

ple cysts and those containing papillary projections. Inspection of the tumor with the naked eye reveals numerous papillæ on the inner surface of the cyst wall. These may be few in number or else so numerous as completely to fill the cavity of the cyst and even at times cause its rupture. The papillæ are pedunculated and vary from a simple projection to a most complicated branching structure. Not only does this shape vary, but the color may range from almost white to a pinkish hue, this depending on the supply of blood going to the papillæ and also on their consistence. They are usually soft, but may contain sand-like bodies which cause the growths to feel gritty. After perforation of the cyst wall the peritoneum and other organs may become infected.

These cysts usually contain a clear, thin, watery fluid of a yellow color and alkaline reaction. It has a specific gravity of from 1.005 to 1.040, and does not coagulate on standing. It responds to the tests for albumin. On examining the fluid with the microscope, it may be seen to contain epithelial elements, compound granular bodies, and sometimes cholesterin and hæmatoidin crystals. Instead of the fluid being clear, however, it may be dark and turbid or even grumous, the character varying at times even in different parts of the same tumor.

Microscopical Appearances.—In a pedunculated cyst the wall has an outer layer which is thin and dense. It is composed of laminated tissue, a few cells, and occasionally non-striated muscular tissue may be seen. The next layer is thicker and more cellular. Both contain blood-vessels. Internal to this second is a third layer, composed of epithelium which sometimes rests upon a thin homogeneous basement membrane. The epithelial cells may be cuboidal, cylindrical, or, in fact, almost any shape. Cilia may or may not be present, and even in the same tumor some cells may bear cilia while their neighbors do not, their absence or presence being purely accidental and having no bearing upon the case (J. W. Williams). These cells may be in one layer or in several, and in small cysts they are not usually so high as where they simply cover papillæ, the low merging gradually into the high. In the smaller cysts also, part of the outer wall may be replaced by true ovarian tissue. The stroma of the cyst wall, which may be dense and well formed, or else somewhat myxomatous, continues up through the pedicle into the papillæ, and is usually well supplied with blood-vessels, which are thus enabled to pour out a portion of their serum and so contribute their quota toward the fluid contents of the cyst.

The sand-like bodies, above referred to, are called psammomata, and consist of particles of carbonate and phosphate of calcium arranged in concentric rings.

Papillomata may extend from their primary site by three methods. They may do so by direct extension to contiguous structures, by the attachment of small broken-off fragments of the growth to the peritoneum, and lastly by true metastatic formation.

In the early stage no diagnosis of the exact nature of the pathological process is possible. This is clear only when the ascites can be made out, when the psammomata can be felt per vaginam, or when papillomatous masses burst into the bladder or rectum. Freund considers that the simultaneous appearance of ascites and hydrothorax favors the diagnosis of papilloma ovarii.

These cysts are apt to burrow between the layers of the broad ligament, both toward its base and laterally toward the uterus. They occur most frequently between the ages of twenty-five and fifty.

2. *Superficial papillomata of the ovary* are more rare than intracystic growths, and like them are nearly always bilateral. They are formed of branched, usually pedunculated masses, springing from the surface of the ovary. Their histological structure resembles that of the intracystic form of the disease, the epithelium being continuous with the germinal epithelium, as is also the case in some intracystic growths, although the etiology of the latter is uncertain.

The treatment of papillomatous disease of the ovary is

prompt and thorough removal of the diseased structures, and this is usually followed by permanent relief.

F. A. J. Lockhart.

OVARIOTOMY.—Ovariectomy (from the Latin ovarium, ovary, and Greek *τομή*, cutting) is to be classed among the unsatisfactory terms which unfortunately are too common in medical nomenclature. Leaving out of consideration its hybrid formation, the word by no means expresses the removal of the ovary. In this sense oöphorectomy (*ὄοφορον*, ovary, *ἐκτομή*, excision) is far more appropriate; and if the Fallopian tube be also removed, *salpingo-oöphorectomy* should be employed.

Under the heading "ovariotomy" most text-books consider the operation for tumor formations alone of the ovary, ignoring the inflammatory and other conditions for which identically the same procedure is more frequently undertaken. In accordance with custom, however, the first class of cases will be dealt with here.

HISTORY.—The history of this procedure is of considerable interest. The kings of ancient Lydia are said to have had it performed upon women either for the purpose of preserving their youthful characteristics, or in order that they might be employed in the place of eunuchs. The actual nature of the operation, however, is somewhat doubtful, as in some instances in all probability only the clitoris was removed, although from the scanty details procurable it may be inferred that at least some genuine ovariectomies were performed. During the seventeenth century a Hungarian sow-gelder is said to have removed the ovaries from his daughter as a punishment for her frequent lapses from virtue. In the eighteenth century, although suggested much earlier by continental surgeons, the possibility of the operation was seriously discussed, more particularly by John Hunter in England and John Bell of Edinburgh, although, owing to the high mortality of all intra-abdominal operations, these men lacked the courage of their convictions and were unwilling themselves to undertake a hitherto untried procedure. Their teachings, however, bore fruit, and the first prearranged and successful ovariectomy was accomplished in 1809 by Ephraim McDowell, of Kentucky, who had been one of Bell's students in Edinburgh. It must of course be conceded that the ovaries had been removed by operation previous to this time, but in the majority of such cases, if not in all, the real nature of the procedure had not been recognized until later. Moreover, in several other instances ovarian cysts had been tapped through an abdominal incision, and portions of the sac walls had been resected. Nevertheless, it is important to recognize the fact that all such operations had lacked the careful pre-arrangement or the successful issue of McDowell's case.

In the United States the operation was repeated by the originator twice before 1817. Nathan Smith, of Connecticut, unaware of McDowell's cases, performed it in 1821; Rogers, of New York, in 1829; Billinger in 1835; and in 1843 Dunlap, of Ohio, and the Atlee brothers, of Pennsylvania, obtained favorable results. From this time on, the operation gained in favor in America, and the excellent work of W. L. Atlee and of Peaslee did much to popularize it.

In Great Britain Lizars, of Edinburgh, performed the operation four times in 1825, but no other attempts were made in Scotland until 1845. In 1833 Jeaffreson, of Framlingham, obtained the first successful result in England, although Granville had had two failures in 1826 and 1827. Interest in the procedure was revived in 1842 by Clay, of Manchester, who soon became noted for his work. Spencer Wells from 1858 to 1871 performed the operation 440 times, and his total number of ovariectomies reached nearly 2,000. His successors, Keith and Tait, also obtained splendid results. The first successful operation in Europe was performed by the German surgeon Chrysmar in 1820, a similar case in the previous year having terminated fatally. In Germany, until 1850, only 23 ovariectomies with 7 successes had been done, and until

1870 there had been only 180 with a mortality of 105, or over 58 per cent.

