Effects of oral supplementation of ewes with aureomycin and effects of delayed feeding of ewes upon lamb production

by Donald J Dierschke

A THESIS Submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of Master of SCIENCE in Animal Industry at Montana State College
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Abstract:
The purpose of this study was to determine the effects of feeding Aureomycin to ewes before and after lambing and the effects of delayed supplemental feeding of ewes after lambing on lamb production. A total of 672 ewes managed at two different locations, were used in collecting the data reported in this manuscript.

Feeding a supplemental ration providing 50 milligrams of Aureomycin per head per day for a period of about a month prior to lambing, compared to feeding the same supplemental ration without Aureomycin, caused very little difference in average birth weights between the two lots and the trend was not consistent at the two locations.- Strength scores at birth showed no particular advantage for either type of feeding. Six more lambs from the Aureomycin lot than from the control lot showed signs of scours.

The Aureomycin supplemented lot had more total death losses than the control lot at both locations. There appeared to be no consistent relation between causes of death and type of feeding.

Biological assay of colostrum and milk samples showed little transfer of Aureomycin into the colostrum of ewes; there were detectable traces of the antibiotic in the milk only when the ewe was receiving Aureomycin in her ration at the time the sample was collected.

Feeding a supplemental ration with or without Aureomycin or delaying supplemental feeding for 10 days after lambing resulted in no statistically significant differences in average daily gain of the lambs at either of the two weigh periods. Time of lambing likewise had no significant effect on average daily lamb gain. A significant interaction was noted between type of feeding and time of lambing in both single and twin lambs from mature ewes at the first weigh period, but the trend was not consistent and the interaction disappeared at the second weigh period.' Where no postlambing feed treatment was imposed, the differences in final weight gains of the lambs due to prelambing feed treatment were not significant.

Ewes with single lambs which were fed a supplement containing Atjreo-myciri immediately after lambing lost less or gained more weight during the supplemental feeding period than did comparable ewes which were fed the same ration without Aureomycin or did not receive a supplemental ration immediately after lambing.

EFFECTS OF ORAL SUPPLEMENTATION OF EWES WITH AUREOMYCIN AND EFFECTS OF DELAYED FEEDING OF EWES UPON LAMB PRODUCTION

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ABSTRACT

The purpose of this study was to determine the effects of feeding Aureomycin to ewes before and after lambing and the effects of delayed supplemental feeding of ewes after lambing on lamb production. A total of 672 ewes, managed at two different locations, were used in collecting the data reported in this manuscript.

Feeding a supplemental ration providing 50 milligrams of Aureomycin per head per day for a period of about a month prior to lambing, compared to feeding the same supplemental ration without Aureomycin, caused very little difference in average birth weights between the two lots and the trend was not consistent at the two locations. Strength scores at birth showed no particular advantage for either type of feeding. Six more lambs from the Aureomycin lot than from the control lot showed signs of scours.

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Feeding a supplemental ration with or without Aureomycin or delaying supplemental feeding for 10 days after lambing resulted in no statistically significant differences in average daily gain of the lambs at either of the two weigh periods. Time of lambing likewise had no significant effect on average daily lamb gain. A significant interaction was noted between type of feeding and time of lambing in both single and twin lambs from mature ewes at the first weigh period, but the trend was not consistent and the interaction disappeared at the second weigh period. Where no postlambing feed treatment was imposed, the differences in final weight gains of the lambs due to prelambing feed treatment were not significant.

Ewes with single lambs which were fed a supplement containing Aureomycin immediately after lambing lost less or gained more weight during the supplemental feeding period than did comparable ewes which were fed the same ration without Aureomycin or did not receive a supplemental ration immediately after lambing.

INTRODUCTION

Baby lamb mortality is a major problem in any sheep operation. Even though this loss commonly occurs, its cause or causes and ways and means of reducing the loss are subjects of vital concern to every sheep raiser. The object is to save every lamb that can be saved. This goal stems from the indisputable realization that there is no profit in a dead lamb. It must also be taken into consideration that every dead lamb is lost potential in taking full advantage of gains made as a result of applying proven production and marketing methods.

It is estimated that between 15 and 30 percent of all lambs born never reach weaning age. Most of these deaths occur during the first few days or weeks after birth. One of the greatest single causes of death is pneumonia. Enterotoxemia and digestive disorders such as scours also take their toll. These diseases are often thought to be caused by predisposing conditions; nevertheless, antibiotics have been successfully used in controlling such diseases both in human medicine, especially in the case of pneumonia, and in the field of veterinary medicine. In order for an antibiotic to be of any benefit in preventing young lamb disease or mortality, however, some method must be used where the lamb would receive a fairly large dose of the antibiotic at a very early age. This method must also be practical where large numbers of ewes are being lambed. One objective of this experiment was to determine if Aureomycin would be transferred to the colostrum of ewes which had received this antibiotic in a supplemental ration during the latter part of gestation. If this transfer occurred, the lamb would possibly have a ready-made source of disease preventative in the first nourishment it received in the form of colostrum as well as any it might have received in prenatal life.

Soon after results of research appeared showing the beneficial effects of antibiotics in the rations of poultry and swine, much attention was given to their use in the rations of ruminants as well. It was found that the greatest benefits along this line could be expected from young ruminants when their digestive tracts are similar to those of monogastric animals. Beneficial results have also been found in the feeding of growing and fattening ruminants. Advantages found from feeding antibiotics to suckling and fattening lambs are faster and more economical gains, less trouble with pneumonia and scours, and, in some cases, reduced death losses from enterotoxemia. Good results, such as improved health and weight gains, have also been obtained when antibiotics were fed to cull or scrub lambs. Drenching and subcutaneous implanting are methods of administering antibiotics other than through the ration.

Another objective of this trial was to determine if Aureomycin would be transferred to the milk of ewes receiving the antibiotic at that time as well as to determine if there is a carry-over effect when the supplemental Aureomycin is discontinued. Biological assay of milk samples and average lamb rate of gain was used as a measure of these particular effects.

It has been shown many times that the weight increase of young lambs is highly correlated with milk consumption. In very young lambs the limiting factor seems to be the appetite or ingestion capacity of the lamb itself, whereas in older lambs it is probably the producing capacity of the ewe. The peak of milk production in ewes usually comes about the third to fourth week of lactation which, in the case of a single lamb, may be too early for the lamb to take full advantage of it. In the case of twin lambs, however, the production capacity of the ewe may not be able to meet the demand at any period. Workers in the dairy field report that improved methods of feeding and management would bring about the greatest returns in the direction of improved persistency of lactation. The other objective of this experiment was to determine if the peak of milk production in ewes with single lambs could be retarded until the lamb is large enough to consume the full potential and in this way also increase total production. The method used to accomplish this was to delay supplemental feeding until 10 days after the initiation of lactation.

