III. A PRELIMINARY NOTE ON THE OESTROUS CYCLE IN THE SHEEP

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Marshall (1922) says that shepherds and flockmasters have long held the view that nutrition is an important factor in the occurrence of heat or oestrum, and that it plays an important role in conception and twinning. Their practice is to place the flock of breeding ewes on green pasture, or to otherwise increase the ration so as to have the ewes gaining in flesh during the breeding season. This practice is called "flushing." This, they believe, results in the entire flock coming in heat more nearly at the same time, in a larger proportion of successful matings, and a larger number of twin lambs. The percentage lamb crop is larger the following spring, therefore, and the lambs are more uniform in age.

The present paper is a preliminary report on one phase of an experiment designed to test the validity of the belief in "flushing." A thorough knowledge of the changing picture of the genital tract in the ewe throughout the course of the normal reproductive cycle was thought to be a prerequisite to a study of the influences of "flushing." Since September tenth this year vaginal smears have been made daily from ten yearling ewes of grade Merino breeding. These ewes have been tried daily with the ram to determine the occurrence of heat. Actual mating has been prevented and the ewes have gone through three or more complete oestrous cycles to date. Their ration has been two and one-half pounds of alfalfa hay daily. Fifty other ewes of similar age and breeding have been tried each day with the ram and have been bred as they came in heat. In case of unsuccessful matings, they have been rebred at subsequent heats.

The average length of the oestrous cycle in these ewes has been seventeen and one-half days. There has been a range from sixteen to twenty-one days, but the greater proportion of the fifty-three cycles observed has

been either seventeen or eighteen days. The cycle based on daily observations has been measured from the beginning of one oestrum or heat until the beginning of the next. Marshall (1922), Kupfer (1928), and others have reported variations in the cycle ranging from thirteen to twenty-one days.

Material for smears was taken from the walls of the vagina anterior to the vulvo-vaginal sphincter by means of an open glass tube and glass rod. Smears were made in a drop of physiological saline solution colored with water soluble eosin, and spread on an ordinary glass slide. They were examined immediately, without drying, and described as to the kind and relative proportions of cells present.

The following description of smears made throughout the oestrous cycle is based on a summary of these daily observations: Very little or no material visible to the naked eye clings to the glass rod when the ewe is in full heat. There may be a variable quantity of clear stringy mucus present. Leucocytes are few or absent. There are several squamous epithelial cells but no cornified ones. Frequently the epithelial cells are rather small and quite uniform in size and shape. This picture of oestrum in the sheep is very similar to that reported by Stockard and Papanicolaou (1917) in the guinea pig, and by Long and Evans (1922) in the rat.

Following oestrum there is rapid increrase in the quantity of material which clings to the sampling rod, until the fourth or fifth day it has become very thick or cheesy, white or slightly yellow in color, and fairly dry. Leucocytes appear in increasing numbers during metoestrum, reaching a maximum about a week following oestrum. Squamous epithelial cells* are fewer during metoestrum than during the occurrence of oestrum. The cornified elements increase rapidly after heat until at the end of the fourth or fifth day they constitute most of the material of the smear. Thus with a thickening or increase in cheesy character of the material sloughed from the vaginal wall, there is a parallel increase in the number of scales present in the smear, and the latter may be considered the cause of the cheesy condition. This is in accord with the findings of Stockard and Papanicolaou (1917), Long and Evans (1922), and McKenzie (1926) in their studies of other species of mammals.

Leucocytes continue to increase for two or three days after the cornified squamous epithelial cells have reached their maximum, and the material removed by the sampling rod becomes softer and thinner in consistency. Squamous epithelial cells are few in proportion to leucocytes, and scales for several days following oestrum; but as the scales decrease in number, the proportion of epithelial cells slowly increases toward the approach of another oestrum. The increase is not always regular, however, for often there are very few cells of any kind in the smear from two to five days preceding the next heat.

Leucocytes do not increase in absolute numbers throughout the period of dioestrum, but this type of cell is more numerous than either epithelial cells or scales during late dioestrum. If estimated in relative numbers, leucocytes are most numerous about the fifteenth day after heat, though in absolute numbers the maximum is reached about a week earlier. As the ewe

*Only well shaped fairly "full" cells with a well defined nucleus have been classified as squamous epithelial cells in the present summary. Flat cells with irregular outlines have been called cornified epithelial cells or scales, although in many cases the nucleus was clearly visible. More recently we have included the flattened cell with a well shaped nucleus in the class of squamous epithelial cells, and have called those scales which were flake-like without nuclei or with broken or poorly defined nuclei. Since the scale is but a cornifield squamous epithelial cell, the effect in our future reports will be to draw the line of division between these two types of cells at a more advanced stage of cornification than that used in the present discussion.

comes in heat again, leucocytes rapidly disappear from the vaginal smear, and are few or absent when she is in full oestrum. Squamous epithelial cells do not become very numerous until the advent of oestrum. Cornified squamous epithelial cells gradually decrease in number after about the fifth day following the occurrence of oestrum, are few or absent during the latter half of dioestrum, and appear after another oestrum. There is a corresponding change in the character of the material of the smear as removed by the glass sampling rod; it becomes thin and quite liquid after about a week following oestrum, and usually it is clear after the fourteenth to sixteenth day, or the second or fourth day before the next oestrum.

Summary

The length of the oestrous cycle in the sheep, measured from the beginning of one oestrum to the beginning of the next and based on daily observations of grade yearling Merino ewes, has been about seventeen and one-half days. This may or may not be representative for the species. Vaginal smears from ewes in full heat showed the presence of some mucus, many squamous epithelial cells, and few or no leucocytes. The picture changed to show many cornified epithelial cells after the second day, these cells reaching a maximum number about five days after the onset of oestrum. Squamous epithelial cells were much fewer at this time than at oestrum. Leucocytes increased in number soon after oestrum and attained a maximum about a week post-oestrum.

Cornified squamous epithelial cells gradually disappeared from the smear following the peak reached on the fourth or fifth day post-oestrum and were practically absent by the end of the second week after heat. Leucocytes decreased somewhat in number after the first week post-oestrum, but remained fairly numerous until just preceding the next oestrum, at which time the number dropped to very few or none. Squamous epithelial cells were at a minimum about the time the scales or cornified elements were at a maximum. They slowly increased in relative numbers during dioestrum, but there was an abrupt increase in numbers of this type of cell with the onset of the next oestrum.

Material which clung to the sampling rod was thin or clear, and sometimes stringy with mucus at full oestrum. It rapidly became thicker in consistency until the fourth or fifth day post-oestrum, when the cornified epithelial cells were at a maximum, at which time it was very thick or cheesy and fairly dry. Then it gradually softened and become more liquid with advance into dioestrum, until it was quite clear some two days preceding the next oestrum.

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