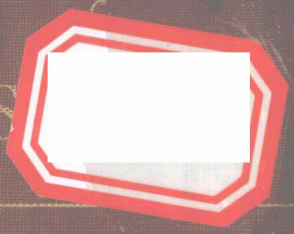
Principles and Practice of OBS



DE LEE–GREENHILL

9th Edition

SAUNDERS

Principles and Practice of

OBSTETRICS

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NINTH EDITION, WITH 1108 ILLUSTRATIONS ON 860 FIGURES, 211 IN COLOR

W. B. SAUNDERS COMPANY

PHILADELPHIA AND LONDON

1948

Reprinted July, 1947, and May, 1948

MADE IN U. S. A.

PRESS OF
W. B. SAUNDERS COMPANY
PHILADELPHIA

PREFACE TO THE NINTH EDITION

THE enthusiastic acceptance of the eighth edition of this textbook, not only by teachers of obstetrics and obstetricians but also by medical students and general practitioners, indicated to me that the changes made in that edition were necessary and perhaps helpful. Therefore I have practically rewritten the entire text along the lines begun in the previous edition.

New chapters have been added, a few have been omitted or combined with others, several chapters have been replaced completely by new ones and all the remaining chapters have been rewritten and new pertinent material added. The new chapters are as follows: "Minor Disturbances of Pregnancy," "Premature Labor, Prolonged Pregnancy or Postmaturity and Missed Labor," "Fetal Erythroblastosis," "Care of Premature Babies" and "Circumcision." The chapters which have been replaced by new ones are "Physiology of the Fetus," "Antepartum Care" and "Postpartum Care."

Among the major changes in the text is the inclusion of additional material in the chapter on "Analgesia and Anesthesia" which now deals with not only the new analgesic drugs but also detailed descriptions with illustrations of direct, local and infiltration anesthesia and caudal analgesia. Additions also have been incorporated in the section dealing with diseases of the blood and surgical operations. Considerable changes have been made in the chapters on hyperemesis gravidarum, toxemias of pregnancy, postpartum hemorrhage, placenta praevia, abruptio placentae, placenta accreta and the acute and chronic infectious diseases complicating pregnancy. Detailed information is given concerning the use of penicillin and the sulfonamides in the treatment of puerperal infection, mastitis, syphilis, gonorrhea and gonorrheal ophthalmia. The importance of German measles in obstetrics is emphasized and a section on pemphigus neonatorum has been included. Many new illustrations have been added, among them are four which depict the beautiful and highly instructive dissections of the pelvis prepared by Anson and Curtis. The literature at the end of each chapter contains the original reference for every name mentioned in the entire textbook; each reference not only contains the source and date of publication but also the full title of the article or book in question.

My aim has been to have the continuity of this book so placed as to make its contents both scientific and practical. I hope it will be useful to all who are interested in obstetrics, not only specialists but also physicians who deliver women in their homes.

Many have assisted in the preparation of this edition. Dr. George W. Bartelmez corrected the chapter on "Embryology." Dr. Mary Karp checked the chapter on "Analgesia and Anesthesia" and prepared the sections on caudal analgesia and cyclopropane. Dr. I. Davidsohn wrote the chapter on "Fetal Erythroblastosis" and Dr. Louis Rudolph again gave considerable help on the sections dealing with the physiology of uterine activity, retraction rings and the mechanism of labor. I am grateful to Dr. M. Edward Davis for unpublished data dealing with the statistics of the Chicago Lying-in Hospital. Special thanks are due Miss Zola Wist who edited the proof and improved it considerably. Likewise I am most grateful to the W. B. Saunders Company for their splendid cooperation at all times. I also wish to thank the many physicians who have written to offer suggestions and criticisms. This includes the physicians in South America and Mexico who possess the Spanish edition of this textbook.

If I have succeeded in a small way in helping to make this book a memorial to the late Dr. Joseph B. DeLee I shall feel well repaid for all of my efforts.

J. P. GREENHILL

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THE PHYSIOLOGY OF REPRODUCTION, PREGNANCY, LABOR AND THE PUERPERIUM

SECTION I—PHYSIOLOGY OF REPRODUCTION AND DEVELOPMENT OF THE OVUM

CHAPTER I

OVULATION AND CONCEPTION

OBSTETRICS is that branch of medicine which deals with the function of reproduction. The word *obstetrics* comes from the Latin and means "to stand before" or "to protect." Strictly speaking the word *obstetrics* should be applied to labor or parturition, but usage sanctions its application to all phases of reproduction. This includes conception, pregnancy, labor, lactation and involution. Synonyms for obstetrics are *midwifery* and *tocology*.

