relations of the contractor to both the producer and consumer are well portrayed, and the many and almost insurmountable problems of bringing milk to the doors of the consumers in as pure a state, and as quickly as possible, without prohibitive cost, are clearly presented and discussed from every possible angle. The pages in the last chapter on municipal and state control of milk production and distribution, with types of ordinances as examples, should be of much interest to health officers and milk inspectors. The practical application of scientific principles to milk production, and the different bacteriological and chemical methods and standards for controlling the purity of milk, receive their due share of attention. The book concludes with a discussion of infant mortality.

It is unfortunate that grammatical errors should have been allowed to creep into the book here and there, as for example the following: "Enough data *has* been collected" (page 180), and "the relations between the farmer and city milkman *is* delicate"; and in the use of scientific names, as for instance in "streptococci, staphylococci and *bacteria* were found." A very common error in punctuation is the absence of the comma between the principal parts of a compound sentence, especially where the conjunctive "but" is used. These are, however, but minor defects which will undoubtedly be eliminated from future editions.

The author does not claim originality, but as he states, has drawn from a wide field of experience of others, experts in their own domain, who have been given full credit, and to whose work references are given at the end of the individual chapters. Throughout the book original tables and illustrations materially add to its value.

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SPECIAL ARTICLES

CORPUS LUTEUM AND THE PERIODICITY IN THE SEXUAL CYCLE

IN a recent paper G. W. Corner and F. H. Hurni report on experiments in which they injected intraperitoneally rats with suspensions of corpus luteum preparations.[1] In all but one animal the substance prepared by Armour & Company was used.

While Corner and Hurni find that such injections may cause peritoneal adhesions and peritonitis, they failed to inhibit ovulation. So far the experiments of these authors are essentially in agreement with the results not mentioned by Corner and Hurni which I previously obtained in guinea-pigs.[2] I stated:

> While in some injected guinea-pigs ovulation was apparently delayed, in others it took place at the expected term despite the fact that these animals had repeatedly received large doses of lutein. We may therefore conclude that injections of lutein extract can not wholly take the place of the living corpus luteum. Whether or not they can do so partially in mammals, I am not prepared to say on the evidence at hand.

Some details as to doses used in these experiments are found in a paper in which in conjunction with Dr. Cora Hesselberg I reported on the effect of such injections on the cycle of the mammary gland in the guinea-pig.[3]

Our experiments on the effect of injections of corpus luteum substance had been suggested through positive results which R. Pearl and Surface had previously published concerning the retarding effect of such injections on the ovulation in birds.[4]

We emphasized the negative character of our results, because a slight delay in ovulation can be induced in the guinea-pig through various experimental interferences, and especially did we find that undernourishment prevented the normal maturation of follicles.[5]

The experiments in which ovulation oc-

[1] George W. Corner and Felix H. Hurni, *American Journal of Physiology*, 1918, XLVI., 483.

[2] Leo Loeb, "Surgery, Gynecology and Obstetrics," 1917, XXV., 300.

[3] Leo Loeb and Cora Hesselberg, *Journal Exper. Medicine*, 1917, XXV., p. 305.

[4] Raymond Pearl and F. M. Surface, *Journal Biol. Chem.*, 1914, XIX., p. 263.

[5] Leo Loeb, *Biological Bulletin*, 1917, XXXII., p. 91.

curred at the normal term, notwithstanding the injections, seemed to us therefore of greater significance. Corner and Hurni, however, go further in their conclusions and state: "Thus it would seem that Loeb's experiments do not prove an acceleration of ovulation following the removal of the corpora lutea."

This conclusion rests (1) on the lack of effect of the injection of dried corpus luteum substance in inhibiting ovulation. (2) On the alleged proof given by Stockard and Papanicolaou that I assumed the normal sexual cycle in the guinea-pig to be longer than they found it to be by a method which they believed to be superior to the one which I used.

Inasmuch as, to my knowledge, my investigations provide the essential experimental basis for the conclusion that the corpus luteum has the stated function, and that the denial of the correctness of my conclusion would invalidate the significance of the corpus luteum as an important factor in the mechanism regulating the sexual cycle, I believe it advisable to inquire whether or not the statement made by Corner and Hurni is warranted by facts.