REVIEW OF LITERATURE

Effects of Aureomycin in livestock and poultry feeding

It is logical to expect that the rate of growth of an animal will be increased when a pathogenic or debilitating infection is eliminated. This, according to Jukes and Williams (1953), is the reason for feeding antibiotics. It was found that the addition of small quantities of antibiotics to the diets of young animals not only served to control certain obvious disturbances such as diarrhea and mild respiratory infections but also produced unsuspected increases in growth rate even when the animals were asymptomatic. It appeared that subclinical intestinal infections of an unsuspected and undefined nature were commonly present; perhaps the infecting organisms merely displacing "beneficial" bacteria. In any event, improvements in growth were noted in apparently healthy animals, and popular interest was aroused in the feeding of antibiotics.

The present interest in antibiotics as additives to animal feeds stems from investigations of Streptomyces aureofaciens as a source of vitamin B_{12} by Stokstad et al (1949). They found that a response was produced in chicks by adding crude preparations of S. aureofaciens culture materials to diets of natural foods even when vitamin B_{12} was present in adequate amounts in the basal diet. The response was later shown to be due to the presence of surprisingly small amounts of Aureomycin[1/] and other antibiotics which were active.

Stokstad and Jukes (1950) confirmed the foregoing results by feeding

1/ The trade name of Lederle Laboratories Division, American Cyanamid Company, for chlortetracycline is Aureomycin.

to chicks a diet containing adequate levels of vitamin B_{12} with small amounts of Aureomycin added. They concluded that the growth stimulation which was observed when Aureomycin fermentation materials or crystalline Aureomycin was fed could be attributed, at least in part, to the Aureomycin content.

At about this same time Jukes et al (1950), working with pigs, reported an experiment in which they found that the addition of 100 milligrams of Aureomycin HCl per kilogram of basal diet to a ration already supplemented with vitamin B_{12} gave an increase of 0.25 pound in average daily gain. In a second experiment these same workers added 50 and 200 milligrams of Aureomycin HCl per kilogram of basal diet to a ration containing adequate vitamin B_{12} and reported average daily gains of 1.22 pounds and 1.51 pounds respectively in comparison to 0.88 pound per day where only vitamin B_{12} was supplemented.

Many other investigators soon published similar results from experiments with pigs. Cunha (1956) reviewed the information available on antibiotics in swine nutrition and presented the following as some benefits which could be expected from feeding Aureomycin and Terramycin1/, especially during the early growth period: antibiotics increase growth rate an average of 10 to 20 percent and efficiency of feed utilization about 5 percent; they help control certain types of nonspecific enteritis (scours), reduce the number of runts and increase bloom and appearance of the animal.

1/ The trade name of Charles Pfizer Company for oxytetracycline is Terramycin. Chlortetracycline and oxytetracycline, both classed as "broad spectrum" antibiotics, are very similar in their activity of suppressing many species of bacteria.

Soon after research appeared showing the benefits of feeding Aureomycin to poultry and swine, investigators found that this antibiotic promoted growth and helped to eliminate scours in dairy calves as well. Because of subsequent findings that antibiotics could affect the activity of rumen microflora in mature cattle, the feeding of antibiotics to ruminant animals was not advocated. Recently, however, more evidence has accumulated to show that the feeding of Aureomycin is beneficial not only in calves but also in mature cattle.

In 1950, Bell and coworkers found that feeding Aureomycin to 620 pound steers at the rate of 600 milligrams per head daily caused adverse effects in the form of a marked anorexia and a fetid diarrhea within 48 to 72 hours. Feeding 200 milligrams produced somewhat milder digestive disturbances but also caused a marked reduction in the digestibility of crude fiber. The digestibility of dry matter and nitrogen-free extract was also reduced. This report discouraged further investigations of the effects of feeding antibiotics to beef animals and led to the belief that antibiotics could be fed only to young calves before the rumen began functioning.

Intensive research on the feeding of antibiotics continued in the dairy calf field, however. Reviews by Knodt (1953), Jukes and Williams (1953) and Lassiter (1955) show that the feeding of Aureomycin and Terramycin stimulated the growth rate of calves from 10 to 35 percent and in a few cases up to 70 percent under a variety of experimental conditions and rations. Most of the growth improvement resulted before the calves were eight weeks old and any growth advantage afforded by these antibiotics during the early life of the calf was not noticeable in the mature animal.

Although there appeared to be few advantages of feeding antibiotics after the calves were 12 to 16 weeks of age, Aureomycin apparently had no pronounced effect on the appetites or the well-being of mature dairy cattle. In addition to an improvement in growth, antibiotics appeared to reduce the incidence of scours, increase feed consumption and feed efficiency and improve the over-all condition and well-being of the animal. Fifteen to twenty milligrams of Aureomycin per 100 pounds of body weight daily seemed to be about the right amount for dairy calves. In addition Knodt (1953) reported that the feeding of Aureomycin did not affect rumen or fecal flora in these animals as far as had been determined.

As information accumulated showing that the feeding of Aureomycin was beneficial to growing dairy calves and was not harmful to mature lactating cows, interest was renewed and further trials were undertaken to investigate the use of this antibiotic in rations for beef animals. The research information obtained to date by Cunha (1956) indicates the following benefits from Aureomycin feeding to beef cattle: 1) decreases incidence of scours, increases growth rate and reduces liver abcesses in calves. 2) may increase rate of gain and feed efficiency in fattening steers. 3) improves hair coat and causes more bloom in animals. Elliot and Maddock (1955) report that for continuous feeding, a level of 10 milligrams of Aureomycin per 100 pounds of live weight daily or 75 milligrams per head per day over the entire feeding period for yearling cattle gives optimal results. They also say that feeding Aureomycin has no detrimental effect on carcass grade or dressing percentage and may even increase carcass quality.

Reports made on use of antibiotics in sheep have been varied and in-consistent. Colby et al (1950a, 1950b) reported that 100 milligrams of Aureomycin daily was harmful to fattening lambs and concluded that the use of antibiotics in ruminant rations could not be recommended. Jordan (1952) conducted four feeding experiments involving 199 native and western lambs and concluded that Aureomycin could be included in lamb fattening rations at levels from 7 to 14 milligrams per lamb daily over a period of 100 days without causing the lambs to go off feed or increasing the incidence of scouring. Aureomycin at the level of 14.4 milligrams per lamb daily, however, reduced the rate of gain and feed efficiency. It was also observed in these trials that the Aureomycin-fed lambs were easier to get on full feed. In experiments conducted in Texas, Bridges et al (1953) showed that increases in rate of gain resulting from feeding Aureomycin were relatively small and were not statistically significant. An apparent improvement in feed efficiency was evident, however, when Aureomycin was fed at levels of 2.2 to 5.0 milligrams per pound of total feed.

An experiment involving 400 lambs was reported by Botkin and Paules (1955) in which the lambs fed antibiotics at the rate of 5 milligrams per pound of feed gained slightly faster and more efficiently than those not getting antibiotics, but feed cost per pound of gain was slightly higher for lambs receiving antibiotics. Both Aureomycin and Terramycin reacted in the same manner in this experiment. Botkin and Paules (1954) also reported that Aureomycin fed at the level of 10 milligrams per pound of feed gave some advantage in rate and efficiency of gain and dressing percentage, but was not economical because of the high cost of supplementation. Thomas et al (1956) showed that the addition of Aureomycin increased the cost of feed but did not increase the weight gains. Lambs fed the antibiotic in this experiment dressed out higher than any of the other lambs.

