Jackson (A. R.)

THE

OVULATION THEORY OF MENSTRUATION:

WILL IT STAND?

BY

A. REEVES JACKSON, A.M., M.D.,

Surgeon-in-Chief of the Woman's Hospital of the State of Illinois; Lecturer on the Diseases of Women in Rush Medical College; Corresponding Member of the Gynecological Society of Boston, etc., etc.

Reprinted from the American Journal of Obstetrics and Diseases of Women and Children, Vol. IX., No. IV., October, 1876.

NEW YORK:
WILLIAM WOOD & CO., 27 GREAT JONES STREET.
1876.

THE

OVULATION THEORY OF MENSTRUATION:

WILL IT STAND?

BY

A. REEVES JACKSON, A.M., M.D.,

Surgeon-in-Chief of the Woman's Hospital of the State of Illinois; Lecturer on the Diseases of Women in Rush Medical College; Corresponding Member of the Gynecological Society of Boston, etc., etc.

Reprinted from the American Journal of Obstetrics and Diseases of Women and Children, Vol. IX., No. IV., October, 1876.

NEW YORK:
WILLIAM WOOD & CO., 27 GREAT JONES STREET.
1876.

THE

OVULATION THEORY OF MENSTRUATION.

WILL IT STAND?

BY

A. REEVES JACKSON, A.M., M.D.,

Surgeon-in-Chief of the Woman's Hospital of the State of Illinois; Lecturer on the Diseases of Women in Rush Medical College; Corresponding Member of the Gynecological Society of Boston, etc., etc.

[Read, by abstract, before the Illinois State Medical Society, at its annual meeting, May 17, 1876.]

It is my purpose, in this paper, to examine the evidence upon which is based the ovular or ovulation theory of menstruation.

This subject has received a large share of attention during the past few years, and great discrepancy of opinion exists in regard to many points connected with it. I do not expect to reconcile these discordant views; indeed, in the present state of our knowledge, it would perhaps be impossible to do so. Our great need in this, as in many other problems of a physiological character, is an increased number of well-observed facts; those which we have thus far are too few in number,

and, apparently, too contradictory to warrant a definite and entirely satisfactory conclusion.

The progress of scientific knowledge is greatly retarded by the admission of what may be termed, paradoxically, false facts; that is to say, facts which by representing only partially the truth, lead to false results. Conclusions founded upon such premises must almost necessarily be erroneous. Truth in science is rarely found wholly unmixed with error, and, in order that we may rightly appreciate the former, we must properly estimate the latter also. Like the diamond, whose facets reflect a differently colored ray according to the angle from which they are seen, so may a scientific truth present a different aspect to those who behold it from different points of observation. While to one person the gem appears green, to another it is red, and to a third, yellow. He only who sees it from all directions can know the whole truth. Thus it is that imperfectly-observed, partial, or perverted facts result in the formation of a false theory; and a false theory, once adopted, has a most injurious influence. He who is governed by it sees everything through a false medium. As observed by Paris, "He who is guided by preconceived opinions, may be compared to a spectator who views the surrounding objects through colored glasses, each assuming a tinge similar to that of the glass employed." The advocates of the ovulation theory are, it seems to me, somewhat in this position. Many facts have been observed which give apparent support to their opinions, and on these they have been content to rest, overlooking, or, at least under-estimating other facts, equally well known, which strongly militate against those opinions.

The ovulation theory of menstruation implies the following essential propositions:

1. At regular periods, of about twenty-eight days, in the human female, a matured ovule is discharged from the ovary, passes into the Fallopian tube, and is transmitted to the uterus.

2. Coincident with, and dependent upon the maturing and bursting of the Graafian vesicle and the extrusion of the ovule, certain changes occur in the mucous membrane of the body of the uterus, which result in a sanguineous discharge from that organ.

In support of these propositions, evidence consisting of certain facts and analogies has been adduced, as follows: (a) Observations made on the bodies of women who have died during, or soon after the menstrual period, have revealed the presence in one or other ovary of a ruptured Graafian vesicle, and its cavity filled with a blood-coagulum, or, its remains, a corpus luteum, in various stages of development or decadence; (b) Physiologically, the period of menstruation in woman corresponds with the rut or œstrus of other mammalia, when, it is well known, ova are discharged from the ovaria; (c) The artificial removal of the ovaries causes an immediate cessation of the menstrual function. I purpose considering, *seriatim*, these propositions, together with the facts which have been advanced for their support.

1. *At regular monthly periods, in the human female, and coincident with the monthly flow, an ovule is discharged from the ovary, is received into the Fallopian tube, and by it transmitted to the uterus.*

The minor proposition, namely, that the matured ovule passes from the ovary to the uterus through the Fallopian tube is admitted on all hands, and, not being in dispute, need not detain us. The essence of the controversy centres in the alleged periodicity of this process, and of its time relations with the menstrual discharge.

The Graafian vesicles, from the time of their description in 1673, by De Graaf, down to the year 1827, were thought to be the actual ova of mammalia. It was not until the last named period that Baer discovered the true ovule and the relations it bore to its containing vesicle. However, as early as 1672, Kerkringius[1] advanced the idea that ova were discharged at the time of menstruation, but it does not seem to have been founded upon any observations. The first writer who gives positive evidence upon the subject is Sir Everard Home, who noticed the ruptured follicle during menstruation, although its import was not then understood. In 1821, Dr. Power clearly enunciated the doctrine of the periodical ripening of the follicle at the menstrual period; and the discovery six years later

[1] Tyler Smith, Lectures on Obstetrics, third edition, p. 80.

by Baer, already alluded to, that this was only the enveloping structure of the ovule and not the ovule itself, made the rupture an intelligible fact; and so we may regard this as the real birth of the ovulation theory. In 1831, Negrier,[1] working independently, showed by anatomical preparations that the periodical discharge of menstruation was the consequence of an internal hidden function—ovulation. Fresh proofs were brought forward by Gendrin, Paterson, Barry, Raciborski, Bischoff, Pouchet, and others, all tending to show that ovulation and menstruation are simultaneous and necessarily connected one with the other; and the doctrine was so beautiful and reasonable, and seemed so well sustained by the evidence adduced, that we cannot wonder at the fact that it was generally received and adopted by physiologists. Still, there have always been some who were not convinced of its correctness, and who regarded the proofs alluded to as insufficient and inconclusive; who, in the language of Mr. Kesteven,[2] looked upon the doctrine "as a plausible and ingenious theory, wanting, however, in the true elements of an inductive theory; in short, an example of the *post ergo propter* line of argument."

In examining the cases which have been cited in support of the ovulation theory, one cannot fail to be struck with the complacency with which conclusions are frequently drawn from irrelevant, or, in some instances, even adverse facts.

An example of this is to be found in a review of Bischoff's work on Human Ovulation, in the *American Journal of the Medical Sciences*, vol. 28, p. 137.

These cases of Bischoff have always been regarded with especial favor and as of great value by the advocates of the ovular theory; and, as they are frequently alluded to, I feel constrained to present a very brief synopsis of them.

