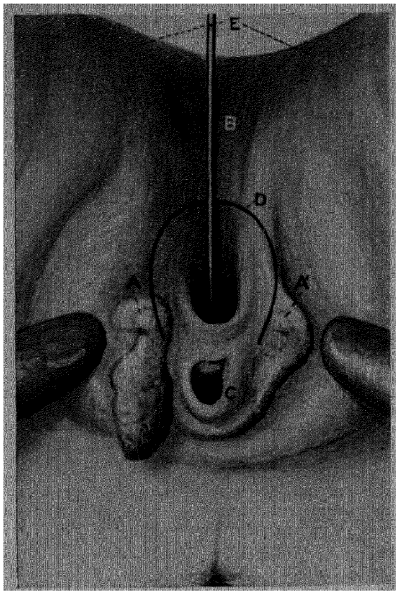


FIG. 547. OPERATION FOR EPISPADIAS :[1] 1ST STAGE. The labia (A A') are retracted by an assistant. A horseshoe-shaped incision (D) defines the skin-flap which is used for constructing a roof for the urethra.

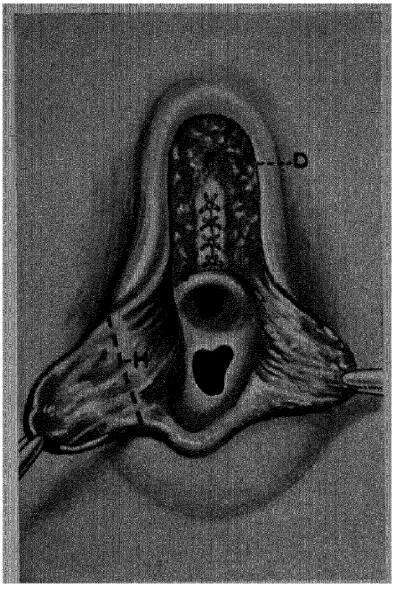
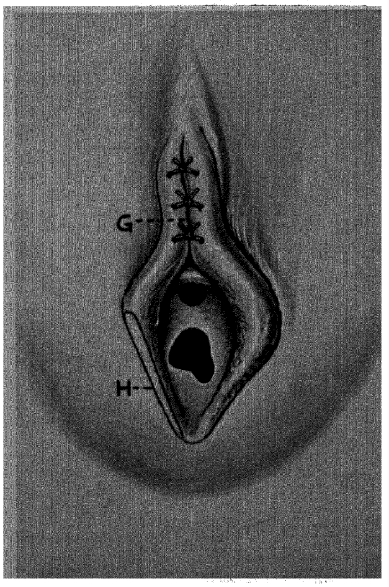
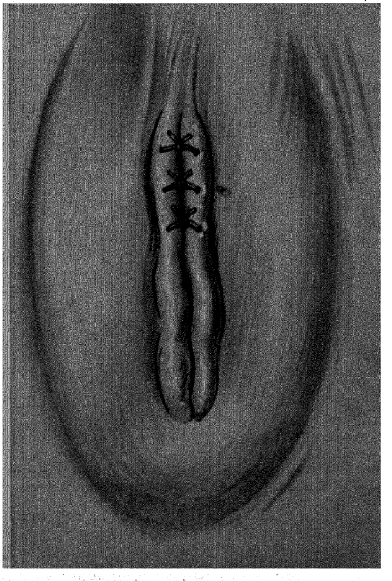


FIG. 548. THE SAME OPERATION : 2ND STAGE. The flap outlined in Figure 547 has been reflected, leaving the raw surface F. The edges of the flap are seen united in the mid-line ; thus a roof for the urethra is formed. The circumferential stitches described in the text are not shown.





FIGS. 549, 550. FINAL STAGE OF OPERATION FOR EPISPADIAS. The skin edges (G) are brought together over the new urethral roof. H, removal of pendulous nympha.

[1] The condition of the parts before operation are shown in Figure 101, page 145.

of 2 cm. above that structure, and extending from the pubic spine to the internal abdominal ring. The skin and superficial fascia are first divided, and superficial vessels are tied off. Then the aponeurosis of the external oblique muscle is slit up along the whole length of the wound, and the canal of Nuck is thus exposed. The peritoneum of the latter may be found to be distended with fluid only at its terminal part, or it may present as a cyst reaching from one end of the wound to the other. The cyst must be completely freed from the round ligament and the adjacent tissues; it is then opened up and its contents allowed to escape. The peritoneal sac is next seized with pressure-forceps and twisted until the neck is found to yield. A ligature is now applied to the twisted neck and the rest of the sac cut off. The stump is then fixed to the parietes above and external to the internal abdominal ring. In closing the wound the aponeurotic flaps of the external oblique are held aside whilst two mattress-sutures are passed through the muscular fibres of the internal oblique and through the external oblique aponeurosis close to its attachment to Poupart's ligament. As there is no spermatic cord in the female, these buried sutures are passed in the same plane. Finally the external aponeurosis is united. This is best done by drawing down the upper flap over the lower so as to strengthen the wound by providing for a double layer of aponeurosis over the line of the incision. The overlapping aponeurotic flaps are kept in apposition by mattress-sutures. The skin is united by subcuticular suture. Catgut may be used throughout the operation. A collodion scab, a pad of wool, and a spica-bandage are applied, and the patient is kept in bed for a fortnight. Reference has already been made to the fact that adenomyoma of the round ligament is met with in this situation. It may be mistaken for hydrocele because it frequently contains a blood-cavity.

Labial Hernia. An epiplocele or enterocele may form a swelling in the canal of Nuck or in the *labium majus*. When the hernia has extended into the external genitals the incision described above may have to be prolonged in order to reach the lower end of the sac, or, when not very adherent, the labial part of the sac can be drawn up into the wound without the latter being enlarged. On opening the sac it must be emptied of its contents, bowel must be returned into the abdomen, omentum must be tied and cut off. In other respects the operation is the same as that for hydrocele of the canal of Nuck.

Warts of the External Genitalia. Before operating for this condition it is necessary to keep the patient in bed, and to give repeated vaginal douches, also to treat any infective condition of the cervix or urethra which may be present.

Vulval and pudendal hairs should be removed as far as is possible and the whole vulva swabbed with acetone and painted with iodine (2 *per cent.*). The larger warts are then removed by a scalpel and the smaller ones are scraped off with a sharp spoon. It may be necessary to unite the edges of the wounds with a fine catgut stitch in the case of the larger warts. An aseptic dressing is applied, and the patient is kept in bed until the wounds and abrasions have healed.

Epithelioma of the Vulva. In the removal of a malignant growth from the vulva it is essential to extirpate the inguinal glands on both sides at the same time, whether they are palpable or not. Cancer which involves the vestibule often spreads across the mid-line (*see* **Fig. 180, p. 317**); it is

also not infrequently multiple, appearing on both sides simultaneously (*see* Fig. 178, p. 316); in such cases, therefore, it becomes necessary to remove the glands from *both* groins. The operation proceeds as follows (*see* Figs. 551 and 552):

An incision through skin and superficial fascia is made above and parallel to Poupart's ligaments, and the fatty tissue of the groin, carrying the glands

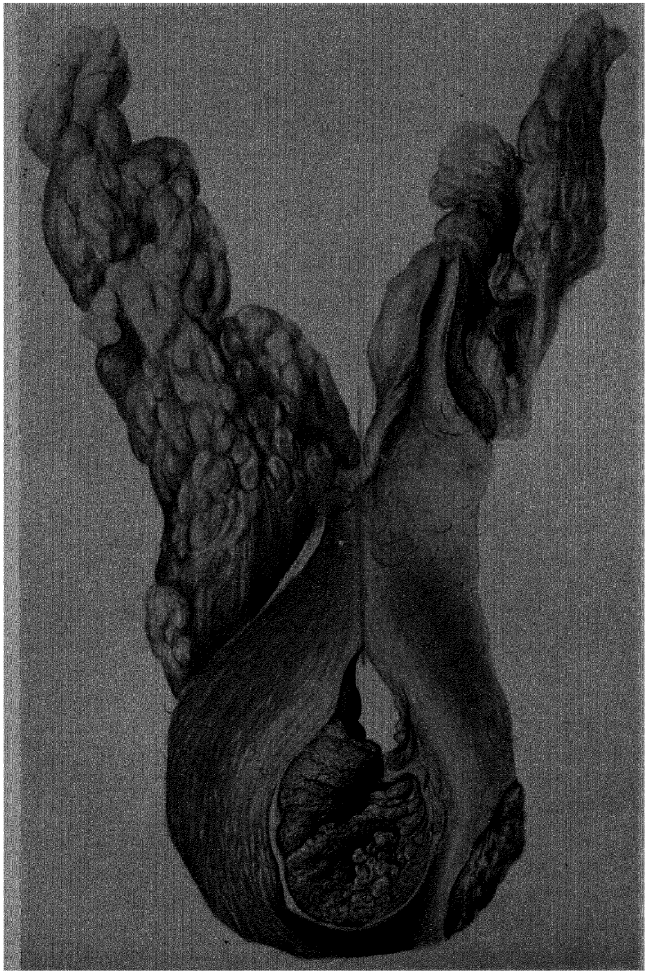


FIG. 551. EXCISION OF VULVA AND INGUINAL GLANDS PERFORMED FOR VULVO-VAGINAL CANCER.

of both the inguinal and femoral groups, is dissected out *en masse* from without inwards. This is done on both sides, the divided vessels being clamped and ligatured as the operation proceeds. The mass of glands and fat is not removed at this stage, but is wrapped in sterile gauze and removed in conjunction with the cancerous tissue later in the operation. After dissection of the glands the inguinal wounds are closed with interrupted fishing-gut sutures and covered with a sterilized towel.