OVULATION

Ovulation is the process by which the ripe graafian follicle ruptures and discharges the ovum from its cavity.

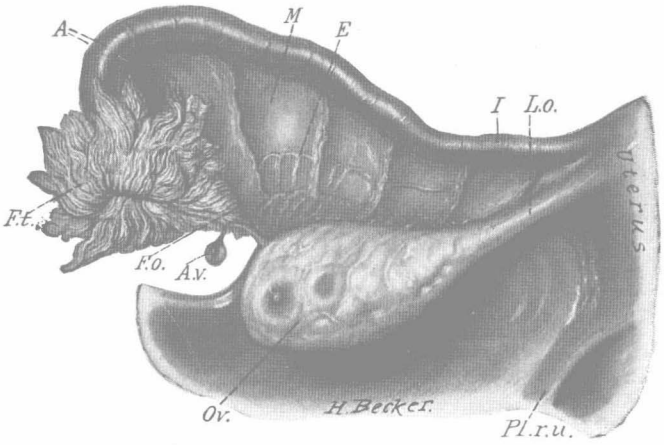

Fig. 1.—Normal ovary and fallopian tube.

F.t., Fimbria; *A*, ampulla; *M*, mesosalpinx; *E*, parovarium; *I*, isthmus; *L.o.*, ovarian ligament; *F.o.*, fimbria ovarica; *A.v.*, hydatid of Morgagni; *Ov.*, ovary; *Pl.r.u.*, plica recto-uterina.

The ovary (Fig. 1) is a densely fibrous organ situated on the posterior surface of the broad ligament, in a shallow pouch—the "fossa ovarica." It averages 39 mm. in length, 19 mm. in width and 8 to 13 mm. in thickness, and weighs about 5 gm. The right one is usually larger than the left, and is more liable to disease, because of the proximity of the appendix.

The organ is shaped like a large almond, being attached to the broad ligament by two layers of peritoneum, between which the vessels and nerves enter its substance. At birth the ovary is relatively large. Its growth up to maturity is caused by the formation of connective tissue, vessels and the enlargement of existing primordial follicles. After the menopause the ovary shrinks. Accessory ovaries have been found on the broad ligaments. A third ovary and corresponding tube have been found, which is interesting from several clinical and medicolegal points of view. The ovary is covered by a layer of low, columnar, lusterless epithelium, called the germinal epithelium, under which is the tough tunica albuginea. Beneath this are small unripe ova, while deeper down are larger ova in the process of growth. These ova are surrounded by stroma, a characteristic, highly cellular, reticular connective tissue. The blood supply is abundant, and numerous fine nerves form networks around the follicles.

The formation of ova begins in fetal life. On the posterior wall of the abdomen of the embryo, on the ventral surface of the wolffian bodies, two light streaks of celom-peritoneal epithelium appear. They are supported by connective tissue, and are the primary structures of the future ovary or testicle. In the somewhat

proliferated peritoneal epithelium (germinal epithelium of Waldeyer) there are many cells of greater size than the others, spheric in shape, and with a pale vesicular nucleus, the primordial eggs, or ova. These may develop into primordial seminal cells if the fetus is a male. The germinal epithelium proliferates actively, as do also the primordial ova, and usually dips down into the stroma of the ovary, carrying with it the ova. The connective tissue surrounding these columns of epithelial cells grows in such a manner that masses of germinal epithelium containing one or two primordial ova are split off, until finally the ovary is formed completely of such "primordial follicles" and connective-tissue stroma. The primordial follicles develop into the larger structures, which de Graaf discovered in 1672 and have been named after him. The ova are nearly all completed during fetal life; perhaps some are formed during the first few years of life. The ovary of the newborn infant contains about 420,000 ovocytes (Häggström). These are closely arranged in the periphery of the ovary, while toward the hilum are a few follicles in further advancement. The main function of the ovary is to mature and discharge the ova lying in the graafian follicles.