The observations[3] were thirteen in number. Of these, the time of the menstrual period was known in only ten; the remaining three have therefore no value so far as this inquiry is concerned. Of the ten, three died during menstruation, and in each of these there was found a ruptured follicle. A fourth died two days after menstruation; the right ovary contained a

[1] Recueil de Faits pour servir à l'Histoire des Ovaires. Angers, 1858.
[2] Lond. Med. Gazette, 1849.
[3] Beiträge zur Lehre von der Menstruation und Befruchtung, 1853.

pretty large projecting follicle, which was *still closed.* Both ovaries contained small corpora lutea. In a fifth case, the menstrual period had just passed; the left ovary contained a very distinct corpus luteum, and the right ovary a ruptured Graafian follicle filled with fresh blood. Number six died seven days after menstruation; in the right ovary was a recent corpus luteum. In the seventh, death occurred ten days after menstruation; the right ovary contained a very large Graafian follicle *unopened.* Number eight died ten days after menstruation; the right ovary contained a *recently ruptured Graafian follicle and a fresh corpus luteum.* In number nine, menstruation had occurred eighteen days before death; the right ovary contained a very large corpus luteum. Lastly, number ten died four weeks after menstruation; the right ovary contained a ruptured Graafian follicle.

After detailing these cases, the reviewer says: "The results here obtained show that in the human female, at each menstrual period, a Graafian follicle is ripened, swells, and usually bursts, discharging an egg,[1] and forming a corpus luteum." Now, I submit to any candid inquirer that the cases cited do not show these things. Indeed, so far as they prove anything, it is that there is not even an approximate correspondence between the rupture of the follicle and the menstrual period. In two of the cases menstruation had occurred without any such rupture at all. In Cases 5 and 8 the ovaries are described as containing a fresh corpus luteum *and* a recently ruptured follicle; yet, in the one case, menstruation had "just passed," and in the other, had ceased ten days before death. Inasmuch as a corpus luteum is an older formation than a recently-ruptured follicle, we should naturally refer the latter to the last menstrual period. But to what period or periods do the *fresh corpora lutea* belong? Dalton[2] says that the corpus luteum of menstruation "reaches its greatest development about three weeks after ovulation, and from this time rapidly disappears, a small cicatrix only remaining." This being the case, can we refer these "fresh" corpora lutea to a menstrual period, in one case thirty and the other thirty-eight days past? If we can do

[1] Notwithstanding the most diligent search, Bischoff was unable, in a single instance, to discover the ovule.

[2] Prize Essay "On the Corpus Luteum of Menstruation and Pregnancy."

so—if a recent corpus luteum signifies one which may be associated with a menstruation which occurred four to six weeks before—then what shall we say of Case 6, where the presence of such a one is connected with a period *seven days* past?

Barnes,[1] too, with a similar disregard of consistency, after stating that the preparations of Coste, preserved in the College of France, prove that the ripening of a Graafian follicle always coincides with the turgescence of the genital organs, and, according as the circumstances are more or less favorable, bursts at the commencement, towards the end, or at any time during the menstrual discharge—proceeds to state what these preparations are in detail, thus: "In a woman who died on the first day of the appearance of the menses, the ovarian vesicle was manifestly ruptured. In another, who died four or five days after the cessation of the menses, the right ovary presented a vesicle still intact, but so distended that the slightest pressure made it burst. Lastly, in a young virgin, who died fifteen days after menstruation, there was no recent trace of a yellow body, and it could not be doubted that the Graafian vesicle had been arrested in its development." Surely, these cases, taken together, so far from proving that a Graafian follicle bursts at the menstrual period, show that menstruation occurs, in two-thirds of the cases, without such rupture, and in one-third without even a maturation of a follicle. For in one only of the three was there actually found a ruptured follicle; in one, menstruation had occurred and ceased several days before without any rupture, the follicle being burst by external force *post-mortem*, and in the third there had not been even the ripening of one!

Such a course as is indicated in the foregoing instances is more reprehensible than reasoning without facts; it is reasoning against them. Yet these are only samples of the sort of argumentation which is frequently found in connection with this subject.

(A) MENSTRUATION MAY OCCUR WITHOUT ACCOMPANYING OVULATION.

At first glance it would seem that we ought to accept the discovery of a rent follicle filled with blood, in persons who

[1] Diseases of Women, p. 147.

have died during menstruation, as a proof that the flow is, if not the result of, at least coincident with, ovulation. But such evidence is not at all conclusive, and may be erroneous, for Ritchie[1] has "repeatedly seen the opening of a discharged vesicle to be still patent, and sometimes the vesicle to be filled with a florid blood-clot in the third and fourth month of pregnancy; and, in one case, he found the corpus luteum of a woman in the ninth month to communicate with the surface by a distinct foramen."

We must bear in mind, in the consideration of this subject, that Graafian vesicles are maturing and rupturing, and corpora lutea are forming and disappearing continually; hence it should be expected that, in a woman dying at almost any time, some of these conditions would be found in the ovary. And when we further consider that the menstrual periods occupy from one-sixth to one-fourth of a woman's lifetime for thirty years, we may equally expect to find such ovarian changes at these periods also. So that it seems strange, indeed, that persons who are satisfied of the correctness of the ovular theory because occasionally a ruptured follicle or a corpus luteum is found coincident with a menstrual period, should ever have a lack of evidence. And yet, abundant as such evidence unquestionably is, it does sometimes fail; for menstruation frequently occurs without any such contemporaneous change in the ovary. Many instances of this character have been recorded, but it is only necessary to call attention to a few of them.

Dr. W. W. Gerhard[2] presented to the College of Physicians of Philadelphia the uterus and appendages of a multipara, twenty-five years old, who died of apoplexy during a menstrual period. "At several points on the surface of the ovary there were minute dot-like orifices, each one corresponding to a Graafian follicle. Two of these being examined under the microscope, were found to present a few granular nucleated cells floating in a homogeneous liquid." Although this woman had been the subject of menorrhagia, the discharge latterly returning profusely every two weeks, there was no evidence of any recent ripening or rupture of a follicle. Again, Dr. Stedman[3]

[1] Tilt, Uterine and Ovarian Inflammation, p. 66.
[2] Amer. Jour. Med. Science, vol. 36, p. 410.
[3] Amer. Jour. Med. Science, vol. 24, p. 83.

has reported the case of a married woman, forty-five years of age, who died of some pulmonary affection. Menstruation was regular nearly to the time of her death, and yet on examination there was found no trace of the left ovary, but in its place a thin and simple serous cyst nearly two and a half inches in diameter; while on the other side there was a collection of cysts, forming a mass twice the size of an English walnut, upon the surface of which were spread out the thin flattened atrophied remains of the ovary.

Furthermore, it is the experience of ovariotomists, that in many cases in which both ovaries have been removed, these organs have been found so thoroughly diseased as to preclude the idea that they could possibly have performed their function of ovulation normally, if at all, and yet the regularity of menstruation has suffered no interruption.

Some of the reported cases of hernia of the ovaries throw valuable light upon this question. For example, Dr. Oldham[1] presented one to the Royal Society, the subject of which was a tall, well-formed woman, nineteen years of age, in whom both ovaries had descended through the inguinal canals, and occupied positions in the upper part of the labia majora. The mammæ and external genital organs were well developed, but neither uterus nor vagina could be detected. The left ovary was in a quiescent state, and had never been the seat of pain or swelling. She was under Dr. Oldham's observation six years, during which time he had frequent opportunities of seeing her. For the first three years the right ovary was exclusively enlarged, the intervals varying from three weeks to three months. For the last two years the left ovary was most frequently affected, the right remaining quiescent. Occasionally both were tumid, but one always more so than the other. The swelling sometimes occurred suddenly, although usually it was gradual, the volume of the organ increasing slowly for four days, remaining stationary for three days, and then slowly declining, the whole process lasting ten or twelve days. During this period the organ was tender when pressed, but was otherwise not painful, and did not interrupt the patient's ordinary duties. There were no manifest sympathies excited in the mammary glands

[1] Amer. Jour. Med. Science, vol. 35, p. 284.

or other organs; and there was no vicarious flux, either of blood or other secretion. The ovary alone seemed engaged in the act. It was supposed, reasonably, that these periods of enlargement were those of ovulation, and I beg to call attention to the fact that they were quite irregular in their occurrence, the intervals varying from three weeks to as many months.