It was not until 1844 that Woyerkowsky scored the first success in France, but here as in Germany the profession were so opposed to the operation that it made but little headway, and was not recognized until long after it had been established in America and England.

Following the introduction of the principles of antiseptic and asepsis the mortality was reduced to a remarkable degree until, instead of being regarded, as it was by many leading surgeons of fifty years ago, as almost the equivalent of murder, the procedure is now looked upon in uncomplicated cases and in the hands of a skillful operator, employing a rigid aseptic technique, as one of the simplest of abdominal operations. The gradual development of ovariectomy is very fully presented by Peaslee ("Ovarian Tumors," 1872).

Indications.—Internal medication and local treatment are futile in cases of ovarian tumor, and the days of simply tapping cysts are now past. So soon as the diagnosis is made, operative measures should be instituted. Some operators prefer the vaginal route, wherever possible, and in suitable cases this answers the purpose admirably. The relative merits of the two methods cannot be discussed here, but to-day, as a rule, the abdominal incision is chosen; since by its employment the tumors can be rendered plainly visible and accessible to close examination, and the question of complete or partial removal of one or both ovaries is consequently more easily decided.

It is true that in many instances an ovarian tumor may exist throughout a patient's lifetime, without detriment to her health, or without producing any symptoms whatever, so that its discovery is often more or less accidental. But despite this well-recognized fact we must always take into consideration the comparative frequency of malignancy in these tumors, and the liability to the occurrence of secondary implantations and metastases, even at a period when the main growth is causing no unpleasant manifestations. Moreover, the possibility of certain accidents, as torsion of the pedicle, or rupture of a cyst with perhaps a resulting hemorrhage or peritonitis, is worthy of consideration. Infection of the cyst contents from an adherent bowel may also occur and greatly increase the danger. Adhesions are likely to form, rendering operation at a later date more difficult, and secondary changes in other organs may begin insidiously and make considerable and rapid progress.

Age as a rule seems to make but little difference. Generally speaking, elderly women bear the operation very well. In children we must always bear in mind the relative frequency of sarcomatous tumors.

The coexistence of pregnancy does not modify to any extent the indications for operation, inasmuch as statistics show that fatalities to the mother and fetus are much more likely to occur when the ovarian tumor is allowed to remain undisturbed than when it is removed even during the pregnancy. In the case of a malignant tumor the dangers incident to expectant treatment are even greater than in the non-pregnant state, since the physiological congestion tends to promote rapid growth. The liability to torsion of the pedicle is naturally increased as the enlarging uterus crowds the tumor, often rotating it, in its attempts to occupy the narrowing space to the best advantage. Thus in one series of one hundred and nine cases of ovarian tumor with pregnancy torsion occurred ten times. Large tumors in the presence of the additional bulk of the uterus may lead to pressure symptoms, sufficiently severe to endanger the life of the mother, and growths of relatively small size have been known to cause the death of the fetus. Smaller tumors, especially if solid, may become impacted in the pelvis below the growing uterus, the accident either leading to abortion or giving rise to an impassable obstacle to delivery at term, thus necessitating a Cæsarean section or other radical measures. The pregnant uterus may also be crowded backward under the promontory of the sacrum, so that its development is

hindered, and abortion is very likely to occur. Adhesions of the ovarian tumor to the uterus may prevent the symmetrical enlargement of the latter, leading to abortion or sometimes to a malposition of the fetus. The adhesions may be torn apart by the traction exerted by the uterus, sometimes in conjunction with a sudden trauma. In such cases alarming or even fatal hemorrhage has been known to take place. Rupture of an ovarian cyst is also liable to occur from pressure or trauma, in the latter case because there is less room for the movement of the tumor, so that even a slight blow might suffice to cause such an accident.

The question of the advisability of operation during pregnancy is very apt to present itself, since a tumor that has existed unknown to the patient may attract her attention as soon as it is displaced upward, into the abdomen, by the growing uterus. The physician may also discover it during an examination in a case of apparently normal pregnancy.

If the tumor be discovered only in the later months, especially if it be small and cause no trouble, and if after it has been carefully watched for some time it shows no signs of enlarging, operation may be deferred until after delivery has taken place. All the various factors, however, in the individual case must receive careful consideration. If a cyst causes disturbances only during the last four weeks of pregnancy, or after the onset of labor, tapping may become necessary, and the short respite thus obtained may tide the patient over until a more favorable time for a radical operation. There is also the possibility that the cyst may not refill. In the earlier months, inasmuch as pregnancy is less liable to be interrupted by operation, interference is clearly indicated. The operation should be done as rapidly as is consistent with proper precautions, and during all the various manipulations the pregnant uterus should be protected from trauma, and the pedicle carefully ligated. In view of the stretching that may be exercised by the enlarging uterus, the tissues should not be too tightly bunched; it is far preferable to employ several ligatures, each including a small portion of the pedicle. The case should be treated afterward as if abortion were imminent, and opiates should be administered if necessary.

The only absolute contraindication to the operation may be the enfeebled physical condition of the patient. Thus in torsion of a pedicle with resulting collapse it will sometimes be very difficult to decide whether a postponement is not justifiable in the hope that the patient can be tided over the acute attack, and not submitted to operation until some days later when her condition is improved. Many unfavorable symptoms apparently contraindicating operation may be due entirely to the tumor, and disappear after its removal. Among the most important of these are ascites, circulatory and even respiratory changes induced by pressure, albuminuria, and in some cases glycosuria. In several instances sugar, which had been present in the urine of patients suffering from ovarian cysts, disappeared entirely after removal of the tumor.

Even in apparently hopeless cases unexpected results are sometimes obtained, and records are found of cases of widespread papillary adenocystomata and endotheliomata with peritoneal metastases, in which these latter caused no further trouble after the main tumor had been removed. Moreover, in densely adherent cases which at first seem to defy even an expert operator, by patience and careful work the tumor may probably be freed and then removed. At times in almost moribund patients radical measures may be indicated, and unless the condition be due to cachexia brought about by a malignant tumor, after prompt and active stimulation and infusion or intravenous transfusion of decinormal salt solution, operation will sometimes save. More particularly is this true in cases of torsion or rupture of a cyst or when the symptoms are due to pressure.