When a follicle begins to ripen the epithelium of the follicle proliferates rapidly and a fluid appears in the center of the mass of cells, which are thus pressed against the wall of the follicle (Fig. 2). This layer of cells is called the stratum granulosum; the liquid, the liquor folliculi. The liquor folliculi is a clear, viscid, alkaline, albuminoid fluid, containing globules of oil and a few granules. At one part of the periphery of the follicle a small clump of cells of the stratum granulosum is seen, called the cumulus oophorus or discus proligerus which surrounds the ovum. The stratum granulosum rests on a layer of loose connective tissue with characteristic large cells, the tunica interna, and this in turn on a layer of closely felted fibrous tissue, the tunica externa; both of the latter are derived from the stroma of the ovary, and called the theca folliculi (Fig. 2). The blood supply of the

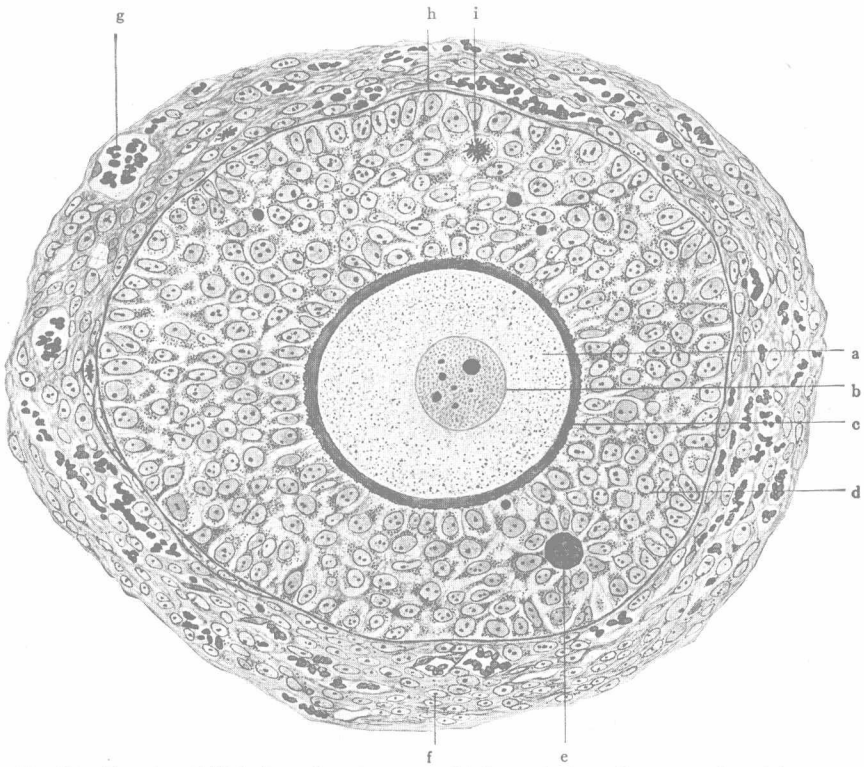

Fig. 2.—Growing follicle from human ovary (eighteenth day of menstrual cycle).

f, *a*, Ovum; *b*, its nucleus; *c*. zona pellucida; *d*, follicular epithelium with mitochondria; *e*, vacuoles of Call-Exner theca folliculi (outer and inner layer not differentiated as yet); *g*, blood vessels with erythrocytes; *h*, basement membrane; *i*, mitosis of follicular cell (× 375) (Maximow and Bloom: "Textbook of Histology").

ovary is increased, and there is a local congestion around the growing follicle. The cells of the follicle proliferate rapidly, the liquor folliculi increases and the follicle approaches the surface of the ovary. At the spot nearest the surface burst, the ovum dies, and the follicle undergoes involution. This is not ovulation. Coincident with the normal transformation in the follicles, changes destined to prepare it for the reception of the male element are going on in the ovum