Dr. Alfred Meadows,[1] also, mentions a case of similar character. The patient was a single woman, twenty-three years of age, who began to menstruate at fifteen, and continued doing so at regular intervals, with some pain, down to the age of twenty, when, after stooping, a swelling suddenly appeared in the right inguinal region, caused, as was subsequently learned, by the prolapsed ovary. At the menstrual period following this she suffered violent pain of a character different from any she had experienced before; it preceded the hemorrhage; at the same time the tumor was much increased in size. From that time on she suffered in a similar way, sometimes more acutely, so that at every monthly period she was obliged to lie in bed for a week or more. Sometimes the tumor would swell up to the size of "two fists," and be exquisitely tender to the touch. She had no suffering during the inter-menstrual periods. To what does this history point? Are we not prepared to accept it as an evidence of the truth of the ovular theory? Prior to the occurrence of each monthly flow, for a period of three years, the ovary enlarges, becomes the seat of pain, and the swelling does not subside until after the cessation of the discharge. What more ought we to require?

Mark the sequel. At the suggestion of Dr. Meadows the tumor was removed. It was not contained in any cyst or sac, and was readily separated from its fatty and cellular attachments. The upper portion or pedicle, which went through the abdominal ring, was found distended with fluid. This was punctured and about an ounce of the contents let out. The pedicle was then tied and the tumor removed. "The tumor, which measured about two inches in diameter, proved, on section, to be the right ovary. It had, however, undergone remarkable structural change. Instead of presenting the usual dense compact appearance, it contained throughout numerous irregu-

[1] Amer. Jour. Obstetrics, etc., vol. 6, p. 231.

larly-shaped spaces varying in size from a pin's head to a quarter or even half an inch, and all were filled with the same kind of fluid as flowed from the pedicle. These cells appeared to communicate with one another, and the whole organ to be infiltrated, as it were, with the fluid in question. There were no proper Graafian vesicles to be seen." No Graafian vesicles,—no ovules—no ovulation, to account for the great increase in the size of the ovary preceding and during the catamenial period. What is the plain inference? Is it not that the swelling of the ovary was caused by the pelvic congestion attendant upon the menstrual period? And yet, Dr. Meadows has introduced the account of this case in an argument affirming, among other things, the dominating influence of the ovaria, and the fact of ovulation producing the menstrual flow.

This last mentioned case of ovarian hernia, as also one reported by Dr. McCluer,[1] and another which I am informed[2] has been published by Dr. Joseph English, of Vienna, shows that the cystic degeneration of the prolapsed ovary, even when its essential vesicular structure is wholly destroyed, does not prevent the organ from enlarging and becoming painful during the menstrual epoch. In all of these cases the ovary, which had swollen month after month at regular periods corresponding with the menstrual flow, was found to be so diseased as to leave no vestige of Graafian vesicles, thus proving ovulation to be impossible.

Dr. Tilt says: "In three cases in which Dr. Ashwell had opportunities of examining the ovaria of women who died during the flow of the catamenia, there were no signs of the rupture of the Graafian vesicle and the escape of ovules. In one of these cases, the woman had menstruated regularly for several years, and yet the ovaria were perfectly smooth; there was neither rent nor cicatrix marking the site of either a present or former maturation and escape of a Graafian vesicle." Ritchie[3] also reports five examples of menstruation which were not accompanied, and could not have been caused, by ovulation. In one of these, the woman died ten days after menstruation. The ovaries were filled with vesicles, but neither of them pre-

[1] Amer. Jour. Obs., vol. vi., p. 613.
[2] Dr. Paul F. Mundé, private letter.
[3] Ovarian Phys. and Path., London, 1865.

sented either a puncture or cicatrix. In another, death occurred thirteen days after menstruation. Here, too, the ovaries contained numerous vesicles, one as large as a garden pea, but in neither of them was puncture or cicatrix. In a third, menstruation had occurred a week before death; but there was neither scar nor opening on the surface of either ovary. Again, in another case where death occurred a fortnight after menstruation, neither ovary presented any sign of recent rupture.

Dr. John Williams' has published a series of cases bearing upon the temporal relations of the discharge of ova with the menstrual flow. He believes that the ova are discharged, usually, before the appearance of the catamenial flux, and details observations made by him upon sixteen cases. In several of these, where death occurred during the inter-menstrual period, his conclusions are drawn from the condition of the corpus luteum; but inasmuch as the changes in these bodies do not always take place uniformly, and, as it is always difficult to determine the age of effused blood, the results founded upon these cannot be accepted as certainly accurate. Passing by these, therefore, I wish to invite attention to those of his cases in which death occurred during the menstrual period.

(1.) Was a young woman who died on the fifth day of the flow. "On the surface of the left ovary was a rough, brownish-colored, star-like cicatrix. On section there was seen under the cicatrix a corpus luteum dilated in the middle and narrow at both ends, nearly three-quarters of an inch in length and half an inch in width; its walls were in some parts of a pinkish, and in others of a yellowish color. In the centre was a partially decolorized clot." (2.) Was a patient who died on the ninth day of typhoid fever and the fourth day of menstruation. One ovary contained a corpus luteum, similar to that in case No. 1. In both of these rupture of the follicle had taken place evidently several days before. (3.) Woman had undergone operation for fistula-in-ano, and died five days after the appearance of menstruation; one ovary contained a follicle five-eighths of an inch by one-third of an inch, in which was found a bright-red, fresh, loose clot, and its walls were thin and smooth. *No rupture had taken place.* (4.) Patient with fibroid tumor

[1] Obstet. Jour. Great Britain and Ireland, vol. 3, p. 620.

of the uterus; died on the third or fourth day of menstruation. Left ovary contained a follicle nearly an inch in length, in which was found a soft, dark-colored clot, which appeared to be several days old; *follicle had not ruptured.* (5.) Patient died when the menstrual flow had almost ceased. *There was no rupture in either ovary,* but the right ovary contained a Graafian follicle about the size of a small pea. (6.) Young suicide; died three days after cessation of the flow. *There was no recent rupture in either ovary;* the left contained a follicle similar to the preceding.

Of the foregoing six cases, in only two did a ruptured Graafian vesicle even seem to correspond with a menstrual period; and in two of the cases, the follicles most advanced were so immature that Dr. Williams expresses the opinion that they would probably have ripened by the next return of the flow.

Mr. Paget[1] has reported a case of a woman who was executed for some crime, and the *post-mortem* appearances tell very forcibly against the ovular theory. The woman had begun to menstruate twelve hours before her execution. "The ovaries were of moderate size and presented numerous marks of cicatrices upon their surfaces. In the right ovary, three Graafian follicles projected slightly on the surface and looked healthy, containing clear serous fluid. A fourth was of very large size and prominent. In the left ovary, one Graafian follicle was fully developed and prominent. We looked for ova in the contents of all these, but in vain. The surface of the ovaries was generally rather more than usually vascular, but there was no peculiarly vascular spot, nor any appearance of the recent rupture of a vesicle, or the discharge of an ovum. In the right ovary, near the surface, was a small cyst or cavity, containing what looked like a decolorized clot, and bounded by a thin layer of a bright yellow-ochre substance, an excellent example of a fibro-corpus luteum, of one or more months' date, certainly not more recent."