In brief, then, the indications for treatment in cases of ovarian tumors may be summed up as follows: Operate as soon as you are satisfied of the presence of such a tu-

mor, unless there is good reason for believing that the physical resistance of the patient may be materially improved by waiting a few days.

Technique.—Too much stress cannot be laid upon a rigid technique. In view of our present knowledge it is absolutely criminal knowingly to transgress its well-recognized principles. The whole subject is dealt with in detail elsewhere. Suffice it to say here that we must bear in mind that sepsis not only regards our actions in the operating-room and our surroundings there, but also includes the careful preparation of the patient as concerns the field of operation, the evacuation of the bowels and all other details the proper conduct of which will put her in the best condition possible for the operation. In the room itself everything should be as clean as possible, and all materials coming in contact with the field of operation should be sterile. Especially does this apply to the hands which, although they cannot be rendered absolutely aseptic, can at least be made innocuous by means of diligent scrubbing, by the employment of antiseptic solutions, and by the additional precaution of using rubber gloves. Instruments should be boiled in soda solution, all dressings, towels, etc., should be sterilized with steam, preferably in the autoclave. Sea sponges, owing to the difficulty of satisfactorily disinfecting them, had better be discarded. Frequent rinsing of the hands in a basin of sterile water during the course of the operation is to be recommended, for by so doing we are less liable to transfer infection from one part of the field of operation to another, as for instance if the hand has become contaminated by the contents of a cyst during evacuation.

Instruments.—For an ovariectomy the instruments used in an ordinary abdominal section are required, and in addition several others devised more especially for this operation. The choice of instruments is largely an individual matter, and in simple cases one can manage with but very few. Nevertheless it is always best to be prepared for every contingency and the routine sterilization of a few extra instruments, even if they are only occasionally required, will sometimes save no little vexation. The following list of instruments will suffice:

Scalpels	2
Dissecting forceps, toothed	2
Dissecting forceps, toothed, long	1
Artery forceps, small	12
Artery forceps, long	6
Retractors	2
Transfixion needles	1
Needleholder	1
Needles (assorted sizes)	6
Scissors, straight	1
Scissors, curved on the flat	1
Museux forceps	2
Sponge holders	4
Ligatures and sutures, trocar with rubber tubing	2
Cyst forceps	2
Catheter	1
Syringes, dressings, drainage gauze, cautery, portable electric light and other accessories of an operating-room	

The above instruments are all well known and need not be described here; the pattern is immaterial so long as each is satisfactory to the individual surgeon. The long dressing forceps will be found useful in repairing injuries deep down in the pelvis. The needles, ligatures, and suture material will vary with the predilections of the operator. The writer prefers full-curved sharp needles of three sizes for suturing everything, except the bowel, for which full-curved round needles are used. I generally employ Chinese silk twist for the pedicles and close the abdomen in layers, using a continuous catgut suture for the peritoneum, mattress sutures of silver wire for the fascia, and a subcuticular catgut suture for the skin. The Museux forceps proves of value when traction has to be made on a solid tumor, and the cyst forceps serves a similar purpose if the growth is cystic. The trocar and rubber tubing should be of rather large calibre, since the cyst fluid is often thick and tenacious and is liable to clog a narrow lumen. Sponges are preferably made of gauze, and must be carefully counted before and after the operation, to guard

against the possibility of leaving one in the abdominal cavity. The cautery is used in searing the pedicle, to lessen the chance of the formation of adhesions; moreover, its employment will often control oozing from denuded surfaces where it may be impossible to pass sutures.

Anæsthetic.—The relative merits of ether and chloroform as an anæsthetic, and the cases most suitable for each, cannot be discussed here. The main point is that the patient remain deeply narcotized throughout the operation, and that there be a condition of complete muscular relaxation. It is very disturbing to have the patient vomiting or straining during an abdominal operation, and the anæsthetizer should have served a thorough apprenticeship in giving anæsthetics for minor procedures before being entrusted with this duty in abdominal sections. The administration of nitrous oxide gas with oxygen until the patient is completely unconscious and then continuing with ether is a very satisfactory plan. With the former the muscular relaxation is not so complete as with ether or chloroform, and as yet we have not sufficient data to warrant its use alone for ovariectomy, although in certain cases anæsthesia has been prolonged for several hours. Local anæsthesia with cocaine has also been used for abdominal sections, but is applicable only to exceptional cases, and general anæsthesia is almost always preferable.

Incision.—Everything being ready for the surgeon, so that he may proceed with the operation, the patient should be put in the Trendelenburg position, which facilitates the exposure of the pelvic organs. The abdominal incision should be in the median line and should be short at first; if it be necessary to enlarge it later, this can be very easily done, while in many cases of large ovarian cysts it may be possible to remove the sac, after evacuation of the contents, through a very small opening. Before the incision is made the bladder should be catheterized, and it is a good rule to pass a sound in all cases of pelvic tumor in order to determine whether the viscus has been carried upward. Not infrequently the bladder has been opened in making the abdominal incision through neglect of this simple precaution. The skin and subcutaneous fat are divided and the bleeding, which is usually slight, is controlled by hæmostatic forceps. The fascia is then divided in the median line. In doing this very frequently the sheath of one rectus will be opened, but this is a matter of no great moment. The adipose and areolar tissue having been separated down to the peritoneum, the latter is carefully picked up between two pairs of dissecting forceps and a small nick made in it. Through this the air enters, allowing the intestines to fall away, after which the opening can be enlarged as much as necessary. When the parietal peritoneum is adherent to the tumor, the intestines, or the omentum, great care must be exercised in opening it in order not to injure the structures lying beneath. It is important to see that the peritoneum is actually opened before attempting to separate the adhesions, as a mistake may lead to a widespread separation of the peritoneum from its attachment to the abdominal wall. Occasionally it will be found possible to get in above the adherent area through an opening made a little higher up. During the progress of the operation the incision may be enlarged as much as is found necessary, it being borne in mind that when we meet with a cyst, a small opening may suffice, while even solid tumors with a little judicious manipulation may often be delivered through a relatively small incision. The operator must not, however, handicap his efforts by trying to work through too small an aperture. Two fingers are now introduced, or if need be the whole hand, and the nature of the tumor, its location, the presence or absence of adhesions and their extent, are then determined. If it be a cystic growth the question of evacuating the fluid will have to be considered.