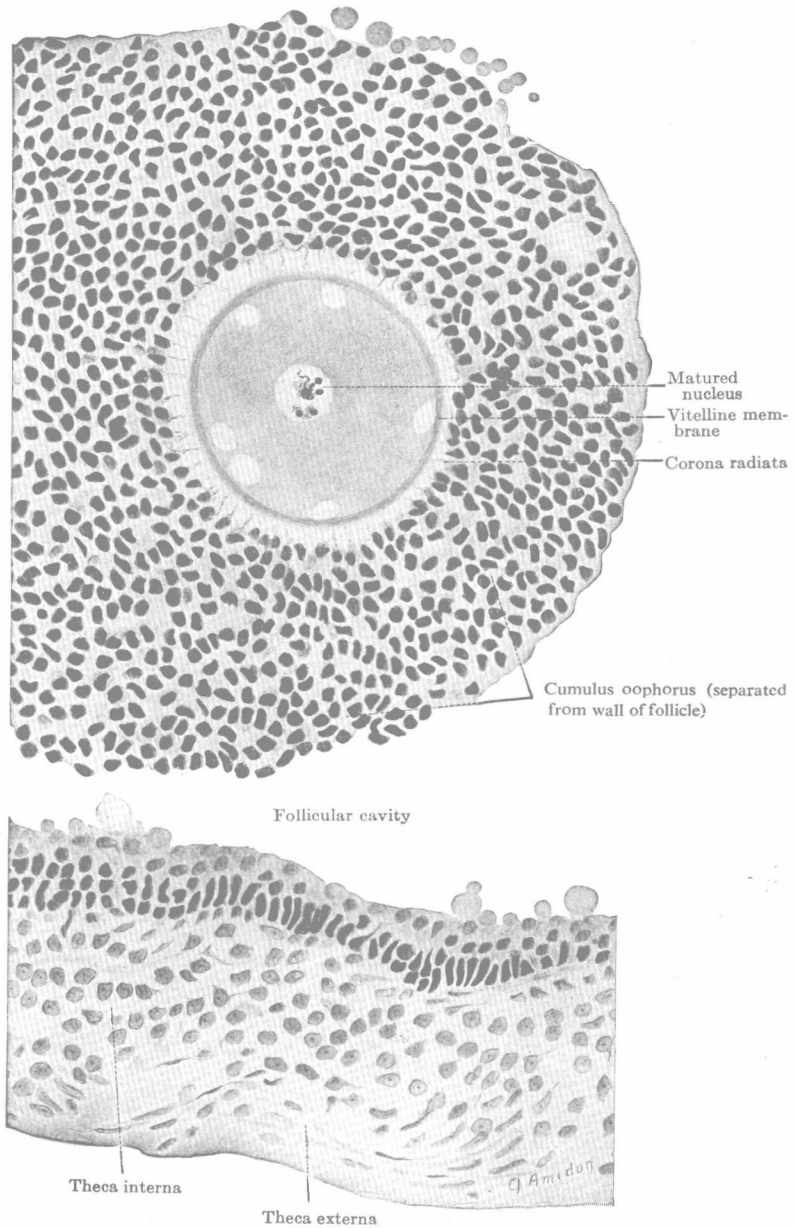

Fig. 3.—The ovum near maturity.

the theca folliculi atrophies, or its fibers separate, and the follicle bursts at this point (the stigma), and the ovum, surrounded by cells from the cumulus oophorus, escapes. This is ovulation. Frequently the follicle does not embedded in the cumulus oophorus. The ovum is a typical cell, and consists of a cell wall, cytoplasm, deutoplasm, or yolk (which appears later in the development), and a nucleus (or germinal vesicle), with a nucleolus or germinal

spot. Shortly before ovulation the nucleus approaches the surface and undergoes karyokinesis. After the resolution of the chromatin into distinct chromosomes two successive cell divisions occur by which small globules, or polar cells, are extruded to lie beneath the zona pellucida. Through these divisions the chromosomes are reduced to one half their original number. The smaller germinal vesicle now rests, and is called the female pronucleus. The second maturation is never completed and the female pronucleus never forms unless the ovum is fertilized. The formation and the extrusion of the polar globules are necessary to reduce the number of chromosomes of the female nucleus. A similar reduction in chromosomes takes place in the formation of the spermatozoid, except that the end-products are all of equal size and function. The halving of the number of chromosomes in both the ovum and the spermatozoon prior to their union at conception, when the normal number is restored, is important in maintaining the mechanism of inheritance.

What causes the graafian follicle suddenly to become active, ripen and burst, that is, ovulate, is only now beginning to be understood. Something acts on the anterior pituitary, causing it to elaborate hormones which stimulate the follicle to develop and rupture, and thereafter initiate the formation of a corpus luteum.

