

Sex-Physiology of Sheep.

Studies on the Nature of the Onset of Oestrus in Ewes Following a Period of Sexual Inactivity.

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THE work already published on sex-physiology of sheep in South Africa was carried out for the most part at four centres: Middelburg, Cape Province; Ermelo, Transvaal; Onderstepoort, Transvaal; and Bestersput, Free State. The environmental conditions prevailing at each of these centres differ considerably. During these studies it became apparent that Merino sheep maintained under different environmental conditions did not always show the same sexual behaviour. Quinlan and Maré (1931), working at Middelburg, Cape Province, during a season when the veld nutrition was above the average, showed that the duration of oestrus in Merino sheep was approximately 40 hours, but that it may be as short as 24 hours and as long as 96 hours. Ovulation took place between the 36th to the 40th hour following the onset of oestrus. Previous studies by Küpfer (1928) in the Free State, indicated that oestrus in the Merino sheep is a seasonal occurrence, commencing in January and ending in June or July. The work done by Quinlan and Maré (1931) did not corroborate this view, but it must be pointed out that their observations were conducted in a different environment. Quinlan and Maré (1931) state: "There is no doubt that Merino sheep in South Africa continue to show oestrus at fairly regular intervals throughout the year, as is the case under European conditions, provided the condition is maintained by suitable nourishment. In South Africa the changeable climatic conditions and their relation to the pasturage are factors which govern the cyclical ovarian changes in the ewe". Küpfer (1928) showed that the oestrous period of Merino sheep at Bestersput, Free State, lasted two days: On the third day the symptoms had disappeared. He found the interoestrous period to be about 18 days.

In view of the fact that shorter oestrous periods (Engela 1940), than those recorded above, have been observed in South Africa, it is well to point out that Quinlan, Maré and Roux (1932) have mated

Merino sheep normally up to 45 hours after the onset of oestrus, thus confirming their previous work under similar environmental conditions. Roux (1936) made observations on Merino sheep at Ermelo, Transvaal, and showed that the duration of oestrus was thirty hours, with a mode of thirty to thirty-two hours. The duration of the oestrous cycle was 16·8 days, with a range of 12·5 to 18·4 days. The sexual activity was seasonal, extending from February to August. Marais (1936), working at Onderstepoort, Transvaal, with sheep in "dry lot", reported that the duration of oestrus in Merino sheep was 17·45 days, with a range of 15 to 24 days. The average duration of oestrus was 39·8 hours. He states that oestrous periods of under sixteen hours are not frequently observed; theoretically not more often than in 0·025 per cent. of cases.

Since the publication of Roux's work observations on sex-physiology of sheep have been continuously conducted at the Ermelo, Middelburg, and Onderstepoort stations, and it is quite evident that there is a period of low sexual activity in Merino sheep throughout the country. Its intensity and duration, however, appear, to a large extent, to be governed by local environmental conditions, of which the nature of nutrition appears to play an important rôle. McKenzie and Terrill (1937) have recorded that the first and last oestrous periods of the breeding season are shortest, and are usually preceded or followed by one or more ovulations unaccompanied by oestrus. The ovulation rate at these "Semi-estrual" periods is lower than during the corresponding portions of the breeding season.

There is no doubt that physiological sexual activity rendered quiescent during the period of anoestrus is not only influenced by the nature of the nutrition, but that other environmental agencies act concurrently. It has been observed that sheep transferred from Europe to South Africa usually have a period of anoestrus, but they adopt the sexual behaviour of acclimatised sheep of the same breed during the following breeding season. Marshall (1937) has also recorded this sexual acclimatisation in ewes taken across the equator to the Southern Hemisphere. He states that the gonadal endocrine rhythm of the higher animals is readily altered by exteroceptive stimuli or other environmental influences, and even to such an extent that the individuals of a species may have two breeding seasons in one year, when they normally would have only one. He believes the climatic sexual adjustment is due to environmental influences on the hypothalamohypophysial mechanism.

An intensive study has been made on the sex-physiology of various breeds of sheep and their crosses at Middelburg, Cape, of Merinos at Ermelo, Transvaal, and at Onderstepoort, Transvaal, during the past four years. The results, not yet published, indicate that sexual activity is at its lowest during the last three months of each year. In fact there are years during which there may be almost complete absence of sexual activity during October, November, and December on the high veld of the Transvaal. It may be taken that this is the normal condition in Merino sheep, although it appears that when the nutritional content of the veld ration is high the anoestrous period is shorter and the sheep begin to show sexual activity in December.

Working with Merino sheep under "dry-lot" conditions at Onderstepoort, from the 20th November 1939 to the 20th December 1939, the authors have observed 65 oestrous periods in 47 sheep out of a group of 99 (47.47 per cent.), submitted to a three-hourly test for oestrus from 6 p.m. to 6 a.m. Marais (1936), also working at Onderstepoort, reported that high sexual activity occurred between the end of November and the end of July. There was a rapid decline in sexual activity from August until October, when it was at its lowest. During October only 20.5 per cent. of ewes showed oestrus, but during the first 3 weeks in November sexual activity had risen to 30 per cent.

