BOYLSTON MEDICAL PRIZE QUESTIONS.—The Boylston Medical Committee, appointed by the President and Fellows of Harvard University, consists of the following Physicians:

J. B. S. Jackson, M. D. — Henry J. Bigelow, M. D.
D. H. Storer, M. D. — Richard M. Hodges, M. D.
Chas. G. Putnam, M. D. — Calvin Ellis, M. D.
Morrill Wyman, M. D. — Samuel Cabot, M. D.

At the annual meeting, held June 1, 1874, it was voted that no dissertation, worthy of a prize, had been offered on either of the subjects proposed for 1874.

The following are the subjects proposed for 1875:

1. Original Researches in Medical Science.

2. So-called "Concussion of the Spine."

The author of a dissertation, considered worthy of a prize, on either of the subjects proposed for 1875, will be entitled to a premium of One Hundred and Fifty Dollars.

Dissertations on the above subjects must be transmitted, post-paid, to J. B. S. Jackson, M. D., Boston, *on, or before, the first Wednesday in April*, 1875.

The following are the questions proposed for 1876:

1. Civil Hospital-Construction (not of Lunatic Asylums); Location, Materials, Arrangement, Warming, Ventilation, Drainage, Lighting; with Designs.

The author of a dissertation on this subject, considered worthy of a prize, will be entitled to a premium of Three Hundred Dollars.

2. Do women require mental and bodily rest during Menstruation: and to what extent?

The author of a dissertation on this subject, considered worthy of a prize, will be entitled to a premium of Two Hundred Dollars.

Dissertations on these subjects must be transmitted as above, on or before, the first Wednesday in April, 1876.

Each dissertation must be accompanied by a sealed packet, on which shall be written some device or sentence, and within which shall be enclosed the author's name and residence. The same device or sentence is to be written on the dissertation to which the packet is attached.

The writer of each dissertation is expected to transmit his communication to the President of the Committee, J. B. S. Jackson, M. D., in a distinct and plain handwriting, and with the pages bound in book form, within the time specified.

Any clue by which the authorship of a dissertation is made known to the Committee, will debar such dissertation from competition.

Preference will be given to dissertations which exhibit original work.

All unsuccessful dissertations are deposited with the Secretary, from whom they may be obtained, with the sealed packet unopened, if called for within one year after they have been received.

By an order adopted in 1826, the Secretary was directed to publish annually the following votes:

1st. That the Board do not consider themselves as approving the doctrines contained in any of the dissertations to which premiums may be adjudged.

2d. That in case of publication of a successful dissertation, the author be considered as bound to print the above vote in connection therewith.

RICHARD M. HODGES, M.D., Sec.,
BOSTON, MASS.

THE QUESTION OF REST FOR WOMEN DURING MENSTRUATION

BY

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THE BOYLSTON PRIZE ESSAY OF HARVARD UNIVERSITY FOR 1876.

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INTRODUCTORY NOTE.

THE writer of the present essay feels the necessity of craving indulgence for many imperfections, due, in part at least, to the necessity of completing it within a given time, whether or no the necessary material had been accumulated. This difficulty is inherent in all competitions for prizes, awarded at a fixed date. It was somewhat increased in the present case, from the fact that the work was only begun one year before the date for conferring the prize, instead of two years, as intended by the committee.

The author desires to express her great obligations to Dr. Victoria White, and Dr. Mary Baldwin, and other ladies connected with the N. Y. Infirmary, for their great assistance in preparing the tables of urea analyses. A large number of these analyses were made entirely by Dr. White.

The writer also seizes this opportunity to thank very warmly the ladies, many of them perfect strangers to her, who have exerted themselves in procuring the statistics upon which the first part of this essay is based.

110 *West Thirty-Fourth Street*, NEW YORK, *April*, 1877.

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DO WOMEN REQUIRE MENTAL AND BODILY REST DURING MENSTRUATION?

(BOYLSTON PRIZE ESSAY, 1876.)

SECTION I.

INTRODUCTORY.—HISTORICAL.—GENERAL CONSIDERATIONS IN REGARD TO LABOR.

AN inquiry into the limits of human nature is always legitimate, and often exceedingly useful. When honestly made, it tends to increase real force while dissipating illusions concerning imaginary powers. Thus knowledge of the limits of muscular strength stimulates the invention of machines many times man power. Compressed by the admitted limits of religious thought[1] religious speculation is forced into more definite channels, and assumes tasks at once more robust and more profitable than those, only apparently more splendid, which had hitherto absorbed its energies. When arbitrary attempts to modify the social organism are rebutted by the unsuspected limits imposed by its laws, resources as unsuspected are revealed to those who choose to look for them. Such indeed is the audacity of the human intellect, that the discovery of limits usually proves hopeless in only one case, namely, when they are perceived to apply to a different race, class, or sex, from that to which the investigator himself belongs. An inquiry into the limits to activity and attainments that may be imposed by sex, is very frequently carried on in the same spirit

[1] See Mansel. Limits of Religious Thought.

as that which hastens to ascribe to permanent differences in race all the peculiarities of a class, and this because the sex that is supposed to be limiting in its nature, is nearly always different from that of the person conducting the inquiry. It is true that men have inquired with great research into the influence exerted upon the general organization of man by the special character and working of his sexual organization, but it is rare that this influence has been regarded as "limiting" in its nature. Moralists and theologians have pointed out the narrow limits into which its undue ascendancy might reduce the rest of the physical and mental life, but their exhortations have always assumed that such undue ascendancy would never be attained except by wilful negligence or moral sin. Physiologists and physicians again, while demonstrating the slavery that results from abuse of the sexual functions, have hinted of no danger consequent upon their normal exercise. On the contrary their stimulating effects upon the rest of the economy have been portrayed in brilliant colors by even sober pens. To the reproductive apparatus is generally ascribed a permanent influence upon the organism of whose maximum development it constitutes the most elaborate expression. The development and activity of this apparatus, by means of which the life of the individual is linked to that of the race, are said to be correlative with the development and activity of the organs of individual life, and not in inverse proportion to them. It may indeed be considered as quite a modern eccentricity to claim as an element of superiority in man, that, in the intervals of the voluntary exercise of sexual functions, "he is practically unsexed."[1] Were the assertion true, which it is far from being, it would prove a marked inferiority on his part to organisms whose sexual characters are permanent, since both in plants and animals, sexual organisms rank higher than asexual; the development of sex marks a progress from the primitively neutral condition of

[1] Ely Vande Walker, Popular Science Monthly, July, 1875.

young animals, and privation of the organs of sex is liable to seriously deteriorate some of the robust organs of individual life. All this is generally recognized in regard to the masculine sex. But as soon as there is question of the other, the fundamental conception of the subject seems to be changed. Not alone the accidents of sex or the abnormal exercise of its functions, but the sex itself seems to be regarded as a pathological fact, constantly detracting from the sum total of health, and of healthful activities. "Woman, in the interest of the race has been endowed with a set of organs peculiar to herself, whose complexity, delicacy, sympathies and force, are among the marvels of creation,[1] (Sex in Education, p. 83). Comty, (Traité des maladies des femmes, p. 274), enumerates the natural phenomena of menstruation, copulation, gestation, parturition, among the causes of the frequency of uterine disease.[2] Dr. Guerin (Movement medical quoted by Mundé Journal Obstetrics, Aug., 1875), says, "There is no physiological condition so nearly resembling disease as that which produces every month in an adult woman a change so profound that it has been looked upon as the expression of a morbid condition." Tilt, who declares that diseases of menstruation have been the engrossing study of his life, defines this process to be a "sero sanguinolent secretion" propelled by an ovarian influence from all or different parts of the generative intestine, and principally from the womb. It is a natural function peculiar to women. . . . who are subject to this *natural infirmity* for about seven out of the thirty years of reproductive life.[3] Hutchins, in a prize essay ac-

[1] It is true the author adds, "If properly nurtured and cared for, they, (these organs) are a source of strength and power to her," and disclaims that any organ or function in plant, animal, or human kind can properly be regarded as a disability or source of weakness.

[2] It is menstruation that is generally considered the peculiarity of the sex, which most seriously cripples the individual energies of woman, since it alone exerts its influence upon all, and at all times during adult life.

[3] On Diseases of Menstruation, 1851, p. 23.

cepted by a State Medical Association, says, [1] "Woman has a sum total of nervous force equivalent to a man's, but this is distributed over a greater multiplicity of organs and directed to the development and support of special reproductive energies in addition to those of individual nutrition. The nervous force is therefore weakened in each organ,—and the period of resistance of each organ is weakened,—it is more sensitive, more liable to derangement.[2] In another place the author quotes an experiment of Rabuteau, as a proof that during menstruation the general nutrition of the body is diminished.[3] Hirt calls menstruation a condition which, if not precisely morbid, is still often upon the limits of pathology, and under all circumstances determines a greater predisposition to different diseases."[4] The author calculated that "every four weeks the uterus becomes hyperæmiated in such manner that almost the entire organism is involved in sympathetic suffering; and this during three to five days every month, or one to two months out of every year." Thus even for the non-pregnant woman, "a great portion of the time during the period of maturity is passed under the influence of the genital sphere."[5] Storer, in his essay on criminal abortion, appends a note to the paragraph devoted to female physicians, considered as a special class of accomplices to this crime (p. 98), in which he remarks that, "granting that women in exceptional cases may have all the courage, tact, ability, pecuniary means, education, and

[1] Transactions New York State Medical Association, 1875.

[2] The inference that women are more liable to contract diseases at the menstrual period bears so directly upon the subject of this essay that it will be discussed in full further on. It is vigorously contradicted by Herard.

[3] We shall have occasion to refer again to this experiment, and to discuss it in view of others made to control it.

[4] Die Gewerbeliche Thatigkeit der Frauen, 1873.

[5] We shall see, however, that practically, Hirt thinks that no modifications of the industrial work of women, based upon the existence of menstruation, are either desirable or practicable.

patience necessary to fit persons for the cares and responsibilities of professional life, they still are and must be subject to the periodical *infirmity* of their sex; which for the time, and in every case, *however unattended by physical suffering*, unfits them for any responsible effort of mind, and in many cases of body also. It is not to women as physicians we would object; . . . but to their often *infirmity*, during which neither life nor limb submitted to them would be as safe as at other times. We could hardly allow to a female physician (?) convicted of criminal abortion, the plea that the act was committed during the *temporary insanity of her menstruation;* and yet at such times a woman is undoubtedly more prone than men to commit any unusual or outrageous act."[1] In the same sense Dr. Tilt, in an address to the Obstetrical Society of London for 1874, congratulated the members upon their almost unanimous decision that women were not admissible,—"for the profession felt that the verdict really meant that women[2] were not qualified by nature to make good midwifery practitioners; that they were unfit to bear the physical fatigues and mental anxieties of obstetrical practice, at *menstrual periods*, during pregnancy and puerperality; and that it was unfair to society to encourage women to suppose they could fit themselves to assume responsibilities in those formidable obstetric emergencies which too often completely paralyze even men of experience."[3] Already, in 1805, Roussel[4] had declared menstruation to be

[1] Criminal Abortion, p. 101. Boston. 1868.

[2] *i. e.*, in the opinion of the Society.

[3] British Med. Jour., Jan. 16, 1875. It is interesting to find in the same volume of this journal, an editorial commenting upon a local epidemic of puerperal fever that had been caused by the ignorance of a midwife, and concluding with these words: "Every day the fact *presents itself with increasing importunity* and sometimes hideous vividness, that midwives must be improved or abolished. The latter plan is undesirable and impossible, the former is practicable, urgently demanded, and, to our shame be it written, *has been adopted in every European country but Great Britain.*"

[4] Système Morale et Physique de la Femme, p. 100.

a salutary crisis intended to relieve a pathological condition induced by the excesses at table common in advanced civilizations; and Auber[1] attributed the phenomena to the unnatural restraint imposed by these same civilizations upon the sexual instinct [see Beigel]. According to Hageivisch, menstruation is an hereditary disease, developed by civilization, and according to Moscati, by the upright position of the human female.[2] A modification of the doctrines of the Roussel school has been recently advanced by King, of Washington, who is apparently unacquainted with the arguments of his predecessors. He asserts that menstruation, far from affording relief to pathological conditions, itself constitutes a morbid state fraught with danger, inasmuch as it is proof of functional inactivity on the part of the uterus, which becomes therefore liable to atrophy by sclerosis.[3] It is the function of the uterus to bear the product of conception, but, impregnation not taking place, involution occurs in the membrane by fatty degeneration just as it does in the muscular walls of the womb after delivery, with this difference, that it is at the beginning instead of the end of the normal function, and before the mucous membrane has at all accomplished the office for which it had been so highly developed." Thus, as has been said, a woman menstruates, only because she does not conceive." To Dr. King this remark is not merely the statement of an obvious physiological sequence, as when it is said that a man sleeps because he is not awake, or fasts because not employed in digestion. But he infers that since gestation is the proper function of the adult uterus, in the absence of gestation, *i. e.*, in the presence of menstruation, the uterus is threatened with the atrophy incurred by all organs whose functions are unnat-

[1] Quoted by Raciborski, Traité de la Menstruation, p. 18.

[2] Quoted and combated by Burdach—Die Physiologie Erste Band. p. 249. 1835.

[3] Am. Journ. Obst. August and Nov. 1875.

urally suspended. "Nature will not support the nutrition of a useless organ; in the physiological offices of the system she will allow no sinecures; hence we always find that organs performing no useful purpose become prone to disease, degeneration, and decay." As a practical inference, Dr. King recommends that girls be encouraged to marry immediately upon arriving at the age of puberty, so that menstruation may be at once interrupted by a pregnancy which should be repeated so frequently as to entirely exclude its pathological substitute from the existence of the woman. This view of menstruation as a pathological process grafted upon the female economy by a progressively deteriorating civilization, is in striking contrast with the opinions that prevailed throughout antiquity, the middle ages, and even, until recently, in modern times. According to these elder ideas, women are naturally plethoric, in order to be able at the proper time to utilize their excess of blood for the development of the fœtus.[1] Aristotle, to whom Raciborski attributes the first enunciation of this theory, calls the menstrual blood the marble, the sperm the sculptor, the fœtus the statue.[2] The Hindoo Susruta writing thirteen or fourteen hundred years before the Christian era, also explains fecundation by the admixture of the semen with the menstrual blood, in which latter is contained the germ of the embryo.[3]

The plethoric theory of menstruation was based; first upon the general analogy of the menstrual flux with other evacuations; and second upon its relations to pregnancy, of which the most superficial observation showed it to be the substitute. The sense of discomfort or even experience of danger attendant on suppression of the evacuations of fæces or urine, offered a basis of sensation, upon which was easily built the theory,

[1] Raciborski, loc. cit., p. 8.

[2] Quoted by Flourens, Cours d'Embryologie.

[3] Quoted by Kreiger, Die Menstruation, 1869.

that all spontaneous evacuations implied the existence of some morbific material whose retention was extremely perilous to the economy. The menstrual "purgation" was included in the generalization. "The opinion, observes Kreiger, that the body was purified by the flux from the uterus, became permanent, and was asserted still more emphatically in the Commentaries on Hippocrates in the sixteenth and seventeenth centuries. So for instance, Bapt. Moretarus, de uterin affectionibus, p. 221." "The uterus is the sewer of all the excrements existing in the body; for all decrements flow to the uterus."[1] On the other hand, the enormous amount of nutritive material required for the development of the fœtus was supposed to be derived from some reserve habitually not utilized for individual nutrition; this reserve could be none other than the blood thrown away as superfluous during non-pregnant states, but retained as soon as the embryo began to develop. If women escaped annihilation during pregnancy, it could only be in virtue of a plethora existing in all other conditions. Hippocrates gives an ingenious explanation of the cause of this plethora, not accepting as sufficient the teleological statement of its utility. "The woman," he says, "has a flesh more loose and soft (in texture) than the man, and which therefore absorbs from the abdomen (nourishing) fluids more rapidly and in greater abundance than the masculine body. With this laxity, when the body is (stuffed) full of blood, the tissues become hot and plethoric, and if no evacuation is effected, a state of suffering supervenes. The blood of the woman is warmer, and this is why she herself is warmer than the man.[2] If, however, the plenitude is evacuated (in due time) neither heat nor suffering is produced. The body of the man, on the other hand, not being soft (and relaxed) is not susceptible of such vascular plenitude, and he is not therefore liable to an excess of heat as a consequence of plethora. Besides, as he exercises

[1] Kreiger. Loc. cit. p. 5.

[2] This is also asserted by Longet.

more than the woman, a part of the (nutritive) fluid is dissipated by fatigue."[1]

Sanctorius believed that a monthly plethora occurred in both men and women, each of whom increased periodically in weight to the amount of one or two pounds."[2]

Boerhaave explains the plethora of women in a different manner. "About the time," he says, "that the body of a female is arrived at its full growth, it uses to make a greater quantity of blood, than what the vessels will contain, which is the reason why part of it is let out at the end of the arteries of the womb, which evacuation is called the monthly courses. If the blood is retained then follows a plethora."[3] The correlation between the cessation of growth, and the establishment of the menstrual flow that is presumed to represent the nutritive material become excessive for the needs of the body, is insisted upon at greater length by Haller. "At the age of thirteen, at the same time that the semen begins to form in the male, the whole mass of blood circulates with increased force. At this time when the growth of the body begins considerably to diminish, and the blood, finding easy admittance to completed viscera, is prepared in greater quantity, a plethora frequently (?) follows. In the male this is frequently vented by the nose. In the female a more easy vent is found downwards. The uterine vessels are enlarged, of a soft fleecy fabric, seated in a loose hollow part, with a great deal of cellular fabric interspersed, very yielding and succulent. For these causes the vessels being more easily distensible, the blood finds a more easy passage into the cavity of the uterus than into any other part. —Again, the return of blood is more slow, both because of the flexures of the arteries which become serpentine, and retard

[1] Oeuvres d'Hippocrate Traduction Littré Traitè des maladies des femmes, p. 13.

[2] Aphorism LXV., 1770.

[3] Aphorisms, 1290 and 1291. Translation from Latin. 1728.

the blood motion, and also because it passes with more difficulty through the veins. The blood, therefore, first collects in the vessels of the uterus, then accumulates in the arteries of the loins, and the aorta itself, which, urging on a new torrent of blood augments in force so far as to discharge the red blood into the serous vessels.[1] The quantity of the menstrual flux is promoted by everything that either increases the quantity or the momentum of the blood more particularly to the uterus, such as joy, lust, rich diet, warm air, lively temperament."[2]

Burdach[3] (1835) remarks that "as menstruation offers local and general phenomena, so it depends upon local and general causes. The general cause is evidently, that in the female body the formation of blood is sufficiently rich to provide every four weeks for an overflow of the same—whose evacuation becomes a necessity. For after this evacuation is there complete health and regularity of all forces, and the body has the same weight as before. The menstruation is richer when the formation of blood is abundant, and weaker when blood is deficient, from insufficient foods, tedious disease, etc. We believe this excess of blood depends upon an excess of formative power in the woman, and that the menstruation, in its increase and decrease, stands in exact proportion to the formative activity, and also to its expenditure. For where matter and force are employed for the movement and nutrition of the muscles, the plastic force can develop itself less in other directions; when on the contrary the muscular power is less exercised, then developes easily a ('uppige') formation of fluid material. The menstruation is more profuse in weakness than in vigorous health, in towns-

[1] This partly foreshadows Rouget's theory of the erectile accumulation of blood in the pelvic blood vessels, on account of the serpentine flexures of the arteries, and of hindrance to the reflux through the veins.

[2] Haller Elements of Physiology, 1786. (English Translation, vol. 2, p. 183.)

[3] Loc. cit., p. 241.

women than in peasants. The local cause of menstruation is the specific direction of the plastic force to the organs of generation. On account of their high vitality, menstruation may exist even in the absence of any general abundance of blood." Wagner (Handworterbuch, Bd. 4. p. 879. 1853), after accepting the ovular theory of menstruation, unknown to Burdach, says: "The blood that is evacuated at the time of menstruation contains all the constituents of normal blood, and *is* a part of the blood which circulated in the body. It is an *excess* which is acquired in the ('*Getriebe*') of the individual life, whose formation is rendered possible through the entire mechanical disposition (*anlage*) of the body. It is completely analogous to the formative material elsewhere employed for the development of the embryo. The menstrual flow ceases during pregnancy. The excess, which at other times may be eliminated without danger to the individual life, which indeed must be eliminated, under pain of multiple disturbances, now serves to cover the increased expenditure."[1] "The evacuation of the menstrual blood is nothing else than the elimination, under a special form, of superfluous productive material." The author, who considers the slight hemorrhages accompanying the rut in some of the higher mammalia to be completely analogous to menstruation, observes that this evacuation is confined to mammalian animals because in them the ovum is so small as to make only the most insignificant demand upon the plastic force, and this therefore remains in excess. Astruc declared that the blood and lymph destined for the nutrition of the fœtus is derived from that which, previous to puberty, had been used for growth, and during the maturity of the woman continually accumulates in certain veins on the inner surface

[1] Wagner endeavors to show that the weight of menstrual blood saved during ten months gestation exactly equals the weight of the fœtus at term. But by the utmost stretching this can only be found by admitting that ten ounces of blood are lost at each menstruation, which is evidently too much.

of the uterus. When these are swollen by the accumulation, they protrude into the uterine cavity, are called "cœcal appendages," and from them flows the blood at menstruation. Allan Thompson, writing about the same time as Burdach,[1] says menstruation is to be regarded as the means for relieving the female system from an overplus of blood, which exists during the whole time that it is capable of propagation. It is to be regarded as indicating a surplus, but not constituting the whole amount required for the fœtus. For as only five or six ounces are lost at each menstrual period, only fifty ounces or eight pounds (three pounds and two ounces avoirdupois) could be accumulated in the ten months of pregnancy, whereas the fœtus weighs from six to ten pounds. Capuron attributes the theory of plethora to Galen, and disputes it. He himself explains menstruation as the result of a general shock given to all the organism and especially to the womb, to dispose it to conceive, to retain the germ, and to develop it during pregnancy.

It may therefore be confidently asserted that, previous to the discoveries which associated menstruation with the dehiscence of ova, this peculiar phenomena was almost universally regarded as a proof of an excess of nutritive force in the sex upon whom devolved the greatest cost of reproduction. From Hippocrates to Burdach (see ut supra), this presumed excess of nutritive force in women is constantly contrasted with their deficiency of muscular force as compared with that of man, and with the arrest of the growth which is continuous in children. Menstruation in women, muscular force in man, growth in children, were held to be more or less exact equivalents to one another.[2] But in 1845, with the establishment of the fact of spontaneous ovulation, the conditions of general nutrition upon which

[1] Todd's Cyclopedia, Art. Generation. 1836.

[2] Though Hermann considers the menstrual fluid to be the exact equivalent—in plastic force—of the sperm.

menstruation could be supposed to depend began to be lost sight of in comparison with the remarkable local phenomena with which they were asserted to be exclusively associated. The congestion of the ovary, ripening of the ovule, effusion of the serum and blood into the Graafian follicle; its rupture; the escape of the reproductive cell; its seizure by the fimbriæ of the Fallopian tube; its journey along the oviduct and descent into the uterus; the hyperannia of the latter, the turgesence of its mucous membrane, the rupture of its blood vessels, and local hemorrhage; this entire succession of processes seemed the more surprising because more recently demonstrated, and to cause a greater perturbation of the economy, because occurring at intervals. For the first time the periodicity of menstruation began to be considered as a morbid circumstance. Although physiologists pointed out that the periodicity of menstruation belonged to the general law of vital phenomena,[1] as earlier rude observations had associated it with the periodicity of cosmic phenomena,[2] clinicians came gradually to look upon it as a fact which isolated menstruation from all other physiological processes, which rendered its ordinary course dangerous, its derangements fatal, and itself was sufficient to make any utero-ovarian disease baffle the skill of the physician. Aran, who disputes the ovular theory of menstruation, saw in the periodical return of uterine "congestions" the main reason for the desperate tenacity of uterine disease—the patient

[1] Dalton, Treatise on Physiology, p. 548. Beclard, Elements de la Physiologie, 1867. Longet, Traité de la Physiologie.

[2] See Mead, De imperio solis et Lunæ. Darwin, Descent of Man, p. 204, vol. II, associates it with periodical alterations of nutrition, to which were subjected the primitive ascidian ancestors of the human race, from the lunar revolutions of the tides. "All vital functions tend to run their course in fixed and recurrent periods, and with tidal animals the periods would probably be lunar, for such animals must have been left dry or covered deep with water—supplied with copious food or stinted—during endless generations, at regular lunar intervals."

being exposed to incessant relapses at the very brink of recovery. In the same spirit, Courty remarks that "menstruation" constantly intervenes to produce and aggravate uterine disorders by fluxion, congestions, and critical evacuation.[1] Scanzoni says that during a chronic metritis, every menstruation offers an occasion for the development of a new acute inflammation.[2] Kiwisch, speaking of the desquamation of the mucous membrane of the uterus during menstruation, observes: "This periodic physiological process determines at the same time a disposition to various anomalies of menstruation;"[3] and again, "Chronic inflammatory affections of the uterus are almost constantly aggravated at each menstrual period, or even return after they have been removed, so that the greatest hindrance in the treatment of many cases of metritis is the repeated menstrual congestion."[4] Finally, all writers, of whom some have been already quoted, who call menstruation an "infirmity," base the epithet mainly upon the periodicity of the hemorrhage. "It is a constantly recurring infirmity that occupies about seven years out of thirty of a woman's adult life." It would seem as if for these writers, were the flux continual, or of as frequent occurrence as defecation or micturition, the idea of infirmity would be abolished. On the other hand, Beigel,[5] writing in most recent times, and after investigations have shown the "periodical congestion of the uterus to be much more extended in duration than was formerly supposed," observes that "menstruation is of so much the more

[1] Loc. cit., p. 286.

[2] Die Chronische Metritis. 1867. (For a more favorable view by the same author, see at infra.)

[3] Mutterkrankheiten, Bd. I. p. 4.

[4] Loc. cit., p. 14. This is equivalent to saying that the greatest obstacle to the cure of any visceral disease is the continuance of the functions of the organs involved, which keep up hyperæmia and innervation. The fact is true, but not peculiar to uterine pathology.

[5] Die Krankheiten der weiblichen Geschlechtorgane.

significance in relation to chronic metritis because its influence is almost uninterrupted. In the most favorable cases we can only suppose ten to fourteen days rest, and that is not quite certain. This continual ebb and flow of circulation of the pelvic organs, constitutes a predisposition to the development of most diseases of the female sexual sphere." "At the time of menstruation the uterus is in a state which offers all the conditions from which metritis developes itself."[1]

Thus one of the most essential apparent peculiarities of the menstrual process, its periodicity, that formerly was supposed to indicate a periodical increase in the vital forces of the female organism, has come to be considered as a mark of constantly recurring debility, a means of constantly recurring exhaustion demanding rest as decidedly as a fracture or a paralysis. The comparative novelty of this view is assuredly no proof that it is erroneous. Investigations into the laws of animal organisms, have repeatedly shown them to be far more complex and more delicate than had been imagined by the rough common sense of mankind. The nature and urgency of the perils menacing the life of young children, of puerperal women, of wounded men, have only recently been demonstrated with sufficient clearness to attempt their prophylaxis. The dangers have been proven to be inherent in crowds of habitual circumstances that for centuries have been regarded with indifference or accepted with complacency; air, supposed to be healthful has been proved foul; water, believed innocuous, has been convicted of poison; food, the staple support of entire populations, has been accused as the cause of their most desolating epidemics; or certain articles of food considered insignificant, have been shown to be so essential that certain diseases are specifically correlated to their absence.[2] Lucrative trades have been condemned as

[1] The same might be said of the stomach during digestion, or the brain during activity, *i. e.*, that then gastritis or meningitis *seemed* to be the most imminent.

[2] Vegetables and scurvy—Iodine and goitre.

incompatible with the health of the workmen who embraced them in ignorance and with alacrity;[1] methods of work and hours of work, shown to be deadly in their influence over the laborers upon whom they were imposed;[2] and gigantic industries are revealed as reposing upon holocausts of human beings. Indeed it may be said, that in the need and greed of human life, all the conditions of human existence have been trampled upon so ruthlessly that the marvel is that it has so often survived. It is not therefore inconsistent with what we know of the acquirement of knowledge about the most obvious physical conditions, that this special condition of menstruation, should have been hitherto misinterpreted in regard to its influence upon the activity of the persons subjected to it. Although not yet proved, it is conceivable that all women should require an extra rest on account of it, as all children have been shown to require extra sleep on account of their immaturity. It is not impossible that the organization of the industrial world without reference to this physiological requirement, has been at least as great a hardship to women, as inattention to requirements of ventilation and drainage have proved to be to all laborers. It is scarcely more improbable to ascribe ill health of women to neglect of precautions in regard to this physiological process, than in regard to the physiological process of parturition which is unquestionably the starting point of hosts of diseases, and the cause of death to about one woman in 180. A line of argument not more subtle than was employed by Hahneman in tracing insanity and consumption to suppression of scabies, might even demonstrate that the majority of all cases of disease in the female sex, resulted from prevalent habits in regard to the menstrual period, the minority only of individuals escaping the legitimate consequences of their mode of life, on account of some exceptional strength of constitution

[1] Cutlery—Lead—Phosphorus factories.

[2] On mines, (coal and quicksilver) dressmakers, factory children.

But if these hypotheses be true, the practical consequences are at once so important and so inconvenient, that they should only be accepted after the strictest scrutiny. It is well to glance for a moment at the statistics of the work performed by women in various parts of the world, without any attempt to secure for themselves rest during the menstrual period. Leroy Beaulieu, in his prize essay,[1] has shown by a few well selected examples, that at no time and in no country have domestic occupations absorbed the existence of the woman in the working classes; that this ideal society where the man might suffice for the necessities of the family, and the woman only be obliged to look after the house and the education of the children, has never existed in the past; that whenever a branch of remunerative employment has been open to women, they have precipitated themselves upon it with avidity, and that in the absence of industrial pursuits, they have fallen back upon occupations coarser and less productive.

"The workshop existed in Europe long before the tenth century, under the name of gynecee, sometimes attached to the house of the lord of the manor and under the direction of his wife, sometimes belonging to abbeys, and controlled by a superintendent. In convents the nuns manufactured everything needed for their own use, then for sale in the world. Spinning and dyeing of wool occupied a large part of their days. In the Registers of trades and merchandises of Depping is proof that the trades corporations, contrary to a prevalent opinion, were arranged to include women. We find mentioned, workwomen in silk cloths, silk spinners, weavers of kerchiefs, embroideresses, combers of wool, silk hatters, and many other trades, where the women were not only admitted as aids, but might become mistresses, or even be eligible for the dignities of the corporation. The history of female labor in epochs nearer to us would be the history

[1] Le Travail des Femmes au xix Siecle, 1873.

of industry itself. The more civilization is developed and refined, the more women participate in production, and this participation, constantly greater and more active, is regarded by women themselves as an advantage." In 1640, a decree of the parliament of Toulouse, on the pretext that lace manufacture carried off too many women from domestic occupations, forbade this work throughout the limits of its jurisdiction. Thousands of workwomen were thus deprived of their bread until the decree was reversed. Although the occupations of women under the old regime were much more numerous than is generally believed, they were nevertheless too little for the necessities of the women. In 1789 appeared the petition of the women of the Third Estate to the king, in which they claimed for their sex the right of working without (reglementary) hindrance, and even demanded that all trades for sewing, spinning, or knitting should be handed over exclusively to them. Thus before the new world about to open, the first cry of the women was, not to repudiate, but to invoke labor, not to decline and repulse the name of workwomen, but to claim it and make of it a title of honor."[1] This in 1789. In 1851 Paris alone contained 112,189 workingwomen, of whom 60,000 were employed in various kinds of needle-work. In 1873 it may be calculated that about 400,000 or 450,000 women are employed in France in manufactories of cotton, wool, linen, or silk. In 1861, in Great Britain, the textile industries occupied 467,261 women and 808,273 men, or about three women for every two men." In 1864—we continue to quote Leroy Beaulieu—in 1864 a total of 747,261 women were engaged in the industrial establishments of Great Britain. Lord Brougham, in a speech before the Social Science Association in 1862, affirmed that "three-quarters of adult unmarried women, two-thirds of the widows, and a seventh of married women, are occupied in Great Britain on independent or isolated labors, without

[1] See also Richter, Recht der Frauen auf Arbeit. 1869.

counting the multitude of wives, daughters, and sisters, who share in the work of their relatives at the counter, in the dairy, or by the needle."

In Germany, Hirt enumerates female laborers in manufactories for bronzes, (Nuremberg) pins, gold leaf, glass and porcelain, wool, flax, tobacco, paper, straw hats, india rubber, paints, looking-glasses, toys, phosphorus matches, sugar refineries, colors, etc., etc. In the United States, the census for 1870 shows that out of 9,750,000 females above ten years old, 1,594,783 are represented on tables of occupations taking part in the paid industry of the country.[1] This is one-sixth of the entire female population. Among these, 373,832 are registered as agricultural laborers, and of these the immense majority is in the Southern States, and probably consists of negroes, who for our purposes may be excluded from the reckoning. This leaves 1,221,451 white women engaged in work of sufficient regularity and importance to render the question of monthly vacations a serious one. Of these, 22,681 are farmers and planters, mostly in the Southern States, but amounting to 1,027 in Pennsylvania, and less in some of the others. Professional and "personal" occupations claim 1,066,672 out of the 1,198,270 remaining after subtracting the agriculturists. Manufactures, 353,950, while trade and commerce only employ 18,698.[2] Under the head of personal and professional employments, domestic service ranks much the highest in the numbers. It enrolls 867,354. Afterwards comes the profession of teaching (84,047). The next in order is the business of keeping boarding-houses, which employs 7,060 women.[3] The only other classes at all

[1] The number recorded as keeping house is 7,400,000, thus leaving a deficiency unaccounted for, *i.e.* apparently without any employment, of 755,217, or about three-quarters of a million.

[2] This opposition between manufacturing and commercial industry is in direct contradiction to the theoretical estimate made by Mill, that women should be more extensively employed in distribution than in production.

[3] A priori, we might have expected a much larger number under this head.

numerously filled, are that of barbers and hairdressers (1,179) and midwives (1,186), numbers almost equal to one another.[1] Although, therefore, the number of women engaged in paid employments is in all countries the minority, relatively to the entire population, yet in itself the number is immense. For to estimate the influence of steady occupation upon female existence, we must add to those engaged at any given time, a large proportion of the classes who do not then appear on the tables, but are registered as married or keeping house. A very great many of those have been occupied in paid pursuits previous to marriage, and from the statistics of widowhood in England and America, we know that many are destined to return to the same at a later period of life. Tilt has pointed out that the tables of the Registrar General indicate late marriages and late child-bearing as much more frequent than is generally supposed.[2] Since marriage and domestic service constitute the only natural equivalent for the paid industry of women, everything which delays marriage tends to increase the extent to which they will engage in non-domestic professional or industrial occupations, and the regulation of their labor becomes therefore of more importance.

In Europe very much more than in America, and on the continent more than in Great Britain, marriage among the laboring classes does not interrupt industrial life, since the earnings of the woman are needed for the support of the family. "It is unfortunately evident," says M. Simon,[3] "that if the average wages of a good workman are two francs a day, and that the sum needed for the support of his family is three francs, the best advice that can be given to the mother is to learn a trade and earn the requisite twenty sous. This conclusion is inexorable, and there is neither theory, nor eloquence, nor sentiment, which can resist a demonstration of

[1] The number of women registered as physicians is between five and six hundred (we forget at this moment the exact figure).

[2] Change of Life. 1857. p. 19.

[3] L'Ouvrière, p. 12.

this kind." "The *a priori* character of the family organization as derived from the unequal distribution of strength between the man and the woman, are far from being realized in actual life." It is impossible to exclude young girls from manufactures, our industry has need of the labor of woman and women are in imperative need of the salaries afforded by wholesale industry."[1] The preoccupations of philanthropists like Simon, are concentrated upon the demoralization of the family, alleged to be inevitable when the mother is at work out of the house, though the life of the workshop or the factory is not deleterious to health, indeed both more hygienic and more remunerative than any work which can under the present system be carried on at home. On the other hand the attention of hygienists like Hirt,[2] is directed almost exclusively to the increased number of abortions and higher rate of infantile mortality which is asserted to accompany the extended employment of married women in factories. The author's suggestion for legal interference to regulate female labor, bears exclusively upon this point, and, although at the beginning of his essay, he classes menstruation with pregnancy, parturition and lactation, in its tendency to diminish the industrial capacity of women, yet at the close he declares impossible and unnecessary any attempt to frame regulations in accordance with the supposed exigencies of this physiological process.[3]

From this brief glance at the actual condition of modern society, it is evident that its existing regulations are little prepared to "yield to nature her inexorable demand for rest during one week out of every four" in the adult life of women. If the answer to the question asked by the com-

[1] Leroy Beaulieu, Les Travail des femmes au xix siecle, 1873. I condense the substance of several scattered remarks.

[2] Die Gewerbliche Thatigkeit der Frauen, 1873.

[3] The quotation made by Ames (Sex in Industry) from the first page of Hirt's Essay, conveys an impression that is not confirmed by Hirt's conclusions.

mittee be in the affirmative, a revolution in industrial customs should be required at least as radical as those enforced by the English Factory Laws of 1842. This question though apparently simple, is in reality difficult even to ask with precision. Each term is susceptible of various shades of meaning. If it be said, "It *is* necessary that women rest during menstruation," we must ask necessary for what purpose? The preservation of life? Evidently not, since the most superficial observation shows thousands of women of all races and ages engaged in work of various degrees of severity without attempting to secure repose at the menstrual epoch. But in regard to the periodical repose of sleep, it is impossible even to imagine that it should be secured, at least to some extent, even though insufficiently. It is indeed superfluous to assert that any condition really necessary to life, cannot be destroyed except under penalty of death. It is, however, conceivable that rest during menstruation may be necessary for the attainment of a high standard of health, or for the avoidance of certain forms of disease. The average amount of diurnal repose is a tolerably fixed quantity, the limits of whose variations are known, and any marked transgression of those limits is certainly followed by serious deterioration of health. The injury is severe in proportion to the immaturity of the individual, and to the length of time to which he is exposed to the deteriorating influence. If the necessity for menstrual rest be in any way so imperious as that for a fixed amount of sleep, it must follow that the persons deprived of the one will suffer as certainly and proportionately as those robbed of the other. Moreover it should be made as clear in the one case as in the other that the condition examined was alone sufficient to produce the deterioration of health, in the absence of all the other circumstances by which it is habitually complicated. After sifting out these circumstances as completely as possible, we should discover a strict correlation, both direct and inverse, between the degree of

health attained by different classes of women, and the degree to which they obtained the amount of menstrual rest ascertained to be the necessary average. We are authorized to expect this from the facility of establishing such a correlation in regard to sleep,—the type of periodical repose. If the degree were fixed to which menstrual rest of some kind may be necessary in order to avoid a special predisposition to disease, the duration of that rest would still remain to be determined. This indeed is appreciated by the committee who have framed the question submitted for decision. This duration might be fixed empirically, that is by ascertaining the number of days the women who do rest habitually claim for that purpose; or else it may be determined theoretically from consideration of the succession of phenomena that constitute the menstrual process, the length of time occupied by each, and the presumed relations of each to the rest of the economy. In regard to this point, a very slight investigation will disclose a singular discrepancy between the claims of theories and the habit of practice, and also between the inference that may be derived from different theories, and especially when these have been advanced at different states of knowledge in regard to the physiology of menstruation.

But the degree of rest does not vary merely in its duration relatively to that of the menstrual epoch, but in its intensity relatively to the occupation habitually pursued. It might be supposed that the rest, if required at all, must necessarily be complete, in proportion to the strenuousness of the occupation. It is certain, however, that this is by no means the case, either in regard to physical or to mental strain. It has been impossible to obtain, as we had hoped, a complete table of women engaged in various employments that exacted unremitting attendance; and to compare the suffering experienced by them at the menstrual epoch with that claimed by others, whose more luxurious mode of life

permitted complete repose. But some data have been procured on this point which are far from useless.

There is another point of view from which this question of menstrual rest may be considered. If the working capacity of women during the period of hæmorrhage be really and uniformly diminished, the work done at this time should be expected to be inferior in quality to that performed at other times. Since at any given time, out of any given number of women, a certain proportion will always be found menstruating, it is possible that the average inferiority that is ascribed to their collective work, as compared with that of men, may be explained by this condition peculiar to their sex, which, although not always operative upon each individual, is always influencing women considered *en masse*. Room would then be afforded for the suggestion, that the quality of work performed in non-menstrual, *i. e.* non-hemorrhagic periods, would be raised above the average, if an absolute rest from work were observed at the time of the menstrual flow; and that thus the quality of women's work would be everywhere raised to the level of that of men's. This, indeed, is the formal proposition of Dr. Clarke in relation both to the work of school-girls and to the industrial and professional work of adult women. This suggestion is plausible, and requires all the more careful scrutiny, lest if it be not in accordance with the real facts of the case, it should be adopted in the place of some other provision for rest which is.

The question proposed by the committee resolves itself into the following series of questions:

1. What proportion of women habitually suffer pain or discomfort of any kind during any part of the menstrual period?

2. How many out of this proportion are compelled to suspend their ordinary avocations on account of this pain?

3. Is there any uniform relation between the nature of

the occupation and the necessity for its interruption, *i. e.* do some occupations more frequently necessitate intermissions than others?

4. Among women who, on account of immunity from menstrual pain, have never been in the habit of resting at the menstrual period, are there any considerable number whose health has progressively deteriorated without the presence of any other condition that could be assigned as the cause of such deterioration?

5. What is the real succession of phenomena in the menstrual process, and what relation does it bear to the other processes of the economy?

6. This relation established, what inferences in regard to women's capacity for work, should be theoretically deduced from it?

7. If discrepancies exist between the practical statistics and theoretical inference, how are they to be explained?

8. Finally, do either facts or theory point to any hygienic rules exclusively applicable to the work of women?

SECTION II.

STATISTICS.

THE answer to this first question, if asked without distinction of age, constitution, family history or occupation, is not very difficult to obtain; although considerable time must often be expended upon inquiry. The statistics obtained by Brierre de Boismont and frequently quoted, are compiled from three hundred and sixty women. Of these, two hundred and seventy-eight suffered various degrees of colic, some very slight, at the menstrual period (77 per cent.), while eighty-two enjoyed complete immunity. This is less than 23 per cent. In regard to general symptoms, three hundred and thirty-four women were questioned, replies are given from two hundred and twenty-three; of whom 181 declared that they were conscious of no change during menstruation, while forty-three, about one-fifth, admitted that menstruation was a period of suffering, especially nervous or moral. These brute statistics have precisely the same value as the empirical formula of a compound substance submitted to elementary analysis. The rational formula can only be obtained by comparing the single datum, pain or not pain, with a variety of other circumstances. In order to do this effectually, we have prepared the following table of questions, each of which was to be answered by the person replying to the one question in regard to pain.

The undersigned, desirous of collecting reliable statistics in regard to the menstruation of women in America, would feel indebted to all who would answer accurately, the following questions.

No signature is necessary.

1. Age of going to and of leaving school.
2. Health under 13. Specify any disease of parents or sisters.
3. Number of hours a day spent in study at school.
4. Hours spent in exercise every day during same period.
5. Studies pursued between ages 13 and leaving school.
6. Occupation (if any) since leaving school, and hours of work.
7. Health, general, since leaving school. Specify date of any illness. Do you have headache or neuralgia?
8. Date of first menstruation.
9. Pain at menstruation, while at school and since leaving.
10. Does pain occur before, during, or after flow? Spasmodic, cramp-like, or steady and burning?
11. Does pain exist between menstrual periods?
12. What is duration of flow? Has it ever been excessive or too scanty?
13. Has it been necessary to rest during period? If so, how long? When did this first become necessary?
14. Strength, as measured by capacity for exercise. How far can you walk?
15. Have you ever been treated for uterine disease?
16. Are you thin or stout, rosy or pale, tall or short? Has any change taken place since twenty in color, flesh, or strength?

Although a thousand of these tables were prepared for circulation, we have only been able to obtain up to this date two hundred and sixty-eight answers. Out of this number, ninety-four persons record themselves as never having suffered either pain, discomfort, or weakness during the menstrual flow. This is 35 per cent. of the whole—less than one-half, but more than the percentage given by Brierre de Boismont.

The total number of cases divide themselves, therefore, into two classes, each of which must be separately analyzed. Of the first class (those who have not suffered pain), the following table presents the statistics in regard to attendance at school:

[1] TABLE I.—SCHOOL ATTENDANCE. (GROUP 1.)

Age at Beginning.	No. Cases.	Age of Leaving.	No. Cases.	Hours of Study.	No. Cases.
2 years.	1	12 years.	1	4 hours.	2
3 "	4	13 "	1	5 "	13
4 "	7	14 "	4	6 "	36
5 "	12	15 "	6	7 "	10
6 "	15	16 "	16	8 "	8
7 "	15	17 "	11	10 "	1
8 "	10	18 "	6	Not specified.	18
9 "	7	19 "	8	.....	....
10 "	2	20 "	6	.....	....
11 "	2	21 "	2	.....	....
12 "	8	22 "	4	.....	....
14 "	1	23 "	1	.....	....
Not specified.	15	25 "	2	.....	....
.....	....	27 "	1	.....	...
.....	....	30 "	1	.....	....
.....	....	Prof. studies not	4	.....	....
.....	....	specified.	15	.....	....
Total	94	Total	89	Total	88

This table shows: 1. That the great majority of persons of whom we have been able to obtain statistics have attended school during a number of years.

2. That school attendance begins at the age of five, six, seven, or eight, in about the same number of persons, and these collectively are 52, or 55⅓ per cent. of the whole number (94) of whom the earliest date of attendance is specified.

3. The age of leaving school, or rather of ceasing to study, varies much more. The greatest number, sixteen, leave at the age of sixteen. This is nearly 18 per cent. of the whole number recorded (89). The next age in point of frequency is seventeen, where the number of persons is 11, or 12 per cent. The next is nineteen, with a record of eight or nearly nine per cent, while the ages of fifteen and eighteen give the same number, six or nine per cent. This coinci-

[1] It will be seen that the figures of totals on the tables are not always identical. This is because all the questions asked in the circular are not answered in each response.

dence is probably accidental, and of no significance in the small number of figures operated upon. But the ages, fifteen, sixteen, seventeen, eighteen, and nineteen, represent collectively the age of cessation of study for forty-seven persons, or over 52 per cent. of the whole number specified (64).

4. The nine persons who are stated to have left school at ages of twenty-two, and over four at twenty-two, one at twenty-three, two at twenty-five, one at twenty-seven, one at thirty, were all engaged in professional studies, and their number should therefore be added to the four of which this was specified, making a total of thirteen, or a percentage of fourteen.

5. No average has been calculated for the number of years passed at school or in study, for no useful purpose would be served by it. But the persons who are represented as beginning school early do not cease attendance any earlier than the others. Thus of the thirteen who began to go to school at the age of five, two left at fifteen, three at sixteen, two at seventeen, one at eighteen, one at twenty, one at twenty-one, one at twenty-two, one at twenty-five, and one is not specified ; and of the nine persons who began school at the age of two, three, or four, two went until seventeen, two until eighteen, one until twenty, and one until twenty-four, or two-thirds of the whole ceased at a later age than the average, the remaining three somewhat earlier (14, 15, 16).

Early attendance at school is not to be regarded as proof of very precocious forcing of the intelligence, for the studies pursued are rarely stimulating, or beyond the intelligence of American children. But the confinement of school hours for children under nine years of age, is a circumstance of serious moment in the hygienic history of women. Among those for whom the age of beginning school is specified, seventy-one began school at nine years old or under (75 per

cent.). Of these, only one, who went to school from the age of four to eighteen, is said to have studied only four hours during the early childhood. Of the others, eighteen are said to have studied five hours a day, and thirty-six six hours. This is 51 per cent. of those recorded.

It is certain that this amount only covers the time actually spent at the school-hours, whose sessions are habitually either five hours or six. But, except for the youngest children, this session is always supplemented by at least two hours study out of school, and this is acknowledged by ten persons, who record themselves as studying seven hours a day.

Let us compare now the amount of exercise taken by the children and young girls who sustained this amount of sedentary confinement.

TABLE I½. EXERCISE. (GROUP I.)

One Hour or one and a half.	Two Hours.	Three Hours.	Four Hours.	Five or Six Hours.	All out of School.	Irregular or Unknown.
12	15	11	15	4	4	25

Out of eighty-six cases in which the exercise is recorded, forty-nine exercised two hours and over, or 57 per cent., while 37, or 42 per cent. exercised insufficiently or irregularly. This is probably the case with two others who are not specified. If we include among those who exercised insufficiently, all who exercised two hours, we have a total of 52, or 59 per cent. instead of 42, and 34, or 38 per cent. who seem to have had abundant exercise.

The object of the 5th question in the circular is to ascertain as far as possible to what extent mental strain had existed during the period of the establishment of menstruation, and to distinguish its influence from that of prolonged seden-

tary occupation or of deficient exercise.[1] The studies are therefore compared with the hours of exercise.

By the higher English branches are meant History, Rhetoric or Logic, Philosophy, Literature; by Mathematics, Algebra, Geometry or Trigonometry, one or all; by natural sciences, Botany, Chemistry or Physiology. It is probable that in the majority of cases these latter studies at least were extremely superficial.

From a detailed table, specifying the exact studies in each case, we have prepared the following condensed table. The studies grouped as "Ornamental," indicate the scheme of education most common among the well-to-do classes in cities, which includes French, sometimes German, Music and Drawing, but excludes Latin and Mathematics. The so-called "Higher Education," includes these. The studies in Natural Sciences, except in a few cases of medical students (by no means in all of these), can scarcely be considered superior.

TABLE II. STUDIES AND EXERCISE. (GROUP I.)

Common Ed.	Ornamental.	Higher.	Exercise after 13.	
20 or	14 or	42 or	Common.	2 Hrs. and over 7 cases, under,[2] 13.
$26\frac{1}{3}$	$18\frac{1}{2}$	$55\frac{1}{3}$	Ornamental.	2 Hrs. and over 11 cases, under, 13.
per cent.	per cent.	per cent.	Higher.	2 Hrs. and over 26 cases, under, 16.

The table shows that of seventy-six cases specified, twenty only studied the common English branches, and were

[1] These two conditions are far from identical, since abundant exercise and even prolonged schooling are far more healthful than short school hours, but inaction outside of them. This point will be dwelt upon later.

[2] *i. e.* under two hours.

among the first to leave school; forty-two took a full course of studies, that is as estimated by the existing standard for girls' education, and which includes Latin and the higher mathematics,[1] while fourteen took an ornamental course, without Latin, and principally devoted to music and the modern languages. Of the first twenty who only had a common English education, only seven exercised daily two hours and over, thirteen under two hours, or quite indefinitely.

Of the second group of forty-two, twenty-six took sufficient exercise, (2, 3, or 4 hours) sixteen insufficient, (under 2 hours.)

Of the third group of fourteen, eleven are recorded with sufficient exercise, three with insufficient.

The proportion of these who exercised to those who did not is in the first group,=36 per cent. to 63 per cent.

In the second,=59 per cent. to 38 per cent.

In the third,=78 per cent to 21 per cent.

If any conclusion could be drawn from these figures, it would be that the ordinary "Ornamental" system of education, was that found to be most compatible with important hygienic conditions. But the fact that in the class of painlessly menstruating women, only the smallest number had pursued this system of education, is a counter-fact that much diminishes the significance of the first.

The sixth question is intended to ascertain the effect upon the menstrual health of the occupation pursued after leaving school. It was hoped that the answers to this question would cover a wide range of employments, but they are on the contrary very limited. This is owing to the great difficulty of obtaining answers from women of the industrial classes, unless during a medical consultation, when they are of course sick, and to be excluded from a table of healthy cases.