Rabbits and ferrets ovulate only after copulation, and the original impetus is neural as is proved by the fact that it is possible to induce ovulation by mechanical and electrical irritation of the genitals. In human beings ovulation usually occurs regularly, about fourteen days before the ensuing menstrual bleeding begins. It may occur before birth, before puberty, after the menopause and during periods of amenorrhea and lactation.

The ovum as it is expelled from the graafian follicle (Fig. 3) is just visible to the eye as a fine white point. It is surrounded by 100 or more epithelial cells derived from the stratum granulosum, arranged radially around the ovum, and called the corona radiata; inside this is the oolemma or zona pellucida, formed by the cells of the follicle characteristic of mammals. Within the ovum itself is a broad peripheral zone of clear cytoplasm and a large central zone of dark, coarsely granular deutoplasm; buried in the latter is the female pronucleus—which was the germinal vesicle.

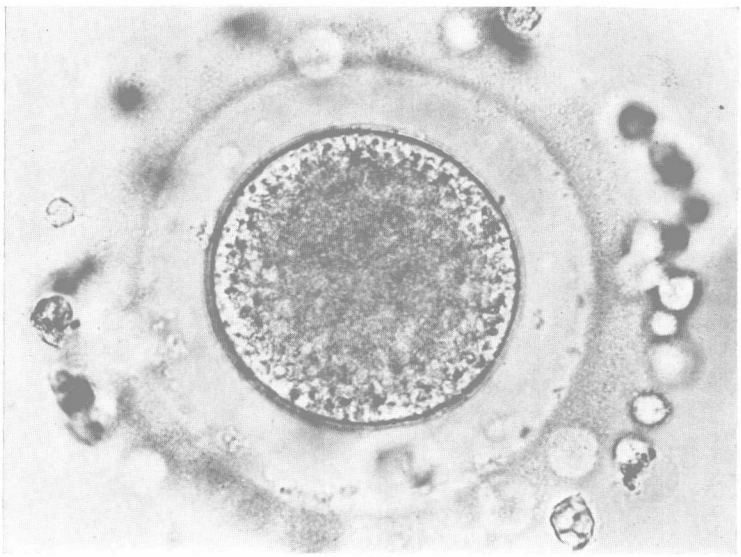

Fig. 4.—Unfertilized human tubal egg (A. T. Hertig). × 450.

The ovum is extruded when the graafian follicle bursts, the former having already been loosened from its bed in the cumulus oophorus by vacuolization of the cells of the stratum granulosum. The ovum finds its way to the tube, to await fertilization by the male element (Fig. 4).

The Formation of the Corpus Luteum.—After the ovum and part of the liquor folliculi escape from the graafian follicle, the walls of the latter collapse. The cavity is invaded by connective-tissue cells from the theca, containing a yellow, refracting pigment—lutein or carotin, a sub-

stance identical with the coloring matter of carrots. However, the corpus luteum is not yellow for at least one week. There is an active enlargement of granulosa lutein cells, which form in mm. in diameter (Fig. 5). Now retrogression occurs, the connective tissue replaces the lutein cells, whereby its yellow color changes to silvery white producing the corpus albicans; after sev-

Fig. 5.—Ovary with corpus luteum only a few hours old. (Normal size.)

festoons around the central blood clot. The small collapsed follicle grows in the first two weeks to about 10 mm., and shows the irregular yellow outline of lutein cells around the clot. eral weeks more the corpus luteum is represented only by a small retracted scar.

If pregnancy follows this ovulation, there is an excessive growth of the corpus luteum. The

Fig. 6.—Corpus luteum of pregnancy or true corpus luteum.

Fibrous tissue grows into the lutein mass and the blood clot from the periphery, giving the structure its irregular outline, and at the end of three weeks the corpus luteum is from 15 to 20 histologic changes are the same as those described, but greater and prolonged (Fig. 6). Meyer distinguishes four stages—proliferation of the granulosa cells, vascularization, the stage

of bloom and regression. The full growth is attained at the thirteenth week, when the corpus luteum may take up one third of the ovary, being about 25 mm. in diameter and sometimes palpable on bimanual examination. It remains this size until toward the end of pregnancy, when regressive changes begin which are completed several months after delivery. The large corpus luteum of pregnancy is sometimes called a true corpus luteum (Figs. 6 and 7). The small corpus luteum of menstruation is sometimes called a false corpus luteum. It is usually possible to distinguish one from the other. Some follicles become atretic, and are replaced by fibrous tissue, and others become cystic—the ovum disappears in both instances. Sometimes the corpus luteum does not retrogress, but enlarges into a cyst requiring operative removal.