Johnson et al (1956) conducted an experiment involving 798 lambs maintained under feed-lot conditions and reported that the average final weights and average daily gains for the group receiving 10 milligrams of chlortetracycline per pound of feed continuously throughout the 48 days of the trial were significantly higher than the controls or other treatment groups. It was also concluded from this trial that antibiotic supplementation during the entire feeding period proved to be highly effective in the control of enterotoxemia since no death occurred in pens fed in this manner. In contrast, death did occur in the control pens and in pens which had received chlortetracycline for 21 days followed by no antibiotic. All deaths in this latter group occurred after the discontinuance of chlortetracycline supplementation.

Similarly, Kunkel et al (1956) reported that chlortetracycline apparently reduced the incidence of digestive disorders, diarrhea accompanying self-feeding and enterotoxemia in experiments conducted by these workers. No lambs were lost from enterotoxemia among those receiving the antibiotic in their ration (353 lambs total) while 4.3 percent were lost among those receiving no antibiotic (230 lambs total). Of the lambs in the chlortetracycline lots, 1.7 percent died from all causes as compared to 5.2 percent in the control lots. The authors stated that this effect of Aureomycin may have been the result of a transitory diminution of voluntary food consumption during the first two weeks of the feeding trial. In addition, the antibiotic supplementation in these experiments resulted in improved efficiency of feed utilization but no statistically significant differences in gain.

The results of two trials conducted by Elliot and Ellsworth (1953) to compare the effect of two levels of Aureomycin and three types of rations for feeder lambs showed a consistent increase in gain and improvement in feed efficiency with the addition of 10 and 20 milligrams of the antibiotic to rations of 80 percent hay-20 percent grain; as the percentage of grain was increased, however, the response became more variable. Conversely, Botkin and Paules (1954) reported that as the level of roughage in the ration increased, the rate of gain and the efficiency of feed utilization as well as the dressing percentage, decreased, with or without the addition of Aureomycin at the rate of 10 milligrams per pound of feed.

Some investigations have also been made on the use of antibiotics with young lambs other than feeder lambs. Kinsman and Riddell (1952) fed a creep ration containing 15 milligrams of Aureomycin per pound of concentrate to suckling lambs and found no appreciable difference in rates of daily gain due to the antibiotic. The Aureomycin group did show a slight advantage in amount of feed consumed per pound of gain, however. Luce et al (1953) reported that the use of Aureomycin at the rate of 10 milligrams per head per day for suckling lambs gave no increase in weight over the control group. This experiment also showed that the lambs that received Aureomycin until weaning did not gain weight as fast as the control group or the groups that received the antibiotic for a shorter period of time. No differences in health were noted in either of these experiments.

According to Madsen et al (1955), the addition of 10 milligrams of

Aureomycin per pound of concentrate mixture had no measurable effect upon growth rate and feed consumption of suckling lambs. During the first two weeks of a seven-week trial conducted by Daley (1956), Aureomycin apparently increased rate of gain of suckling lambs receiving different types of creep rations. At the end of the trial, however, results from the two groups receiving 20 milligrams of Aureomycin per pound of ration in two different types of pellets were conflicting. One group showed no increase in rate of gain but increased feed efficiency paid for the Aureomycin supplement while in the other group the highest rate of gain but the lowest feed efficiency was noted as compared to all the other groups.

In an experiment where detailed records were kept on lamb disease and mortality in connection with the feeding of chlortetracycline, McGowan (1957) concluded that the inclusion of the antibiotic in a grain ration for nursing range lambs exerted no influence on the incidence of a small pneumonic lesion which occurred in a high percentage of all the experimental lambs. There were, however, fewer losses due to enterotoxemia in the treated group than in the other groups. The treated group also showed an advantage in average daily gain, percentage of fat lambs at weaning time and carcass quality. The levels of chlortetracycline fed in this trial were changed as the lambs grew in an attempt to maintain a daily intake of 0.5 milligram of the drug to 1.0 pound of body weight.

Methods of administering antibiotics other than through the ration have also been used in work with suckling lambs. In the first of seven experiments reported by Jordan and Bell (1954), suckling lambs were drenched with 5 milligrams of Aureomycin HCl in solution daily for a period of 42 days. This practice resulted in an increased daily gain of 0.09 pound as compared to the control lambs. It was noted that the greater rate of gain, over-all thrift and bloom of the treated lambs was most apparent during the first four weeks of the trial which were rainy and cold. In the three trials which followed, the average daily gain of lambs consuming 4.3, 5.0, and 10.8 milligrams of Aureomycin per day for 33 to 50 days exceeded that of the controls by 0.08 to 0.10 pound. Also, feed per 100 pounds of gain was slightly reduced in the Aureomycin supplemented lots.

In the remaining trials reported by Jordan and Bell (1954), eighty milligrams of Aureomycin was subcutaneously implanted near the forerib of suckling lambs. No apparent physiological effects resulted and no significant effect on gain was noted. In an experiment conducted by Beeson et al (1954), the subcutaneous implantation of lambs at two days of age with 140 milligrams of Aureomycin HCl had no significant effect on growth rate. Similarly, no effect on growth rate was shown when lambs at an average age of 44 days were implanted with a total of 140 milligrams of Aureomycin per lamb.

In studies involving both fattening and other lambs, Bohman et al (1955) reported an experiment in which graduated levels of Aureomycin were fed to 120 fattening lambs and 20 orphan lambs from two to four weeks of age to market weight. These treatments did not significantly improve rate of gain, dressing percentage or carcass grade. Three trials involving 190 suckling and feeder lambs were conducted by Hatfield et al (1954) in which rations supplemented with Aureomycin HCl gave small but consistently higher average daily gains. In the pooled results of the trials, the lambs which received rations containing the antibiotic showed average daily gains higher by 0.055 ± 0.014 pound. Average feed efficiencies were also higher for the Aureomycin supplemented lots. The authors concluded from the results of these trials that antibiotics have a practical use in growing and fattening rations for lambs by improving rate and efficiency of gains and by reducing the number of unthrifty lambs.

The investigations made on use of antibiotics with lambs is well summed up in the statement of Jukes (1955):

> The experimental work with lambs indicates that a variable but predominantly favorable effect is obtained when lambs are fed a low level of chlortetracycline, about 10 milligrams per pound of diet. Many of the observed effects appear to be related to the suppression of harmful bacteria. High dosage with antibiotics may cause digestive disturbances. Good results have been found when antibiotics were fed to cull or scrub lambs.

Since both chlortetracycline and oxytetracycline have been classed as "broad spectrum" antibiotics, that is, those effective against many species of bacteria, it can be expected that they will give about the same results when fed at appropriate levels. Twenty-five milligrams per head per day is the amount of oxytetracycline recommended to give a substantial enhancement of both growth rate and feed efficiency in growing lambs as set forth in Pfizer Agricultural Technical Bulletin Number 27. In comparison, the amount of chlortetracycline recommended by Jukes (1955) is 10 milligrams per pound of diet.