Emptying a Cyst.—If the cyst be small enough to allow readily of removal through the incision, puncture is not necessary. If, however, it be large and free from ad-

hesions, it had better be emptied. On the other hand, if it be adherent it may be easier first to separate the adhesions, as the contour and relations of the tumor are then more easily recognized than when it is collapsed. Usually it is best to empty it at once, otherwise it is liable to rupture during manipulation. In the case of a large cyst there will also be more room for working, and the site of the adhesions can be more readily exposed if it is first emptied. It is important to avoid contaminating the abdominal cavity with the cyst fluid, inasmuch as we can never be sure that the contents are innocuous. Thus in the case of a papillary adenocarcinoma, the escape of the cyst contents into the abdomen would be very likely to cause secondary implantations. Or, again, the contents may be the greasy product of a dermoid cyst which may possibly be infectious in character, and at any rate will be extremely difficult to remove if once they become distributed in the abdominal cavity. To guard against such accidents gauze sponges are carefully packed around the presenting tumor to wall off the peritoneal cavity and to protect the edges of the incision. The patient is turned slightly on one side so that the escaping fluid may be more readily prevented from soiling the field of operation, and a cyst trocar with rubber tubing attached is then plunged into the tumor. If the tumor wall be too resistant, a small nick with a scalpel may greatly facilitate matters. In making the puncture the large vessels, which can be plainly seen coursing over the cyst wall, should always be avoided. As the sac wall collapses it is gradually drawn out with the hand or with a pair of cyst forceps, and the remaining part squeezed; or pressure is made upon the abdominal walls in such a manner as to get rid of as much of the fluid as possible. A lateral position of the patient is also of advantage in this connection. Any compartments in a multilocular cyst are usually broken down with ease. As soon as the sac has been emptied as far as is possible, the trocar is removed and the opening closed by grasping the edges in a pair of hæmostatic forceps, or by tying a ligature securely around it. The surrounding part of the wall should be carefully cleansed and the whole enveloped in a piece of gauze which has been saturated with sterile hot salt solution.

Adhesions.—Ovarian tumors that are not adherent or that have not grown downward between the layers of the broad ligament can usually be removed without much difficulty. The tendency of the growth at first is to drop down into the cul-de-sac, or later, if there be much enlargement, to ascend out of the pelvis into the upper abdominal cavity, where there is more space for it. Either of these displacements tends to produce an elongation of the broad ligament, to the posterior fold of which the ovary is attached, and also of the infundibulo-pelvic and ovarian ligaments, at the outer and inner poles of the ovary respectively. In this way a pedicle is formed which allows the tumor to be delivered through the abdominal incision, and which can be ligated and then severed.

True ovarian tumors rarely extend between the folds of the broad ligament, such growths being usually of parovarian origin. If there be no inflammatory action tumors of the latter class, as a rule, can be shelled out from between the folds by splitting the peritoneal covering and stripping back the two layers of the ligament. After the growth has been removed the two edges may be sutured with catgut. Hemorrhage is rarely severe, but any excessive bleeding can be controlled by clamping or ligating the ovarian vessels in the infundibulo-pelvic ligament, and the communicating branches from the uterine vessels at the cornu of the uterus. On the other hand, if chronic inflammatory changes exist, the removal of the uterus together with the tumor may be necessary. In these cases it is well to begin with a supravaginal hysterectomy on the side opposite the growth. The uterine vessels on the affected side are ligated and divided and the tumor is attacked from below. Removal, even in this manner, may at times appear too risky, in which case an incomplete operation must be done. For-

tunately, however, in such instances drainage per vaginam is usually a feasible procedure.

Adhesions to the surrounding viscera form the most frequent complication of ovarian tumors. These vary from a few spider-web-like strands to masses of dense, organized connective tissue, requiring division with the scalpel or scissors. The method of dealing with these adhesions varies. If they are of recent origin they may be separated with the fingers, or pushed apart with a gauze sponge. If they are more resistant, the handle or blade of the scalpel may be required to divide them. Whenever possible, the separation should be done under the eye of the operator. By dragging the collapsed cyst well out of the incision with a pair of cyst forceps, or with the fingers covered with a gauze sponge to prevent slipping, or by making traction on a solid growth with a Museux forceps, the adherent structures can usually be drawn up also and separated in plain view. On the other hand, when the adherent viscera are fixed, it is sometimes impossible to expose the site of the adhesions satisfactorily, even with the aid of retractors and by packing aside the intestines with gauze. This complication is likely to occur when a large solid tumor is adherent posteriorly. In such cases it is necessary to deal with the adhesions by the aid of the sense of touch, and the knowledge of the anatomical relations. The site from which the tumor has been separated should be examined at the earliest possible moment to ascertain if there has been any damage done, in order that instant repair may be instituted. Adhesions to the parietal wall, which have been mentioned already, occur only in connection with tumors of considerable size.

Omental adhesions are rarely troublesome since, if need be, this tissue can always be sacrificed. It can usually be peeled off from the surface of the growth, but when more resistant it can be ligated and cut away. Even small omental vessels, if left unligated, are apt to continue to bleed; hence the omentum should be examined carefully for any hemorrhage before closing the abdomen.

Bowel adhesions represent the most serious complications, and great care must be exercised in dealing with them. In cases of inflammation of recent origin no trouble is apt to be found, as the adherent bowel may be gently peeled back with the finger or a sponge. If the adhesions be older and firmer, an occasional touch with the scalpel may be required, and if no line of cleavage be apparent, part of the tumor tissue may be left adhering to the bowel. In carrying out this manipulation a cyst, which has not been previously emptied, is liable to rupture at the weakened spot, and the operator must be prepared for this accident. If the intestinal wall be injured it must be immediately repaired, a round-pointed needle being employed for this purpose, and care being taken that no undue narrowing of the lumen of the bowel be produced. Free oozing from the outer surface of the bowel may continue for a short time, but unless the muscularis itself or the mesentery be injured it will soon stop. If the bleeding persists, however, measures must be taken to control it. When the injury has been severe and there is doubt as to the success of the repair, the question of drainage comes up. This will be discussed later.

The bladder is seldom apt to be injured, as it is less likely to be drawn up out of the pelvis than is the case in uterine tumors. The necessity of obtaining a positive assurance on this point has already been mentioned. The same rules, as to the separation of adhesions and repair of injuries, apply to this as to other important organs.

The ureters are rarely involved unless the growth be intraligamentary. If they be liable to injury, their relations must be established either by following their course down from the pelvic brim over the pelvic floor, or by means of catheterization through the bladder.