The Functions of the Corpus Luteum.—Loeb found in guinea pigs that the corpus luteum secretes a hormone, later called progesterone, which sensitizes the uterine mucosa so that it reacts to the stimulation of the ovum (or, indeed, any foreign body), with the production of exuberant decidua. Progesterone inhibits uterine contractions and guarantees the stability of gestation, but, since pregnancy and labor have been undisturbed in some instances by early, double oophorectomy, other organs, particularly the placenta and the adrenals, act for the corpus luteum.

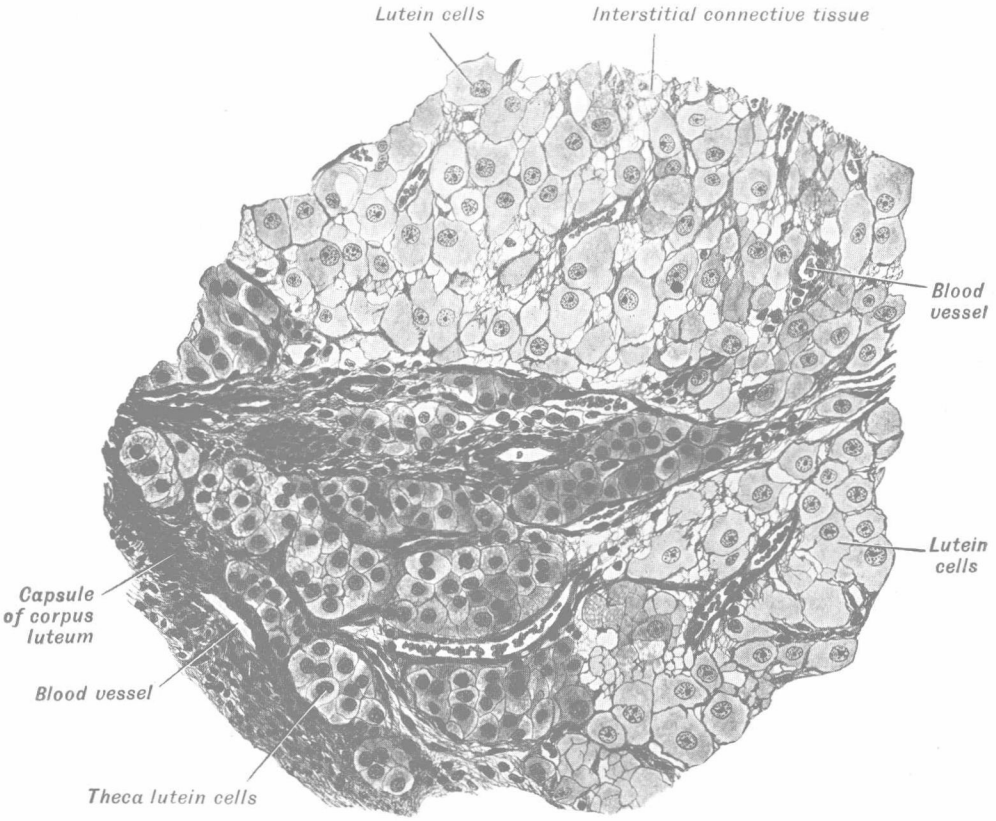

Fig. 7.—Cross section of the peripheral layer of a human corpus luteum of pregnancy. Stained for reticular fibers. 281×, reduced to $\frac{2}{3}$. (Maximow and Bloom: "Textbook of Histology.")

CONCEPTION

Conception, in its obstetric sense, means the union of the male and female elements of procreation, from which union a new being is developed. It has variously been termed fecundation, impregnation and fertilization.

The testicle and the ovary are developed in the fetus from identical structures—the germinal folds along the inside of the wolffian bodies. The germinal epithelium in the female develops into graafian follicles; in the male it lines the tubuli contorti of the testicle. The genesis of the spermatozoon is similar to that of the ovum. The spermatozoon is the active, aggressive agent in the function of impregna-

tion and is capable of rapid locomotion. It is almost the smallest of cell elements, having been divested of all that is not needed for the performance of its function, which is to seek out the female pronucleus and fuse with it. The ovum, on the other hand, must possess the nourishment needed for the new life until the egg can derive nourishment from its parent. It is one of the largest cells in the body.