Although the effects of antibiotics in livestock feeding have been shown to be beneficial in many cases, the way in which antibiotics act in order to produce such effects is still a question. Some of the postulations made by Jukes and Williams (1953), Rusoff et al (1954), Lassiter (1955), Jukes (1955), Maddock and Brackett (1956) and Bird (1956) may be summarized as follows:

1. Effect on gastro-intestinal microflora

   a) The antibiotics may inhibit or destroy organisms which produce subclinical infections; that is, they suppress organisms which produce toxic reactions and cause a slowing of growth of the host animal.

   b) Antibiotics may produce an increase in the number or activity of organisms which synthesize certain known or unknown vitamins or growth factors which are eventually made available to the host.

   c) Antibiotics inhibit organisms which compete with the host for available nutrients.

2. Antibiotics may have a direct effect by subduing or preventing definite infection or toxemia.

3. Antibiotics may cause a stimulation of the pituitary gland and an increased production of growth hormone.

4. Bone metabolism may be the area in which antibiotics exert their effect.

Transfer of Aureomycin into milk and effects

Because very little work has been reported where Aureomycin was fed to mature sheep, it is necessary to go to swine and dairy cattle nutrition in order to review this particular phase of antibiotic activity.

Concerning the effect of Aureomycin in dairy rations, Rusoff and Haq (1954) reported that milk production of Holstein cows and percentages of all constituents of milk which were studied were not influenced by feeding supplements of Aureomycin at the rate of 130 milligrams daily.

Studies have also been conducted where bacterial activity was used as the method of determining the presence of Aureomycin in the milk of cows which had received the antibiotic in their ration. Haq et al (1952) fed one group of Holstein cows 130 milligrams of Aureomycin daily and reported that the feeding of antibiotics had no effect on the bacterial flora of milk. This indicated to the authors that the antibiotic was probably not coming into the milk, or if present at all, was of such low concentrations as not to interfere with curd formation. The data reported by Martin et al (1955) showed no significant differences in total plate counts on the milk or in the amount of acid developed in milk inoculated with starter from the lots tested. The rate of Aureomycin feeding in this trial was equivalent to an average of 390 milligrams per cow daily.

As determined by chemical assay, no Aureomycin was found in the milk of cows fed 700 milligrams of the antibiotic daily for 10 days (Loosli and Warner, 1952). Similarly, the findings of Martin et al (1955) showed no detectable amount of Aureomycin in the milk of cows previously fed Aureomycin at the average rate of 390 milligrams daily or in the milk of cows currently receiving the antibiotic at the same rate. Maddock (1953) reported that approximately 1.5 milligrams of chlortetracycline per pound of body weight was required to obtain consistent detectable levels of the antibiotic in the milk of sows. This level of Aureomycin would correspond to 80 to 100 grams of chlortetracycline per ton of ration, depending upon the feeding rate.

Vestal (1951) fed spring gilts an Aureomycin supplement from the time they weighed 50 pounds until their first litters were farrowed the following spring. No beneficial results were obtained from the use of Aureomycin; in fact, feeding the antibiotic supplement to gilts resulted in smaller litters, lighter birth weights, weaker pigs at birth and greater mortality of pigs during the first three days after birth. A later experiment conducted by this same worker (Vestal, 1952) showed no apparent benefit from feeding Aureomycin to bred sows.

In a third experiment (Vestal et al, 1952), 20 grams of Aureomycin per ton of ration was used. Gilts fed this level of the antibiotic during gestation farrowed more and heavier pigs than those on the basal ration, but the death rate of the pigs was higher during the first three days after farrowing. In one group of gilts in which the Aureomycin was continued at the same level for mothers and their litters through lactation, as compared to mothers and litters on the basal ration and where Aureomycin was removed one week after farrowing, the pigs were slightly heavier and a higher percentage of the pigs were rated strong at eight weeks. The authors commented that the higher level of antibiotic apparently was necessary for a response from the pigs.

The 56-day weaning weights of pigs was increased from 25 to 36 pounds by feeding sows a diet containing 0.5 percent of an APF supplement which contained Aureomycin and providing a creep diet that contained 1 percent of the supplement in an experiment conducted by Carpenter (1951). Rather than attributing this growth stimulation to any substance transferred to the pigs through the milk, however, the author states that it was entirely due to the Aureomycin present in the APF supplement. This fact was demonstrated when a similar growth stimulation was obtained by feeding a creep diet containing pure Aureomycin. The litter size or size and livability of newly born pigs was not affected by feeding Aureomycin in this trial.

When Davey and Stevenson (1953) fed levels of 0, 10, 50 and 100 milligrams of Aureomycin per pound of diet to two generations of gilts from breeding time until their litters were weaned, the only significant benefit resulting from the feeding of the antibiotic was an increase in the weaning weights of the pigs. Beeson et al (1953, 1954), in two trials with swine, fed chlortetracycline supplemented rations to sows from pregestation to one week after farrowing and concluded that 20 to 45 grams of chlortetracycline per ton of ration increased birth weights of pigs 0.09 to 0.31 pound but did not improve the number of pigs farrowed per litter, the livability of pigs, the percent of pigs weaned or the weaning weight of pigs.

Maddock and Brackett (1956) summed up the effects of feeding Aureomycin to gestating and lactating swine by saying that the evidence strongly suggests that baby pigs benefit only indirectly from the feeding of this antibiotic to their dams during gestation and lactation. The possible benefits, according to these authors, may be the result of an improvement in the general health of the sow and a reduction in the over-all level of disease infection in the environment.

The only report of this type of investigation with ewes was an experiment conducted by Bassett (1957). Results of this trial showed no difference in average birth weights of lambs from ewes which had received 50 milligrams of Aureomycin per day for a month prior to lambing and those of lambs from ewes which had received the same pelleted ration without Aureomycin. The death loss of single lambs within the first week after birth was approximately the same for both rations, but there was a lower mortality in lambs from the antibiotic supplemented ewes both in twins during the first week after birth and also in all lambs for the entire trial period. Feeding an Aureomycin supplement to the ewes for an average of 18 to 20 days after lambing showed no benefit in lamb weaning weight in this trial. In fact, single lambs from mature ewes which received the control ration showed significantly greater gains to weaning than did single lambs from ewes receiving an Aureomycin supplemented ration. Differences noted in other groups were smaller.

Also in the foregoing experiment, laboratory assay of colostrum and milk samples showed a detectable transfer of the Aureomycin only when the ewe was being fed the antibiotic supplement at the time the sample was taken. The highest average level of Aureomycin content was found in the milk samples from two-year-old ewes which were receiving an average of 100 milligrams of Aureomycin per day.

Causes of death in lambs

In order to learn possible implications of the feeding of Aureomycin in relation to the prevention of death in lambs, it was thought that some literature review concerned with the actual causes of young lamb mortality would be advisable.

Many investigators report pneumonia as being one of the greatest single causes of death in young lambs. Reporting on data collected at the Montana Agricultural Experiment Station, Safford (1955) showed that 16 percent of the total death loss was due to pneumonia. Other workers set this figure as low as 10.14 percent (Matthews and Ogden, 1957) and as high as 30.4 percent (Venkatachalam et al, 1949). Another big cause is enterotoxemia. Other conditions associated with young lamb mortality are slinks, stillbirths, light birth weights and low vigor at birth.