[1] From enumeration of the *names* of studies pursued, a false impression would be conveyed that these were much more arduous than in truth was the case.

TABLE III.—OCCUPATIONS. (GROUP I.)

Married.	Social and Housework.	Teaching.	Other employ.	Married and Employed.
....	....	....	Literary = 3	....
....	....	27, or 29⅔	Medicine = 8	....
23, or	....	per cent.	Factory = 4	6
....	....	....	Clerk = 1	....
25 per cent.	....	....	Business = 1	....
....	9, or	...	Machine work = 1	....
....	8 per cent.	....	Servants = 3	....
....	....	....	Study = 3 + 5 = 8	....
....	...	....	Matron = 1	13+6=19, or
....	....	....	Total, 13	20 per cent.

Among the married women it was interesting to ascertain the number of children born. Adding to the twenty-three married and devoted to household duties exclusively, the six who continued teaching, literature, or medicine, after marriage and childbirth, we have:

One.	Two.	Three.	Four.	Five.	Six.	Seven.	Eight.	Nine.	Ten.	None.
3	7	4	1	3	2				1	5

Thus twenty-one women bore children, five were childless; in three cases questions not answered.

Among the twenty-one mothers the pregnancies were nearly all favorable.

An important question is the fourteenth, regarding the amount of exercise of which the women are capable who are free from menstrual disorder. The following table shows that by far the greatest number of persons in this class are capable of considerable physical exertion, and even take a good deal of exercise habitually.

TABLE IV.

Able to walk from 3 to 15 miles...	68
Walk 2 miles or under	18

The majority of persons in the first class claim to be able to walk five or six miles with ease at any time, and ten or fifteen when called upon to do so, especially during summer vacations in the country.

The percentages are respectively 79 and 21.

Having ascertained that ninety-four women out of our total list of two hundred and fifty-two do not suffer pain or disturbance at the menstrual period, it is necessary to learn whether this had been avoided by the habit of resting at that time. Also whether, in the absence of rest, but with habitually normal menstruation, uterine diseases had ever occurred. Finally, whether this class of persons had lost or gained in health since the age of twenty. This question has no significance for women under thirty, but, as we shall see in analyzing the cases of disturbed menstruation, it is of much importance at or after that age. Questions 13, 15, and 16 were framed to meet these indications. Out of the total number of ninety answers, the following alone were other than negative:

TABLE V.

Habit of resting.	Treated for uterine disease.	Change in health since 20.	
		Increased strength.	Diminished strength.
9, or 10 per cent.	3	10	8

From this table it could certainly not be inferred that the immunity from menstrual pain was due to the habit of resting during the menstrual flow, for such habit existed in only a small minority of the cases. Among the nine persons in the habit of resting, the duration of the rest, and the reasons for taking it, were very various, as shown by the following table:

TABLE VI.

No.	Duration of rest.	Remarks.
13	First day.	To avoid dyspepsia.
62	Whole week.	To avoid aggravation of chronic dyspepsia resulting from dilatation of stomach.
81	Sometimes half a day.	
63	Whole week.	Extremely nervous person, subject to prolonged hay asthma debility.
71	Whole week.	Anemia after diphtheria and two confinements.
85	Seldom.	
39	An hour.	
88	First day.	
82	Only during two years while suffering from "ulceration" of uterus.	

We must now analyze one hundred and seventy-four cases in which menstruation was painful, or presented some anomaly in regard to quantity or regularity. We will first compare these cases, as far as possible, with those of the first class, in a series of tables similar to those already framed. One hundred and seventy cases are represented on the first table.

TABLE VII.—OF ATTENDANCE AT SCHOOL OF SECOND CLASS.

Age of beginning school.	No.	Age of leaving school.	No.	Hours of study.	No.
2 years.	1	12 years.	1	2	2
3 "	8	13 "	2	4	3
4 "	18	14 "	8	5	..
5 "	22	15 "	6	..	20
6 "	19	16 "	18	6	49
7 "	27	17 "	29	7	17
8 "	16	18 "	26	8	12
9 "	9	19 "	14	9	11
10 "	1	20 "	8	10	2
11 "	1	21 "	3	12	1
12 "	3	22 "	4	..	..
17 "	1	23 "	1	..	..
.....	..	24 "	2	..	..
.....	..	25 "	3	..	..
.....	..	30 "	1	..	..
Total	127	Total	126	Total.....	117

Not specified, but very little education	31	..
Not specified, but very much study	2	..
Special remarks	10	..
Total	43	..
Total (43 + 127) =	170	..

Additional to above, with special remarks:

No. 49	School from 9–10, and from 15–16, then until 18. Study hours there 9–10.
" 60	Educated at home.
" 53	Educated at home. 3–4 hours study daily.
" 69	Complete literary and medical course.
" 84	Graduated at medical college.
" 88	Study hours vary from 4 to 12.
" 94	Interruption school between 18 and 21.
" 103	No school between 10 and 19, then for 1½ years.
" 105	Attended school from 13 to 17, then from 21 to 24.
" 143	Educated at home till 15, then school to 18, now till 20.

Comparing item by item this table with the corresponding table in the first class we find:

1. That a large majority of the number attended school for a number of years, spending a number of hours daily in study, but a considerable minority, whose attendance is not specified, received very little education; thirty-one cases, drawn from personal observation, have been ranked in this way, and in the additional table for special remarks, it appears that out of the ten cases, one was educated at home, with three to four hours daily study, one did not go to school until fifteen, and four sustained interruptions in their studies of several years. The proportion of persons whose schooling has been slight, is much larger therefore in the second class, that is among those whose menstruation is painful, than in the first where it is not painful, 170: 31 = 18 per cent.

2. Among the cases where this is specified, the age of beginning school is as in the first table, principally between

five and eight. But the proportion who begin at this epoch is smaller than in the first class, being 74 or nearly 59 per cent, instead of 69. The per centage to the entire number (170) is 43. On the other hand the proportion of those who began to go to school under five, is larger, being 27 or 21 per cent, (15 per cent. of the whole number 170) while in the first table it is 12, or 13 per cent. The number of persons who first went to school at two years or over, is only 13, or less than 12 per cent, (17 per cent. of the whole) while in the first class it is 15, or 17 per cent.

3. The age of leaving school differs from that of the first table. The greatest number recorded, twenty-nine, leave at seventeen instead of sixteen. This is 22 per cent. of those specified, nearly the same proportion as left a year younger in the first table. But of the whole number (169) it is only 17 per cent. The next age in frequency is eighteen, when the number is twenty-six, or 20 per cent, (18 per cent. of whole) and fourteen persons or 11 per cent, do not leave till nineteen. The percentage of this age is thus but little over that on the first table, and calculated on the whole number is less, being 8 per cent. But the ages seventeen and eighteen furnish collectively, 55 or 43 per cent, (32 per cent. of whole) while on the first table, the same ages give only 24 per cent. In this class therefore, the proportion of persons who leave school late is much larger than in the first class. The excess of schooling, however, is only for one year, and does not extend beyond the age of eighteen, percentage for nineteen, being nearly identical on the two tables.

4. Only eleven persons are recorded as pursuing studies to or beyond the age of twenty-two, a percentage of 8½ against a percentage of 16 on the first table (6 per cent. of the whole). This comparison shows that while the duration of primary and secondary education was more prolonged in the second class than in the first, the proportion of what may be presumed to be comparatively advanced studies was twice

or nearly three times as large in the first class as in the second.

5. The number of hours spent in study during school life is about the same as in the first table. This was to be expected from the uniformity of the school routine to which American girls are subjected. Forty-nine are said to have studied six hours a day. This, however, is only 39 per cent. of those specified, or 22 per cent. of the whole, while on the first table this number covers 51 per cent. of those specified, or 43 per cent. of the whole. Twenty-five persons, that is, 19 per cent. of the specified cases, or 14 per cent. of the whole, studied less than this, the majority, (20) occupying five hours. This proportion is sensibly the same as that of the first class, (18 per cent. of those specified, 15 per cent. of the whole). Forty-three persons are said to have studied seven hours and over, of whom three claim to have thus spent from ten to twelve hours daily. These then were among those whose studies were continued after age of twenty-one. This proportion is 33 per cent. of those specified, or 25 per cent. of the whole. In the first class the percentages are 26 and 22, a good deal less.

The next table shows the amount of exercise taken by girls, in whom this was specified.

TABLE VIII. EXERCISE OF SECOND CLASS.

Half Hour.	One Hour.	Two Hours.	Three Hours.	Four Hours.	Five or Six Hours.	All out of School.	Irregular or Indefinite.
13	30	29	17	10	13	11	46

Out of the one hundred and sixty-nine cases, eighty, or 47 per cent. are said to have exercised two hours or over, and eighty-nine, or nearly 50 per cent. have exercised irregularly or insufficiently. The proportions, therefore, are exactly the reverse of those of the first class, which we have

found to be respectively 57 and 42 per cent. (see page 30.) Now for children and young girls, two hours must certainly be considered as the very minimum of exercise, admissible as hygienic. In the second class, it represents much the largest number of cases among those who can be considered to have exercised at all, namely 29, as compared with 17, 10, 13 and 11, while in the first class the number 15, of those who exercised two hours, is equalled by those who exercised four. In the first class the percentage of persons exercising three hours and over is 38, while in the second class it is only 30. It is clear, therefore, that as a whole, the amount of exercise taken during school life by persons who, at any age, became subject to painful menstruation, is inferior to that taken by those who, up to date, were perfectly free from menstrual inconvenience. The absolute figures, however, 80 and 89, are sufficiently near alike to necessitate a closer analysis. Among the one hundred and sixty-nine cases here grouped together as suffering from menstrual pain, the degree of suffering, the age at which it first occurred, and the concomitant circumstances of general health vary considerably, and one of the most important distinctions is to be made between the cases where menstruation was painful from the beginning, and those in which the habit of pain was only acquired later in life. Among the one hundred and seventy persons, menstruation had been more or less painful, scanty or excessive from the beginning in 90, or 53 per cent; while in 80, or 46 per cent. no inconvenience was experienced, until some time after its establishment. We will call these two classes of cases, Groups II and IV.[1] In Group II, three persons are said to have suffered exclusively during the first two years of menstruation, which coincided with school life, while others continued to do so up to date. In one of these, (No 177) the pain is said to have been "dreadful" and spasmodic, before marriage, and

[1] Group I being the class without pain. Group III includes those who suffered from the beginning, but slightly.

not to have existed since. In three of the remaining cases, the patients suffered, not from pain, but from amenorrhea (cases 116, 127, 143). The history of each of these is interesting, and will be analyzed later. In sixteen cases the pain at menstruation was so slight, that practically the patients might have been ranked in the class of painless cases. Finally seventy persons suffered from pain decided or severe, in some cases very severe, or else, instead of pain, were prostrated by excessive flowing. These latter, however, were in the minority, only six. Two of these (130 and 146) suffered from severe dysmenorrhea during the first six or seven years of menstrual life, but later the pain was replaced by menorrhagia. The interpretation of such cases is of much importance. These general results may be thus tabulated.

TABLE IX. (Groups 2 and 3.)

Severe pain.	Menorrhagia.	Amenorrhea.	Per cent. of preceding.	Slight pain.	Per cent.
64	6	3	80 per cent.	18	19 per cent.

Among the seventy-three cases of those who suffered severely from pain, menorrhagia, or amenorrhea, forty-three, or 58 per cent., exercised while at school two hours and under a day, frequently not more than one, while twenty-one, or 28 per cent., exercised three hours and over. Nine cases are not specified. Among the eighteen who suffered but slightly, eleven, or 61 per cent., exercised two hours and under, and seven, or 37½ per cent., exercised three hours and over.

TABLE X.—EXERCISE IN SCHOOL LIFE. (Groups 2 and 3.)

	Two hours or under.	Three hours or over.
Severe pain ...	58 per cent.	28 per cent. (30 per cent of whole).
Slight pain....	61 per cent.	37½ per cent.

The proportions do not vary enough to largely explain the comparative immunity of the second division by a greater attention to exercise during school life, yet the balance, such as it is, is in favor of this influence, since in this division 37½ per cent. obtained abundant exercise, while this was the case with only 32 per cent. of the first division. Individual cases are not always in accordance with this general average, however. Thus case 85 was accustomed to only one and a half hours exercise, yet suffered little pain, while No. 54 exercised five to six hours, yet suffered severe menstrual pain until the birth of first child.[1] Nevertheless, from the general average, we are warranted in concluding that insufficient exercise during school life may be one factor in the production of severely painful menstruation, since among those who suffered severely, a smaller proportion of girls exercised sufficiently than among those who experienced only slight discomfort.

Upon comparing these results with those obtained from the first series of ninety cases, in which menstruation occasioned no pain or inconvenience, we find that the proportion of exercise was in them greater than among the cases of the second series. This has been shown, page 30. The proportion of those who exercised over two hours was 57⅛ per cent., and under, 42⅞ per cent. If we add together the numbers of those who suffered very slightly and those who did not suffer at all, we have a total of one hundred and eight, of whom sixty-five, or 60 per cent., took sufficient exercise, while thirty-nine, or 36 per cent., exercised very little. The difference between the two is 24 per cent, while the difference between the two divisions of those who suffered severe pain is 30 per cent.

[1] This patient was treated for subinvolution, but reports herself cured. As the larger number of very severe dysmenorrheas of early adolescence are associated with a narrow os uteri, and this is an index of general lack of development of the organ, there is an indication of deficient nutritive force in the generative organs that might be expected to favor subinvolution.

The family history of girls who began to suffer pain with their first menstruation is most important. Among sixty-seven persons suffering from severe pain, or else from amenorrhea, the family health is said to have been good in twenty-six, or 38⅔ per cent., and poor in forty-one, or 61 per cent. Among the twenty-six cases, twenty-one are reported simply as good, one as very good, one as perfectly good, one as perfect, one as excellent, one as unsurpassed. The family history of the forty-one other cases deserves to be tabulated.

TABLE XI. FAMILY HEALTH. (GROUP II.)

	Good.
	26, or 38⅔ per cent.
	Poor.
	41, or 61⅓ per cent.
17	Scrofula.
24	Poor.
26	Scrofula.
28	Childhood delicate.
10	Mother consumptive.
36	" uterine disease.
39	" cancer.
42	Father consumptive.
51	Childhood delicate.
54	Parents "
61	Consumptive.
74	Father rheumatic.
78	Gout rheumatism.
75	"
81	Childhood sickly.
84	Parents consumptive.
93	"
99	Poor.
100	Consumption.
101	"
111	Sister tuberculous, subinvolved uterus
112	" severely epileptic.

115	Mother menorrhagic.
116	" subinvolved uterus.
120	Sister with uterine disease.
123	Mother " " "
126	Sisters " " "
127	Poor.
129	Gout.
130	Sister endometritis.
131	Family hysterical.
134	Poor.
140	Gout.
144	Mother subinvolution.
146	Uterine disease.
148	Delicate.
149	"
150	"
153	"
159	Father consumptive.
160	Sister uterine disease.
172	Poor, rheumatism.

Of the eighteen persons suffering slight pain, in ten the family health was delicate or consumptive, in six only was good, in two was not specified. As in the table for exercise it is well to add together, for the comparison of family health, the group of persons suffering *slight* menstrual pain during adolescence, (which we will henceforth call Group III,) and of those who did not suffer at all (Group I). The following table represents the family health of the latter group:

TABLE XII.—FAMILY HEALTH OF GROUP I.

	Good.
	58 cases, or 63⅔ per cent. (1 excellent, 2 perfect).
	Poor.
	33, or 36⅓ per cent.
4	Mother, cancer.
2	Very delicate.
5	Chorea and hemiplegia as child.

13	Mother consumptive, childhood delicate.
17	Not very strong.
18	Sister epileptic.
22	Father consumptive.
28	Mother scrofulous.
29	Delicate.
30	Poor.
36	Mother and brother consumptive.
35	Sisters invalids.
39	Mother consumptive.
14	Very poor.
43	Not robust. Rheumatism.
46	Childhood delicate.
47	" frail, mother consumptive.
48	" " " rheumatic.
49	Mother consumptive.
51	Delicate childhood.
54	Eczema in family.
50	"Bilious."
53	Uterine disease.
60	Consumptive. Gout.
67	Poor.
68	Very delicate child.
70	Delicate.
76	Poor.
80	Delicate.
81	Poor.
82	Father head disease, sister consumptive.
85	Mother and sister delicate.
88	Mother rheumatic.

We then have:

TABLE XII.—FAMILY HEALTH. (GROUPS 1 AND 3.)

58 + 6 = 64, or 59 per cent.	Health of family good.
33 + 10 = 43, or 40 per cent.	Health of family poor.

The difference in the percentages of the two groups—that

in whom family health was good, and that in whom it was poor—is much lessened when the sixteen cases of "slight pain" are added to the ninety-one cases of "no pain." To assist in the interpretation of this fact, it is necessary to examine the statistics of the general health of the cases in the three groups thus far analyzed, namely, those who (Group I.) never have suffered pain at menstruation, those who from the first have suffered either from severe pain, from excessive flowing, or from amenorrhea (Group II.), and those who, also from the establishment of menstruation, have only experienced slight inconvenience (Group III.). The table is based on the answers to the seventh question in the circular, and to the fourteenth, the latter regarding the strength as estimated by the capacity for daily exercise. Eighty-seven cases are recorded.

TABLE XIV.—GENERAL HEALTH. GROUP I.

Good.	Poor.
70, or 80 per cent.	17, or 19 per cent.

The details of this table are given below:

TABLE GENERAL HEALTH. GROUP WITHOUT PAIN.

Nos.	General Health.	No. miles that can be walked daily.	Nos.	General Health.	No. miles that can be walked daily.
18	Improving till 24, then very good.	Till 15, 1 mile, now 6–8.	38	Good.	Very strong.
23	Good.	3–5.	43	Good.	Many miles
82	Sick headache.	1 mile.	39	Good.	4–6.
89	Good.	Indefinite.	14	Good.	12.
87	Good.	Long walks.	19	Very good.	3–4.
90	Good.	3 miles an hour.	10	Always good.	10.
92	Good.	3 miles.	27	Threatened with phthisis.	1 mile.
17	Good.	4–10.	7	Very good.	4 miles.
11	Excellent.	10.	48	Nearly perfect.	10 miles.
55	Good.	3–9.	9	Nearly perfect.	5–6.
40	Perfect.	8–10–12.	33	Sound.	3–6.
			24	Excellent.	20.

Nos.	General Health.	No. miles that can be walked daily	Nos.	General Health.	No. miles that can be walked daily.
3	Generally good.	4 till after 2d child.	41	Very good.	5–8.
			66	Congestive headaches at 30.	10.
2	Good.	9 miles.	67	Bad. Severe dyspepsia.	1.
22	Excellent.	5–6.			
20	Generally good.	1½.	68	Delicate.	1.
46	Good.	6.	81	Very good.	6–12.
80	Good.	5.	34	Good till marriage, now weak.	Formerly 6–10.
5	Fair.	Indefinite.			
85	Invalid from 17 to 25, now stronger.	2–3.	1	Excellent.	Strong.
			21	Very good.	All day.
45	Good.	6–7.	31	Perfect.	15 miles.
52	Good.	Long distance	26	Good.	10 miles.
56	Good.	5 miles.	32	Not vigorous.	1–2 miles.
29	Delicate.	3–4.	25	Only fair.	1 mile.
28	Strong in America.	1½.	47	Very good, but neuralgic.	Not much.
60	Bad health.	No distance.			
59	Very fine.	3 miles.	73	Good.	Not much.
58	Good.	10.	46	Excellent.	Strong.
91	Generally very good.	3–5.	37	Perfectly healthy.	Strong.
44	Always good.	5–10–20.	75	Sick headache.	3 hours.
8	Good. Sick headache.	Strong.	69	Good.	2 miles.
			71	Anemia after marriage.	1 mile.
13	Not good. Dyspepsia	1–2 miles.			
12	Good.	3 miles.	72	Good.	5–6.
16	Good.	5–6.	74	Good.	3–4.
54	Good, but osteitis once.	2 miles.	6	Perfectly good.	5–6.
			36	Fair.	3.
88	Good.	5–10.	53	Hysteria, anemia.	1.
4	Poor last 5 years.	3 miles.	56	Anemia.	2–3.
20	Good.	Several.	57	Delicate.	2.
49	Good.	4.	61	Robust, not accustomed to walk.	
15	Excellent.	5.			
51	Good.	Several.	62	Perfectly good.	10.
42	Good.	No distance.	63	Good.	2.
35	Good.	5 miles.	64	Good.	2.
52	Good.	5 miles.	65	Perfect.	10.

Out of eighty-six cases on this table, sixteen had delicate or poor health; the remaining seventy report themselves as in health—good, very good, excellent, or perfect. The proportions are 19 per cent. and 80 per cent. Upon comparing the specific cases on this table with those of Table XII. giving the family health of thirty-three cases of this Group I., we find that seven out of the seventeen cases of poor health report delicate childhood, hereditary consump-

tion, delicate family health, and in one case, uterine disease in other members of the family. The remaining ten cases, however, are included among the fifty-eight of Table XII., in which family health, and that of childhood, is reported as good or excellent.

On the other hand, out of seventy reported in good health and able to walk from three to twelve miles, twenty are recorded on Table XII with a bad family history. Thus No. 49, is able to walk nine miles, but the mother was consumptive. No 48 reports a frail childhood, but at present writing, "nearly perfect health" and ability to walk ten or eleven miles. No. 22, the father was consumptive, but present health is excellent, and ability to walk reaches five or six miles, and so on for the other twenty cases. That is to say that in 28 per cent. of the persons in good health, and free from menstrual pain, the health had decidedly improved since childhood and adolescence,[1] while in fifty cases or 71 per cent. the family health, and health during childhood had always been good.

The next Table exhibits the general health of the persons of the second group, those namely who have suffered severe pain from the beginning of menstruation.

TABLE XV. GENERAL HEALTH. (GROUP II.)

Good.	Poor.
24, or 34 per cent.	39, or 56 per cent.

The details are given below:

[1] It is assumed in this calculation, that the children of consumptive parents, generally exhibit some effects of inheritance under the age of twenty or not at all.

TABLE OF GENERAL HEALTH OF SECOND GROUP.

Nos.	General Health.	No. Miles.	Nos.	General Health.	No. Miles.
106	Good.	Blank.	161	Not strong.	Bet. 25 & 32.
76	"	5.	51	Excellent.	4–5.
97	" but neuralgic.	Little.	112	Extremely nervous.	1.
26	Not strong.	"	113	Good.	1.
84	Not stated.	4–5.	114	"	5–6.
39	Not strong.	Little.	115	Anemia.	1.
168	Medium.	15. (?)	116	Neurotic amenorrhea	4–5.
81	Not stated.	1.	120	Anemia.	1.
9	Fair.	1–6.	123	Good.	3–4.
175	Pretty fair.	3.	125	Anemia.	2–3.
6	Constant improvement.	3.	126	Congestion uterus.	½.
57	Very good.	Many.	127	Good, amenorrhea.	4–5.
130	Poor.	¼.	129	Neurotic.	2.
132	Good.	2.	78	Delicate.	5–6.
134	Neuralgic anemia.	2.	46	Fair.	Little.
140	Anemia.	2.	99	Very good.	Much.
143	Good, amenorrhea.	10.	110	" "	3–4.
145	Very good.	6.	21	Good.	4.
144	Fair.	4.	98	"	1–2.
146		2.	111	Poor.	½.
153	Anemic.	3.	3	Very good.	2–3.
154	Poor from uterine disease,	1.	42	Anemia.	2.
156	Severe hysteria.	Blank.	17	Not strong.	2.
61	Congest. uterus.	5 miles.	72	Good.	10.
55	Good.	Little.	28	Poor.	Very Little.
10	" backache last two years.	5–6.	75	Neuralgic.	2.
11	Good.	Blank,	26	Blank.	Blank.
87	"	Little.	101	Very good.	5.
100	"	3–20.	93	Kidney disease.	Little.
22	Blank.	Blank.	59	Poor, Neuralgic.	1–2.
25	"	1.	48	Good.	10 miles.
159	Improving.	Not much.	24	Blank.	3–4.
74	Headache.	2 bet. 19 & 25.	160	"	2 miles.
36	Not strong.	5.	41	Excellent.	3.
			171	Poor.	2.
			172	"	½.

Out of seventy cases (the three cases of amenorrhea are not included), seven are blank, twenty-four, or 34 per cent., are in good health, thirty-nine, or 56 per cent., in delicate or decidedly poor health. These proportions are in marked contrast to those of the first group, where 19 per cent. reported delicate health, and 80 per cent. good and excellent health. The amount of exercise taken by the persons of this

second group who consider their health good, is also inferior to that of the first group. Thus, after subtracting from the seventy women in good health, of the first group, ten who report indefinitely in regard to their capacity for exercise, stating it as many miles, "several miles," "long distance," etc., we find that the several maximum capacities of the remaining sixty would, if added together, amount to three hundred and fifty-five miles. This is an average of about six miles to each person, while, as the whole table shows, many profess to be able to walk ten, twelve, or even twenty miles. In the twenty-four similar cases from the second group, we must subtract two blanks, two indefinite, as "many miles," two as "very little," leaving eighteen cases. These give a sum total of maximum capacity of one hundred and two miles, or an average of a little over five miles to the individual. The difference is about one-sixth excess of exercise in favor of those who did not suffer pain. But in reality the difference is greater, since in the first group, all who reported indefinitely in regard to exercise (10) speak of being able to walk a great deal, while of the six exceptions in the second group, four walked only a little. If we assume that ten indefinites walked five miles, and the six exceptions two, the difference between the two groups would remain almost exactly the same. Seventy women of the first group would then be shown to walk four hundred and five miles, or an average of five and five-sevenths, and twenty-four women of the second group to walk one hundred and fourteen miles, or four and five-sevenths. The difference is still a mile, but the proportion is a little higher than one-sixth.

The similar statistics from the eighteen cases with slight pain are shown in the next table :

TABLE XVI.—GENERAL HEALTH OF THIRD GROUP.

Nos.	General Health.	No. Miles.	Nos.	General Health.	No. Miles.
91	Poor last 2 years.	3–4.	71	Treat. for uterine disease.	2–3.
85	Very good.	2–3.	88	Good.	5 m.
56	Excellent.	Long dist.	54	Good until child-bearing.	Very little.
44	Dyspepsia.	" "	102		Blank.
105	Good.	8.	58	Very fair.	8–9.
64	Improved.	6.	32	Good. Slight neuralgia.	Several.
107	Stronger.	5.	131	Neurotic.	2.
4	Very good.	8–10.	165	Good.	Little.
96	Blank.	3.			
15	Good.	6 m.			

From this table it appears that twelve, or 26 per cent., enjoy good health, while in six, or 33 per cent., the health is broken, or at least below par. The twelve persons in good health have a collective maximum capacity for exercise of sixty-four miles, or an average of five and one-fourth. In this estimate we have counted the report of "Long distance" as seven miles, "Several," three, "Blank" as two, and "Little" as one. The average is curiously similar to that obtained from the group of persons who suffered no pain, and in the same proportion superior to the section of the second group, where, in spite of painful menstruation, the general health was said to be good.

To show the constancy of these proportions we have made still another calculation from the exercise capacity tables of the second and third groups, in which the persons in good health and poor health, *i. e.* all the cases on the table, are taken together. The B. "Blank" is estimated at two miles, "Little" at one mile, and "many" at five. In the group second then, seventy persons walk collectively two hundred and twenty-eight miles, an average of three and one-fourth, while in group third, eighteen persons walk eighty-two miles, an average of four and five-ninths. Group

I., estimated in the same manner, gives four hundred and thirty-five miles for eighty-seven persons; or an average of exactly five miles. These results may be compared better in a single table bringing them together:

TABLE XVII.—MAXIMUM CAPACITY FOR EXERCISE.

Group 1. No Pain.	Group 2. Severe Pain.	Group 3. Slight Pain.
Average of entire group: 435 miles, or 5 a piece.	Average of entire group: 228 miles, or $3\frac{1}{4}$ a piece.	Average of entire group: 82 miles, or $4\frac{5}{9}$ a piece.
Average healthy section: 405 miles, or $5\frac{5}{7}$ a piece.	Average healthy section: 114 miles, or $4\frac{5}{7}$ a piece.	Average healthy section: 64 miles, or $5\frac{1}{4}$ a piece.

Before tabulating the statistics of occupations and of periodical rest of Groups 2 and 3, it is desirable to analyze the fourth group—of persons namely who began to suffer pain or other inconvenience during menstruation only at some period after its establishment. These cases have been separated from the rest, in order to distinguish between the influence of hereditary constitutions or congenital conditions, and that of modes of life, since the first would be expected to be felt, if at all, during adolescence; the second would only make itself apparent later, and should deepen with the persistence of its cause.

There are seventy-one cases in this category, or Group 4.[1] Of these, forty-three, or 60 per cent., suffered severely, while twenty-eight, or 39 per cent., only suffered occasionally or slightly.

These proportions differ considerably from those of the class in whom menstrual disturbance existed from the first (see Table IX.). The result may be contrasted in a single table:

[1] The remaining nine cases (see page 76) have not given sufficiently detailed histories.

TABLE XVIII.

Pain, etc., from first menstruation.		Pain, etc., subsequent to first.	
Severe.	Slight.	Severe.	Slight.
80 per cent.	19 per cent.	60 per cent.	39 per cent.

The statistics in regard to school attendance of this group have already been considered in contrasting the whole of the second class with the whole of the first.

It is desirable, however, to contrast the different schemes of education in the two divisions of the second class:

TABLE XIX.

Pain, etc., from the first. Education.			Pain, etc., subsequently. Education.		
Common Ed.	Ornamental.	Higher.	Common Ed.	Ornamental.	Higher.
28, or $31\frac{1}{2}$ per cent.	21, or 23 per cent.	40, or $44\frac{8}{10}$ per cent.	16, or 22 per cent.	26, or 36 per cent.	30, or 41 per cent.

The proportion in the two classes of persons who have only received a common English education, is 12 per cent. in favor of the first section. In ornamental education there is a difference of 13 per cent. in favor of the second section; and in the higher education, nearly 4 per cent. in favor of the first again. Thus those who had the least education were not thereby prevented from being the most precocious in menstrual suffering; and on the other hand, those in whom education was the most prolonged were not predominantly they in whom pain began a few years after the establishment of menstruation, *i. e.* at the epoch when the average course of study was being extended.

Finally the greatest difference obtains in regard to the

ornamental section which furnishes a much larger proportion of persons whose menstruation becomes deranged after the usual period of school life is over.

The next table shows the statistics of exercise taken while in school. The calculation excludes the third column.

TABLE XX. EXERCISE. (GROUP 4.)

Under Three Hours.	Three Hours and over.	Not stated.
41, or 62 per cent.	25, or 29 per cent.	6, or $8\frac{1}{3}$ per cent.

This table has been based on the calculation that any degree of exercise less than three hours, is insufficient for a growing school girl, and the very large proportion of cases from this group, when only this amount was taken, shows the influence the poor régime exercises upon the after life. It very closely resembles the per centage table in Groups II and III, when the pain was experienced from the first, (Table X), and also Table $1\frac{1}{2}$ of the painless cases. Nevertheless there is 3 per cent. insufficient exercise cases in favor of the Table of suffering persons, the per centages of really sufficient exercise being almost identical, while compared with the Table of those who suffered from the first, excess of insufficiency is 4 per cent, and excess of sufficiency in the former table, 1 per cent. It would follow that insufficient exercise during school life, exerted somewhat more influence upon the menstruation after the school epoch was completed than at the time.

The next table exhibits the family history of Group IV, compared with the preceding. The health is said to have been good in twenty-seven cases of the seventy in which it is recorded, or 39 per cent., and poor in forty-three, or 61 per

[1] The percentage in table will be found to be the same, if calculated on the whole number, as in the two groups, the second per centage is 30.

cent. These proportions much resemble those of the Group II, (severe pain.)

TABLE XXI OF FAMILY HEALTH OF FOUR GROUPS.

Group 1.		Group 2.		Group 3.		Group 4.	
Good.	58 or $63\frac{2}{3}$ per cent.	Good.	26 or $38\frac{2}{3}$ per cent.	Good.	6 or $37\frac{1}{2}$ per cent.	Good.	27 or 38 per cent.
Poor.	33 or $36\frac{1}{3}$ per cent.	Poor.	41 or $61\frac{2}{3}$ per cent.	Poor.	10 or $62\frac{1}{2}$ per cent.	Poor.	43 or 61 per cent.

Indeed a glance at the above table shows that the condition of family health, or health during childhood, was exceedingly alike in all three of the Groups representing pain, while in Group I or the painless Group, the proportions of good health to bad are exactly reversed. There is even a larger proportion of good hereditary antecedents in this Group, than there is of poor in the others. Specifications of poor health are about the same as in the other tables.

The occupations of Group IV are of much importance to consider.

TABLE XXII. OCCUPATIONS. (GROUP 4.)

Social.	Married.	Teaching.	Miscellaneous.
23, or $31\frac{7}{18}$ per cent.	9, or 11 per cent.	17, or 22 per cent.	Art ..... 3 Medicine..... 7 Servant ..... 1 Missionary ..... 1 Factory ..... 4 Clerk ..... 2 Photographs .... 1 Matron ..... 1 Literary ..... 1 Sister Charity... 1 22, or 30 per cent.

It is most important to contrast the Table of Occupations of Group 4, with that of Group I. For convenience, their contrast may be shown in a single table.

TABLE XXIII.

Social, *i. e.* unmarried and unemployed.		Married.		Teaching.		Miscellaneous.	
I.	8 per cent.	I.	25 per cent.	I.	$29\frac{2}{3}$ per cent.	I.	20 per cent.
IV	$31\frac{1}{13}$ per cent.	IV.	11 per cent.	IV.	22 per cent.	IV.	30 per cent.

The term "Social" on the table is used to include all unmarried women without special paid employment. On many of the circulars such persons record themselves as engaged in housework, on others as having no "occupation," or being young ladies "of leisure." Of the married women of Group I, twenty-one bore several children, and thus could be said to have a special employment.

The contrast between the number of married women in the two groups is most remarkable. While among those who never suffer pain at menstruation, 25 per cent. are married, from the group that some time after the establishment of menstruation began to suffer pain, only 11 per cent. are married. Again only 8 per cent. of the painless group are recorded as without special occupations, while nearly 32 per cent. are so recorded in the second division.

This proportion is higher than that of persons engaged in Teaching or Miscellaneous occupations. There is a larger proportion of teachers in the painless than in the painful group, but the proportion of Miscellaneous occupations is larger in the latter. It happens, however, that the actual numbers of the most intellectual and the most mechanical occupation among these, are almost identical in the two groups. In the first group are eight cases for medical, and four for factory work. In the fourth group, seven for medicine, and equally four for the factory.

So far as any inferences can be drawn from these figures,

we may conclude that adult women who are married escape danger of menstrual disturbance in the proportion of 14 per cent., (25–11) and that those who are unmarried and without occupation, incur this danger in the proportion of 24 per cent. (32–8.) Finally that among the small numbers of occupations examined, teaching would seem to be the least liable to be followed by disturbance of menstrual health. This last conclusion, however, cannot be relied upon, since the proportion of no other occupation given is large enough to be compared with teaching.

The significance of a table of occupations of Groups II and III is rather to demonstrate the extent to which women may continue work, even though partially crippled by menstrual suffering, than to show how this could be influenced by their work, since it existed before any occupation was taken up. It has been omitted.

It is now necessary to ascertain what proportion of Group IV retained fair general health and capacity for exercise, even though acquiring the habit of menstrual pain.

Among the seventy-two persons in Group IV, thirty, or $41\frac{2}{3}$ per cent. had been treated for some form of uterine disease, while forty-two, or $58\frac{1}{3}$ per cent. had never been so treated, thirty-two, or $44\frac{1}{3}$ per cent. were in good general health, while forty, or $55\frac{5}{9}$ per cent. were in poor health. Of the thirty-two persons in good general health, only five are said to have had severe pain, in eight cases the degree is not specified, and in nineteen, it is said to have been slight or occasional. In the great majority of the cases therefore, when the habit of menstrual suffering was acquired, it coincided with a breaking down of the general health.

In regard to the maximum capacity for exercise, calculated as for the preceding groups, (see Table XVII), it is found that the seventy-two persons collectively could walk two hundred and eighty-eight miles, or exactly four a-piece. This is less than for any group, except that of severe primary

pain. The thirty-two persons in good health walked one hundred and eighty-two miles, or five and eleven-twelfths a-piece, while the forty persons in poor health walked one hundred and six miles, or two and nine-tenths a piece. This last is very much the smallest on any table, while the average of the healthy section, as seen, does not differ materially from that of the groups who suffered no pain, especially of the healthy section of that group. Unless, therefore, the habit of menstrual pain resulted from or was associated with deterioration of general health, it did not affect the strength or capacity for exercise, nor presumably of work.

The final inquiry refers to the amount of rest observed during the menstrual period by the persons of Group IV. Forty-two persons, or 58⅓ per cent., habitually required rest, during from one-half day (one case) to one week. In all the cases but two, this rest was taken. In thirty cases, or 41⅔ per cent., no rest was indulged in, except occasionally, and in only two of these cases was it considered desirable.

Of Groups II. and III. of ninety-one cases, forty-six required rest; and all but five of them rested, from a few hours to several days. This is 50⅝ per cent. Forty-four, or 48⅓ per cent., required no rest. Of course in this number are included the sixteen cases of very slight pain, and the three cases of amenorrhea, leaving, however, twenty-five cases of dysmenorrhea or menorrhagia, when, notwithstanding the suffering, no rest was claimed.

The statistics of rest for the four groups may be conveniently contrasted in the following table:

TABLE XXIV.—OF REST.

	Group I.	Groups II. and III.	Group IV.
Rest ...	9, or 11 per cent.	46, or 50⅝ per cent.	42, or 58⅓ per cent.
No rest.	80, or 88 per cent.	44, or 48⅓ per cent.	30, or 41⅔ per cent.

It is unfortunately difficult from these tables to infer to what extent the neglect of rest could be blamed for the habit of menstrual pain gradually developed, since in no instance does rest seem to have been observed until or unless pain, or weakness from excessive flow were present; and the habit was stopped as soon as, by the cure of uterine disease, or by improvement of the general health, menstrual discomfort abated. It is worth noting as a net result, that of two hundred and fifty-two women where the detail is stated, ninety-seven, or 38 per cent., were in the habit of resting more or less during menstruation, while one hundred and fifty-five, or 61 per cent., took no rest at all.

We will now summarize the results obtained from the analysis of two hundred and sixty-eight cases, whose histories enter more or less completely into the foregoing series of tables.

1. Out of this number of women interrogated at hazard, ninety-four, or 35 per cent., declare themselves to have been alway's completely free from discomfort during menstruation. Moreover, if we add to this number the eighteen from Table IX, and twenty-eight from Group IV on page 57, who only suffered slightly or occasionally, we have a total of one hundred and forty, or 59 per cent. of cases where menstruation, so far as the consciousness of the women went, could not be considered of sufficient moment to interrupt daily avocations. It is to be remembered that from these statistics are carefully excluded those cases where the women, though suffering slight pain, are more dangerously prostrated by excessive hemorrhage.

If our statistics be combined with those of Brierre de Boismont given on page 26, we shall have a total of (268+360) six hundred and twenty-eight women. Of these (94+82) one hundred and seventy-six were completely free from pain, (28 per cent.), while (154+278) four hundred and thirty-two, or 68⅞ per cent., suffered to a greater or less extent. As Brierre de Boismont, however, does not distinguish between

the trifling colic, to which scarcely any attention is paid, and the severe dysmenorrhea, which temporarily prostrates the unfortunate victim, his statistics are, for practical purposes, much less valuable than ours, and the last combination of them with ours of much less significance than the first.

There remain, however, on our own statistics, one hundred and twenty-eight cases, or 47 per cent., of women to whom menstruation was a seriously painful, therefore morbid process. It may be at once asserted that in all such cases rest, during the existence of such pain, is as desirable as during the occurrence of any other.

2. Of the one hundred and sixty-two painful cases, *i. e.* including all degrees of pain, 53 per cent. had been so from the beginning; in 46 per cent. the habit had been acquired. The importance of this distinction will appear when we discuss in detail the causes of menstrual pain. It is evident at the outset, that wherever pain had existed from the age of thirteen or fourteen, no unremitting occupation, adopted eight or ten years later, could be held to be the cause of it. The only occupation to be considered in this connection is that of study at school.

3. The number of hours spent in study while at school, the studies pursued, and the number of years occupied by education, are all a good deal alike throughout our entire series of cases. Nevertheless, it has been shown (*a*) that 18 per cent. of the second class (pain) received very little education, while none are so specified in the first class. (*b*) The average for beginning school attendance is younger in the second class than in the first (see page 37). The most frequent age in both classes is from five to eight; but in the second class (pain) 21 per cent. of these begin under five, while in the first class it is 13 per cent. (*c*) The average of leaving is also nearly the same, and, from the tables, no reliable conclusions can be drawn in regard to this point. The proportion of persons who pursued advanced studies

beyond the age of twenty-two, was 16 per cent. in the first class (painless), only 8½ in the second, as observed on page 37. The educational coincidences of menstrual pain are therefore with more prolonged primary and secondary education, but seem to have no connection with higher studies. (*d*) Combining the results of Table II., page 31, and Table XIX., page 52, we find that among those specified from the painless group (76 out of 94) the proportions of common, ornamental, and higher systems of education are respectively 26⅓, 18½, 55⅓ per cent., while among the persons who suffered pain it is 27, 29, and 43 per cent. These figures show that the larger proportion of our statistics have been taken (accidentally) from among persons comparatively highly educated. The highest education (at present given to women) is, according to these proportions, much the most favorable to menstrual health; the least favorable is the ornamental system. This is generally received by a class that figure apart on the table of occupations, as having no occupation.

4. Throughout our entire series of cases the majority of persons are shown to have had too little exercise during childhood and girlhood. Comparatively few have received anything like a systematic physical education. But the class who never suffered menstrual pain exercised a great deal more than the other class. 67 per cent. received a fair share of exercise, while in the second class, only 47 per cent. (see page 52).

5. There is a remarkable contrast in the family history of the persons who never suffered pain, and of those who did; and the percentage of good health and bad is almost identical in those who suffered pain from the beginning, and in those in whom the painful habit was acquired. By combining the columns for Groups II. and III. in Table XXI., we have for persons who never suffered pain, good family history in 63⅔ per cent., while in those who suffered from the beginning it was 38, and in those who acquired suffering, also 38 per

cent. The percentages of poor health are respectively $36\frac{1}{3}$, 61, and $62\frac{1}{3}$ per cent. These figures show conclusively that a large proportion, two-thirds, of persons suffering at menstruation, inherit some defect either of general constitution, or of special tendency to uterine disease, or else have passed a delicate childhood; while on the other hand, the very same proportion, two-thirds, of persons healthy in regard to menstruation, had passed a vigorous childhood and inherited strong constitutions.[1] These facts are all to be considered in estimating the degree to which pain at menstruation is to be regarded as a normal character, inherent in a physiological process.

6. Similar inferences are to be drawn from the tables showing the actual general health and maximum capacity for exercise of persons comprised in the different groups. In the persons without pain, the average capacity for exercise was five miles, while many claimed to walk ten or fifteen, a few even twenty. Among the persons who suffered severe pain from the beginning of menstruation the average was three and one-quarter, of slight pain four and five-ninths, and of acquired pain, four miles. Capacity for exercise was nearly always in inverse proportion to the habit of pain.

7. From the tables of occupation the principal fact to be deduced was, that persons without occupation suffered at menstruation in a much larger proportion than those who were occupied. On Table XXIII. only two groups are contrasted, those who never suffered, and those who acquired the habit (see page 55). It has been noticed above, that the persons classed under the head of "social" or housekeeping occupations, are largely those who received the "ornamental" education. They are also all unmarried.

[1] Further that in those whose menstrual health breaks down after several years, family history seems to be accountable to precisely the same extent as in those who suffer from the beginning. This circumstance is of great importance in estimating the influence of occupations that are the apparent cause of the breakdown.

8. Marriage finally (see page 55) is much more opposed than celibacy to the persistence of menstrual pain in adult life. From accidental circumstances, the number of celibates is larger in our series than the number of married women. Were it not so, we should, as it appears, have reason to find a much larger proportion of women free from menstrual pain.[1]

Rest during menstruation cannot be shown, from our present statistics, to exert any influence in preventing pain, since, when no pain existed, it was rarely taken (see page 57, Table XXIV.).

In Group IV., where pain had been acquired, the habit of resting was acquired in many cases with it (58⅓ per cent.), but not in all. It is precisely in regard to this group that the question is pertinent, whether a habit of resting, adopted early in life, might have prevented the development of suffering; but from the table itself, we can obtain no answer to this question.

Judging by these statistics alone, therefore, we should say, that immunity from menstrual suffering was to be expected in proportion to: 1. The vigor of health during childhood, and the soundness of family history, especially in regard to freedom from constitutional taint of scrofula, consumption, or rheumatism, or family tendency to uterine disease.

2. To the degree of exercise taken during school life.

3. To the thoroughness and extension of the mental education.

4. To the degree to which general health, and capacity for exercise, was maintained after cessation of study.

5. To steadiness of occupation.

6. Finally, to marriage at a suitable time.

As regards rest—the most important question for our purpose—we have seen that the above data do not suffice to

[1] We do not of course mean to deny that marriage, by means of childbearing, often becomes the starting point of uterine disease, but even this is not always accompanied by dysmenorrhœa.

inform us of its influence. We can only assert negatively, that in a large proportion of cases it has been quite superfluous.

Several questions are suggested by this summary.

1. Why does menstrual pain exist from the first menstruation in some cases, and not until long after in others, and what is the true cause of it in each class of cases?

2. Why is it that a large number of persons, though the minority, suffer menstrual pain, though otherwise in good health, while conversely, many others (also the minority), though in delicate or even feeble health, experience no special discomfort at the menstrual epoch?

3. Why should pain ever be experienced during the menstrual flow, any more than during an epistaxis, or any other natural evacuation? If menstruation be a physiological process, for which due provision has been made in the economy, why should it, in 46 per cent. of cases of persons in civilized classes of society, create disturbance?

4. Is there anything peculiarly threatening about this disturbance when it exists, so that such resolute effort to disregard it as is frequently considered desirable for other pain --headache, neuralgia—should be strenuously discouraged, as liable to lead to a still greater evil?

5. Finally, is there anything in the nature of menstruation that should lead us to expect a necessity for mental and physical rest, even when no pain was experienced?—the capital question of the Essay.

It is evident that the answers to all these questions depend on the Theory of Menstruation, and this is as yet far from being established upon immovable foundations.

SECTION III.

THEORY OF MENSTRUATION.

AT the beginning of this Essay, a few quotations were made, showing some of the various opinions that had been held upon this interesting topic. These opinions may be divided into three classes, which roughly correspond to three epochs, of very unequal duration.

The first is the Theory of Plethora, which considered the menstrual flux to represent the nutriment, in excess over the wants of the individual, provided for the wants of the fœtus. With this view was generally associated a cosmic theory, by which, in virtue of its peculiar periodicity, the menstrual flux was associated with the phases of the moon, or other cosmic phenomena. This theory prevailed more or less, from the time of Hippocrates to the time of Pouchet.

The second is the famous Ovulation Theory, distinctly formulated about 1845, which construes the menstrual hemorrhage as a subsidiary phenomenon, entirely dependent on the periodical dehiscence of ovules. Around this theory has clustered the most brilliant gynecological literature of modern times. Yet this famous theory is, in these last few years, being attacked and hard pressed on all sides, and seems likely to yield place to a third, scarcely yet defined enough to have a name, according to which ovulation and the menstrual hemorrhage are processes coincident but distinct, the latter being subsidiary, not to changes in the ovary, but in the uterus preparatory for a pregnancy. For our purpose it is worth while to examine each of these theories a little closely, but not in the order stated. The ovulation theory, by right of preëminence, holds the first place, and must be examined first.

In the discussion of the ovular theory, it is not necessary to repeat in detail the history of its establishment, which has been related so frequently (see Pouchet, Courty, Ritchie, Raciborski, etc.). For our purpose it is sufficient to dwell upon the following circumstances that have occasioned the most discussion. These are, the development of the Graafian vesicle; the origin and nature of the ovule; the periodicity or continuity of its growth; the cause of its dehiscence; the relation of this in point of time to the menstrual hemorrhage; the succession of changes occurring in the uterus in connection with the flow; the relations of the hemorrhage to conditions of general nutrition, of the nervous system, or of vascular tension, etc.

Negrier[1] asserted that at birth the ovaries were homogeneous; that the primary vesicles appeared during the first year, and first began to attain any size towards the tenth year. Cruveilhier says: "They (the ovaries of the fœtus) contain a certain number of very small vesicles, or rather granulations."—Anat. Descrip., T. III., p. 649. 1843.

According to Raciborski[2] all anatomists adopted the opinion, until lately, that the ovaries of the fœtus contained only the germs of the Graafian vesicles, around which these latter were formed some years after birth. This author also credits Sappey with the discovery, that in the ovary of a child two years old existed 400,000 follicles.[3] But in 1837, Carus[4] already described Graafian vesicles in young children. In 1864, Henle[5] counted the follicles in the ovary of the newborn, and estimated them at 360,000.

The researches of Pfluger on the origin of the follicles date from 1863. All modern anatomists agree that "the formation, development, and maturation of the Graafian vesicles and ova continue uninterruptedly from infancy to

[1] Recherches sur les Ovaires.
[2] Loc. cit., p. 51.
[3] Traite d'Anatomie Descriptive. 1867.
[4] Mullers Archiv. 1837.
[5] Handbuch der Systematisch Anat., Bd. II., p. 484.

the end of the fruitful period of woman's life."[1] "The Graafian vesicles are formed already in the fœtus and in the new born, but they are also found in the adult.[2] This last statement is formally contradicted by Waldeyer. "The follicles," says this distinguished observer, "appear first at eighteen or twenty weeks of fœtal life. At this time they contain the ovule, and a simple lining of epithelial cells, much smaller than the egg cell."[3] In 1863, Pfluger[4] described the Graafian follicles as originating in tubular prolongations from the peritoneal epithelium, that dip down into the vascular stroma of the ovary. At a period when the stroma is not yet solid, it is easy to distinguish these tubes. Waldeyer compares their invasion to that of the hair follicles and sebaceous glands in the skin. As they penetrate, the extremity near the surface becomes gradually constricted and finally closed, and surrounded by a network of conjunctive tissue. This, by two and a half years, has formed a thick capsular layer, surrounding the ovum.[5] At this time the ovary has almost the same structure as in the adult (Waldeyer). "Follicles more or less ripe, indistinguishable by any sign from those of adult women, may be found in the ovaries of girls from one week to fourteen years old."[6] Ritchie, in 1865, relates in detail three autopsies of children —one at birth, one at sixteen weeks, one at five and one-half years. In each case the surface of the ovaries was smooth; but in the first, two vesicles, in the third, seven or eight, were found, while the interior of the second was found to be thickly studded with extremely delicate vesicles, vary-

[1] Gray, Human Anatomy, p. 753. 2d Ed. 1860. p. 710. 1870.

[2] Beaunis et Bouchard, Elements d'Anatomie Descriptive, p. 829.

[3] Die Eierstocke, p. 21. 1871.

[4] Ueber die Eierstocke du Saugethiere.

[5] Klebs, Die Eierstocke der Saugethiere und Vogel. Arch. Virchow. Bd. 28. 1863.