Conception, impregnation and fecundation must be distinguished from copulation, which means the sexual union of the male and female. Fertile coitus and fertilization are almost synchronous because an unfertilized egg lives only a few hours; spermatozoa live almost a day and reach the fallopian tube, where fertilization is to take place, in less than one hour after coitus (Hartman).

The object of voluntary copulation is to place the semen in such a location that its living elements, the spermatozoa, may reach the ovum. The rest of the function of reproduction is involuntary. Copulation is not absolutely necessary; if the semen is injected into the vagina or even on the introitus vulvae, conception may take place. In all probability the union of the spermatozoon with the ovum occurs in the outer end of the fallopian tube—its ampulla. The frequency of tubal pregnancies indicates this. That impregnation may occur in the ovary is proved by authentic ovarian pregnancies. The general consensus is that spermatozoa gain access to the uterus by their own power and figures are given for the rate of travel. However, in some animals, certainly the rat, dog and guinea pig, the semen, including spermatozoa, is aspirated into the uterus by uterine activity (Rossman) almost immediately after ejaculation. Hartman and Ball were able to aspirate sperm from the apex of the rat uterus within one hundred seconds of a carefully determined ejaculation. Florey and Walton established fistulous connections to the uteri of some rodents. In both the rat and the guinea pig they observed undiluted semen containing masses of spermatozoa appearing at the fistulous opening immediately after ejaculation. Evans collected semen from the fallopian end of the uterus in the dog twenty-five seconds after ejaculation. Hence, in some species, the independent movement of the spermatozoa is a negligible factor as far as their ascent into the uterus is concerned. An exception is the rabbit in which it takes the spermatozoa one and one half to two hours to reach the distal end of the cornua (Parker).

How does the ovum reach the tube from the ovary? The ovary lies in a depression—the fossa ovarica (Fig. 1)—and is covered in part by the mesentery of the tube, whose fimbriae are in close proximity. The ampulla of the tube opens outward in numerous projections—the fimbriae—which are covered with ciliated epithelium. The waving of the cilia being toward the uterus, an efficient aspiratory current is produced in the peritoneal fluid in the neighborhood of the end of the tube. The ovum as it appears on the surface of the ovary, with its clump of cells from the cumulus oophorus and a few drops of liquor folliculi, is caught in this current and led to the tube. Westman's roentgen studies show the fimbriae actually embracing the ovary permitting direct entrance of the ovum into the tube.

It is generally believed that the fertilized ovum is transported to the uterine cavity by means of peristaltic action of the tubes. Burdick, Whitney and Emerson observed ova inside the fallopian tubes of albino mice and found, as did Corner, that peristalsis is responsible for the transportation of the eggs from the ampulla to the uterus. Cilia, however, may play an important role in getting the eggs from the periovarial sac to the ampulla. Although eggs were never seen to descend into the ampulla, ciliary action in this region is sufficiently strong to rotate, en masse, several eggs with their cumulus cells. The ampullary walls are quiet until after fertilization takes place when gentle contractions roll the eggs about, a motion which apparently aids in separating them from their cumulus cells. Approximately twenty-four hours after ovulation, the cumulus cells having dropped away, the isthmian lumen is expanded sufficiently to allow stronger ampullar contractions to force the eggs and some of the accompanying fluid into the first loop of the isthmus. This fluid seems to stimulate the muscle fibers. True peristalsis is confined largely to those loops in the immediate vicinity of the eggs, and appears to be a typical smooth-muscle response to increased bulk. The eggs are advanced slowly as each successive loop becomes sensitized and contractile. Transportation through the isthmus requires only about twenty-four hours. The eggs are advanced slowly in the intramural region and may be found in the uterus at the end of another twenty-four hours.

The time required for the passage of an ovum from the ovary to the uterus in most animals, from the mouse to the cow, is about three days. It is also three days for the monkey

and there is no reason why it should take longer in man (Hartman).

Spermatozoa may pass out through one fallopian tube and fertilize an ovum lying in the closed uterine horn of the opposite side. This is external wandering of the spermatozoa. The ovum may wander from the ovary of one side into the tube of the other; for example, in extirpation of the right tube and the left ovary the ovum crosses over and enters the healthy tube. In extra-uterine pregnancy the corpus luteum may be found on the right side and the ovum in the left tube.

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