Dalton, in the essay on the Corpus Luteum, already referred to, reports two cases, in one of which death occurred during the menstrual period and in the other at its termination. In neither

[1] Tilt's Uterine and Ovarian Inflammation, p. 64.

of them had a follicle recently ruptured, although in the second there was one on the point of doing so.

I have had two opportunities of examining the ovaries of women who died at or near the menstrual period. One was the case of a healthy unmarried woman, twenty-eight years of age, who died from an overdose of morphia, taken accidentally. She had menstruated regularly, and a period had ceased four days before death. Both ovaries were normal in structure and size, the right being somewhat larger than the left. It contained several Graafian vesicles scattered throughout the stroma. Two of these were larger than the rest, one being about an eighth of an inch in diameter, and the other as large as a small currant. This latter was near the surface and caused a slight projection. It contained a clear serous fluid. The left ovary contained fewer vesicles, but had the indistinct remains of a corpus luteum not less, certainly, than four or five weeks old. The mucous membrane of the uterine body was pale and covered with a grayish-pink mucus. The other case was that of a young girl, fifteen years old, who died from the effects of a burn. She had commenced menstruating eighteen months before, but the function had been regularly performed only for about ten months. A period had ceased twelve days prior to death. Neither ovary contained corpora lutea, nor bore the marks of recent rupture. The largest vesicle, which was about a quarter of an inch in diameter, was found in the left ovary about a sixteenth of an inch from the surface.

(B) OVULATION MAY OCCUR WITHOUT ACCOMPANYING MENSTRUATION.

I will next proceed to adduce evidence to show that ovulation certainly and frequently takes place without menstruation.

Malpighi and Vallisneri long ago observed that fully-developed Graafian vesicles are occasionally found in the fully grown fœtus. Ritchie,[1] also, has demonstrated by at least ten dissections, that in the ovaries of new-born infants, and children as early as the sixth year, may be found highly vascular Graafian vesicles; and that at the age of fourteen, and prior to menstruation, they are found as large as small raisins, filled with their usual transparent granular fluid; that menstruation is not essen-

[1] Loc. cit., p. 62.

tial, either as cause or effect, of these conditions; that prior to menstruation, the vesicles are found, as at every other period of life, in continual progression towards the circumference of the ovaries, which they penetrate, discharging themselves through the peritoneal coat, thus proving that the catamenial flow is not an indispensable prerequisite to their rupture.

So, likewise, the more recent researches of Grohe, Slavjansky, and Haussmann have shown that the growth of the Graafian vesicle is quite independent of the menstrual period; and the last named authority,[1] whose observations were made upon eighty-four subjects, asserts that such early development of the follicles as was noticed by Ritchie takes place in about ten per cent. of all cases. Dr. Sinety[2] confirms these observations, and maintains that "in the ovaries of the newly-born, Graafian follicles are almost always visible to the naked eye; and they may at this time often be discovered as well developed as in the adult female, and constituting true cystic ovaries, in which are to be seen ovules whose origin is indubitable. In the ovaries of infants, there are often cicatrices and follicles in different stages of atrophy." What, I would ask, causes these cicatrices? Is it aught but the rupture of the Graafian follicles which, as would seem from the foregoing, may take place at any period of infantile and adult life?

Slavjansky,[3] who has devoted a great deal of time to researches on the physiology and pathology of the ovaries, thus summarizes the results obtained by him:

1. The Graafian follicles develop themselves from the primordial follicles, and are growing towards maturity from the first month of birth to the fortieth year. 2. The larger number of follicles do not mature, do not rupture, do not discharge their contents, but pass over into a condition of atrophy which is analogous to the formation of the corpora lutea. 3. The development and ripening of the Graafian follicles do not take place periodically in a regular manner, and there is no connection between ovulation and menstruation. 4. Menstruation is a physiological phenomenon unconnected with the development and ripening of the Graafian follicle. 5. The rupture of the

[1] Centralblatt, No 2.
[2] Le Progrès Médical.
[3] Allg. Med. Centr. Z. 54, 1874.

more or less ripe follicle is associated with congestion of the genital organs, and is, as yet, an unexplained matter.

On the other hand, ovulation may continue after the menopause. Lawson Tait[1] says: "The cessation of the menses at the climacteric, though it diminishes the activity of the cell-growth at once to a marked extent, never extinguishes it; for the development and extrusion of immature Graafian follicles ceases only with life itself. They are to be found of some size even fifteen or twenty years after the cessation of menstruation."

Of course, ovulation is the necessary condition of impregnation, and it is admitted by all writers that conception may occur in the absence of menstruation. Our literature contains many instances of girls who have conceived prior to the first appearance of the flow; of women who have become pregnant subsequent to the menopause, and during lactation before menstruation has reappeared. Dr. James Young,[2] Tanner,[3] Dubois,[4] Tilt,[5] and, indeed, almost every obstetric author, mention cases of this character. Leishman speaks of a woman who married at twenty-seven, and who menstruated the first time two months after her eighth labor. Raciborski states that he has seen on the ovaries one or two cicatrices, although the subjects had never menstruated.

An argument which has been frequently urged in support of the ovular theory, is the fact that conception is more likely to take place shortly after a menstrual period than at any other time.

Dr. W. H. Studley,[6] alluding to this, considers it as admitting of a very different explanation, and not at all as proving the coincidence of ovulation and the menstrual flow. He says: "My opinion in regard to the rationale of the fact is this: impregnation is more likely to be secured at this time because of the recent deluging with menstrual blood, by which the secretions, especially of the cervical canal, have been washed away, which secretions often prevent impregnation either by their

[1] Hastings Prize Essay of 1873, London, p. 4.
[2] Am. Jour. Med. Science, vol. 60, p. 568.
[3] Hand-book of Pract. Obstetrics, p. 24.
[4] Journal de Méd., 1850.
[5] Uterine and Ovarian Inflammation, p. 49.
[6] Amer. Jour. Obstetrics, 1875, p. 487.

chemical incompatibility with the vitalizing fluid, or by the mechanical obstruction in the form of the firm mucous plug so often found in the canal."

If the ovular theory were true, conception could take place only at or near a menstrual period; but there is abundant evidence to show that it may and does frequently occur at times quite remote from it. My own experience has furnished me with a number of instances where married women, anxious to prevent an increase of family, have observed the "physiological rule" of abstinence for a fortnight after a period, and who have found, to their chagrin, after a time, that their precaution had been unsuccessful.

Dr. Oldham observes: "I know of cases which I have carefully inquired into, where impregnation occurred at the respective times of ten, twelve, and twenty-one days after the menstrual period; and while, on the one hand, I am quite ready to admit a *greater* disposition to impregnation shortly after a menstrual period, yet I know of no facts to disprove the opinion that the human female is susceptible of impregnation at any time between her monthly periods." Hirsch,[1] likewise, has seen a case where impregnation took place twenty-two days after a normal menstrual period; and he observes that, "as the Jewish women are obliged to abstain from intercourse five days before and seven days after menstruating, that race could not be so prolific as it is known to be if the ovular theory of menstruation is true." Tilt,[2] also, mentions the case of a lady, aged forty-seven years, in whom menstruation had been irregular for two years, and who after a single coitus, seventeen days subsequent to a period, became pregnant.

An attempt has been made to explain these and similar cases, by supposing that the spermatozoa, on the one hand, and the ovule, on the other, may retain their vitality in the generative passages for a sufficiently long time to permit the occurrence of impregnation under the circumstances named. But the facts bearing upon the subject, so far as known, do not justify such an explanation. The ovule occupies from eight to ten days in its passage from the ovary to the uterus, and it

[1] Schmidt's Jahrbuch, 1853, No. 2.