All of the above mentioned workers as well as Bell (1947) and Hoversland et al (1955) showed that the rate of mortality is at its highest during the early life of the lamb with the greatest percent of the deaths occurring at birth or a very few days thereafter. These reports also show that well over half of all the lambs that died did so within the first two to three weeks after birth.

Although no references were found pertaining to the therapeutic treatment of lamb diseases with antibiotics, the effects of Aureomycin in rations for suckling lambs have been shown in another section of this review.

Importance of and factors affecting milk production

Several investigators have reported that one of the biggest factors in the rate of growth of young lambs is the milk yield of the mothers. Wallace (1948) and Burris and Baugus (1955) both showed that at the age of one month a value of 0.90 was found for the coefficient of correlation of the weight increase of the lamb with the milk it had consumed up to that time. Barnicoat et al (1949) reported this correlation as being the highest from four to six weeks of age when the lambs were able to consume all the milk produced and milk secretion was also at its peak. According to Hugo (1953) the milk production of ewes and the weight increases of the lambs were highly significant with the correlation coefficient of 0.8465. The results of Owen (1955) showed that in the early stages of lactation most of the variations in the growth rate of lambs were due to variations in the ewe's milk yield. It was also noted by these workers that, although this correlation remains high until weaning, it declines progressively as supplementary feed forms an ever increasing proportion of the lamb's diet.

Wallace (1948) also reported that the level of nutrition of the ewe during the last six weeks of pregnancy had a profound effect on both the birth weight of the lamb and the milk yield of the ewe as well as on the subsequent growth of her lamb. It was shown that the capacity of the young largely governs the actual yield of milk produced and that in many cases one lamb was unable to draw off all the milk available during the first few weeks of lactation. Milk yield reached its maximum during the second and third weeks and fell steadily thereafter.

The results of experiments conducted by Barnicoat et al (1949) showed that feeding during pregnancy was important for maintaining yield during the latter part of lactation but had only moderate influence on total yield, while feeding during lactation was the primary factor influencing both initial and total milk yield. Maximum yield was obtained by liberal feeding during late pregnancy and throughout lactation. It was also noted that single lambs were, in the case of high-producing ewes, unable to consume all the milk particularly during the early stages of life. The yield of ewes with twin lambs was about one-third higher than that of ewes with single lambs. These workers (Barnicoat et al, 1949) stated that since the excess milk production occurred at an early stage of lactation, when milk secretory activity was at its highest, any drying-off effect may have been offset as the lamb's ingestion capacity increased. Twenty to thirty days after lambing was given as the peak of lactation in these trials.

In other experiments where the plane of nutrition of ewes was varied during late gestation and lactation, Hugo (1953) reported that, over the lactation period of 13 weeks, high-level ewes produced an average of 2904.7 ounces of milk whereas the average production of low-level ewes was 1609.1 ounces. Thompson and Thompson (1953) stated that the milk yield of two-year-old Cheviot ewes on a fairly high plane of nutrition during late gestation and lactation, and suckling one lamb, was approximately 20 gallons in 13 weeks of lactation as compared with 11 gallons for those maintained on little more than half the quantity of nutrients supplied to the high-plane ewes. They concluded from this study that undernutrition in the later stages of pregnancy greatly affects the vitality of the newborn lamb and has a still more severe effect on the milk supply of the ewe, particularly in early lactation.

Coop (1950), on the other hand, showed that the level of nutrition during pregnancy had little or no influence on the rate of growth and the weaning weight of the lambs. Differences in weaning weights of the lambs were accounted for entirely by the level of nutrition after lambing. Klosterman <u>et al</u> (1953) also found no significant differences in growth rate of lambs due to prelambing nutrition. The results of three years of work carried out in New Zealand agree with those of the preceding workers, but it was stated that postlambing nutrition must be adequate in order to get satisfactory growth in the young lambs.

Snell (1936) reported an increase of 22.3 pounds in the average gain from birth to 120 days of lambs from ewes which had been full fed continuously as compared to lambs from ewes which had been one-third full fed continuously. The author stated that these differences were evident even though the lambs had been creep-fed grain and concluded that the amount of milk given by the ewe was the principal cause. In an experiment conducted at the Montana Agricultural Experiment Station, Van Horn et al (1957) concluded that increased feed levels in prelambing rations of ewes increased birth weights of lambs and pounds of lamb weaned per ewe.

An experiment was conducted by Bassett (1957) in which two groups of ewes with single lambs were fed only hay for ten days after lambing and were then given a pelleted supplement. Single lambs from mature ewes showed significantly less gain to weaning for the delayed feeding group compared to continued feeding after lambing. Lambs from two-year-old ewes showed a slightly greater but nonsignificant gain when supplemental feeding was delayed.

In persistency of lactation studies with dairy cows, Mahadevan (1951) concluded that improved feeding and management would bring about the greatest returns in the direction of improved persistency. This author also stated that it should be possible to combine high initial milk yield with high persistency to obtain increased total production. Gooch (1935) reported that the more persistent milkers tend to start their lactations relatively low. Sanders (1930) stated that maximum yield may be largely determined by the area of the mammary gland of cows, but persistency seems to be chiefly a nutritional factor.

Gaunya and Eaton (1953) were able to decrease the length of time required to reach the peak of lactation from the time of calving by approximately the same number of days as prepartum milking was begun. This practice, however, did not cause any definite differences in total yields of fat-corrected milk.

EXPERIMENTAL PROCEDURE

Experimental ewes and facilities

The experimental sheep used in this trial were bred ewes included in a range band owned by the Montana Agricultural Experiment Station. This particular group of sheep, totaling 672, is used principally for sheep breeding research, but it is also used for additional studies where such studies would not affect the breeding work. The band consists of purebred Rambouillet, Targhee and Columbia ewes with ages ranging from two to seven years old. The age distribution is similar to that of other range bands in the area with approximately 20 percent being two-year-olds, 5 percent seven-year-olds and the remainder distributed among the other age groups.

The major part of the experiment was conducted at the Fort Ellis farm, which is located 4 miles east of Bozeman, Montana, and is a part of the Montana Agricultural Experiment Station; however, because of lack of facilities, it was necessary to divide the band into two groups. About a month before the trial started, the Rambouillet ewes and half of the Targhee and Columbia ewes were trucked to the Rowe Ranch, located 32 miles west of Bozeman and also a part of the Montana Agricultural Experiment Station, from a White Sulfur Springs ranch where they had been wintered up to that time. The remainder of the ewes were moved to the Fort Ellis farm. The Targhee and Columbia ewes were divided into two separate groups according to breed, age and sire group in order to equalize any differences which might be due to these factors.

The mature ewes at the Fort Ellis farm remained there for lambing and approximately three weeks afterward. The period was about six weeks after lambing for the two-year-old ewes. At the end of these lengths of time, the ewes were again merged into one band at the Rowe Ranch where they were grazed on the range until the conclusion of the experiment.