It had been accepted in South Africa that testing for oestrus twice daily was sufficiently accurate to obtain data on the duration of the sexual cycle and oestrus in sheep. The usual procedure was to bring the sheep into kraals twice daily and test them with vasectomised teasers. During observations being conducted at Middelburg, Cape, the officer in charge of the experiments suggested that the oestrous period, especially during October, November, and December, may be shorter than that recorded by K pfer (1928), Quinlan and Mar  (1931), Roux (1936), and Marais (1936). Consequently "raddled" teasers were placed with certain of the experimental flocks. The result was that some sheep became marked that would not accept service during the routine hours of testing. These observations suggested the necessity for more frequent testing of sheep for oestrus in order to ascertain whether short oestrus occurred during the period of low sexual activity. By this means it could also be ascertained whether the onset and disappearance of oestrus are gradual or abrupt. There has been some controversy on these points in recent publications on sex-physiology of sheep. Quinlan and Mar  (1931) reported that the onset and termination of oestrus in the Merino were gradual. Roux (1936) reported that oestrus began abruptly and ended gradually or abruptly. These are the only recorded observations in this country. However, there are oversea records from McKenzie and Phillips (1930) stating that the beginning of oestrus is abrupt in some cases and gradual in others, and Grant (1934), who states that oestrus begins abruptly and ends gradually.

Since the data to be presented in this article concern a certain aspect of sex-physiology of sheep in a given environment, it is not intended to discuss literature having no direct relevancy to the present investigation. Consequently few publications are discussed except those concerning sex-physiology of sheep in South Africa. The present publication is an amplification of the observations of Quinlan and Mar  (1931), Roux (1936), and Marais (1936) in which the relevant literature is discussed.

MATERIAL AND METHOD.

The data to be presented concern observations made on 99 maiden ewes which were between the ages of 27 and 33 months when the experiment began. The sheep had been obtained from the Karroo during the previous autumn. They were used for testing bluetongue vaccine and had been submitted to routine vaccination with anthrax and black-leg vaccine about six months before being placed under

observation. They were confined to a kraal, 75 yards \times 50 yards, which was provided with a wood and iron shelter. Their daily ration consisted of yellow maize $\frac{3}{4}$ lb., oats $\frac{1}{4}$ lb., dry lucerne and veld hay, ad lib., bone meal $\frac{1}{4}$ oz. and salt $\frac{1}{8}$ oz. Tap water was always accessible. All the sheep had recently been shorn.

The observations were made from the 20th November, 1939, to the 20th December, 1939, every day from 6 p.m. to 6 a.m. at intervals of 3 hours. No observations were made from 6 a.m. to 6 p.m., because during the months of November and December the weather is very warm and testing with teasers is found to be unreliable. During the heat of the day the teasers lose sexual interest, which reawakens towards evening when the temperature falls. Vasectomised teasers were used for testing. They were mostly Welsh-Mountain \times Ronderib-Afrikaner crosses. This cross makes an excellent teaser.

The observations were made by one of the authors and two assistants. One was responsible for the 6 p.m., 9 p.m., and 6 a.m. tests, while the other two took the 12 midnight and 3 a.m. periods. Portable hurdles were used to make teasing pens. Powerful electric lighting was installed.

Before commencing the work the sheep and teasers were accustomed to the artificial light so that they behaved as they did in daylight. They had been accustomed to daily testing for some months previously. The ewes were driven through two successive teasing pens in groups of ten to twelve. There were two teasers in each pen. By adopting this procedure there was a double check. Only trained teasers were selected for the work. It has been noticed that an expert teaser will pick out an ewe in oestrus and serve her after an inexperienced teaser has failed. The teasers were changed after approximately half the sheep had passed through the pens.

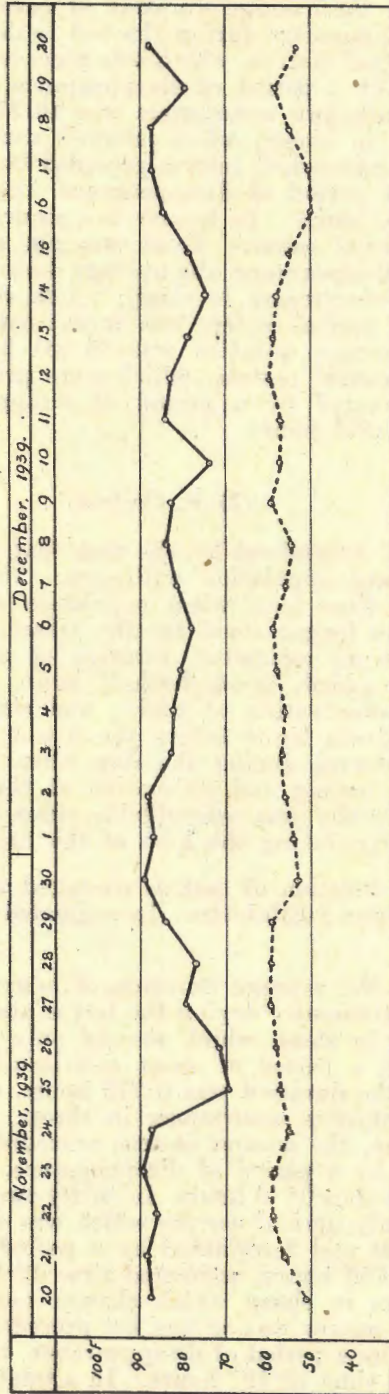
To simplify the recording of ewes large paint numbers were placed on the rump; the numbers running from one to ninety-nine. The usual permanent recording numbers, recorded by ear-tagging, acted as a check when necessary.

It was found necessary to differentiate between five distinct phenomena; namely (1) (a) Onset of oestrus, (b) Oestrus, (c) Disappearance of oestrus; (2) Weak oestrus, either accompanied or unaccompanied by ovulation, and (3) Anoestrus.