[2] Change of Life, p. 69.

may be impregnated at any time within that period, provided it meet with fertilizing material. If, as maintained by Williams and others, the ovule is discharged at the commencement of a menstrual period, rather than at or near its termination, we can still understand how a coitus taking place within a few days prior to the flow might be fruitful as well as one had within eight or ten days subsequent to a period. But when a single intercourse takes place from twelve to twenty-two days after a menstrual period, or ten days before the next, and becomes fruitful, we cannot accept the explanation given by the ovulationists without additional and different facts.

To meet the obvious difficulty here presented, it is urged that the spermatozoa may live a long time—indefinitely, indeed—in the generative passages of the woman. While we are not able to say positively that such is not the truth, we do say, that so far as we have actual knowledge on the subject, the tenure of life in the spermatozoa is quite limited. Dr. Sims,[1] who made many examinations of the semen in order to determine how long the spermatozoa may retain their vitality in the matrix, found none alive at a longer period than forty hours, although he admits that they may live longer under favorable circumstances. And he quotes Dr. S. G. Percy as reporting a case in which he found "living spermatozoa, and many dead ones" issuing from the os uteri eight and a half days after the last sexual connection. If we admit the correctness of all these statements we have no right to assume the persistence of vitality in the human spermatozoon for a longer period than that given. Granting this term of vitality—which I feel assured must be quite exceptional—let us see whether it is sufficient to meet the requirements of some of these cases of impregnation following a single coitus. For example, Montgomery[2] reports a case in which the last menstruation occurred on the 8th of October. Insemination took place on the 10th of November; pregnancy resulted. Now, if the ovule impregnated were shed at the last menstrual period, twenty-three days must have elapsed between that time and insemination. We cannot suppose the ovule to have retained its vitality and capability of impregnation during this long period, for such a supposition is

[1] Uterine Surgery, p. 374.

[2] Signs, etc., of Pregnancy, p. 258.

quite at variance with all observed facts both as regards it [1] and the history of the decidua (Aveling, Williams, Engelmann). On the other hand, if we suppose that the semen remained in the generative tract until an ovule belonging to the next period was extruded, we must suppose the spermatozoa to resist the mechanical washing away by means of the menstrual flow—a highly improbable notion, and one not made more reasonable by the fanciful idea that the uterus, by a sort of instinct anticipates what is going to take place and governs itself accordingly.[2] Likewise, it implies the vitality of the spermatozoa for a period of eight days, *plus* the time necessary to meet the descending ovule—probably four or five days more.

It is well known that many women continue to menstruate, with entire regularity, for a considerable time prior to the final cessation without conceiving; and I believe that this fact is explainable by the gradual failure of the ovaries to furnish perfectly developed ovules. Indeed, it is quite probable that all ova which are thrown off are not capable of impregnation at any period of life; for, where other conditions are apparently equal, some females are impregnated every twelve or thirteen months, others every eighteen months or two years, while others have still longer intervals of rest. Dewees mentions an instance of a lady who conceived every seven years, and who bore four children at that interval; and I knew one who had a lapse of three years between each of six successive pregnancies. It would seem, therefore, that it requires a certain period to perfect an ovule, and that the time required is much greater in some instances than in others. And, if menstruation is produced by ovulation, it appears scarcely probable that a succession of imperfectly developed ovules—so imperfect, indeed, as not to be susceptible of impregnation, or even of extrusion, as we have seen is frequently the fact—should yet be sufficient to maintain a completely normal monthly flow.

Finally, it is not at all uncommon to find the menses suppressed

[1] "How long after its maturation the ovum can retain its vitality and susceptibility to the seminal influence is not known, but probably the time is short."—DUNCAN, *Fecundity, Fertility, and Sterility*, p. 428.

[2] "Under such circumstances, menstruation often does not take place at all, or only very scantily; the uterine system, as it were, anticipating the conception and preventing the failure which might result from a free discharge of blood."—DUNCAN, *Fecundity, etc.*, p. 431.

for some months immediately after marriage, without the occurrence of pregnancy. Are these cases to be explained by supposing that marriage suppresses or retards the development of Graafian follicles?

From all the foregoing considerations, it seems to me conclusive that ovulation and menstruation may, and frequently do, occur independently of each other; that while they may be coincident, there certainly is no such constant connection between the two as to warrant the assertion that "at every menstrual period a matured ovule escapes from the ovary"—an assertion which embodies the very essence of the ovular theory.

2. *Physiologically, the period of the menstruation in woman corresponds with the œstrus or rut of other mammalia.*

It is well known that during certain periods, the intervals between which vary in different species of mammalia below man, ova are matured and extruded from the ovary, and that this process is attended by great excitement of the entire generative apparatus. Upon the supposed similarity of this function—termed rut, œstrus, or œstruation—to menstruation in the human female is based one of the strongest arguments in favor of the ovular theory. Indeed, Cazeaux[1] and Pouchet[2] lay especial stress upon it.

Down to the time of Martin Barry it was believed that sexual congress was the essential determining cause of the rupture of the Graafian follicle, but the experiments of Bischoff, Coste, Pouchet, and others proved that such rupture was spontaneous and entirely independent of male influence of any kind, both in man and the lower animals, although it was hastened in some instances by coitus. Reasoning, then, from the known analogy existing between this and many other of the vital processes in the lower mammalia and the corresponding ones in man, it was assumed that the conditions of rut and menstruation were analogous, and had the same significance.

While it is true that many physiological conditions in man and the other animals of the order to which he belongs are

[1] Second Amer. ed., p. 9.

[2] Théorie Positive de l'Ovulation Spontanée, p. 227.

subject to the same general laws, these conditions differ in specific points just as much as do the different genera and species of that order in their anatomical features.

It may be well in this connection, and before enumerating the important points in which œstruation and menstruation differ, to call attention to the fact, that even in those cases in which the œstrus and ovulation are synchronous, it has never been proven that the former is caused by the latter. Indeed, it is far more probable that they are both the result of a common cause—some erethism of the system resulting in congestion and excitement of the entire sexual apparatus.

The appeal to comparative physiology by the ovulationists has always seemed to me an unfortunate one, for the noteworthy differences between œstruation and menstruation are quite sufficient, I think, to stamp the two processes as wholly dissimilar. These points of difference are as follows:

1. When, during the œstrus, there is a discharge from the genitals (which is not always the case), it is mucous in character, and its source is chiefly the glands of the external organs; its object is to lubricate the parts, and, in some instances, by its odor to attract the male. In woman the discharge is blood, from vascular rupture; its seat, the mucous lining of the body of the uterus, and its presence an indication of the disintegration of that structure.

2. The excitement characterizing the œstrus is the only period during which the male is received, and the only time when impregnation is possible. In woman, while pregnancy is possible at any time, it usually occurs during the period of rest, that is, in the intermenstrual period.

3. On the subsidence of the œstrus, there is a period of inappetence, during which the female not only no longer invites, but successfully resists the male approach. At the corresponding time in woman, sexual desire is commonly increased, and in some, present at no other time.

4. The œstrus, or period of sexual desire, is necessary in the lower mammalia, for the reproduction of the species. In woman, desire is not essential either for intercourse or impregnation.

5. Œstruation and ovulation in many animals are determined by changes in the seasons and other surrounding circum-

stances,[1] and in some animals (deer) the semen is only elaborated at such times. In man, changes of season, etc., produce no such effect, and semen is secreted constantly.