Adhesions in the cul-de-sac, and posterior to the broad ligament, are often very troublesome. They are separated most easily by getting the fingers below the tumor and working upward. By following the posterior surface of the uterus downward from the fundus and then

separating the adherent surfaces laterally, this can often be quite readily accomplished. Hemorrhage may be profuse and may require the placing of clamps or ligatures on the ovarian vessels and at the cornu. If progress be not satisfactory at any one place another point of attack should be selected.

Ligating the Pedicle.—As soon as all adhesions have been divided, the operation has been much simplified. If the pedicle be long enough the mass is now delivered through the abdominal incision; otherwise the ligatures are passed through the pedicle within the abdomen. If there be oozing from the raw surfaces of the viscera or pelvic walls, sponges wrung out of hot salt solution may be packed against them while the tumor is being removed. Silk is generally considered to be the most suitable ligature material. If properly boiled it is sterile, does not slip or swell like catgut, and very rarely causes any trouble. The broad ligament is transfixed in the thin area below the vessels, and a double ligature is carried through. Without being interlocked, one is tied externally over the infundibulo-pelvic ligament, while the other comes close to the uterine cornu. When the pedicle is large and thick more ligatures may be required and the tissues tied in three or four divisions. The ligatures having been secured, the pedicle is severed at least 1 cm. outside them, as the stump is apt to retract through the grasp of the ligatures, an accident which has often been followed by serious or even fatal hemorrhage. The stump may be seared with the Paquelin cautery to lessen the liability of adhesions forming to it, or the peritoneal edges may be approximated with catgut. Silk ligatures for the pedicle have proven so satisfactory that the use of the angiotribe or electric cauterization does not seem necessary.

Incomplete Ovariectomy.—After opening the abdomen and carefully examining the conditions present we may find it utterly impossible or inadvisable to remove the tumors completely. The difficulty may be due either to the character and the extent of the disease or to the dense adhesions binding the growth to important viscera. Papillary malignant disease may be so far advanced that the removal even of the main mass is evidently impossible, or an attempt to do this may be attended by profuse hemorrhage, even after the preliminary ligation of the main vessels, so that it only remains to pack tightly with gauze and not proceed further. In these malignant cases the marked cachexia, which is often present, may contraindicate a radical operation. Even if removal of the main tumor be accomplished, it is impossible to deal with the metastases upon the peritoneum, which, although occasionally disappearing, as a rule cause death. Where there have been inflammatory complications, and especially when chronic suppuration has occurred, the adhesions may be so firm that the time wasted in separating them and the attendant hemorrhage may injure the patient far more than the adoption of one of the alternatives at our disposal. Attempts to release a growth densely adherent to intestines, bladder, ureters, or vessels is liable to cause damage that may be irreparable or that may necessitate a prolongation of the operation which may prove fatal in the case of a patient whose vital energies are already exhausted.

When complete ovariectomy is impossible, various expedients come under consideration. In the case of a cyst we can resect as much of the walls as possible, and suture them to those of the abdominal incision. The interior of the cyst is then packed with gauze which acts as a drain and tends to destroy the epithelial lining of the walls and thus favors the formation of granulation tissue. In course of time this process leads to a union of the surfaces which thus effects a cure. A similar procedure may be carried out from the vagina. If the cyst walls cannot be brought up to the abdominal incision or down to the vaginal vault, the fluid should be evacuated, and an attempt made to destroy the lining epithelium by the application of carbolic acid, searing with the cautery, or even curetting lightly. A gauze drain is then inserted, the end being brought out through the abdominal incision

or into the vagina. The principal indication in these incomplete operations is to see that all hemorrhage is controlled, and for this purpose gauze packing is often required. In the case of solid tumors that have to be left or can only partially be removed, if there be no oozing, the abdomen can usually be closed.

Not infrequently the question of conservatism arises, especially in the case of young women. In malignant conditions, it is best to remove both ovaries as the disease is often bilateral, although but one ovary may present gross pathological appearances. In retention cysts, follicular hypertrophy, corpus luteum cysts, as well as in some dermoid tumors, it is often possible to save a portion of the affected ovary. If the other one be normal, there is no absolute necessity for this; but in bilateral disease a small portion of ovarian tissue should be saved if possible, for the reason that even if pregnancy does not occur, a young woman may avoid a stormy menopause, not to mention the mental suffering that may be engendered by the knowledge of her condition. The Fallopian tube, if not seriously diseased, should also be saved. At times by resecting the diseased portion, enough of the healthy tube may be left to permit of a future conception.

Drainage.—In this respect the progress in surgical technique has been somewhat revolutionary. Whereas formerly drainage was regarded as indispensable in almost all ovariectomies, at the present day it is employed very much less, and very seldom in cases of ovarian tumor. By drainage we leave an avenue for infection which may cause the contamination of a sterile abdomen, and moreover drains partially or wholly fail to accomplish our object. That this is often the case is proved by the rush of fluid that not infrequently follows the removal of the drain. Besides the fact that such devices may be more dangerous than useful, their removal causes shock and pain to the patient, and their employment sometimes not only produces an elevation of temperature, nausea, and other unpleasant symptoms, but also tends to retard convalescence. Moreover, if a drain be employed, it is impossible to make use of the "peritoneal bath," by which is meant the leaving of 500 c.c. of sterile salt solution in the abdominal cavity before closing the incision.

Nevertheless, drainage is occasionally required in certain cases complicated by the presence of pus, which cannot be entirely removed, in persistent and dangerous oozing to meet which we are obliged to keep up compression for a certain length of time, after severe injuries to the bowel and in incomplete ovariectomy.

Fortunately, pus is encountered only in rare cases of ovarian tumor, and when present, as a rule, it is of slight virulence. Drainage may be considered necessary if it has been impossible to protect the general peritoneal cavity from contamination by packing gauze around the pus focus before evacuating it. If, however, the pus as it escapes be caught on sponges, and if the pelvis or the site of the abscess be flushed out with salt solution and then sponged dry, by omitting drainage we have the additional safeguard of filling the abdomen with decinormal salt solution, to dilute any contaminated material that may remain, and to assist in its absorption. If the pus be considered virulent, as for instance when cover slips examined at the time of operation show streptococci, or when there is a communication with the bowel, drainage is usually indicated. A diffuse general peritonitis will often require similar measures. In the writer's experience the presence of gonococci in the pus has not proven an indication for employing the drain.

Persistent oozing from raw surfaces left after separating adhesions rarely requires drainage, but when it cannot be controlled by ligating the individual bleeding points, or by approximating the edges of torn areas, by the employment of mattress sutures and by tightly packing in sponges wrung out of very hot water, by touching the bleeding area with the actual cautery or by using some astringent iron solution, then a gauze drain applied to the bleeding area may give excellent results.