(1) a. *Onset of oestrus.*

Prior to the occurrence of normal oestrus there was a period during which the teasers took a keen interest in the ewe, following her around the pen and trying to mount her, but the ewe would not allow copulation. This period varied considerably in individual ewes. Out of a total of sixty-five normal oestrous periods, fifty-four were preceded by a period of onset, with an average duration 27-511 hours. There were eleven normal oestrous periods which appeared abruptly. Most of these, however, occurred at the 6 p.m. test, so that there may have been a period of onset during the previous twelve hours. Such an occurrence would have been unnoticed owing to the method of testing.

GRAPH I.
 Maximum and Minimum Temperature Curves for Period 20.11.39—20.12.39.



In Table 1, the average duration of onset for groups of sheep which behaved differently during the test is shown. In sheep which showed only normal oestrus, which was preceded by a period of onset and terminated by a period of disappearance, the average duration of onset for twenty-two occurrences was 16.773 hours. In twenty-five occurrences in sheep, which showed weak oestrus as well as normal oestrus, the normal oestrus preceded by a period of onset and terminated by a period of disappearance, the average duration of onset was 31.440 hours. In twenty-five occurrences in sheep which showed only normal oestrus, which was not necessarily terminated by a period of disappearance, the average duration was 15.840 hours. In twenty-nine occurrences in sheep, which showed normal as well as weak oestrus, normal oestrus was or was not preceded by a period of onset, the average duration was 30.931 hours. In forty-seven occurrences of normal oestrus, which were preceded by a period of onset and terminated by a period of disappearance, the average duration was 24.575 hours.

(1) b. *Oestrus.*

Oestrus was determined by the fact that the ewe stood for the teaser and allowed copulation willingly. The actual duration of oestrus was the time from when copulation was willingly allowed until the ewe no longer stood for the teaser. It is possibly more accurate to give an estimated duration of oestrus. Consequently three hours are added, one-and-a-half hours on either side of the actual time of observation at night, and six hours following the 6 a.m. test, and six hours before the 6 p.m. test, as there was a twelve hours interval during the day when no testing was done. This method of testing and estimation of the duration of oestrus, although undesirable, was unavoidable since the teasers would not work satisfactorily during the heat of the day.

The actual duration of oestrus averaged from sixty-five normal oestrous periods was 8.215 hours: In estimated time the duration was 14.585 hours.

In Table 1 the average duration of oestrus of groups of sheep which behaved differently during the test is also recorded. In twenty-two occurrences in sheep which showed only normal oestrus which was preceded by a period of onset and terminated by a period of disappearance, the duration was 6.273 hours, estimated time 12.341 hours. In twenty-five occurrences in sheep, which showed normal and weak oestrus, the normal oestrus preceded by a period of onset and terminated by a period of disappearance, the duration was 8.4 hours, estimated time 15.0 hours. In thirty-two occurrences in sheep, which showed only normal oestrus which was or was not preceded by a period of onset and terminated by a period of disappearance the duration was 6.750 hours, estimated time 12.938 hours. In thirty-three occurrences in sheep which showed normal as well as weak oestrus, normal oestrus was or was not preceded by a period of onset and terminated by a period of disappearance, the duration was 9.636 hours, estimated time 16.181 hours. In a total of forty-seven normal oestrous periods, which were preceded by a period of onset and

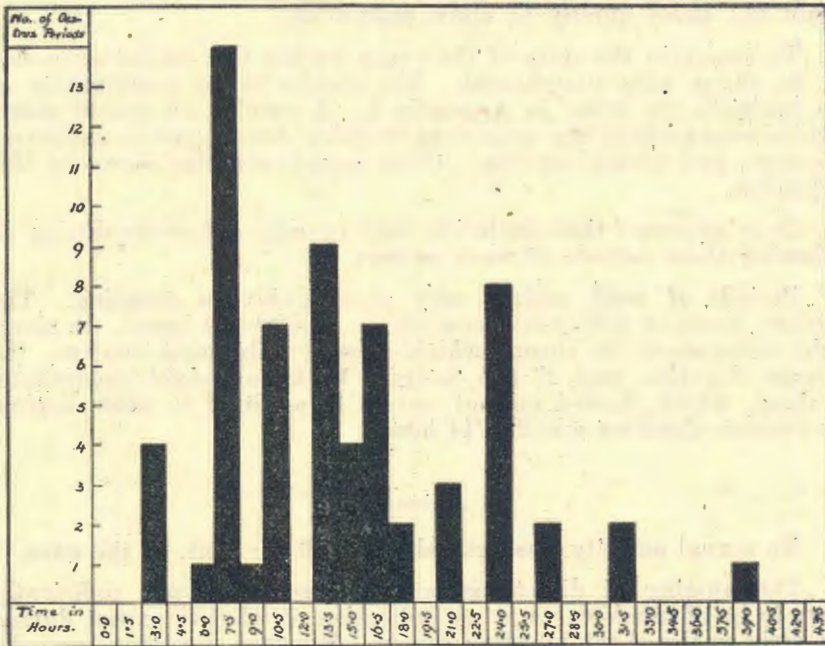
terminated by a period of disappearance, the duration was 7.404 hours, estimated time 13.755 hours. Out of ninety-nine sheep on which the observations were carried out forty-seven, or 47.47 per cent., showed sixty-five normal oestrous periods.

Diagram I shows the frequency distribution of these sixty-five normal oestrous periods recorded from forty-seven sheep.