Without going into a detailed restatement of the results which I have published in a series of preceding papers, I may give a brief summary of some of the essential results obtained. In a first series of investigations I determined the duration of the sexual cycle in guinea-pigs in which in most cases the uterus had been subjected to certain experimental interferences in the early period of the sexual cycle.[6] It was found that while in these cases the second ovulation may occur as early as 16–18 days after the first ovulation, it occurred quite commonly somewhere between the twentieth and thirtieth day after ovulation; this was found to be so, especially in cases in which through incisions made into the uterus deciduomata had been produced experimentally. In a series of guinea-pigs in which the uterus had been treated in a way similar to the control series, but in which, in addition, at an early stage of the sexual cycle the corpora lutea had been completely extirpated with a knife, ovulation occurred in the large majority of cases between the twelfth and sixteenth day after the first ovulation. A period of approximately 9 to 13 days following an ovulation is required for the new formation of mature follicles in the guinea-pig, each ovulation in the guinea-pig being accompanied by an atresia of all but the smallest follicles.[7] While this series, as such, proved the significance of the corpus luteum for the duration of the sexual cycle, the correctness of our interpretation was made certain by our further finding that while in the normal course of pregnancy ovulation does not occur in the guinea-pig, after a preceding extirpation of the corpora lutea about 6–7 days following copulation the pregnancy may proceed, but an early ovulation occurs, notwithstanding the presence of pregnancy just as it does after extirpation of the corpora lutea in the cycle unaccompanied by pregnancy. In this case the difference in the time of ovulation is so great as the result of the extirpation of the corpora lutea that an error of interpretation can be excluded with certainty.

Extirpation of the corpora lutea did not exert this effect on the sexual cycle in a purely mechanical way; excision of control pieces of ovarian tissue did not have the typical effect; neither did such cases respond in which the extirpation of the corpora lutea was incomplete. Complete extirpation of corpora lutea on the other hand exerted its effect on both ovaries, even in cases in which one of the two ovaries had been free from corpora lutea at the time of extirpation. It was probable that this inhibiting effect of the corpus luteum was due to the secretion of a substance on the part of the corpus luteum.

In further experiments I showed that the presence of the corpus luteum did not inhibit the maturation of follicles, but merely the rupture of mature follicles.

In my first publication I called attention to the possibility that the experimental interfer-

[6] Leo Loeb, *Deutsch. mediz. Wochen.*, 1911, No. 1. *Zentralblatt f. Physiol.*, 1910, XXIV., No. 6; 1911, XXV., No. 9.

[7] Leo Loeb, *Journal of Morphology*, 1911, XXII., p. 37. *Virchow's Archiv*, 1911, CCVI., 278.

ence with the uterus which was practised in these cases might somewhat modify the duration of the sexual cycle, but that if such a modification did exist, it applied equally to experiments in which the corpora lutea had been extirpated and to control cases. Therefore our conclusions concerning the inhibiting function of the corpus luteum was not affected by such an interference. However, we had intended to continue our investigation in this direction and in later determinations we found, in guinea-pigs in which the uterus had not previously been interferred with, the length of the sexual period to vary between 15 and 18 or 19 days.[8] In two cases we observed the new ovulation as early as 13½ to 14½ days after the preceding ovulation. A certain latitude exists therefore in the periodicity of the normal sexual cycle.

Again we could confirm our previous results: Excision of the corpora lutea carried out within the first week after copulation brings about a new ovulation between the tenth and fifteenth day after copulation in the majority of such cases, and we were able to observe it as early as 8½ and 9 days after copulation.

As in our previous experiments pregnancy did not prevent the early ovulation after a complete extirpation of the corpora lutea. It is only the persistence of the corpora lutea of pregnancy which prevents ovulation.

While in our previous investigations we had studied mainly the cyclic changes in the ovaries and only incidentally referred to cyclic changes, in the uterus, in the last-named paper we extended our studies to the cyclic changes in the uterus and to the correlation of the cyclic changes in the uterus and ovaries. In our determination of the sexual cycle we made use of the following criteria:

1. Whenever feasible the period of heat was observed; the behavior of the animal as well as the condition of vulva and vagina serving as indicators, which in the hands of an experienced breeder gave reliable results as the subsequent macroscopic and microscopic examination of uterus and ovaries proved in each case. In other animals the observed copulation indicated the approximate time of ovulation. We followed the cyclic changes in uterus and ovaries from day to day and could thus establish a definite and orderly sequence of events. By correlating the condition of the corpora lutea, follicles and uterine mucosa, it was possible to determine the stage of the sexual cycle of the observed guinea-pigs with a precision which was entirely adequate for our purposes. Thus to mention only one instance it was possible by microscopic examination of the uterus alone without examination of the ovaries to determine whether in an animal at an early stage of the sexual cycle ovulation had or had not taken place.