The position and extent of the vulval growth will determine the subsequent steps of the operation. If the growth involves the clitoris and adjacent nymphæ, as shown in Figures 178 and 180 (pp. 316 and 317), these structures are removed *en masse*. To do this the lower ends of the inguinal incisions are prolonged downwards by cutting through the substance of the *labia majora* to a point beyond the lower extremity of the growth, keeping well outside the cancerous area. These lateral incisions are now joined by two

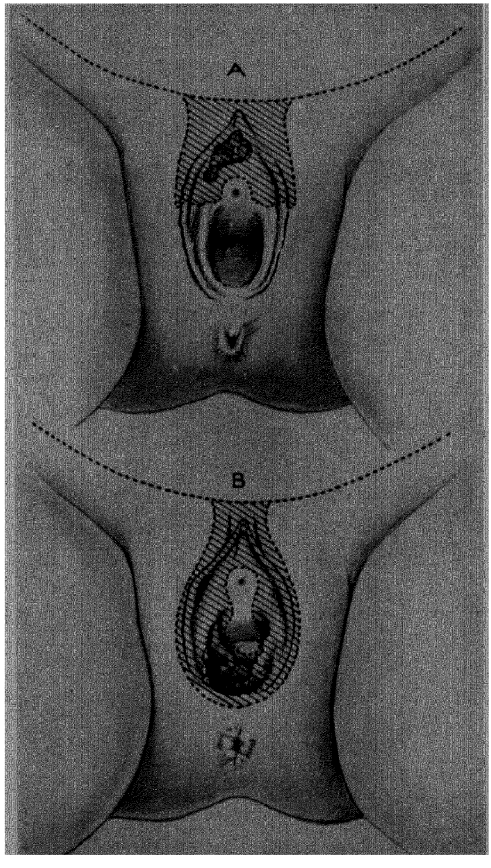


FIG. 552. A. OPERATION FOR CANCER OF THE CLITORIS. Dotted line shows incisions and the shaded area the parts to be removed. B. OPERATION FOR VULVO-VAGINAL CANCER. The incisions are represented by a dotted line. The shaded area shows the parts to be removed.

others running transversely, one through the skin of the *mons Veneris* above the growth and one through mucous membrane below, the latter passing across the vestibule just above the level of the *meatus urinarius* (*see* Fig. 552 A). The tissues thus mapped out are now removed together with the attached inguinal glands. The dissection proceeds from above downwards and in removing the clitoris its crura are divided close to their attachments to the pubic rami and the branches of the pubic arteries which run to the clitoris (*see* Fig. 45, p. 56) are tied off as soon as divided. Care must

be taken to avoid injury to the urethra, a sound being retained in the canal to determine its position. When the disease is confined to the lower part of the vulva, as seen in Figure 551, the skin-incision is made to encircle the vulva and that through the mucosa encircles the vagina and urethra (*see* Fig. 552 B). The area for removal being thus defined, dissection is continued from the point where it was left off. The fatty tissue from the groin which had been held aside whilst the vulval and vaginal incisions were made, is now grasped by the operator, and whilst the vulval tissues are put on the stretch they are dissected off the pubic rami above, and from the perineal body below. Branches of the internal pudic artery running to the clitoris and to the bulb on either side are clamped as soon as cut. The closure of the wound requires careful consideration, in order that the normal situation of the urethral orifice be preserved as far as is possible. It is best, therefore, to begin by approximating the skin-edges to the urethra by a few radially placed fishing-gut sutures; then proceed to unite the vaginal mucosa with the external skin, and finally to close the wide upper area in front of the symphysis pubis. Fishing-gut sutures should be used for apposition, and catgut for hæmostasis.

OPERATIONS ON THE VAGINA

Operation for Vaginismus. In some cases hyperæsthesia and spasm persist in spite of palliative treatment (*see* p. 333). It then becomes necessary, first to incise the superficial vaginal sphincter muscle, and to follow this up by gradual mechanical dilatation. The incision is best made in the middle line posteriorly, commencing at a point an inch above the hymen, and passing over the *fossa navicularis* and perineal body to a point an inch below the hymen (*see* Fig. 553). It should be deep enough to divide skin and mucous membranes, and also the subjacent muscular fibres. Owing to the lateral pull of the divided tissues the median incision leaves a *transversely* spindle-shaped raw surface which can be closed by uniting the upper to the lower edge with interrupted sutures (*see* Fig. 554). Two lateral incisions, of the same kind, may be practised instead of the single median one. After the wound has healed the patient should be taught to use a tubular vulval dilator, such as that shown in Figure 555. At first cocaine ointment may be applied to the vulva before passing the dilator, so as to avoid the discouragement occasioned by pain. It should be introduced every night or every second night, and allowed to remain in position for half an hour to one hour. This treatment persisted in, if necessary, for several weeks, will nearly always effect a cure of the condition.

Partial Absence of the Vagina. In a few rare instances the vagina is absent, in the lower part of its course only, as a congenital defect. If the uterus and ovaries are normally developed, cryptomenorrhœa will result. It is then possible to effect an opening in the following manner.

A sound is passed into the bladder, and at the same time the gloved index finger of the left hand is placed in the rectum, the two together acting as a guide.

A transverse incision is made in the position for the vaginal orifice, and as soon as the skin is divided, a septum of connective tissue is encountered. This has to be teased apart with great care for fear of injuring the bladder or rectum. A pair of sinus-forceps should be inserted, and cautiously opened in the transverse direction, snipping the stretched tissues from time to time

with blunt pointed scissors. The lower end of the imperforate vaginal canal is readily recognized, as it is distended with retained menstrual fluid. After opening it and evacuating the contents its edges are joined up with skin-flaps

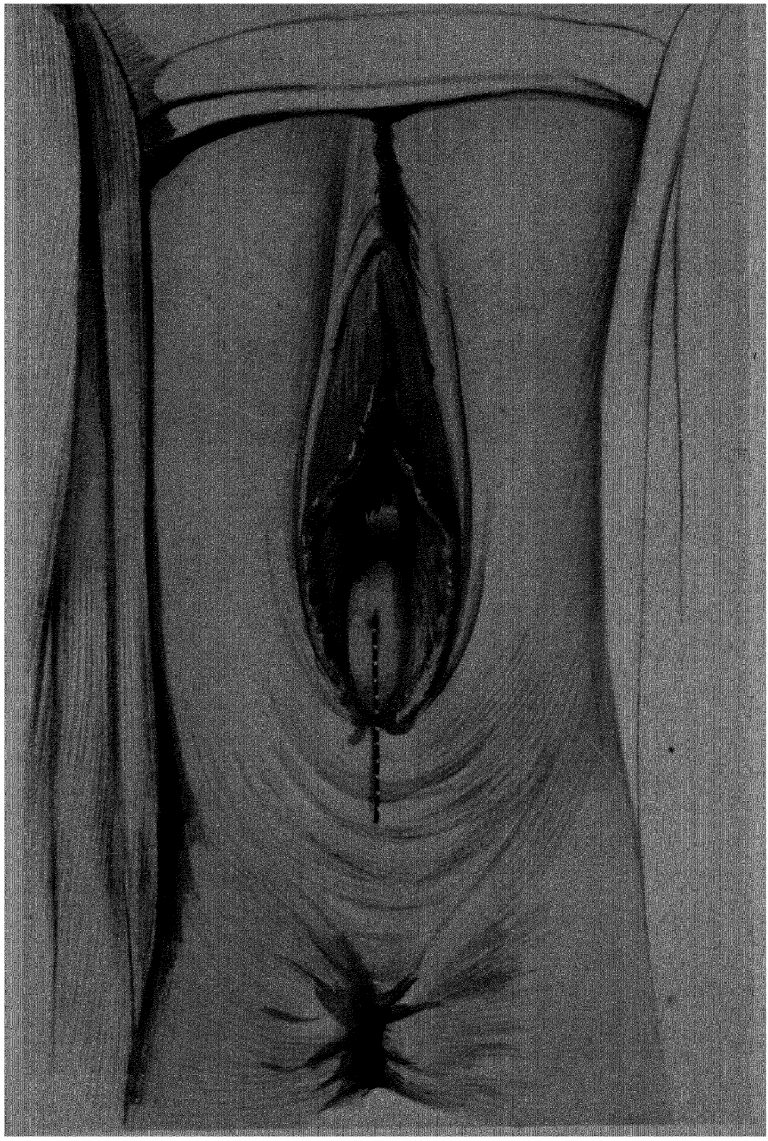


FIG. 553. THE INCISION FOR CASES OF VAGINISMUS.

obtained from the vulva. The opening thus obtained is at first packed with gauze and subsequently dilated with graduated vaginal dilators.