Prelambing treatment

The ewes located at each place were divided into two equal groups according to breed, age and sire group. Before the ewes began receiving the supplemental pellets, they were weighed and paint branded according to the ration they were to receive. Those ewes at Fort Ellis which were to receive Aureomycin in their supplemental ration were branded with a black "2" on the head. A black dot on the hip served to designate the Aureomycin group at the Rowe Ranch. These brands allowed easy identification of the ewes when they were separated each morning for feeding. The groups which received the same supplemental ration without Aureomycin were not branded.

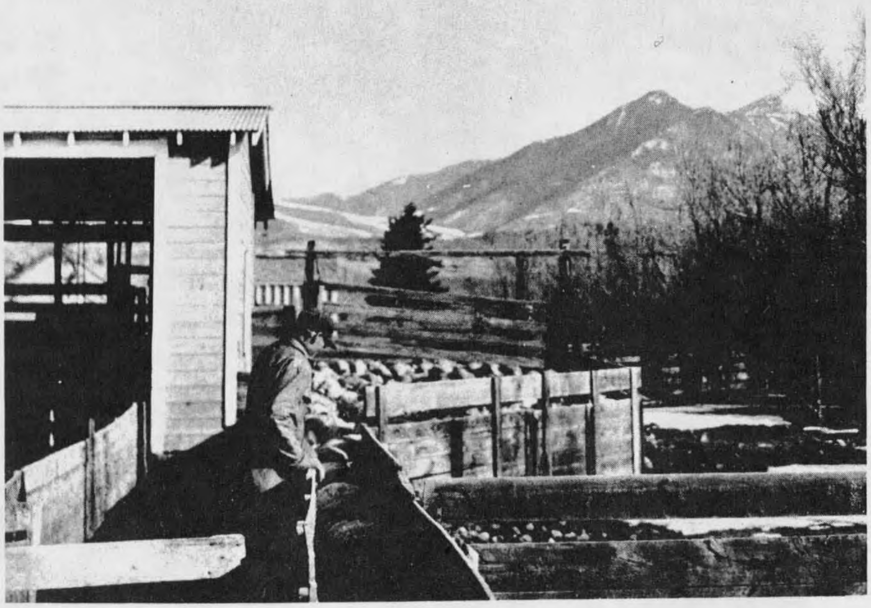

Figure 1. Separating the ewes for supplemental feeding.

Composition of the supplemental rations is shown in Table I. The control ration, which will be referred to as Ration 1, was of the same composition as Ration 2 except for the Aureomycin which was added to the latter at a level of 100 milligrams per pound of feed. Both rations were fed at the rate of one-half pound per head per day.

Table I. Composition of supplemental pellets

Ration number	1	2
Ingredients	Percent of ration	
Barley	27.5	26.5
Wheat mixed feed	25.0	25.0
Soybean oil meal	20.0	20.0
Linseed oil meal	5.0	5.0
Alfalfa, dehydrated	15.0	15.0
Molasses	7.5	7.5
Aurofac 10 1/	0.0	1.0
Total	100.0	100.0

1/ Contains 10 grams of Aureomycin per pound. When added at a one percent level to the ration, the Aureomycin content was 100 milligrams per pound.

Supplemental feeding began approximately a month before the start of lambing. The ewes were separated each morning by means of a cutting chute for the purpose of feeding the different groups their respective rations. After allowing sufficient time for the rations to be consumed, the ewes were combined into one group to beceive their hay and were then allowed to run together the remainder of the day. Since there was no grazing available at any time during this prelamb feeding period, the ewes were fed average quality alfalfa hay at the rate of about five pounds per head per day. This feeding continued for each ewe at Fort Ellis until her lamb was born. For the ewes at the Rowe Ranch, however, the Aureomycin feeding was discontinued as soon as lambing began and treatment for purposes of this experiment was concluded.

In addition to being weighed on the experiment on March 20, 1957, the ewes at Fort Ellis were reweighed on April 3 and again on April 10. Blood samples were also taken from eight ewes in each prelambing group on April 3 to be analysed for carotene, vitamin A and phosphorus content. No weights other than those recorded before the supplemental feeding began were taken on the ewes at the Rowe Ranch.

Postlambing treatment

Figure 2. Two brand new babies.

As the ewes at the Fort Ellis farm began lambing, the ewe and lamb or lambs were moved into the "jug" shed where they remained for about a day. During this time the lambs were weighed, eartagged, and docked with an elastrator. A paint brand number was put on the ewe and a similar number was also put on the lamb for identification. The following information was recorded: lamb number, ewe number, birth date, birth weight, sex, strength score and lambing brand. Scores for milking ability and condition as well as prelambing feed treatment and postlambing feed treatment of the ewe were other items recorded. Pertinent remarks were also recorded.

The ewes were assigned to a postlambing feed treatment on the basis of their age, their prelambing feed treatment and whether they had a single or multiple birth. The same rations used before lambing were also used after lambing, but by varying the amounts and times of feeding, eight different postlambing feed treatments were established. The ewes in each treatment lot were kept separated from ewes in other treatment lots at all times during the experiment.

Mature ewes with single lambs were divided into three lots and fed supplemental rations as follows:

Lot 1--1/2 pound Ration 1 per head per day after leaving the jug

Lot 2--1/2 pound Ration 2 per head per day after leaving the jug

Lot 3--1/2 pound Ration 1 per head per day commencing 10 days after leaving the jug

Two-year-old ewes were fed a higher level than mature ewes with single lambs because of the greater requirements due to the continuing process of growth:

Lot 4--1 pound Ration 1 per head per day after leaving the jug

Lot 5--1 pound Ration 2 per head per day after leaving the jug

Lot 6--1 pound Ration 1 per head per day commencing 10 days after leaving the jug

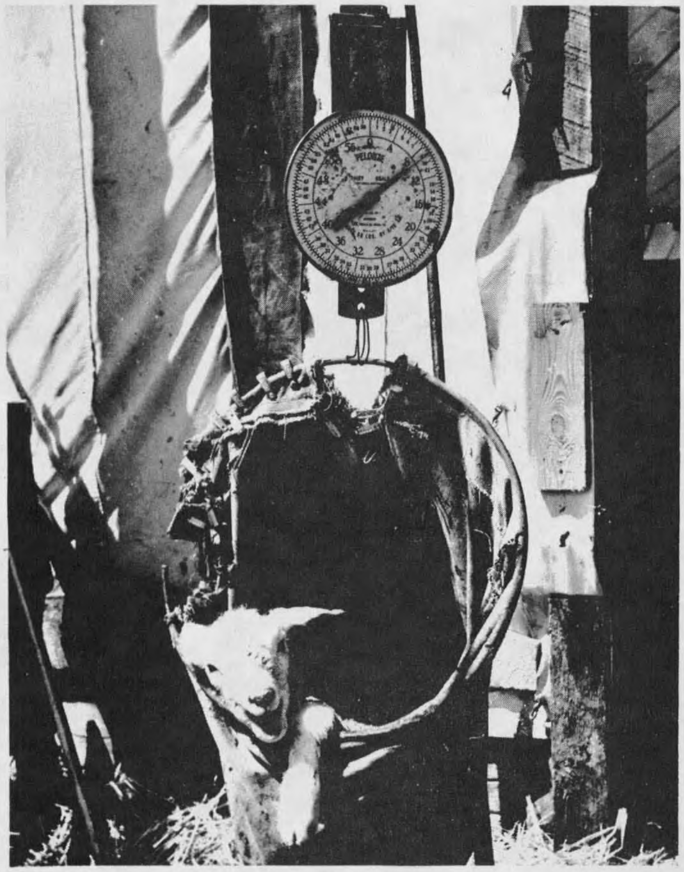

Figure 3. Getting the birth weight. Eartagging, docking, and branding were also done at this time.