[6] Grobe, Ueber der Bau und das Waehsthum des menschlichen Eierstocks Arch. Virch. Bd. 26.

ing in size from a pin's head to a mere point, and filled with a milky fluid. In the ovary from the child of five years old, the largest vesicle was the size of a mustard seed, had an opaque capsule, and contained a reddish colored coagulum. The capsule of another was of a brick red color, and contained a coagulum of lighter shade in its central part, but surrounded by a delicate disc of what appeared to be dark colored blood.[1] Two differences, according to Waldeyer, principally distinguish the ovary of the new born from that of the adult. The layer of conjunctive tissue surrounding the follicles (albuginea) consists of one thin layer of fibres, and little follicles still lie together in grape shaped groups. His and Grobe describe important changes in the stroma, and insist upon its increased vascularization, observed at the approach of puberty; but from the time that the tubes are once converted into circular follicles, the structure of these latter remains essentially the same. Henle (loc. cit.) says that the wall of the follicle consists of a Tunica fibrosa and Tunica propria folliculi, the first derived from the ovarian stroma, the second developed from the lining membrane of cells—membrana granulosa. Waldeyer admits the existence of these two layers, but derives both of them from the stroma of the ovary, in which the original tubular prolongation of cells had been imbedded. This is also the opinion of Klebs. Slaviansky describes the same membranes under the name, "Perifollicular" layer, as distinguished from the parenchyma, and admits, with Henle, a membrana propria, rich in round cells, and an external layer of loose reticulated conjunctive tissue, composed of fibres and fusiform cells. The membrana propria, whose existence is denied by Klebs, is described by Slaviansky as the basement membrane underlying the epithelial cells of the membrana granulosa. It is easily seen in fresh specimens, is originally endothelial, as can be demonstrated by staining with silver, but finally loses

[1] Contributions to Ovarian Physiology and Pathology, p. 16. 1865.

its nuclei. It does not exist in the primordial follicles (Waldeyer). The parenchyma of the follicle (Slaviansky), or contents (Waldeyer), consists of the membrana granulosa, or the epithelial cells lining the follicle, the liquor folliculi, apparently derived from swollen and dissolved cell protoplasma, finally, the ovule surrounded by its discus proligerus. The small follicles measured 50–60 u., the larger 1–1.5 mm, the ovules 35–10 u. Ritchie says, the follicles vary in size from the bulk of a coriander seed to that of a small raisin. The principal difference of opinion between Pfluger and Waldeyer refers to the precise origin of the ovum cell. Pfluger describes certain large cells with clear nuclei, distinguishable in the mass of germinal epithelium of the abdomen, which may be seen in the embryo to enter the open mouths of the flask-shaped prolongations. These he considers to be the original ova, and hence distinct from the epithelium of the follicle. But according to Waldeyer, the ovum is derived from one of these epithelial cells, which simply increases in size. The ovule and epithelium are both therefore directly derived from the germinal epithelium on the surface of the ovary. Thus remotely, from the mass of cells constituting the Wolffian body. His[1] demonstrates that the reproductive cell *must* be an epithelium, since its capacity for growth is required to transcend that of all other elements, and this capacity persists longer in epithelial tissues than any other.[2] Schroen's opinion that the membrana granulosa is derived from connective tissue is in disaccord with the philosophical necessity is justly insisted upon by His.[3]

[1] Unsere Korper Forme, p. 152. 1875.

[2] Rapidity is in inverse proportion to duration ; the nervous system is most rapidly developed, and earliest arrested in its growth, so that it cannot be regenerated after birth. The epithelium is the slowest, and growth persists after birth. The muscular tissue is intermediate between the two. See also remarks of Paget, that "epithelial structures are liable to spontaneous death and extrusion, as hair, teeth, epidermis."—Surgical Pathology, p. 8. The ovule, as an epithelial structure, would simply follow this general law.

[3] Spencer (Prin. Biol., p. 221) observes that these modified epithelium cells

So far therefore as regards the complete Graafian vesicles, containing completed ova, it is certain that they exist long before puberty, or the establishment of menstruation, and that not in a rudimentary condition, but large and completely formed.

Nor is this all. The gradual increase in size of the ovum, known as the process of its "ripening or maturation," followed by a peculiar retrogression or atrophy, is also observed in childhood. The function of the ovary (maturation of follicles), is exercised not only in adult women, but before menstruation, and during childhood.[1] But when during childhood the follicles have attained the size of a pea or over *they do not rupture*, but are submitted to a physiological involution. This differs from that following rupture, when a corpus luteum is formed, in that it is effected by a sclerosis, instead of fatty degeneration. The cavity becomes filled with a granular mass composed of fusiform, round and oval cells, upon which the wall retracts irregularly until finally no trace of the follicle remains but a grayish spot representing the cicatrice.[2] Waldeyer declares, that the abortion of ovules continues not only throughout childhood, when they never rupture, but also in adult life. "Ovaries contain many multiple, folded homogeneous, brilliant membranes surrounding a granular and fibrous mass, which can hardly be interpreted otherwise

are not remarkable for their complexity, but rather for their simplicity. They are cells which have departed but little from the original and most general type. Not peculiarly specialized, rather unspecialized. It is well known that Kölliker derived spermatozoa from epithelium.

[1] Slaviansky, Loc. cit.

[2] The entire evolution of the vesicle would therefore be effected by proliferation of its cellular contents. But after puberty the perifollicular layer is more vascularized, and an increase of tension in its blood vessels, causes an effusion of fluid into the cavity. The pressure exerted upon this fluid by the stroma, is transmitted to the point on the wall where there is the least resistance, causing their gradual thinning and final rupture. A phenomenon of simple cell nutrition has been replaced by one dependent on hyperæmia and changes in blood tension.

than as the remains of aborted follicles.[1] In 1864, Henle described these same cicatrices consisting of "a brilliant structureless multiple folded membrane, forming a vesicle filled with conjunctive tissue, and which are *probably* to be considered as simply collapsed follicles."[2] Ritchie maintains that the Graafian vesicles even rupture during childhood, but then by circular shaped capillary sized pores, through which the transparent granular fluid may be discharged. The cicatrices left by the rupture of vesicles that coincides with menstruation, and after the formation of a corpora lutea *vel* menstrulia, are linear and irregular.

"Cicatrices are found on the surface of children's ovaries, indicating the ripening of follicles, but there is no observation upon human beings showing that previous to puberty, an ovum has escaped from a Graafian follicle. Puberty and sexual maturity do not depend upon the state of development of the Graafian follicle and ovule, because these exist from the second or third year. The ovule, germinal vesicle and germinal spot, have almost the same dimensions as in adults; but in the latter, the number of ripe Graafian vesicles is somewhat larger than in the child. During childhood the ripe follicles undergo a retrograde metamorphosis without bursting. The Liquor folliculi is gradually absorbed, the membrana granulosa falls into fatty degeneration, the cavity becomes smaller, the ovule granular, and finally dissolves."

Ritchie has abundantly demonstrated the presence of large Graafian vesicles, filled with transparent fluid, projecting above the level of the ovary, apparently just ready to burst, in the bodies of women who had died in childbed, or after the persistence of prolonged pathological amenorrhea.

[1] Loc. cit. p. 27.

[2] Whether, observes Henle, the follicle which contains a ripe ovum must necessarily burst: whether the bursting only takes place at the time of menstruation, or at other times, in consequence of coitus, . . . are questions to which no answer at present can be given. Handbuch. Bd. II. p. 488.

The positive evidence for the existence, progressive development, and regressive atrophy of the Graafian vesicles and ova both previous to the attainment of reproductive powers, and at various periods in relation to menstruation, and the consequent independence of this process upon that of menstruation, is negatively much strengthened by a careful examination of the evidence upon which the theory of dependence has been based.

The original advocates of this theory, more especially Bischoff,[1] Raciborski,[2] and Pouchet,[3] were first of all occupied in proving that the bursting of the Graafian vesicle, and dehiscence of the ovule, occurred spontaneously, and independent of coitus. The exclusive association of this dehiscence with menstruation, was originally a pure deduction, *une vue d'esprit*, adopted as a corollary from the experiments which discovered ruptured vesicles in the lower animals, sacrificed during the rut, during which period they had been sedulously isolated. Pouchet announces the following ten Laws, as resuming the Theory which, according to Virchow, has revolutionized all our ideas in regard to this great department of Anthropology.[4]

1. The human species and mammiferæ are subjected to the same fundamental laws.

2. Throughout the animal kingdom, generation is effected by means of ova which exist previous to fecundation.

3. Many obstacles oppose the possibility of contact between the seminal fluid and ovules still contained in the Graafian follicles.

4. Fecundation can only take place when the ovum has acquired a certain degree of development after its separation from the ovary.

[1] Beweis ueber der Begattung. 1854. [2] Traité de la menstruation.

[3] Theorie del'Ovulation spontanée. It is accepted unequivocally by Courty, Longet, Liegois, Brucke, Virchow, Beaunis, etc. It has always been disputed by Aran.

[4] Gesammdt. Abhandlungen, p. 736.

5. Throughout the animal series, it is incontestible that the ovary discharges its ovules independently of fecundation.

6. In all animals ovules are emitted at fixed epochs, in relation with the periodical surexcitation of the genital organs.

7. In the human species, and the mammiferæ, fecundation never occurs, except when the emission of ovules coincides with the presence of the seminal fluid.

8. The menstruation of the woman corresponds to the phenomena of excitement, which is manifested at the rutting seasons in various animals, and especially in the females of the mammiferæ.

9. Fecundation is in constant relation with menstruation; therefore in the human species it is easy to rigorously establish the intermenstrual epoch at which conception is physically impossible.

10. In the human species and mammiferæ, the ovule and the sperm normally encounter each other in the uterus and the neighboring region of the Fallopian tubes, and it is here that fecundation takes place.

Against the first five of these laws the most scrutinizing modern researches have failed to raise the least objection. It is quite otherwise with the sixth, and it is important to examine carefully the proofs upon which so weighty a law is made to repose. Those are divided by Pouchet into two classes, direct and indirect. The direct proofs are as follows: In the entire biological series, when the organism of the animal has reached its maximum of development, certain phenomena are exhibited by the sexual organs, indicating a profound excitement, and soon afterwards, the ovary increases in size, the ovules, which had been in a latent state and of extremely minute dimensions, grow rapidly, and when they are sufficiently organized to be efficaciously impregnated, they are expelled from the germiferous organ, and carried towards the exterior. In many Invertebrates, especially insects, the organism is ex-

hausted by a single crisis of ovulation. In the lower Vertebrates, as fish and reptiles, the turgescence of the ovary only occurs once a year, at the same epoch that the testicles of the male increase in size. Where ovulation and fecundation are normal, they are effected at a time of the year most favorable for the development of the unprotected eggs. In oviparous animals, domesticity, which increases chances of protection, markedly diminishes the interval between the rutting seasons. Nevertheless, after every period of excitement an egg is laid, and in mammiferæ as shown by the experiments of Cruikshank,[1] Haighton,[2] Bischoff,[3] De Baer,[4] when the Fallopian tubes have been tied at the beginning of the rut, the Graafian vesicles are found ruptured, the ovum escaped, and often to be detected in the oviduct.

Pouchet himself only describes observations of corpora lutea found in animals dead during pregnancy or after parturition, and alleges them as proof that the follicles rupture without the influence of coitus or the contact of the seminal fluid. He also describes the ovaries of two young girls, virgins, which offered Graafian vesicles in various stages of development, and also corpora lutea, showing that these latter had formed without fecundation. But those observations, while proving the spontaneous development and dehiscence of the ovules, do not afford the least proof that the latter only occurs at the epoch of the rut. As already observed, the crucial experiments of Raciborski and Bischoff, who, dissecting virgin mammiferæ after the epoch of the rut, discovered ova in the Fallopian tubes, proves that the Graafian vesicles burst at this time, but does not disprove that they burst at any other.

Bischoff was fortunate enough to examine the ovaries of four women, who died during menstruation.[5] In three of the

[1] Phil. Trans. 1797. [2] Phil. Trans. 1797.
[3] Loc. cit. [4] Epistola de ovi mammalium. 1872.
[5] Beweis der period. Reifung und Loslosung der Eier. 1844.

cases were found a Graafian vesicle ruptured and filled with a clot of blood: but, *in the fourth, only an unruptured vesicle.* Pouchet himself has never had the opportunity *to make a similar observation,*[1] and he contents himself with purely deductive reasoning.[2] "Since in the mammiferae, the epoch of the rut is also that of the excitement of the Graafian follicles, and of the expulsion of ovules; as this period is equally marked in many mammiferæ (sow, ape) by an oozing of blood more or less apparent upon the surface of the internal genital apparatus; finally as it has been shown, that female mammiferæ which have been castrated no longer manifest the phenomena of the rut, and that, according to Robert, menstruation ceases in the women of central Asia who have been submitted to this cruel operation: it must be conceded that phenomena which have the same seat, the same causes, the same effects, are phenomena not only analogous, but perfectly identical." (p. 227.) Again, (p. 244) in the chapter dedicated to showing the identity between menstruation and the rut, (7th Law) Ponchet says: "In women, as *has been proved by observation on the mammiferæ,* it should be during this period that the Graafian vesicles develop and experience the internal hemorrhage destined to expel the ovule formed in their cavity, but they do not yet open. The difficulty of observations in regard to this subject in the human species, *only permits us to support our view by analogy:* but in this case, the analogy is so evident that it is impossible to resist it. . . . It is entirely at the end of the catamenial flow, that the follicles open and their ova are expelled.

"*The difficulties afforded by autopsies prevent us from proving this in the human species, but the observation of the great mammiferæ render the* assertion not doubtful." We believe, on the contrary, that the great variety in the phenomena of

[1] Loc. cit. p. 240.

[2] It is this chain of reasoning which constitutes his so-called "Indirect Proof" of the Positive theory of Ovulation.

the rut offered by different species and classes of animals, and especially the variability in its repetition according to variations in the habitus, media, etc., of the same animals, should strictly forbid us from drawing inferences from any of the lower animals to be unqualifiedly applied to the human race.

In regard to this mode of reasoning, we think Ritchie's remarks are perfectly applicable: "The reasoning of many, at present, on the connection of menstruation with the emission of the contents of the ovarian follicles, resembles that formerly employed on the relation of impregnation to what are termed corpora lutea, for as there, the corpora lutea discovered in the ovaries of animals after fecundation were regarded as the necessary results and indubitable proofs of that event, to the exclusion of the rut which went before, so now, because this latter condition in animals is always, and the process of menstruation in women is usually, succeeded by the rupture of some of the vesicles of the ovaries, these states (rut and menstruation) are often considered as the indubitable consequences of the periodical extrusion of ova, to the shutting out of view of the independent vital powers of the ovaries, existing antecedently to both, and of which they are merely correlative effects."

The arguments of Wagner (Handworterbuch, art. Zeugung, p. 878) in support of the unqualified dependence of menstruation upon the bursting of a Graafian follicle are also mainly analogical. But he adduces the following positive evidence. If menstruation in the woman really signify the periodic return of that condition which we call rut in animals, it is above all necessary that it be shown to be accompanied by the ripening and dehiscence of an ovule; and indeed, after recent experiments, this cannot be doubted. . . . So often as the corpse of a woman, whether married or virgin, has been examined during menstruation or shortly after, has a completely ripe or else a burst follicle been found. The

author refers to Ecker, Tanzer, Ritchie, Argenti, Gerres, Hyrtl, Leocatelli, Letheby, Coste, Meckel, Hannover, Gerlach, Dalton. He then relates three cases himself, where he found a corpus luteum at the time of menstruation.

But we know that the ovaries are sometimes filled with mature vesicles, and ova are being constantly extruded, in every form of amenorrhea, and during the normal absence of menstruation; and also that this latter function is often accomplished without the rupture of an ovarian follicle. Ritchie quotes the autopsy of a virgin of sixteen who had never menstruated, and who died on the sixth day of typhus fever. Ovaria were covered with several mahogany-colored points, in one of which was a capillary-sized foramen which led into a Graafian vesicle about as large as a small grape, in which was a little blood.

De Sinety relates the autopsy of a woman who died of phthisis after five months amenorrhea, and a recently ruptured Graafian vesicle was found at the autopsy. (Quoted in American Journal of Science, July, 1874.)

In an autopsy recently made by the present writer, of a woman with advanced chronic nephritis, who died thirty hours after confinement at term, vesicles perfectly corresponding to Ritchie's descriptions were found, two in one ovary, one in the other.

Williams (Proc. Royal Soc., No. 162. 1875. Journal Obstet., Feb., 1876, p. 7271) quotes twenty-eight cases examined by Reichert, in which the genital organs showed signs of menstruation. In one case the follicle had ruptured. In four the follicle had matured before hemorrhage began, in one of which the follicle had actually ruptured, and hemorrhage had taken place into the decidua menstrualis. Reichert concludes that the rupture of the Graafian follicle takes place at an early stage of the menstrual flow. Williams examined sixteen cases. In twelve of *them rupture of a follicle or hemorrhage into its cavity had occurred before the return of*

the catamenia: In one it was doubtful whether rupture of the follicle or the appearance of the discharge would have taken place first; in two a menstrual period had passed without maturation of a follicle; and in one a periodical discharge was *imminent, though the ovaries contained no matured Graafian follicle.* It is not improbable that the follicles found in the three last cases, and which were enlarged to the size of a pea, would have become matured by the next return of the flow. Williams concludes that the rupture occurs, as a rule, *before* the appearance of the monthly flow with which it is connected. We think the just inference may be drawn, that the relations of the rupture of the Graafian vesicle to the uterine hemorrhage are very variable; or, as Tilt says (Loc. cit. p. 28), menstruation and ovulation are shown to be parallel facts, but their causal dependence is by no means proved.

In opposition to the statements which assume to repose upon such an accumulation of facts, Beigel[1] observes that "the opinion which makes menstruation the consequence and expression of ovulation is supported, apart from theoretical grounds, upon *a very few cases*, in which ruptured follicles have been found in the ovaries of women who have died during menstruation. The number of these cases is *extremely small*, and the consequences which have been deduced from them are paralyzed by those autopsies where death, having also occurred during menstruation, such follicles have not been found. Ashwell has had occasion to examine three cadavers whose ovaries, although death took place during menstruation, offered no traces of a rupture of a Graafian follicle. In one of these the woman had menstruated regularly for many years; yet the ovaries were perfectly smooth. Beigel also quotes the famous autopsy of Maria Manning, performed by Paget, as affording a weighty demonstration against the ovulation theory. Twelve hours before death the woman began to menstruate. At the examination the

[1] Die Krankheiten des weiblichen Geschlechts. Bd. I. p. 307. 1874.

ovaries were found of a medium size, and covered by numerous cicatrices. In the right ovary, three Graafian follicles projected somewhat above the surface, appeared healthy, and were filled with a clear serous fluid. A fourth follicle was very large. The left ovary contained a completely developed and prominent Graafian follicle. Ovules were sought for in vain. The surface of the ovaries was somewhat more vascular than usual, and there was one place especially vascularized, but not the least trace of the recent rupture of a vesicle or dehiscence of an ovum. In the right ovary was a little cyst, or several months old corpus luteum.[1]

That the dehiscence of the ovule is not, in the human species, exclusively associated with menstruation, may indeed be positively proved by all the cases, now tolerably numerous, of conception at intermenstrual periods. Pouchet is so convinced of the necessity of this corollary from his sixth law that has been formulated in his ninth, that he insists with vehemence on the impossibility of fecundation except at periods approaching that of menstruation. Raciborski, however, is compelled to admit that this so called law is not invariable. The writer of this Essay is acquainted with at least eight cases, where conception was effected fourteen days after a menstrual period. In three other cases, avoidance of marital intercourse during the first twelve days after menstruation preserved sterility, while conception took place as soon as this period was invaded. But even a few opposite examples, and they could certainly be abundantly multiplied by the experience of every physician, are sufficient to throw discredit on the doctrine which places dehiscence of ripened ova exclusively in the fortnight immediately following a menstrual period.

Dr. Oldham says: "Cases are known to me where conception has occurred ten, twelve, twenty-one days after the

[1] We shall refer again to this autopsy in speaking of the vascular phenomena of menstruation.

cessation of menstruation, and although I am prepared to admit a greater disposition for conception immediately after the monthly flux, I nevertheless possess no facts that should contradict the opinion that the human female may be impregnated at any time after the menses." [1]

Beigel quotes Hirsch [2] as giving a case where conception occurred twenty-two days after cessation of the menses. The author lays stress on the well-known fact, that among the Jews intercourse is forbidden during five days before and seven days after the menstrual flow, yet the fertility of this people is remarkable.

These facts are of all the more importance, on account of the mass of evidence which has been accumulated to show that, until the Graafian vesicle has ruptured, the ovum cannot be fecundated. In some cases where coitus at intermenstrual periods has proved fruitful, it has been assumed that the spermatozoa have remained in this canal until the menstrual period following their entrance, when an ovum is liberated to meet them. This is the interpretation offered by Dr. Ward, of a case where conception was effected, nine days before the period of menstruation, which, however, did not take place.[3] But this explanation is a pure assumption based on the unqualified acceptance of the theory, that the dehiscence of ova never occurs except at a menstrual period.

From what precedes, two facts of importance for our purpose may be considered acquired: First. The formation of ova is a nutritive phenomenon that exists throughout childhood, and therefore before the acquisition of reproductive powers, or the exercise of sexual functions. In its origin and appearance a simple epithelial cell,[4] the ovum developes and

[1] Quoted by Tilt, Ovarian Inflammation, p. 67. 1862.

[2] Said to be in Schmidt's Jahrbucher, 1854, but I have been unable to verify the quotation.

[3] New York Medical Journal. 1875.

[4] Although even before fecundation it has ceased to be a cell, and has devel-

atrophies according to the laws governing epithelial tissues. Second: The characteristic change in the history of the Graafian vesicles that is observed at puberty is their rupture when arrived at a certain size, which rupture is followed by an escape of the ovule and its descent into the uterus.[1] In animals the phenomena of the rut are constantly accompanied by the rupture of one or more follicles, and in a certain number of autopsies of human females, similar conditions have been found to coincide with menstruation. But it is peremptorily demonstrated, both by autopsies, and by the fact of intermenstrual conceptions, (*a*) that the rupture of folliculus may occur not only independently of coitus but in the absence of menstruation; (*b*) that menstruation and coitus may occur without the rupture of follicles. The description of the autopsy given on page 78, shows that the hyperæmiam questionably present in uterine tissues, (or part of them) at the time of menstruation, extends to the ovarian stroma, and even to the perifollicular layer of the Graafian follicle. Now it is indubitable that uterine hemorrhage, indistinguishable in appearance or clinical phenomena from that of menstruation frequently occurs under the influence of any cause that either accelerates the circulation, or raises arterial tension, or both. Hence the "uterine epistaxis," in the first stage of fevers,[2] or the "bringing on of the courses," under the influence of agitating emotions The advocates of the ovular theory of menstruation, should suppose in these cases, that the ripening of a Graafian follicle had been hastened by the acceleration of the circulation,[3] and that "the irritation" thus produced had occasioned the men-

oped to a complex organism by fusion with elements from the discus proligerus. (Waldeyer.)

[1] As we have seen, some authors admit a peculiar kind of rupture even during childhood, but we do not think this to be sufficiently proved.

[2] Pointed out by Gubler.

[3] We saw the other day a lymphatic gland in the neck of an infant, that had been long indolently engorged after nasal irritation, suddenly begin to suppurate at the moment that, with increasing health, the circulation became more active.

strual hyperæmia. But it is purely gratuitous to assume this necessity, and certainly inconsistent with theory of a fatally periodical cycle in the ripening of the ovarian bud. In the few cases, (we do not at this moment recall any,) where follicules have been ruptured coincidently with such irregular "menstruations," the rupture must be considered the *consequence* of the rise of vascular tension, not its *cause*. In these cases at least, that cause is admitted to be general.

We say these facts are of considerable importance for our purpose, because since the promulgation and almost universal acceptance of the ovulation theory, the peculiar changes supposed to take place in the Graafian vesicles at each menstrual period have been supposed to involve a peculiar expenditure of nerve force, which was so much dead loss to the individual life of the woman. The idea that menstruation was the expression of sexual excitement, existed before the ovulation theory (Lecat. Emett, see ut supra,) and is still maintained by such writers as Beigel who nevertheless reject this latter theory altogether. Nevertheless, it is principally under its influence that the growth of the Graafian vesicle and of its contained ovum, has come to be regarded on an entirely different plane from the nutritive phenomena of other cells, and as causing a special irritation of the nerves of the ovary, reflected to the entire nervous system. According to Pfluger the gradual accumulation of this irritation, finally determines by reflex transmission the afflux of blood to the uterus and ovaries which constitutes the catamenial flow.[1] According to Rouget, whose theory we must presently examine in detail, this irritation is sufficiently intense to determine a true erection of all the internal organs of generation. Now whatever view may be held of the periodical hyperæmia of these organs, we believe that sifting of the evidence leaves no plausible pretext to separate the growth of the generative

[1] This theory is adopted by Barnes and many other gynecologists.

epithelium from the general phenomena of nutrition, nor to ascribe to it any special nervous or sexual influence.

Indeed the assumption (for it is scarcely more, though so imposingly supported by authority) of a periodical nervous crisis excited by a periodical development of reproductive cells, serves to confound the two aspects of the reproductive apparatus in women which ought to be kept entirely distinct, namely, the reproductive and the sexual. Reproduction is essentially a process of nutrition.[1] From the lowest infusoria[2] to man, the fusion of two cells, either derived from one individual (agamogenesis) or two (gamogenesis), each cell concentrating in itself molecules representative of the organism from which it is derived,[3] constitutes the essence of this mighty physiological process. As sex is secondary to the necessity for complex development, of which it is a consequence,[4] so sexual instinct and excitement are entirely subordinate to this fundamental fact of the increase in the powers of development of one cell by the absorption of the material, and by the influence of the molecular forces of another.[5] This sexual fusion is again a simple extension of an earlier intraovular fusion, apparently necessary to complete the maturity of the female cell, or fusion between the vesicle of Balbiani and the germinal vesicle (Balbiani, Bernard, Loc. cit.).

The perfectly mature ovule indeed cannot be considered as a simple cell. The follicular epithelium combines with it, having first formed the discus proligerus. Already, therefore, a complex organism has developed from the originally

[1] See Claude Bernard's Lectures at the College of France, published in the Revue des Cours Scientifiques. 1874.

[2] See Balbiani, Sexual Generation in Infusoria; Journal Brown-Sequard, T. I. 1858.

[3] Darwin, Theory of Pangenesis; Variations of Animals under Domesticity. Galton, Journal of Authropolog. Institute, 1876.

[4] Spencer, Principles of Biology; Hirth, Marriage of Near Kin.

[5] See Haeckel, Anthropogenie; His, Loc. cit.

simple epithelial cell, before it becomes surrounded by spermatoza.

The sexual instinct or impulse is necessarily absent in certain large classes of animals; namely, in all who propagate asexually, or by the fusion of cells, both of which are derived from the same individual; and must exist in a modified form in all oviparous animals, as fishes, in which ova are fecundated after complete separation from the body of the female. Now it is precisely in these animals that the periodical growth of ovaries assumes the most marked proportions; in other words, the phenomena of reproduction are effected principally by the one element of increased nutrition. The extrusion from the body of the products of such increased nutrition is accomplished without sexual congress, and in a manner analogous to the processes of defecation and micturition. In animals in whom the union of the sexes *is* essential to fecundation, whether the eggs be impregnated while still in the body of the female, or at the moment of emission, as in frogs, a curious difference exists between the two sexes in regard to the expulsion of the reproductive cell. In the female, this occurs spontaneously; in the male, normally, only as the result of sexual intercourse. The theory of *spontaneous* ovulation means precisely that in the female the essential part of reproduction can be effected without any sexual act. The superior contribution to the nutritive element of reproduction made by the female is balanced by an inferior dependence upon the animal or sexual element; in other words, she is sexually inferior. This is still true even when the manifestation of sexual instinct coincides with the dehiscence of ova, since the gratification of the instinct is not necessary in order that the eggs may be laid. It is especially true of the human female, in whom, in the immense majority of cases, ova dehisce when the sexual instinct is not only ungratified but unawakened. This statement would hold even were it proved that the dehiscence of ova took place

exclusively at menstruation, but since, from what precedes, this famous doctrine is, after all, unproved, the separation of the sexual and nutritive elements of reproduction in the woman must be considered to be complete.

But the Graafian follicles, however important, do not comprise the entire tissue of the ovary, nor, even in the ovular theory, does the dehiscence of ova constitute all the phenomena characteristic of the establishment of puberty or of menstruation. As regards the ovaries, the most important changes observed as the period for menstruation approaches, are to be found in the stroma and blood vessels. We have already mentioned Waldeyer's remark that the albuginea becomes much denser at this age. He attributes its increase to the nutritive irritation exercised on the stroma by the constantly developing follicles imbedded in it. As the ovary grows older, the stroma is further modified by the great increase of blood vessels, and also by the presence of smooth muscular fibres. The arteries of the ovary are early developed, and become helicine like those of the uterus. Extremely numerous branches reach the periphery of the organ and the Graafian follicles, and these are much more highly vascularized at puberty than during childhood (Grobe, Waldeyer, Ritchie). At the base of the ovary exists a plexus of bloodvessels so rich as to constitute a tissue analogous to the corpora cavernosa, and which, since Rouget, has been called the bulb of the ovary. It is this physiologist, in a memoir become famous,[1] who has described with the most care the vascular tissue of the internal organs of generation, demonstrating, by means of injections, a richness of bloodvessels hitherto unsuspected.

Rouget first describes minutely the disposition of bloodvessels in erectile tissues, disputing Miller's assertion that in these the arteries terminate in culs de sac, and describes them

[1] Journal de Physiol., Brown-Sequard, 1859. Rouget's thesis was passed in 1855.

as forming bouquets whose branches twist themselves into brusque spirals, interlaced and anastomosed into vascular knots. These persist during erection, instead of being effaced as would be simple flexuosities. The veins and capillaries also form enormous dilatations and anastomoses, and the whole vascular mass is contained in meshes of smooth muscular trabeculæ. Such erectile tissue exists at the hilus of the ovary, in the parenchyma of the ovary, and above all in the body of the uterus, *but exclusively in the human female.* No other mammifer presents a development of vessels sufficiently considerable relative to the parenchyma to constitute erectile tissue. When the utero-ovarian vessels were injected, the entire pelvis being placed in a vessel of warm water, the body of the uterus rose in the pelvis and remained, ascended and curved forward, so long as the erectile tissues were distended. The same phenomenon was observed in the ovary, but less marked; no change took place in the Fallopian tube.

Rouget's descriptions and diagrams have been copied into most systematic treatises on diseases of women.[1]

His description of the muscular fibre of the ovary is as remarkable as that of the bloodvessels. Before examining that of the human female, he describes muscular planes in various animals, which so envelop the ovary as to guide the eggs to the oviducts. In cartilaginous fishes, the eggs fall into the peritoneum, where many are lost. Those which survive are pushed towards the oviduct by contractions of the abdominal walls. In scaly reptiles, the muscular layer (mesoarium) envelops the oviduct and ovary, and in contracting draws them together. In birds (the hen), the mesoarium is very well developed, and can be seen with the naked eye. In birds the peritoneal fold (broad ligament) essentially consists of muscular fibres. "In women this muscular tissue does not form a continuous membrane, but a species of

[1] See Courty, also Thomas, Diseases of Women: Grailley Hewitt. Liegois, Traite de la Physiologie.

canvas with large meshes, mixed with muscular and nervous fibres, the whole covered and masked by conjunctive tissue. The characteristic muscular fibre cells can only be obtained close by the surface of the membranous ligaments of the peritoneum. *Between the two folds which form this surface we hardly find anything but cellular tissue, vessels, and nerves.* The muscular fibres are not easy to demonstrate *on the child or nulliparous woman.* But during pregnancy, and for a long time afterward, no more doubt is possible." Three systems of fibres are demonstrated. The first arise from the round pubic ligament, and spread fan-shaped the entire height of the uterus, interlacing with those of the opposite side. The second come from the posterior surface of the uterus, and form the ligament of the ovary. They do not terminate abruptly at its internal extremity, but radiate into the stroma of the gland, inclosing Graafian follicles in their meshes. This is also admitted by Groher, but Waldeyer denies that the muscular fibre reaches the follicles. He and Henle and His[1] have found them forming sheaths around the arteries in the medullary portion of the ovary, but not extending further than the limit of the parenchymatous zone. The third system described by Rouget should constitute the lumbar ligament, which, however, is more difficult to demonstrate. They are said to start from the lumbar region and uterus, embrace the entire length of the Fallopian tube[1] and the fimbriated portion, and by their contraction, draw the latter down upon the ovary, close over the most prominent vesicle. "This contraction results from the reflex irritation that has been caused by the distension of the ovarian stroma when the Graafian vesicles reach a certain degree of development." This reflex irritation is propagated to all the muscular apparatus of the internal genital organs. The ovariotubal fibres contract (ut supra), the contraction causes compression in the muscular networks, and the blood is forced

[1] Described also by Hennig, Der Katarrh, p. 3.

back from the ovarian plexus, distending the spongy bodies of the uterus, until finally, under the increased pressure, the bloodvessels of the uterine mucous membrane are ruptured. Hence the menstrual hemorrhage."

This theory has obtained an immense influence. Courty observes that "by artificial erection of the uterus and ovary on the cadaver we can demonstrate their true erectility, and the part it plays in ovulation, menstruation, copulation." These views again probably have had much to do with the habit of considering menstruation as a local congestion,[1] and unquestionably have done much towards confirming the supposed analogies between menstruation and the rut, while, on the other hand, they have themselves been guided by these analogies.

It is unquestionable that the tissue of the ovary becomes vascular at puberty, and smooth muscular fibre cells mingle with conjunctive tissue of its stroma. The entire bulk of the organ is somewhat increased in size. At birth it measures about 1.3 c. m. in length, 1–6 c. m. in breadth, and 3 to 3.5 min. in thickness. In the adult female it is 3.8 c. m. long, 2 c. m. broad, and 15 mm. thick.[2] The few examples of herniated ovaries that have been utilized for science, have shown that the bulk somewhat increases during menstruation, and also the vascularity. This latter has been demonstrated in autopsies.[3] But between these moderate variations and the "erection" supposed to be demonstrated by Rouget, especially the mechanism of the erection by reflex contraction of muscular fibres so delicate that, until they have been developed in pregnancy, their existence can scarcely be demonstrated, between these two sets of facts lies a wide distance. We believe the following substantial objections are to be urged against Rouget's theory:

[1] Peaslee, New York Medical Record. 1876. Barnes, however, denies the appropriateness of this expression (Clinical Lectures). See below, Kundrat and Williams.

[2] Beaunis, Anat. Descriptive.

[3] See p. 173 and p. 181.

1. Even admitting (and we do not admit) that at each menstruation the utero-ovarian plexus of blood vessels becomes as fully distended as in Rouget's injections, such injection would not of itself constitute an erection. Bouquets of arteries, enclosed in the meshes of conjunctive tissue, and trabeculæ containing muscular fibres, exist in the spleen as well as in the erectile tissues. Here also are all provisions for sudden accumulations of blood, causing great distension of the organ, yet no one would describe them as *erections*. The distinction is of much practical importance, because this term necessarily implies such intense excitation of certain cerebro-spinal centres as must, for the time, interfere with the activity of many others.

2. Erectile tissues are everywhere external, developed from the epiblast or embryonic fold of animal life; while the internal organs of generation develop in the hypoblast or nutritive layer, the primitive intestine. The predominance in women of the internal over the external organs of generation is an indication of the predominance in them of reproduction over sexuality, not as Rouget supposes, of a transfer of the seat of the sexual sense.

3. During menstruation sensation is either absent or painful. The cases where a conscious sexual instinct is awakened at this period, are decidedly in the minority.[1] When painful sensations exist, they are either in the form of cramps, burning, or weight. In the latter case the uterus does not rise in the pelvic cavity, but sinks, which is manifestly opposed to both the theory and experiment of Rouget.

I have noticed some exceptions to this rule. In the case of an anemic and sterile woman, who habitually felt well during menstruation, and the week preceding, but languid and exhausted during the other two weeks, I found the uterus retroverted, the examination being made at this latter time. No local pain or discomfort was experienced from the dis-

[1] Bischoff in a famous memoir tries to evade and then explain this difficulty.

placement. On examining the day before menstruation, the uterus was found to be in place,—literally erected.

4. The helicine arteries of the uterus and ovarian bulb have long been regarded as a provision for pregnancy. It has indeed been shown that their flexuosities do not, as was supposed, disappear during pregnancy, and that the arteries never become straight.[1] But the flexuosities permit of the accumulation of a greater quantity of blood during a longer time than would be the case, if the blood vessels were straight. Hence an admirable provision for the nutrition of the fœtus. Moreover, as by the flexures in the cerebral blood vessels delicate tissues, (in this case, those of the embryo,) are saved from the shock to which they would be exposed, were the great mass of blood required for their nourishment, poured directly upon them. In a normal condition, the blood that flows to the utero-ovarian plexus at menstruation, passes off as rapidly as it flows in.[2] A stasis of blood in the parenchyma of uterus or ovaries immediately induces symptoms which are foreign to perfectly healthy menstruation. On the other hand, when conception has taken place, the same accumulation of blood will be effected without causing any feeling of local distress. It is not at all uncommon even for women who habitually suffer pain at menstruation, to pass six or seven weeks of pregnancy without being warned by any pelvic sensation of the physiological hyperæmia of the pelvic viscera. In women who suffer from slight prolapsus or chronic uterine congestion, the disappearance of the dragging sensations about the loins that had become habitual, often constitutes one of the first signs of pregnancy.

The writer recalls at this moment, four well marked illustrations of this fact. This shows that if the rapidity of circulation through the ovarian plexus, be proportioned to the ex-

[1] Barnes, as well as others, insists on this fact.

[2] See p. 97. Williams, description of uterine parenchyma during menstruation.

cess of blood in it, no sensation results from the hyperæmia however enormous.

5. But the mechanism imagined by Rouget implies, not an increased flux, but an increased stasis of blood, whose return through the uterine veins, is impeded by the contraction of muscular fibres. We think it is impossible, even through Rouget's own descriptions, to admit the succession of phenomena he so graphically and imaginatively describes. The existence of planes of muscular fibre surrounding the ovary in other animals, especially the oviparæ does not afford even a presumption that similar planes exist in women except in a rudimentary form. Nothing is more common than to find in the higher animal, and especially in man, rudiments of structures more fully elaborated in lower animals. Rouget's description in women is entirely of *rudimentary* muscular fibre cells, and even these can scarcely be demonstrated except upon the pregnant or recently parturient woman. Again, Rouget insists on the fact that these fibres can only be obtained near the surface of the peritoneal folds. The laminæ that pass over the bulb of the ovary are too much attenuated to exercise, by their contraction, any serious compression of the vessels in the hilus. Yet it is to such compression causing a reflux of blood towards the uterus, that the author ascribes the entire "congestion" that should precede the menstrual hemorrhage. Moreover, an obstacle afforded to the circulation at this point, should not completely dam up the pampiniform circulation, since as Rouget himself points out, this plexus has *three* outlets, into the pudic veins below, the uterine veins in the middle, and into the ovarian veins only above.

We believe, therefore, that Rouget's famous theory of erection is not only unproved but untenable.

1. Because the disposition of blood vessels described by him exists in relation to pregnancy.

2. Because autopsies of menstruating women have never

discovered a distension of these blood vessels in any way comparable to that produced by his injections on the cadaver.

3. Because the sensations of the woman in the early weeks of pregnancy, or during a normal menstruation, show that the subjective expression of pelvic hyperæmia is very different from that of stasis.

4. Because the phenomenon of erection does not depend exclusively upon distension of cavernous tissues with blood, but implies special phenomena of innervation, absent in the menstrual flux in the great majority of cases. It often happens in regard to this point, that the theory invents facts, where the facts themselves would never have suggested the theory.

5. Because erectile tissues, belonging to the sphere of animal life, are developed from the animal layer of the blastoderm, or epiblast, while the generative intestine of the woman is derived from the nutritive layer or hypoblast.

6. Because the muscular fibres in the peritoneal folds are rudimentary except during pregnancy, are superficial, and cannot be shown to compress the deep seated blood vessels at all.

7. Because even were such compression exercised at the bulb of one ovary, abundant outlets exist for the return of blood elsewhere, so that an accumulation of blood by this mechanism is doubly inconceivable.

8. Because the evidence which has been adduced to show that Graafian vesicles may develop to their full size without the occurrence of uterine hemorrhage, shows that such development does not necessarily cause an irritation capable of exciting reflux muscular contractions. This latter evidence has been accumulated since Pfluger's Essay.

In considering the remarkable phenomenon of the menstrual flux, two distinct questions require to be answered, namely:

Why does blood flow *to* the uteri ovarian plexus, and why

does it flow *from* the uterine mucous membrane. Pouchet (see ut supra) by dissections of several domestic mammiferæl showed clearly enough that during the rut, the uterine mucous membrane was hyperæmiated. He even insists that a certain amount of sanguinolent discharge takes place in these animals, and explains its minute quantity in comparison with that of women, by the abundant space offered by the lax tissues of the internal generative organs in which blood may accumulate. This explanation has never been accepted as completely satisfactory. Nor does an increased tension in the uterine blood vessels, sufficiently explain the hemorrhage, since here, as in all other organs, very great congestion may exist without causing a rupture of the vessels, even the capillaries. The imminence of this event, is in proportion to the laxity of the tissues supporting the vessels; hence greatest in the brain, then the spleen, perhaps last of all in the parenchyma of the uterus composed of dense fibrous unyielding tissue. Hence, as will be seen, the extreme rarity of hemorrhage below the level of the mucous membrane.

It is only the internal surface of the uterus, where the least facility exists for rupture of blood vessels, and this only in one case, namely, if the blood vessels ramifying in the endometrium are laid bare by the desquamation of its epithelium.

As early as 1847, Pouchet already described such a desquamation. But the process has lately been much more elaborately investigated in two memoirs, already become classical.

The first is by Kundrat, and published in Stricker's Med. Jahrbucher for 1873, (Heft. 2.)

The second by Williams, in the London Obstetrical Journal, 1875. Both memoirs are founded upon numerous autopsies. We will quote freely from these investigations, beginning with those of Kundrat as the earliest.

In a state of complete repose between the menstrual periods, the uterine mucous membrane is only one millimetre thick at the fundus and sides of the organ, and diminishes in thickness towards the cervix and ostia of the tubes.

This mucous membrane is distinguished by a characteristic conjunctive tissue rich in cells, and by the absence of a submuncosa. The straight tubes constituting the glands, lie side by side in the tissue, almost exclusively composed of spindle-shaped or round cells, packed much like the glands in the gastric mucous membrane. There are no muscular fibres in this layer, but the conjunctive tissue stretches outwards towards the muscular tissue. The glands are lined with cylindrical ciliated cells which are continuous with those covering the mucous membrane between the tubes.

The most essential difference between the mucous membrane before and after puberty is in the glands. In a seven months fœtus, the membrane is 09—15 min. thick, and contains no glands. These first appear at three to four years of age, and then contain round cells. They are more developed in the tenth year, and at twelve to thirteen begin to branch.

During menstruation, the mucous membrane swells from one millimetre to three or six millimetres in thickness, is soft, tumefied, injected in spots or uniformly reddened. The openings of the glands are enlarged, and a whitish opaque mucus is poured out. The cells of the glands are enlarged, (as those of the peptic glands during digestion) and there is a multiplication of the round cells of the conjunctive tissue stroma. The blood vessels are distended with blood. All these appearances are *confined to the superficial layer of mucous membrane.* In the *same layer* occur occasional ecchymoses. There is no proliferation of blood vessels.

These appearances are presumed to be characteristic of menstruation, because found to coincide with the presence of recent corpora lutea in the ovaries. But their precise

relation to the time of the dehiscence of the ovum is not yet fixed. It can be concluded however that these alterations do not begin and end with the menstrual hemorrhage. "In two girls who died suddenly several days before the period, and in others in which no recently ruptured follicle would be found, the mucous membrane was already swollen to two and one-half or three millimetres. We must believe that the swelling begins a long time before the period, but reaches its maximum at this time. It is so rare to find an absolutely normal uterine mucous membrane, that we must infer the period of repose to be very short."

At the time of the hemorrhage, and until the return to the normal condition, the cells are cloudy, and filled with fat granules. This fatty degeneration involves the gland cells, cells of interglandular tissue of the blood vessels, and the epithelium of the surface, but is extremely superficial. "It is my opinion," says the author, "that these alterations develop independently of the hæmorrhage, and indeed determine it, because

"1. In spite of much more intense hyperæmia in the endometrium of the pregnant uterus, no hæmorrhage occurs, showing that hyperæmia alone is insufficient to account for the menstrual flow.

"2. Hæmorrhage *does* occur in other physiological degenerations of the uterine mucous membrane, as at the end of pregnancy. Should the decidua become fatty too soon, hæmorrhage will equally occur before term.

"3. In the menstruating uterus, there is never any extravasation, except in the superficial layer where the fatty degeneration occurs. I conclude that the membrane degenerates because no vessels are developed to nourish it sufficiently in its tumefied state, and that the superficial vessels, thus laid bare, rupture, and permit the oozing of blood."

It is difficult to maintain the old theory that the uterine hemorrhage coincides with the bursting of a Graafian follicle,

for at that time the uterine mucous membrane is in the most unfavorable condition for the reception of the ovum.

The swelling of the endometrium above described, implies preparation for conception, and the retrograde metamorphosis is the consequence of the failure to conceive. "The membrane occasionally thrown off in dysmenorrhea, implies an exaggeration of the normal tumefaction and consequent fatty degeneration."

Williams' researches confirm and extend Kundrat's conclusions. He found that the highest point of development of the uterine mucous membrane was reached three days before menstruation. It was then one-fourth of an inch thick, covered with small white spots, shown under the magnifying glass to be little pits, at the base of which were the orifices of the glands. Thus the membrane was tumefied above the level of the glands. No blood vessels existed in this tumefied portion. Still nearer to menstruation, the membrane was dark red, thick, smooth, very soft, and contained innumerable blood vessels running parallel to the glands. But of the two women on which this description is based, one had succumbed to peritonitis. In four other cases, where the relations to the menstrual epoch were not precisely known, the mucous membrane of the cervix was found to terminate abruptly just above the os internum in an excavation. Above this, the endometrium was injected and tumefied, or else desquamated. The epithelium was in fatty degeneration, and very superficial hemorrhages existed. In two cases, where death took place on the fourth day of menstruation, the desquamation of the mucous membrane above the os internum was complete. The muscular fibres were bare, stained with blood, and covered by small shreds, composed of round and fusiform cells, rod-shaped bodies like nuclei of muscle fibres, and blood corpuscles. From numerous points, blood exuded on pressure. In a case examined just after cessation of flow, the membrane had begun to regen-

erate in the lower two-thirds of the cavity. The upper third was still covered with brownish shreds. The renewal of the lining seemed to begin from the cervix. A little later, the membrane was found renewed throughout, but epithelium was still absent. Still later, the membrane was found complete, but the orifices of the glands on a level with the surrounding surface; hence the development was inferior to that obtained three days before menstruation, and already described.

In reviewing these twelve autopsies, Williams remarks: "It is erroneous to study the menstrual flow as a process complete in itself, or to attribute it to a simple congestion or a prolonged erection. It is only the terminal change of a cycle of changes, which begins at the cessation of one menstrual flow, passes through the developmental phases of the mucous membrane, and ends with the cessation of the flows next following. We are justified in affirming that there is no period of uterine rest, but the organ is ever undergoing those changes which either make it a fit receptacle for the ovum when impregnated, or which prepare it to carry off the ovum when impregnation has failed. If any one stage of the month could appropriately be called a period of uterine inactivity, it would be the bleeding period, for it is then that the mucous membrane ceases to develop, and undergoes fatty degeneration."

The author attributes the hemorrhage to two factors:

"1. The desquamation of the endometrium, by which the blood vessels are laid bare.

"2. Contractions of uterine fibres, by which the blood is forced towards these superficial vessels. The uterine walls are found pale while the mucous and peritoneal surfaces are congested. The increased quantity of blood in the uterus is determined thither by the active processes going on in the development of the mucous membrane, and is in nowise allied to congestion. The flow of blood attains its maximum at the time the proliferation is at its highest, that is, a short

time before the catamenia appear. With fatty degeneration, the flow is suddenly reduced."

For convenience sake we will contrast, in opposite columns, the sum of notions in regard to the processes involved in menstruation, that have been acquired in the last few years by Waldeyer, Slaviansky, Grohe, Kundrat, Williams; and those deduced from the ovulation theory proper, as formulated by Pouchet, Raciborski, Courty, Rouget, Pfluger, etc.

The Graafian vesicles and ova, are either absent during childhood, or exist in a comparatively rudimentary state, undergoing no progressive development.

Graafian vèsicles and ova, indistinguishable from those of the adult female, are found in the ovary at all ages after two years. From this time no new vesicles are ever formed, but those already existing, gradually and successively develop, and having reached a certain maximum atrophy without rupture. (It does not seem to have been ascertained, whether the fusion with the vesicle of Balbiani, and the fusion by apposition with the epithelium of the discus proligerus, that, after puberty are essential to the complete maturation of the ovule, ever occur before puberty. Probably not.)

The establishment of puberty is principally characterized by the sudden development of the ovaries and assumption of characteristic functions in the ripening of ova.

The increase of size of the ovaries during the three or four years preceding menstruation is very gradual, nor is there any such development of either uterus or ovaries as justifies the term "building of a house within a house,"[1] or local process involving a great local drain upon the nutrition. The essential change consists, not in the size of the Graafian vesicle, but in its increased vascularization, and the secretion of fluid into its cavity, leading to the rupture of its walls and escape of the ovum.

[1] Clark, Sex in Education,

To the irritation of the ovarian stroma and peritoneal covering of the ovary, caused by the rapid growth of Graafian vesicles, is due the afflux of blood to the uteri ovarian plexus, (Pfluger) or the contraction of the muscular fibres which causes an accumulation of blood in this plexus by impeding its return. Congestion and hemorrhage are the consequence of ovulation and the dehiscence of ova.

The effusion of serum into the Graafian vesicles, like the effusion of liquor amnii into the cavity of the developed egg, is due to the increased vascular tension in the blood vessels of the ovarian bulb, and ultimately of those ramifying in the perifollicula layer of the vesicle itself. This increased tension, and the increased afflux of blood to the uteri ovarian plexus is due to some condition entirely independent of the development of the ova, which condition only obtains in the organism long after the reproductive cells have learned to grow to maturity. If not ovulation, at least dehiscence of ova, is not the cause but the consequence of pelvic hyperæmia. The surface of the ovary on which the follicles rupture is not covered by peritoneum, (Waldeyer) only a few out of the immense number of Graafian vesicles contained in the ovaries, ripen and rupture at any one time, and as the process of their complete development is gradual, the periods of rupture are necessarily intermittent. This intermittence, however, far from offering a type of physiological periodicity, is one of the most irregular of physiological phenomenas. It is not to be compared with processes associated with rhythmic movements of the circulation, as sleep or wakefulness in the brain, digestion or repose in the stomach. The successive growth of the Graafian vesicles strictly resembles the successive growth of buds on a bough.[1] It is not even exclusively associated with

[1] The distinction between buds and seeds has much perplexed philosophic botanists. We shall refer later to the theories of De Candolle, Spencer and Darwin. Dalton compares the Graafian to the dental follicles.

The ripening and dehiscence of ova occurs periodically at the epochs of the rut in the lower animals, and of menstruation in women. It is this that constitutes the essential part of both processes, and these are strictly analogous to one another. Menstruation is the rutting season for women, the rut is the menstruation of lower animals.

the rhythmic flux constituting menstruation, since vesicles do not always rupture coincidently with this flux, and may rupture when the flux does not take place. The permanent rise of tension occasioned by the development of the ovarian blood vessels at puberty seems to be sufficient to secure the mechanical conditions needed for the liberation of ova.

In the lower animals, in whom the sexual instinct exists exclusively in connection with reproduction, the period of the rut and the rupture of Graafian vesicles does seem to always coincide. At least several vesicles are always found ruptured in animals examined after this period. There is no proof, however, that the congestion of erectile tissues, and the rupture of Graafian follicles, stand in any causal relation to each other, but rather that they are coincident phenomena.