Total Absence of the Vagina. When the vagina is totally absent, the upper Müllerian structures usually remain undeveloped also. In 1910 Baldwin described an operation for total absence of the vagina, the object of which is to render a woman nubile although she is wanting in the essential

organs of generation. In our opinion this operation is unsound ethically and entails unjustifiable risks. Whilst we do not recommend this procedure its chief points are briefly mentioned.

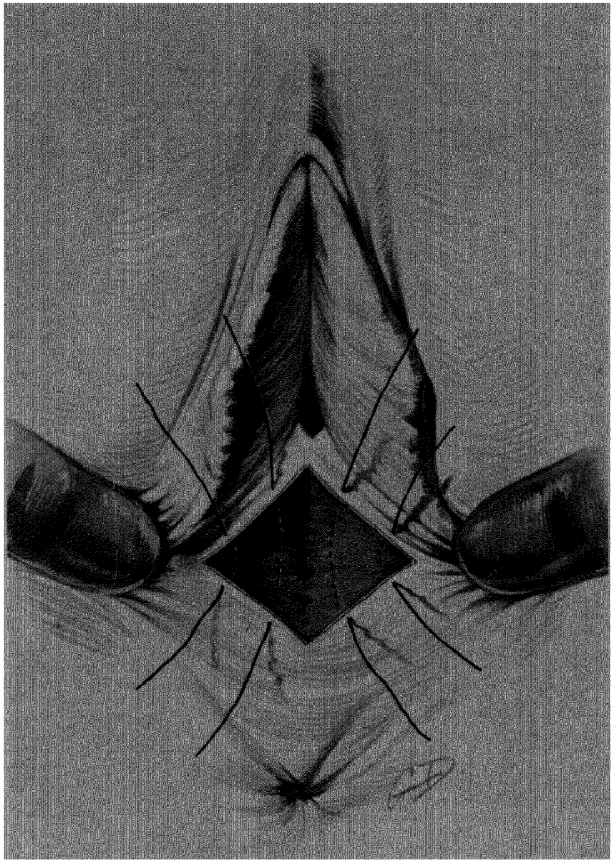


FIG. 554. OPERATION FOR VAGINISMUS. Method of uniting the edges of the diamond-shaped raw area produced by lateral traction with the fingers.

The operation consists in dissecting through the cellular tissues between bladder and rectum from the vulva to the peritoneum. The abdomen is then opened and a dependent loop of ileum isolated, *without disturbance*

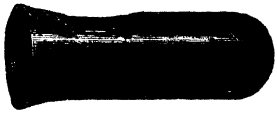


FIG. 555. VAGINAL DILATOR. The instrument resembles a tubular speculum, but is closed at one end. It is made of glass or vulcanite.

to its mesenteric attachment, and the continuity of the gut restored by anastomosis. The isolated loop is then drawn down through the perineal wound and is then opened and sewn to the edges of the vulva. The new

vagina thus consists for the time being of two parallel portions of small gut. During convalescence the median partition is divided and a single canal is thus produced.

There is great strain upon the mesenteric vessels, enough to cause occlusion of some of them, and sloughing of the intestinal coats may occur. In some cases also it is physically impossible to bring the extremity of the loop down to the vulva.

Longitudinal Vaginal Septum. A mesial longitudinal septum sometimes persists as a fœtal relic due to incomplete fusion of the two Müllerian ducts to form a common vagina. Sometimes two septa are seen, one on the anterior and one on the posterior vaginal wall; these relics are the result of partial absorption of the mesial septum composed of the two Müllerian ducts.

No operation is required unless dyspareunia is caused by the presence of such tags or flaps. It then becomes necessary to remove the septum or septa with scissors close to the vaginal walls, and to bring the edges of the linear wounds together with continuous catgut sutures.

Vaginal Cysts (*see* Fig. 201, p. 344) may cause discomfort and bearing-down pain, or they may occasion difficulty in coitus. They should be dealt with surgically by complete excision. When the cyst is large, and has stretched a considerable portion of the vaginal wall to form an investment, a good deal of the latter may be sacrificed. Accordingly, instead of making a linear incision over the convexity of the cyst as was advised when dealing with a cyst of Bartholin's duct, a lozenge-shaped or circular incision may be made so as to leave a portion on the vaginal mucous membrane on the cyst-wall. The outer edges of the incision are then made tense with pressure-forceps and the cyst dissected out of its bed. Care must be taken not to puncture the cyst, as it is more difficult to dissect out the wall of a collapsed cyst than that of one which is tense from fluid-contents. It may be necessary in some cases to dissect deeply into the pelvic cellular tissues at the top of the vagina, or at the sides. When the cyst lies in the anterior vaginal wall, the floor of the urethra and base of the bladder must be dissected off with caution, whilst a sound is retained in the latter. In a recent case, one of us (C.L.) found the cyst very adherent to the floor of the urethra and at its upper end it tailed off into a narrow thick-walled duct of over 1 inch in length. Microscopic section through the "duct" revealed gland tubules. In the case of deeply seated cysts many vessels may have to be tied with catgut, and the cellular bed built up with sutures placed in layers. Finally, after all oozing has ceased, the vaginal mucous membrane is closed with continuous or interrupted sutures.

Solid Tumours of the Vagina. Solid tumours in this situation usually prove to be fibromyomata or adenomyomata. Their site of election is the upper part of the posterior vaginal wall, especially the posterior fornix.

Fibromyomata are generally single spherical growths with a capsule formed of the surrounding connective tissues. They sometimes attain the size of a large orange, and when discovered should be removed. The growth is thoroughly exposed and a linear incision is made through the vaginal wall and through the capsule of the tumour. The latter then appears as a whitish, glistening, solid mass. This is seized with a volsella and forcibly drawn down. It is then enucleated from its capsule with closed blunt-pointed scissors, any adherent strands of tissue being snipped as occasion may require. In the case of large growths, morcellement of

the tumour renders removal more easy, and enables the operator to work through a smaller incision. The capsule-bed is closed with layers of mattress-sutures, and finally the edges of the vaginal mucous membrane are brought together with interrupted sutures. The vagina is then packed with bismuth gauze, and an aseptic dressing applied to the vulva by means of a T binder.

Adenomyomas are generally diffuse, adherent nodules, devoid of a capsule. They may occur singly or they may be multiple. Only the smaller nodules can be successfully dealt with by a vaginal operation. Since they are often densely incorporated with the vaginal mucosa it is necessary to remove the latter together with the nodule.

The growth should be well exposed to view, and the adherent vaginal mucosa grasped with a volsella. An incision is then made *around the adherent mucous membrane* through the whole thickness of the vaginal wall, traction being made on the tumour all the while. On the deep aspect the tumour may adhere so intimately with the peritoneum, or with the utero-sacral ligament, as to necessitate cutting through these structures in effecting its removal. This will require ligature of the utero-sacral fold and closure of the opening made in the pouch of Douglas. If there is troublesome oozing, it is well to insert a small rubber drain, or even to pack the wound with gauze for twenty-four hours. If hæmostasis is satisfactory, the wound in the vaginal wall may be closed by interrupted sutures of chromic gut.

Carcinoma of the Vagina. Secondary carcinoma of the upper part of the vagina, due to spread of a cervical cancer, is dealt with by Wertheim's pan-hysterectomy. If primary cancer is detected in an early stage and is situated near the vulval orifice, it can be removed by extirpating the lower half of the vagina. If the disease lies higher up, the entire vaginal canal must be sacrificed together with the uterus, the latter being removed in order to obviate the risk of uterine discharges being subsequently retained. Figure 202, page 345, shows the entire vagina removed for epithelioma.

Removal of the Vagina and Uterus by the Vaginal Route. A circular incision is made through the vaginal mucosa at its junction with the vulva. The mucous membrane is then dissected as a continuous tube right up to its cervical attachments. The lower free edges of this tube are then inverted, and the canal closed with stout silk which can be used as a tractor. With the vagina completely dissected and only attached to the cervix, the latter can be pulled down by using the former as a tractor. The cellular tissue attached to the cervix will then be found exposed, and if the vaginal orifice is capacious the uterus may be removed by the method described under "Vaginal Hysterectomy from below upwards" (p. 709). If more room is required a paravaginal incision is made on one side. This begins above at the level of the cervix, passes deeply into the ischio-rectal fossa, and externally through the skin and deep structures between the *tuber ischii* and anus; finally curving around the anus, it divides the superficial sphincter and some of the fibres of the levator ani. This is Schuchardt's incision for providing an efficient approach for vaginal hysterectomy. It is rarely required, bilateral episiotomy, *i.e.* division of the anterior margins of the perineum on either side of the mid-line to a depth of about 1 inch being usually sufficient. After the uterus and vagina have been removed, the paravaginal- or episiotomy-wounds are sutured with interrupted stitches. The cavity left by the operation is then packed with bismuth gauze.