(1) c. *Disappearance of oestrus.*

There was a gradual disappearance of oestrus in fifty-six out of sixty-five normal oestrous periods. During this period the teasers showed a keen interest in the ewe, persistently following her and trying to mount, but the ewe would not allow coitus. The average duration recorded from a total of fifty-six occurrences was 26.518 hours.

DIAGRAM I.



In Table 1 the average duration of the disappearance of oestrus in groups of sheep which behaved differently during the test is recorded.

In twenty-two occurrences in sheep which showed only normal oestrus, which was preceded by a period of onset and terminated by a period of disappearance, the duration was 21.546 hours. In twenty-five occurrences in sheep, which showed normal and weak oestrus, normal oestrus preceded by a period of onset and terminated by a period of disappearance, the duration was 33.360 hours. In twenty-seven occurrences in sheep, which showed only normal oestrus,

which was or was not preceded by a period of onset and terminated by a period of disappearance, the duration was 20·667 hours. In twenty-nine occurrences in sheep, which showed normal oestrus as well as weak oestrus, normal oestrus was or was not preceded by a period of onset and terminated by a period of disappearance, the duration was 31·966 hours. In a total of forty-seven occurrences in which normal oestrus was also preceded by a period of onset the duration was 27·830 hours.

2. *Weak Oestrus.*

What has been termed weak oestrus was observed ninety-six times. In some cases it was the only sex-phenomenon seen in the ewes, 25·27 per cent. of the ewes showed weak oestrus only. In other cases it was observed in sheep that previously or subsequently showed normal oestrus. During this phenomenon the teasers were persistent in following the ewes and trying to mount, but they would not stand quietly to allow copulation.

To ascertain the state of the ovary during this period seventeen of the sheep were slaughtered. The results of an examination of the genitalia are given in Appendix 1. A number of control observations were made at the same time on sheep slaughtered in anoestrus, dioestrus, and normal oestrus. These records are also shown in this Appendix.

It is apparent that ovulation may or may not occur during or following these periods of weak oestrus.

Periods of weak oestrus vary considerably in duration. The average, based on ninety-six occurrences, was 20·094 hours. In sixty-eight occurrences in sheep, which showed only weak oestrus, the average duration was 19·015 hours. In twenty-eight occurrences in sheep, which showed normal oestrus in addition to weak oestrus, the average duration was 22·714 hours.

3. *Anoestrus.*

No sexual activity was noticed in 27·26 per cent. of the ewes.

The number of dioestrous periods observed is not sufficiently large to be of much value as an indication of what to expect during the early weeks of the breeding season. Nineteen dioestrous periods, occurring between one normal oestrus period and another, gave an average duration of 15·882 days. Nineteen periods, between a weak oestrus and a normal oestrus, gave an average of 12·803 days. Thirty-three intervals, between one weak oestrus and another, gave an average duration of 11·015 days. Twelve intervals, recorded between a normal and a weak oestrus, averaged 11·208 days. The average duration of the intervals when weak oestrus was concerned in the cycle, either at the commencement or the end, for forty-five such occurrences, was 11·067 days.

The following Table of Means shows in summarised form the results obtained.

TABLE I.
Table of means: All Periods.

	Weak Oestrus.		Dioestrus.		Oestrus Onset.		Oestrus Actual.		Oestrus Estimated.		Oestrus Disappearance.	
	Interval: Days.		Duration: Days.		Duration: Hours.		Duration: Hours.		Duration: Hours.		Duration: Hours.	
	Average.	Number.	Average.	Number.	Average.	Number.	Average.	Number.	Average.	Number.	Average.	Number.
1.....	—	—	—	—	—	—	—	—	—	—	—	—
2.....	—	—	—	—	16.773	22	6.273	22	12.341	22	21.546	22
3.....	—	—	—	—	15.840	25	6.750	32	12.938	32	20.607	27
4.....	—	—	—	—	31.440	25	8.400	25	15.000	25	33.360	25
5.....	—	—	—	—	30.931	29	9.636	33	16.181	31	31.966	29
6.....	—	—	—	—	—	—	—	—	—	—	—	—
7.....	—	—	—	—	24.575	47	7.404	47	13.755	47	27.830	47
8.....	—	—	—	—	27.511	54	8.215	65	14.585	65	26.518	56
9.....	—	—	—	—	—	—	—	—	—	—	—	—
10.....	11.015	33	—	—	—	—	—	—	—	—	—	—
11.....	11.208	12	—	—	—	—	—	—	—	—	—	—
12.....	11.067	45	—	—	—	—	—	—	—	—	—	—
13.....	—	—	12.803	19	—	—	—	—	—	—	—	—
14.....	—	—	15.882	19	—	—	—	—	—	—	—	—

NOTE.—Key to margin numbers—

1. Sheep showing only "weak oestrus".
2. Sheep showing only normal oestrus, which was preceded by a period of "onset" and terminated by a period of "disappearance".
3. Sheep showing only normal oestrus, which was or was not preceded by a period of "onset".
4. Sheep showing normal and "weak oestrus"; normal oestrus preceded by a period of "onset" and terminated by a period of "disappearance".
5. Sheep showing normal and "weak oestrus"; normal oestrus was or was not preceded by a period of "onset".
6. "Weak oestrus" from sheep showing normal and "weak oestrus".
7. Total normal oestrus periods preceded by a period of "onset" and terminated by a period of "disappearance".
8. Total normal oestrus periods which were or were not preceded by a period of "onset".
9. Total weak oestrus periods.
10. "Weak oestrus"; Interval between one "weak oestrus" and other.
11. "Weak oestrus"; Interval between normal and "weak oestrus".
12. Average interoestrus period in all completed cycles in which a "weak oestrus" appeared.
13. Interval between "weak oestrus" and normal oestrus.
14. Interval between normal oestrus periods.