In women the sexual instinct and reproductive capacity remain distinct; there is no longer any necessary association between sexual impulse, menstruation, and the dehiscence of ova.

Reproduction is only possible at certain times before and after the menstrual period.

Reproduction, at no time imperative, is at any time possible, though more probable *before* the menstrual flow.

The menstrual hemorrhage is the result of a periodical congestion of the uterus, caused by the irritation of rupturing follicles in the ovaries, and entirely subsidiary in importance to the ovarian process. By the afflux of blood to the great net-

The menstrual hemorrhage is the climax of a series of processes carried on in the uterus, quite independently of the ovarian budding. The afflux of blood to the uterus is in obedience to an increased nutritive demand made by the develop-

work of vessels surrounding the uterus, or by the stasis of blood in them, the tension is sufficiently raised to rupture the free vessels of the endometrium, so that hemorrhage occurs as in epistaxis.

ing mucous membrane, which constantly increases in thickness, until it has reached a maximum suitable for the retention of an impregnated ovum. The hemorrhage from the uterus is the result of fatty degeneration and desquamation of the mucous membrane, that has failed to receive the stimulus of impregnation necessary for the maintenance of its heightened vitality. By this desquamation, blood vessels are laid bare, and the resulting hemorrhage is strictly analogous to that after the fall of the decidua in parturition.

The vascular tissues of the uterus, ovaries, and broad ligaments, are species of erectile tissues, and their periodical turgescence constitute an erection which should be expected to render the menstrual period an epoch of prolonged sexual excitement.

The helicine arteries and bulbs of the uterus and ovaries are dispositions for pregnancy, not for menstruation. There is no proof that these tissues are ever really "turgescent" in menstruation. In normal menstruation the circulation through these vessels is accelerated in obedience to a nutritive demand on the mucous surface of the uterus, precisely as the circulation through the muscular coat of the stomach and intestines is accelerated during digestion in obedience to an increased nutritive demand upon their mucous surface. But if an *accumulation* of blood and stasis occur, abnormal sensations are produced foreign to healthy menstruation, and indicating that some modification of the healthy process has occurred. All the processes concerned in menstruation converge, not towards the sexual sphere, but the nutritive, or to one department of it—the reproductive.

The periodicity of the menstrual flow constitutes its most striking feature, and renders this process, peculiar to women, an extraordinary exception among physiological phenomena.	The periodicity of the menstrual flow is not an abrupt interruption of the ordinary physiological life. It is the simple climax of a series of consecutive processes perfectly continuous with one another. It does not offer the sudden transition of the functions of animal life, but the gradual transitions characteristic of the functions of vegetative nutritive life, to which indeed it belongs.

The writer of the present Essay accepts the views represented by the second of the above columns. But it may be shown that the explanation of the monthly hemorrhage there given cannot be considered as entirely satisfactory. The analogy shown between the menstrual decidua and that of pregnancy, already suggests that some other cause for hemorrhage must exist than the mere desquamation of the mucous membrane. After parturition, many other conditions are present. The walls of the uterus, full of blood, are incessantly retracting and squeezing the blood out of those enormous sinuses. The immense accumulation of blood in the inter-ovarian plexus that exists at this moment, furnishes abundant source for the hemorrhage. But at menstruation a hemorrhage lasts precisely as long as does the lochial discharge, *i. e.*, the sanguinolent, without the existence of any such local accumulation. According to Williams, the uterine parenchyma was found pale, and although other observers, perhaps somewhat guided by their expectations, have described a general hyperæmia of the organ, yet there is confessedly nothing comparable with the turgescence of a pregnancy at term. Yet, as we repeat, the menstrual flow, and the sanguinolent lochial discharge, are, when each is normal, almost identical in duration and quantity. It is the menstrual flow, however, which most often transcends the period of four days. We are forced to conclude that the blood

comes from elsewhere than the "erectile tissues of the pelvis;" that the local process in the endometrium is only the starting point of an evacuation which is really drawn from the general circulation. For, when the sanguinolent discharge taking place from the uterus after parturition has ceased, the organ still remains very much larger, and the quantity of blood contained in it immensely greater, than is the case in any menstruation. On the other hand, excessive hemorrhage in menstruation, though often connected with hyperæmia, dependent on subinvolution, fungous endometritis, neoplasms, etc., is well known to be often independent of these, and connected with causes affecting the general system—as plethora or anemia of the vascular system, or excitement or exhaustion of the nervous. A physiological excess of blood in the uterus, therefore (as in the post partum state), is in itself insufficient to sustain uterine hemorrhage, even when this has been initiated by desquamation of endometrium, while in the absence of local accumulations of blood in the pelvis, conditions affecting the general nutrition *are* capable of determining the most exhausting hemorrhage.

This is the first fact which indicates that the menstrual flux must depend upon some other causes than the local processes going on in the uterus. "Were the hyperæmia the direct cause of the hemorrhage," observes Gusserow, "extravasations of blood would be found much more frequently in the deeper layers of the Decidua menstrualis."[1] Vicarious menstruation offers an entire series of facts showing, from another point of view, that the cause of menstruation is not located exclusively in the uterus. These facts formerly attracted much attention, but since the prevalence of the ovulation theory they have been thrown into the background. Yet all such cases, of which Puech has collected

[1] Ueber Menstruation and Dysmenorrhæ. Sammlung. Klinike. Vortrage Volkmann.

two hundred, are proof positive of the existence in the female organism of a necessity for the periodical evacuation of a few ounces of blood,—necessity so profound, that if the ordinary mode of exit be barred by congenital smallness of the uterine blood vessels, or defective desquamation of the uterine mucous membrane, the evacuation will nevertheless be effected elsewhere. In only one case did Puech find a ruptured vesicle in the ovary at the time of the vicarious hemorrhage. In the form of chlorosis described by Virchow, associated with congenital smallness of the blood vessels, this condition is not confined to the vessels of the pelvis, but is generalized throughout the body. Here, therefore, the amenorrhea is uncompensated by any vicarious flux.

We do not propose, in this place, to examine the various theories that have been advanced in the most remote and the most modern times, to explain the menstrual flux by some necessity of purification, or of elimination from the blood of morbific material. This theory, originally derived from the Jewish views on the subject of uncleanness, was supported by Aran by means of the researches of Andral and Gavarret on the respiration. These physiologists, as is well known, asserted that during menstrual life women habitually exhaled less carbonic acid by respiration than do men. Aran suggested that the deficiency was made good by the carbon evacuated with the menstrual blood. Dr. Clarke rather vaguely admits a necessity for "elimination" of *something*, as one for which special provision must be made during the time of menstruation. The reviewer of Dr. Clarke, in the American Journal of Medical Science, enlarges upon the same idea.

Rabuteau[1] has reëxamined these experiments of Andral and Gavarret, and affirms that in them, not sufficient attention has been paid to the time in relation to the menstrual epoch. That during the period comprised between the five

[1] Gaz. Hebd. 1870.

or six days that follow the cessation of menstruation, and a day or two before its return, the elimination of carbonic acid was found the same in the woman experimented upon as in man. But during menstruation, the carbonic acid diminishes, because from the loss of blood corpuscles the amount of oxygen introduced into the blood, and consequently the organic combustions, are diminished.

The temporary diminution in the elimination of carbon from the lungs, while indicating a temporary diminution in the energy of respiration and in the nutritive processes of disassimilation, is very far from indicating an accumulation of carbonaceous material in the blood. "The amount of CO_2 extracted," says Ranke,[1] "depends upon the metamorphosis of tissues. It is increased by muscular movement, but more so by any increase in the hydrocarbons of the food, and in comparison with these, all other circumstances, as age and sex, are of very little importance. Part of the CO_2 eliminated, passes out of the tissues in a solid state in saline combinations in which the venous blood is richer than the arterial."[2] According to this, either venous or capillary hemorrhage, such as constitutes the menstrual flux, *would* compensate, were it necessary a defective elimination of CO_2 by the lungs.

It does not therefore follow, however, that in amenorrhea, unless dependent, as is exceptionally the case, upon a local impediment to evacuation by the uterus, there is the least danger that hydrocarbons will accumulate in the blood. For with the above exception amenorrhea is always accompanied by a defective nutrition of tissues, lowered vitality of cells, hence a diminution in the absorption of Oxygen and corresponding diminution in the formation of CO_2———"The most important circumstance, observes Pfluger, determining an increased absorption of O, is an increased vital activity in one or more organs."

The condition of vital activity or of general nutrition that

[1] Grundzuge der Physiologie. p. 465. 1875. [2] Ibid, p. 471.

obtains during the menstrual period is of great importance for the question discussed in this Essay.

We have devoted so much space to the examination of this so called ovular theory of menstruation, because it has been predominant in inducing the conviction, that during the time of the hemorrhagic flow, the general nutrition and vital activity of the woman must be lowered.

This view has not been universally held, nor is it only held by the advocates of the ovulation theory, but also by those whose attention is especially fixed upon the fact of the periodical hemorrhage. Each group may be subdivided into two on this point, according to the different interpretation given to the same facts. Thus:

During menstruation, nutrition and nervo muscular action must be lowered.

1. Because the local processes effected in the ovary and uterus are so complex, and involve such an expenditure of vascular, nervous and nutritive force, that the rest of the body must become temporarily bankrupt.

2. Because the loss of blood by the catamenial flow acts like any other hemorrhage to anemiate the blood, lower the tension of the vascular system, and by the loss of blood corpuscles interfere with the absorption of oxygen, with formation of CO_2, and of urea, in a word with the assimilative and disassimilative processes of nutrition.

Or on the other hand:

The menstrual period should be one of increased vital energy.

3. Because the entering upon active functions of the ovaries implied by the rapid maturing and dehiscence of the Graafian vesicles affords a powerful stimulus to the entire nervous system, like the shock from an electric battery:

> 4. Because the hemorrhage which when restrained to normal proportions is not followed by any of the consequences of accidental hemorrhage implies that the nutrition of the woman has reached a high maximum, in excess of her individual needs, and affording a surplus of material that must be utilized or thrown away.

Our commentary on the above would be as follows:

1. The increased nutrition of the ova in the ovary in the cases, far from universal, where this coincides with menstruation and the increased development of the mucous membrane of the uterus, do *divert from the general circulation* an amount of blood comparable to what is diverted during the functional activity of many other organs. Into all active organs blood streams in consequence of nerve action, and the blood current is accelerated.

In rabbits at rest the locomotive apparatus contains 36.6% of the blood mass; but in rabbits in motion, 66%. The mass of blood in any organ is in proportion to the metamorphosis of tissue in the organ. There is a coincidence, therefore, of activity and hyperæmia of one set of organs with repose and anemia of another.[1]

In animals killed during digestion. the entire digestive apparatus is found reddened and richly injected with blood. The stomach, intestinal mucous membrane, and pancreas, show this change most markedly; the liver is slightly enlarged." "There is such an opposition between the circulation in the muscles and the digestive, that we are enabled to dissipate congestions of the liver by means of muscular exercise."

I am not aware of any experiments upon women analogous to those made by Ranke in animals, by which the

[1] Ranke, Loc. cit. p. 374.

amount of blood circulating in the uterus and ovaries during menstruation could be estimated. For reasons already set forth, neither the forced injections made by Rouget on the cadaver, nor the intense hyperæmia observed on the external genital organs of animals during the rut, can be relied upon as a basis for this estimate. But the size of the organs, relative to the mass of the body, indicates that, until the beginning of pregnancy, the diversion of blood, even to so rich a plexus of vessels as the uteri-ovarian, cannot be as extensive as to the liver, gastro-intestinal tract, or brain. In rabbits, Ranke has estimated the usual distribution of blood thus:

Spleen	0.23 per cent. of the whole mass of blood.		
Brain and cord	1.24	Bones	8.24
Kidneys	1.63	Heart, lungs, great vessels	22.76
Skin	2.10	Muscles in repose	29.20
Intestines	6.30	Liver	29.30

It is certain that the amount of blood determined to the pelvis during menstruation (before the flow) varies extremely in physiological and pathological cases. In analyzing painful cases we shall find a marked contrast between the cases where no pain is experienced, or where it only comes on in the shape of cramps during the first day or two of the hemorrhage, and those other cases where the flow is preceded for several days by sensations of weight, dragging, fullness about the loins, indicative of pelvis congestion.

We shall have occasion to speak of these cases again. It suffices here to insist on the fact, that as they differ, to however slight a degree, from perfectly healthy cases, they cannot be considered to illustrate the type; and that wherever the sensation of weight is absent, trifling, or only just precedes the flow that relieves it, we may affirm that the pelvis blood vessels have not been distended by an amount of blood sufficiently considerable to seriously deplete the rest of the system.

The appearance of the mucous membrane during menstruation has been frequently compared with that offered by others in acute catarrhal inflammation (Courty, Beigel, Virchow, etc.). The term suggests a pathological condition, which, however, lies in the term. If, as is certainly true (see our statistics), this process can be accomplished in 53 per cent. of cases without the least interference with the consciousness of well being, it is evident that the resemblance with inflammation is deceptive, since quite a slight degree of inflammation of this same membrane always involves distinct suffering. Expenditure of nervous or formative force involved in the rupture of follicles and growth of the decidua, ceases to appear a brusque robbery from the sum total of the individual force, when these processes are seen to be so gradual in their evolution. Although only one Graafian follicle (in the human subject) be ever ready to rupture at any given time, yet it is admitted on all sides that the development of different follicles at various grades is incessant. Still more gradual (if possible) has been shown to be the growth of the endometrium, which is scarcely inactive during eight or ten days, if at all. Nor are these days those, except in persons affected with endometritis, on which the woman habitually feels in the best health, for that is during the week immediately preceding menstruation, when the tumefaction and injection of the membrane reach their height.

It is true therefore that the vital activity of the cells of the ovary and uterus proves the necessity for an amount of vital force in the organism superior to what would be required by an individual having no corresponding organs.

But as this demand for vital force is, as we have shown, continuous, it implies a permanent provision for its existence in the organism, and not a succession of temporary revolutions of that organism's resources. A body more rich in organs, an organ more rich in cells, consumes absolutely

more material than one poorer in organs, (Ranke Loc. cit. p. 19.) In other words, it is constructed on a higher type.

2. The best commentary to be made upon this statement, is the counter statement under the fourth head, showing that the menstrual flux does not resemble in its phenomena or in its effects any accidental hemorrhage.

3. We have a certain number of facts to be related further on, which indicate that the period of menstruation may be one of increased vital energy and especially of increased mental force. But we cannot find in the ripening of the Graafian follicles, any cause for an increased stimulus to the nervous system.

It is the presumed analogy between menstruation and the rut, and the theory that the starting point of the whole menstrual nisus was to be found in the bursting of this tiny vesicle,[1] that has theoretically invested a nutritive process, so minute in extent, however mighty in result, with such an immense influence on the nervous system. The peritoneal wound (shown by Waldeyer not to exist, since the peritoneum does not cover this portion of the ovary,) which excited such luxuriant compassion on the part of Michelet, should by this time be relieved of the responsibilities laid upon it. We think indeed that the female economy can be shown to normally experience a stimulus, more or less powerful in connection with menstruation, but there is nothing to show that this is derived from a sudden and fermentative evolution of nerve force in the ovaries.[2]

[1] "All facts agree to prove that menstruation is the *consequence* of the ovarian process on which depends the development and rupture of the Graafian vesicle. The menstrual hemorrhage is an *accident* due to the insufficient resistance of the capillaries of the endometrium, when congested at the time of the development of an ovarian vesicle." Liegois, Traitè de Physiologie. 1869. Pp. 262–264.

[2] Chereau, Maladies des ovaries.

The extent to which the ovaries have succeeded to the uterus, in the capacity for inflaming the scientific imagination, may be gathered from these words of Virchow. "The woman is only woman on account of her generative glands"

4. These remarkable peculiarities of the menstrual flow, which to the majority, of observers learned or simple, have always distinguished it from accidental hemorrhage, demand an explanation if any theoretical conclusion can be arrived at in regard to the effect of menstruation on the working capacity of women. It is certain that in the case of any other hemorrhage of far less amount and duration, the most complete rest of body and mind would be claimed as a matter of course. It would not be necessary for instance, to forbid peasant women from treading out grapes in a wine vat, during an attack of epistaxis, as it has been found necessary to do during menstruation, not for the sake of hygiene but cleanliness. Their own bodily discomfort would suffice to preserve the proprieties.

If of the two modern theories, periodical or reflex irritation from the ovaries, or fatty degeneration of a uterine decidua rendered useless by the failure of conception, neither serves to completely explain the menstrual hemorrhage, we

(ovaries). All the peculiarities of her body and mind, of her nutrition and nerve activity, the sweet delicacy and round contour of her limbs, the characteristic shape of her pelvis, the development of her bosom, the gentleness of her voice, the beautiful lustre of her hair, and the scarcely perceptible down on her cheeks; then again, the depth of feeling, devotion and fidelity, in short all the feminine qualities that we admire and honor in the true woman, are only a consequence of the ovary. What wonder then if by the periodical dehiscence of ova, phenomena occur which indicate the general participation of nutrition and nerve force? I will remind the practical physician of teething, a process which consists in the periodical reproduction of parts of much less significance, and which nevertheless is accompanied with the liveliest disturbance of nutrition and nerve force. (Der puerperale Zustand. Das Weib, and Die Zelle, 1848. P. 751.)

We think in regard to this language, the remark of Puech, who comments upon it, is justified: "Certainly if brilliancy of thought, if elevation of language occupied the place of arguments, we must incline before this panegyric, but in physiology as in medicine, the authority of the master is dominated by the authority of facts. In view of the observations related in this chapter, [showing the persistence of feminine qualities in the absence or after the extirpation of the ovaries,] the idea of Virchow regarding their rolë is not only gratuitous, it is illogical." Des ovaries, de leurs anomalies, 1873, p. 125.

are led back to the older theory, which has prevailed half as many centuries as the ovulation theory has years, the theory, namely, of an excess in women of nutritive force and material, which, when not utilized in reproduction, is expended in menstruation. Wagner, whom we have already quoted as a champion of the ovulation theory, *i. e.*, as considering "the characteristic-cause of menstruation to reside in the ovaries," adds, "Nevertheless, we are far from contesting a special physiological significance to this hemorrhage. . . . The blood which is evacuated at the time of menstruation contains all the essential constituents of normal blood. . . . Whatever peculiarities it offers are explained by the external condition of its evacuation. We should therefore with difficulty be justified in considering the menstrual blood as useless material. It is a surplus acquired in the mechanism of individual life, and whose formation is effected by the entire mechanism of the body. It is completely analogous to the formative material which elsewhere is employed for the development of the embryo, for the nutrition of the egg, etc. The surplus, which could with impunity be removed from the individual existence, which indeed must be removed under penalty of manifold disturbances, serves to cover increased expenditures. . . . According to our opinion, the separation of the menstrual blood is nothing else than the separation of a superfluous formative material in a characteristic form. What in other cases (*i. e.* in oviparous animals) leaves the material body as the substance of the ovum, here passes away as blood, in the same form in which it originally is brought to the ovum.

On this account is the menstrual flux limited to the mammiferæ. *For in these animals the ovum is so small that after its formation a large amount of formative material is left over.* Again, were the mammiferæ egg-laying animals like birds, then doubtless must the egg contain all the nutriment required by the embryo. Thus, in a human being, the

egg must contain as much nutriment as is absorbed from the maternal body during ten months' gestation. In that case, an egg could only ripen every ten months, and the possibilities of conception would therefore be extremely limited. But in fact, the material which we have imagined concentrated upon a single rut, is divided over ten successive periods of rutting, at each of which conception is possible. The striking minuteness of the mammalian ovum, therefore, may be considered as a means whereby the possibilities of fecundation are multiplied, and thus indirectly, the fertility of the mammiferæ heightened."

Reproduction, without a previous provision of reproductive material and of formative force, is unknown throughout the vegetable and animal kingdom, and is indeed inconceivable. In plants, nutritive material accumulates regularly at the nodes of the stems, and the degree of development attained by the bud springing from the nodes, is proportioned to the space between them or the internodes. So has Wagner again shown that the number of offspring of any race of animals is in exactly inverse proportion to the weight of offspring at a birth, and this proportioned to the length of gestation. "Genesis, under every form," says Herbert Spencer,[1] "is a process of negative or positive disintegration, and is thus essentially opposed to that process of integration which is one element of individual evolution. Negative disintegration occurs in those cases where, as among the compound Hydrozoa, there is a continuous development of new individuals by budding from the bodies of older individuals; and where the older individuals are thus prevented from growing to a greater size. Positive disintegration occurs in those cases of agamogenesis where the formation of new individuals is discontinuous; and in all cases of gamogenesis. . . . The degree of disintegration becomes less marked as we approach the higher organic forms. Among

[1] Principles of Biology, Vol. I., p. 216.

the higher animals there is no case in which the parent individuality is habitually lost in the production of new individualities. To the last, however, there is of necessity a greater or less disintegration. The seeds and pollen grains of a flowering plant are disintegrated portions of tissue, as are also the ova and spermatozoa of animals." Again (p. 224), "Agamogenesis continues so long as the forces which result in growth are greatly in excess of the antagonistic forces, while conversely, we find that the recurrence of gamogenesis takes place when the conditions are no longer so favorable to growth. . . . Very high nutrition in plants prevents or arrests gamogenesis." De Candolle says,[1] "The indefinite development of boughs which do not flower, favors the birth and growth of a great number of nutritive leaves, which tend to increase the aggregate, and to deposit here and there stores of nourishment suited to favor new development of germs or flowers. The termination in flowers tends to deprive branches of the development of nutritive organs, and to consume the nourishment stored up in the branches, stems, or roots. In caulocarpal plants, the flower is small, and only consumes the nourishment stored in its own peduncle and immediate supports. These are perennial plants, trees, and shrubs. In rhizocarpals the flowers are more numerous, in proportion to the strength of the stem, and exhaust all its nourishment, so that it dies down to the root. These are perennial herbs. In manocarpals, the flowers are still more numerous, and exhaust the root as well as the stem. These are annual or bisannual plants." Darwin[2] says of sterile cultivated plants, with double flowers, rich seedless fruit with largely developed organs of vegetation, that there is in them a saving of nutriment and vital force, because the sexual organs do not act, or act imperfectly. In his treatise on sexual selections, *passim*, the author insists

[1] Organographie Vegetale, 1827, p. 230.

[2] Variations of Animals under Domesticity, Vol. II., pp. 131, 172.

on the secondary sexual characters of brilliant plumage and various appendages in the male of various animals, especially birds, that seem to serve as an equipoise to the excess of reproductive force in the female.[1]

[1] A. B. Blackwell (Sexes throughout Nature) has justly pointed out that these secondary sexual characters are much more strongly marked in polygamic birds, and where food is easily accessible, so that the male is not compelled to exert himself even for the indirect nutrition of offspring.

SECTION IV.

EXPERIMENTAL.

ON the hypothesis that the menstrual period represents the climax in the development of a surplus of nutritive force and material, we should expect to find a rhythmic wave of nutrition gradually rising from a minimum point just after menstruation, to a maximum just before the next flow.

The traces of this rhythmic wave should be measured by the consumption of oxygen, the excretion of CO_2 and of urea, by the tension of the arterial system, the vital capacity of the lungs, possibly also by the dynamic force of muscles. We have attempted to make a few of these measurements. The following tables show the results of daily measurements of urea in the urine of six persons for a period of one, two, or three months.

The urea was measured by Liebig's volumetric method. The whole quantity of urine passed in twenty-four hours was collected, and the specimen analyzed was selected from the whole amount.

No. 1.

	A. M.					P. M.								
		Temperature.		Dynamom.			Temperature.		Dynamom.					Remarks.
Date.	Pulse.	Axillary.	Rectal.	Right.	Left.	Pulse.	Axillary.	Rectal.	Right.	Left.	Grms. Urine.	Grms. Urea.	Per Ct.	
June 19*	49	.....	98.8	.....	.....	51	97.8	98.8	.....	.....	1714.632	68.685	4	
" 20*	51	.....	98.8	.....	.....	50	.....	98.4	.....	.....	.....	.....	.....	
" 21*	50	.....	98.8	.....	.....	52	.....	99.	.....	.....	.....	.....	.....	
" 22	52	.....	99.	.....	.....	54	97.8	98.8	23	17	.....	.....	.....	
" 23	52	97.3	99.8	20	17	52	.....	98.8	20	17	886.410	16.398	$1\frac{84}{100}$	
" 24	52	.....	98.8	19	"	56	.....	98.8	"	"	668.222	21.383	$3\frac{2}{10}$	
" 25	58	.....	98.7	23	21	"	.....	99.1	27	25	.....	.....	.....	
" 26	54	.....	98.75	25	22	48	.....	99.25	"	"	620.487	24.509	$3\frac{95}{100}$	
" 27	50	.....	99.25	"	24	50	.....	99.25	"	"	.....	.....	.....	
" 28	50	.....	99.25	"	23	48	.....	.....	28	"	945.504	20.801	$2\frac{2}{10}$	
" 29	48	.....	N.	"	"	46	97.5	.....	26	22	.....	.....	.....	
" 30	53	.....	N.	"	21	56	97.75	99.5	"	"	709.128	23.755	$3\frac{95}{100}$	
July 1	52	97.5	N.	24	23	48	97.6	.....	31	29	.....	.....	.....	
" 2	48	97.6	N.	27	25	"	97.5	.....	30	25	1063.692	28.187	$2\frac{65}{100}$	
" 3	52	97.6	N.	"	"	50	97.	.....	29	26	.....	.....	.....	
" 4	56	98.4	99.5	25	23	48	97.8	98.8	30	25	1565.991	28.187	$1\frac{8}{10}$	
" 5	54	97.8	98.8	27	25	54	97.6	99.4	29	27	.....	.....	.....	
" 6	54	97.5	99.	28	"	"	97.25	99.4	28	26	.....	.....	.....	

"	7	54	98.1	99.1	25	23	48	98.75	100.4	29	"	945.504	20.801	$2\frac{2}{10}$
"	8	54	98.5	99.5	26	24	54	.....	99.75	28	"	.....	.....	.....
"	9	48	97.75	99.1	28	25	48	.....	99.75	30	25	1388.709	30.829	$2\frac{22}{100}$
"	10	48	98.5	99.25	"	26	54	.....	99.5	29	"	.....	.....	.....
"	11	48	98.1	99.25	"	"	52	99.	100.*	28	"	1181.880	29.547	$2\frac{5}{10}$
"	12	48	98.75	99.75	"	"	54	.....	99.4	"	26	.....	.....	.....
"	13	52	98.25	99.	30	"	52	.....	99.3	"	24	650.034	25.676	$3\frac{95}{100}$
"	14	54	98.	99.	30	25	54	98.	99.	28	26	753.448	25.240	$3\frac{85}{100}$
"	15	51	97.75	99.8	28	27	50	97.75	98.75	29	24	827.316	23.578	$2\frac{85}{100}$
"	16*	54	97.9	N.	28	26	54	97.4	99.	30	25	1565.991	25.838	$1\frac{65}{100}$
"	17*	54	.....	99.	"	"	60	.....	100.1	30	24	1285.294	35.345	$2\frac{75}{100}$
"	18*	48	97.5	N.	"	24	54	97.5	99.25	$30\frac{1}{2}$	26	738.675	19.943	$2\frac{7}{10}$
"	19*	48	98.7	99.4	29	25	50	98.	99.5	31	26	1359.162	25.824	$1\frac{9}{10}$
"	20	48	98.	99.1	28	25	48	98.	99.4	30	"	886.410	26.592	3
"	21	48	98.75	99.5	29	24	54	97.75	99.25	28	"	1034.145	23.785	$2\frac{3}{10}$
"	22	48	97.5	N.	28	25	52	97.50	98.75	29	"	709.128	22.337	$3\frac{15}{100}$
"	23	48	97.25	N.	28	"	47	98.	.....	31	28	812.542	22.548	$3\frac{28}{100}$
"	24	56	97.75	N.	"	26	48	97.75	99.5	28	26	1004.598	29.133	$2\frac{9}{10}$
"	25	48	.....	.....	31	23	.....	98.	99.	.....	.....	.....	.....	.....
"	26	56	97.75	N.	28	26	.....	.....	.....	.....	.....	827.316	20.682	$2\frac{5}{10}$
"	27	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
"	28	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	723.901	25.336	$3\frac{5}{10}$

* Slight indigestion.

No. II.

	A. M.					P. M.								
Date.	Pulse.	Temperature.		Dynamom.		Pulse.	Temperature.		Dynamom.		Grms. Urine.	Grms. Urea.	Per Ct.	Remarks.
		Axillary.	Rectal.	Right.	Left.		Axillary.	Rectal.	Right.	Left.				
June 22	70	97.75	98.25	....	..	76	98.5	99.25	...	..	.....	.....	....	
" 23	72	"	98.5	....	..	80	97.75	99.75	$28\frac{1}{2}$	25	1477.35	34.569	$2\frac{34}{100}$	
" 24	80	98.5	99.25	$29\frac{1}{2}$	26	100	99.5	100.	$29\frac{1}{2}$	$26\frac{1}{2}$	1377.35	39.254	$2\frac{85}{100}$	
" 25	"	"	99.	"	"	82	"	"	$26\frac{1}{2}$	23	.....	.....	....	
" 26	74	"	"	$28\frac{1}{2}$	$27\frac{1}{2}$	"	99.	99.5	$31\frac{1}{2}$	$28\frac{1}{2}$	709.028	28.365	4	
" 27	80	"	"	"	27	80	99.25	100.	$30\frac{1}{2}$	$27\frac{1}{2}$	.....	.....	....	
" 28	70	98.25	98.75	$29\frac{1}{2}$	"	"	"	"	29	28	856.853	37.701	$4\frac{4}{10}$	
" 29	"	98.5	"	"	26	74	"	99.75	33	30	.....	. ....	...	
" 30	"	"	"	28	"	72	99.	99.5	30	27	1240.974	31.024	$2\frac{5}{10}$	
July 1	"	"	"	"	"	70	98.25	99.	32	$30\frac{1}{2}$	.....	.....	....	Mens. began to-day.
" 2*	"	98.	98.5	31	$29\frac{1}{2}$	80	98.25	99.	$33\frac{7}{8}$	$30\frac{1}{2}$	976.151	31.724	$3\frac{25}{100}$	No pain.
" 3*	68	"	98.75	$28\frac{1}{2}$	27	76	98.25	99.	34	$30\frac{1}{2}$	1447.803	37.642	$2\frac{6}{10}$	
" 4*	70	98.25	"	31	28	70	98.5	"	"	"	1713.726	41.129	$2\frac{4}{10}$	
" 5	72	"	"	"	"	74	"	"	$34\frac{1}{2}$	"	1181.880	30.728	$2\frac{6}{10}$	
" 6	70	"	98.5	30	"	72	"	"	32	30	.....	.....	....	
" 7	68	98.	"	28	27	76	98.75	99.5	33	29	1063.692	39.888	$3\frac{75}{100}$	
" 8	"	"	"	$31\frac{1}{2}$	$28\frac{1}{2}$	72	98.25	99.	35	$31\frac{1}{2}$	.....	.... .	....	

"	9	70	98.5	98.75	$33\frac{1}{2}$	$29\frac{1}{2}$	78	98.5	99.25	$35\frac{3}{4}$	$32\frac{1}{2}$	1300.068	35.751	$2\frac{75}{100}$	
"	10	"	98.25	"	$32\frac{1}{2}$	29	70	98.25	98.75	34	$29\frac{1}{2}$	.....	.....	....	
"	11	74	"	"	32	$27\frac{1}{2}$	"	"	99.	$33\frac{1}{2}$	"	1418.256	39.711	$2\frac{8}{10}$	
"	12	70	"	98.5	35	$30\frac{1}{2}$	76	98.5	99.25	37	33	.....	.....	....	
"	13	"	"	"	$35\frac{3}{4}$	$32\frac{1}{2}$	"	"	99.5	34	$30\frac{1}{2}$	1004.498	33.148	$3\frac{3}{10}$	
"	14	"	98.5	99.25	31	$31\frac{1}{2}$	"	"	"	35	32	.....	.....	....	
"	15	76	98.	98.75	33	29	"	98.75	99.5	34	33	875.051	30.189	$3\frac{45}{100}$	
"	16	70	"	98.5	35	31	"	98.25	99.25	37	34	.....	.....	....	
"	17	72	"	"	34	30	78	"	99.	34	30	1270.521	33.033	$2\frac{6}{10}$	
"	18	74	98.25	99.	"	"	72	"	99.25	36	34	.....	.....	....	
"	19	72	"	"	$32\frac{1}{2}$	31	"	"	99.5	36	32	1181.880	28.365	$2\frac{4}{10}$	
"	20	70	98.	99.	34	30	"	98.5	"	33	32	.....	.....	....	
"	21	"	98.25	99.25	34	31	"	"	99.75	33	30	1595.538	29.517	$1\frac{85}{100}$	
"	22	72	98.5	99.5	"	"	80	"	99.5	32	31	.....	.. ...	....	
"	23	76	"	"	33	$30\frac{1}{2}$	76	99.	100.5	"	"	970.050	32.496	$3\frac{35}{100}$	
"	24	70	98.	99.	$33\frac{1}{2}$	$32\frac{1}{2}$	76	99.	100.	$35\frac{1}{2}$	33	.....	.....	....	
"	25	74	98.5	99.5	$34\frac{1}{2}$	$32\frac{1}{2}$	78	"	"	34	32	1270.521	36.845	$2\frac{9}{10}$	
"	26	76	99.	100.25	34	32	"	"	100.5	33	"	.....	.....	....	
"	27	74	98.	99.25	33	$33\frac{1}{2}$	76	98.75	99.75	"	"	650.034	25.026	$3\frac{85}{100}$	
"	28	"	98.5	99.25	"	32	78	99.	"	36	$33\frac{1}{2}$	930.730	32.575	$3\frac{5}{10}$	
"	29	..	"	"	35	33	74	98.75	99.5	33	34	827.316	29.369	$3\frac{55}{100}$	
"	30	..	"	99.5	$34\frac{1}{2}$	32	"	"	"	37	$34\frac{1}{2}$	1255.747	29.510	$2\frac{35}{100}$	
"	31	74	98.	98.75	$35\frac{1}{2}$	33	68	"	"	$37\frac{1}{2}$	35	975.051	27.301	$2\frac{8}{10}$	
Aug.	1*	"	"	98.5	$36\frac{1}{2}$	35	72	"	"	"	"	1034.145	31.541	$3\frac{5}{100}$	Menstr began today. No pain.
"	2*	72	98.5	99.75	36	33	"	98.5	99.25	$36\frac{1}{2}$	$36\frac{1}{2}$	1477.350	30.285	$2\frac{35}{100}$	

No. II. (*Continued.*)

	A. M.					P. M.								
		Temperature.		Dynamom.			Temperature.		Dynamom.					
Date.	Pulse.	Axillary.	Rectal.	Right.	Left.	Pulse.	Axillary.	Rectal.	Right.	Left.	Grms. Urine.	Grms. Urea.	Per Ct.	Remarks.
Aug. 3*	"	98.	98.5	37	34½	"	98.	98.5	36	35	1684.179	32.841	$1\frac{95}{100}$	
" 4	..	"	"	34	33	74	98.75	99.5	"	34	1300.068	28.601	$2\frac{2}{10}$	Sewing.
" 5	74	98.	"	"	"	76	"	"	35	"	1063.692	23.933	$2\frac{25}{100}$	"
" 6	72	"	"	"	"	"	"	"	35½	"	827.316	22.751	$2\frac{75}{100}$	"
" 7	76	98.75	99.5	35	33½	"	"	99.75	38½	35	.....	.....	4	
" 8	74	"	"	36½	34	"	"	99.5	35½	33	856.863	28.704	....	
" 9	"	98.5	99.25	"	33	70	"	99.25	36½	36½	.....	.....	....	
" 10	"	"	"	33	"	76	98.5	"	36	34	886.410	23.046	$3\frac{35}{100}$	
" 11	..	98.	98.5	35	33	72	"	"	36½	34½	....	.....	....	
" 12	72	"	"	36	"	"	"	"	37	35	1034.145	29.990	$2\frac{6}{10}$	
" 13	76	"	"	34	"	78	"	99.5	35	34	.....	... ..	....	
" 14	..	98.5	99.25	37	35	84	99.	100.25	33	33	915.957	28.852	$3\frac{15}{100}$	Cold in the head.
" 15	..	98.75	99.5	34	32	86	98.75	99.75	"	32	.....	.....	....	
" 16	84	"	"	33	"	"	99.	100.25	36	34	1152.333	26.503	$2\frac{8}{10}$	
" 17	"	98.25	99.	35½	34½	80	98.25	99.25	"	"	.....	.....	....	
" 18	..	....	...	36	33	76	98.25	99.	36½	"	.....	.....	....	
" 19	74	98.	98.75	35½	32	"	"	"	35½	34½	886.410	24.376	$2\frac{76}{100}$	
" 20	"	"	"	35	33	"	"	"	36½	36½	768.222	22.278	$2\frac{9}{10}$	

"	21	"	"	"	$35\frac{1}{2}$	34	74	98.5	99.5	"	33	.....	.....	....	
"	22	72	98.25	99.	"	"	..	"	"	37	34	1536.434	31.496	$2\frac{5}{100}$	
"	23	..	"	"	36	"	76	"	"	"	$34\frac{1}{2}$	.....	.....	....	
"	24	..	"	"	....	..	72	"	99.25	$38\frac{1}{2}$	35	1979.649	34.643	$1\frac{75}{100}$	
"	25	72	98.5	99.5	36	32	74	98.5	...	"	34	.....	.....	....	
"	26	..	"	"	35	$31\frac{1}{2}$	..	"	....	37	"	1447.803	31.127	$2\frac{15}{100}$	
"	27	..	"	....	$35\frac{1}{2}$	33	..	"	....	"	$33\frac{1}{2}$	.....	.....	....	
"	28	..	"	....	$36\frac{1}{2}$	34	76	"	....	35	32	1462.765	35.833	$2\frac{45}{100}$	
"	29	..	"	99.5	"	32	74	99.	100.	36	$32\frac{1}{2}$	945.504	27.419	$2\frac{9}{10}$	
"	30	..	"	"	$34\frac{1}{2}$	31	..	"	"	35	$32\frac{1}{2}$	1152.333	27.079	$2\frac{85}{100}$	
"	31	76	98.	99.	$35\frac{1}{2}$	32	..	98.2	99.2	37	$34\frac{1}{2}$	1004.598	25.114	$2\frac{5}{10}$	
Sept.	1*	..	"	"	$36\frac{1}{2}$	33	72	98.	98.75	37	33	768.222	26.887	$3\frac{5}{10}$	Mens. began about 10 P. M.
"	2*	..	"	....	35	"	80	98.5	....	37	35	1093.239	31.157	$2\frac{85}{100}$	
"	3*	..	"	....	"	"	"	98.	....	$37\frac{1}{2}$	33	1167.106	30.344	$2\frac{6}{10}$	
"	4	..	"	....	36	$33\frac{1}{2}$	..	"	....	37	"	797.769	27.124	$3\frac{4}{10}$	Excursion to Sandy Hook.
"	5	..	"	...	"	33	..	98.5	.	35	32	709.128	28.573	$4\frac{29}{100}$	
"	6	..	...	....	....	..	..	...	....	...	..	1388.709	25.323	$1\frac{823}{100}$	

NO. III.

A. M.

Date '75	Pulse. 7 o'clk	Pulse. 11 o'clk	Temperature. 7 Mouth.	Axilla.	Vagina.	11 Rectum.	Dynamics. Right.	Left.	Pulse. 4 o'clk.	11 o'clk.
June 19	72	73	99.2	98.7	100.	100.1	..	..	74	67
" 20	66	..	98.9	98.	99.8	99.8	..	..	..	68
			98.5	97.9	99.	99.1				
" 21	74	76	98.6	98.	99.5	99.5	..	..	..	82
			98.4	98.3	99.	99.				
" 22*	68	74	99.2	98.	99.2½	99.3	25½	25	..	65
			98.4	98.	98.7½	98.7½				
" 23*	65	68	99.	98.5	99.2½	99.2½	26	26½	70	64
			98.3	98.	98.5	98.6				
" 24*	72	78	99.	98.4	99.6	99.6	28½	29	94	71
			98.5	98.1	98.6	98.7				
" 25	72	70	99.2½	98.7½	99.2½	99.4	27½	28½	74	70
			98.2½	98.	98.3	98.5				
" 26	70	76	99.2	98.4	99.5	99.5	30½	32½	76	68
			98.4	98.	98.6	98.8				
" 27	68	70	.....	.....	.....	.....	..	..	76	70
			98.1	98.	98.5	98.6				
" 28	66	72	.....	.....	.....	.....	..	..	74	70
			98.2	97.8	98.5	98.5				
" 29	64	..	.....	.....	.....	.....	..	..	70	66
			98.4	98.	98.5	98.6				
" 30	60	70	99.2½	98.9	98.8	99.8	28½	28	80	78
			98.1	97.8	99.	99.1				
July 1	84	92	99.2	98.9	99.5	99.5	31	30	86	62
			98.5	97.3	98.6	98.6				
" 2	62	70	98.7½	98.5	99.7½	99.	31	29	78	66
			98.5	98.2½	98.7½	98.7½				
" 3	66	76	98.2½	98.5	99.5	99.1	31½	30½	80	60
			98.4	98.	98.7½	98.6				
" 4	62	84	99.	98.9	99.7½	99.8	30	30	84	64
			98.5	98.2½	98.6	99.				
" 5	64	72	99.5	98.8	99.5	99.6	32	30	80	62
			98.5	98.	99.1	99.1				
" 6	62	80	99.5	99.	99.7½	99.8	32½	31½	82	66
			98.5	98.	99.	99.				
" 7	68	..	.....	.....	.....	.....	34	29	..	64
			98.5	98.2	99.	99.2				
" 8	66	72	99.5	99.2	99.9	99.7½	34½	29	76	74
			99.	98.8	99.2½	99.2½				
" 9	70	..	.....	.....	.....	.....	30	28	90	..
			.....	.....	.....	.....				
" 10	..	..	.....	.....	.....	.....	30	29	..	88
			99.	98.3	99.5	99.6				
" 11	80	82	99.1	99.1	99.2½	99.5	32	30	88	74
			98.4	98.2	98.6	99.				
" 12	62	84	99.	98.9	99.7	99.8	32	30	..	..
			98.6	98.4½	99.2	99.3				
" 13	66	70	99.2½	99.3	99.6	99.6	33½	30	72	66
			98.4	98.1	99.2½	99.3				
" 14	78	..	.....	.....	.....	.....	33	30	86	70
			99.	98.5	99.1	99.				
" 15*	76	76	99.2½	98.4	99.4	99.6	35	29	84	66

NO. III.

P. M

7	Temperature.		11	Dynamics.					
Mouth.	Axilla.	Vagina.	Rectum.	Right.	Left.	Grms. Urine.	Grms. Urea.	Per Ct.	Remarks.
98.8	98.4	99.7	99.5	..	..	.....	....	....	
.....	.....	.....	.....						
98.7½	98.2½	99.	99.	..	..	.....	....	...	
.....	.....	.....	.....						
98.6	98.2	99.4	99.5	..	..	.....	....	....	Sick Headache.
.....	.....	.....	.....						*Mens.* this morn
98.2	98.1	98.8	98.8	28½	27½	.....	....	....	Some pain of
99.4	98.6	99.4	99.4						steady character
98.4	98.	98.6	98.6	28½	28½	886.41	16.227	$1\frac{68}{100}$	*Mens.* flow slight
99.	98.4	99.5	99.7						*Mens.* flow just
98.5	98.2½	98.7½	99.	30	30	1123.692	28.092	$2\frac{9}{10}$	noticeable. Con-
99.3	98.5	99.6	99.7						gestive head-
99.	98.4	99.1	99.2½	30½	30½	.....	....	....	ache from over-
99.4	98.8	99.6	99.8						heating.
98.4	98.	98.6	98.7	30	30	886.41	29.251	$3\frac{3}{10}$	Went to country
99.1	98.6	99.	99.2						in P. M.
98.4	98.	99.	99.1	..	..	.....	....	....	
99.	98.8	99.5	99.5						
98.5	98.3	98.8	98.8	..	..	.....	....	....	
99.6	98.6	99.3	99.5						
98.4	98.	98.7½	98.7½	..	..	1211.427	26.651	$2\frac{2}{10}$	Returned this A.
99.4	99.	99.7½	99.7½						M.
98.4	97.8	98.5	98.6	29½	28½	.....	....	....	
99.	98.4	99.4	99.6						
98.2½	97.9	99.4	99.4	30	30	1418.256	31.910	$2\frac{25}{100}$	Headache.
99.1	98.6	99.2½	99.2½						Studied late.
98.4	98.	98.2½	98.4	35	30	.....	....	....	
98.7½	98.5	99.2½	99.2½						
98.	98.	98.1½	98.2½	32	31	1419.162	36.896	$2\frac{6}{10}$	
99.5	98.6	99 9	99.9						
98.5	98.2½	98.7½	99.6	37	32	.....	....	....	
99.1	98.9	99.5	99.5						
98.9	98.2½	99.	99.	35½	31½	915.957	25.188	$2\frac{75}{100}$	
99.5	98.8½	99.9	100.						
99.	98.5	99.1	99.2¾	37	31½	.....	....	....	
.....	.....	.....	.....						
98.5	98.3	99.	99.	35	30	1181.880	31.910	$2\frac{7}{10}$	
.....	.....	.....	.....						
98.5	98.2½	99.	99.1	..	..	.....	....	....	
99.6	99.4	100.1	100.3						
.....	.....	.....	.....	35	31½	1137.559	25.595	$2\frac{25}{100}$	
.....	.....	.....	.....						
.....	.....	.....	.....	32	30	.....	....	....	
99.7½	99.5	100.	100.3						
98.4	98.	98.6½	98.5½	31	29	1063.692	27.655	$2\frac{60}{100}$	
.....	.....	.....	.. ...						
... ..	.....	.....	.....	..	..	.....	....	....	
.....	.....	.....	.....						
98.3½	97.9	98.6	98.5	33	31	1152.333	28.808	$2\frac{50}{100}$	
99.5	99.	99.9	99.8						
98.3	98.4	99.2	99.5	40	33	.....	....	....	
98.3	98.5	100.	100.						
98.5	98.	99.5	99.6	34	30	945.504	31.674	$3\frac{35}{100}$	*Mens.*

NO. III. (*Continued.*)

A. M.

Date '75	Pulse. 7 o'clk	Pulse. 11 o'clk	Temperature. 7 Mouth.	Temperature. 7 Axilla.	Temperature. 7 Vagina.	Temperature. 11 Rectum.	Dynamics. Right.	Dynamics. Left.	Pulse. 4 o'clk.	Pulse. 11 o'clk.
			98.4	98.	98.6	98.7½				
July 16*	68	76	99.1	98.5	99.2½	99.2½	32½	29	88	..
			98.2½	98.	98.5	98.6				
" 17*	66	74	99.	98.4	99.	99.	33	29	98	66
			98.4	98.	98 6	99.				
" 18	68	74	99.	98.6	99.9	99.9	38½	30	96	60
			98.2½	97.7½	98.4	98.3				
" 19	64	80	98.7½	98.3	99.2	99.2	32	28	78	60
			.....	.....	.....	.....				
" 20	68	80	98.7½	98.7½	99.5	99.6	32	26½	98	62
			98.	97.7½	98.5	98.6				
" 21	60	64	98.7½	98.5	99.2½	99.2	35	30	80	68
			.....	.....	.....	.....				
" 22	64	66	98.8	98.4	99.2½	99.2½	34	28	82	74
			.....	.....	.....	.....				
" 23	..	86	99.3	99.	99.6	99.8	34½	26	74	60
			98.5	97.8	98.5	98.5				
" 24	68	..	.....	.....	.....	.....	35	32	..	64
			.....	.....	.....	.....				
" 25	..	76	99.	98.6	99.7½	100.	34	28	74	66
			98.5	98.	99.	99.				
" 26	70	86	99.1	98.8	99.5	99.6	30	28	78	74
			98.5	97.9	98.7½	98.8				
" 27	66	74	99.2	99.	99.6	99.9	33	28	78	70
			.....	.....	.....	.....				
" 28	..	76	99.2	98.7½	100.1	100.	33	28	80	68
			98.6	98.2	99.2	99.2½				
" 29	72	82	99.2½	98.9	99.5	99.5	32	27	82	74
			.....	.....	.....	.....				
" 30	..	80	99.5	99.	99.6	99.8	30	26½	74	60
			.....	.....	.....	.....				
" 31	66	..	99.2	98.7½	99.2½	99.2	35	27	..	80
			.....	.....	.....	.....				
Aug. 1	..	76	99.4	99.	100.4	100.5½	36	30½	80	66
			99.2	98.5	99.7½	99.7½				
" 2	72	..	.....	.....	.....	.....	33	29	66	66
			98.5	98.5	99.5	99.6				
" 3	68	72	99.6	98.8	99.6	99.7½	30	29	86	76
			98.8	98.	99.3	99.3				
" 4	74	80	99.4	99.2	100.	100.	32	30	80	64
			98.6	98.2½	99.	99.2½				
" 5	66	..	.....	.....	.....	.....	34	28	72	64
			98.8	98.2½	99.	99.1				
" 6	62	72	99.2	98.6	99.6	99.6	..	..	72	64
			99.	98.5	99.2½	99.2½				
" 7*	70	..	99.2½	99.	99.6	99.	31½	30	70	68
			99.8	98.2½	99.	99.4				
" 8*	60	72	99.	98.4	99.5	99.5	32	30	..	62
			98.5	98.2½	99.	99.1				
" 9*	66	76	99.2½	98.8	99.7½	99.8	34½	29	72	64
			98.2½	98.	99.2½	99.2½				
" 10	62	78	99.4	99.	99.5	99.5	..	..	70	66
			.....	.....	.....	.....				

NO. III.