COCCYGECTOMY

The conditions for which this procedure is indicated are discussed on pages 333–334. The operation is carried out as follows:

The patient is anæsthetized and then placed in the Sims's position. The natal cleft and adjacent skin are painted with 2 *per cent.* solution of iodine. A straight incision carried down to the bone is made over the central coccygeal line from its tip to the end of the sacrum. The tissues are separated with hooked retractors and all the soft structures are cut loose from the bone. The forefinger of the left hand is inserted under the tip of the coccyx to act as a guide and to protect the rectum.

The dissection should extend to above the level of the alæ of the first coccygeal segment, so as to make sure of leaving no part of the coccyx behind.

Hirst recommends that at this stage a swab be inserted into the cavity beneath the isolated coccyx to catch fragments of bone-dust and to control hæmorrhage. A Gigli saw is now inserted under the bone and pushed up so as to remove the tip of the sacrum. After the bone has been sawn off, the median sacral artery is tied with catgut. A small drain is inserted and the wound closed with interrupted fishing-gut sutures. The drain is removed after twenty-four hours.

THE AFTER-TREATMENT OF GYNÆCOLOGICAL OPERATIONS

A great number of points arise for consideration in connection with the after-treatment of operations, and it will be convenient to deal with the subject systematically, considering first the management of simple cases and then the management of severe and complicated cases. Further, the immediate treatment, *i.e.* treatment during the first twenty-four hours, will be considered in each group apart from the later treatment.

I. AFTER-TREATMENT OF A SIMPLE ABDOMINAL CASE

(A) **The Immediate Treatment.** This begins with the removal of the patient from the operating table to her bed. It should be done in all cases skilfully, gently, and with no unnecessary delay. The bed should be previously warmed with hot-water bottles, *which should be removed when the patient is placed in it.* Burning of the skin is very readily caused during unconsciousness, and accidents with hot-water bottles frequently occur unless the greatest care is taken. If hot-water bottles are specially ordered, they should be put in the bed after the patient has been placed there, and their position carefully arranged. One of the duties of the attendant nurse is to assure herself from time to time that the protective coverings of the bottles are not disturbed by the patient's movements. A pint of saline with 60 grains of bromide may be given *per rectum.*

Posture. The most convenient position for the patient at first is the horizontal, and she should be turned a little on her side with a pillow to support the back. In this position vomiting is easier, and the mouth and throat can be kept clearer than when she lies on her back. When vomiting is over, she may be laid on her back either flat or with the shoulders raised

with pillows. Slight changes of posture, from time to time, are very grateful to the patient and do no harm if carefully carried out.

In all cases when infective lesions have been dealt with, whether drainage has been adopted or not, the posture known as 'Fowler's position' is of great advantage. The patient is propped with pillows in a semi-upright, sitting position, and a bolster placed beneath the bent knees and tied to the bed-head prevents her from slipping down again. A useful modification of Fowler's position can be obtained by elevating the bed-head; this is done by resting the feet of the bed-head upon the seats of two strong wooden chairs. This is often found more comfortable than Fowler's position. This posture may be assumed as soon as the reflexes have been re-established. It serves to prevent dissemination of infective fluids from the pelvis or lower abdomen into the dangerous upper abdominal zone, where absorption is more rapid, and the results more serious, than is the case with the pelvic peritoneum. The fluids present find their way into the most dependent part of the peritoneum, *i.e.* the pouch of Douglas, whence they can be withdrawn by drainage, or, if no drain-tubes have been used, isolated by plastic adhesions so that their effects become strictly localized.

Anaesthetic Vomiting. Inhalation-anæsthesia leads almost invariably to nausea and vomiting. This symptom is, however, very variable in intensity, and somewhat variable also in the time at which it occurs. Sometimes it is slight and infrequent, and ceases in a few hours. In other cases it is frequent, prolonged, violent, and accompanied by retching of the most distressing kind. Besides exhausting the patient this causes much pain in the abdominal wound.

The ejected fluids are frothy and greenish, and may at first contain large quantities of mucus which have been swallowed. The amount is seldom great when the patient has been properly prepared for the operation.

Usually the vomiting ceases in from twelve to twenty-four hours; occasionally some vomiting persists for two or three days, not changing its type, and being unaccompanied by other symptoms. Everything swallowed is immediately rejected, but the pulse and temperature are not elevated, and the vomit still consists only of the gastric secretion. These points serve to distinguish it from the vomiting due to commencing peritonitis even when, as sometimes happens, considerable dilatation of the stomach with gases occurs. A characteristic prominence is formed in the epigastric region, which is highly resonant on percussion (*vide infra*).

Treatment. Anæsthetic vomiting can be largely prevented by careful preparation of the patient and by the administration of sugar, *e.g.* barley sugar, and by the use of narcotics before operation. The *cause* is mainly to be found in irritation of the gastric mucous membrane by mucus, charged with anæsthetic, which has been swallowed during the operation. No attempt should be made at first to check the vomiting by sedatives; on the contrary, it should be encouraged until the mucus has all been got rid of. Warm water containing a teaspoonful of bicarbonate of soda to four ounces may be freely given; if rejected, it will bring with it fresh quantities of mucus.

If vomiting persists after six hours, attempts to stop it should be made. Sips of boiling water often give temporary relief. Three or four ounces of strong coffee with a teaspoonful of bicarbonate of soda, or the same quantity of a 10 *per cent.* solution of glucose, are sometimes successful. Bromides

per os or *per rectum* may succeed, and a mustard leaf may be applied to the epigastrium. In obstinate cases all mouth-feeding should be absolutely withheld for six hours, and saline enemata given. If this fails, gastric lavage is the only remaining remedy, and this almost invariably succeeds; it causes so much distress, however, that it should be reserved for cases which have resisted all other measures.

Thirst. This is one of the most distressing symptoms of the early convalescence in almost all cases. When vomiting is severe it is greatly aggravated by the further loss of fluid thus entailed, and by inability to take fluids by the mouth. As soon as vomiting has ceased hot water may be given freely in small quantities. When water cannot be given by the mouth, thirst may be partially relieved by administering enemata of normal saline solution; not more than a pint should be given, and the injection may be repeated every four hours for the first twenty-four hours if necessary. Bromide, or bromide combined with chloral may usefully be given with the rectal saline during the first twenty-four hours; 30 grains of each may be dissolved in the pint or half pint of saline to be injected. Rectal saline is also useful in counteracting the effects of shock and hæmorrhage.

Pain. The chief seat of pain is the abdominal wound and, as already stated, vomiting greatly aggravates it. There is no necessity to withhold sedatives, and morphia ($\frac{1}{6}$ gr.) or heroin ($\frac{1}{6}$ gr.) may be given hypodermically a few hours after operation, and repeated as may be required.

Bladder. The renal secretion is scanty for the first twenty-four hours after an abdominal operation, and the first evacuation of the bladder is not as a rule required for 12 to 18 hours. The patient is not always conscious of necessity, but the natural voiding of the urine should be encouraged. The quantity voided or withdrawn by catheter should be measured each time, and noted on the chart by the nurse. The first urine obtained should be kept for examination; blood may be present, indicating injury to the bladder or ureter. Care must be taken that the bladder does not become gradually over-distended through repeated incomplete evacuation. If less than four to six ounces is voided naturally at a time, or if the patient complains of bladder irritability, the catheter should be passed.

Occasionally complete retention occurs after operation, and this may last for several days, or sometimes until the patient is allowed to get up. Nervousness is the chief factor in its occurrence. When prolonged use of the catheter is required, prophylactic measures against cystitis should be promptly carried out, hexamine and acid sodium phosphate being regularly administered (*see also* p. 241).

(B) **Treatment after the first Twenty-four Hours.** *Diet.* Fluid food in small quantities may be given as soon as the anæsthetic vomiting has ceased. Milk and barley water, weak tea and milk, soups and jellies, with abundance of water to drink, suffice for the first forty-eight hours. Solid food in the shape of rusks, boiled fish, stewed fruit, baked apples, and custard will be as readily digested as fluids, and indeed often cause less flatulence. After the bowels have been moved a light convalescent diet may be given.