6. The œstrus may be excited in some animals (the mare) by the importunities or teasing of the male. Menstruation is neither excited nor hastened by the presence of the male; on the contrary, undue excitement of the generative organs, or of the sexual passion, seems frequently to have a tendency to arrest it, as witnessed in newly-married women.

7. During the œstrus, both the male and female evince a desire for copulation. During menstruation, the female has a delicate shrinking from the act, and the male likewise feels more indifference than at any other time, amounting in many cases to positive repugnance.

8. The ovaries in the lower animals contain ripe ova *only* at the period of heat (Bischoff). In the human female, ripe ova are found at all times without reference to the period of menstruation.

The foregoing points of disimilarity are so distinctive, and refer to such important features, that I feel warranted in denying that œstruation and menstruation are corresponding processes.

3. *The removal of the ovaries is at once followed by cessation of menstruation.*

Percival Pott, Cazeaux, Wells, Battey, and others, have reported cases in which the artificial removal of the ovaries was followed by the immediate and permanent cessation of the menstrual function; and these facts have been cited to prove the necessity of these organs for the maintenance of the periodical flow.

It must be admitted that, if such an effect were the constant and certain result of double ovariotomy, it would go far towards showing the necessity for ovarian influence. But such result is not constant; indeed, the instances in which both ovaries have

[1] Barnes, *Diseases of Women*, p. 148, states that in the wild state the rabbit has only one or two litters a year, but when its young are taken away at a suitable time, it has perhaps seven. So likewise the period of ovular maturation is changed in the case of the pigeon, domestic hen, etc.

been removed without interruption or discontinuance of the menstrual flow are so numerous and authentic, that recent writers, who, like Leishman, affirm as an admitted fact, "the invariable and immediate cessation of menstruation when the ovaries have been removed," subject themselves fairly to charges either of ignorance or want of candor.

Dr. John Goodman[1] has compiled the following table showing the effect of double ovariotomy upon the menstrual function in all the cases of which he could obtain information down to the year 1872:

Table of Cases in which both Ovaries have been successfully Removed from Women under Forty-five years of Age.

No.	Operator.	Quoted from.	D'te	Age	
1	Pott.....	.....	178-	23	
2	J. L. Atlee....	A. J. Med. Sci., 1844	1843	29	
3	Bird.....	Lancet, 1848.....	1847	32	Menstruation uninterrupted; tendency to menorrhagia.
4	Peaslee.....	Lyman's Table.....	1850	24	
5	Burnham.....	Lyman's Table	1853	42	
6	W. L. Atlee,...	Atlee on Ov. Tumors..	1854	35	Menstruation regular. Ceased in 1864, forty-fifth year.
7	W. L. Atlee....	Atlee on Ov. Tumors....	1855	19	Regular molimen with white discharge.
8	W. L. Atlee....	Atlee on Ov. Tumors....	1861	40	Menstruation regular to 1863, when last reported.
9	Peaslee.....	A. J. Med. Sci., 1863....	1862	35	
10	Peaslee.....	A. J. Med. Sci., 1864....	1863	39	
11	W. L. Atlee....	Atlee on Ov. Tumors...	1864	34	Last report 1870. Menstruation regular to that time.
12	Beattey.....	Wells, Dis. of Ovaries....	1865	37	
13	Storer.....	A. J. Med. Sci., 1868 ...	1866	..	Menstruating regularly a year after operation.
14	Storer.....	Peaslee on Ov. Tumors..	1867	43	
15	Wells.....	Wells, Dis. of Ovaries...	1868	39	
16	Wells..... ...	Wells, Dis. of Ovaries...	1869	22	
17	Hicks.....	Wells, Dis. of Ovaries...	1869	39	
18	Monro.....	Wells, Dis. of Ovaries...	1870	34	
19	Mayer	Wells, Dis. of Ovaries...	1871	29	Last report one year after operation. Menstruation regular.
20	Meadows.....	Lancet, 1872.....	1871	..	Last report six months after operation. Menstruation regular.
21	Priestly.....	Wells, Dis. of Ovaries..	1872	22	
22	A. R. Jackson.	Peaslee, Ov. Tumors.....	1865	44	Continued to menstruate to the forty-seventh year of her age.
23	Le Fort.....	Peaslee, Ov. Tumors.....	....	..	Menstruation regular.
24	Baker Brown..	Peaslee, Ov. Tumors.....	....	..	Menstruates, but not regularly.
25	Baker Brown..	Peaslee, Ov. Tumors.....	....	..	* Menstruates regularly from cicatrix and vagina.
26	Koeberle.	Peaslee, Ov. Tumors.....	....	..	Menstruation regular.
27	Battey	Personal information....	1872	23	Irregular sanguineous discharges; sometimes profuse.

Clay, of Manchester, had four cases in which there was subsequent sanguineous discharge.—(Peaslee.)

* The whole uterus, except cervix, removed with ovaries.

Dr. Goodman says: "In order to determine as accurately as

[1] Richmond and Louisville Med. Jour., Dec., 1875.

possible the effects of the removal of both ovaries upon the menstrual function, I have carefully examined and arranged all the cases of which I could obtain reports; . . . . . irregular sanguineous discharges, I have, of course, not counted as menstrual.

"Of the twenty-seven cases here recorded, it will be observed that in nearly one-half menstruation was not affected by the removal of the ovaries; in one, the hemorrhagic discharge was increased; in one, it was diminished; and, in several, sanguineous flows occured at irregular intervals."

Dr. Ely McClellan, of Louisville, Ky., in a private letter, dated March 18, 1876, gives the following facts bearing upon this point, and kindly places them at my disposal. The cases referred to were operated upon for pernicious ovulation, by "Battey's Operation," or that known as "Normal Ovariotomy."

"Case I.—But one ovary was removed.

"Case II.—Both ovaries were removed, one in May, 1875, and the other in September, 1875. This lady has regularly and persistently menstruated since the operation.

"Case III.—Both ovaries removed in August, 1875. This case had menstruated vicariously prior to the operation, and is still the subject of such disorder.

"Case IV.—The ovaries of this lady were removed in September, 1875. She menstruates regularly.

"So far as these Louisville cases go, the removal of both ovaries, after the menstrual function has been established, produces no influence upon the regularity of its occurrence. What may result after the lapse of a few more months, it is of course impossible to determine."

Indeed, it is so well known that the removal of the ovaries does not necessarily induce the menopause, that many of those who formerly denied the fact now admit it; but they endeavor to explain the circumstance consistently with the ovular theory. Some of these allege that the ovaries are not the only source of Graafian vesicles. Spencer Wells, for example, states,[1] that, occasionally, the essential elements of the ovaries are sometimes scattered between the layers of the peritoneum, as in the lower animals; and that in some cases "Graafian follicles have been

[1] Diseases of the Ovaries, p. 11.

seen developing in some of the mammalia at a distance from the entire ovary, and that such vesicles have developed into unilocular tumors." Sappey,[1] likewise, states that it is not rare to find a score or more cystic ovules, some of them the size of a pea, on the alar mesentery, in the neighborhood of the ovary, and he accounts for their presence in this unnatural situation by supposing that they "failed to reach their destination owing to some abnormal relations on the part of the Fallopian tube."