DISCUSSION.

These observations were conducted during the early weeks of the breeding season on sheep which had passed through a period of sexual quiescence. There is no doubt that the cause of low sexual activity during the months of October, November, and December on the high-veld of the Transvaal, is seasonal and due to insufficiency of the gonadotrophic and follicular hormones. This was proved in an experiment, not yet published, carried out during the same season on a parallel group of sheep under the same environment. Ovulation, usually without oestrus, followed injection of gonadotrophic hormone (Prolan, "Behringwerke," Leverkusen. A.Rh.), and oestrus usually without ovulation followed the injection of the follicular hormone (Provetan, Schering, A.G. Berlin). These observations were carried out on sheep which had been in a state of anoestrus of some weeks. Normal mating and artificial insemination of sheep showing oestrus, following the injection of Provetan, did not produce a single pregnancy, but fertile matings followed the oestrus occurring after one completed ovarian cycle. Artificial insemination, about twelve to twenty-four hours prior to an expected ovulation, following the injection of Prolan, also failed to produce a single pregnancy. Parkes and Hammond (1940) have shown that injections of extract of horse pituitary in out-of-season ewes will produce ovulation, but that full oestrus was not usually attained. It may be necessary to give a second injection after an interval of sixteen or seventeen days to produce normal oestrus and ovulation.

It appears that the return to high-level secretion of the gonadotrophic hormone and the follicular hormone, sufficient to establish normal oestrus and ovulation following a period of ovarian quiescence, is, in many cases, a gradual process. This results in "weak oestrus", with or without ovulation, shorter oestrous periods and prolongation of anoestrus beyond the usual season. It is highly probable that "flushing" is the natural method of stimulating the pituitary and the ovary to high-level production. These observations would also explain the high percentage of infertility and the prolonged breeding season experienced in this country when the seasonal rains are delayed. It may also be an explanation of the low fertility experienced in first season sheep; sheep that should attain sexual maturity following the usual period of anoestrus in mature sheep.

Parkes and Hammond (1940) indicate the practical value of the gonadotrophic hormone in sheep husbandry. They suggest that its use may be extended to reinforce oestrus in ewe lambs during their first breeding season, to increase the fertility of normal matings by increasing the output of ova, to breed from barren and lost-lamb ewes during the nonbreeding season, to obtain two crops of lambs during one year, and to speed up ewes coming to the ram at the beginning of the breeding season.

A further series of experiments not yet completed, carried out under somewhat different environmental conditions at Ermelo, Transvaal, indicates that the use of the gonadotrophic and follicular hormones towards the end of the anoestrous period may be followed

by a sterile oestrus or ovulation, but the genitalia are rapidly re-awakened to normality and after a normal dioestrous period a fertile oestrus follows. As a result of these observations it is not unreasonable to deduct that the use of the gonadotrophic and follicular hormones on stud flocks, where the expense is warranted, towards the end of the anoestrous period, would compensate for the absence of the natural stimulation by "flushing" during seasons of sub-normal nutrition due to drought.

CONCLUSIONS.

1. Ninety-nine maiden Merino ewes, between the ages of 27 and 33 months, kept in an enforced environment in "dry lot" were submitted to a 3 hourly test for oestrus, from 6 p.m. to 6 a.m., at the commencement of the usual breeding season, following a period of anoestrus.

2. Forty-seven ewes showed oestrus. The oestrus was preceded by a definite period of "onset" in fifty-four out of sixty-five cases: There was a definite period of disappearance on fifty-six out of sixty-five cases.

3. The actual average duration of a total of sixty-five normal oestrous periods was 8.215 hours, with an estimated average of 14.585 hours. This is considerably shorter than that previously recorded in this country when observations were not confined to the onset of the breeding season, but were carried out throughout the year.

4. The duration of the dioestrous period averaged from nineteen normal cycles was 15.882 days.

5. "Weak oestrus" was a common occurrence. It was observed ninety-six times. It occurred in sheep which previously or subsequently showed normal oestrus: 25.27 per cent. of the ewes showed "weak oestrus" only. It was or was not followed by ovulation. The average duration of ninety-six weak oestrous periods was 20.094 hours. In 68 occurrences in sheep which showed "weak oestrus" only, the average duration was 19.015 hours. In twenty-eight occurrences in sheep which showed normal oestrus in addition to "weak oestrus" the average duration of "weak oestrus" was 22.714 hours.

6. The duration of the interval between one "weak oestrus" and another (33) was 11.015 days. The interval between normal and "weak oestrus" (12) was 11.208 days. The interval between "weak" and normal oestrus (19) was 12.803 days. The duration of the interval between the total weak oestrus periods (45) was 11.067 days. The dioestrous period, when a "weak oestrus" was concerned, either at the commencement or the termination, was shorter by four days than that between normal oestrous periods.

7. Ovulation may or may not follow periods of "weak oestrus".

8. The hormones governing genital activity appear to reach a low-level output during the months of October and November. This seasonal genital quiescence appears to be the result of environmental factors other than nutrition, because sheep fed in "dry lot" on a regulated ration behave in the same way as veld-fed sheep.