Bowels. The chief discomfort of the early convalescence is the colicky pain which arises from flatulent distension of the intestines, and its severity is proportionate to the duration and extent of the operation, and is most marked in cases which have required actual handling of the intestines. It is probably due to a paresis of reflex origin, and is occasioned by peritoneal irritation, or possibly by plastic peritonitis in the neighbourhood of intra-

abdominal ligatures or raw areas. The temperature is often raised to 100° F. After a free evacuation of the bowels has been obtained it soon disappears in cases which are doing well; its persistence is an indication of the onset of peritonitis. On the second day of convalescence an enema consisting of a pint of soapy water with an ounce of turpentine, well mixed together, should be given; this usually brings away with it a large quantity of flatus and thus gives great temporary relief. It may be repeated as required. A soft rubber tube may be passed for 6 inches into the rectum and allowed to remain there for half an hour, and this often aids the passage of flatus. The aperient should be given on the morning of the third day, and nothing is better, or more certain, than castor oil; calomel (3 grs. in divided one grain doses), followed by a saline such as "white mixture" or a full dose of Epsom salts, is the best substitute for castor oil. A daily mild aperient or enema is usually required during subsequent convalescence.

Dressings and Stitches. Wounds that have not been drained and that have been made through healthy tissues do not require re-dressing for several days. Wounds that have been drained should, however, be re-dressed once or twice every twenty-four hours, and this must be carried out with full antiseptic precautions, including the use of rubber gloves. Sterilized gauze and cotton-wool are the best materials for receiving discharges, and they must never be allowed to become soaked through. Drainage-tracks which pass into the peritoneal cavity should not be irrigated, for if the track is imperfectly isolated infective material may be forced into neighbouring areas by the irrigation.

Superficial stitches, *i.e.* those which include the cutaneous layer only, or Michel's clips, can be removed on the fourth or fifth day. Deep stitches which have taken up the fascial layer as well as the skin should be allowed to remain for eight to ten days. If suppuration appears the affected stitches should at once be removed.

Getting up is fixed for the tenth to the fourteenth day, and in three weeks the patient may again be walking about. In simple cases a week in bed may sometimes suffice; on the other hand, debilitated subjects may require a longer period of rest. When the abdominal incision has healed by first intention it is unnecessary, in most cases, for the patient to wear an abdominal belt. If drainage has been employed through the abdominal incision the scar always has a weak spot, and a belt should be worn for at least six months. This may also be desirable when the abdominal muscles are abnormally weak, as from multiparity, or over-distension by a large abdominal tumour. Breathing exercises, and exercises for the abdominal muscles, are also valuable in such circumstances for the prevention of hernia.

II. COMPLICATIONS AFTER ABDOMINAL OPERATIONS

Shock. The causation of post-operative shock is still the subject of much dispute. Of the many theories which have been advanced three may be selected for mention, inasmuch as they have been supported by serious experimental work. (1) The theory of Crile is that post-operative shock is due to depression of the vasomotor centre, due partly to noxious nerve-influences from the site of operation, partly to direct poisoning by the anæsthetic; (2) Boise has advanced the view that it is due to cardiac

spasm; while (3) Henderson contends that shock is due to an excess of carbon dioxide in the blood, *i.e.* to a degree of asphyxia. In the present state of our knowledge no practical purpose would be served by examining the relative merits of these theories.

The essential feature of post-operative shock is *profound depression of the circulation*, indicated by cardiac feebleness and low blood-pressure. It is present to a moderate extent after all severe intra-peritoneal operations; in different circumstances many different degrees of severity are observed, and in some cases the patient may die of shock without recovering consciousness. The conditions which may be expected to lead to severe shock are great loss of blood, severe trauma, chilling of viscera by exposure, rough handling of the abdominal organs, prolonged anæsthesia, and a precedent loss of vitality from illness. To a great extent these predisposing causes can be avoided by careful management, but not, of course, in all cases. A useful prophylactic measure, when a severe operation is contemplated, is to keep the patient in bed for a few days beforehand, to clear the lower bowel without the use of drastic purges such as castor oil, and to secure sleep by the use of hypnotics if necessary. In cases of profound anæmia, prophylactic transfusion of blood may be desirable. During the operation it is important to maintain the body-heat and avoid unnecessary exposure of abdominal viscera. During the operation a continuous subcutaneous injection of saline can be kept up in the manner described below.

After severe abdominal operations a pint of normal saline solution may be poured into the peritoneal cavity and left for absorption; this diminishes shock and relieves thirst. It cannot be used in infective cases owing to the risk of distributing infective material over the general peritoneal cavity.

Shock, when severe, is clearly manifested before the effect of the anæsthetic has passed off, and while the patient is still unconscious. The skin is pale and cold, and the lips and finger-tips are slightly cyanotic; sometimes a cold sweat is found, especially upon the face and palms of the hands. The pulse is rapid, small, and very feeble, but the outline of the artery is distinct; the temperature is subnormal, the respiration shallow, and usually increased in rapidity. The mental condition is lethargic, and though the patient can be roused she rapidly becomes again somnolent. The renal secretion is more or less completely suspended, and in severe cases of shock suppression of urine, lasting for twenty-four hours or upwards, may occur.

It is, of course, of prime importance to distinguish shock from hæmorrhage, and the following points of contrast must be borne in mind.

Shock	*Haemorrhage*
(1) Onset immediate.	Onset after an interval, it may be, of several hours.
(2) Patient lethargic, sleepy or stuporous.	Patient distressed, or restless and excited.
(3) No pain.	Abdominal pain, often severe.
(4) Pulse small, rapid, artery distinct.	Pulse small, rapid, artery flabby.
(5) Respiration shallow and quick.	Respiration deep and laboured.
(6) No attacks of syncope.	Recurrent attacks of syncope.

Shock may continue for many hours in spite of treatment, and sometimes all attempts at restoration fail and the patient dies. Usually, however,

a gradual reaction sets in, the pallor diminishes, the surface of the body becomes warmer, the temperature rises, and the pulse becomes stronger and more rapid.

The *treatment* consists in the first place in endeavouring to maintain the body-heat by wrapping the patient in warm blankets; outside these are placed hot bottles which, however, must be very carefully shielded from contact with the skin. Burns of a serious nature may be caused during unconsciousness by comparatively low temperatures. A more effective method is the use of the radiant heat bath, which in its simplest form consists of a cage covered with electric light bulbs, which is placed over the body from the shoulders to the feet. In this way a temperature of 120° and upwards can be maintained without difficulty.

In addition, a pint of warm saline should be administered *per rectum*, and the foot of the bed raised to a height of 10 to 12 inches. Other means may be employed to raise blood-pressure, and for this purpose nothing is more effectual than pituitary extract, which should be given hypodermically in the doses previously stated (*see* p. 117). This may be repeated in four hours if necessary. Strychnine in full hypodermic doses ($\frac{1}{30}$ gr.) is also freely given by some surgeons, although Crile, on theoretical grounds, advises against it. Its stimulant action on nerve-centres is probably of service.

In very severe cases reliance must be placed upon the subcutaneous or intravenous injection of saline solution; the former is the simpler method and suffices for all but the most urgent cases, for which the intravenous method should be reserved.

A convenient apparatus for subcutaneous transfusion is that shown in Figure 556, the whole of which may be readily sterilized by boiling. In the female, the best place for the injection is beneath the mamma or beneath the skin covering the ribs in the axilla; half a pint can be introduced on each side, and will be rapidly absorbed. The skin must be carefully sterilized before introducing the needle; air must be completely expelled from the tubing, and the whole procedure conducted with scrupulous antiseptic precautions. Extensive suppuration, or even sloughing of cellular tissue, may result from failure of these precautions. The temperature of the solution in the bag should be maintained at about 100° F. This method of subcutaneous transfusion may also with advantage be practised during the performance of a severe operation.

Recurrent Hæmorrhage. Serious hæmorrhage in the first twenty-four hours is almost invariably due to *slipping of a ligature* which has included a large vessel, and the ovarian pedicle is the commonest seat of this accident. Pain, restlessness, and a rising pulse-rate, together form an unmistakable picture of concealed bleeding and serve to distinguish it, as has been explained, from shock. In cases of severe bleeding, pallor and air-hunger may be superadded to these symptoms. The differential diagnosis of shock and internal hæmorrhage is obviously a matter of the greatest practical importance from the standpoint of treatment. In the presence of these symptoms, the abdomen must be reopened without delay, the bleeding-points securely controlled, and the effused blood removed by swabbing from the peritoneal cavity. Occasionally, severe hæmorrhage occurs from vessels in the parietal incision, but as a rule the bleeding is intra-peritoneal. Saline transfusion, either intravenous or subcutaneous, should be begun in severe cases immediately before reopening the abdomen,

one or two pints of sterile saline solution may be left in the peritoneal cavity before closing the abdominal wound. The necessity for speed must not excuse slackness in aseptic detail, for after severe hæmorrhage the power of the tissues to resist infection is greatly reduced.