Injuries to the bowel wall sustained during the separa-

tion of dense adhesions should be repaired as soon as recognized. In these cases the tissues are apt to be so infiltrated and friable that sutures will not hold unless so much tissue is included as dangerously to narrow the lumen of the bowel. In such cases, when subsequent rupture of the coats of the intestine is to be feared, a drain should be inserted. In injuries to the sigmoid flexure and to the lower rectum, which are frequently implicated, vaginal drainage is most suitable.

When incomplete ovariectomy has been performed, drainage may be required to permit the escape of the fluids or the breaking-down tissues. The gauze thus applied facilitates the obliteration of the cavities of the cysts, which cannot be removed. For the same reason, if suppuration has occurred, and the abscess wall cannot be removed completely, a drain may be required.

In instituting drainage we have the choice of two routes, the abdominal and the vaginal. The latter is usually to be preferred, since it provides an exit at the most dependent point of the pelvis. The abdominal sinus which is left after removing the gauze, even with the greatest care and the best technique, is very liable to become infected, and as a result a track is left which must close slowly from the bottom. The drain inserted through the abdominal incision requires to be removed much earlier than one used through the vagina. The mental effect upon the patient is not unimportant, and the old saying, "Out of sight, out of mind" is not without weight here.

As regards the form of drain used, experience goes to show that glass tubes should be discarded. Gauze either in the form of strips or a "Mikulicz drain" answers very well. If strips be used, they may be tied end to end, forming one long continuous wick; but if left separate, the end of each should reach the external opening and the first to be removed should be identified in some way, as by tying a piece of silk around the end or by knotting the gauze itself.

Toilet of the Peritoneum.—Having removed the tumor, the surgeon's next duty is to inspect the field of operation very carefully, to see that everything is in order. After first satisfying himself that no hemorrhage is in progress, he should examine the pedicle, and then inspect the broad ligaments, the pelvic walls, and any other situation where he has had occasion to separate adhesions. If there be any oozing, measures to control it must at once be instituted. The bowel must also be examined, more especially the rectum and the sigmoid flexure, as these are the parts most likely to be injured. The omentum is drawn out of the incision and laid upon a gauze sponge, when any bleeding points will be indicated by the staining of the material, and can readily be secured. Any holes in the omentum should be sutured and any ragged ends should be ligated and removed. Owing to the occasional implication of the vermiform appendix in pelvic disease, it should be examined as a matter of routine and, if necessary, removed. All bleeding having ceased, the abdomen is to be thoroughly flushed out with decinormal salt solution, and then sponged dry. This can be done by holding the uterus forward and the intestine back, while an assistant pours the sterile salt solution down into the cul-de-sac. Occasionally the employment of a funnel and rubber tube will prove more convenient. All clots or fluid having been removed by this procedure, the sponges and instruments should be counted to prevent the possibility of any being left in the abdomen. If drainage be indicated, the gauze is now inserted; otherwise the abdomen is filled with decinormal salt solution and the incision closed by the method in favor with the operator.

Dressing.—The incision having been closed, the surrounding skin is sponged with a bichloride solution (1 to 1,000) and afterward with alcohol. A small amount of sterile iodoform or boric-acid powder may be dusted along the line of the suture. Several layers of fine gauze are then placed over the wound, and above this a liberal amount of absorbent cotton. To retain the dressing in place wide strips of adhesive plaster are used, reaching

well around on the sides of the abdomen, and extending from the pubes for some distance above the umbilicus. Over this is placed a scultetus bandage reaching from just below the trochanters up to the costal angle, and held down snugly in place by means of two strips passing around the inside of the thighs. The scultetus bandage may be changed daily, or as frequently as it is soiled. Unless the skin show considerable irritation from the adhesive plaster, the latter may be left undisturbed for ten days. By this time the skin incision will be well united and the subcuticular catgut suture absorbed. If, however, there be a rise of temperature, and pain along the incision be complained of, the whole dressing should be removed, in order to ascertain if there be suppuration in the wound.

With an abdominal dressing firmly applied in the above manner, there is less danger of the sutures tearing out during the vomiting. Distention also seems to be lessened by it, and there is no danger in turning the patient on her side, as soon as the nausea has diminished. The change of posture is one of the most welcome privileges allowed to a patient after a celiotomy. Care must be taken that the dressing does not become drawn away from the pubes, as the lower end of the incision is not far above this point and exposure of it may lead to suppuration and the breaking down of the wound. After the first ten days a small strip of gauze held in place by two strips of adhesive plaster is a sufficient protection.

After-Treatment.—The after-treatment is that usually carried out after any abdominal section, and the details will vary with different operators. It is a very good plan to have a definite scheme of procedure written down, to be given to the nurse in charge of the patient. This may be suited to a moderately severe case, but can be modified as desired. Even if the operation has been a simple one and the shock slight, the patient will not suffer from the extra precautions taken.

Before the patient leaves the operating-room the stomach may be washed out, and it is a good plan to administer a stimulating enema composed of an ounce of brandy, five grains of ammonium carbonate, and one-twentieth of a grain of strychnine sulphate in a pint of decinormal salt solution. This is rapidly absorbed, and while greatly diminishing the thirst, also promotes diuresis, diluting the urine which otherwise is apt to irritate the bladder from its concentration. On reaching her room the patient is put into a warm bed, and hot-water bottles are placed around her to counteract any shock. These must be carefully protected so as not to burn her. The foot of the bed is elevated fourteen inches to facilitate the absorption of the salt solution which has been left in the abdomen. With the head low, as in this position, the nausea probably will be less. An attendant must remain at the bedside until the patient is perfectly conscious, as she is very apt to try to get out of bed when coming out from the anæsthetic. Shock must be combated by the use of stimulants, and of these strychnine is the most satisfactory; one-thirtieth of a grain may be given hypodermically as soon as the patient reaches her room. If the pulse remain over 120 to the minute, this had better be repeated every hour for four or five times; otherwise every two hours for three or four doses is sufficient, and after this every four to six hours, according to the character and rate of the pulse. It is probable that the work now being done on the determination of the blood pressure will ultimately give us more definite data for the employment of stimulating drugs under these circumstances. For the nausea nothing much can be done; drugs as a rule are useless, and sips of hot or cold water only aggravate it. A hot turpentine stupe or a small hot-water bag applied to the epigastrium above the level of the dressing, often affords some relief. Gastric lavage at the time of operation acts as a preventive, and may also be employed after the first twenty-four hours in persistent cases. As soon as consciousness returns the first complaint will be probably of thirst, but beyond moistening the lips and wiping out the mouth with a moist piece of gauze nothing much can

be done for some hours. When, however, the nausea has subsided, water in small quantities may be given every few minutes. Hot water is preferable to cold, and the quantity may gradually be increased if no ill effects are seen. As has been said before, the administration of the enema and leaving 500 c.c. of salt solution in the abdomen will lessen the thirst very considerably. For the pain, if severe, a small dose of morphine or codeine may be given hypodermically. It is much better to avoid opiates whenever possible, and their routine use is to be condemned. Besides augmenting the nausea, in many patients they are apt to retard the opening of the bowels. Rubbing with chloroform liniment will often relieve the severe backache, and a change of position is always grateful. With the abdominal dressing described above there is no risk in moving the patient from one side to the other.