9. The return to sexual activity at the commencement of a breeding season is, in many cases, a gradual process, the high-level secretion of the gonadotrophic hormone and the follicular hormone, necessary to produce full oestrus and ovulation, may not be reached at once, so that "weak oestrus" with or without ovulation is a frequent occurrence.

10. Individual sheep react differently, some with delayed response, to the extroceptive stimuli which initiate sexual activity at the commencement of the breeding season. During the period 20th November 1939 to the 20th December 1939, out of 99 sheep, kept in "dry lot" in a controlled environment on a similar level of nutrition, 47.47 per cent. showed normal oestrus of a shorter duration than that usually observed; 25.27 per cent. showed "weak oestrus" only; 27.26 per cent. did not show sexual activity.

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APPENDIX.

Details of the anti-mortem observations on sexual activity and the post-mortem examinations of the genitalia of the ewes slaughtered.

Ewe No. 81, D.O.B. No. 55805.

TABLE 2.

Date.	3 a.m.	6 a.m.	6 p.m.	9 p.m.	12 m.n.
22/11/39.....	—	—	0*	—	0
23/11/39.....	—	0	—	—	—
30/11/39.....	0	—	—	—	—
8/12/39.....	—	—	—	—	0
10/12/39.....	—	—	—	—	0
14/12/39.....	—	—	0	0	0
15/12/39.....	—	0	—	0	—
16/12/39.....	—	0	—	—	0
17/12/39.....	—	0	—	0	0
18/12/39.....	0	0	—	—	—
20/12/39.....	0	—	—	—	—

* NOTE.—The symbol 0 indicates that the ram was interested in the ewe but she did not allow coitus.

Slaughtered 21.12.39.

Cervix.—4 cm. in length.

Uterus, including the uterine horns.—±11.5 cm. in length.

Right Ovary.—1.2×1.3×0.7 cm., weighs 0.5 grammes. There are a large number of small Graafian follicles on the surface and on section a remnant of a corpus luteum.

Left Ovary.—1.3×1.4×1.0 cm., weighs 0.8 grammes. A large number of small Graafian follicles are present on its surface and on section a remnant of corpus luteum I is present. The uterus shows prominent cotyledonary buds in the pars indivisa and the horns.

Remarks.—No rapidly developing Graafian follicle and no recent ovulation.

Ewe, No. 23, D.O.B. No. 55871.

TABLE 3.

Date.	3 a.m.	6 a.m.	6 p.m.	9 p.m.	12 m.n.
29/11/39.....	—	—	—	0	—
30/11/39.....	0	0	—	—	0
1/12/39.....	0	0	0	—	0
18/12/39.....	—	0	—	—	0
19/12/39.....	0	—	—	—	—

Slaughtered 21.12.39.

SEX PHYSIOLOGY OF SHEEP.

Cervix.—4.5 cm. in length.

Uterus, including the uterine horns.—±12.5 cm. Total weight 37.6 grammes. The cotyledonary buds towards the pars indivisa in both horns are small.

Left Ovary.—1.0 × 1.2 × 0.8 cm., weighs 0.775 gm. Shows a remnant of a corpus luteum, ±4 mm. in diameter, and one fairly well marked Graafian follicle.

Right Ovary.—0.6 × 0.9 × 0.8 cm., weighs 0.55 gm. This ovary contains a fairly well developed Graafian follicle.

Remarks.—There is evidence of a ripening follicle. It is difficult to say whether ovulation followed the "weak oestrus" on 29.11.39, but the probability is that ovulation did occur.

Ewe No. 12, D.O.B. No. 55926.

TABLE 4.

Date.	3 a.m.	6 a.m.	6 p.m.	9 p.m.	12 m.n.
7/12/39.....	—	—	—	0	—
18/12/39.....	—	—	—	—	0

Slaughtered 21.12.39.

Cervix.—3.5 cm. in length.

Uterus, including the uterine horns.—±6.5 cm. Total weight is 12.5 grammes. The Uterus shows marked infantilism. The cotyledonary buds are quite marked in the pars indivisa and the horns. There are several small black areas present on the mucosa. These black patches vary in size up to 0.5 cm. in length, and they are scattered irregularly in the pars indivisa and the horns.

Right Ovary.—1.2 × 0.9 × 0.8 cm., weighs 0.6 grammes. A number of small Graafian follicles are present in this ovary, both on the surface and on section.

Left Ovary.—1.3 × 1.0 × 0.8 cm., weighs 0.7 gm. There is no trace of a corpus luteum. A number of small Graafian follicles are present on the surface and on section.

Remarks.—There is no recent ovulation and no rapidly developing Graafian follicle.

Ewe No. 45, D.O.B. 55829.

This ewe did not show any signs of oestrus.

Slaughtered 21.12.39.

Cervix.—3.5 cm. in length and comma-shaped.

Uterus, including uterine horns.— ± 8.5 cm. long. The total weight is 24 grammes. The cotyledonary buds in the pars indivisa and the horns are prominent.

Right Ovary.— $0.8 \times 0.8 \times 0.7$ cm., weighs 0.5 gm. A number of small Graafian follicles are present on the surface of the ovary and on section one Graafian follicle is 0.4 cm. in diameter.

Left Ovary.— $1.2 \times 1.0 \times 0.7$ cm., weighs 0.65 gm. This ovary contains a corpus luteum 0.6 cm. in diameter and very pale yellow in colour.

Remarks.—It is difficult to estimate the age of the corpus luteum, but it would not appear to be that observed during a normal dioestrous period.