P. M

7 Temperature. 11				Dynamics.					
Mouth.	Axilla.	Vagina.	Rectum.	Right.	Left.	Grms. Urine.	Grms. Urea.	Per Ct.	Remarks.
99.3	99.1	99.5	99.5						
98.4	98.	99.	99.	..	..	590.940	19 796	$3\frac{85}{100}$	Headache.
99.5	98.5	98.8	100.2						
$98.7\frac{1}{2}$	98.	98.5	98.5	37	30	1226.200	26.363	$2\frac{15}{100}$	
99.4	98.4	99.	99.						
$98.2\frac{1}{2}$	97.5	98.1	99.1	35	30	590.940	16.250	$2\frac{75}{100}$	
99.	$98.6\frac{1}{2}$	99.3	99.6						
$98.2\frac{1}{2}$	97.5	98.1	98.4	35	31	753.448	24.110	$3\frac{20}{100}$	
99.5	$98.7\frac{1}{2}$	99.5	99.5						
98.	98.	98.5	98.4	35	29	.....	....	....	
$99.2\frac{1}{2}$	$98.7\frac{1}{2}$	99.5	$99.5\frac{1}{2}$						
98.6	98.3	99.	99.	34	28	915.957	25.188	$2\frac{75}{100}$	
$99.2\frac{1}{2}$	$98.6\frac{1}{2}$	99.5	$99.7\frac{1}{2}$						
98.5	$98.2\frac{1}{2}$	98.5	98.5	36	32	.....	....	....	
99.4	98.9	99.5	99.4						
98.	98.	98.5	98.5	36	32	1048.918	30.418	$2\frac{90}{100}$	
.....	.....	.....	.....						
98.5	97.9	98.5	$98.6\frac{1}{2}$	34	26	.....	....	...	
$99.2\frac{1}{2}$	99.1	99.9	99.9						
$98.2\frac{1}{2}$	98.	98.5	98.6	33	29	975.051	23.401	$2\frac{40}{100}$	
99.5	... ..	100.	100.						
98.9	$98.2\frac{1}{2}$	99.1	$99.2\frac{1}{2}$	...	..	.....	....	....	
.....	.....	.....	.....						
.....	.....	.....	... ...	..	..	1181.880	22.455	$1\frac{90}{100}$	
99.5	.....	99.9	$99.6\frac{1}{2}$						
98.5	98.3	99.1	$99.2\frac{1}{2}$	34	29	.....	....	....	
.....	.....	.....	.....						
.....	.....	.....	.....	..	..	1004.598	25.114	$2\frac{50}{100}$	
.....	.....	.....	.....						
99.	98.5	99.	99.	36	$32\frac{1}{2}$	.....	....	....	Slept very little.
.....	.....	.....	.....						At work mentally anxious.
.....	.....	.....	.....	..	..	1521.670	33.476	$2\frac{20}{100}$	
.....	.....	.....	.....						
$99.2\frac{1}{2}$	98.8	99.7	100.	36	30	.....	. ..	....	Constipated.
$99.2\frac{1}{2}$	99.	100.	100.						
$98.7\frac{1}{2}$	$98.5\frac{1}{2}$	$98.7\frac{1}{2}$	99.	39	35	1100.625	25.864	$2\frac{35}{100}$	Constipated.
$99.5\frac{1}{2}$	99.4	$99.7\frac{1}{2}$	99.8						
98.4	98.	$98.7\frac{1}{2}$	$98.8\frac{1}{2}$	38	30	.....	....	....	Cold and rainy.
100.1	99.2	$100.2\frac{1}{2}$	100.3						
98.7	98.	99.2	$99.2\frac{1}{2}$	$34\frac{1}{2}$	$31\frac{1}{2}$	1248.360	26.839	$2\frac{15}{100}$	
99.5	99.	$99.7\frac{1}{2}$	99.9						
99.	98.3	99.3	99.2	$36\frac{1}{2}$	$31\frac{1}{2}$	.....	....	....	
99.6	99.	100.	100.						
98.9	98.5	99.	$99.1\frac{1}{2}$	..	..	1034.145	25.853	$2\frac{5}{100}$	
99.5	98.8	$99.7\frac{1}{2}$	99.9						*Mens.* this evening, no pain to notice.
98.8	98.5	99.	98.9	33	$29\frac{1}{2}$	.....	....	....	
.....	.....	.....	.....						
98.	98.	98.5	98.5	33	29	1226.200	28.815	$2\frac{35}{100}$	
99.	98.5	$99.2\frac{1}{2}$	$99.3\frac{1}{2}$						
.....	.....	.....	.....	35	$31\frac{1}{2}$	1011.984	24.793	$2\frac{45}{100}$	
.....	.....	.....	.....						
.....	.....	.....	.....	..	..	.....	....	....	
.....	.....	.....	.....						

NO. III. (*Continued.*)

A. M.

Date '75	Pulse. 7 o'clk	Pulse. 11 o'clk	Temperature. 7 Mouth.	Axilla.	Vagina.	Rectum. 11	Dynamics. Right.	Left.	Pulse. 4 o'clk.	11 o'clk.
Aug. 11	..	70	99.3	98.7½	99.5	99.5½	30	26	86	66
" 12	..	..	.....	.....	.....	.....	..	..	80	64
" 13	..	..	.....	.....	.....	.....	..	..	72	64
" 14	..	68	98.5	98.	99.	99.	..	..	70	68
" 15	..	70	99.4	99.	100.	100.1	32	27	..	68
" 16	..	..	.....	.....	.....	.....	33½	30	80	68
" 17	..	74	98.7½	98.5	99.2½	99.2½	32	28	..	70
" 18	66	84	98.3 99.4	.....	98.5 99.5	.....	32	29	82	70
" 19	66	72	98. 99.	.....	.....	98.4 99.3	34	30	70	62
" 20	64	76	98.5½ 99.	98.	99.	98.5 99.5	34	29½	80	68
" 21	64	80	98.5 99.2	.....	98.9 100.1	.....	31½	26	70	..
" 22	72	90	99. 99.5½	.....	99.2 99.8	.....	34	29½	72	..
" 23	..	80	.....	.....	.....	.....	..	..	..	66
" 24	68	..	99. 98.6	.....	99.8 99.6	.....	35	29½	70	..
" 25	66	76	.....	.....	.....	.....	35	25½	..	..
" 26	..	..	99. 99.4 98.5	.....	99 2 99.8 99.3	.....	35	28	78	..
" 27	74	74	99.7 98.9 99.6	.....	100.1 99.2½ 99.7½	.....	35	29½	90	..
" 28	80	..	99.	.....	99.5	.....	34	30	82	..
" 29	78	78	99.2½ 99.4	.....	98.8 99.5	.....	33	27½	..	..
" 30*	68	78	98.5 99.7½	.....	98.5 100.	.....	34	27½	..	..
" 31*	60	76	98.5 99.	.....	99.5 99.5	.....	35	30	..	..
Sept. 1*	70	82	98.4 99.5	.....	99. 99.5	.....	35	30	..	..
" 2	66	76	98.5 99.2½	.....	99. 99.5	.....	..	..	..	..
" 3	66	74	98.2½ 99.3	.....	98.7 99.5	.....	33	30	..	..
" 4	64	..	98.5	.....	98.7	.....	..	..	..	..
" 5	70	94	98.4 99.	.....	98.5 99.7½	.....	37½	32	..	..

NO. III.

P. M.

7	Temperature.		11	Dynamics.					
Mouth.	Axilla.	Vagina.	Rectum.	Right.	Left.	Grms. Urine.	Grms. Urea.	Per Ct.	Remarks.
98.2½	98.2½	98.3	98.4	34	29	856.863	21.421	2 5/100	
.....	.....	.....	.....						
.....	.....	.....	.....	..	..	1255.747	18.836	1 5/100	
.....	.....	.....	.....						
.....	.....	.....	.....	..	..	598.326	18.548	3 1/10	
.....	.....	.....	.....						
.....	.....	.....	.....	..	..	797.769	27.921	3 5/10	
.....	.....	.....	.....						
99.2½	98.	99.	99.	33	29	.....	....	....	
99.2	.....	.....	100.						
98.3	... ..	98.5	.....	..	..	.....	....	....	
.....	... ..	.....	.....						
98.9	.....	.....	99.2	34	30	.....	....	...	
99.6	.....	.....	100.						
98.4	.....	.....	99.	34	29	856.863	22.706	2 6/100	
99.5	.....	.....	99.7½						
98.5	.....	.....	98.5	33½	29	.....	....	....	
99.7	.....	.....	100.5						
99.	.....	99.5	.....	36	30	1359.162	25.824	1 9/100	
99.8	.....	100.	.....						
.....	.....	.....	.....	35	30	.....	....	....	
99.5	.....	100.2½	.....						
.....	.....	.....	.....	35	30	1388.719	28.468	2 5/100	
.....	.....	.....	.....						
.....	.....	.....	.....	31	26½	.....	....	....	
99.5	.....	99.½	.....						
.....	.....	.....	.....	33½	28½	989.824	25.240	2 5/100	
.....	.....	.....	.....						
.....	.....	....	.....	34	29	.....	....	....	
99.5	.....	99.7	.....						
.....	.....	.....	.....	33	27	1034.545	23.785	2 3/10	
.....	.....	.....	.....						
99.6	.....	99.9	.....	33	27	620.487	17.363	2 8/10	
....	.....	.....	.....						
99.5	.....	99.6	.....	..	..	886.410	18.614	2 1/10	
.....	.....	.....	.....						
.....	.....	.....	.....	33	28½	738.675	21.421	2 9/10	
.....	.....	.....	.....						
.....	.....	.....	.....	32	27	827.316	20.682	2 5/10	
.....	.....	.....	.....						
.....	.....	.....	.....	33½	27½	1418.256	21.273	1 5/10	
.....	.....	.. ...	.....						
.....	.....	.....	.....	37½	30	945.504	23.637	2 5/10	
.....	.....	.....	.....						
... .	.....	.....	.....	33½	30	590.940	19.501	2 3/10	
.....	.....	.....	.....						
.....	.....	. ....	.....	..	..	753.448	21.096	2 8/10	
.....	.....	.....	.....						
.....	.....	.....	.....	32	27½	531.846	19.678	2 7/10	
.....	.....	.....	.....						
.....	.....	.....	.....	36	30	620.487	21.899	....	
			.....						

No. IV.

	A. M.					P. M.								
		Temperature.		Dynamics.			Temperature.		Dynamics.					
Date.	Pulse.	Axillary.	Rectal.	Right.	Left.	Pulse.	Axillary.	Rectal.	Right.	Left.	Grms. Urine.	Grms. Urea.	Per Ct.	Remarks.
June 17	80	98.	98.4	..	..	80	98.2	98.6	..	..	.....	.....	....	
" 18	"	"	"	..	..	"	98.3	"	..	..	.....	.....	....	
" 19	72	"	"	..	..	72	98.1	98.5	..	..	.....	.....	....	
" 20	84	97.8	"	..	..	84	98.3	98.6	..	..	.....	.....	....	
" 21	72	98.	"	..	..	72	98.4	98.8	..	..	.....	.....	....	
" 22	"	97.6	"	..	..	"	98.3	98.7	..	..	.....	.....	....	
" 23	"	98.	"	..	..	80	"	"	..	..	590.940	28.956	$4\frac{9}{10}$	
" 24	"	"	98.5	25	23	72	"	98.6	25	22	.....	.....	....	
" 25	84	"	98.4	"	26	80	98.2	"	"	23	650.034	33.801	$5\frac{3}{10}$	
" 26	80	97.8	"	"	24	72	98.3	98.7	27	21	.....	.....	....	
" 27	..	...	...	"	$23\frac{1}{2}$	68	98.4	99.	25	23	.....	.....	....	
" 28	72	97.4	98.4	27	24	80	98.5	"	26	24	.....	.....	....	
" 29	"	97.8	98.6	24	20	"	98.3	98.7	27	23	502.299	22.101	$4\frac{1}{10}$	Cathartic.
" 30	84	98.	98.7	27	22	"	98.2	98.6	25	21	.....	.....	....	
July 1	72	97.75	98.5	23	21	72	98.	98.75	"	23	828.222	32.714	$3\frac{55}{100}$	
" 2	"	"	"	24	19	"	"	100.2	26	20	.....	.....	....	
" 3	"	98.	99.9	"	$22\frac{1}{2}$	"	98.4	99.9	25	23	1418.256	37.583	$2\frac{65}{100}$	
" 4	"	98.9	99.8	"	21	80	98.9	99.9	"	24	.....	.....	....	

"	5	80	"	99.9	25	23	84	98.	100.	26	22	590.940	26.001	4$\frac{4}{10}$	Sunday.
"	6	84	98.5	100.	23	20	"	99.25	100.1	24	21	....	.....	....	
"	7	68	98.4	99.5	24	"	76	98.4	99.4	25	23	709.128	28.010	3$\frac{95}{100}$	Menstr. began at 1
"	8	72	98.3	99.3	25	22	80	"	"	26	"	... .	......	....	P. M. Dull, steady
"	9*	88	"	99.6	"	23	"	98.3	99.9	25$\frac{1}{2}$	"	797.769	30.315	3$\frac{86}{100}$	pain for 24 hours.
"	10*	72	98.4	99.4	"	22	"	98.4	99.4	26	"	709.128	28.010	3$\frac{95}{100}$	
"	11*	68	98.3	99.25	26	23	"	"	"	"	"	827.316	26.887	3$\frac{25}{100}$	
"	12*	80	98.4	99.4	"	"	84	98.2	99.3	33	30	709.128	30.492	4$\frac{3}{10}$	
"	13*	84	98.	99.	28	26	"	98.	98.6	25	23	590.940	29.251	4$\frac{95}{100}$	
"	14	80	"	"	26	24	80	98.4	99.	27	24	886.410	33.326	3$\frac{85}{100}$	
"	15	"	"	"	30	25	"	"	"	29	"	590.940	24.376	4$\frac{12}{100}$	
"	16	"	98.	99.	32	26	84	98.5	99.	30	25	620.487	19.545	3$\frac{15}{100}$	
"	17	"	98.4	99.4	29	24	80	98.	"	25	23	650.030	15.600	2$\frac{4}{10}$	
"	18	"	98.3	99.2	27	"	"	98.3	99.4	26	"	....	......	....	
"	19	80	98.4	99.4	28	25	80	98.5	99.6	30	25	....	......	....	
"	20	84	98.2	99.3	26	24	88	98.4	99.5	28	24	709.128	29.176	4$\frac{1}{10}$	
"	21	80	98.3	99.4	25	23	80	"	99.4	26	22	502.299	20.594	"	
"	22	"	98.7	100.	"	"	"	98.2	99.5	25	23	472.752	22.928	4$\frac{85}{100}$	
"	23	"	98.	99.4	"	"	"	"	"	"	"	768.222	37.258	"	
"	24	"	98.4	100.2	26	"	"	98.3	99.4	27	"	....	......	....	
"	25	"	98.	99.4	25	"	"	98.4	"	26	"	738.675	25.114	3$\frac{4}{10}$	
"	26	"	"	"	"	"	"	98.3	99.3	25	"	....	......	....	
"	27	"	"	"	"	"	"	"	"	26	"	....	......	....	
"	28	"	"	"	"	"	"	98.2	99.4	25	"	1048.918	46.152	4$\frac{4}{10}$	Mental and physical exertion.

No. IV. (*Continued.*)

Date.	A. M. Pulse.	A. M. Temperature. Axillary.	A. M. Temperature. Rectal.	A. M. Dynamics. Right.	A. M. Dynamics. Left.	P. M. Pulse.	P. M. Temperature. Axillary.	P. M. Temperature. Rectal.	P. M. Dynamics. Right.	P. M. Dynamics. Left.	Grms. Urine.	Grms. Urea.	Per Ct.	Remarks.
July 29*	"	"	"	"	"	"	98.3	"	"	"	561.393	29.473	$5\frac{25}{100}$	Mens. began at 6:30 A. M. Unexpected. No pain.
" 30*	"	"	99.5	"	"	"	98.	99.5	"	"	738.675	31.024	$4\frac{2}{10}$	
" 31*	"	"	"	"	"	"	"	"	26	"	827.316	26.887	$3\frac{25}{100}$	
Aug. 1*	"	"	"	27	"	88	99.	102.	25	"	679.581	29.221	$4\frac{3}{10}$	
" 2*	84	99.	101.	..	..	80	"	101.	..	..	709.128	20.564	$2\frac{9}{10}$	Sunday.
" 3	80	98.	99.5	..	..	68	98.	99.1	26	23	1418.256	36.874	$2\frac{86}{10}$	
" 4	"	"	"	26	23	80	"	99.5	"	"	561.393	29.192	$5\frac{2}{10}$	
" 5	"	"	99.6	25	"	"	"	"	25	"	768.222	34.185	$4\frac{45}{100}$	
" 6	76	98.2	99.4	"	"	72	98.3	99.4	26	"	590.940	28.956	$4\frac{9}{10}$	
" 7	"	"	99.5	"	"	80	"	99.5	"	"	.....	.....	....	
" 8	78	"	99.4	"	"	"	"	"	27	"	620.487	26.370	$4\frac{25}{100}$	
" 9	80	"	"	27	"	"	"	99.4	"	"	.....	.....	...	
" 10	72	"	"	28	22	84	98.	99.2	"	"	886.410	23.933	$2\frac{7}{10}$	
" 11	"	98.	99.	25	23	80	"	"	26	"	.....	.....	....	
" 12	76	"	99.1	"	"	"	"	99.3	"	"	620.487	26.370	$4\frac{25}{100}$	
" 13	"	"	99.2	"	"	"	98.	99.4	"	"	.....	.....	....	
" 14	80	98.2	99.2	"	"	"	98.1	99.3	"	"	827.316	35.160	$4\frac{25}{100}$	Mental exertion.

"	15	"	98.3	99.3	"	"	"	98.2	99.4	"	"	.....	.....	....	
"	16	88	98.1	99.4	"	"	108	98.	99.7	27	"	.....	.....	....	
"	17	80	98.	99.5	"	"	80	98.2	99.5	25	"	.....	.....	....	
"	18	"	"	99.4	"	"	"	98.3	99.3	26	"	945.504	24.583	$2\frac{6}{10}$	
"	19	"	98.1	99.3	"	"	"	98.2	99.4	"	"	.....	.....	....	
"	20	80	98.1	99.3	25	23	80	98.2	99.3	26	23	650.034	22.751	$3\frac{5}{10}$	
"	21	"	98.2	"	"	"	"	98.1	99.4	"	"	679.581	33.979	5	
"	22	100	99.5	101.75	26	"	"	98.3	"	"	"	709.128	32.575	$4\frac{7}{10}$	
"	23	104	"	100.5	"	"	84	99.	100.	"	"	723.901	33.329	$4\frac{5}{10}$	
"	24	90	99.	100.	"	"	86	"	"	"	"	650.034	21.451	$3\frac{3}{10}$	
"	25	88	"	"	"	"	84	"	"	"	"	1063.692	21.805	$2\frac{5}{10}$	
"	26	92	"	"	"	"	82	"	"	"	"	915.957	22.669	$2\frac{475}{1000}$	Mens. began at 9 P. M. Nothing pathological.
"	27	80	98.5	99.5	"	"	80	98.5	99.6	"	"	"	22.898	$2\frac{5}{10}$	
"	28	"	98.	99.4	"	"	"	98.2	99 5	"	"	1359.162	25.144	$1\frac{85}{100}$	
"	29	"	"	99.25	"	"	"	"	99.4	"	"	945.504	25.055	$2\frac{65}{100}$	
"	30	78	"	"	"	"	78	98.	99.25	"	"	812.542	24.376	3	
"	31	"	"	"	..	..	..	...	....	..	..	709.128	31.209	$4\frac{4}{10}$	

No. V.

	A. M.					P. M.								
		Temperature.		Dynamics.			Temperature.		Dynamics.					
Date.	Pulse.	Axillary.	Rectal.	Right.	Left.	Pulse.	Axillary.	Rectal.	Right.	Left.	Grms. Urine.	Grms. Urea.	Per Ct.	Remarks.
June 22	68	98.75	99.	..	..	..	98.	99.	..	..	.....	.....	....	
" 23	"	"	"	..	..	..	97.75	100.	..	..	975.051	31.201	$3\frac{2}{10}$	This calculated for 24 hrs., from am't passed in 16 hrs.
" 24	"	98.	99.	..	..	..	98.	99.5	..	..	975.051	36.076	$3\frac{7}{10}$	
" 25	70	"	99.75	$24\frac{1}{2}$	22	..	99.	100.5	..	..	.....	.....	....	
" 26	74	98.75	99.5	..	..	60	98.5	99.25	..	..	.....	.....	....	
" 27	70	99.	99.75	27	$24\frac{1}{2}$	70	"	"	..	..	.....	.....	....	
" 28	..	...	....	..	..	80	99.75	100.25	..	..	.....	.....	....	
" 29	76	98.75	99.5	..	..	62	98.	99.	..	..	.....	.....	....	The above is the am't for the 29th.
" 30	68	99.	100.	..	..	65	98.75	99.5	..	..	.....	.....	....	
July 1	"	99.	99.75	27	$24\frac{1}{2}$	76	99.25	100.	..	..	1418.256	37.583	$2\frac{65}{100}$	
" 2	66	"	"	31	25	"	99.	99.5	..	..	.....	.....	....	
" 3	80	99.5	100.	..	..	70	98.75	99.75	..	..	.....	.....	....	
" 4	79	99.25	100.	$29\frac{1}{2}$	30	72	98.	99.	..	..	.....	.....	....	
" 5	76	99.	99.75	31	30	76	98.75	"	..	..	679.585	20.387	3	

"	6	"	"	99.5	27	26	"	"	99.75	..	..	.....	.....	....	Mens. began to-day about noon. Some pain.
"	7*	"	99.25	"	..	..	78	"	99.	..	..	827.316	17.787	$2\frac{15}{100}$	
"	8*	66	98.75	99.5	..	..	"	....	....	..	..	1181.880	21.864	$1\frac{85}{100}$	
"	9*	76	....	....	..	..	..	....	....	..	..	.....	.....	....	
"	10*	"	98.75	99.75	27	26	77	98.	99.5	..	..	827.316	25.646	$3\frac{1}{10}$	
"	11*	72	98.	99.25	$28\frac{1}{2}$	30	76	"	98.75	..	..	590.940	22.160	$3\frac{75}{100}$	
"	12*	76	"	99.5	30	$30\frac{1}{2}$	78	"	98.5	..	..	827.316	23.164	$2\frac{8}{10}$	
"	13	78	98.25	"	$30\frac{1}{2}$	30	68	98.75	100.	..	..	.....	.....	....	
"	14	82	98.75	99.75	30	29	62	98.	99.	..	..	650.034	19.826	$3\frac{5}{100}$	Sewing.
"	15	70	98.	99.	..	..	..	....	....	..	..	.....	.....	....	"
"	16	80	98.75	99.5	27	25	68	98.	99.	..	..	1063.692	18.609	$1\frac{75}{100}$	"
"	17	72	98.5	99.	..	..	70	"	99.5	..	..	.....	.....	....	"
"	18	79	98.	"	..	..	76	97.75	98.	..	..	531.846	16.487	$3\frac{1}{10}$	"
"	19	..	"	99.75	..	..	80	99.	99.75	..	..	.....	.....	....	"
"	20	78	99.	99.5	..	..	72	"	99.5	..	..	709.128	15.600	$2\frac{2}{10}$	"
"	21	72	"	"	..	..	"	99.5	100.5	..	..	.....	.....	....	
"	22	..	...	....	..	..	..	....	....	..	..	1063.692	23.401	$2\frac{2}{10}$	Studying.

No. VI.

1875.	Therm. in Axilla. A. M.	Therm. in Rectum. A. M.	Pulse. A. M.	Weight lifted, lbs. A. M.	Oz. of Urine in past 24 hrs.	Specific gravity of same.	C. C. of Urea in same.	Percentage of Urea.	Therm. in Axilla. P. M.	Therm. in Rectum. P. M.	Pulse. P. M.	Weight lifted, lbs. P. M.	Remarks.
July 14	...	....	..	...	..	....	.....	....	98.2	99.	70	225	
" 15	97.9	100.	76	230	16	....	19.028	....	97.9	99.1	87	230	
" 16	99.	99.9	83	260	18	....	19.260	....	97.9	100.	80	260	
" 17	98.	99.9	80	260	25	....	17.358	....	98.1	99.1	70	240	*
" 18	97 9	99.9	80	240	21	....	14.581	....	98.3	99.9	74	240	" Home all day.
" 19	98.1	99.8	73	240	26	....	16.132	....	97.9	99.8	74	240	"
" 20	97.9	99.9	65	240	$26\frac{1}{2}$	....	14.876	....	97.6	99.9	70	240	"
" 21	97.6	99.2	69	245	28	....	18.184	....	96.9	99.8	73	240	"
" 22	97.6	99.	74	245	35	....	19.	....	97.5	100.	80	245	
" 23	97.7	99.	80	245	28	....	18.614	....	97.6	98.6	80	245	
" 24	97.3	98.4	70	245	$20\frac{1}{4}$	....	19.147	....	97.5	98.8	80	245	
" 25	97.8	98.6	75	245	18	1032	20.476	....	97.8	99.6	80	245	
" 26	97.6	98.6	69	245	20	1020	15.364	....	97.4	99.4	87	245	
" 27	97.8	98.6	70	245	21	1022	18.614	....	97.8	100.	94	245	
" 28	97.4	98.8	76	245	12	1033	12.480	....	97.8	99.2	75	245	
" 29	97.5	98.5	73	245	$14\frac{1}{4}$	1026	14.904	$3\frac{54}{100}$	98.	99.3	75	245	
" 30	97.9	98.6	70	250	24	1014	13.047	$1\frac{84}{100}$	97.5	98.4	82	250	
" 31	98.2	98.9	72	250	37	1012	11.588	$1\frac{06}{100}$	97.3	99.6	80	250	

Aug.	1	97.	99.2	75	250	32	1020	26.096	$2\frac{76}{100}$	97.5	99.6	75	250	
"	2	98.	99.4	75	250	56	1011	23.165	$1\frac{4}{10}$	96.6	99.8	80	250	
"	3	96.	99.1	70	260	39	1015	26.043	$2\frac{26}{100}$	97.8	99.9	75	260	
"	4	96.	99.2	70	260	56	1011	25 977	$1\frac{57}{100}$	98.2	99.9	80	260	
"	5	97.5	99.1	75	260	23	1025	25.212	$3\frac{71}{100}$	96.2	99.6	80	260	
"	6	98.3	99.1	71	260	22	1023	25.091	$3\frac{86}{100}$	97.8	100.	80	260	
"	7	96.	99.3	80	260	23	1020	28.365	3	96.	99.9	83	260	
"	8	98.2	99.4	75	265	$29\frac{3}{4}$	1019	24.964	$2\frac{84}{100}$	96.4	101.	90	265	
"	9	97.4	99.4	80	265	$22\frac{1}{2}$	1024	23.867	$3\frac{59}{100}$	96.8	99.9	80	265	
"	10	97.3	99.	75	265	$26\frac{1}{2}$	1021	26.230	$3\frac{35}{100}$	96.	100.	80	265	
"	11	98.	99.1	73	265	$39\frac{1}{2}$	1015	26.377	$2\frac{26}{100}$	97.8	99.9	83	265	
"	12	96.	99.2	75	270	$40\frac{1}{2}$	1017	30.155	$2\frac{52}{100}$	97.3	99.8	83	270	
"	13	98.	99.	80	270	24	1025	29.429	$4\frac{15}{100}$	96.2	99.9	79	270	
"	14	97.2	99.	70	280	44	1014	26.001	2	96.6	99.2	80	280	
"	15	97.6	98.8	73	280	$34\frac{1}{2}$	1020	26 095	$2\frac{56}{100}$	97.4	99.2	81	280	
"	16	97.7	99.	76	280	29	1020	23.992	$2\frac{8}{10}$	96.2	99.3	80	260	*
"	17	97.8	99.4	75	260	25	1019	24.154	$3\frac{27}{100}$	96.4	99.4	80	260	"
"	18	96.	98.7	76	260	$42\frac{1}{4}$	1013	26.215	$2\frac{1}{10}$	97.	99.	80	260	"
"	19	96.9	98.8	70	260	32	1020	28.648	$3\frac{03}{100}$	96.8	99.4	80	260	"
"	20	96.	98.5	69	260	41	1105	31.497	$2\frac{6}{10}$	96.	99.2	77	260	"
"	21	97.9	98.6	70	260	29	1019	22.878	$2\frac{67}{100}$	96.8	99.1	73	260	
"	22	96.2	99.	80	260	$27\frac{1}{2}$	1024	27.139	$3\frac{34}{100}$	95.	99.1	70	260	
"	23	98.4	99.	70	260	42	1013	21.965	$1\frac{77}{100}$	96.	99.	71	260	

No. VI. (*Continued.*)

1875.	Therm. in Axilla. A. M.	Therm. in Rectum. A. M.	Pulse. A. M.	Weight lifted, lbs. A. M.	Oz. of Urine in past 24 hrs.	Specific gravity of same.	C. C. of Urea in same.	Percentage of Urea.	Therm. in Axilla. P. M.	Therm. in Rectum. P. M.	Pulse. P. M.	Weight lifted, lbs. P. M.	Remarks.
Aug. 24	97.3	98.	65	260	46	1012	22.698	$1\frac{67}{100}$	97.	99.	72	260	
" 25	96.3	98.6	72	260	38	1017	27.395	$2\frac{44}{100}$	96.	98.6	78	260	
" 26	97.3	98.8	73	260	51	1015	30.740	$2\frac{04}{100}$	96.	98.3	76	260	
" 27	97.	98.6	73	260	38	1020	24.701	$2\frac{20}{100}$	97.4	99.	80	260	
" 28	97.9	98.5	73	260	49	1018	32.720	$2\frac{26}{100}$	97.4	99.2	80	260	
" 29	97.8	99.2	70	260	51	1015	28.932	$1\frac{92}{100}$	97.5	99.6	80	260	
" 30	96.	99.1	70	260	41	1020	33.435	$2\frac{76}{100}$	97.2	99.8	80	260	
" 31	97.4	99.2	70	260	38	1020	30.876	$2\frac{75}{100}$	96.3	99.6	80	260	
Sept. 1	97.4	99.1	75	260	$43\frac{1}{2}$	1018	34.304	$2\frac{70}{100}$	96.2	100.2	80	260	
" 2	....	....	..	...	..	....	... .	.. .	....	....	..	...	
" 3	....	....	..	...	..	....	.....	....	....	....	..	...	
" 4	98.9	99.1	80	260	21	1030	28.666	$4\frac{62}{100}$	97.2	99.8	73	260	
" 5	97.5	99.3	73	265	$32\frac{1}{2}$	1020	29.	$3\frac{02}{100}$	96.4	99.8	76	265	
" 6	97.1	99.1	72	265	$36\frac{1}{2}$	1020	32.353	3	97.4	99.6	78	265	

" 7	97.8	99.2	76	270	$35\frac{1}{2}$	1020	31.048	$2\frac{96}{100}$	98.	100.	80	270	
" 8	....	....	..	270	..	....	.....	....	....	....	..	270	
" 9	....	....	..	280	..	....	.....	....	96.1	100.2	74	280	
" 10	98.7	100.	74	280	41	1020	.....	....	97.8	100.	80	280	
" 11	97.6	99.8	75	300	45	1019	30.448	$2\frac{29}{100}$	97.3	100.1	80	300	
" 12	97.1	99.6	75	300	46	1018	29.901	$2\frac{20}{100}$	98.3	100.1	70	300	
" 13	98.	99 9	75	320	$45\frac{1}{2}$	1020	29.442	$2\frac{19}{100}$	97.7	99.9	80	320	
" 14	96.6	99.4	79	320	37	1022	32.469	$2\frac{37}{100}$	96.6	99.8	73	280	
" 15	97.4	99.4	76	280	52	1018	33.802	$2\frac{20}{100}$	96.5	99.8	76	280	
" 16	98.3	99.6	79	280	44	1018	26.781	$2\frac{06}{100}$	97.2	99.7	77	280	
" 17	97.5	99.6	77	280	55	1020	33.314	$2\frac{05}{100}$	96.5	99.9	77	280	
" 18	97.6	99.9	75	280	56	1016	27.632	$1\frac{67}{100}$	96.5	99.9	80	280	
" 19	97.1	99.5	73	280	52	1017	29.038	$1\frac{89}{100}$	98.2	99.6	76	280	

A glance at these tables taken from six persons, during two or even three months, shows that the average amount of urea excreted was considerably in excess of the amount stated by Rabuteau. His figures vary from 14 to 22 grammes daily, while in our tables the amount rarely falls below 20 grammes, is much more frequently 25 or 28, and in a great many cases rises to 35 or 38. The individual variations are quite marked. Thus No. II shows quite a high range, No. V, when however, the analyses do not run over so long a period, has a lower average. This first difference between Rabuteau's table and ours is, we think, to be explained by this fact, that his single case was a woman living in a hospital, perfectly quiescent in mind, and not too active in body, while our cases are all students subjected to considerable mental strain. Any increase of this strain caused an immediate increase in the amount of urea.[1] Thus in No. I, after twelve hours of severe mental and bodily fatigue, 68.585 grammes of urea were excreted. The amount of urine as well as the per centage of urea were both exceedingly increased. On another occasion in the same table mental anxiety was followed, (July 16) by a rise in the urea, from 25.838 grammes of the day before to 35.345. On the next day, complete relaxation being taken, the urea fell to 19.943 grammes. In No. III, after mental anxiety and sleeplessness, the excretion of urea rose from 25.114 grammes to 33.476 grammes (July 31st). In No. IV, on July 27th, the amount of urea rose to 46.152 grammes, coincidently with mental and bodily exertion. The highest amount reached on any other day than this, from June 17 to August 31st, was 37.583 grammes (July 3d). In No V, a week, during which the urea varied from 15 to 19 grammes, (and a fraction) was spent in sewing (July 14–20,) on the 22d study was recommenced, and the urea rose to 23.401 grammes. In No VI, the occasions for exertion, all midwifery cases,

[1] We have recently examined the urine of a woman suffering from incipient melancholia, and mentally inactive, and the excretion of urea remained at 14 or 15 grammes daily.

vary extremely in the amount of urea. Thus the first, when forceps was used, only 18.614 grammes were said to be excreted; on the second occasion, 28.365; on the fourth, 23.932; on the fifth, 31.497; and on the sixth, 32.720. It is possible that the exertion involved more expenditure of muscular than mental force.

The amounts of urea excreted on any given day of the menstrual period, (the days of the flow are marked with an asterisk in the tables), vary very much. Thus in No I, the large amount of urea excreted on June 19th, coincided with the first day of menstruation. At the first day of the next menstruation (July 16), the amount was only 25.838 grammes. The rise on the second day again coincided with the mental anxiety as before noticed, and the fall the third, in connection with an afternoon of relaxation, took place in spite of the continuance of the menstrual flow. In No. II, the first menstrual period, (July 2–4) contains higher amounts of urea than at any other period on the table (41.129), but the amount on the second day (37.642 grammes) is equalled on several non-menstruating days, and the amount on the first day (31.724) falls below that of several other days.

Perceiving that these individual figures would be of little value, we have compiled a summary from the tables, showing the sum total of different days.

No. I.—EXCRETION OF UREA DURING

5 days preceding menstruation.	5 days of menstruation.	5 days following menstruation.	5 days in middle inter menstruation period.
134.870 Grms.	133.542 Grms.	118.485 Grms.	121.731

No. II.—EXCRETION OF UREA DURING

1st m.	3 days before menstruation.	3 days of menses.	3 days succeeding menses.	3 days in middle interm. period.
	97.020	110.495	106.367	90.580

2d m.	3 days before menses.	3 days of menses.	3 days succeeding menses.	3 days in middle interm. period.
	86.180	94.667	75.285	78.150
3d m.	3 days before menses.	3 days of menses.	3 days succeeding menses.	....
	79.612	88.388	81.020	.....

No. III.—EXCRETION OF UREA DURING

3d m.	2 days before menses.	2 days of menses.	2 days succeeding menses.	....
	52.692	53.608	90.257	.....
4th m.	3 days before menses.	3 days of menses.	3 days succeeding menses.	3 days middle interm. period.
	57.198 Grms. (diarrhœa.)	65.592	60.275	79.532
2d m.	3 days before menses.	3 days of menses.	3 days succeeding menses.	3 days middle interm. period.
	82.058	77.833	65.548	93.

No. IV.—EXCRETION OF UREA DURING

1st m.	5 days before menses.	5 days of menses.	5 days succeeding menses.	....
	146.429	144.955	122.023	.....
2d m.	5 days before menses.	5 days of menses.	5 days succeeding menses.	5 days in midst of interm. period.
	152.046	137.169	155.577	117.254
3d m.	5 days before menses.	5 days of menses.	....	5 days in midst of interm. period.
	142.139	120.142	.....	132.797 Grms.

No. V.—EXCRETION OF UREA DURING

4 days before menses.	4 days out of 6 menses.	4 days succeeding menses.
125.247	87.457	70.522

No. VI.—EXCRETION OF UREA DURING

1st m.	2 days before menses.	2 days of menses. (days)	2 days succeeding menses.	2 days middle interm. period.
	38.288	31.939	37.614	31.094
2d m.	5 days before menses.	5 days of menses.	5 days succeeding menses.	5 days middle interm. period.
	138.057	134.506	122.073	127.499
3d m.	5 days before menses.	5 days of menses.	5 days succeeding menses.	5 days middle interm period.
	153.998	153.998	.....	156.281

The most constant relation discoverable from these tables is that between the amount of urea during menstruation and during the days immediately following. Out of fourteen cases (distributed among six persons), the urea diminished quite markedly in ten. In two cases there is a slight increase, and in two (the 3d month of No. VI.), and the 3d of No. III., the urea is not estimated during the post-menstrual week. The percentage of the diminution after the cessation of the flow is extremely variable. Estimating the difference as the percentage of the amount eliminated during the menstrual flow, we have in one case 3 per cent., in two cases 8 per cent., in one 2 per cent., in one 11 per cent., in one 15 per cent., in one 19 per cent., in one 20 per cent., in one 25 per cent., and in one 29 per cent.

In five cases out of the eight in which this detail is

specified, the amount of urea immediately after menstruation was less than the average for the corresponding intermenstrual period; in the other three it was more.

The relation of the amount of urea excreted during menstruation to that excreted just before, varies with the persons. It is diminished in No. I. (one analysis), in No. IV. (three analyses), in No. V. (one analysis), and in No. VI. (three analyses); also in one out of three analyses of No. III. In two analyses of No. III. it is increased, and in the three analyses of No. II. There seems reason to suppose that the individual tendency predominates; still, in the majority of the cases (nine) we can say that the urea is diminished during the flow; in five increased. We have said that in the decided majority of our cases, the urea during menstruation was more abundant than during the week immediately following. In comparing it, however, with the amount excreted during a corresponding number of days at intermenstrual periods, we find, out of fourteen cases, in four it is not specified, in one the quantity is the same, in four it is less, and in five more.

No conclusion can be drawn from this limited number of cases, where the variations are much greater than in the other proportions. This is probably owing to the fact that the amount of urea is always influenced by a variety of circumstances, among which menstruation only counts for one.

The most general result to be deduced from these tables is the following.

During the few days preceding the menstrual flow, the excretion of urea is generally increased above the average at intermenstrual periods (seven cases out of ten specified). In the majority of cases (nine out of fourteen), the urea diminishes from this excess during the flow, while in a minority of cases (five out of fourteen), it continues to increase. The alternative of increase or diminution seems to depend on peculiarities generally persistent in the same individual.

In the great majority of cases, the urea decreases markedly *after* the cessation of the menstrual flow (ten cases out of twelve specified); and in the two cases in which an increase seems to have existed, it was much slighter than the usual decrease.

The average of pulse and temperature have been examined in the same way.

TABLE No. I.—P. AND T., FIVE DAYS AVERAGE.

Pulse.				Rectal Temperature. A. M.			
Before.	During.	After.	Interm.	Before.	During.	After.	Interm.
50	50	49	54	99.36	99.26	99.78	99.18

TABLE No. II.—P. AND T., AVERAGE THREE DAYS.

	Pulse.				Rectal Temperature. A. M.			
1st m.	Before.	During.	After.	Interm.	Before.	During.	After.	Interm.
	70	69	70	$70\frac{2}{3}$	98.75	98.75	98.58	99.25
2d m.	74	$72\frac{2}{3}$	74	74	99.16	98.91	98.50	99.00

TABLE No. III.—P. AND T., AVERAGE THREE DAYS.

	Pulse.				Rectal Temperature. A. M.			
2d m.	Before.	During.	After.	Interm.	Before.	During.	After.	Interm.
	$70\frac{2}{3}$	68	70	$70\frac{2}{3}$	99.8	99.36	99.23	99.73
3d m.	67	$65\frac{1}{3}$	72	83	99.6	99.43	99.50	99.43
4th m.	84	66	$65\frac{1}{3}$	. .	99.53	99.66	99.23	. . . .

TABLE No. IV.—P. AND T., AVERAGE FIVE DAYS.

	Pulse.				Rectal Temperature. A. M.			
1st m.	Before.	During.	After.	Interm.	Before.	During.	After.	Interm.
	76	78	80	77	98.60	99.33	99.12	98.40
2d m.	80	80.8	73.2	81.6	99.32	99.25	99.5	99.38
3d m.	96.4	82	. .	81.6	100.11	101.23	....	99.38

TABLE No. V.—P. AND T., AVERAGE SIX DAYS.

Pulse.				Rectal Temperature. A. M.			
Before.	During.	After.	Interm.	Before.	During.	After.	Interm.
74	$73\frac{2}{3}$	$76\frac{5}{6}$	67	98	99.58	99.29	99.33

TABLE No. VI.—P. AND T., AVERAGE FIVE DAYS.

	Pulse.				Rectal Temperature. A. M.			
	Before.	During.	After.	Interm.	Before.	During.	After.	Interm.
2d m.	74	73	71	71	99.	98.8	98.6	99
3d m.	74	77	. .	71	99.86	99.58	....	99

The results from these tables do not justify either the description of a "febrile condition" occasioned by menstruation (Allan Thomson), or a "lowering of pulse or temperature" (Rabuteau), as constant conditions. In Nos. I, II, and III, the pulse during the flow was a few beats lower than during intermenstrual period; but in Nos. IV, V, and VI, it was about as much higher. As regards the temperature, in the 1st, 3d, 4th, 5th, 7th, 8th, 9th, and 11th analyses (eight out of twelve) the temperature was diminished during

the flow, but very slightly, from .07 of a degree to .44—never, therefore, as much as half a degree. In one case the temperature was exactly the same during the flow as during the preceding week; in one there was a rise of .13 of a degree; in one of 1½ degrees; and in one the temperature was decidedly febrile (101.23), rising 1.12 over that of the preceding week.

In eight cases out of eleven in which intermediate temperature is given, we find that the premenstrual temperature was higher than the average existing between the periods. The excess ranges from .07 to .86 of a degree.

The following table compares at a glance the two sets of variations:

Excess Premenst. over Menst.	Excess Premenst. over Interm.
8 cases out of 12, fractions of a degree.	8 cases out of 11, fractions of a degree.
.07 . . . . .25 28	. . . . . .17 50
.17 . . . . .26 44	.07 . . . . .18 73
.20 . . . . .27	.16 . . . . .20 86

This shows, as indeed can be seen by reference to the previous tables, that the diminution of temperature observed during the menstrual flow is hardly ever (three cases) to a point below the average, but only below the level of a temperature that had been attained just previously. That is to say, the temperature rises from one to eight-tenths of a degree during the week preceding menstruation. It falls gradually during the flow, but in the majority of cases does not even then reach the normal average.

An attempt has been made to estimate possible variations in muscular force in relation to menstruation.

This estimate is imperfect because only based upon trials made with the hand dynamometer. In the comparative estimates of muscular force in men and women, as they have

been made by Quetelet,[1] the results obtained by this instrument were supplemented by others obtained by Regnier's dynamometer for measuring the strength of the muscles of the back and loins. During menstruation, however, it might be expected that the force of this set of muscles would be diminished, out of proportion to that of the rest of the body.

The following averages have been obtained with the dynamometer. We have made from the general tables a summary of a few days, only taking the test with the right hand and for the morning.

TABLE No. I.—DYNAMOMETER TEST, FIVE DAYS.

Before Menst.	During Menses.	After Menses.	Intermenst.
$29\frac{3}{5}$	$28\frac{1}{5}$	$28\frac{1}{5}$	$26\frac{4}{5}$ or 27

TABLE No. II.—DYNAMOMETER TEST, THREE DAYS.

	Before.	During.	After.	Intermenst.
1st m.	28	30.16	29.66	33.5
2d m.	35	36.5	34	34.16
3d m.	35.5	35.5	36	36

TABLE No. III. DYNAMOMETER TEST, THREE DAYS.

	Before.	During.	After.	Interment.
1st m.	. . . .	26.66	26.16	32.83
2d m.	32.83	33.5	34.16	34.5
3d m.	32	32.66	. . . .	33.16
4th m.	33.66	31.33	33	. . . .

[1] To which we shall have occasion to refer.

TABLE No. IV. DYNAMOMETER TEST, THREE DAYS.

	Before.	During.	After.	Intermenst.
1st m.	25.2	25.8	25.2	25.
2d m.	24.4	26.	28.8	. .
3d m.	25.8	26.	. . .	. .

TABLE No. V. DYNAMOMETER TEST, THREE DAYS.

Before.	During.	After.	Intermenst.
29.16	28.5.	30.16	28.33

In the sixth case, muscular power was tested by lifting weights, calculated from the tables. For five days we have —

TABLE No. VI.

	Before.	During.	After.	Intermenst.
1st	255 lbs.	253 lbs. average.	245 lbs.	260 lbs.
2d	275 lbs.	264 lbs.	260 lbs.	260 lbs.
3d	292 lbs.	288 lbs.	. . . . .	. . . . .

Out of fifteen examinations on these tables, the muscular strength during the menstrual flow was less than that during the preceding days in seven cases, was increased in seven, and in one, was exactly the same.

It is Table VI, where the test was made by the lifting of weights, that the diminution was most uniform, notwithstanding a constant increase in muscular power during the three months of practice. We consider this the most reliable

table, as the results from the dynamometer, except for comparison between the right and left hand, are too much influenced by the degree of skill, the force of the hand and wrist muscles, not always proportioned to that of the rest of the body, and finally by the most transient conditions of health. Transient fatigue is excluded, since the test was always applied at 8 A. M. The full tables show, however, that the evening test was by no means inferior to the morning.

The last measurement of rhythmic waves of nutrition or vital force, that we have been able to make, relate to sphygmographic traces of the radial artery. Before considering these traces, we will quote from Landois,[1] certain laws, that are illustrated by our cases or serve to explain them.

1. The dicrotic elevation (*Rückstoss elevation*) is so much the greater, the less, (*ceteris paribus*) the tension of the arterial walls, and vice versa (5th Law, p. 192.)

2. By increase of pressure, in consequence of a hindrance to the outflow, the elasticity elevations on the descending curve, rise higher in proportion to the summit, (7th Law, p. 199.)

3. By very low tension of the arterial walls, the elasticity elevations may entirely disappear. This happens for instance, when there is a great diminution of the blood, from a hemorrhage or exhausting disease (8th Law, p. 200).

4. In one and the same artery, the number of elasticity elevations increases with the degree of tension of the arterial wall.

5. Increased pressure has for consequence a stronger primary pulse wave and more marked elasticity elevations, without an essential increase of the dicrotic elevation (p. 125.)

6. Since increased activity of the heart increases, *ceteris paribus*, the pressure in the arterial system, it causes a rise in the level of the entire curve.

7.[2] The primary pulse wave rises when the pressure in the

[1] Die Lehre vom arterien Pals, 1872.

[2] This law as seen, is not from Landois.

artery is increased by an increased mass of blood, whether this be caused by expiration (p. 193), by inspiration of compressed air,[1] by compression of a large artery (p. 195) by Morbus Brightii (p. 197.) Diminution of the mass of blood lowers the tension and increases the dicrotism.

According to Waldenburg, if the level of the entire curve rises, while the height of the primary pulse wave diminishes, and the summit becomes more round, the fullness of the artery, and the tension of its walls are both increased. If the fullness and side pressure are diminished the dicrotism is increased, the elasticity elevations diminished, the curve is lower, and each pulse wave smaller.

The following traces have been taken with Mahomed's sphygmograph, in which exists a mechanism for varying and accurately estimating the degree of pressure exerted on the artery by the lever of the instrument. We have in nearly all the cases, taken the trace at four degrees of pressure marked respectively 2, 5, 6, 7; pressure 5 gives the best average.

No. I is taken from a young woman of rather delicate appearance, but in good health, and who never suffers any inconvenience during menstruation. The premenstrual pulse is given for two successive months. The first ranges from December 22 to December 24 (two traces); the second from January 14 to January 22 (four traces). The intermenstrual pulse is represented by the two traces of January 7 and January 11, respectively ten and fourteen days after cessation of menstruation.

On the fourteenth day after menstruation (January 11) the trace is as follows: primary pulse wave (line of ascension) moderately developed, summit rounded, showing a fair degree of fullness of artery and resistance in its wall;

[1] Waldenburg, Die Pneumatische. Behandlung, pp. 288, 290.

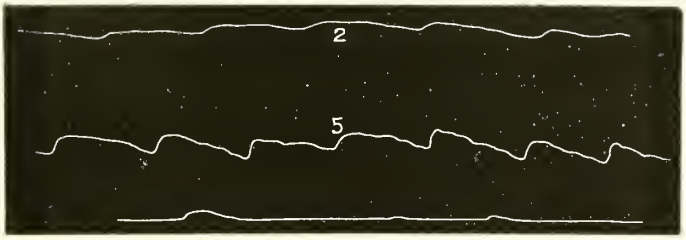
dicrotism scarcely perceptible, elasticity elevations only occasional; the entire curve elevated and arching above the starting point; these last three characters all indicating good tension and well-filled arteries.

On December 22 (first premenstrual trace) the primary pulse wave (ascension line), marked 5 and 7, is decidedly higher than the corresponding lines on January 11. The summit is more prolonged, even flattened, in line 7, showing considerable increase in the tension. In line 5, elasticity elevations appear distinctly. The rise in the general curve is not more marked for line 5, and does not appear very decided in line 7, until this is compared with the similar line in January 11. On that day the artery seemed unable to resist so high a degree of pressure, and the curve sank instead of rising. Moreover, the height of the line of ascent was not greater with 7 than with 6 or 5. But three days before menstruation the line of ascent is much higher under a strong pressure than under one a little weaker. All these characters indicate a considerable increase in the tension of the artery, and increased resistance of the wall. Were the resistance only increased, the line of ascent would be lower, even though the height of the general curve remained the same.

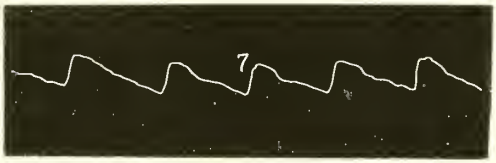
On December 24, one day before menstruation, the curve is a little more elevated, the summit more rounded, while the line of ascent is more oblique than on either December 22 or January 11, but not so high (compare lines 5 and lines 6 on the three days).

There is therefore still greater fullness of the blood vessel and resistance of its wall (pulsus plenus). For this month we have no trace during menstruation; but two days after its cessation we have a very peculiar trace. The pulse was 100, the line of ascent brusquely vertical, increasing in height with each degree of pressure, and at 5, 6, or 7, much higher than in any other trace from this subject. The summit,

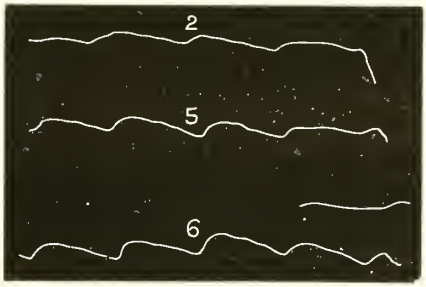
No. I.



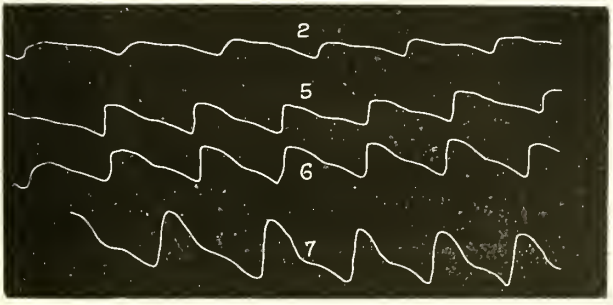
Dec. 22d. 3 days before menses.



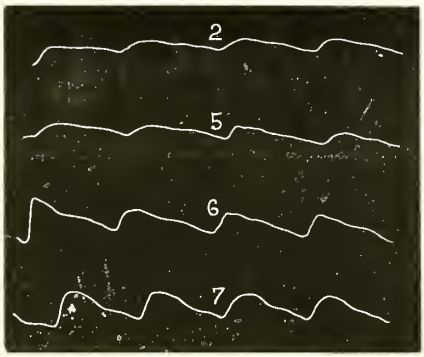
Dec. 22d. (*continued*)



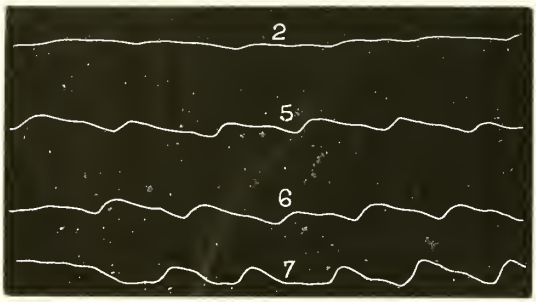
Dec. 24th. Menstruation.