Slight oozing from small bleeding-points, in the pelvis, may result in the formation of a *pelvic haematocele*. The amount of blood thus lost may be insufficient to produce any of the constitutional symptoms just enumerated. A rise of temperature towards the end of the first week usually results, and if the blood becomes infected from the bowel, or from some other source, fever may be high and accompanied by abdominal pain and distension. On

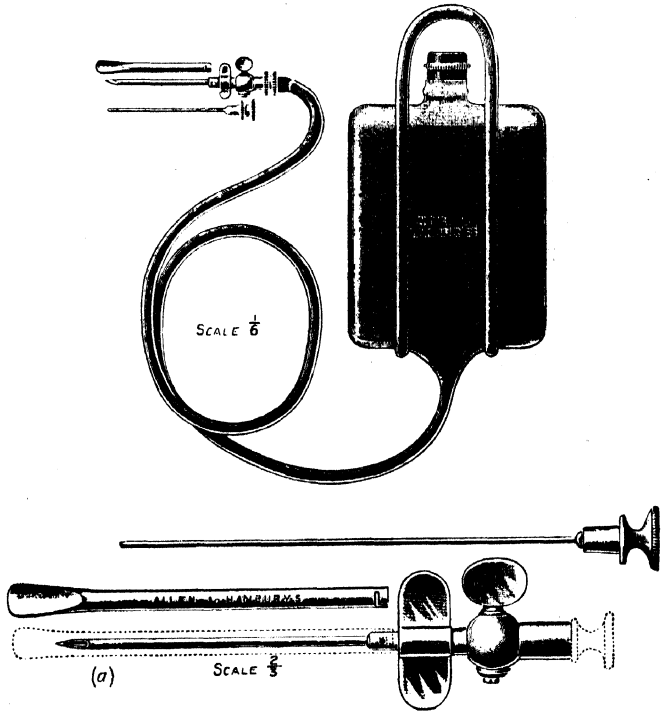


FIG. 556. ARBUTHNOT LANE'S APPARATUS FOR SUBCUTANEOUS SALINE TRANSFUSION. It consists of a rubber bag and rubber tubing, with a needle furnished with a stop-cock, for subcutaneous use, shown at (*a*).

vaginal examination a characteristic soft swelling will be found in the pouch of Douglas, and when infected this may burrow deeply between the rectum and the vagina, causing the upper part of the posterior vaginal wall to bulge prominently. The treatment in all cases is to open the posterior fornix by posterior colpotomy and drain the hæmatocele into the vagina.

Acute Abdominal Distension. A moderate amount of distension usually occurs after all intraperitoneal operations upon the second and third days. It is accompanied by colicky pains and flatulence, and yields readily when a satisfactory evacuation of the bowels has occurred. *Acute* abdominal distension may supervene rapidly at about the same period, or later, and it must be recognized that there are four different causes to which it may be

due, viz. (1) peritonitis; (2) intestinal obstruction; (3) intestinal paresis or pseudo-ileus; (4) acute dilatation of the stomach (gastrectasia). These conditions must be considered with care, for upon their early and correct recognition the success of the treatment largely depends.

I. **Peritonitis.** Acute post-operative peritonitis is always due to infection; the plastic peritonitis which often occurs in the neighbourhood of ligatures and lines of incision in the peritoneum is of a very mild type. Infective peritonitis may be the result of imperfect asepsis during operation, when it is usually staphylococcal or streptococcal; or the infective agent may have been present in the tissues at the time of operation; or it may gain access later from the bowel as the result of injury to the bowel-wall, when bowel organisms (*B. coli* or *S. faecalis*) are commonly found. From the clinical point of view the results of the infection depend largely upon the extent of peritoneum involved, and it is convenient to divide cases of acute peritonitis into *general or diffused* and *localized*.

General or Diffused Peritonitis. This formidable complication is now seldom seen, owing to the efficiency of modern technique. The clinical features are by no means uniform; sometimes they are so marked as to make the diagnosis obvious at a glance, sometimes they are so unobtrusive that their serious import may be unappreciated. Usually the symptoms occur early; post-anæsthetic vomiting may pass into the vomiting of peritonitis, which is nearly constant, spontaneous, and independent of food or drink; the vomited matters are brownish and ultimately they become fæcal. Great thirst usually accompanies continued vomiting. The temperature and pulse rise quickly in irregular steps, the abdomen becomes rapidly distended and the abdominal walls rigid; constant pain, referred to the abdomen generally, is complained of, and the patient's expression indicates suffering. The leucocyte-count is definitely raised, perhaps to 40,000, in the earlier stages with a corresponding rise in polymorphonuclear leucocytes, but in advanced stages this leucocytosis may subside. The sedimentation time may also be altered as described on page 566. Cutaneous rashes often appear. Complete obstruction of the bowels supervenes after a day or two, although at the beginning flatus and fæces may be passed with the aid of enemata. The pulse becomes feebler and thinner as it increases in rapidity, and the outlook is in all cases extremely grave.

In occasional cases pain, abdominal distension and rigidity may be absent; there is nausea but no vomiting; the temperature does not rise above 100°; but the pulse-rate is rapid and increasing, and the general condition is unsatisfactory. After two or three days the classical signs of peritonitis appear with extraordinary rapidity, and if the abdomen is then opened general suppurative peritonitis may be discovered.

Treatment. Attention must once more be drawn to the necessity scrupulously observing all the precautions detailed in the sectic Technique in order to prevent the occurrence of peritoneal infection the operation, especially when dealing with infected organs. W the condition has declared itself, treatment must be prompt and the following methods may be adopted: (*a*) drainage; (*b*) sion; (*c*) stimulation; (*d*) specific vaccines and sera.

Drainage of the peritoneum is difficult to carry out stances, and when extensive adhesions have form draining the whole peritoneal sac are greatly inc

useful to drain the great pouches, viz. the pouch of Douglas and the renal pouches, and for this purpose small incisions should be made in the selected spots. Rubber-tubes of large size are best for this purpose. It must not be forgotten that peritoneal drainage is greatly facilitated by maintaining Fowler's position, which favours accumulation of fluids in the lower abdominal zone and hinders the upward spread of infection to the dangerous subdiaphragmatic zone.

Saline is best administered, in septic conditions, by slow continuous rectal injection—*proctoclysis*. It is essential that the injection should run very slowly—a drip from the end of the tube is all that is required—and the temperature of the solution should be carefully regulated and uniformly maintained. If these precautions are observed intolerance is very seldom met with; when the fluid is rejected by the bowel the explanation usually is either that the temperature of the solution is above or below body-heat, or that the flow is too rapid. Several pints may thus be absorbed in twenty-four hours and the treatment may be continued for several days; it is, however, well not to make the injection absolutely continuous, but to suspend it for an hour or two from time to time. Saline acts in three ways: (*a*) by diluting the dose of toxins absorbed into the blood; (*b*) by promoting leucocytosis; (*c*) by stimulating the excretory functions, especially of the liver, the kidneys, and the skin.

Specific treatment has proved disappointing in acute septic conditions. Antistreptococcic serum of the polyvalent kind may be given at once, in most instances, without waiting for bacteriological diagnosis to be made. It does no harm, even if some other organism than the streptococcus is concerned. As soon as possible, cultures should be made from the blood and the peritoneal exudate, and an autogenous vaccine prepared. Only small doses of about one million should be given at first until the extent of the reaction has been observed.

Attention is now being given to the treatment of acute septic conditions by the transference of immunised blood from a donor who has been inoculated with a mild dose of a vaccine prepared from the subject. It deserves a trial in all cases.[1]

Localized Peritonitis. This may occur in two forms: (1) Around the site of an infected organ (appendix or pyosalpinx) which was removed at the operation, or (2) around an effusion of blood (hæmatocele) which has formed as the result of imperfect hæmostasis, and has become infected by organisms either introduced at the operation or derived from the bowel. The symptoms bear a general resemblance to those just described, but differ as follows: (*a*) The elevation of temperature and pulse-rate is less pronounced; (*b*) pain and rigidity are localized either in the lower abdominal [illegible] or in one or other iliac fossa; (*c*) on vaginal examination a tense and [illegible]ender swelling may be found behind the cervix; (*d*) the onset is [illegible]t later and the condition does not, as a rule, become fully developed [illegible]n the end of the first week; (*e*) vomiting is less persistent, and [illegible]stinal obstruction rarely occurs, although obstinate constipation

[illegible]ign is the formation, sooner or later, of a definite area of [illegible]distinct mass, which indicates the focus of infection. [illegible]re or less extensive zone of plastic peritonitis occurs,

[illegible]ke & Storer. *Lancet*, 1923, ii., page 1341.

and if the organisms concerned are sufficiently virulent, this barrier may be passed, and the peritonitis may eventually become general or diffused. It is often difficult to decide whether suppuration has occurred or not.

Treatment. If suppuration does not occur a localized peritonitis may subside, and the exudate may become in time completely absorbed. Effusions of blood are less likely to become absorbed than serous or plastic exudates, and the process is always very slow. When a *definite fluid effusion* is present in the pouch of Douglas, no hesitation need be felt in opening it by posterior colpotomy. When in doubt as to whether pus has formed or not, opening the posterior fornix may still prove useful, and can do no harm. The finger can be passed into the pouch of Douglas and light adhesions broken down in the search for an encysted collection of fluid. Even if no such accumulation is encountered, the pouch should be drained by means of a large rubber-tube stitched to the edge of the vaginal incision. Considerable quantities of serous fluid may gradually drain away, and this promotes resolution of the inflammatory process.