Ewe No. 52, *D.O.B. No.* 55736.

TABLE 5.

Date.	3 a.m.	6 a.m.	6 p.m.	9 p.m.	12 m.n.
2/12/39.....	—	—	0	—	—
18/12/39.....	—	—	—	0	—
19/12/39.....	0	0	—	0	0
20/12/39.....	0	—	—	—	—

Slaughtered 21.12.39.

Cervix.—4.5 cm. in length.

Uterus, including the uterine horns.— ± 11.5 cm. in length and weighs 29 grammes. The cotyledonary buds in the uterine horns and pars indivisa are quite prominent.

Right Ovary.— $0.8 \times 0.7 \times 0.6$ cm., weighs 0.54 gm. There are some small Graafian follicles on the surface and no sign of a corpus luteum.

Left Ovary.— $1.4 \times 0.7 \times 1.2$ cm., weighs 0.552 gm. This ovary shows some small Graafian follicles and an imbedded corpus luteum 1, which is 0.35 cm. in diameter.

Remarks.—No rapidly developing Graafian follicles and no recent ovulation.

SEX PHYSIOLOGY OF SHEEP.

Ewe No. 57.

TABLE 6.

Date.	3 a.m.	6 a.m.	6 p.m.	9 p.m.	12 m.n.
30/11/39.....	—	—	—	0	0
1/12/39.....	0	0	0	0	0
2/12/39.....	0	0	×*	×	×
3/12/39.....	×	0	—	—	0
18/12/39.....	—	—	—	—	0
19/12/39.....	0	—	0	—	0
20/12/39.....	0	0	—	—	—

* NOTE.—The symbol × indicates that the ewe allowed coitus.

Slaughtered 21.12.39.

Cervix.—5.5 cm. in length.*Uterus*, including uterine horns.—±11 cm. long. Weighs 60.5 grammes. Somewhat flabby. On section it shows prominent cotyledonary buds which are of a pale, whitish-yellow colour.*Left Ovary.*—1.7 × 1.2 × 1.0 cm., weighs 1 gm. There are several small Graafian follicles present on the surface and on section a corpus luteum 1, which is 0.7 cm. in diameter. This corpus luteum is pale yellow in colour.*Right Ovary.*—1.8 × 1.2 × 0.7 cm., weighs 0.750 gm. On section there is one Graafian follicle with a diameter of 0.3 cm.*Remarks.*—The corpus luteum is from the ovulation following the oestrous period of 2.12.39. There is no more recent ovulation.

Ewe No. 74, D.O.B. No. 55789.

TABLE 7.

Date.	3 a.m.	6 a.m.	6 p.m.	9 p.m.	12 m.n.
21/11/39.....	—	—	0	0	—
22/11/39.....	—	—	—	0	—
19/12/39.....	—	0	0	—	0
20/12/39.....	0	—	—	—	—

Slaughtered 21.12.39.

Cervix.—3.5 cm. in length.*Uterus*, including the uterine horns.—±7.75 cm. in length and shows marked infantilism. The cotyledonary buds are marked in the pars indivisa and the horns.*Right Ovary.*—0.6 × 0.7 × 0.8 cm., weighs 0.45 gm. On section there is a trace of an old corpus luteum.

Left Ovary.— $0.8 \times 0.6 \times 0.7$ cm., weighs 0.5 grm. There are a few Graafian follicles present on the surface and on section a trace of an old corpus luteum.

Remarks.—No rapidly developing Graafian follicles and no recent ovulation.

Ewe No. 36, D.O.B. No. 55873.

TABLE 8.

Date.	3 a.m.	6 a.m.	6 p.m.	9 p.m.	12 m.n.
21/11/39.....	0	—	—	—	—
30/11/39.....	—	—	—	0	—
2/12/39.....	0	—	—	—	—
7/12/39.....	—	—	—	—	0
8/12/39.....	—	—	—	—	0
9/12/39.....	0	0	—	—	—
10/12/39.....	—	—	0	0	0
11/12/39.....	0	0	0	0	0
12/12/39.....	0	0	—	0	—

Slaughtered 15.12.39.

Cervix.—3.5 cm. in length.

Uterus, including the uterine horns.—+13 cm. long. The cotyledonary buds in the pars indivisa and uterine horns are prominent.

Right Ovary.— $1.5 \times 0.8 \times 0.7$ cm. This ovary contains a corpus luteum measuring $0.8 \times 0.6 \times 0.6$ cm., approximately 24 hours old.

Left Ovary.— $1.2 \times 0.6 \times 0.7$ cm. Some small Graafian follicles can be seen through the surface of this ovary.

Remarks.—Recent ovulation.

Ewe No. 78, D.O.B. No. 55833.

TABLE 9.

Date.	3 a.m.	6 a.m.	6 p.m.	9 p.m.	12 m.n.
25/11/39.....	—	—	—	0	—
11/12/39.....	—	—	0	0	0
12/12/39.....	0	0	0	0	0
13/12/39.....	0	0	—	—	—

Slaughtered 15.12.39.

Cervix.—4.5 cm. in length.

Uterus, including uterine horns is ± 11 cm. in length. The cotyledonary buds in the pars indivisa and uterine horns are very well marked.

Right Ovary.— $1.2 \times 0.6 \times 0.8$ cm. Contains a small corpus luteum which is 0.4 cm. in diameter.

Left Ovary.— $1.0 \times 0.8 \times 1.0$ cm. Contains some small Graafian follicles which can be seen through the surface. On section there is one large Graafian follicle which is 0.6 cm. in diameter.