There were only two treatments for mature ewes with twin lambs since all these ewes received supplemental rations as soon as they left the jug.

Lot 7--1 pound Ration 1 per head per day

Lot 8--1 pound Ration 2 per head per day

All lots received average quality alfalfa hay at the rate of about five pounds per head per day.

The ewes were placed on these treatments at random as they lambed, and an attempt was made to equalize the numbers of ewes from both prelambing feed treatments in each of the postlambing lots. Seven-year-old ewes were also distributed evenly in the postlambing feed treatments.

Two-year-old ewes having multiple births were allowed to keep only the largest lamb. This was done to minimize the drain on the ewe which was still growing. Also, the numbers of two-year-old ewes having twin births would probably not be great enough to justify another treatment.

The ewes and lambs were moved from the jug shed into doubling-up pens and were gradually worked into larger groups in about a week depending upon weather conditions and intensity of lambing. The lambs were carefully watched and a record was kept of signs of scours. No lamb was treated for this disorder until the symptoms were evident. Mortality records were also kept and any ewe which lost a lamb was removed from the experiment.

In order to keep the data from mature ewes lambing early separate from those lambing later and also to get a duplication of treatments, a second group, which will be referred to as Group II, was started on April 24 as this date was thought to be about the middle of the lambing period. The ewes in Group I remained on their respective feed treatments for a period

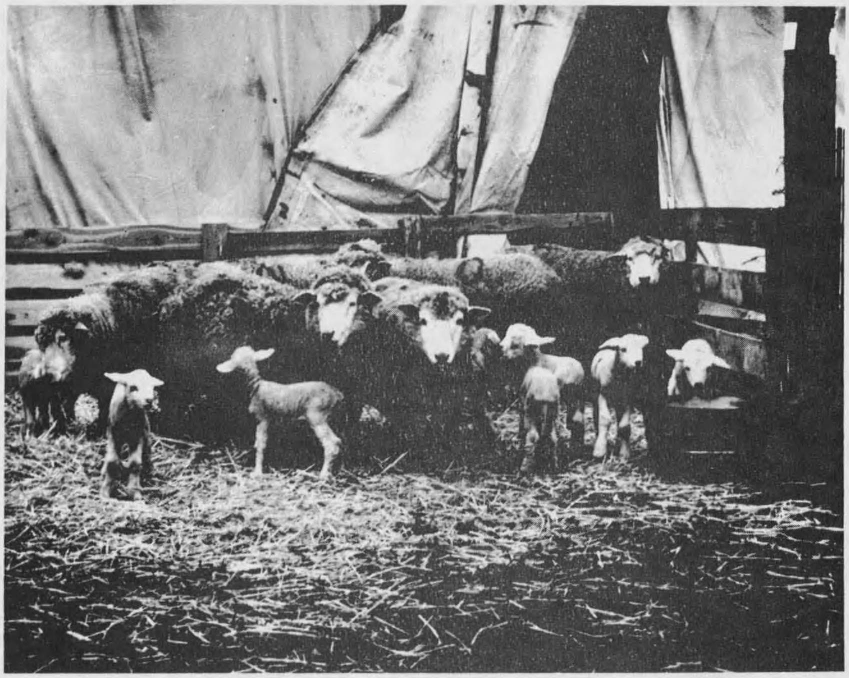

Figure 4. A doubling-up pen for mature ewes with twin lambs.

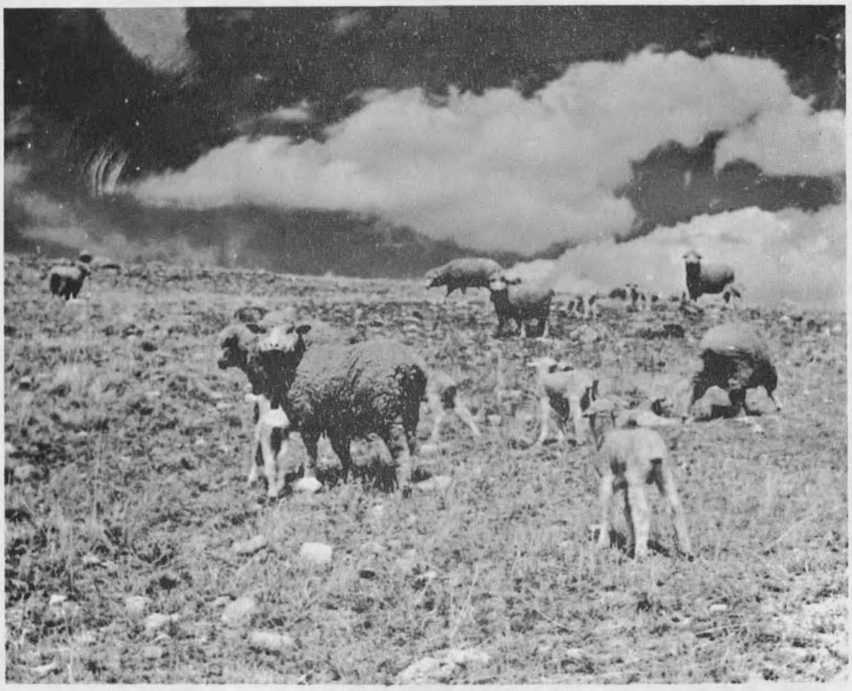

Figure 5. Ewes and lambs on the range.

of 10 days after April 24 before being moved to the range. Group II ewes were handled in exactly the same manner as the first group. They were fed supplemental rations until May 20, which was 10 days after the last ewe and lamb was assigned to a feed treatment. The ewes were then moved to the Rowe Ranch and mixed with the other groups on range. Because of the limited numbers, the two-year-old ewes were not divided into two groups; all of these ewes and their lambs remained on their respective feed treatments the entire period and were then moved to the range along with the Group II mature ewes and lambs. The ewes which had not lambed by May 9 were returned to the main band at the Rowe Ranch on that date.

All lambs were weighed and their weights recorded once a week as long as they remained at Fort Ellis. Each lamb was also given a shot of antitoxin for enterotoxemia. This vaccinating was done while the lambs were being weighed. Lamb weights were recorded again on June 24 for the Fort Ellis lambs as well as for the lambs which had been at the Rowe Ranch. All ewes were also weighed and their weights recorded just prior to leaving Fort Ellis.

Colostrum and milk samples

Samples of colostrum and milk were collected from ewes with single lambs to be assayed individually for Aureomycin content. Samples were not collected from ewes with twin lambs because it was felt that the lambs would need all the milk these ewes could produce.

A colostrum sample of about three ounces was hand-milked from one side of the udder soon after the lamb was born. The interval between lambing and collection of the sample varied considerably, but the majority of the samples were taken within two hours after birth of the lamb. The samples were frozen on dry ice in a portable icebox at the site and then stored in a freezer until shipped for analysis.