If the affected area can only be reached by opening the abdomen, operation is attended by greater risks and should not be undertaken unless the indications are clear. Reasonable suspicion of the presence of pus always justifies operation under such circumstances. It is then better, if possible, not to drain through the original incision but through stab-incisions placed immediately over the affected area ; this avoids the risk of the long incision becoming infected.

II. **Intestinal Obstruction. Mechanical Ileus.** This condition may occur during convalescence from an abdominal operation : (*a*) From kinking of a loop of small gut due to adhesions to a line of sutures or a raw surface, *e.g.* the ovarian pedicle ; (*b*) from strangulation beneath a band of adhesions or in an artificial aperture, *e.g.* a hole in the omentum or mesentery ; (*c*) from volvulus. The first named is the commonest condition, the apex of a prolapsed loop of small intestine being found adherent to some point on the pelvic floor. Independent conditions such as a hernia or a malignant stricture of the colon, which have been unobserved at the operation, may be found.

Intestinal obstruction is attended by symptoms which bear a general resemblance to those of acute peritonitis, viz. vomiting, thirst, pain, abdominal distension, and complete retention of the bowel-contents. Certain points of distinction may, however, be noted : (*a*) The onset of obstruction is usually later, commonly towards the end of the first week ; (*b*) pain is paroxysmal and between the spasms the patient is comfortable ; (*c*) although much distended the abdomen is not markedly rigid ; (*d*) the temperature is often normal or subnormal, and even when fever is present it is seldom high ; (*e*) the pulse-rate is quickened out of all proportion to the temperature ; (*f*) vomiting becomes fæculent earlier than with peritonitis ; (*g*) [illegible]ly distended coils of intestine may be seen through the abdominal wa[illegible] show exaggerated peristaltic contraction (dysperistalsis) ; somet[illegible] coils run across the abdomen like the rungs of a ladder.

When a diagnosis of obstruction has been made op[illegible] immediately undertaken. If there has been fæcal vo[illegible] should be emptied and thoroughly irrigated through [illegible] absolutely necessary intra-abdominal procedures sh[illegible] moment ; the general condition of the patient us[illegible] as resection and anastomosis of bowel. Dam[illegible]

be brought out at the wound, fixed there and opened, so as to drain the intestine above the seat of obstruction. The resulting fæcal fistula can be closed later.

III. **Intestinal Paresis. Paralytic Ileus.** When met with as a post-operative complication this condition resembles in its general features general peritonitis, already described. Its onset is at approximately the same time; vomiting and abdominal distension are early and persistent; a certain amount of fever and of rise in the pulse-rate are met with. When unrelieved, the distension of the abdomen may attain an extreme degree in a day or two. There is, however, no rigidity of the abdominal wall, and no marked leucocytosis. It may be possible to distinguish it from mechanical ileus by noting the complete absence of any visible signs of intestinal peristalsis; further, the paroxysmal pain characteristic of mechanical obstruction is absent, and no borborygmi are audible even on auscultation of the abdomen. Absolute arrest of the intestinal contents, both flatus and fæces, is seldom met with; a little flatus or fæces may usually be obtained by high enemata.

The *treatment* consists in adopting measures to restore the muscular contractions of the intestine, and the effect of the treatment is a valuable aid to diagnosis also. If the obstruction can be overcome by these means, mechanical causes and general peritonitis can usually be excluded.

Purgatives, colon-irrigation by high enemata, and the use of certain drugs such as pituitrin and eserine, which act powerfully upon intestinal peristalsis, are the methods of choice. Purgatives will not prove of service unless given in the early stages, when castor-oil or calomel, in full doses, is the most reliable. If unsuccessful, the dose should not be repeated, but instead frequent and copious high enemata consisting of soapy water or saline solution should be given. A long colon tube should be used, and the patient laid on her right side; this posture favours the flow of the fluid into the transverse portion of the colon, and so to the descending portion. In all forms of obstruction the first one or two enemata thus given may evacuate fæces and flatus which have previously passed the seat of obstruction. In mechanical obstruction absolute retention of the bowel-contents is ultimately developed.

Pituitrin may be given in four-hourly doses of 1 c.c., in combination with $\frac{1}{100}$ gr. of eserine sulphate, and $\frac{1}{30}$ gr. of strychnine; here again it must be said that unless given in the early stages not much help will be obtained from these drugs. But their prophylactic use, in cases in which, from the nature of the operation, intestinal complications are anticipated, is strongly to be recommended. Their administration in half the dose just mentioned may be begun immediately after the operation and continued [illegible] the bowels have acted freely. When vomiting interferes with the [illegible] of purgatives, these hypodermic remedies form useful substitutes. [illegible]miting is persistent the use of the stomach-tube will be useful. [illegible]nts of the organ have been removed, the stomach is washed [illegible]ree pints of warm alkaline solution, which exerts a solvent [illegible]d thus cleanses the gastric mucosa. After emptying the [illegible]ulphate of magnesia in concentrated solution may be [illegible]ain.

[illegible]he Stomach is much rarer than the three above-[illegible]st resembles paralytic ileus, and is probably

due to similar causes. There is acute abdominal distension which is most marked in the *upper zone* and is accompanied by a rapid pulse, and a temperature not much above normal, or it may be even subnormal. There may be periodic attacks of copious vomiting, or if the loss of tone is absolute, there may be no vomiting at all. The stomach-tube will clear up the diagnosis in a doubtful case. Sometimes reverse peristalsis takes place and the stomach-contents become fæcal.

The *treatment* consists mainly in evacuation of the stomach-contents with the stomach-tube, and free lavage; this may have to be repeated several times. Posture is of some service, the patient being encouraged to lie in the position in which the stomach will drain most readily into the duodenum. This is approximately Sims's position, with the patient on the right side instead of the left and the foot of the bed raised a few inches upon blocks. Nothing should be given by the mouth, but small enemata may be administered at regular intervals of four to six hours, a 10 *per cent.* solution of glucose in saline being the most suitable for these cases.

Suppression of Urine. Severe shock is usually characterized by great diminution of the renal secretion, which, however, becomes re-established after the reaction has set in. In cases of chronic nephritis uræmic suppression may occur, but if the patient is properly prepared for the operation and the condition of the kidneys observed, the surgeon will not be taken by surprise. With this exception, partial or complete suppression persisting after recovery from shock, suggests the possibility of one or both ureters having been included in ligatures or clamps. It is in the operations of pan-hysterectomy and the removal of broad ligament tumours, that such injuries to the ureter are liable to occur. Cystoscopic examination and catheterization of the ureters is the surest means of recognizing this serious mishap.

The *treatment* of suppression depends upon its cause. When due to shock the treatment already advised for this condition should be vigorously carried out. In addition, dry-cupping the loins or the application of mustard to the renal regions will be found useful. When due to obstruction of the ureters, the abdomen must be reopened without delay and the obstruction removed. Dilatation of the ureter on the proximal side of the ligature renders this procedure comparatively easy. If the accident is promptly discovered it will be sufficient to release the ureter from the ligature. After prolonged ligation the vitality of the ureter is not well maintained at the site of the ligature, and sloughing may occur. Therefore anastomosis of the proximal end into the bladder may be required in such cases.

Cystitis. After certain pelvic operations which involve extensive separation of the bladder from its attachments, such as pan-hysterectomy, cystitis is a frequent complication. The vitality of the vesical mucosa probably suffers in consequence of circulatory disturbances, and bacterial invasion *per urethram* by catheterization or spontaneous ascent is thereby greatly facilitated. Another frequent cause of severe cystitis is the performance of such operations as the above in the presence of pre-existing urinary infection; serious exacerbations may then occur. The introduction of a septic catheter may of course set up an acute cystitis, but even if adequate precautions are taken repeated catheterization is usually followed by a subacute infection of the bladder. This is probably to be explained by slight traumatism *plus* the introduction of urethral bacteria (*see* p. 209) into the bladder in numbers too great to be dealt with by the natural

germicidal force of the acid secretion, and further, some organisms, such as the *B. coli*, appear to flourish best in acid urine.

Prophylaxis may be practised by administering urinary antiseptics before operation, or in commencing them at once in cases of retention of urine where regular catheterization is required. The treatment of the condition when established has been considered in another place (*see* p. 241).