Now, while it would be presumptuous to deny that such a condition of things as that mentioned by the last named author is possible, surely it must be exceedingly rare; and, so far as I am aware, there is no instance in which such an anomaly has been found in the human female. I apprehend, therefore, that not the most ardent advocate of the ovular theory would be willing to advance such a hypothetical circumstance to account for the appearance of a periodic monthly hemorrhage in thirteen of twenty-seven cases of removal of the ovaries. For, such an argument would involve the absurd assumption that an ovum which had failed to reach the uterus, after maturation and extrusion, could return to the immature condition and ripen over again, and that, too, without its enveloping fluid and capsule!

The condition mentioned by Mr. Wells must be equally rare, and seems equally weak as a foundation for an argument. In regard to both of these conditions, Dr. Goodman, in the paper already referred to, says: "I think it a very fair conclusion that if such vesicles really existed, they were totally extirpated in some, if not the greater part of the thirteen cases, in which menstruation continued after the removal of both ovaries. Even if some of them remained, it is clearly impossible that they could have been sufficiently numerous to have afforded a ripened vesicle every month for ten or more years. Their only effect would have been to stimulate the nervous system, and maintain in a more perfect degree the ovarian development."

Others, again, have explained the persistence of menstruation after extirpation of the ovaries by force of habit. Schroeder[2] expresses the argument thus: "We prefer in such exceptional cases, instead of drawing the conclusion which is directly

[1] Quoted by Savage, on the "Female Pelvic Organs."
[2] Diseases of the Female Sexual Organs, p. 318.

opposed to all our views, viz., that menstruation has absolutely nothing to do with the presence of ovaries, to assume that in these women, too, menstruation was caused by the growth of Graafian follicles in their ovaries, but that the organism had, in the course of years, become so accustomed to the regular discharge of blood that this still continued, although the ovaries were removed."

But, surely, this is no explanation; it is nothing more than a reiteration of the fact in other terms. The "habits" of our bodies are not causeless; they are all explainable on a rational basis. No act is performed in the animal economy without some antecedent cause, and the same may be said of every recurrence of such act. In the case of the menstrual flow, if its periodicity were maintained in the past by the successive evolution of ovules, such ovular action would be necessary still; and if the cause ceased at any time to act, so likewise would the effect cease. But even this alleged force of habit fails to meet the facts in a case reported by the writer in the *Chicago Medical Journal* for October, 1870, and which appears in Dr. Goodman's table as No. 22. In this case, the patient, forty-four years of age, had both ovaries, together with a portion of the Fallopian tubes, removed. A menstrual period had ceased on the 30th August, 1865; the operation was performed the following day. On October 1st, thirty-one days afterwards, a sanguineous discharge appeared and lasted four days, attended by the usual symptoms of menstruation—lassitude, nervousness, backache, etc. There now occurred an interval of eighty-three days, the discharge reappearing December 22d. Its next appearance was on January 20, 1866—four weeks after—and from this last date it continued to return with entire regularity every twenty-eight or twenty-nine days, attended by all the ordinary menstrual accompaniments, and lasting each time from three to five days, down to October, 1867—a period of twenty-two months. It then ceased until February, 1867, when it appeared for the last time, the lady being then forty-seven years of age.

In this instance, the interval of nearly three months, during which the discharge was absent, was certainly sufficiently long to break up any mere habit, and shows that we must look to some other impelling force in order to account for the subse-

quent return to regularity. Here were no ovaries, no monthly-developing ovules, an interruption for nearly three periods of the menstrual "habit," and yet menstruation returned and continued regularly to reappear down to the normal time of final cessation.

The facts of periodicity in the human body are more numerous than generally supposed, and most interesting in their character. Without any intention of amplifying upon the subject, I will merely remark that it is now universally admitted that all the forms of periodicity, whether of a physiological or pathological character, depend upon the nervous system; and there are numerous facts which warrant us in narrowing this dependence still farther, and limiting it to a particular division of the nervous system—the sympathetic. It is well known that a frog's heart will continue its regular systole and diastole a considerable time after its removal from the thorax. The only motive agency left to it then, so far as we know, is that furnished by the sympathetic ganglia which are embedded in its substance. The influence of these centres of nervous action is neither continuous nor occasional, but rhythmical—that is, periodic. The uterus resembles the heart in also possessing numerous sympathetic ganglia embedded in its walls, and in being wholly independent of the cerebro-spinal system in its movements. Furthermore, the recent researches of Goltz and Freusberg[1] seem to show that there exists in the lumbar portion of the spine a nervous centre for the sexual functions. These facts and investigations may afford a clue to the explanation of the persistence of sexual appetite and functional activity of the generative organs after the destruction by disease, or removal of the ovaries—although in these organs undoubtedly originates the primary impelling force which sets this complex sexual machinery in motion. But whatever may be the nature or exact seat of this force, I believe that its action must be persistent and, in a sense, continuous, although some of its results be rhythmical. A pendulum may be set in motion by a single forcible impulse, and for a time it will continue to swing; but unless the application of the force be continuous or repeated, the arc described by the moving

[1] See Dr. Duncan's Address, *Obstet. Jour.*, Great Brit. and Ireland, 1875, p. 361.

body will become shorter and shorter, until finally the motion will cease wholly.

According to the light thrown upon the subject of menstruation by the latest researches, we are perhaps justified in propounding the following as embodying the main facts:

The reproductive organs of the female, including the ovaries, Fallopian tubes, uterus, and vagina, receive their vascular and nervous supplies from the same sources. Prior to the age of puberty, all these organs are in a state of comparative quiescence, and the uterus of a girl of eleven or twelve years is scarcely larger than the organ in infancy. Notwithstanding the fact that ova undergo some degree of development and are discharged from the ovaries from early childhood onward, their growth proceeds slowly, and, so to speak, unperceived by the nervous system. At or about the fifteenth year, the uterine mucous membrane attains a high degree of development, and, at the same time, the erectile tissues of the other genital organs, external and internal, arrive at their structural completion. Like a wound-up clock, with its needed touch to the pendulum, these organs now only wait for some sufficient impulse to arouse them to functional activity. This is afforded by the next recurring period of ovulation. By the advancing growth of one or more vesicles, an irritation of the ovarian nerves is produced; the effect of this upon the sympathetic, and, by reflex action, upon the vaso-motor nerves, is an increased hyperæmia in the uterus and other genital organs. The uterine congestion thus produced especially affects the lining membrane of the organ, for the reason that, structurally, it is more liable to vascular turgescence than the parenchyma. This vascular activity is followed by a corresponding increase of nutrition and hyper-growth—this latter consisting both in multiplication of the cellular elements of the part and development of those already existing. The superficial vessels of the membrane are greatly enlarged around the glandular orifices, as are also the glands themselves. The entire membrane is so thickened and convoluted that the uterine cavity seems scarcely large enough to contain it. This process—called "nidation" by Aveling—takes place in order to supply the possible needs of an impregnated ovum, and should such a one reach the uterine cavity the developed membrane becomes its future nidus.

But if not, a retrograde metamorphosis now takes place. The super-grown parts of the uterus, consisting, as already stated, chiefly of the mucous membrane, lose their excess of blood supply and die of starvation. The first elements which suffer death are the epithelial cells which line the mucous membrane; next, the new cells of the connective-tissue stratum below; and, finally, the vessels which are developing, or may have developed from this surface. All these parts become infiltrated with fat, the new formations are carried off, the vessels open, and there results the active hemorrhage which constitutes the menstrual flow. This process is repeated at regular intervals corresponding to the periodic life of the individual, and varying somewhat in different cases.