It is advisable to have the patient urinate naturally, and unless there is some contraindication, such as trauma to the bladder wall during the operation, from eight to ten hours may be allowed to pass without an evacuation of urine. After this time, if her efforts to void naturally have failed, she should be catheterized with the usual aseptic precautions. This should not be repeated unless it is absolutely necessary. If she have much distress referable to the bladder, it may be emptied earlier.

Most of the discomfort incident to abdominal operations is due to the tympanites, which is usually worse in those cases in which the structures have been adherent, and in which there has been much handling of the bowels. It is also frequently due to neglect in properly emptying them before the operation. This complication can be relieved very often by passing the long rectal tube and applying heat to the epigastrium. Tincture of capsicum in three-minim doses may be administered after the cessation of the nausea. In neurotic women a good deal of discomfort is usually the rule.

The patient generally feels much easier as soon as the bowels have been well moved. Eighteen or twenty hours after the operation two grains of calomel may be given. Eight or ten hours later a turpentine enema will often produce a satisfactory evacuation; if ineffectual it may be repeated in four hours, or a glycerin enema may be given instead. If there be still no results small doses of magnesium sulphate may be given.

The temperature, pulse rate, and number of respirations should be taken every three hours at first, and later every four or six hours, according to the progress made by the patient. A careful chart should be kept so that her condition from time to time may be readily ascertained.

In the matter of diet nothing but water had better be given by mouth until the bowels have been moved, but nutrient enemata consisting of peptonized milk, with the whites of two eggs and twenty grains of table salt, may be administered every three hours. As soon as the bowels have moved satisfactorily milk with lime water or carbonated water, albumin water or broth may be retained if given in small quantities at first. After the first three or four days, if satisfactory progress is being made, the patient may take soft food, and after about two weeks an ordinary light diet may be ordered.

Where there is no suspicion that suppuration is occurring in the abdominal wound, the dressing need not be disturbed for ten days; but if through-and-through sutures have been used for the abdominal incision, as in cases in which speed in closing the wound has been necessary, or if unabsorbable sutures have been employed for the skin alone, an earlier examination is advisable, and if any redness be found around the suture the offender had better be removed. All of them can be taken out as a rule on the seventh day. If the incision be firmly united, a small pad of gauze over it will be sufficient; transverse strips of plaster may be used to hold this in place, and at the same time prevent any stretching of the newly formed scar tissue. The scultetus bandage is worn until the patient is out of bed, after which a special elastic abdominal supporter should be provided. If no complications occur, the patient may sit up in bed on the

sixteenth or eighteenth day after the operation, and get out of bed on the nineteenth or twenty-first day. Undoubtedly in many cases a shorter time than this is sufficient, but it is far better to be on the safe side.

Mortality.—The mortality depends upon a number of factors, such as the skill and experience of the operator, his facilities for carrying out an aseptic technique, and also the care of the patient after the operation. Granted that these have been all that could be desired and that the cases are uncomplicated, the percentage of deaths from the operation should be almost nothing. It is very difficult to determine the real mortality since statistics are notoriously misleading.

The results are steadily improving. A few references to the mortality in the early days of the operation have already been made, and half a century ago it was over fifty per cent. Owing to an aseptic technique, and to our knowledge gained by experience, the average mortality in cases subjected to operation for ovarian tumors at the present day is below ten per cent. Individual operators will have far better results than this. Lawson Tait a number of years ago reported a series of 139 ovariectomies without a death, and the results to-day are better than at that time. Even in coeliotomies for all sorts of pelvic diseases, including pelvic abscess, ectopic gestation, etc., records of series of over 100 consecutive cases without a death have been reported. The author has recently had two such series, one of 108, the other of 114 consecutive successful operations in a hospital practice, in which all conditions, including pus cases in a large proportion, were encountered.

The average skilful operator, taking cases as they come, and having every facility for good work, should have a mortality of not over three to four per cent. in ovariectomy. *Hunter Robb.*

OVARY (ANATOMICAL). See *Sexual Organs, Female.*

OVULATION. See *Menstruation.*

OVUM.—(Greek *óvov*, Latin *ovum*, an egg.)

The *ovum*, or egg proper, is a cell capable under certain conditions of giving rise by subsequent cell divisions to a complete multicellular organism. This definition applies to the female germ cells of plants as well as to

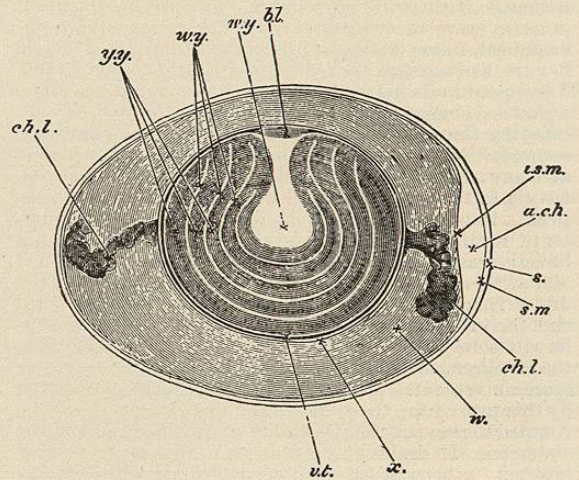


FIG. 3712.—Diagrammatic Section of an Unincubated Hen's Egg. *bl.*, Blastoderm; *w.y.*, white yolk; *y.y.*, yellow yolk; *v.t.*, vitelline membrane; *u.*, albumen; *ch.l.*, chalaza; *a.ch.*, air chamber; *i.s.m.*, inner shell membrane; *s.m.*, outer shell membrane; *s.*, shell. (From Balfour, modified from Allen Thomson.)

those of animals. Frequently the terms ovum and egg are used loosely, however, not only to include the envelopes surrounding the egg proper, but even to designate the embryo and its fetal membranes.