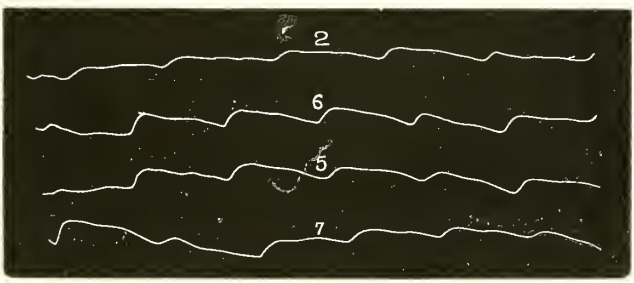
Dec. 30th. Pulse 100. Menses ceased Dec. 28th.



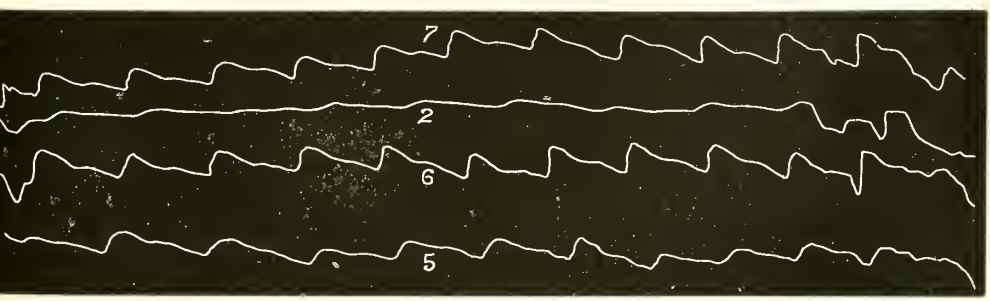
Jan. 2d. Pulse 100. 5th day after menses.



Jan. 7th. 10th day after menses.

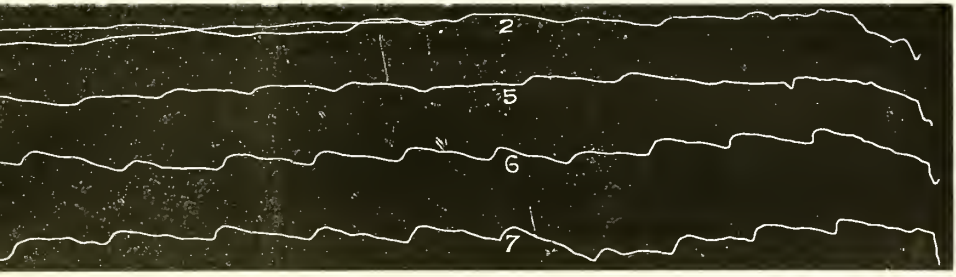


Jan. 11th. 14th day after menses.

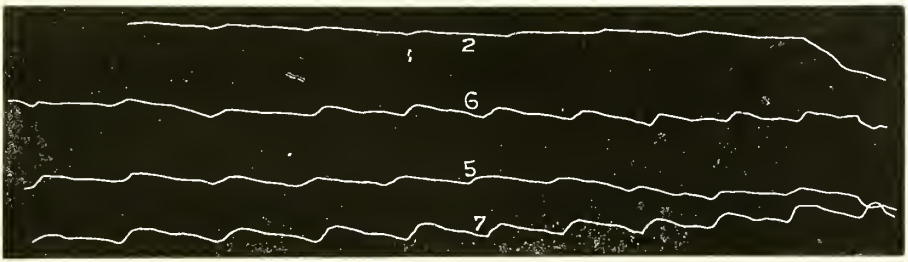


Jan. 14th. 9 days before menses.

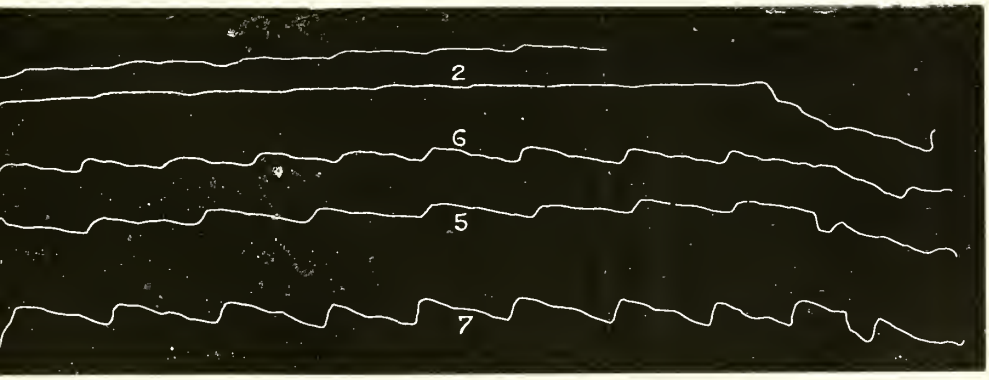
No. I. *(continued)*



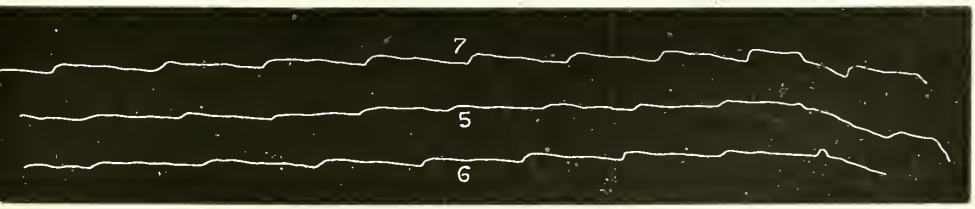
Jan. 16th.



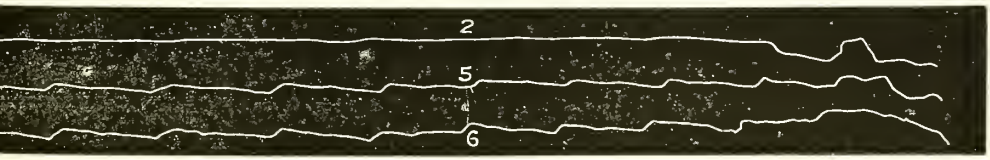
Jan. 21st. 2 days before menses.



Jan. 22d Day before menses.



Jan. 23d. 18 hours after menses.



Jan. 26th. Menses ceased Jan. 25th.

instead of being rounded, forms an acute angle with the line of ascent, especially noticeable with pressure 7. The dicrotic elevation is more marked; the elasticity elevations have altogether disappeared. These characters indicate diminished tension in the arterial walls, combined with increased energy of the cardiac systole. The young lady felt perfectly well, and could refer to no circumstance capable of explaining this remarkable alteration from her habitual pulse, alteration not repeated on the following month. Three days later the pulse is still 100, but the line of ascent in the pulse-waves has fallen markedly (compare lines 5 and 6 for the two days, December 30 and January 2). On January 14, nine days before the next menstruation, the fullness of the artery is much increased, as indicated by the marked rise in the curve, especially at pressure 7.

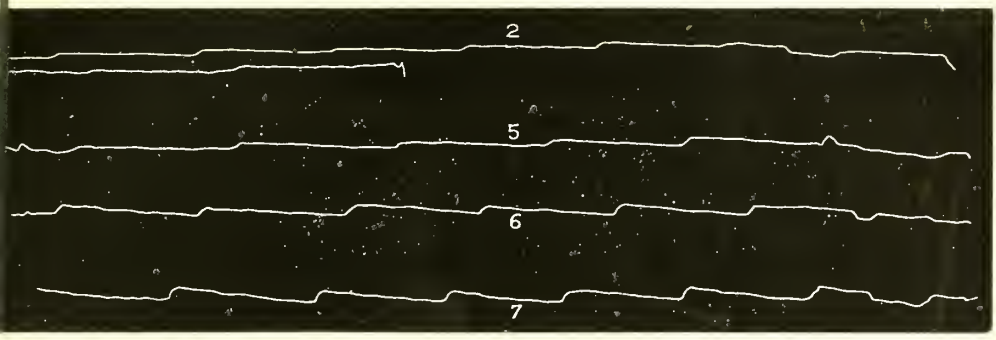
The line of ascent is again higher, and the summit more rounded than in the intermenstrual trace. But the dicrotic elevation is more perceptible, and there are no elasticity elevations, while the pressure, resulting from fullness of the artery, is therefore increased, the resistance of the wall seems to be somewhat diminished. On the 16th these characters were less marked; on the 21st, two days before menstruation, the *curve sinks*, and all the characters indicate a lowered tension of the radical artery. On the 22d, however, the tension rises again, and (line 7) elasticity elevations appear. Finally, eighteen hours after the menstrual flow (January 23), the trace shows greatly diminished fullness of the artery (curve low, line of ascension low, summit little marked), while the tonicity of the walls is not diminished, there being no marked dicrotism. The same characters persist on the day after the cessation of the flow.

No. II is from a young lady of robust appearance, but the member of a gouty family, and herself suffering occasionally from dyspepsia, acne, sciatica. Very little pain at men-

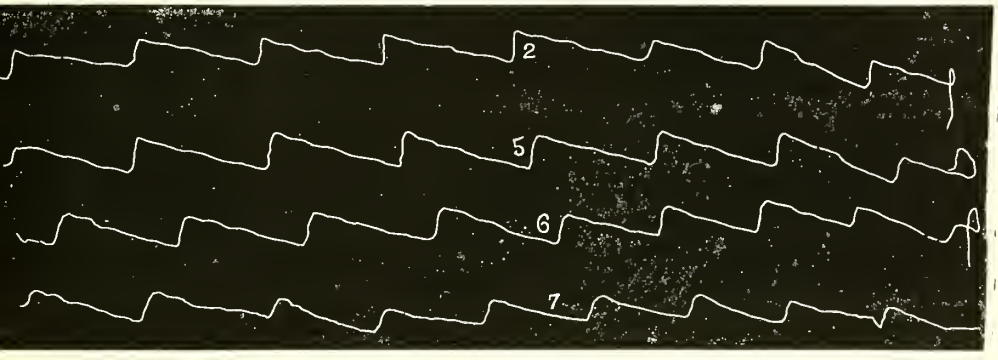
struation, but great weakness, although the flow is not excessive. On this account, No. II habitually remains on the sofa during four or five days. She is in easy circumstances, and not compelled to any exertion, otherwise it is probable that this would be found more possible than it appears. Of this case, unfortunately, I have no intermenstrual trace, but two sets of traces for menstrual periods. On December 28, just after the cessation of the menses, it is evident that the pressure is low. The curve sinks, and the ascension line is very short. The resistance of the arterial wall is not especially diminished, or else the signs of such diminution (vertical ascension line, dicrotic curve, peaked summit) are absent, owing to the diminution in the contents of the artery, and in the energy of the cardiac systole. The trace on the second post-menstrual period (January 21) altogether resembles this first, except under pressure 7, the ascension line becomes more vertical, and the dicrotic elevation is more marked. In the other lines, a trifle more fullness in the artery seems indicated by a little more roundness of the summit. On January 10, four days before the first menstruation, a striking alteration is observed. The curve, though not high, is sustained without sinking; the ascension line is nearly vertical, and much higher, but the summit is tolerably sharp. This shows increased force of the heart's action, without a corresponding increase in arterial tonicity. It is noticeable that the height of the ascension line increases with the degree of pressure applied up to 6, but with 7 it falls below that of 2.

This is the reverse of what is observed in No. I, December 30. It seems to imply that the vigor of the cardiac systole would not be sufficient to so greatly develop the primary pulse wave if the resistance of the arterial wall were very great. At the same time the dicrotism is little marked, and elasticity elevations appear. On the whole, therefore, the tension is raised by intra-arterial pressure. January 12,

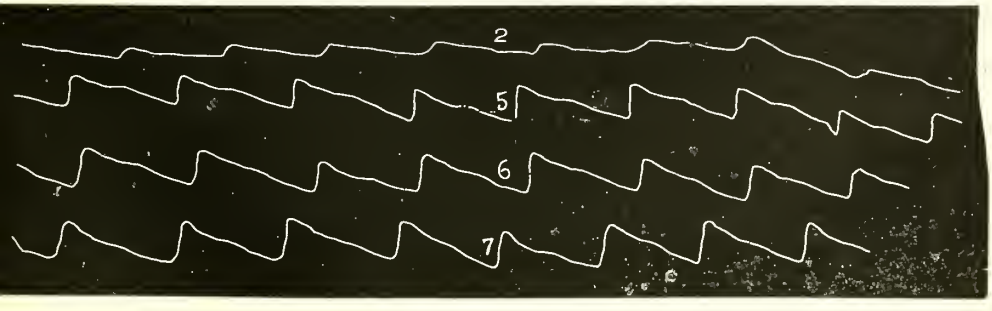
No. II.



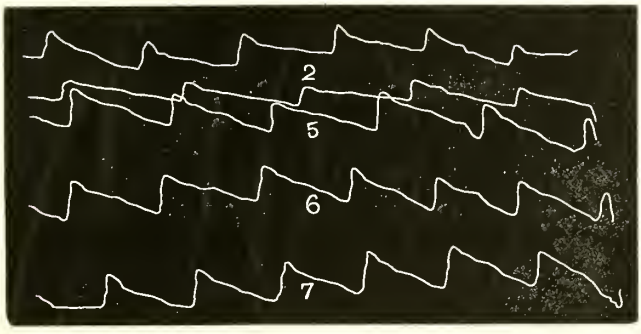
Dec. 28th. Menses just ceased.



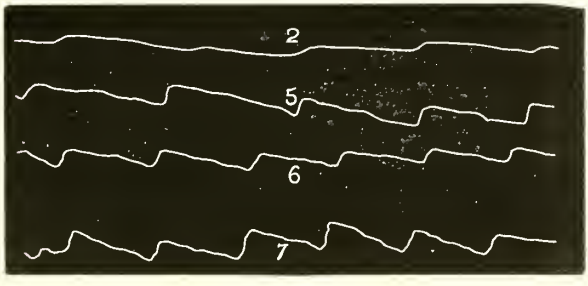
Jan. 10th. 4 days before menses.



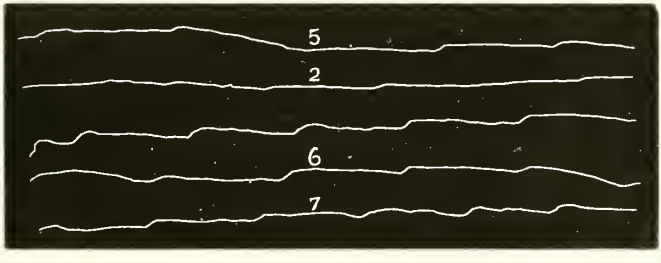
Jan. 12th. 2 days before menses.



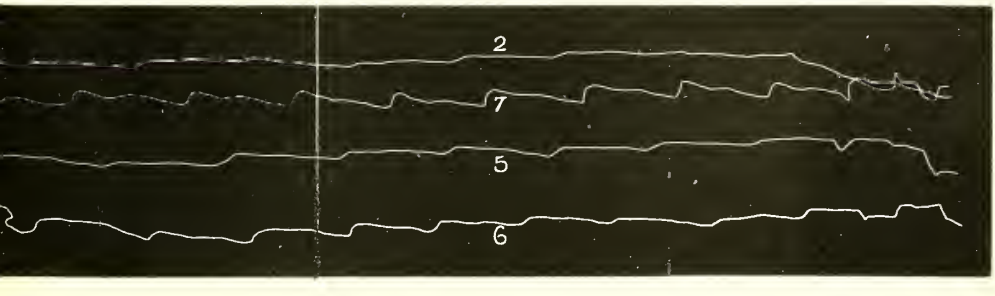
Jan. 13th. 1 day before menses.



Jan. 14th. 1st day menses.



Jan. 17th. 4th day menses.



Jan. 21st. Menses ceased Jan. 19th.

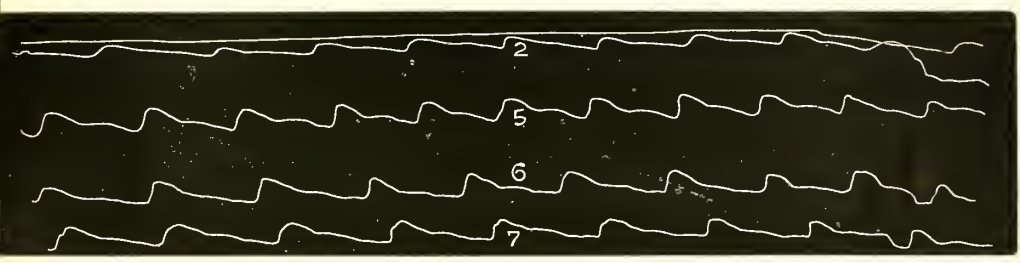
two days before menstruation, these characters persist, except that the primary pulse wave is smaller with pressure 2, and much increased with pressure 7. Dicrotism is more marked, the elasticity elevations less so, showing that while the pressure remains the same, the resistance is somewhat lessened. On January 13, the day preceding menstruation, the resistance is decidedly diminished, the pressure remaining nearly the same; the angle of the summit is quite acute, the dicrotism much more marked. On January 14, the first day of menstruation, the intra-arterial pressure falls, but the resistance is somewhat increased, as indicated by a more oblique line of ascent, and a more rounded summit. On the fourth day of the hemorrhage (January 17) the pressure is reduced to the minimum, being lower even than on the two post-menstrual days, December 28 and January 21. The curve in trace under pressure 5 sinks notably, and 6 and 7 are very much less distinct than on two days after menstruation. There (line 7), though the resistance is low, as shown by the dicrotism, the primary pulse wave is tolerably developed, but on the 17th it is extremely small.

No. III exhibits the pulse of an extremely robust person, sanguine temperament, vigorous health. The menstruation, however, generally came only every five or six weeks, but then was normal in quantity and unattended by inconvenience. It is noteworthy that this person, though only about thirty years old, was very fat. The premenstrual traces were taken on the ninth, seventh, and second day before menstruation (December 22, 24, 29). The trace on January 16, ten days after menstruation, is the nearest we have to a complete intermenstrual trace, to serve for term of comparison. The primary pulse wave is fairly developed, the summit rounded, but dicrotism is very distinct. We should infer arteries tolerably well filled, but with not very resistant walls. Such are precisely the characters to be expected in well nourished, plethoric fat people, in whom

muscular tissue is never adequately developed. Nine days before menstruation (December 22) the tension falls, the height of the ascension line is somewhat increased, showing greater plenitude, but the summit is more angular, and dicrotism more marked. The trace on December 24 was taken an hour after the young lady had drunk a glass of light wine, to which she was unaccustomed. While interesting as showing the effect of wine in increasing both the cardiac systole and arterial tonicity, it is of little avail for our purpose. Two days before menstruation the plenitude of the artery is increased, as shown by the rise of the curve; the other characters remain almost as on December 22, only the line of descent descends much less abruptly. On the first day of menstruation the tension is much increased, there is no angle at the summit, the line of descent is very gradual, the dicrotism is almost completely obliterated. Nine days after cessation of menses, the fullness of the artery is greatly diminished, and, possibly on that account, the arterial tension seems to be relatively increased. We have taken the following day as the type of the intermenstrual period.

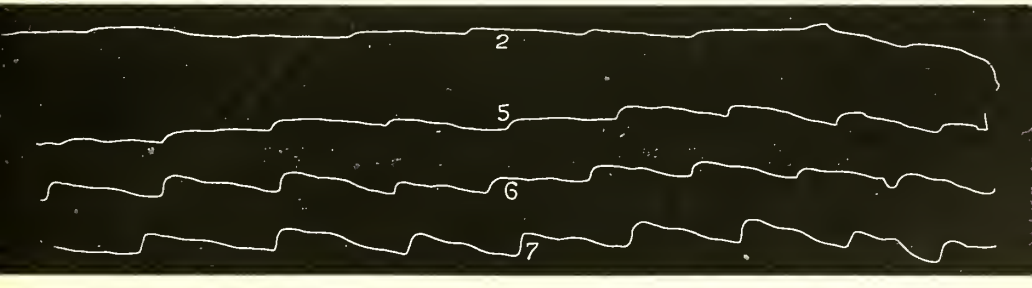
No. IV is the pulse of an anæmic and neurotic person, who suffers a good deal of cramp-like pain during menstruation. When this person is in poor health and losing flesh, menstruation occurs with great regularity every month; as soon as she improves in strength and gains in flesh, menstruation recurs only every six weeks, and is much less painful. Her period of greatest vigor is during the week (or three weeks in the six weeks' menstruation cycle) that precedes the monthly flow. At the time of taking the traces, the menstruation was delayed seventeen days, and so the traces of December 30, 31, January 3 and January 4, all represent the premenstrual condition. December 30 and January 3 are the most accurate in this respect. The intermenstrual trace has unfortunately been lost, but the plenitude of December 30 is very marked. On December 31 the trace

No. III.

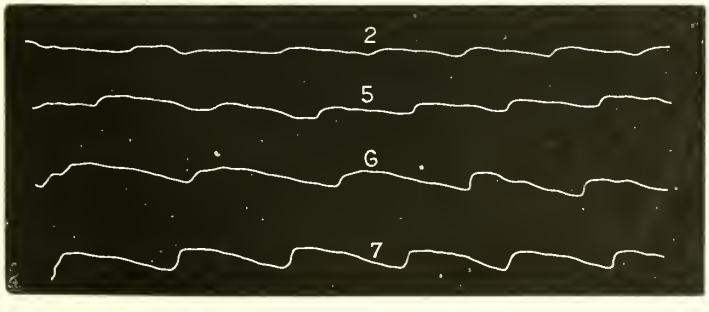


Dec. 22d. 9 days before menses.

Dec. 24th. 7 days before menses.

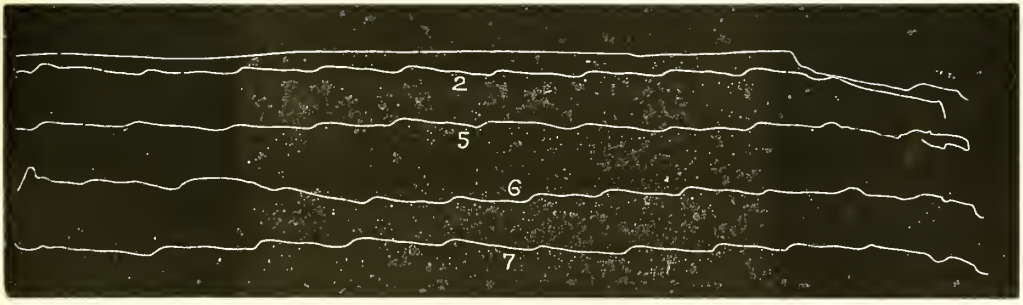


Dec. 29th. 2 days before menses.

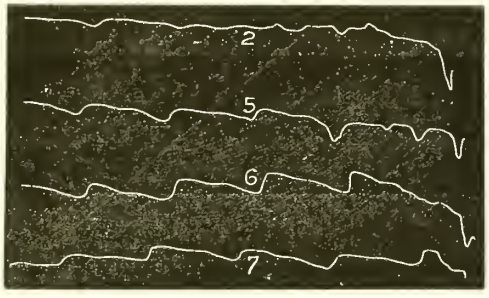


Dec 31st. 1st day menses.

No. III. (*continued*)

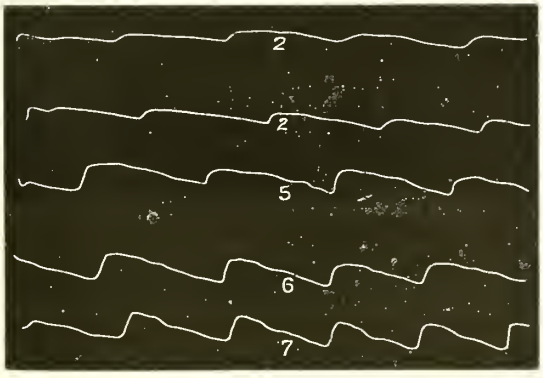


Jan. 15th. Menses ceased Jan. 6th.

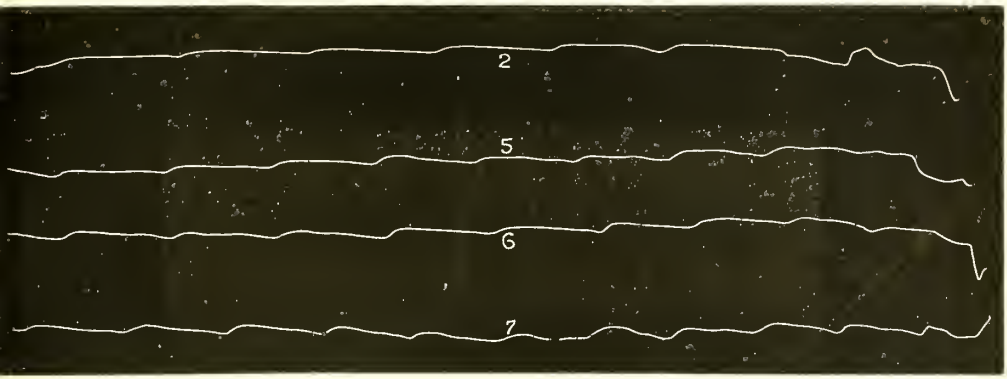


Jan. 16th. 10 days after menses.

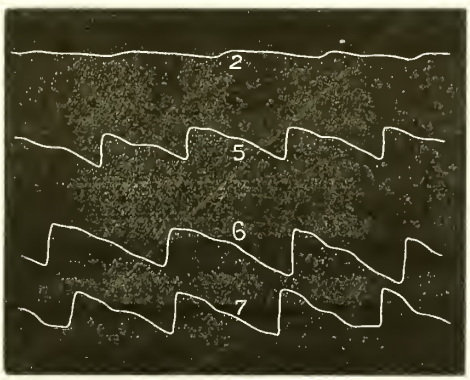
No. IV.



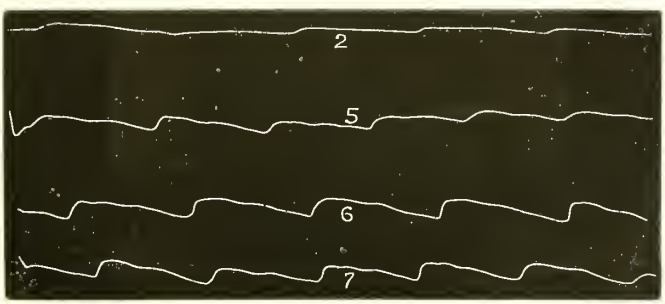
Dec. 30th. Menses expected Jan. 1st; arrived Jan. 18th.



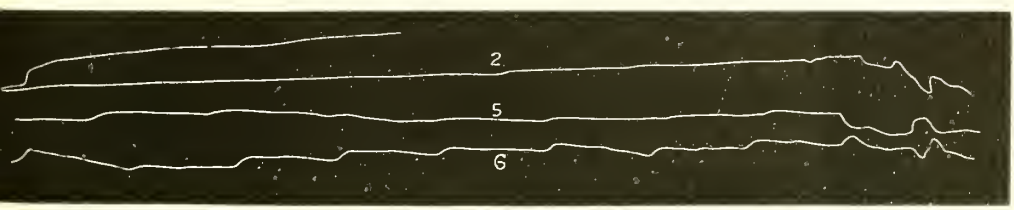
Dec. 31st. After Excitement. Menses expected Dec. 31st; arrived Jan. 18th.



Jan. 3d. Menses ut supra.



Jan. 4th. Menses ut supra.



Jan. 26th. Menses just ceased.

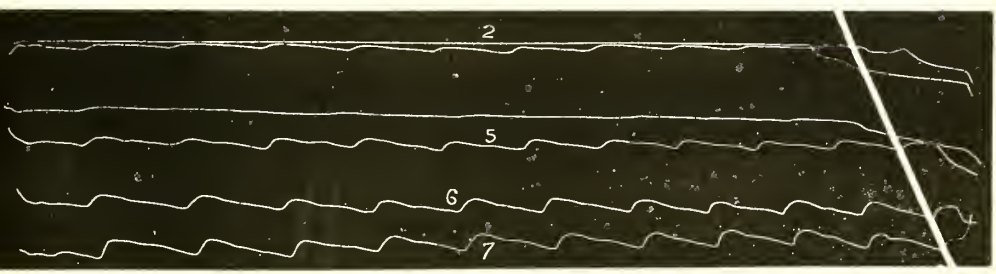
No. IV. (*continued*)

Feb. 21st. Menses expected; arrived 10 days later.

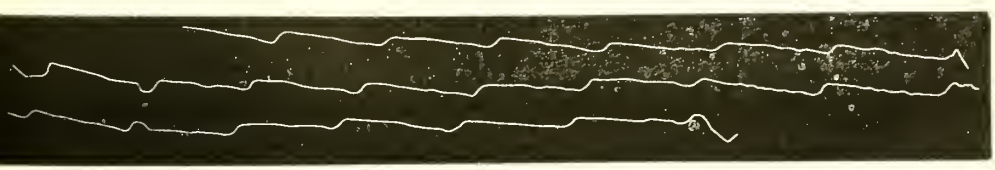
No. V.

Dec. 21st. 1st day menses.

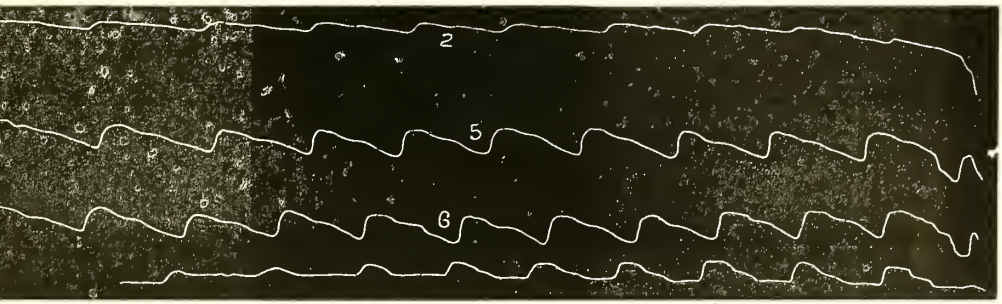
Dec. 24th. 4th day menses.



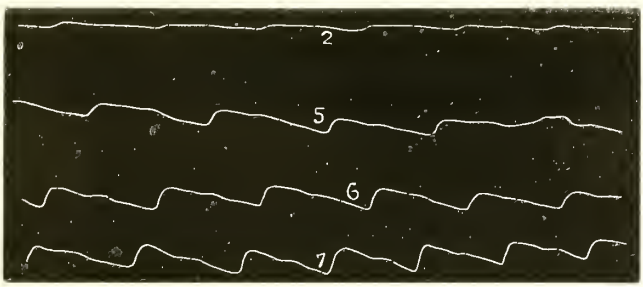
Dec. 27th. Menses ceased Dec. 26th.



Jan. 3d. 10 days after menses.

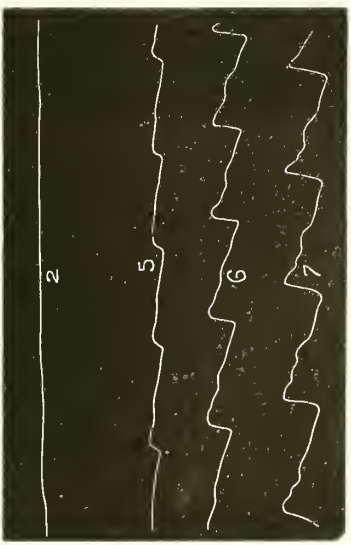


Dec. 31st. Menses ceased Dec. 26th.

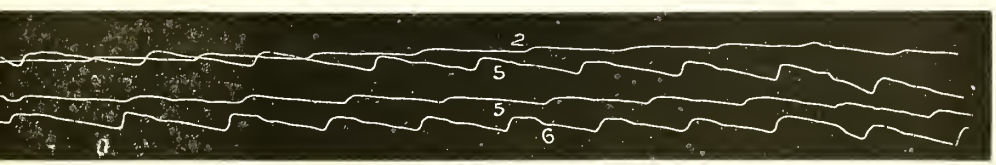


Jan. 4th. 11 days after menses.

Jan. 11th.



Jan. 13th. 10 days before menses.



Jan. 27th. Menses just ceased.

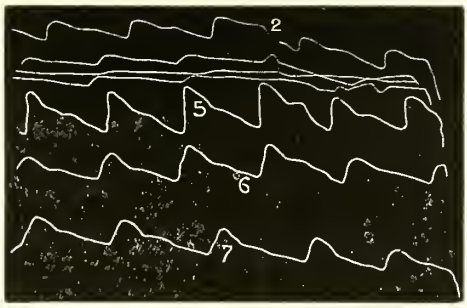
was taken while the patient was still under the influence of strong excitement from annoyance. There was probably spasmodic contraction of arteries from vaso motor irritation. On January 3, still nearer to menstruation, the primary pulse wave is still more developed, indeed out of proportion to the resistance, so that the summit is peaked, especially in the trace under pressure 6; dicrotism is more marked. In a condition like this, when menstruation really arrived as expected, the patient habitually began to suffer from ovarian pain. On January 4 the pulse is again changed, under the influence of a profuse sweating from a dose of Jaborandi, given with the express purpose of lessening the intra-arterial pressure. It is evident from the trace that the effect was obtained. It was impossible to obtain a trace on the first day of menstruation. The trace on January 26 represents the condition just after the cessation of the flow. The emptied condition of the artery is shown by the sinking of the curve, as well as by the smallness of the primary pulse waves. On February 21, which corresponds to January 4, inasmuch as the menstruation was expected, yet did not arrive until ten days later, the characters of the trace very much resemble those on that day. The tension is raised, the fullness somewhat increased, very markedly so over the post-menstrual trace of January 26.

No. V is taken from a very healthy young woman, but rather pale, and who rarely menstruates more than once in three or four months. She did, however, menstruate on December 21, and again on January 23, which she considered exceptional. January 4 and January 11, give the average intermenstrual traces. The only premenstrual trace is on January 13, and this is as much as ten days before the flow. It is evident from comparison of lines 6 and 7, that the plenitude of the artery is increased more than the tension; the summit being peaked, and dicrotism more marked. There are, however, elasticity elevations on the line of descent.

The first day of menstrual period (though not that following the trace on January 13) shows increased tension, (especially at pressure 5,) and diminished fullness. The dicrotism disappears, is replaced by elasticity elevations, while the line of descent is a little less abrupt, but the line of descent is lower and the curve sinks. On the fourth day, December 24, the primary pulse wave is still less developed. The day after cessation of the flow, it is, however, much more developed, and on the fifth day after, December 31, the trace is more vigorous than any of the series. On the tenth day, January 3, the pulse becomes very miserable, the entire curve sinking. It is even less developed than on January 27, the day marking the cessation of the second menstrual period.

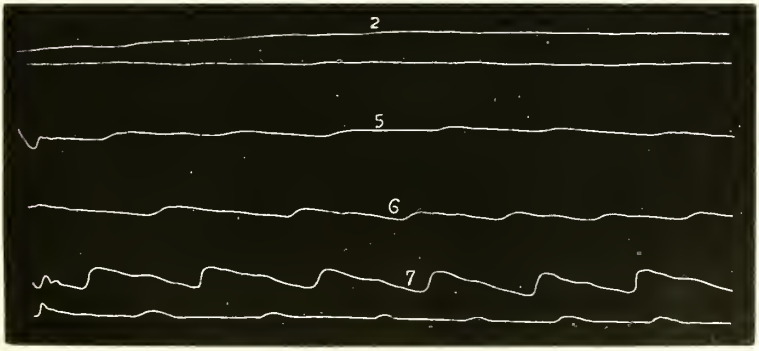
This case, therefore, is by no means so regular in its evolution as those hitherto examined, and is evidently more influenced by transient conditions, still the general tenor is the same.

No. VI, is from a very healthy young girl of twenty, well nourished, well colored, with good muscular capacity, menstruating regularly and with very little pain. The nearest approach we have to our intermenstrual trace, is on January 24, nine days after menstruation. Taking it as a standard comparison, we find on February 8, two days before a menstrual period, that then the tension is diminished, without any evident increase in arterial fullness. For the dicrotism is increased, while the primary pulse wave remains the same. We have already noticed instances, when the fullness and tensions, increased a week before menstruation, were both lowered on the second day preceding it. On January 11, the second day of a menstrual period, the plenitude is very much increased, but the resistance is diminished, peaked summit, abrupt line of descent, dicrotism, primary pulse wave higher under pressure five, than with six, and this higher than seven. On January 15, day of cessation, plenitude diminished, tonicity increased. This is especially shown by the firm

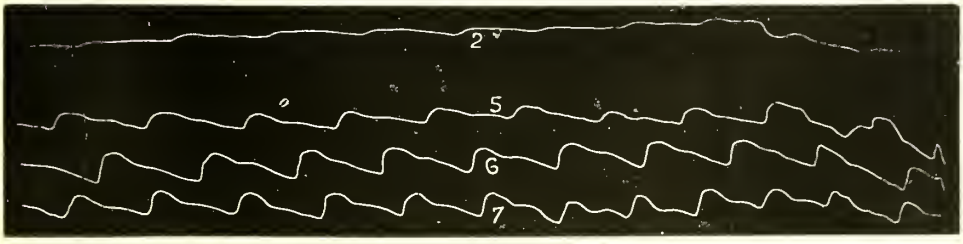


Jan. 11th. Menses began Jan. 10th.

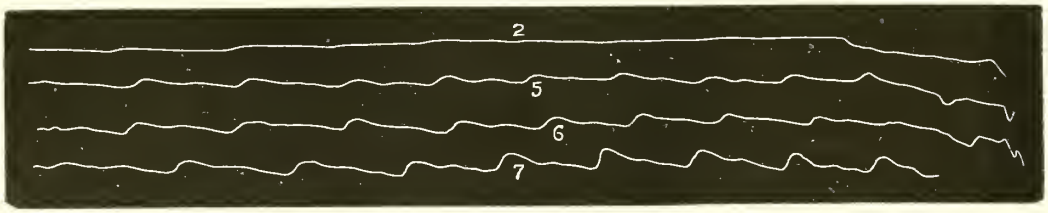
Jan. 15th. Menses ceased to-day.



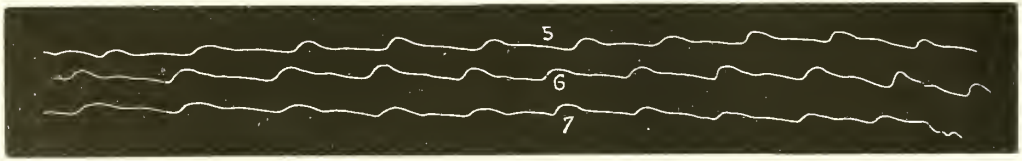
Jan. 15th. Menses ut supra.



Jan. 17th. 2 days after menses.



Jan. 24th. 9 days after menses.



Feb. 8th. 2 days before menses.

No. VI. (*continued*)

and vigorous tracing under pressure seven. The curves *en masse* sink. Two days after menses the artery is full again. Its tracing showing a combination of plenitude and tonicity, is in marked contrast with that of January 11, when plenitude existed without the tonicity.

No. VII is from a young German servant eighteen years old, in good health, but rather pallid. December 19, represents the intermenstrual trace, which shows considerable plenitude of the arteries, and well marked tonus.[1] On the twenty-fourth, nine days before menstruation, these characters are increased, and the pulse is considerably accelerated (the number of pulse beats has been omitted). On the second of menstruation (January 5,) the height of the primary pulse wave is lowered, and a little dicrotism appears. But upon abrupt cessation of the flow on the second day under the influence of violent moral emotion, the plenitude and arterial tension are both raised to the highest point in the series, at this time the girl suffered from a throbbing headache.

No. VIII is from a person who represents the most typical health of any on the list, a young married woman, six months after cessation of lactation, menstruation perfectly regular and painless. This person possessed fine muscular tone, and is recorded elsewhere on our tables, as capable of walking twenty miles. The intermenstrual trace is represented at the bottom of the sheet. Four days before menstruation, the level of the curve rises, the summit of the angle becomes much more rounded. On the first day of menstruation, all these characters change, the curve rises less or sinks, the primary pulse wave is a little developed. But though the fullness of the artery is much diminished the tension is not, as shown by the elasticity elevations. Ten days after menstruation the pressure and tensions have begun to rise again, and continue to do so until reaching a maxi-

[1] I have never examined this subject's heart, and from the trace, suspect a little hypertrophy.

mum (on our table) four days before the period. It is very possible that the real maximum was reached seven days before.

From these experiments, at all events until they should be contradicted by others, we are justified in affirming:

1. That, taking the middle of the intermenstrual period for point of comparison,[1] there is an increase in the tension of the arteries, dependent on an increase in their plenitude during the seven to nine days preceding menstruation. Nos. I, II, III, IV, VII, VIII.

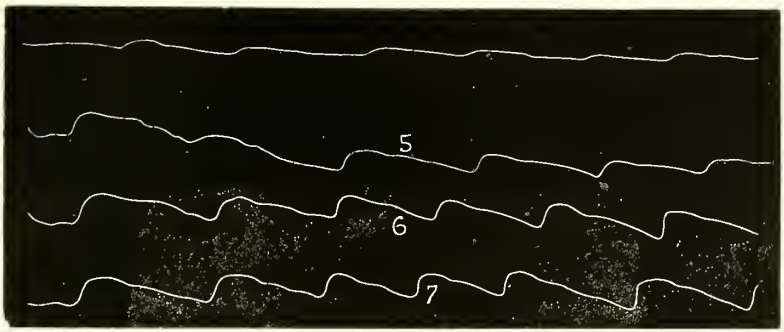
2. In one of the two cases where this does not appear clearly demonstrated by our tables (No. V), the menstruation was of an unusual type; and we lack, moreover, tables of premenstrual days nearer than the tenth. This, however, shows an increase of fullness, though not of tension, over the intermenstrual trace. In the other case (No. VI), we are again deficient in the premenstrual trace for any day but the second.

3. The increase of plenitude and tension may be more marked seven or eight days before menstruation than on the first or second day before (Nos. I, II), or the increase may continue up to the very day of the flow (Nos. III, VIII). In this case the first day of the flow may exhibit little or no lowering of the pressure or tension (No. III), or even show increased pressure (Nos. V and VI).

4. As a rule, however, the pressure and tension in the artery are both markedly lowered a few hours after the beginning of the hemorrhage (No. I, II, V, VII, VIII), and continue to diminish as long as this lasts (No. V).

5. The lowest point is reached immediately after the cessation of the flow (January 26 of No. I, No. IV), and this degree may continue for several days (Nos. III, V, VIII). In some cases, however, the plenitude and tension become in

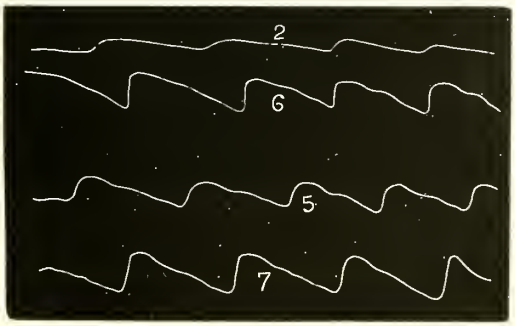
[1] "Over the degree of pressure, the strength of the cardiac systole, etc., sphygmographic observations have only a relative value."—Cyon, Methodic. der Physiol. Experiments, 1876, p. 165.



Dec. 19th. Menses Jan. 3d.

Dec. 24th. Menses Jan. 3d.

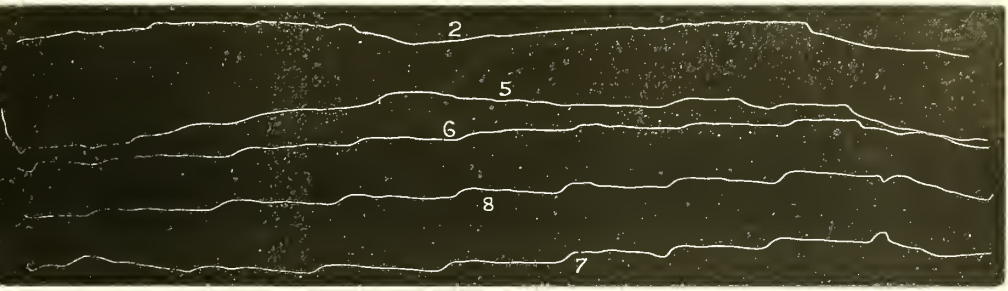
Jan. 5th. 2d day menses.



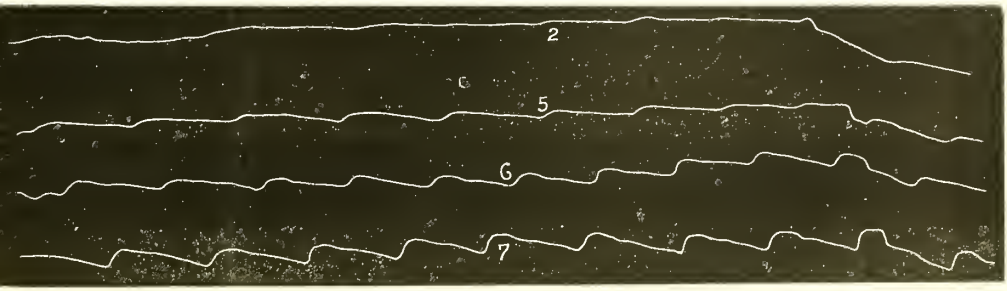
Jan. 7th. Menses ceased abruptly on 3d day under moral emotion

No. VIII.

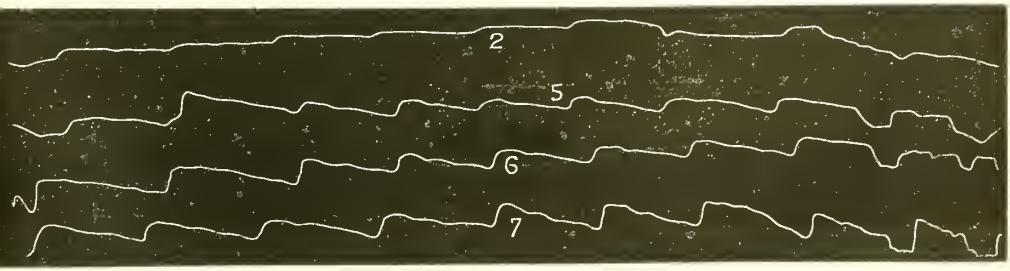
4 days before menses.



1st day of menses.



10 days after menses.



2 weeks after menses.

two days much increased over their condition on the fourth day of menstruation, or even on the first day after (Nos. II, VI, December 30 of No. I).

6. We should conclude, therefore, that in women exists a rhythmic wave of plenitude and tension of the arterial system, at all events perceptible in the radical artery, which begins at a minimum point, from one to four days after the cessation of menstruation, and gradually rises to a maximum, either seven or eight days before menstruation, or at any day nearer than this, or even during the first day of the flow.

That the resistance of the wall and fullness of the arteries should be proportionate to each other, and is so in normal cases; but this parallelism is frequently interrupted. (See especially No. IV.)

How is this rhythmic wave to be explained?

The increased pressure must depend on one of three things: increased energy of the cardiac systole; obstacle to the free egress of blood from the arteries; or finally, increase in the mass of the circulating fluid.

Now the force of the cardiac systole is certainly increased whenever the line of ascent in the sphygmographic trace is heightened, as it is in all our cases. When this heightening was excessive, we found in one case that the heart beat more frequently (No. I, December 30)—100 a minute. But in No. VII the frequency of the pulse was increased without producing this remarkably high vertical line of ascent.

If, however, the energetic cardiac systole existed alone, the line of ascent would be followed by a peaked summit and abrupt line of descent, as in the first menstrual trace of No. I, December 30. Again, any hindrance suddenly offered to the egress of blood from the arteries should produce such a trace as we have in No. VII, January 7, when menstruation was prematurely checked. But it is evident from this trace that the resistance is increased more than the internal pressure; whereas in our premenstrual traces, the pressure

is always increased more than the resistance. We are then obliged to refer to the third condition of increased tension, namely, an increase in the mass of the circulating fluid. In perfectly normal cases the tonicity of the arterial wall is increased *pari passu* with the increase of pressure. It is precisely where this is not the case that the rise of tension is accompanied by symptoms of general nervous disturbance, plainly to be referred to the pressure sustained by the vessels in the nerve centres and not adequately resisted.

How may we explain the fact, (noticed under third) that the arterial tension is sometimes higher six or seven days before menstruation than it is on the day or two immediately preceding?

If we refer to the descriptions of the uterus on the day just before menstruation, given pp. 93 and 95, we shall see that it is just at this time that blood begins to flow towards the pelvic vessels, and the uter-ovarian plexus, and a slight diversion is therefore effected from the mass of blood circulating in the upper half of the body, which should be expected to somewhat lower the tension in the radial artery. In the first month of pregnancy the same effect would probably be produced in the sphygmographic trace of this artery from a similar cause. For during this month, the woman often suffers from cerebral anæmia, as indicated by giddiness upon assuming an erect position, giddiness quite relieved by lying down, and the amount of urine, (not merely the frequency of its evacuation) is greatly increased. We have not yet positively proved that this diuresis is unaccompanied by an increase in the excretion of urea, such as exists in the latter months of pregnancy, but from the limpid appearance of the urine we believe (subject to correction,) that it is independent of any such increased movement of nutrition as would be then implied, and due simply to an increased circulation in the abdominal and pelvic blood vessels.

In the later months of pregnancy, at the same time that

the excretion of urea is increased, a high tension has been observed in the sphygmographic trace.[1] This has been explained by the increased mass of blood, the hypertrophied heart, the additional pressure on the kidneys from extra excretion of effete matter, finally by a functional increase of nerve force. Our observations if confirmed by others more numerous, should show *that in all these respects the intermenstrual, and especially the premenstrual period, represents a pregnancy in miniature.*[2]

In the investigation of these waves of nutrition, the greatest assistance should be afforded by the measurement of the blood corpuscles, according to the new method introduced by Potain and Malassez.[3] We should expect to find a gradual increase in the number of blood corpuscles from the minimum point, immediately after the menstrual hemorrhage, to a maximum just before. It is only by such a complete series of measurements that any valuable result can be obtained. To ascertain, as we believe has been,[4] that the blood corpuscles are decreased immediately after menstruation, is perfectly useless until it has been shown whether any provision has been made for this physiological diminution, by a corresponding increase immediately before.

Circumstances beyond our control, have hitherto prevented us from pursuing this research, which we propose to do later. Setting this aside, we may sum up the results de-

[1] Fancourt Obstet. Trans. vol. xvi. p. 263.

[2] Several writers admit an increased tension in blood vessels just before menstruation, as a consequence of "ovarian irritation." This could only act by vasomotor spasm, and hence hindrance to the egress of blood. But the subjective phenomena which accompany an "irritative rise of tension," are entirely different from those exhibited with these rhythmic traces.

[3] Archives de Physiologie, 1873. See the application of this method, Wilbouchewitch, in Archives de Physiol. 1873, and by Keys Am. Journ. Med. Science, Jan. 1876.

[4] We have not by us at this moment the memoir of Malassez, but we think he mentions this experiment among his others, Archives de Physiologie, 1874.

rived from the foregoing observations on the excretion of urea, on the pulse and temperature, and finally on the sphygmographic trace of menstruating women during the different periods of the month. We find that in the majority of cases, the excretion of urea is increased during the few days preceding menstruation, over that of the intermenstrual period; that it decreases during the menstrual flow, and is at its minimum just afterwards; that the pulse shows no uniform rate of variation, but that the temperature rises just before menstruation, to fall during the flow, but at this time rarely reaching the point of the intermenstrual period. Finally that the sphygmographic trace shows a constantly increasing rise of arterial tension from a minimum point reached just after menstruation to a maximum point just before, but rapidly lessened during the menstrual flow.

From our tables as well as from the experiments made by many others,[1] it is certain that increased nervous action determines an increase in the excretion, and probably in the production of urea. It is important for our purpose, however, to remember that an increase in the number of the blood corpuscles has the same effect. Thus men in whose blood is a larger number of blood corpuscles, habitually excrete a larger amount of urea than women.