Urinary Fistulæ. These fistulæ may form either through the abdominal wound or into the vagina, and may involve either the bladder or the ureter. Injuries to these organs are most likely to occur in abdominal pan-hysterectomy, in vaginal hysterectomy, and in the removal of broad-ligament tumours. If laceration of the bladder or division of a ureter has occurred and has not been detected, the escape of urine is immediate. Usually, however, several days elapse before the leakage of urine manifests itself. Injury has then been sustained by the bladder or ureter which so impairs its vitality that sloughing occurs and the wall gives way. Therefore until the slough has separated there may be no indication of the damage which has been done. Convalescence is, however, usually febrile from the commencement, and the patient is not "doing well." Urinary infection always accompanies the formation of these fistulæ, and in the case of bladder-fistulæ a very acute cystitis may supervene. This adds greatly to the risks and the discomfort of the condition, for the infected urine causes excoriation of the skin of the abdominal wall or of the vaginal and vulval mucosa.

Treatment is therefore first directed to the condition of the urine, for not only is spontaneous healing impossible in the presence of infected urine, but also operative procedures for repair of the injury are impracticable while it lasts. Spontaneous closure of a urinary fistula is exceptional; as a rule operation is required on the lines laid down in a previous section (*see* p. 758).

Fæcal Fistulæ. Post-operative fæcal fistulæ are usually abdominal; more rarely they occur in the vagina from injury to the rectum. The abdominal fistulæ are met with after operations for acute appendicitis, and after operations in which injury to bowel has occurred, and the subsequent process of repair has been defective. The intestinal leak usually appears towards the end of the first week.

Abdominal Faecal Fistulae, when carefully treated, show a strong tendency to spontaneous closure. The constant leakage of fæcal matter calls for the most careful nursing, and frequent changes of dressing are required, while the surrounding skin must be protected from the excoriating action of the intestinal juices with a thick layer of boric ointment spread on lint. One of the most troublesome results in the earlier stages is the occurrence of parietal abscesses in the neighbourhood of the fistula from the passage of infective material into the deeper layers. Three important points in management must be insisted upon, viz.: (1) Frequent dressings and careful nursing; (2) daily enemata to ensure that the lower bowel is kept empty, for the passage of intestinal contents into the distal segment, *i.e.* the part beyond the fistula, is promoted by keeping the distal segment empty; (3) keeping the bowel quiet by avoiding aperients, making the diet chiefly fluid, and administering small doses of opium regularly. The process of spontaneous closure is very slow, and several months may elapse before the leakage entirely ceases.

Vaginal Faecal Fistulae show little tendency to spontaneous closure;

their general management is to be carried out upon the same lines as the above.

Infection of the Abdominal Wound. This may take the simple and unimportant form of a *stitch-abscess*, or a diffuse infection may occur resulting in suppuration beneath the aponeurosis, or in the subcutaneous fat-layers, or in both. Suppuration in the deep layers is attended by pain in the wound and considerable fever. The skin-edges may have united, but the skin-surface is tense and shiny, and there is considerable diffused tenderness on pressure. One or two stitches should be removed, and the subcutaneous layers explored with a director or sinus-forceps; next, one or two of the fascial stitches should be divided and removed and the subaponeurotic layer exposed. When the abscess has been reached free drainage must be provided, counter-openings being made where required. Sometimes considerable sloughing occurs from a virulent infection, and then the whole length of the wound should be laid open and freely irrigated with hypertonic saline solution.

Rupture of the Abdominal Wound. This accident may occur in two ways, viz. from non-union or from infection. *Non-union* usually results from two factors: (*a*) Excessive strain upon the wound as from persistent, violent vomiting, or from coughing; (*b*) premature absorption of catgut ligatures in the aponeurotic layers. On account of the latter danger, specially hardened catgut should be used for the abdominal wound (*see* p. 661). Occasionally, however, rupture occurs when unabsorbable ligatures have been used, the ligatures being apparently torn out of the tissues by the strain to which they are subjected. In cases of virulent infection with sloughing, rupture may occur even when no undue strain is put upon the wound. It occasionally happens that the peritoneal and aponeurotic layers rupture while the skin-stitches still hold; coils of intestine are then expelled into the subcutaneous layer, and unless the accident is promptly discovered dense bowel-adhesions soon form to the edges of the peritoneum and aponeurosis. If a continuous skin-stitch has been used, the detection of this accident is difficult; if the stitches are interrupted, the edges open up between the sutures and the presence of bowel can then be detected.

The *treatment* is, of course, immediately to re-suture the wound after carefully freeing and returning any structures that have become herniated.

Post-operative Parotitis and Phlebitis. These are examples of septic metastasis. *Parotitis* has become very uncommon since the elaboration of modern methods of aseptic surgery. In some cases it was traced to oral sepsis, and consequently it is advisable that carious teeth should be removed, or pyorrhœa treated before operation, if the necessary time is available. *Phlebitis* is more common than parotitis, but its rate of occurrence appears to have diminished in recent years. Sometimes small superficial or deep veins in the calf of the leg are attacked, but from this no serious consequences follow. When the femoral vein is affected the result is œdema, pain and swelling of the affected limb, with elevation of temperature and general malaise. The treatment is prolonged rest and the avoidance of movement of the limb; this must be continued for a week after all pain has disappeared and the temperature has become normal. A certain amount of swelling of the ankle, and stiffness or pain on movement, may remain for several months, and these are best treated by massage and the use of an elastic bandage.

Pulmonary Embolism. This occurrence, although occasionally seen after surgical operations upon all parts of the body, is met with after abdominal operations with greater relative frequency than any others. The age or general condition of the patient do not appear to influence its occurrence, and it is exceptional to find any clinical evidence of infection. Sudden or undue effort is rarely recorded in these cases, and it is undoubted that the accident may occur when the patient is completely at rest. The majority of cases occur in the second week, but numerous instances have been recorded in the third and fourth weeks of convalescence.

The *symptoms* come on with great suddenness. A sharp or even violent pain in the side is first complained of, and immediately followed by gasping respiration, and a feeling of distress in the region of the heart. The skin becomes cold and moist, cyanosis appears, and the pulse rises to 120 or 140 and becomes very feeble. Death may ensue within a few minutes; on the other hand the symptoms may be less urgent, when the patient may survive a few hours, and in occasional cases may recover. The size of the pulmonary vessel which has been blocked probably determines the result.

The *treatment* consists in the inhalation of oxygen and the hypodermic administration of cardiac stimulants in full doses. Artificial respiration may be practised as long as the heart continues to beat.

Pulmonary Infarction. When a minute branch of the pulmonary vein becomes blocked by a portion of clot carried in the blood-stream, the result may be the formation of a patch of consolidation, *i.e.* an infarct. The initial symptoms of this occurrence are shock, acute pain in the chest, and more or less urgent dyspnœa. After a few hours the symptoms subside and in a day or two the appearance of a pleuritic rub and blood-stained sputum make the diagnosis clear. When the patient is recovering from the first attack, a second, and even a third, may occur. If the embolic clot is infective, septic pneumonia results and invariably proves fatal. In the absence of an extensive pneumonic process the prognosis is good.

III. AFTER-TREATMENT OF VAGINAL OPERATIONS

Major Vaginal Operations, *i.e.* those which involve opening the pelvic peritoneal cavity, are to be managed upon the same lines as an abdominal cœliotomy. They produce less shock than abdominal operations, and the early convalescence is attended by less distress from thirst, pain, and intestinal flatulence. Unless the pelvic peritoneal cavity and the vaginal incision are completely closed at the operation it is, however, difficult to avoid the occurrence of a mild form of infection of the vaginal wound, which manifests itself by slight fever and an offensive discharge towards the end of the first week. If gauze packing has been used, it should be got rid of on the second day. Vaginal douching is inadvisable for the first four days, but after this it is useful and adds to the comfort of the patient. The time to be spent in the recumbent position is about the same as after an abdominal operation.

Minor Vaginal Operations, in which are included the plastic procedures such as the radical cure of cystocele and perineorrhaphy, depend for their success to a great extent upon careful treatment during convalescence. Primary union is more difficult to secure in a vaginal or vulval, than in an abdominal wound. Not only is the vaginal wall more difficult to disinfect

before operation, but also much more difficult to preserve from post-operative infection, owing to the proximity of the urethra and anus. Operations, such as curettage and dilatation of the cervix, which involve no cutting, require no special after-treatment, except a few days' rest in bed.

External wounds should be carefully and simply treated. After evacuation of the bowels or bladder the surfaces should be irrigated with a weak antiseptic solution, then carefully dried and painted over with iodine-solution for the first three or four days; after this the wound can be kept clean and covered merely with a sterile dressing.

After vulval operations, including perineorrhaphy, the patient may be allowed to pass water naturally. An aperient should be given on the third morning. In the case of perineorrhaphy for complete rupture involving the anus, the first action of the bowels requires careful management. The diet should be fluid only until this time has been passed, in order to limit the bulk of the contents of the bowel. Castor-oil is probably the best aperient to administer, and it may usefully be supplemented by giving a small enema of warm olive oil, which may be retained for a time and will serve to soften the rectal fæces. In this manner the first action is usually rendered easy and painless. Subsequently it is best to secure a daily action in order to avoid the formation of hard masses. Straining at stool is more liable than anything else to do harm in the case of a complete perineorrhaphy.

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