Remarks.—Developing follicle present, no recent ovulation.

Ewe No. 30, D.O.B. No. 55771 (Control sheep in mid-dioestrus).

This ewe allowed copulation 19.9.39., 6.10.39., and 23.10.39. Slaughtered in mid-dioestrus 31.10.39.

Cervix.—Firm and cordlike. There is a small quantity of jelly-like material present between the cervical folds.

Uterus.—Weighs 39.6 grammes. The cotyledonary buds in the pars indivisa and the horns are only slightly elevated.

Left Ovary.—Weighs 1.25 grms. Contains a corpus luteum 1.0 cm. in diameter with a central cavity 0.5 cm. in diameter.

Right Ovary.—Weighs 0.8 gm. Several Graafian follicles can be seen on the surface.

Remarks.—Recent ovulation.

Ewe No. 32, D.O.B. 55682 (Control sheep in mid-dioestrus).

Slaughtered in mid-dioestrus 31.10.39.

Cervix.—Nothing unusual.

Uterus.—Weighs 52.5 grms. The cotyledonary buds are not elevated and the wall appears oedematous.

Left Ovary.—Weighs 1.6 grms. There are several small Graafian follicles present and a corpus luteum ± 1.0 cm. in diameter.

Right Ovary.—Weighs 0.9 gm. There are several small Graafian follicles present but no trace of a corpus luteum.

Remarks.—Recent ovulation.

Ewe No. 20, D.O.B. No. 55893 (Control sheep in anoestrus).

Slaughtered in anoestrus 3.11.39.

Cervix.—Cordlike and contains a small amount of mucous material between the cervical folds.

Uterus.—Weighs 26.7 grms. The cotyledonary buds are only slightly elevated.

Left Ovary.—Weighs 1.65 grms. Contains a large corpus luteum 1.0 cm. in diameter with a central cavity 1.0 mm. in diameter. There are several Graafian follicles present, the largest being 3.0 mm. in diameter.

Right Ovary.—Weighs 0.7 gram. Surface is smooth and pale. Several small follicles are present.

Remarks.—Recent ovulation.

Ewe No. 31, D.O.B. No. 55790 (Control sheep in anoestrus).

Slaughtered in anoestrus 3.11.39.

Cervix.—Nothing unusual.

Uterus.—The cotyledonary buds are very prominent.

Left Ovary.—Weighs 0.85 gm. There are present a small corpus albicans and several small Graafian follicles, the largest of which is ± 4 mm. in diameter.

Right Ovary.—Weighs 0.6 gm. On section there are a few small Graafian follicles present: The largest is ± 2.5 mm. in diameter.

Remarks.—No recent ovulation.

Ewe No. 4, D.O.B. No. 55841, (Control sheep in anoestrus).

Slaughtered in anoestrus 22.11.39.

Cervix.—Nothing unusual.

Uterus.—Weighs 20.4 gm. The mucosa is of a pale brownish colour. The cotyledonary buds in the pars indivisa and horns are prominent.

Left Ovary.—Weighs 0.5 gm. There are some immature Graafian follicles, ± 1.5 mm. in diameter, present.

Right Ovary.—Weighs 0.5 gram. The appearance is the same as that of the left ovary.

Remarks.—No recent ovulation.

Ewe No. 7, D.O.B. No. 55651 (Control sheep in anoestrus).

Slaughtered in anoestrus 22.11.39.

Uterus.—Cotyledonary buds show up well through the wrinkling of the mucous membrane. The uterus is small and pale in colour.

Ovaries.—Small, pale and inactive. There are a few small Graafian follicles present in both ovaries.

Remarks.—No recent ovulation and no rapidly developing Graafian follicles.

SEX PHYSIOLOGY OF SHEEP.

Ewe No. 1, D.O.B. No. 55854 (Control sheep slaughtered in anoestrus).
Slaughtered in anoestrus 22.11.39.

Uterus.—Small and pale in colour. The cotyledonary buds are prominent in the pars indivisa and horns. The mucous membrane is wrinkled.

Ovaries.—Small, pale and inactive. Several small Graafian follicles are present in both ovaries.

Remarks.—No recent ovulation and no rapidly developing Graafian follicles.

Ewe No. 94, D.O.B. No. 55944 (Control showing normal oestrus).

TABLE 10.

Date.	3 a.m.	6 a.m.	6 p.m.	9 p.m.	12 m.n.
20/11/39.....	—	×	×	×	0
21/11/39.....	0	—	—	—	—
24/11/39.....	—	—	×	—	—
8/12/39.....	—	—	×	×	×
9/12/39.....	×	×	—	—	—

This ewe died 27.12.39. (Fatty degeneration of the liver).

Cervix.—4.7 cm. in length.

Uterus.—Pars indivisa and the left horn 12.5 cm.; pars indivisa and the right horn 13.5 cm. The cotyledonary buds are prominent in the pars indivisa and horns.

Right Ovary.—1.3 × 1.0 × 0.9 cm. On section this ovary contains a corpus luteum I, 0.9 cm. in diameter. There is also a corpus luteum II, 0.4 cm. in diameter. Corpus luteum I is of a pale flesh colour with a tinge of yellow. Corpus luteum II is white in colour.

Left Ovary.—1.5 × 1.0 × 0.6 cm. There are some Graafian follicles present in this ovary and a remnant of a corpus luteum III.

Remarks.—Evidence of normal ovarian activity.