Whatever the ultimate cause, however, it is unquestionable that this phenomenon always implies an increased movement of disassimilation and oxidation of albuminous tissues, principally of the nervous and muscular. This may exist alone, as in diabetes or in fever, but when accompanied by good health and increased vigor, certainly presupposes a previous increase in the rate of assimilation, that is of nutrition.

Now in the majority of women, the week preceding menstruation is a period of increased vigor, consciousness of increased nervo-muscular strength.[2] We are therefore justified

[1] Neubauer and Vogel, Analyse des Harnes.

[2] The cases where the contrary is observed will be considered later.

in assuming that the increased excretion of urea observed in the majority of cases at the premenstrual period, implies an increased movement of nutrition, although not very marked.

When the urea continues to increase during the menstrual period, it is probably due to other causes, perhaps to the nervous irritation which in many cases accompanies menstruation.

The diminution of urea during the flow, is susceptible of three interpretations; either the general nutritive movement of assimilation and disassimilation has decreased, or the urea in the blood has been carried off by the menstrual hemorrhage;[1] or finally the assimilation of albuminous substances from the blood is diminished, so that these pass off in the shape of the albuminoid constituents of the menstrual blood. The first is the opinion of Rabuteau, who, as we have seen, explains the decrease by the loss of the red corpuscles needed for the oxidation. As only five or six ounces of blood are lost during menstruation, and the proportion of urea in the normal blood is almost imperceptible, (one gramme in the entire body) it is improbable that the amount of urea deficient could be excreted as such in the menstrual blood, whose composition is the same as that circulating in the veins. We accept therefore, the first or third explanations, probably both.[2] The slackening of the movement of nutrition in nerves and muscles, is in strict correlation with the loss of oxidizing corpuscles by the hemorrhage. Finally the diminu-

[1] In the ultimate stages of renal cirrhosis, when the excretion of urea by the kidneys has become almost impossible, intestinal hemorrhage not unfrequently occurs, and compensates the suppression of the normal evacuation. We have recently seen such a case in our own practice, and where an extensive ulceration developed around the anus which we ascribed to irritation of ammonia derived from the urea presumably contained in the blood. At the autopsy, no visceral disease was found, except the most extensive cirrhosis of the kidneys, and superficial ulceration of the large intestine.

[2] The relative analysis of blood for albumine would be as desirable as for blood corpuscles, but much more difficult to obtain.

tion of urea during the days following menstruation, at first sight appears to be analogous to that observed after pathological hemorrhage. In the latter case, however, the patient always suffers from a feeling of exhaustion, just as indeed, do certain persons after menstruation, whether this be excessive or apparently normal in quantity. But usually, as Bischoff long ago insisted, women feel very well at this time, fact entirely incompatible with the supposition that nervo-muscular nutrition has been *depressed below its normal level.* We must rather infer that the depression is relative, and shows a decrease from a temporary elevation.

The rise in temperature indicates the same curve of oxidations as the alterations in the amount of urea, and again, we are led to suspect as a probable proximate cause, an increase in the number of blood corpuscles.

Finally the rise of the tension as indicated by the sphygmographic trace, seems to intimate, for the reasons above given, an increase in the mass of the circulating fluid.

In all the details examined therefore, we find evidences of such a gradual but steady preparation for the menstrual hemorrhage, as should exclude the idea that this, when normal, has any tendency to deplete the nutrition or lower the strength. It is to be regarded as the simple equivalent of an accumulation effected by a constantly rising wave of nutrition, primarily, (in all probability) affecting the blood, but secondarily, and as a result incidental to the main object of the wave, affecting the nervous and muscular system through which that blood circulates. The blood of the woman, non-pregnant as well as pregnant, *maintains constant provision for the nutrition of offspring*, just as the sap of the tree contains constant provision for the nutrition of buds.

The special variations of this blood, *i. e.* as regards sex, are all relative to this circumstance, but incidentally, the nutrition of the woman's own organs is effected.

If richer blood circulates in a slightly increased quantity,

and under a higher pressure, through the nervo-muscular organs, the nutritive movements in their tissues are accelerated, and the acceleration is marked by the increase of urea. When, in virtue of the rhythmic movement inherent in their form of nutrition, a portion of the nutritive fluids of women becomes in excess of their individual needs, this excess begins to accumulate in the circulation, until finally, the tension becoming excessive, the closed system gives way at its weakest point, the blood vessels of the fattily degenerated uterine decidua, and hemorrhage occurs.[1]

From all this it should follow that *reproduction in the human female is not intermittent, but incessant, not periodical, but rhythmic, not dependent on the volitions of animal life, but as involuntary and inevitable as are all the phenomena of nutritive life.* Vulpian, (Physiol. de l'amnios et de l'allantois. J. Br. Sequard, V. i. p. 616,) remarks that the allantois of the chicken shows rhythmic contractions from the eighth day, and the amnios from the sixth or seventh, at a time when no nerve elements exist in the amnios, so that its rhythmic action cannot be dependent on periodical nervous influence. The author questions whether the movement can be attributed to alternate modes in the nutrition of the blood. He is prepared to admit that the rhythmic type is general to the movement of nutrition.

In animals, many nutritive phenomena, essentially the same as those of plants, appear to change their character,

[1] Leigois ridicules the "plethoric" theory of menstruation on the ground that woman's blood has been shown to be habitually anemic relative to man's, *i. e.* to have fewer blood corpuscles than men's. From what precedes it is evident that no measure of blood corpuscles is of value, unless repeated throughout the month. Moreover, even were an absolute inferiority proved, we should attribute it to the absolute inferiority of muscle needing less oxidation. "There is," observes Paget. loc. cit. p. 11, "no fixed standard to the composition of the blood. From birth onwards the blood and tissues of each creature are adapted to one another, and the maintenance of health depends on the maintenance of their mutual reactions."

because in their complete evolution the functions of animal life, especially voluntary movement, have intervened. Thus in the two great departments of nutrition, the primary and the ultimate, absorption of food, and reproduction of the individual, the movements that in plants depend upon external agencies, in animals depend on the individual volition. Currents of air being food to the plant, currents of water being food to the mollusk, which in its immobility resembles an important character of plants; but the animal must go in search of its fodder or prey.[1]

These remarks are not irrelevant, because of the widespread though unconscious perversion of view that has resulted from the habit of associating menstruation with the sexual instead of the reproductive functions of women; and of expecting it to be accompanied by some especial excitement of the cerebro-spinal nervous system, such as must necessarily hold in abeyance all other activity of the central nervous organs.

The suggestion so frequently made (see former quotations), that by means of menstruation celibate women were enabled, to a certain extent, to compensate their celibacy, rests upon the slenderest foundations. But we should assert

[1] Nevertheless the voluntary movements of the animal are ultimately dependent upon rhythmic waves of excitation in the masses of nerve matter where they originate. Food is brought to the ganglion cells by the blood currents, as passively as to the oyster by the water currents. "Let us remember," observes Wundt, "that slight excitations generally vanish in the central substance of the cell, while stronger excitations set free its latent force. The excitation of the blood current impinging on the periphery of the cell must accumulate until they reach a given strength, sufficient to liberate the force of the cell, which is then transmitted to its central region, and thence to its motor nerve. After this discharge of force, equilibrium is restored, and the process begins all over again. Nerve centres submitted exclusively to the excitation of the blood act automatically and rhythmically. . . . This rhythm is interrupted or rendered irregular when the influence of other nerve centres inhibits the discharge of accumulated force." (Untersuch. zur Mechanik der Nerven. 1876.)

that the menstrual process, peculiar[1] to the one class of animals who are capable of avoiding or of missing an opportunity to propagate their species, indicates that this freedom of choice is only superficial or apparent, and that the initial steps of reproduction are being constantly, not periodically, taken by the force of nature, working independent of human will or of social accident. The woman buds as surely and as incessantly as the plant, continually generating not only the reproductive cell, but the nutritive material without which this would be useless, whether or no either be utilized in further development. Whence is this nutritive material obtained?

[1] Notwithstanding Pouchet. It would bring us too far from our subject to discuss the vexed questions of this peculiarity. It is difficult to understand that a provision for the nutrition of an embryo in one mammalian animal should not be required in all. Pouchet's opinion, that in many animals the same proportionate amount of blood is diverted to the pelvic organs during the rut, but that those being looser in texture are able to retain it without evacuation, seems extremely probable. Moreover, if in animals every rutting season is intended to be followed by a conception, the habit of evacuation of the provisional nutriment would never be established.

SECTION V.

THEORY OF SUPPLEMENTAL NUTRITION.

THIS certainly does not come from extra nourishment, for women eat less than men, and female animals and female plants eat no more. It must therefore be derived from a reserve drawn from the ordinary nutritive supply of the body, and it is the possibility of making this reserve which constitutes the essential peculiarity of the female sex.[1]

Spencer's generalization, already made by Haller, that reproduction is only possible when growth ceases, affords no explanation of the differences between the sexes which physically are so much more marked in human beings than in the lower animals. His further proposition, that in women individual development must be arrested on a lower type than that of men, in order to leave a margin for reproduction, is useless, and even untrue, on account of the width of the generalization. Nevertheless, in view of the primitive equality or even identity of the sexes,[2] this margin must exist, the reserve must be drawn from somewhere in the sex which sustains the greatest cost of reproduction; and as the most obvious difference between the sexes consists in the amount of motor force possessed by each, and in the development of the motor apparatus, the muscles and the bones, the nutri-

[1] Even if it were admitted with Hermann, that the ordinary cost of reproduction is the same in both sexes (see pp. 12 and 173), this would no longer hold during gestation. For this, an organic habit of nutrition must be provided, quite peculiar to the female.

[1] Embryologically and to a less extent during childhood.

tive margin theoretically admitted, has often been derived from this apparatus.

This entire locomotor apparatus is much more developed in men than in women. The muscles are more massive even relatively to the size of the body, and the body in all male animals above fishes is larger. "If it be asked why girls arrive at puberty earlier than boys, we reply that as men are much larger and stronger than women, as they have the body more solid, more massive, the bones harder, the muscles more firm, we should expect that the time needed for the growth of their body would be larger than that necessary for women; and as it can only be after the completion of growth, that the surplus of organic nourishment begins to be sent from all the parts of the body to the organs of generation, it happens that in women the nourishment is sent there sooner, because their growth is sooner completed.[1] The development of the bones is the consequence, not the cause of the development of the muscles, formed earlier, and of superior physiological significance; size is added to motor force, not motor force to size. Comparison between the nervous apparatus of the two sexes, though often made, is by no means so easy. We may, however, consider the following facts to be proved. 1. That the structural development and functional activity of the central nervous organs, is by no means in proportion, inverse or direct to their mass.

2. That this mass, especially as considered in the white substance, is proportioned to the degree of muscular development.

3. That the bony cases containing the central nervous organs, although in their growth closely following that of their contents, are nevertheless, in their outer aspect in the development of their prominences, rugosities, apophyses, closely related to the development of the muscular system.

[1] Buffon, Hist. Naturelle de l'homme. Quoted by Quetelet, Anthropometrie, p. 201.

These characters even appear on fossil skulls,[1] whose sex is (presumably) easy to distinguish by them.

4. To these propositions, generally admitted, may be perhaps added a fourth based upon less certain data. The localization in the anterior lobes of the cerebral hemispheres, of ideo motor centres,[2] tends to attribute if proved,[3] the preponderance of this portion of the brain in men, as compared with women, at least in part to the preponderance in them of muscular strength and motor force.[4] Whether or no the ideo motor centres of the convolutions be admitted, it is indisputable that the largest and most exclusively motor tract of nerve fibres, that which is carried up in the foot of the peduncles, terminates entirely in the anterior province of the brain, namely in the cortex of the cerebral hemispheres, in the corpora striata, and in the extra ventricular nucleus. (Huguenin, Wundt.)

From all these circumstances we may at least presume, that any general inferiority in the entire mass of the central nervous organs in women, as compared with those of men, (out of proportion to the smaller size of the body of course) principally relates to the organs of motility, the anatomical conditions of sensibility and of thought remaining the same. This fact leaves much room for variation in the dynamical conditions. Further, that while the mass of these central organs of motility is permanently less, we have no facts which prove an equally necessary inferiority in the elaboration of their structure.

This distinction is extremely important, for if, owing to the smaller mass of muscle, the woman requires less quantum

[1] Quatrefages et de Hamy, Crania Ethnica, 1873.

[2] Hitzig, Untersuch ueber das Gehirn, 1874. Wundt, Physiologischen Psychologie. Dalton, Report of Committee of N. Y. Society of Neurology, 1875. Ferrier, Functions of the Brain, 1876.

[3] It is vigorously disputed by Dupuy, These de Paris, 1873, and denied by Hermann.

[4] The exact relative proportions between different parts of the brain in the two sexes, is by no means completely determined.

of nerve force to be generated in the motor centres, yet the tonus of each individual fibre is as important for her as for the man, and hence there is as much demand for the power to generate force in each nerve cell; in other words, for as fine a structure of the nerve centres.

That this power is frequently deficient in women, that to it is due the major part of both their inefficiencies and ailments, is unquestionable, but there is nothing to show that such deficiency is either a primary or secondary sexual characteristic.

Of all the tissues, therefore, it is the muscular, to which the bones and probably certain portions of the nervous system are accessory or correlative, that exhibits the greatest difference in the quantum of development in the two sexes. These differences are most marked in the human race, and increasingly so in proportion to the luxury of civilization; but they exist, at least the preponderance of size exists, in the larger number of the vertebrated animals above fishes.

Again, these differences are not sensibly perceptible until the approach of puberty, children under ten years of age being, if submitted to the same régime of exercise, about equal in muscular force and development. We are, therefore, almost forced to the conclusion that "the arrest of individual development" which marks the unfolding of reproductive powers in the girl, does not take place in her entire body,[1] but in her locomotor system, including all the organs comprised in it, muscles, bones, and nerves, or motor nerve centres. This arrest implies that at this epoch the muscles begin to refuse to assimilate a certain proportion out of each group of nutritive molecules which is brought to them by the circulation. They cannot refuse all, for then their waste would not be repaired, and they would atrophy. Nor can it be said that the amount of nutriment brought to the muscles

[1] The question of arrest of mental development is foreign to our subject, except as implied in the question of development of nerve centres.

merely remains the same as it had been during childhood. If the amount and distribution of nutrition *did* remain the same, the body must necessarily remain in the same condition, permanently childish, incapable of reproduction. This presumption is realized in certain idiots and cretins. Now the amount of food taken by boys at puberty does increase, and they continue to grow, while girls, even in full health, hardly eat any more at sixteen than at ten, and their growth usually ceases. The amount of nutriment, therefore, is proportioned to the growth of the individual, and approximately, to the bulk of the muscular osseous system.[1] The only change possible in order to secure a margin of nutrition for reproduction, must be in the distribution of nutriment. Since this margin is required in both sexes, the change in distribution is required in both, and is effected throughout the entire animal as well as vegetable creation, by means of an arrest of individual growth. The difference in this respect between the two sexes, is a difference not of kind, but of degree. It is a difference not explained, as has been foolishly asserted, by the presence in the female of more highly developed organs of generation, since they are exactly balanced in the two sexes.[2] An excess of bulk in one direction is compensated by an inferiority in another, so that the sum total is the same. Hence *here* is no reason for arresting muscular development in the woman earlier than in the man. Again, any extra nutrition demanded by the increase of size in the uterus and ovaries at puberty, is much too trifling to necessitate any important change in the nutrition of other organs. It could not be a cause of change in the distribution of nutrition, because nutritive currents have been from birth directed to the same organs, and, for several years before

[1] Of course mere size, depending on fat, is excluded from consideration.

[2] The details of these analogies are so familiar to anatomists that it would be useless to refer to them, were it not for the extraordinary statements that have been made concerning the preponderance of such organs in woman. See Flourens, Cours d' Embryologie.

puberty, in almost as great abundance as after its establishment.

The demand for an altered distribution of nutrition is not in relation to new organs, but to a new function, or it refers not to special anatomical tissues, but to physiological processes in which all tissues share. The difference in the degree of the demand, or the cost of reproduction in the two sexes, is partly indicated by the different degrees in which the individual nutrition is altered. The difference for the cost of the processes actually instituted is not so great. In the woman the extra development of the germ cell is comparatively trifling, the amount of nutritive fluid (as represented by the menstrual blood) more abundant. In the other sex, the analogous nutritive fluid is much less in quantity, but on the other hand, the germ cells begin to be formed at puberty, and if smaller in size, are more numerous than the ova. In the woman it is the *potential* cost of reproduction which is in such immense excess. Ovulation and menstruation do not represent, as do the corresponding processes in the man, the entire contribution of the organism to reproduction; they only sketch out the work that is to be accomplished by it in pregnancy. It is for this especially that a new habit of nutrition of the entire body is required, and it is instituted in advance, just as the habit of breathing with the upper part of the thorax is begun, a habit useless except in pregnancy. Were it merely necessary to provide an amount of nutriment corresponding to what is contained in the ovule, and the five or six ounces of blood lost in the monthly hemorrhage, or were menstruation constant, *i. e.* a physiological phenomenon of short intermittence like digestion, it is conceivable that this should have been done in the one sex as in the other, by means of an extra amount of food, and by the arrest of growth after that had reached a higher degree of development. Instead of this, the cost of reproduction in its initial stage, is provided for by the same mechanism which will be-

come necessary in a later stage. The amount of nutriment is not increased, but a portion of it is diverted into new channels. The organs from which it is so diverted, can be no other than those which cease to develop in bulk and functional power, not only absolutely but relatively to the rest of the body, and fall below the typical possibility of the race as exhibited in men. The only organs in which such changes are evident are the muscles, and their accessories the bones.

If the first establishment of menstruation is correlative to a diminution of muscular nutrition, we are already justified in looking in this same direction for the provision that we should expect to be made for its continuance. It is almost an axiom in physiology, that the entire interval between the recurrences of a rhythmically intermittent process, is occupied by preparation for that process. The longer the interval, therefore, the more salient must become the marks of preparation. In the case in question, the interval is long enough to reproduce in miniature at each menstrual period certain conditions of the first menstruation. To carry out the resemblance, we should be able to detect a gradual deviation from muscular nutrition resulting in an accumulation in the blood vessels of nutritive fluid refused by the muscles, until the tension has been raised to a maximum just before degeneration of the uterine mucous membrane permits the blood vessels to rupture at this point. There can be no question that this series of phenomena occurs at puberty. In what way could it be repeated at succeeding menstruations?

Two distinct series of chemical processes are carried on in muscles, which, as both concern molecular movements of integration and disintegration, may be classed together under the general head of nutritive. Only one, however, really relates to the nutrition, *i. e.* to the development or the repair of waste, of the muscular fibre proper. This is the series of processes by which is effected the assimilation of plastic (albuminous) material. The other series of processes is con-

nected with the function of the muscle, and though, by affecting the mass of juices contained in the muscle, it modifies the size or nutrition of the organ as a whole, it is not directly connected with the assimilation in the fibres constituting the parenchyma. It has been demonstrated that the contraction of muscles during exertion is attended by an increased excretion of carbonic acid, while the excretion of urea remains the same. This is positive proof, and is accepted as such by all physiologists, that the heat required for the production of motor force is not derived from combustion of the albuminous parenchyma of the muscle, but of the substances, principally hydrocarbonaceous, contained in its juices. Schiff compares these to the coal contained in the locomotive, whose motor power is derived from oxidation of its contents, and not of the substance of its machinery.

The chain of phenomena which intervene between the oxidations in the muscular juices and the contraction of the muscular fibre, is somewhat variously interpreted. According to some physiologists, the lactic, and possibly other acids, formed, partially coagulate the myosine of the fibre, which is thus condensed. Tetanic contractions, and the rigor mortis, are only an exaggeration of the condition present in every living movement (Hermann, Brown-Sequard). According to others, the sarcous elements move spontaneously like the amœba under the stimulus of the heat, protruding in one direction while retracting in another, or the heat may be said to be directly converted into molecular movements within these sarcous elements (Pettigrew[1]). However immediately effected, contraction of muscular fibre quickens the circulation by compression of the blood vessels, and the accelerated blood current removes the products of oxidation accumulated in the muscle, and brings a fresh supply of oxidizable material, together with the plastic material for the repair of waste in the fibre. Thus the conditions of function and the

[1] This writer has explained but I believe not originated this theory.

conditions of nutrition of this fibre are fulfilled at the same time, provided the composition of the blood be normal. Hence the peculiarly intimate relation known to exist in muscles between the activity of their functions and the perfection of their nutrition.

Four circumstances may determine an alteration in the chemico-vital processes sustained in muscles. First, the composition of the blood may be altered. Deficiency of blood corpuscles, or anemia, interferes with the oxidation of the juices, hence with the entire series of processes necessary for muscular contraction; hence by imperfect contractions the circulation becomes sluggish, oxidized material is not removed, but, accumulating, causes the sensation of fatigue, which has been proved experimentally to depend upon such accumulations. The same sluggishness of circulation interferes with the supply of plastic material so that the nutrition of fibre suffers coincidently with its function. The clinical expression of these phenomena is of very frequent occurrence. Other variations in the composition of the blood would produce analogous results.

2. Diversion of the blood supply by causes external to the muscle has the same double effect. The function is interfered with first, so that in the regular physiological derivations of blood from the muscles to the gastro-intestinal tract, which correspond to the intervals of digestion, (see p. 106) the activity of function is alone affected. Before nutrition could be impaired, (we are speaking of normal conditions,) the blood wave returns.

3. The oxidations of hydrocarbons in muscular juices, are not only utilized in the production of motor force, but are the principal source of animal heat. Further, Liebermeister has shown that in all probability, the regulation of the heat of the body to a fixed standard, is effected in the superficial layer of muscles just underlying the skin. To the standard of temperature existing here, the temperature of the body is

conformed in spite of external variations, by means of impressions made upon the superficial muscular or subcutaneous nerves.[1] The chemical processes furnishing motor force, are therefore controlled by the same reflex innervation which regulates temperature, and may be expected to vary like the latter, sometimes under the same, sometimes under other conditions.

4. The assimilative power of the muscular fibre must be presumed to vary like that of all other anatomical elements, though it must be far from possessing the active influence in abstracting assimilable material, that we have reason to attribute to ganglionic nerve cells. The lesions which afford positive proof that assimilation has diminished or ceased, the blood supply remaining the same, fatty and waxy degeneration, and simple atrophy, have all been traced to alterations in the temperature or composition of the blood, to an arrest of innervation, or to irritation of the nerve centre with which the muscular nerve is connected. Apart from these circumstances, we know of no proof that the muscular fibre is able to refuse to assimilate nutriment that may be brought to it. Provisionally, however, we may admit such a possibility.

Finally, voluntary innervation, determining voluntary muscular contraction, has a most powerful influence over muscular nutrition, but as it acts merely by initiating the chemical processes already considered, its *immediate* effect must be resolved into one of them.

We may now return to our starting point, and inquire whether there be any evidence that one or more of these processes in muscles, are so modified, that nutritive material is periodically accumulated in the blood to meet the demands of reproductive nutrition.

On the most superficial view, the second condition mentioned above seems to be realized by the derivation of blood to the pelvis, and therefore, presumably, from the muscles

[1] Lehre des Fieber, 1876.

during the menstrual hemorrhage. The alternation between the circulation of the muscles, and of the generative intestine, would be analogous to that shown to exist between the muscles and the digestive tract. But the analogy would fail in one important point. The blood diverted from the muscles during digestion, is returned to them afterwards, enriched by fresh nutriment, but the blood diverted during menstruation is lost. Unless, therefore, a surplus had previously been accumulated in the muscles, the hemorrhage, if effected at the expense of their circulation, must on each occasion tend to lower their nutrition.

On the other hand, the gradual increase of vascular tension during the intermenstrual period, and its maximum just before the menstrual flow, must, other things being equal, increase the nutritive movement in muscular tissue, so long as it lasts. This is the first indication that for a temporary diminution of muscular nutrition during the menstrual hemorrhage special provision is made, by means of a special increase in this nutrition just before the flow.

So much for the second condition modifying muscular nutrition, and its relations to menstruation. The fourth condition—diminution in assimilation of plastic material—exists at puberty, and causes the arrest of muscular development, characteristic of that epoch. During menstrual life, no such great change in assimilation could be expected to take place, nor does it, but we may mark lesser variations approximately by measuring the excretion of urea. In a general way it may be said, that the quantity of urea measures the quantity of function performed by the nervous system, and the quantity of nutritive disassimilation effected in the muscular.[1] This proposition may be disputed by those who assume that a "waste of tissue" accompanies all nervous action, and measure that waste by the urea, whose quantity is undoubt-

[1] It does not vary with the functions of the latter, which are measured by the excretion of carbonic acid.

edly increased by such action, most demonstrably by action of the brain. But we believe that there is no proof that the functioning of nerve cells is necessarily accompanied by disintegration of their essential structural elements. We shall return to this point further on. In the mean time, we are justified in resting upon the well averred coincidence between increased brain function and increased excretion of urea, without going behind it to the hypothesis of structural waste. The fact itself is already shown quite markedly on our tables.

Apart from this hypothesis, however, and during equilibrium of function in the nerve centres, it must be admitted that we have reason to suppose that an increased movement of disassimilation in nervous tissue apart from increased functional activity must be followed, as in muscular tissue, by an increased excretion of urea. The increase during fevers and diabetes is habitually ascribed to this double source, disintegration of nerve and muscular tissues. Now our tables of urea have shown that, besides marked variations according to degrees of mental activity, a regular curve of variation occurred (in the majority of cases), according to which the amount of urea excreted was increased during the few days preceding menstruation, generally began to fall during the flow, to reach a minimum point just afterwards. In some cases it was increased during the flow, and in some of these cases, at least, this increase seemed to be due to increased mental exertion. But when this circumstance is eliminated, the quantitative curve of urea indicates a certain increase of disassimilation in nervo-muscular tissues during the premenstrual period, and a diminution of the same during the menstrual and post-menstrual period. The diminution may presumably be attributed either to diversion of the circulation or to loss of blood corpuscles. The premenstrual increase can only be explained by a previous increase in the movement of assimilation—such as should result from increased blood pressure in these tissues.

There is, therefore, no evidence of a direct rhythmic diminution in the assimilation of plastic material in muscular tissue, by which nutritive material might be periodically saved for reproduction. There is, however, evidence of a temporary diminution of muscular nutrition during the menstrual flow in correlation with a relative temporary increase which occurs just before it.

In regard to the first condition modifying muscular nutrition, namely, the composition of the blood, the absence of the positive experiments on numeration of blood corpuscles which may now be so readily performed, compels us to defer speculation. If we should argue from analogy with the vascular tension and the urea curve, we should expect to find an increase of blood corpuscles during the premenstrual period, which should compensate their loss during menstruation. But if we judge by the analogy of pregnancy, we should expect to find a diminution of blood corpuscles relative to the plasma, just before the menstrual parturition—a diminution which, in pregnancy, we have inferred to rather imply an increase of plasma. It is noticeable that this condition of the blood in the latter months of pregnancy coincides with a great rise of vascular tension, and increase in the excretion of urea. Leaving this most interesting detail to be determined by further researches,[1] we may consider the third possible modification of chemical processes in muscles, that, namely, of the oxidations of hydrocarbons, upon which depends the accomplishment of muscular function. We have seen that these oxidations must be modified by the abundance and rapidity of the circulation, and also by the voluntary innervation which compels muscular contraction. But the fact that these same processes are slackened or quickened according to the demand for the production of heat—demand appreciated by impressions produced upon and transmitted by the superficial muscular nerves—shows that modifications of these

[1] Which we have already begun.

processes may be initiated within the muscle, as well as controlled from without, by, for instance, variations of circulation.

Let us suppose that at any given moment, an ideal moment of complete equilibrium, the amount of oxidizable material in the juices of the entire muscular system consumed in an hour = A.

Let us further suppose that at the end of the hour a spontaneous slackening of the oxidations takes place under the influence of reflex nervous impressions analogous to those which, in some as yet unknown manner, regulate the production of heat, at the end of the second hour, the total amount of material consumed would = A + A — a.

If the ratio of diminution continued the same, we should have at the end of the third hour, A + A — a + A — a, and so on. Let A = 12, and a = 1. Then at the end of the second hour we have 12 + 12 — 1 = 23. At the end of the third, 12 + 12 — 1 + 12 — 1, or 23 + 11 = 34, and at the end of twelve hours would equal 12 × 12 — 11 = 133. Had the equilibrium been maintained, the consumption at the end of twelve hours would equal 144.

Eleven molecules of oxidizable material would, therefore, remain in the circulation, because while the supply of nutriment to the blood remained the same, elimination *from* the blood had been diminished to that amount. The change in the mass of the blood would be greater than is indicated merely by these figures. The afflux of blood to the muscles is diminished by diminution in the activity of chemical processes going on in them, out of proportion to the diminution of eliminated material. As a consequence, the whole amount of blood remaining the same, there must be a surplus capable of being diverted to other organs, and which, until so diverted, continues to circulate in the blood vessels and increase arterial tension. Thus would be fulfilled the conditions which are in fact observed just previous to menstruation, and in this wide spread alteration of nutritive processes spontaneously initi-

ated in muscles, relating, not to their assimilation, but their function, we should discover a theoretically satisfactory origin for the surplus nutritive material periodically wasted in menstruation.

Finally, while the diversion of blood *from* the voluntary muscles, diminishes their functional capacity, a correlative afflux of blood *to* the uterus, should increase *its* functional capacity, *i. e.* the contractility of its muscular fibre. The small increase of contractile power acquired at each menstruation, is needed to force blood towards the cavity of the uterus, as the enormous increase at parturition is needed to expel the fruit from the cavity.

The oxidations of muscular juices are measured by the quantity of carbonic acid formed, which is a measure both for the production of heat and the intensity of muscular contraction.

It has long been admitted that, during menstrual life, women exhale less carbonic acid than men, measured per kilogramme of weight of body. It is also known that in case of amenorrhea, other than that of pregnancy (?) the proportion of carbonic acid in the expiration of the one sex becomes equal to that of the other. No measurements have been made comparing the amount of carbonic acid exhaled by women at different periods of the menstrual cycle. But the general correlation between menstruation and a diminished quantity of carbonic acid was insisted upon long ago by Andral and Gavarret, whose experiments are quoted by Aran in defense of a constitutional, as opposed to a purely local theory of menstruation. The experiment required to test the truth of our hypothesis, consists in a daily measurement of the amount of carbonic acid excreted throughout an entire menstrual cycle. According to the hypothesis, this amount should be at a maximum at the middle of the intermenstrual period, should then gradually diminish to a minimum just before menstruation, and should be found immediately after

menstruation, about the same as just before, and this should be the case notwithstanding a different curve for the abundance of red corpuscles in the blood.

On account of the laborious difficulties of this experiment, we have as yet not been able to carry it out with the necessary precision, and defer appealing to it until researches in regard to the other nutritive curves have been further developed. We are, however, justified in advancing the theory, as a strictly "verifiable hypothesis," and therefore admissible. Partial verifications we shall endeavor to adduce further on, from several details of pathological phenomena. It is worth while in this place, however, to consider whether the arguments we have offered in favor of an alteration of muscular function as a proximate cause of menstruation, *i. e.*, of reproductive capacity, in any way apply to the function or nutrition of nerve centres. There is much looseness of thought in the present day about these latter functions, and confusion between them and those of the muscles; and in no connection, perhaps, is this confusion more palpable, than when the reproductive functions of women are under consideration.

Obscure as is our knowledge of the chemical processes of nutrition in either muscles or nerves, a few facts are well established. Assuming, for the moment, that the assimilative processes securing the repair of waste are essentially the same in the nerve cell and the muscular fibre, we have every reason to believe that there is a striking contrast between the chemical processes underlying their respective functions. It is certain that in muscle these processes consist of a series of oxidations, or of reduction of complex elements to simpler. But, as Wundt points out, the formation in the nerve centres of the complex molecules of lecithine, from the less complex molecules of fat and albumen, proves that in at least these tissues of the animal body are carried on chemical processes quite other than those of oxidation. Instead of a reduction

of complex molecules to simpler, long held to be the chemical process peculiar to animal nutrition, there is a synthesis of simpler elements to more complex, such as takes place in plants.[1] Now, according to the law of correlation of forces, force becomes latent during chemical combination, and is set free during chemical decomposition. During the formation of lecithine, therefore, in the interior of a ganglion cell force becomes latent, or is stored up in the cell. This process constitutes the "negative or internal work" of the cell. When the molecule of lecithine is decomposed, force is liberated, and in quantity proportioned to the extreme atomic complexity of the molecule. This force, discharged along the motor fibre emanating from the cell, constitutes the "positive or external work" of the latter. It is not a strained hypothesis to admit, with Wundt, that the negative work is principally effected in the interior of the cell, and the positive at the periphery. In a state of repose or equilibrium, a rhythmic alternation is constantly maintained between the two processes—rhythm which may be modified by any circumstance, physiological or morbid, which facilitates or impedes the peripheric discharge of force, or which increases or diminishes its central accumulation so that the proportions between the two processes are changed. This mechanism for the generation or accumulation of force is probably limited to the ganglionic nerve cells, and in intimate connection with their recognized influence upon general nutrition. An absolutely larger amount of material must be consumed in those chemical processes which result in the generation of nerve force, than in those which repair waste in tissue. The assimilation of albuminous nutriment to repair waste in the muscular mass, is, on the contrary, from its greater size, on a larger scale in these tissues than in the nervous. The double processes in each may be thus tabulated :

[1] See also Hermann, Habilitations Schrift. Zurich. 1869.

NERVOUS TISSUES (GANGLIONIC).

Repair of waste. GENERATION OF FORCE.	DISCHARGE OF FORCE (CENTRAL OR PERIPHERIC INNERVATION).

MUSCULAR TISSUES.

REPAIR OF WASTE. CONVERSION OF FORCE.	DISCHARGE OF FORCE.

Or, for the first case, we might construct the formula, $r + F = D$—for the second, $R + F = D$. Theoretically, we should presume that the larger letters in the formula were those covering the widest margin, and hence admitting of greatest variation, and so far clinical facts abound to justify this presumption. It is indeed very common at the present day to ascribe functional nervous disorders to "deficient nutrition," or "excessive waste" of nerve substance. As, however, in the cases in question, the most complete development of the disease (*i. e.*, spinal irritation, etc.) remains unattended by atrophy of nerve substance, not the least anatomical proof can be alleged of this hypothetical "waste." The clinical facts express a disturbance in the special function of the ganglion cell, *i. e.*, in the generation or in the discharge of nerve force. It is theoretically quite conceivable, although structural waste of the morphological elements of the cell were completely repaired, that alterations should occur in the formation of the lecithine molecule,[1] or in the process of its decomposition, or in the intra cellular molecular circulation, or in the degree of resistance offered by inter cellular fibres to the transmission of impressions, etc. Indeed, disturbance in the functions of nerve cells must imply alteration of one or more of these processes. To go behind them,

[1] If we adopt the strongly fortified hypothesis of Wundt.

and imagine a further alteration in the assimilation or disassimilation processes, *i. e.*, in the structural nutrition of the cell, as a necessary basis for such disturbance, is to adopt an hypothesis for which there is, to say the least, no proof, nor by any means the analogies which justify Wundt's scheme of nerve functions. We claim, on the contrary, from the simplest comparison between "functional" diseases of the nervous system, and the organic diseases resulting in fatty degeneration, atrophy, and sclerosis, that the generation of force in nerve cells is very frequently interfered with, but the repair of waste, in comparison, rarely; and, almost as a corollary, the disturbance of function results in disorders, which, however alarming, may be cured; but the disturbance of nutrition results in lesions, whose effects, infinitely more insidious, are generally incurable.

These considerations should already show that there can be no reason for presuming identity or parallelism between the activity of the nutrition or function of nerve centres and of muscles. The current theories of menstruation, however, which lay great stress upon the generation of force presumed to be involved in the maturation and dehiscence of the ovule, do constantly insist, tacitly or implicitly, that in order to compensate for this there must be a corresponding diminution in the generation of force elsewhere. These theories assume a spontaneous diminution in the functions of certain nerve centres, in order to liberate force for the organs of reproduction, in a manner somewhat analogous to the diminution in functional muscular nutrition which we have tried to show is necessary, in order to provide for the surplus material needed for reproduction. Besides the arguments already adduced in favor of the latter theory, we may urge the following objections against the former:

1. During menstruation, even during any period of the menstrual cycle there is no expenditure of plastic nerve force, especially is there none in any way comparable to that of preg-

nancy with which nevertheless it is often half consciously compared. The analogies between menstruation and pregnancy relate to all other particulars rather than this. The ripening of the ovarian epithelium, and the tumefaction of the uterine mucous membrane are nutritive phenomena on a tolerably minute scale; involving it is true the innervation of the organs, as do nutritive phenomena in any organs, but in very trifling excess at one time of the menstrual cycle over another?

2. The nervous disturbances that so frequently accompany the menstrual hemorrhage, (which only corresponds to one part of the menstrual cycle, and that not the most significant,) do not imply an "increased generation of force" in nerve centres, supposed to preside over the organs of generation. They constitute, as will be frequently shown, reflex irritations, that are either expended on the muscular fibre of the uterus, causing local cramps, or on any distant portions of the nervous system by the medium of the spinal cord according to the usual mechanism of reflex irritations. They are as pathological as the reflex irritations of digestion in dyspepsia.

3. In the absence of subjective evidence, the vascular turgescence of the bulb of the ovary at menstruation, cannot be assimilated to the phenomena of erection, nor can conditions of innervation analogous to those of the latter process be inferred.

Is it possible to arrive at any numerical equivalence between the factors of which we believe to have indicated the equivalence, or, of any nearer idea of the mechanism by which the equivalence may be effected.

To do this we should not rely upon comparison of the averages of each set of factors, but compare in a series of individual cases the following groups of physiological facts: the muscular strength; the evolution of heat, and its consumption during muscular action; the number of blood corpuscles;

the vital capacity of the lungs; the elimination of urea; the excretion of CO_2, and the amount of menstrual blood.

These should be measured against each other during menstruation, and during the premenstrual, post-menstrual and intermenstrual periods. As it is, the data at our disposition are extremely unprecise. In regard to muscular strength. we have the rather famous measurements of Quetelet, to which reference has already been made.[1] These estimates are made by means of a dynamometer that measures the strength of the muscles of the back (*force rénale*) then with a dynamometer for the hands.

With the first, Quetelet found, that from the age of seven to thirteen the strength of the boy to that of the girl was as 14 to 10. From thirteen to eighteen it was as 18 to 10. Of the man after twenty to the woman of the same age, as 14 to 10, or nearly double. At twenty, the force of the two hands in the man was 78.6, in the woman 46.6, a difference of 32, which is proportionately less.

This difference of muscular strength is much greater than the difference of muscular mass. It implies a greater intensity of muscular contraction. But this implies a greater consumption of the non-nitrogenous substances whose oxidation supplies the heat-equivalent of the mechanical force evolved.[2] It is this same class of substances, especially the fats which are utilized in the development of embryonic tissues. In non-pregnant women, there is more fat in the blood than in men; in pregnant women the excess of fat is stored up in the liver. In both cases it is saved from diminished muscular consumption. According to Longet, women have habitually a higher temperature than men. Is less heat converted into motor force? The more abundant oxidation in the man, necessitates on the one hand a larger proportion

[1] Anthropometric, p. 370, 1870.

[2] Hardy; Principes de Chimie Biologique, p. 253, 1871. See also Schiff, Fisk, Gavarret, Ranke, etc., already quoted.

of blood corpuscles to the plasma of the blood, and a greater vital capacity of the lungs in respiration. Since the introduction of methods for counting directly the blood corpuscles, no other method of estimating them can be relied upon, except for the most approximate estimate. According to the older method employed by Andral and Gavarret, Becquerel and Rodier, Robin,[1] and Hoppe,[2] the proportion of blood corpuscles to a thousand parts of blood, was estimated. Robin reckons in 1,000 parts of blood, 320 red corpuscles for a man, and 300 for a woman, that is, the latter should have one-sixteenth fewer than the former. By the new method, the number of corpuscles in a cubic millimetre is enumerated. Now by this method, it has been shown that a healthy man's blood contains about five million corpuscles to the cubic millimetre, a woman's four million and a half.[3]

With this diminution of hematies is a diminution in the amount of air taken into the lungs, the vital capacity of women as measured by the spirometer being only from two-thirds to three-fourths that of man's, (Waldenburg,) or 16.7.5 cubic centimetres, for every one centimetre of weight, instead of 22–24 as in the case of the average man, (Wintrich).

Now these differences do not correspond. The muscular force is half, the breathing capacity three-fourths, the number of hematies destined to carry oxygen from the lungs to the muscles is nine-tenths of that of man.

It is noteworthy that the proportions between respiration and muscular force are much nearer approached than are either to the proportion of blood corpuscles.

This already suggests that while the two first variations are probably in relation with one another, the latter is inde-

[1] Leçons sur les Humeurs. p. 40, 1867.

[2] Physiol. Chemie.

[3] This is the calculation of Vierordt. Keyes, (loc. cit.) arrived at the same conclusion. Malassez gives a lower estimate for the blood of men, 4,500,000.

pendent of both. The estimate of the number of blood corpuscles, indeed, is only relative to the amount of blood plasma, and is to be accepted quite as much as a proof that the plasma is increased, as that the corpuscles are diminished. On this point, a remark by Robin is perhaps apropos. "At the moment of birth, the blood cells (hematies and leucocytes together), instead of being in the proportion of 320 parts to 680 parts of plasma, may be precisely inverse, that is, 680 parts to 320 parts of plasma. . . . The further back in the intra-uterine existence the examination is made, the greater is the proportion of the globules. . . . The reason is easy to understand. In the fœtus the plasma is furnished entirely by the mother, is apt for assimilation, and only very little elaborated by the fœtus, consequently it is assimilated as fast as it arrives, so that, so to speak, there is no time to increase its quantity, proportionably to the increase in the number of hematies."—Loc. cit. p. 41. If now in the woman, at all times liable to the demands of reproduction, a certain proportion of nutritive plasma remains unassimilated (see ut supra), it will remain in the blood, in relative excess to the number of blood corpuscles, and tending, unless appropriated by the embryo, to accumulate in the circulatory system, to raise vascular tension, and thus to prepare the way for the menstrual hemorrhage. The same reasoning should apply to the "physiological anemia" of pregnancy. From this point of view, therefore, we might expect to find a *relative diminution* of blood corpuscles before menstruation, instead of a rise. From the analogy with the composition of the blood in pregnancy, we should be led to conclude that, roughly speaking, the number of hematies furnished the measure for the energy of muscular oxidation and evolution of motor force, the plasma, for the abundance of nutritive material and reproductive force.

It would not be profitable at the present time, and with the data at our disposal, to pursue this inquiry further;

although many of its details invite investigation. It is better for the purpose of this Essay, to now turn our attention to applying the theory of menstruation as above exposed towards the theoretical elucidation of the question: Do women require rest during it?

SECTION VI.

APPLICATION.

FROM the review of the menstrual process which has been given, we are obliged to admit several decided contradictions between the deductions of theory and the facts of practice. Thus we have seen that, in the great majority of cases, when menstrual rest is either advised or taken, it is made to coincide exclusively with the menstrual hemorrhage. Yet this period, as Williams justly observes, is really the least important of all, in the succession of periods constituting the entire process.

The hyperæmia of the uterine mucous membrane, and frequently also (though by no means always) of the ovarian bulb and Graafian which constitutes the so-called "pelvic congestion," precedes menstruation, *i. e.*, the menstrual flow, and, if analogous to pathological congestions, should be a period of sufficient discomfort and local distress to necessitate rest. Yet during this period, the majority of women feel remarkably well, and would be astonished if advised to keep their bed or sofa. Nor are they recommended to do so by their most solicitous advisers. On the other hand, the week succeeding the hemorrhage, if we reason from analogy with pathological hemorrhages,[1] should be a period of exhaustion, during which again, exertion would be difficult or even im-

[1] Other than hæmoptysis, after which the patient feels often extremely refreshed. The reason is obvious; the hemorrhage, as in menstruation, has been prepared for by a rise of vascular tension, that upon weak nerve centres may cause irritation and often fever.

possible. Yet in the majority of cases, *i. e.*, of women considered in fair health, there is then a great capacity for exertion, and feeling of well being; "Elle est plus frais, plus dispos," to use the French idiom. On the other hand, the moment when the pelvic congestion is relieved, the heightened muscular tension lowered by the onset of the hemorrhage, is the time when pain is most frequent, and when, if ever, the woman seeks repose. Two questions must be answered, 1st, Why should pain ever occur at this time? 2d, What relation exists between the successive phases of the menstrual process as we understand it, and the variations in the clinical phenomena presented by women at the periods corresponding to these phases?

The following propositions require no argument to be admitted.

1. In the majority of women, otherwise in good health, who suffer pain, this begins either with the flow, or a few hours before, and lasts six, twelve, twenty-four hours; in some cases forty-eight, but then always, in the cases we are considering, in much diminished severity.

2. In a limited number of cases, the woman feels an increase of health, and especially of mental vigor, during the period of the menstrual flow. (We have several such on our list.)

3. In the cases of pain, it consists either in cramps, or in a feeling of weight, and may be very moderate in intensity.

4. Dysmenorrhea, with the above characters, represents the mildest form, and often scarcely merits the name.

5. In another class of cases the pain has the same duration, and coincidence with the flow, but is much increased in severity, the cramps being violent in character, and bearing more or less resemblance to pain in parturition. This pain generally does not begin until after the flow.

6. In both the above classes, the premenstrual period is generally one of increased health and energy; as it is also in

the cases where no pain is suffered at all. In another class, the patients begin to suffer two weeks, one week, or two days, before the menstrual flow, from backache, pelvic weight, or even burning pain in the hypogastrium. Such persons generally suffer burning pain at menstruation instead of cramps. The cases are of much graver import than the preceding.

7. The post-menstrual week is also usually a period of well being. This condition is not apt to be damaged by the existence of pain during menstruation, but is very much affected by excessive flowing, which nearly always leaves a state of prostration, which often is not recovered from for several days.

After these admitted statements a few postulates.

1. The variations in the quantity of the menstrual flux are in relation partly with the degree of individual nutrition of the woman, but partly also with the rhythmic wave of supplemental nutrition. It is possible that the latter may be defective, yet the former good, indeed better, on account of the deficiency of the supplemental wave. Again, the old opinion that the menstrual flux was never to be considered excessive, unless the nutrition or nervo-muscular energy of the woman were evidently weakened by it, is true. For it may imply either larger absolute development of the supplemental wave of nutrition, or a less demand on the part of the nervo-muscular tissues from the individual nutrition.

2. There is really no evidence that complete amenorrhea, *i. e.*, without menstrual molimen, is ever dependent on defective ovulation.[1] After extirpation of the ovaries, although menstrual hemorrhage usually ceases, the menstrual molimen frequently persists. Eight cases have been collected where menstruation returned after double ovariotomy. (Journal Obstet.)

[1] Although Barnes, Clinical Lectures, p. 181, enumerates this as a cause, and Althaus (Med. Times, 1874) applies electricity to the ovaries to remedy it.

In Dr. Thomas' case of *normal* double ovariotomy for excessive dysmenorrhea, the operation, which at first afforded relief, was afterwards followed by a return of periodical pain. But there is abundant proof of its *dependence* upon deficiency in the supplemental nutrition, and its frequent association with deficiency of individual nutrition, whose original starting point is more frequently an alteration in the *functions* of the nervous system, than in the digestion and hematosis.[1]

3. Menorrhagia and dysmenorrhea, on the contrary, are much more frequently to be traced to perversions in the assimilation of nutritive material by the blood (simple anemia), or in the generation of force in nerve centres (neurotic anemia).

The cause of the simple spasmodic form of menstrual pain is as follows:

The increased rapidity of circulation in the walls of the uterus excites the contractility of the uterine fibres, in virtue of which the blood is forced towards the free surface of the endometrium. Rindfleisch[2] observes that the hyperæmia of mucous membranes, as of the stomach and intestines, is largely effected by the contractions of the muscular membranes underlying them. And it has justly been observed that the parenchyma of the uterus is to be considered as the muscular wall of its mucous membrane, hypertrophied to meet the special exigencies of the organ.

In perfectly normal cases, these contractions are slow, rhythmic, as painless as the contractions of the uterus demonstrated to occur during pregnancy,[3] or of the intestines in healthy peristaltis.

If, however, the vaso motor nerves of the uterine vessels become irritated under the increased pressure of blood, or by transmitted irritation from cerebro spinal centres, unable to

[1] Though the contrary is the opinion of Beau, as expressed in his treatise on Dyspepsia.

[2] Pathologischen Gewebelehre. 1871. [3] Snow Beck. Obstetrical Trans. 1873.

sustain the increased blood pressure, spasmodic contractions of blood vessels will take place from time to time, rendering the circulation of the parenchyma irregular, the fibre here anemiated then hyperæmiated, inducing therefore spasmodic, tetanic contractions of the muscular fibre, which cause pain of various degrees of intensity.[1] Susceptibility to vaso motor irritation is in inverse proportion to the stability of function of the brain and spinal cord, therefore this form of dysmenorrhea if well marked, indicates deficient generation of force in the nerve centres, and is frequently, (though by no means always) accompanied by cramps of the stomach and intestine, dependent on the same conditions. This form of pain, from its cause, ceases when the increased tension in the blood vessels of the parenchyma is relieved by the rupture of blood vessels in the tumefied endometrium. Hence, in the mildest form of all, it subsides in from two to six hours. When prolonged much beyond the free establishment of the flow, it shows either that the vaso motor irritation, once set up, persists after cessation of its cause, as is common; or else that in the spasmodic contraction of uterine fibres, the os is frequently closed to the egress of blood. The excess of vaso motor irritation is a proof of diminished resistance offered by the spinal cord to the transmission of impressions.

This form of dysmenorrhea may exist from the beginning of menstruation, but in such cases, the girls are either decidedly neurotic, (*i. e.* with insufficient assimilative power in the tissues of the nerve centres,) or anemic, *i. e.* with insufficient blood to nourish them. These cases are very frequent in families inheriting consumption. If, however, the anemia be pushed beyond a certain point, the supplemental wave of nutrition never rises sufficiently high, to greatly increase the tension either in the general circulation of the uterine blood

[1] See Oser and Schlesinger, Schmidt's Jahrbucher. Experiments on Contractions of uterus, induced by closure of the aorta. Also Putnam Jacobi, Note on nitrite of amyle in dysmenorrhea, Medical Record, 1875.

vessels. Such persons, therefore, though feeble, suffer no pain on menstruation. This is generally scanty; when profuse, (in these cases) it indicates a debilitated relaxation of blood vessels, unable to resist the periodical tension. We have, as in all vaso motor paresis, reason to attribute this to paresis of central innervation; the limit is passed at which irritation of vaso motor centres is occasioned, and it is replaced by vaso motor exhaustion favoring prolonged hemorrhage without pain.

These considerations answer in part questions 1, 2 and 3, on p. 143.

But this form of dysmenorrhea is often acquired.[1] Any condition capable of determining the requisite degree of anemia or of neurosis may induce it, and our tables of cases show a number of instances where the habit of spasmodic menstrual pain has been acquired under circumstances tending to produce these conditions. Over-work is one frequent cause. During excessive muscular exercise (*i. e.* as compared to the individual muscular capacity) the blood becomes watery, (Ranke) and thus anemia produced. But on our tables we have very few cases, (perhaps half a dozen from factory girls,) when this cause could be alleged. A very much larger number of persons have been engaged in work such as is generally described as involving "nervous strain," such as teaching. Now "nervous strain" must mean excessive action of nerve centres, in one of three directions, namely, intellectual activity, moral emotion, especially anxiety, or motor force expended in muscular activity. Teaching six hours a day, (we select this occupation as the one most numerously represented on our tables, and also on the census, after agriculture and domestic service,) cannot be said under ordinary circumstances, to involve any excess of either intellectual or emotional activity. But, when analyzed, we find

[1] Whether more often acquired than congenital, *i. e.* primary, we have not, at present, data to determine.

that it does involve much *forced fixity of attention.* Now attention, even when involuntary, that is, excited by the influence of an absorbing idea or emotion, always implies the maintenance of muscles in a fixed position for a certain length of time.