Subsequent to our last mentioned investigations, Stockard and Papanicolaou[9] published a study of the sexual cycle in the uterus of the guinea-pig, in which they used the naked eye observations of vaginal changes as a criterion of the stage of the sexual cycle. These investigators confirmed in all essential points our previous results, though they do not mention our principal paper in which we gave a detailed description of the uterine cyclic changes in the guinea-pig. This omission, Dr. Stockard informed me later, was due to his failure to read my paper.

The difference in the duration of the sexual cycle in our first and second series of experiments led to a further elucidation of the factors on which the mechanism of the sexual cycle depends. We found that the presence of experimentally produced deciduomata without accompanying pregnancy prolongs the duration of the sexual cycle, but only in cases in which the corpora lutea are present. After extirpation of the corpora lutea an accelerated ovulation takes place notwithstanding the presence of living deciduomata; the deciduomata act, therefore, in a way similar to pregnancy. We found furthermore that after degeneration of the deciduomata ovulation occurs. We may therefore conclude that living deciduomata probably prolong the life of the corpora lutea and that this effect leads to a

[8] Leo Loeb, *Biological Bulletin*, 1914, XXVII., p. 1.

[9] Charles R. Stockard and G. N. Papanicolaou, *Am. Jour. Anatomy*, 1917, XXII., p. 225.

prolongation of the sexual cycle. It may be that also in pregnancy the decidua may contribute directly to the prolonged life of the corpora lutea and thus indirectly be responsible for the lack of ovulation during the period of gestation. We found further that during pregnancy the life of experimental deciduomata is prolonged very considerably, and we may provisionally assume that directly or indirectly the presence of an embryo is responsible for the preservation of deciduomata during pregnancy. It accords with these observations that in a case of experimentally produced extrauterine pregnancy in which a living embryo, but no decidua was present, we did not find the life of the corpus luteum prolonged, and consequently an ovulation had taken place despite the presence of a living embryo.[10] In a provisional way we may therefore assume that the life of the corpus luteum, which is one of the determiners of the duration of the sexual cycle, depends among other factors upon the life of the deciduomata or decidua and that the latter depends upon the existence of a living embryo. We have carried out a series of experiments concerning this question several years ago, but stress of other work has so far prevented a detailed study of our results. However, we referred to them in a preliminary way in a recent communication dealing with those problems.

We have now to consider briefly the reason why it is that while we can consider as firmly established the significance of the corpus luteum for the sexual cycle, injections of dried corpus luteum substance are without a decided effect on ovulation, and likewise without effect on the growth of the mammary gland in the guinea-pig, as we established more recently. We can not answer this question definitely at the present time, but we can at least consider certain possibilities and refer to some interesting analogies. It might be that the isolated lipoid extract of the corpus luteum would have been active where we established the lack of efficiency in dried gland from which, as was the case in Armour's preparation, the lipoids had been previously removed. This would be in accordance with the observation made by several investigators who found that injection of lipoid extracts of corpus luteum or placenta causes growth processes in the uterus and mammary gland. However, these induced growth processes are evidently not identical with the cyclic changes normally taking place in these organs. Or it might be that the process of drying destroyed the active principle. Thus we know that while suspension of living cells when injected produce immunity against tumor growth in the mouse, cells which have been previously treated in a way similar to the treatment accorded to the corpus luteum and thus killed, have completely lost their efficiency. We know furthermore, that the antigens against mouse tumors are species specific; on the whole only tissues of the mouse are able to immunize against mouse tumors; tissues of the cow for instance being completely inert. We can not therefore exclude the possibility that extracts prepared from homologous corpora lutea might have been more efficient than those from the cow.

There remains a last possibility which I suggested a number of years ago when I found that a substance given off by the corpus luteum is one of the factors of significance in initiating the decidual reaction and the development of deciduomata in the uterus. At that time I tried to imitate the effect of the corpus luteum on the mucosa of the uterus through implantation of living young corpora lutea obtained from other guinea-pigs in the appropriate stage of the sexual cycle. The implantation of this substance gave either entirely negative results or at least its effects were very weak. I then pointed out that the corpus luteum functions by giving off a small amount of substance continuously during a relatively long period of time, while injection or implantation of corpus luteum substance leads only to the temporary introduction of a larger quantity which is probably rapidly absorbed and eliminated or destroyed, and that it is impossible to imitate in this way the action which takes place in nature.