In the sense and to the extent just indicated, I regard ovulation as necessary to menstruation; it furnishes to the structurally-completed uterus, through the medium of the ganglionic nervous system, a needed hyperæmia to *originate* the menstrual discharge. In order to do this, it is not necessary that a follicle should burst (Ritchie), although it may do so. Indeed, I have no doubt that a follicle may pass through several periods without discharging its contained ovule. Doubtless, the pelvic congestion of the menstrual period greatly stimulates the maturation of the follicle, just as does the excitement of sexual intercourse, and to a much greater extent, probably, because of its longer continuance; and a follicle which has been subject to these successive periods of excitement eventually matures and bursts, with, perhaps, an occasional exception. The increase in its fluid contents, the thinning of its walls, and its near approach to the surface of the ovary, all conduce to its easy rupture; and such rupture may occur at any time, although it is clearly more likely to do so during the menstrual congestion, the excitement of intercourse, or, when on the point of bursting, from a blow on the abdomen (Schroeder). Such is probably the usual course, although, as already intimated, not an invariable one; for all authorities admit that some follicles never attain full development, but after arriving at a certain stage of growth, cease to enlarge and finally shrink and disappear.

Menstruation, with its phenomena of regularly recurring development and disintegration of the uterine mucous mem-

brane, once established, proceeds side by side with the process of ovulation. The two, while accompanying and aiding each the other, are yet mutually independent; and menstruation, instead of being an effect of ovular maturation and dehiscence, is rather, in a certain sense, their cause. In menstruation, the organ chiefly, and the only one essentially employed, is the mucous membrane of the body of the uterus; the other pelvic organs, that is to say, the uterus proper, the ovaries, Fallopian tubes and vagina, have no part in the process beyond their share in the attendant general pelvic congestion (Beigel).

There are many facts connected with menstruation which are not satisfactorily accounted for by the ovular theory, and I desire, in conclusion, to call attention briefly to a few of them.

(a) The first is that variety of the function known as *remittent*, where the habitual type is changed to another in which the flow occurs usually at shorter intervals—every fortnight, for example. These cases are strongly antagonistic to the received theory. Tilt[1] considers them as dependent "upon some perversion of the nervous force presiding over the generative function, because those in whom the anomaly is observed are generally of a delicate and nervous temperament," and also because he has always succeeded in restoring menstruation to the monthly type by the exhibition of quinine, a remedy whose efficacy in controlling nervous derangement of a periodical character is well known. Negrier,[2] quoted by Tilt, after observing that several patients did not suffer from fortnightly menstruation, says: "I do not believe that the ripening of the ovarian vesicles can take place in less than a month; so, in these cases, I think it more natural to suppose that the two ovaries might so progress monthly that, for instance, the right would contain a ripe vesicle on the first of the month, while in the left ovary a vesicle would ripen on the fifteenth." Does any one regard ovulation as a process whose type of periodicity would be changed by the administration of quinine?

(b) Again, the ovular theory does not account for the regular recurrence of menstruation after the removal of one ovary.

[1] Uterine and Ovarian Inflammation, third Lond. ed., p. 205.

[2] This author believed that the ovaries alternated their action, one furnishing an ovule one month, and the other the next. This is likewise the opinion of Girdwood.

Ovariotomists are unanimous in the statement that in cases where a single ovary is removed, a healthy one being left, menstruation is not interrupted, or, at least, the function is no more deranged than it would be by any other equally severe surgical operation.

It is not known how the work of maturing ovules is divided between the two ovaries. Mr. Girdwood, from observations made in several cases, states that the number of cicatrices found in the ovaries corresponded with the known number of menstrual periods, and that they were equally distributed between the two organs. Others think that for many months in succession one ovary may furnish all the ovules, and then remaining quiescent, that the other assumes the work for an equal, or possibly an unequal length of time. But it is plain that if either of these hypotheses be accepted—if ovulation be regular in any manner, and its periodicity depend upon the presence of both ovaries, it would be interrupted necessarily by the removal of either of these organs. In the first case it would occur only at intervals of two months; and, in the second, according as the active or quiescent organ, for the time being, were removed, we should have an entire temporary cessation at once, or at the end of its term of activity; and if menstruation were dependent upon ovulation, a corresponding aberration of regularity would be observed in it also. But this never takes place, for, as already stated, single ovariotomy is, as a rule, followed by no change whatever in the menstrual periodicity.

It cannot be said, in answer to this, that, as in the case of the kidneys or testicles, the removal of one gland is followed by increased and compensating work by its fellow. The ovary is not a gland, and the Graafian vesicle is not a secretion. The office of the ovary is simply and only to furnish a suitable place for the development of the primordial follicles existent in its stroma from the beginning.

(c) The remarkable regularity in the ripening and discharge of ovules, one after another, month after month, which is assumed by the ovular theory, is combatted also by the frequent occurrence of a simultaneous discharge of two or more ova.[1] Multiparous pregnancies can, I think, only be rationally

[1] Ritchie, in a case reported by Cazeaux, found six ova in the uterus at one time.

accounted for by the fact that the shedding of ovules is an irregular function, proceeding in both ovaries simultaneously and independently.

(d) The ovular theory wholly fails, too, to account for the menstrual irregularities caused by mental influence. Tilt[2] says: "I have patients in whom any unusual nervous emotion or over-exertion will bring on the menstrual flow, with the usual menstrual symptoms, although they may have only just recovered from this discharge. How can it be supposed that an ovule can be ripened, and the dense ovarian envelope suddenly perforated, by the fatigue of a dinner party, by hearing disagreeable news, or by an altercation with a servant?" It is well known that influences such as those just mentioned may cause the discharge to appear, and may equally check it when present; and it is likewise known that these, or other similar disturbing causes, may at once change the menstrual regularity; the flow appearing after the usual interval, whether the last one occurred at the right or wrong time. "This sudden shifting of periodic action is the special attribute of the nervous system; it shows the menstrual flow to be impelled by nervous influence, and explains how a strong emotion may repel it or alter the time of its appearance" (Tilt).

The argument which I have endeavored to make may be thus summarized:

1. Ovulation and menstruation may each occur independently of the other.

2. Ovulation is the irregular but constant function of the ovaries, while menstruation is the regular rhythmical function of the uterus (Kesteven).

3. Ova are matured and discharged from the ovaries at all periods of female life, from early childhood to old age, both before puberty and after the menopause; hence, the one cannot be the sign of the other.

4. Menstruation is the consequence of conditions established by the structurally-completed uterus, and depends upon ovulation *only* for its origination.

5. The mucous membrane of the uterine body is the only organ essentially concerned in the menstrual act; the uterus

[2] Change of Life, p. 72.

proper, the ovaries, Fallopian tubes and vagina have their functional activity increased, however, by receiving a share of the general pelvic congestion which accompanies the process.

6. The menstrual congestion of the pelvic organs—of the ovaries in particular—is, of all causes, the one most likely to determine the ovipont when a Graafian vesicle is sufficiently mature, and hence ovulation and menstruation are frequently concurrent.

7. The theory that would make menstruation dependent upon ovulation fails to account for the possible occurrence of pregnancy at any and all times between the menstrual periods; for multiparous conceptions; for the frequent persistence of menstruation after the removal of *both* ovaries; for the non-interference with menstrual regularity by removal of *one* ovary, and for the menstrual derangements and the shifting of menstrual periodicity from mental emotion.

8. All the known facts in regard to both ovulation and menstruation are consistent with the theory that, after the latter is once established, the two functions proceed side by side, but independently of each other, the former occurring at irregular and the latter at regular intervals; while, on the contrary, many of these facts are wholly inconsistent with the theory, that assumes a necessary ovular maturity and rupture at each menstrual period.