Reading, writing, speaking according to a certain routine, even sitting still and listening to a recitation, all imply that the body shall be held steadily in a certain position, which necessitates the voluntary contraction of a great many muscles. The less naturally interesting the subject, the greater is the voluntary effort required to maintain the requisite muscular tension, hence the greater the liability to fatigue. But, even more important for the case we are considering, the *mental act of attention requires processes in nerve centres, closely analogous to those which precede muscular action, if indeed the motor centres themselves be not always called into activity in every act of volition.*

The first elementary expression of volition is a muscular movement; the first degrees of complexity in the development of volition are expressed by corresponding degrees of combination among voluntary muscular movements; and the most complete determination of the will cannot be carried out except by means of muscular movements, though it be only those required for speech or for writing.[1] In this account the ultimate effect of work involving continuous forced attention and little apparent muscular activity, may be exactly the same as that of work involving much muscular action and little attention. The immediate sensation of fatigue is often precisely the same, indeed is often much more exhausting, when the exertion of motor force has been in the form of pure volition apparently expended on the mind, *i. e.* in compelling the maintenance of a certain train of

[1] This proposition in regard to the relation of all acts of volition to the motor centres, must be left in this place undeveloped, and even undefended, from lack of space and time. We hope to enlarge upon it on another occasion.

ideas, as when it has been expended on the muscles. It has not excited that increase in movements of nutrition, by which muscular activity, unless excessive, is habitually compensated.

Now it is very noticeable in women, that, as their characteristic bodily deficiency is lack of muscular strength, so their characteristic mental deficiency, taken as a class, should be lack of power of attention. The very highest degrees of sustained attention have rarely been even attempted by women; while the lower degrees, necessitated by the exigencies of every day life, are frequently followed by a collapse of nervous energy that seems perfectly unaccountable when we consider only the amount of work accomplished, its severity, or its difficulty.[1] From whatever point of view we look, we find indeed that the *difficulty* of the work bears no kind of proportion to its effect upon the health of women. But they are much more dependent than men upon their degree of interest in their work, for the reasons, as already seen, that in proportion as the work is interesting, does effort become involuntary, and require less deliberate exercise of volition. Very hard work that thoroughly excites the sympathies may be accomplished with ease. This is of course true both of men and women. But it is very much more true of the latter, that simple continuous work which is either indifferent or repellent, will, if pursued for a long time, be followed by a "breaking down" in health.

The first symptom of such break down is backache; the second, a greater or less degree of pain at menstruation. Headache and neuralgia occur in predisposed persons.

What has happened in such cases? We think that the initial circumstance of the "breaking down," consists in an encroachment upon the individual nutrition of the supplemental wave of reproductive nutrition, which we have held to be peculiar to the female economy.

[1] If, however, we should consider *absolutely*, the amount of work requiring sustained attention that is performed by women, we should find it to be immense.

The backache, so often mistaken for a symptom of uterine disease, is the typical as well as initial symptom. It is a marked characteristic of the chloro anemia of puberty, but is rarely absent from the states of acquired anemia of which we are speaking. Let us see if the theory of menstruation as exposed, will offer an explanation of this muscular asthenopia.

The theory of muscular contraction shows that asthenopia or loss of function may be quite independent of alteration of nutrition proper, *i. e.* of assimilation in the muscular fibre. It is admitted to-day that the sensation of fatigue depends on the accumulation in the muscle of the oxidized products formed during the process of muscular contraction. Since both the oxidations and the circulation of the blood current which washes away their products, are involuntary movements regulated by the reflex innervations of the muscle, the sensation of fatigue may be prematurely determined by alterations in this innervation, especially at the central, *i. e.* spinal cord portion of the reflex arc. Exhaustion of the innervation in this way causes muscular weakness and fatigue. On the other hand, the innervation remaining intact, the molecular movements of the muscular fibre during contraction, may be so diminished in energy that all the heat evolved in the oxidation is not converted into motion, hence the demand for oxidation ceases before the chemical process initiated by the influx of nerve force, has been completed. Instead therefore of continuing to the ultimate term, the formation of carbonic acid, the process stops short while yet incomplete, and partially oxidized material remains, producing the sensation of fatigue. Asthenopia would then be really of muscular origin, starting from the perverted mode of function of muscular fibre. Many facts of physiological experiment, showing the degree of independence of muscle and nerve, indicate the possibility of such an independent starting point, however obscurely we can represent to ourselves the precise condition in which it consists.

Assuming, however, as we are so well justified in doing, a change in the molecular movements of the sarcous elements, whereby the energy of muscular contraction as a whole is diminished, we must seek the cause of this change in the structure or chemical composition of these elements. This must be effected by the assimilation and disassimilation carried on in them; in other words, by their nutrition proper. To say that a badly nourished muscle contracts feebly, is only to state a well known clinical fact.

Let us suppose that the habitual force of muscular contraction was diminished by one-quarter from a type standard. There would be a corresponding diminution in the afflux of blood to the muscles—thus also one-quarter. Suppose, further, that the habitual margin left for periodical reproductive diminution in the energy of muscular function was one-eighth of the whole amount; it would therefore, in the given case, be one-eighth of three-quarters ($\frac{1}{8}$ of $\frac{3}{4} = \frac{3}{32}$), or about one-tenth instead of one-eighth. But this amount may be insufficient to liberate the amount of blood required for the reproductive *node*,[1] that is, for menstruation. As the necessity for reproductive nutrition, once established, will, for a long time, take the precedence of individual nutrition,[2] the deficiency must be made up, and is made up by diminishing the afflux of blood and nutritive material required, not only for the functions of the muscle, but for the repair of waste in its fibre Hence insufficient nutrition of muscular fibre, and then, by the vicious circle common to all pathological processes, diminished contractility or function, pain in function, especially of the muscular fibres of the uterus, diminished afflux of blood for further nutrition.

A suggestion in passing. It is known that in vegetable reproduction ceases unless the individual nutrition be devel

[1] The term "node" is of course used here from the analogy with plants.

[2] Which, for the human species, is equivalent to saying that profoundly anemic women will continue to menstruate and bear children.

oped to a certain standard, while in animals reproduction continues long after profound deterioration of the individual nutrition. Is not this because in the former, material for reproduction can only be saved out of the material for individual nutrition, while in the latter, the reserve is formed by the material that would be used in functions?

From the above, we should conclude that the circumstance which mainly favors the deterioration of muscular nutrition by the supplemental reproductive wave, is the original feebleness of muscular function. Practically we find that the habit of disordered and painful menstruation is more frequently associated with habits of feeble muscular exercise than with any other one circumstance.

Into the effects of overwork upon the nervous apparatus of women, in connection with menstruation, it is much more difficult to enter, because the normal relations between the two are much more obscure. The facts so often alleged in profusion to demonstrate a peculiarly intimate relation, can, as we have seen, all be classified as cases of reflex irritation, in which impressions have been transmitted to nerve centres whose power of resistance has been abnormally diminished. "The neuroses of menstruation," on which Berthier has written a voluminous monograph, all belong to this class. Hysteria, convulsions, paroxysms of insanity, simple outbursts of ill-temper, headaches, cramps, catalepsies, phenomena however extraordinary or however multiplied, add nothing to the principle already contained in the simplest. This principle is, that any new vital action, *i. e.*, a process in any organ or tissue necessarily involving vascularization and innervation, may become the starting point of impressions that, when transmitted by centripetal nerves, will be extinguished in nerve centres of normal power of resistance, but will be diffused in centres of diminished power of resistance. Or again, with normal resistance in nerve centres, a perverted vital action on the periphery, irritating nerve filaments,

may again cause centric irritation. The case of menstruation is precisely paralleled by that of teething. In menstruation, the second condition is fulfilled either in the obscure disease known as "subacute ovaritis," where the vascular turgescence accompanying the rupture of the follicle becomes a source of irritation to the ovarian nerves, or else, in the various conditions of irregular circulation, or imperfect nutrition or contractility of the muscular fibre of the uterus, which renders the afflux of blood towards the cavity a source of irritation to the nerves of the parenchyma..

The essential precaution against such reflex disorders consists in obtaining such an organization of the central nervous system as will raise its power of resistance to peripheric impressions to the normal standard. This is chiefly done either through inheritance, or through influences brought to bear during childhood. Much less can be effected in adult life, especially in relation to regularly recurring impressions at long intervals, like those from the uterus and ovaries at menstruation.

It appears evident, therefore, that the functional condition of the muscular system at puberty, and the organic condition of the nerve centres, powerfully influence the regularity and tranquillity of the menstrual process. Disturbance is acquired when these conditions have been determined by the given influence; for instance, by overwork. Thus:

1. In work involving much muscular exertion, or exertion long time repeated, the supplemental wave of nutrition may be unable to establish itself out of the small residue of nutriment left over from that consumed in the function of the muscles; it then will be derived from their nutrition, and then the chain of sequences already noted[1] will be initiated.

2. In work involving much fixed attention, and perhaps the activity of motor centres in the brain, the generation of force in the nerve centres seems liable to become impaired,

[1] See p. 201.

and, coincidently, their resistance to impressions diminished. In this case, amidst much which is obscure, we can distinguish the general fact that the repeated expenditure of nerve force finally renders the generation of force difficult. All excitation is so rapidly transferred to the periphery of ganglionic cells, that too little remains to store up force in the centre.

That the ganglionic nerve cells of women seem, on the whole, to be more easily exhausted than those of men, so that prolonged effort requiring prolonged generation of nerve force is more readily followed by collapse, is a fact that cannot be doubted. That this peculiarity must be in some way dependent upon their reproductive nutrition is also certain, but the exact relation between is not easy to determine, even hypothetically. There is, however, much reason to believe that the relation exists through the medium of the muscular system. As the vito-chemical processes carried on at the periphery of the nervous system in muscular and other tissues are constantly regulated by the influx of forces coming from the nerve centres, so the generation of force in these centres is constantly influenced by the arrival of impressions coming from the periphery, and by none more than those caused by muscular contractions. The influence of systematic muscular exercise, passive or active, upon the nerve centres, is most strikingly manifested in many well known cases of nervous disease, as, to a certain extent, hemicrania, and still more notably, spinal exhaustion. The feebler muscular contraction in woman, therefore, should be expected to correspond to a diminished quantum of force generated in the centres connected with centripetal muscular nerve fibres.

For reasons already urged, the peculiarities observed in women's power of exertion and attention are theoretically explained by such peculiarities limited to the motor centres. They do not imply, and there is much difficulty in admitting, a primary extension of the rule to sensory or intellectual centres.

An apparent exception exists in the case of peasant women with strongly developed muscular systems, who are yet not unfrequently liable to hysteria in its most violent convulsive form—liability which proves greatly diminished resistance to the diffusion of impressions in the nerve centres. We have ourselves noticed such muscular hysteria, whose paroxysms generally coincided with the menstrual period, in a girl whose mental development was arrested on the borders of idiocy; and such cases are common. These must certainly all be referred to an original imperfection of structure of the nerve centres, involving the sensory and intellectual centres to a much greater extent than the motor. This is positively proved by the large amount of power possessed to sustain prolonged and intense motor exertion, and the deficiency in the power to resist sensory impressions, or to generate or combine ideas. The condition of such women is precisely the inverse of that typically characteristic of their sex.

To say that the quantum of force habitually generated in a given time in one nerve cell, is less than that in another, is to say that the periods of expenditure of force must be shorter for the second than for the first, and the interval of repose longer, in order that an identical amount of force may be obtained from both. The case is analogous to that of a feebly contracting heart, when by the administration of digitalis, which prolongs the intervals between the contractions, a greater amount of force is accumulated to be expended at each of them.

The practical inference to be drawn from these considerations, in regard to the adjustment of female work to the reproductive necessities of her economy, is, that this should be constantly intermittent, *not at long intervals but at short*. Since the menstrual flow does not itself constitute the reproductive demand made upon the individual nutrition, but only expresses the result of that demand, since the latter is

made constantly, and only its effects accumulate in a rising curve, nothing would be gained, but much lost, by a single intermittence of work during the few days of the menstrual hemorrhage, the strenuousness of the rest of the month being left unchanged. From all the facts hitherto reviewed, we can find none to indicate that such a method of rest would *prevent* the occurrence of pain or breaking down in health, in any peculiar way, or different from what might be expected of frequent vacations taken at any other time. Nor from our tables of cases, do we find that the habit of resting exclusively at this time, frequently acquired when menstruation habitually became painful, ever exercised any influence in removing the pain. This might be removed by other agencies; it would always be rendered more tolerable by repose, but there is nothing, at least in the evidence before us, to show that *exclusively* menstrual rest is capable of exerting a curative influence. The kind of rest needed by women consists in interruptions to employment every two or three hours, not every three or four weeks.[1] The immense preponderance of domestic service over every other form of female labor, we mean of labor demanding the same degree of capacity, is in itself an indication of preference for work involving more hours but frequent interruptions, over work more compactly arranged, in an unbroken series of hours, though these terminated earlier. On the other hand, in higher employments, eight hours steady work is felt as a severe burden, when we believe (we are not at this moment prepared to absolutely *prove* it) two sessions of work, of four hours each, would entail little fatigue.

We do not, therefore, find it necessary to assert, even theoretically, that since muscular power is diminished in

[1] Thackrah, in his pioneer treatise on the influence of the professions upon health, mentions the marked improvement effected in the condition of the operatives in a certain factory after the habit of an afternoon lunch had been introduced (1837).

women, in correlation with their immense capacity for reproduction, that therefore they should never be allowed to perform any muscular work at all. On the contrary, as in the most abstract sense movement has been shown to be the one principle out of which all forms of existence were differentiated; as motor force has been shown to be, in animals, the reserve or balance fund, by which differences, and especially differences between the two sexes, are brought into equilibrium; so in the female sex, does the muscular nutrition constitute the main reserve, out of which may be met all the demands of reproduction, without detriment to the individual life. It is well known that muscular exercise increases muscular nutrition. It increases the sum of nutritive material stored up in the muscles, ready at any moment to be appropriated, either for the evolution of motor force in muscular contractions, or for the development of the supplemental wave of nutrition, destined to terminate after one month in menstruation, or after nine months, in parturition. The more the muscles are exercised, the larger their mass, hence the larger the amount of nutritive material stored up in them for this double disposition; hence the less the danger that the development of the supplemental wave shall encroach upon the nutriment necessary for the muscles or the nerve centres. The consequences of excessive muscular action, *i. e.* what is beyond the assimilative capacity of the muscular fibres to repair, have been several times referred to in the preceding pages. Such consequences are undoubtedly incurred among the working classes of Europe, though less among the agriculturists than might be expected. In them, muscular nutrition seems to invariably increase in exact proportion to the demand for muscular strength; and whoever has ever watched the female porters at Boulogne handle trunks that gentlemen travellers would hesitate to lift, may doubt whether there be any limit to the development of

muscular power in female peasants.[1] The brutishness of the nervous system in these persons suggests that in them the entire activity of the nervous system had been concentrated on the motor centres—result certainly most undesirable. But in this country, the danger is certainly the other way. A cardinal weakness is left in the basis of our society by the absence of peasantry and of peasant blood--weakness only to be compensated by a strenuous cultivation, to which our country people have not attained. Little work is here attempted that is beyond what should be the standard of a healthy woman's strength, while very much is declined that is unquestionably within its compass. The defects in the industrial or other work occupying our women, lie, not in the degree of force required for its accomplishment, but in the prolonged sessions during which the force must be exerted, or in the constrained positions it necessitates. Whatever posture interferes with the free return of venous blood, especially from the pelvis, is injurious to a woman. Hence, of course, long continued standing.

But, without permitting ourselves to speculate on the probabilities of over-work among the mass of women, and confining ourselves to our personal statistics, we find that on the one hand a certain number (32, or 44⅓ per cent.) acquired menstrual pain without losing good general health, which is contrary to the series of pathological processes above detailed; and on the other hand, that among those in whom menstruation became painful, the number engaged in fixed employment was decidedly less than the number having no employment at all (31 per cent. against 52 per cent. unmarried, p. 61). Of course in the latter cases, the question of methods of work or over-work do not come up. What circumstances should make so large a proportion of persons suffer during a

[1] "Mighty daughters of the plough,
Stronger than men."

menstruation, who had not been predisposed to such suffering by congenital or hereditary conditions?

Since menstrual pain, at least of the character, duration and intensity that we are now considering, is so frequent a symptom of deterioration of general health from any cause, and since in the wear and tear of existence, women as well as men are exposed to the trials, moral and physical, whose repetition is destined to ultimately exhaust the sum of vital resistance, it is to be expected that its occurrence would often have no more special significance than the occurrence of dyspepsia or headache in either sex. But in addition there is one special condition represented in our tables, namely, celibacy. By reference to the tables, it will be seen that the proportion of married women who learned to suffer at menstruation was 11 per cent., while that of unmarried was 84 per cent. (p. 125.) The influence of celibacy is of the utmost importance in estimating the health of adult women, especially in the upper classes, but this influence, which has been frequently signalized by gynecologists, is very much neglected by hygienists and sociologists. The influence works in three directions.

1. In all the social classes in which marriage is considered the only possible or at least the only desirable career for women, no other resources are accumulated, and celibacy implies a social failure, for which exists hardly a pretext of compensation. This is all the more depressing to women on account of their habitual dependence upon social opinion, and slender habits of personal resource. To this general cause of depression must often be added the personal disappointments which may have been the proximate cause of celibacy. Depressing moral emotions always *tend* to interfere with the nutrition of the nerve centres that constitute the organs of thought,[1] and thence secondarily of other centres, and of the blood.

[1] We could allege many instances of this. See Tuke, Influence of Mind on Body.

2. The rhythmic waves of nutrition which, in the non-pregnant woman, rise and fall in monthly periods, are destined by the necessities of reproduction, to be interrupted from time to time, and be replaced by the longer system and more powerful nutritive wave of pregnancy.

In a normal pregnancy, this follows precisely the type of the mensual waves, that is, it starts from a minimum point, both in the nutrition of the embryo and of the mother, immediately after conception, and rises to a maximum just before parturition. We have seen that at this time the assimilable blood plasma is the most abundant relative to the corpuscles,[1] the vascular tension, the highest, the excretion of urea most abundant, muscular force alone is diminished,[2] as if by experimental magnifying of the minute diminutions effected for menstruation. In pregnancy therefore holds true, and on a larger and more important scale, the remark we have made in regard to the nutritive wave preparatory to menstruation, namely, that its effects transcend the limits of the supplemental nutrition, and are experienced by the individual tissues of the mother. The reverse may be true of course, and after a certain number of pregnancies, the reproductive wave is liable to be maintained only at the expense of the maternal

[1] Whence their relative diminution.

[2] This is not the place to show as we think might be done, that a large amount at least of apparent intellectual inferiority in women is due to deficiency of muscular tonicity. Without this, there is none of the feeling of elasticity and enterprise that is as requisite, nay more so, to pursue a chain of thought, as to accomplish many physical actions. All intellectual actions require muscular actions for their expression. The maximum is in scientific investigations. We think it not too bold a generalization to assert, that the antagonism held by many to exist between the intellectual capacity and reproductive force in women, and which in a certain sense and to a certain extent exists, does so through the medium of the muscular system and muscular energy. Development of the latter alone, merely leads to more fertile reproduction, as in peasant women. But the systematic development of muscular force, in connection with systematic training of the nerve centres of intelligence and will, should greatly increase if not the amount of intellectual force generated, at least very largely the amount of it that is made effective.

nutrition.[1] But these cases are pathological. It is noteworthy that they are much more frequent after the multiple pregnancies of healthy women, than at the first pregnancy of a delicate one; chloro anemic girls frequently become fat, strong and rosy, during their first pregnancy, to fall into anemia again it is true, during lactation, but not unfrequently to have their health permanently improved. The reproductive force for women, as for plants, is fixed not only according to the race, but according to the individual. The power of voluntarily increasing the achievements of this force, by multiplying at will the number of pregnancies, is only apparent; for, as we have seen, if the resources of reproductive nutrition or force are exhausted, they are not regained, but eked out at the expense of the maternal organism. Conversely, the power is very limited of maintaining the nutrition of this organism, without reference to the supplemental wave of nutrition, and to the occasional stimulus of pregnancy, in view of which the entire economy has been constructed. It would seem as if in the uninterrupted recurrence of menstruation, the lesser supplemental wave of nutrition gradually encroached on the individual nutrition; precisely as, in a too frequent recurrence of pregnancies, we have seen to be the case. Our attention has been frequently called to the fact, that in unmarried women between the ages of twenty-eight and thirty-five, living apparently in the most healthy and admirable conditions, is often observed a general failure of strength without any apparent cause. Unless some special predisposition exists, no special disease is developed, (in the case we are considering,) but there is loss of flesh, of muscular strength, of mental energy, diminished appetite, pallor,

[1] Duncan shows that the mortality of the ninth childbirth rises to the level of that of the first. The physical conditions of many women at a ninth pregnancy, which favors so many accidents, uterine inertia, hemorrhage, transverse positions, septic absortion, is however often reached much earlier, even at the fourth or fifth. The essence of the condition lies in the complete exhaustion of muscular tonicity.

backache, anemic blood, often neuralgia, often dyspepsia. In these cases menstrual disturbance is often entirely absent, but at other times the milder form of spasmodic dysmenorrhea supervenes. After passing through a period of three, four or five years in this condition, the health gradually improves, with apparently as little reason as it had deteriorated. We have acquired the habit of calling these cases, "pseudo-pregnancies." They are sometimes observed much earlier, three or four years after leaving school or college, when attendance has been prolonged till twenty or twenty-one, and it is rather the fashion then, to attribute them to overwork at college. But when occurring only some time after the close of college life independent of any influence of adverse circumstances, of local disease or hereditary predisposition, we believe they are to be explained by the lack of stimulus that should be derived from reproduction.

So predominant is this necessity, that the same condition of health may be seen in the women who are married but sterile. These however, are more prone to local disease of the uterus or ovaries. While assigning to the necessity for reproduction, the predominant place in the female organism, the importance to general nutrition of the physical stimulus, derived from the exercise of the sexual functions must not certainly be overlooked.

It cannot be said, that it is overlooked by the physicians who have written on diseases of women; but many arrangements of society in modern times, seem to have been planned on the assumption of almost the complete absence of such necessity.

3. The last effect of celibacy and sterility we have to consider, is that on the uterus and ovaries. In this respect while much truth has been perceived, many exaggerations and misstatements have been uttered. Thus Barnes says, "That the activities of the ovaries, uterus, and mammary glands, are intended to periodically relieve each other by the alternations

of ovulation, pregnancy, and lactation." We have seen, however, that the development of ovules by no means necessarily ceases during pregnancy, and the activity of the mammary glands is of too short duration to require relief. The cessation of menstruation during lactation however, does preserve the uterus in a more quiescent state than when its walls are subjected to the monthly afflux of blood, even though that only passes through them, and does not accumulate there. This period of quiet, necessitated after the extra nutrition of pregnancy, is probably desirable on other grounds, as excluding for awhile the liability to stasis and congestion, into which the menstrual afflux may be converted. King's idea, already quoted, that the non-pregnant uterus begins to suffer atrophy by sclerosis, because not permitted to enter upon its functions, is unsupported by any fact. But the suggestion seems to contain the germ of an important truth that a uterus which never has been impregnated, remains permanently in a rudimentary condition relative to its type, and hence partially unfit to meet the exigencies of a period of life at which it is destined to be more highly developed.

The degree of deficiency, however, can only be slight, as may be seen by comparing with some other imaginary arrest of development, such, for instance, as should make the milk teeth persist in adult life. Nevertheless, in feeble constitutions, or under special influences, this degree may count for much. To speak precisely: we have seen that normal menstruation requires a rhythmic painless contraction of the muscular fibres of the uterine wall, by means of which the blood shall be propelled regularly towards the cavity of the uterus. If now, from imperfect vitality or regressive structure of these fibres, their contractility be deficient, the blood will accumulate in the parenchyma of the uterus, causing congestion of the body of the uterus. This disorder is certainly much more frequent in sterile women, whether married or unmarried, than any other one uterine complaint; and

admittedly more so than in women who have borne children, in whom disease of the cervix predominates.[1] Such deficient contractility of uterine fibre is the cause of that form of menstrual pain which consists in pelvic weight and heaviness. It is equivalent, in the menstrual cycle, to the uterine inertia of the parturient cycle, which is the cause of so many, and sometimes such terrific, disasters.

In addition to this deficient contractility of uterine fibre, Chapman[2] points out that from the density and resistance of the parenchyma of the nulliparous uterus, any undue accumulation of blood must cause much more irritation than in the yielding tissues of the multiparous uterus, from greater compression of nerves. Moreover, the blood is more likely to be "dammed up towards the ovaries," and so call into fiendish activity the normally obtuse sensibility of these organs. If, under these circumstances, the complete regression of the menstrual decidua be arrested, it will persist as the sensitive, hyperæmiated endometrium of endometritis. Corporeal endometritis and ovaritis are diseases again, which relatively to cervical inflammation, are admitted to be very much more frequent in sterile women than in others. Out of thirteen cases of uterine disease in nulliparous women, other than functional, or dependent on congenital predisposition or defects of structure, which have recently fallen under the writer's observation, there were nine such cases.

From this review of the possible consequences of celibacy, it must be evident that they must be taken into account in every estimate made of the working capacity of women, and that, when a woman engaged in any employment, deteriorates in her general or uterine health, it is necessary, before ascribing the breakdown to the work, to carefully eliminate the influence of this wide-spread cause of evil.

It happens, moreover, that in this country the women who

[1] Cases of subinvolution of course excepted, and results of prolapsus, etc.

[2] Diseases of Women. New York, 1874.

escape these dangers by marriage and childbearing, do not utilize their increased vitality in labor other than domestic. We have seen that one-seventh of the married women of Great Britain do work.

Fortunately in practice, and as shown by our statistics, many of the evils threatened by celibacy are never really produced, and to this, as to other conditions imposed by the social organism, the human organism shows a marvellous power of adapting itself. As already noticed, these considerations in regard to the pathological influence of sterility are of course not intended to shut out of sight the morbid conditions that may result from parturition. But these are foreign to our subject, which is confined to menstruation in women presumably healthy.

In regard to other causes of acquired menstrual pain, such as sudden suppression of the flow through exposure to cold, nervous excitement, etc., it is unnecessary to say any thing in this essay, for so much has been said elsewhere. Of course all influences capable of suddenly checking the uterine hemorrhage, can only operate during that period of the menstrual cycle. Such sudden suppression may unquestionably become the starting point of chronic uterine congestion or inflammation. But these accidents are confessedly due to causes acting suddenly, and exceptionally, to unusual emergencies, in a word. Hence again, they have little to do with the question of *habitual* occupation or work.

We have dwelt so long upon the first form of menstrual pain, that we may pass quite cursorily over the others. In regard to the second spasmodic pain of very great intensity, setting in with the first establishment of menstruation, it is certain that this depends, in the great majority of cases, upon local anatomical conditions, interfering with the egress of blood from the uterus. These are well known to be, stricture of the os flexion, deformity of the cervix. *They nearly always imply a defective development of the organs of*

generation, except in a few cases where a local peritonitis, preceding menstruation, has caused flexion by means of uterine adhesions. One of the most severe cases of primary dysmenorrhea represented on our tables, is that of a young German servant, in whom this accident had occurred. Out of six cases of stricture of the os without flexion, all nulliparous (two married and four unmarried,) women, in three the uterus measured less than six centimetres in length. In one of these cases (married and sterile), there was no pain at menstruation, *because* (probably) this was so scanty. The patient was remarkably small, the deficient development of the uterus seeming to be shared by the entire physique. In another, on the contrary, the patient was remarkably tall, but preserved a certain childishness of character and appearance. Here the development of the organs of generation had remained behind that of the rest of the body. It is well known that after menstruation has persisted during some years, while the os is contracted, congestion, inflammation, flexion, or even hypertrophy of the uterine body, is frequently induced by the violence of the repeated menstrual efforts at expulsion. Even spasmodic stricture, existing during the first years of menstruation in the neurotic cases already described, may, by inducing undue tumefaction of the endometrium, entail the results of organic stricture. The same result, from undue hyperæmia of the uterus. It is the latter condition, and that of organic stricture or of congenital flexion, which most often explain the dysmenorrhea in young girls of otherwise sound health, and who had passed a vigorous childhood, but who are too often destined to break down after puberty as miserable invalids. Unfortunately the precise cause of these anatomical deficiencies upon which such grave consequences will depend, at present escapes us, so that the prophylactic measures that might be carried out during childhood, and which are so efficacious against other

forms of dysmenorrhea, are here too often powerless.[1] [2] But these cases are very frequently cured by marriage, when conception takes place, which is by no means always hindered by the same conditions which in other cases may appear to be the sole cause of sterility. If the marriage takes place early enough, the uterus may continue to develop after it, and hence the results of its imperfect development gradually disappear. But when this does not occur, or when celibacy or sterility exclude the natural cure of the consequences of premature menstruation,[3] we still possess efficacious resources in medical and surgical treatment. The introduction of various methods for treatment of stricture and flexion that have only recently been popularized, is a fact that should radically change the lives of thousands of women.[4] Of course there are, as it is superfluous to observe in this place, many cases where such treatment is quite unavailable, but the appropriate cases are really extremely numerous, and success of treatment is often proportioned to its early date. Each such patient restored to health by a technical opera-

[1] The large proportion of cases noted in our Table of primary dysmenorrhea where the education was limited to "common English," shows that these cases abound in classes of society where the childhood is less cared for than in wealthier classes, and less nutriment provided for the growing body.

[2] Except as all measures tending to secure an equable development of the body may influence the special development of the uterus.

[3] Premature, that is, in comparison with the development of the uterus. It is very noticeable that in peasant girls, if somewhat chloro anemic and ill developed, menstruation is often delayed till eighteen or nineteen, and then sets in without pain; but in the upper classes, especially of girls living in cities, while the general nutrition of the body is still imperfect, and its development incomplete, menstruation nevertheless occurs at the usual age, but with great suffering. Here it is evident that the reproductive system is forced into a precocious development as compared to that of the individual, even although its establishment appears to be at the most normal time. Hence certainly many cases of organic primary dysmenorrhea.

[4] As decidedly as Donder's treatment of hypermetropia by convex glasses has changed the existence of thousands, who were formerly condemned to disappointment or misery by the vague diagnosis, "weak eyes."

tion, is a permanent witness to the folly of attempting to explain, still more to rectify, women's sufferings by sentimental and empty generalizations on the abstract nature of the female sex. It would be as rational to treat any other infirmity dependent on anatomical imperfections upon principles derived from Pascal's lofty aphorisms concerning the nature of man!

Finally for the purpose of this essay, it is most important to notice, that in this class of cases, rest during menstruation is generally necessitated, and the patient has no choice in the matter. But on the other hand, that such rest has no influence in preventing a recurrence of pain, or the development of the usual train of morbid symptoms. All that can be said is, that uterine congestion may be aggravated by exertion, and this consequently is to be avoided. The patient is not a type of a menstruating woman, but a sick person, and to be treated, when possible, accordingly.

Referring now to the sixth proposition on p. 193, we encounter a third class of cases, of much deeper pathological significance. In these, premenstrual pain exists, and the menstrual pain is burning, not cramp like. In such persons it is certain that the hyperæmia of the uterine ovarian plexus, demonstrated to precede menstruation, is either excessive, or the innervation of uterus and ovaries so perverted that even the normal afflux of blood and increased rapidity of circulation causes irritation instead of the normal stimulus; or the assimilated capacity of their tissue elements is so depressed, that these are unable to appropriate increased nutriment offered by the increased blood supply, and hence here as elsewhere, increased blood pressure, unaccompanied by increased nutritive or functional activity of the tissues in which it exists, causes pain. We have already noticed some of the results, if the motor force, the contractility of the uterine fibres, fail to be temporarily increased by the temporary increase in the energy of their circulation. If the

deficiency be carried farther than in the first class of cases, blood accumulates in the uterine walls instead of being propelled towards the surface of the mucous membrane, hence a real congestion, instead of the superficial hyperæmia which is normal. According to the intensity with which these causes operate, we have all degrees of morbid states, from simple congestion to chronic metritis, endometritis, ovaritis.

The intermenstrual pain, beginning two weeks before the menstrual period, has been associated by many with the commencement of periodical ovulation. It seems indeed probable that wherever the parenchyma of the ovary is morbidly hyperæmiated, as in this class of cases, that the ripening of the Graafian follicle would have the same effect as the growth of the tooth follicle in a hyperæmiated gum. Although we cannot admit pressure upon the peritoneum, yet pressure upon the stroma, perhaps from over distension by an excess of Liquor folliculi or undue prolongation of the period preceding the rupture, is theoretically capable of inducing such irritation. The analogy between the tooth follicles and the Graafian follicles is great, and the irritation that may be produced coincidently with their development on the nervous systems of the woman and of the child, offer many points of resemblance.

From what we have said before, it is evident that we do not admit a precise coincidence between this special time of the intermenstrual period, and the maturation of any one Graafian vesicle as often as has been supposed. But from the evidence before us, it seems at least not improbable, that in certain individuals this coincidence is exact, and that this peculiar premenstrual pain depends not only on the utero ovarian hyperæmia, (morbidly converted into congestion) but also on morbid development of an ovule.

All these symptoms indicate utero-ovarian disease of very varying degrees of severity, but all requiring treatment. It is in these cases that rest is most imperatively needed, precisely because it is most apt to be neglected in all cases where

the pain is not extremely severe. It must never be forgotten, that the significance of menstrual pain is less in proportion to its degree, than to its kind, its duration, and its correspondence with certain stages of the menstrual process. Six hours' violent cramp, if unconnected with organic defect of the uterus, is of less importance than moderate endurable pain, which begins a week before the menstrual flow, continues throughout it, and leaves the patient for several days bruised and fatigued. This latter indicates nutritive disease, although possibly of a low grade.

There is another form of premenstrual suffering that is entirely different from the above described. It consists, not in a local pain, but in general uneasiness, excitability, often headache, dyspepsia, or even fever. These symptoms depend upon the increased vascular tension, and increased blood pressure upon nerve centres possessing deficient powers of resistance.

These effects of the general rise of the vascular tension resemble the local phenomena previously described as dependent on the local rise of tension in the blood vessels of the pelvis. They are identical with the symptoms observed in many cases of amenorrhea, where the supplemental wave of nutrition seems to rise high enough to increase the general vascular tension, but not enough to rupture the uterine blood vessels; or where this is rendered impossible by deficient development, or deficient fatty degeneration of the menstrual decidua. Two of our cases of prolonged amenorrhea showed the effects of blood pressure on nerve centres, excessive relatively to their power of resistance, in a very marked manner. In one of these cases, the girl had suffered from severe chorea every summer for three years in succession, from the age of thirteen to sixteen. She menstruated from fourteen to fifteen, afterwards once at eighteen, then not again, except once while under treatment, until twenty-two. She was neurotic, and extremely fat, with the anemia characteristic of fat girls. So long as menstruation was not

established, she suffered extremely from tympanites of the bowels, rapidly developed after eating. After some entirely unsuccessful treatment, including electrical applications, leeches were applied once a month to the cervix uteri. On each occasion, for three months in succession, the bleeding from the leech bites ceased in a few hours, to be followed in two or three days by a regular hemorrhage. From the first occasion on which this occurred, the tympanites ceased, and the superfluous fat began to rapidly diminish.

In another case, where menstruation was regular, the patient had also suffered from chorea, indeed from the age of ten to that of fourteen without interruption. For ten days before menstruation she habitually suffered from tympanites, headache, flushes, ringing in the ears, etc. As soon as the flow set in, all unpleasant symptoms disappeared, and she felt extremely well. She had no trace of utero ovarian disease, but at the time the above symptoms were detailed to me, suffered from cardiac hypertrophy and double valvular disease, the result of two attacks of rheumatism. Here two conditions of distress existed, the cardiac hypertrophy, exaggerating the normal increase of tension, and the imperfect nutrition of the nerve centres, already indicated by the chorea.

On the other hand, it is in a normal, or even slightly anemic condition of the nerve centres, that an increase of health and energy is experienced during the premenstrual week. This is true, although at the same time the most complex nutritive processes are being effected in the uterus, and sometimes in the ovary also. This fact alone demonstrates that, in a complex organism, the general law of balance between functional activities of different organs does not imply that temporary increase in the nutrition of one must determine a deficiency in the nutrition of the others, sufficiently marked to be perceptible to consciousness. In certain cases of impaired nutrition of nerve centres, unaccompanied by vaso motor paresis, or, therefore, by menorrhagia

(such conditions frequently constitute the basis of hysteria), the increased feeling of energy begun during the premenstrual week is extended throughout the menstrual flow. We have related the history of one such case where this circumstance was extremely marked. The increase in mental energy in such persons is often remarkable, and offers a miniature resemblance, on account of its etiology, to certain forms of "circular insanity." For the nutrition of the brain centres is habitually below par, and their activity consequently weak; but under the increased blood pressure and rapidity of circulation of the pre-menstrual period, this is raised to normal intensity. In the pathological cases, the activity, raised above the normal point, and perverted, constitutes mania. Moreau (Psychologie morbide) relates cases, observed in both sexes, where periods of semi-idiocy regularly alternated with periods of considerable literary talent. During the first, the circulation was sluggish, during the second, accelerated.

CONCLUSIONS.

HAVING exhausted the material we have been, on this occasion, able to collect for observation or reasoning in regard to the question considered by this essay, we may now sum up the conclusions which we believe may be legitimately derived from its analysis. These conclusions may be best summarized in the form of answers to the questions propounded on pp. 193–194.

1. When pain exists from the first menstruation it depends upon: (*a*) Imperfect power of resistance in the nerve centres, which renders them unduly susceptible to the excitement of the increased vascular tension that prepares the menstrual flow. This excitement may be in itself a cause of general disturbance, or be followed by exhaustion, which is necessarily accompanied by vaso motor irritation, hence local disturbance in the circulation of the uterine walls, and consequent atonic contractions of its fibre. (*b*) Disproportion between the development of the uterus and that of the rest of the body, resulting in various organic defects of the genital canal. The proximate cause of such disproportion, in the actual state of science, often escapes us. But in a certain class of cases, there is reason to accuse a precocious completion of development of the central nervous organs, especially those of the cranial cavity,[1] and an equally precocious diminution of muscular activity. On both accounts the moment is early attained at which the muscles assume the habit of rejecting a certain proportion of nutriment, in order to

[1] We follow Brown-Sequard in using this expression instead of the collective term brain.

provide for the development of the supplemental wave. Individual nutrition is arrested, reproductive nutrition commences before the organs of the individual have been properly elaborated, and before the organs of reproduction have been sufficiently developed. Hence a double cause of disorder and suffering, whose frequence is in direct proportion to the prevalence of habits of luxury and of purely ornamental education.[1] (*c*) Menstrual pain on the contrary is *acquired* either by the acquisition of the states of imperfect nutrition, which in the first cases are congenital or developed during childhood; or by the continual aggravation of the effects of the local organic imperfections, whose influence was at first slight; or finally in consequence of organic utero ovarian disease. The first and third cases may result from various accidents common to the genesis of any disease in either sex; but also from two causes, very much more frequently operative in women than men, namely, ill-arranged work and celibacy; finally from a third class of causes, necessarily peculiar to women, sudden suppression of menstrual hemorrhage, or the accidents of pregnancy and parturition. These last again are not in equal relation to all forms of menstrual pain, or uterine disorder that may have existed before marriage; their liability is very much increased, in any case where the contractility of uterine fibre has become deficient or exhausted during repeated menstruations. It is true, therefore, to say, that in certain cases, prolonged celibacy or sterility, has been the real cause of the accidents of parturition, and that the physiological necessity for reproduction, existing to a greater or less extent in all women, is very much more imperious and earlier imposed in some women than in others.[2]

[1] All authors agree on the evils of premature menstruation, but we have not seen these connected in the above manner with the genesis of neurotic disorder, and of organic uterine disease.

[2] It is infinitely probable that the *time* at which this necessity is first felt by the organism (if we may so speak) is very much modified, as are all circumstances

2. When persons in good health suffer *severe* menstrual pain, this is nearly always dependent upon some anatomical imperfection of the uterus. Like many other congenital imperfections, this may originally appear a mere trifle in the sum of organic development, yet from the peculiar circumstances of the case, its results may assume gigantic proportions.

When persons in delicate health are free from menstrual distress, it is because the supplemental wave of nutrition does not rise sufficiently to greatly increase general vascular tension, or because the uterus is too slightly hyperæmiated to excite reaction. We believe we have observed, though as yet have no statistics to prove it, that the chlorotic or consumptive girls who have suffered pain before marriage, sustain their first pregnancy better, or are even improved by it more, than those in whom, with equally low individual nutrition, the supplemental wave had been too defective to cause irritation.

3. That 46 per cent. of the women we have examined suffer more or less disturbance at menstruation, is a fact certainly connected with the habits of civilized life and the very slender provision made for the physical education of girls, especially for the development of their muscular nutrition. No anatomical or physiological condition revealed to us by the impartial analysis of the series of phenomena constituting the entire menstrual process, is necessarily productive of suffering. On the contrary, we discover in these rhythmic waves of nutrition, as in the larger waves of gestation, remarkable provisions for rhythmically (we cannot say *periodically*) increasing nutrition and the vital energy of the woman. These provisions should serve to compensate for the deficiency in the stimulus afforded by muscular activity.

of reproduction, by the social medium. For the age of marriage is constantly receding, or at all events, marriages formerly called "late" are becoming more and more frequent.

The social perversions, by which these processes so often deteriorate what they are naturally adapted to improve, are: Bad physical education during childhood and adolescence;[1] absence of employment, or work that is either absolutely excessive or excessive relative to woman's constitution, by being prolonged too much during a single session, or else which is insufficiently relieved by recreation or insufficiently spurred by interest; unduly prolonged celibacy, and unequal distribution of reproduction, on account of which many women are broken down by excessive child-bearing, while many others never obtain the opportunity to bear a single child, for which, nevertheless, every fibre of their physical and moral being is yearning.

4. The danger of disregarding menstrual pain when it exists, varies with its proximate causes. Purely spasmodic pain of moderate intensity, may be, and certainly is, tolerated in an immense majority of cases, far better while the ordinary occupations are continued. The tables show this. Pain from organic defect, or from local nutritive disorder (congestion, inflammation), should, wherever it be possible, claim rest; but this will not cure the pain, unless special treatment be instituted. The only cases where rest really cures or prevents menstrual pain, are those where general debility is so marked that the loss of blood at menstruation is sufficient to lower the nutrition of the nerve centres below the level to which they are capable of generating force with ease. In such case, any expenditure of force weakens them still further, and vaso motor irritation and uterine cramps are the result. Such persons may feel perfectly comfortable during the menstrual flow, while inactive, but excitement or exertion of body or mind brings on pain. In them the supplemental wave of nutrition has been insufficient, yet the hemorrhage,

[1] It is curious to notice how the effects of misery, and the effects of luxury, during the childhood of a girl, are found so often to result in an identical mode of stunted development in adolescence.

once commenced, is continued by habit and relaxation of tissues; the deficiency is supplied from the blood needed for the individual nutrition.

5. The fifth question is answered by all that precedes, and especially by the last paragraph. *There is nothing in the nature of menstruation to imply the necessity, or even the desirability, of rest, for women whose nutrition is really normal.* The habit of periodical rest, in them, might indeed easily become injurious, because in the cessation of nervo muscular activity, the blood properly attracted to the muscles and nerve centres would be diverted from them, and tend towards the pelvis, increasing its hyperæmia above the physiological standard. Many cases of pelvic congestion, developed in healthy but indolent and luxurious women, are often due to no other cause.

The reasoning which would attempt to show the existence during the menstrual flow of a cerebro-spinal excitement, determined by "ovarian irritation," incompatible with cerebro-spinal activity, is entirely fallacious, and based on false analogies, especially with those of the rut. The menstrual flow is the least important part of the menstrual process, and arguments for rest drawn from the complexity of the physiological phenomena involved in this, should logically demand rest for women during at least twenty days out of the twenty-eight or thirty. In other words, should consign them to the inactivity of a Turkish harem, where indeed, anemia, if not dysmenorrhea is said to be extremely frequent.

In the line of thought pursued throughout this essay, the writer has held in view the demands for exertion made by industrial labor, or by any such employments, as clerkships, or teaching in average schools, as cannot be considered to involve any decided *mental* labor. Indeed, if the question proposed by the committee be regarded merely from the point of view of the statistics of the census, we might be surprised that the clause relating to *mental* rest had been

inserted. This clause is evidently intended to cover the position of women in school or college, in the professions, finally in any pursuit of independent responsibility, where at any moment may be required the exertion of independent judgment, thought, and will. The clause may indeed be intended to meet either negatively or affirmatively, a rather widely diffused sentiment in regard to women's capacity for such independent responsibilities. The habitual modesty of American speech often enforces silence in regard to the fact upon which this sentiment is supposed to be based, but from time to time the silence is broken, and it is plumply asserted, that "during the temporary insanity of menstruation,"[1] female judgment is unreliable, even unsafe, because no form of mental action can be adequately carried on at this time. It must follow, therefore, that no duties as those of law or medicine for instance, for whose fulfillment the woman is liable to be called upon during this critical period, should ever be assumed by her. Justice to the public, if not to herself, demands that she should be peremptorily excluded from such responsible fields of action, even when her own ill-starred ambition may lead her to invade them. Among all the facts we have examined, there is but one group that might seem to justify the theory, that *mental* rest was imperative for women in menstruation, whatever might be the case with physical. We have seen that alterations of pressure exerted in the brain, by varying degrees of vascular tension, may cause the most extraordinary alterations in its functional activity and capacity for function, and a cardinal point in this essay has been the attempt to show that in women exist certain fixed alterations of vascular tension, over and above those common to the physiological processes of the two sexes. But; 1st. These alterations succeed each other so gradually that the brain sustains no shock for them. 2d. The rise in tension, which presumably should affect the brain, does *not* occur

[1] See our former quotations.

during the menstrual hemorrhage, which is the single period covered by the question of the committee. 3d. Granted that the brain is stimulated by increased vascular tension, it is certain that when any habit of susceptibility has once been established, it counts in the ordinary working of the organ. 4th. The reactions of the brain to alterations of blood pressure are proportionate not only to them, but to the degree of resistance of its own tissues. Our statistics show that 53 per cent. out of two hundred and sixty-three women interrogated at hazard, exhibit such a degree of resistance in their nerve tissues as to enable them to bear with impunity the increased vascular tension of the premenstrual week. It is equally certain, however, that the reverse holds in a large number of cases, though by no means in the 46 per cent. of our tables. It is when the nutrition, and hence the vital resistance of the nerve centres has been diminished, that the rise in tension irritates nerve elements, and all degrees of nervous erethism may be produced, from ill temper to insanity. Berthier[1] (already referred to) has collected a large number of cases where the approach of menstruation was heralded by various forms of neurotic disorders—excitement, epilepsy, hysteria, mania. But his list is burdened with many cases, quite irrelevant, where the outbreak of the nervous disease coincided with a suppression of menstruation, and hence was due, either to the abrupt pathological increase of vascular tension (where the suppression was sudden), or to the same disorder of nutrition as had caused the amenorrhea (in gradual cases). Similarly, all treatises on nervous or mental disorders are crowded with cases showing that the menstrual periods are frequently preceded by exacerbations of the disease. We have, however, deemed it quite unnecessary for our purpose to pass these cases in review. However numerous, or however fantastic or various in character, they all serve to illustrate only one fact, namely, that, when

[1] Neuroses Menstruelles.

the nutrition of the brain centres is weakened, increase of blood pressure will cause various degrees of irritation of the elements of which their tissues are composed. These pathological causes are of no value for our purpose, except as indicating the rhythmic increase of vascular tension upon which we have insisted; and they do not in the least show that menstruation, *per se*, constitutes any temporary predisposition to either hysteria or insanity. 5. The real predisposition to all the grand neuroses lies, not in the peripheric conditions that may become exciting causes of their development, but in the original structure of the central nervous organs, without which these peripheric irritations could have no effect. From what we have said of the peculiar mode of nutrition that obtains in the female economy, it becomes evident why women are so very much more frequently hysterical. If the physiological denutrition of the muscles be extended to the nerve centres, we have the atonic hysteria of towns; if the supplemental wave of nutrition be formed at the expense of the nerve centres instead of the muscles, we have the muscular hysteria of peasants. It is indeed primarily owing to the necessities of reproductive nutrition that women are more liable to hysteria, and to anemia than men. But until the anatomical basis of these diseases shall have been raised, the "reproductive demand" can only be considered a "cause" of them, in the same sense in which birth may be said to cause death. In a word, whenever women exhibit mental irritability and consequent weakness, at or before menstruation, it is a proof that the resistance of their nerve centres is weakened below the normal standard, sometimes congenitally and by inheritance. If the impairment be sufficiently extensive, mental action will be rendered unreliable, and the woman be subjected, therefore, to periods of temporary incapacity, of varying degrees. In certain such cases, the attempt to force mental action would interfere still further with the nutrition of nerve tissues, and

hence aggravate the original difficulty. In these cases *rest is desirable during whatever period of the month the nervous excitement may be experienced;* but this will be more frequently through the two or three days preceding the hemorrhage, than at the time of the flow. In slighter cases, rest is unnecessary; in those more severe, it is in itself useless, *i. e.*, other measures must be taken in order to cure the disease. In those cases of congenital hysteria where a cure cannot be effected, it is evident that the women *are* permanently unfit to bear severe responsibilities, or to undergo mental strain. Of their mental action it must be said, as we have said in regard to muscular action in weak subjects, that at any time it tends to exhaust the small reserve of force accumulated by the feeble nutritive capacity of the tissues. Thus, if beyond the individual capacity at an intermenstrual period, it will inflict an injury that cannot be repaired by rest during menstruation.

In regard to women other than those considered in the above classes, we can find no reason to suppose that menstrual rest is desirable or necessary. Wherever it *is* so, it will be taken, *i. e.*, no really *mental* work will ever be performed at a time that the brain is really unable to perform it. Whatever *is* done at such times, should be classed with work involving muscular effort and the strain of fixed attention. It is, therefore, only in regard to school girls and young persons, called upon to perform mental work to order, (*i. e.* without spontaneity) that the question really practically applies. To these must be applied all that has been said in the foregoing paragraph, with one addition, that in adolescence, and during the first years that the reproductive wave of nutrition is being formed, mental work exacted *in excess of the capacity of the individual*, may seriously derange the nutrition. In grading the work therefore, it must be proportioned; 1st. To the conscious ease with which it can be performed. 2d. To the duration of the separate sessions of study. 3d.

To the known standard of nutrition of the nerve centres, in the individual case, especially as measured by predisposition to hysteria, chorea, insanity or consumption. 4th. To the coincident maintenance of proper hygienic conditions, especially in regard to food, air and exercise. The regulations for menstruation, as said, to be entirely individual, and in accordance with what has been detailed in speaking of the mental work of adult women.

Any modifications which may be demanded in female labor (modifications unnecessary in multitudes of individual cases, but desirable for the mass) are in relation, not with the menstrual flow, nor with "nervous excitability" which may be occasioned by it in pathological cases, but with the nutritive provision for reproduction, of which the flow is only one indication. *It is to the development of a supplemental wave of nutrition, and the manner in which it intersects the waves of individual nutrition*, that are due most of the peculiarities of the female organism and of its activity, and not the mere existence of reproductive organs. For theoretical reasons exposed in detail, and from the results of observation, we are authorized in asserting that women do work better, and with much greater safety to health when their work is frequently intermitted; but that those intermittences should be at short intervals and lasting a short time, not at long intervals and lasting longer.

Finally, that they are required at all times, and have no special reference to the period of the menstrual flow.

It remains true, however, that in our existing social conditions, 46 per cent. of women suffer more or less at menstruation, and for a large number of these when engaged in industrial pursuits or others, under the command of an employer, humanity dictates that rest from work during the period of pain be afforded whenever practicable.