While we can not be certain at the present

[10] Leo Loeb, *Biological Bulletin*, 1915, XXVIII., p. 59.

time as to which of these explanations will prove to be the correct one, we can at least be certain that the living corpus luteum has the function of inhibiting ovulation and of being a decisive factor in the mechanism of the sexual cycle.

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THE OHIO ACADEMY OF SCIENCE

THE twenty-eighth annual meeting of the Ohio Academy of Science was held at Ohio State University, Columbus, May 30 to June 1, 1918, under the presidency of Professor Francis L. Landacre. Forty-seven members were registered as in attendance; ten new members were elected.

It was reported by the trustees that Mr. Emerson McMillin, of New York City, had again contributed two hundred and fifty dollars to the research fund of the academy.

War conditions were noticeable in a somewhat reduced attendance, as well as in a suggestion of the trustees that a part of the research fund be invested in Liberty Bonds—a suggestion enthusiastically endorsed by the academy.

The following resolution was also adopted, relative to the study of German in the colleges:

The Ohio Academy of Science places itself on record as deprecating the suppression of the study of the German language in the curricula of some of our colleges.

The study of German should be continued not only by reason of its direct utility to our troops abroad, but also because it is fundamentally necessary to science and productive scholarship.

It is not the language, but Prussian ideas, which are antagonistic to the Allied nations; and any action which prevents the efficient development of scholarship and science, and of the industries dependent upon them, will prove advantageous to our enemies.

After adjournment of the formal sessions, the botanists and zoologists made a short auto excursion to the picturesque and ecologically interesting Sugar Grove region, and the geologists took a longer trip for the study of the rock series (Niagara to Carboniferous) and topography between Hillsboro and the Scioto River. Both excursions were eminently successful.

Officers were elected as follows: *President,* M. M. Metcalf, Oberlin College. *Vice-presidents:* Zoology, R. A. Budington, Oberlin College; Botany, C. E. O'Neal, Ohio Wesleyan University; Geology, G. F. Lamb, Mt. Union College; Physics, S. R. Williams, Oberlin College; Medical Sciences, Ernest Scott, Ohio State University. *Secretary,* E. L. Rice, Ohio Wesleyan University. *Treasurer,* J. S. Hine, Ohio State University.

The scientific program was as follows:

PRESIDENTIAL ADDRESS

The origin of the cerebral ganglia of the vertebrates: PROFESSOR F. L. LANDACRE, Ohio State University.

SYMPOSIUM ON SCIENCE AND THE WAR

The work of the ground schools in the training of the air forces of the United States: PROFESSOR F. C. BLAKE, Ohio State University.

Modern methods of plant disease control: PROFESSOR W. G. STOVER, Ohio State University.

Psychological tests in the army: CAPTAIN GEORGE F. ARPS, Ohio State University.

Methods of teaching the theory of flight in schools of aeronautics: PROFESSOR H. C. LORD, Ohio State University.

Topography and the war on the western front: PROFESSOR T. M. HILLS, Ohio State University.

The newer demands on physics and physics teachers due to the war: PROFESSOR E. H. JOHNSON, Kenyon College.

PAPERS

A peculiar habit of the rusty grackle: EDWARD L. RICE.

Notes on distribution of North Atlantic Bryozoa: RAYMOND C. OSBURN.

Economic value of the Ephemerida: CHAS. P. FOX.

Remarks on leaf hoppers of Hawaiian Islands: HERBERT OSBORN.

The fauna of a series of rock-bottomed ponds: F. H. KRECKER.

The habits of the folding-door spiders: W. M. BARROWS.

The subterranean life of meadows and pastures: HERBERT OSBORN.

Opalina and the origin of the Ciliata: MAYNARD M. METCALF.

The bryozoan gizzard: RAYMOND C. OSBURN.

Free-swimming larval colonies of Pectinatella from Black Channel, Cedar Point: STEPHEN R. WILLIAMS.

Anatomy of Echinorhynchus sp.: C. F. MCKHANN, JR., introduced by STEPHEN R. WILLIAMS.

The effect of certain ductless gland extracts on plant tissues: R. A. BUDINGTON.

Our knowledge of Ohio Crustacea: RAYMOND C. OSBURN.