Historical.—Although a hen's egg has been probably one of the most familiar of objects since long before man

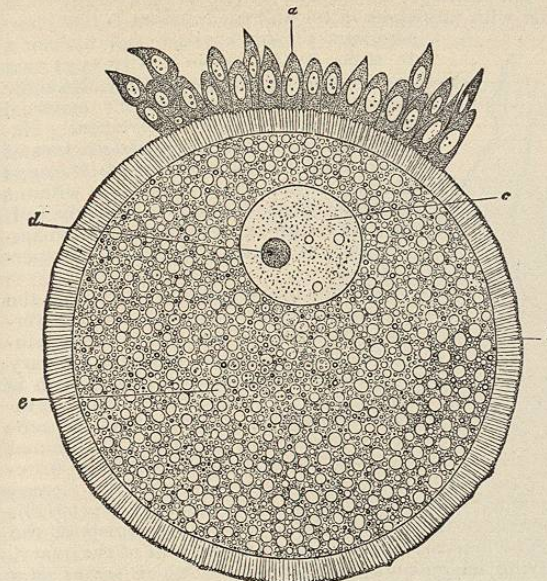


FIG. 3713.—Rabbit's Ovum, from a Graafian Follicle measuring 2 mm. *a.*, Discus proligerus; *b.*, zona radiata; *c.*, nucleus; *d.*, nucleolus; *e.*, yolk-granule in the cytoplasm. Highly magnified. (From Waldeyer.)

ever thought of domesticating wild animals, it remained for the anatomists of the nineteenth century to discover its true nature; and although investigators of this subject were never before so active as during the last decade, and have carried on their work with a refinement of technique not dreamed of in earlier years, there is still a great deal to be learned.

Modern embryological observations may be said to have begun with William Harvey, who published his results in 1651. The best microscope that he could obtain was a simple lens, and with this he was able to make out the general outline of a chick embryo during the second day of incubation. His view of the ovum was that it consisted of a fluid matrix in which the embryo appeared by a process of spontaneous generation. The female sexual product was supposed at that time to be a fluid secreted by the "testes muliebres," the term "ovarium" not having been invented by Stenson until some years later.

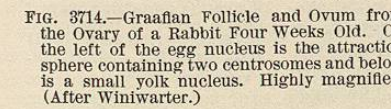


FIG. 3714.—Graafian Follicle and Ovum from the Ovary of a Rabbit Four Weeks Old. On the left of the egg nucleus is the attraction sphere containing two centrosomes and below is a small yolk nucleus. Highly magnified. (After Winivarter.)

Regnier de Graaf published in 1677 a description of the follicles, which have since borne his name. He found that they contained a fluid which was capable of being coagulated by heat into a firm, white substance. He discovered also that in the Fallopian tubes of a rabbit killed seventy-two hours after coitus there were to be

found a number of eggs which were vesicles and contained a fluid that could be coagulated by heat, like the white of egg, and, moreover, these corresponded in number to the empty follicles found in the ovaries of the same subject. He concluded, therefore, that the Graafian follicles were ova. But the chain of evidence was not complete because all trace of the eggs was lost between the time of coitus and the end of the third day, and, more-

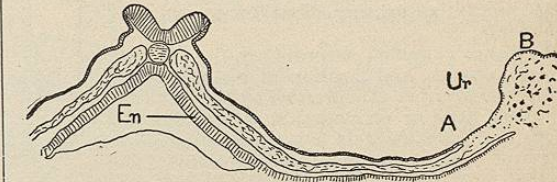


FIG. 3715.—Cross Section of an Embryo Dogfish 2.75 mm. Long. *A-B*, Blastodermic rim containing all the germ cells; *En*, endoderm. $\times 38$. (After Woods.)

over, the blastoderms in the Fallopian tubes were not so large as the empty follicles. During the same year, 1677, Leeuwenhoek announced the discovery of spermatozoa, and there followed a long dispute as to whether the spermatozoon is the true germ and the egg a matrix

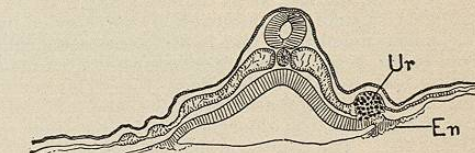


FIG. 3716.—Cross Section of an Embryo Dogfish, 3.5 mm. Long. *En*, Endoderm; *Ur*, germ cells. $\times 38$. (After Woods.)

for its nutrition, or whether the germ dwells originally in the egg itself (see article *Evolution*).

It was not until 1827 that Carl Ernst von Baer was able to show that the Graafian follicle is not the ovum; but that the ovum is a minute body embedded in the follicular epithelium. And it was not until 1838 that Schwann was able to declare the egg to be a cell with the same fundamental structure as the other cells of the body.

Morphology.—The ovum is usually a more or less spherical body, but may be flattened or elongated, as is the case with most insect eggs.

The protoplasmic contents of the egg consist of a nucleus and a mass of cytoplasm, as in all cells, and, in addition, the cytoplasm usually contains a greater or less amount of yolk, or *deutoplasm*.

The cytoplasm of the eggs of echinoderms and other invertebrates has been shown to have a distinctly vesicular, or foam-like, structure, and it is probable that all eggs will show a similar structure. It is within the vesicles of the foam that the deutoplasm is deposited, sometimes in the form of clear oil globules, as in some worms and fishes, more often as more or less opaque yolk granules. In the hen's egg there are two principal kinds of yolk granules, the yellow and the white. The white granules are gathered together in the form of a small flask-shaped body, extending from the centre of the ovum to the upper pole, and the yellow yolk forms concentric layers surrounding this and alternating with thinner layers of white yolk (Fig. 3712). These may be seen in a carefully made section of a hard-boiled egg. Where the white yolk approaches the surface there is in the unfertilized egg a portion of the cytoplasm comparatively free from yolk and containing the nucleus.

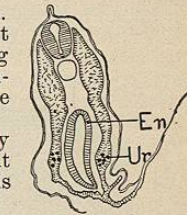


FIG. 3717.—Cross Section of an Embryo Dogfish, 5 mm. long. *En*, Endoderm; *Ur*, germ cells. $\times 38$. (After Woods.)