On the tenth day following collection of colostrum samples, milk samples were taken from the same ewes except those which had lost their lamb and were removed from the experiment. This milk collection was accomplished by separating the ewe and lamb for a period of about four hours prior to time of collection. These samples were quite varied in size, ranging from about one to three ounces. This variation was presumably due to differences in milk producing ability of the ewes. After collection, the samples were handled in the same manner as the colostrum samples and then they were all shipped together on dry ice to the American Cyanamid Company, Princeton, New Jersey, for determination of Aureomycin content.

Postmortem autopsy of lambs

In order to determine possible effects of Aureomycin in preventing mortality, all lambs which were born dead or died after birth were taken to the Montana Veterinary Research Laboratory for autopsy. The lambs were placed in a refrigerator as soon after death as possible until the autopsy could be performed.

RESULTS AND DISCUSSION

Lambing data

The average ewe body weights taken on three different dates prior to lambing are shown in Table II. The average body weight gain for the Aureomycin supplemented ewes from March 20 to April 10 was 20.3 pounds as compared to 16.2 pounds for ewes fed the supplement without Aureomycin. The greatest weight increase for both groups occurred during the initial part of the feeding period.

Table II. Average weights prior to lambing of ewes at Fort Ellis

Ration number Aureomycin	1 0	2 50 mg/day
Average body weight, lbs.		
Weigh date		
March 20	134.7	133.1
April 3	148.8	150.1
April 10	150.9	153.4

Blood samples were also collected from a representative portion of the ewes to be analysed for carotene, vitamin A and phosphorus content. This was done two weeks after the beginning of the feeding period. Table III presents the results of these analyses. Vitamin A and phosphorus levels were within the normal range for that time of the year according to Marsh and Swingle (1955). There was very little difference in the average phosphorus content, but the amount of vitamin A was higher in the Aureomycin group than in the control group. Carotene content was also normal as given by Pierce (1946) for sheep grazing on green grass. No reference was found concerning this value in sheep which were being fed alfalfa hay. Here again the level was higher in Lot 2 than in Lot 1, but there was also a large amount of individual variation in all these determinations.

Table III. Results of blood analyses of samples taken from ewes at Fort Ellis

Ration number Aureomycin	1 0	2 50 mg/day
Carotene, mcg. per 100 ml. plasma	5.54	7.88
Vitamin A, mcg. per 100 ml. plasma	25.94	31.58
Phosphorus, mg. per 100 ml. plasma	5.37	5.35

The first lambs were born on April 12. This date was earlier than expected and consequently the three lambs which were born to two ewes early that morning froze to death. Lambing then continued until May 9. A summary of lambing during this period is shown in Table IV.

Very nearly the same number of ewes lambed from each prelambing treatment. During the early part of lambing, quite a large number of ewes gave birth to twin lambs; however, this tendency for multiple births did not continue in the latter part of the lambing period. As a result, Group I contained a larger number of twin lambs than single lambs while the opposite is true for Group II. A total of ten more single lambs were born in prelambing Lot 1 than in Lot 2, whereas eighteen more twin lambs were born in Lot 2 than in Lot 1. None of the two-year-old ewes from the prelambing control lot gave birth to twin lambs. No reason other than chance can be given for this occurrence. Two sets of triplets were born — one in each prelambing lot and also one in each of the two postlambing mature ewe groups. The over-all lambing percentage for the lot which had received 50

Table IV. Lambing data of sheep at Fort Ellis

Ration number	1	2
Aureomycin	0	50 mg/day
	Number	Number
Ewes on experiment	92	91
Ewes lambing		
Group I, April 12-23	29	29
Group II, April 24-May 9	29	27
Two-year-old ewes, April 12-May 9	20	21
Total	78	77
Percentage ewes lambing to May 9	84.8	84.6
	Number	Number
Lambs born, dead or alive		
Singles		
Group I	15	12
Group II	22	20
Two-year-old ewes	20	15
Total	57	47
Twins		
Group I	28	32
Group II	12	14
Two-year-old ewes	0	12
Total	40	58
Triplets		
Group I	0	3
Group II	3	0
Total	3	3
Total of all groups	100	108
Lambing percentage	128.2	140.3

milligrams of Aureomycin per head per day was somewhat higher as compared to the control lot.

Average birth weights are shown in Table V. Average weights for the Aureomycin supplemented lot were higher than the control lot in all cases except for two-year-old ewes with single lambs. The average birth weight of all groups was also slightly greater for Lot 2 than for Lot 1; however, none of the differences in birth weight between Lot 1 and Lot 2 were significant at the 5 percent level. In all cases the average birth weight of lambs from Group II mature ewes was higher. This difference might be expected since those ewes had been on the prelambing feed treatment for a longer period of time than the Group I ewes.

Table V. Average birth weights of lambs at Fort Ellis

Ration number Aureomycin	1 0	2 50 mg/day
Average birth weight, lbs.		
Singles		
Group I	10.1	10.8 1/
Group II	10.4	11.3
Two-year-old ewes	9.4	9.3
Total	10.0	10.5
Twins		
Group I	8.9	9.5
Group II	9.1	10.1
Two-year-old ewes	0.0	7.7 1/
Total	9.0	9.3
Triplets		
Group I	0.0	9.0
Group II	8.8	0.0
Total	8.8	9.0
Average of all groups	9.5	9.8

1/ No weights were recorded for the lambs that froze to death the first night.

Each lamb was also given a strength score at birth. This score was

Table VI. Strength scores at birth of lambs at Fort Ellis

Ration number	1	2
Aureomycin	0	50 mg/day
Strength score	Number of lambs 1/	
1 - Big active lamb	3	1
2 - Above average	11	21
3 - Average lamb	81	75
4 - Below average	5	4
5 - Small inactive lamb	0	0
Total	100	101

1/ Lambs which died before tagging were not given any of these scores.

Table VII. Evidence of scours in lambs at Fort Ellis

Ration number	1	2
Aureomycin	0	50 mg/day
Lambs showing signs of scours	Number	Number
Singles		
Group I	10	9
Group II	6	6
Two-year-old ewes	12	9
Total	28	24
Twins		
Group I	16	21
Group II	3	5
Two-year-old ewes	0	5
Total	19	31
Triplets		
Group I	0	0
Group II	2	0
Total	2	0
Total of all groups	49	55
Percentage of lambs showing signs of scours	49.0	54.5

purely a visual estimate and therefore subject to error. Table VI gives the distribution of these scores. The number of lambs receiving each score was very similar for the two prelambing lots. It may be noted, however, that two more lambs from Lot 1 received the score of 1, which is the highest, whereas ten more lambs from the Aureomycin supplemented group were given the next best score of 2.

As was mentioned before, all lambs were observed each day and a careful record was kept of the signs of scours. These findings are summarized in Table VII. Here again only visual observation was used to determine this condition. Such an observation is subject to much inaccuracy because the distinction between an actual case of scours and normal baby lamb fecal matter is not a definite one. The general health and well-being of the lamb was used as a consideration in determining this distinction. The greatest difference noted in Table VII is the number of twin lambs showing signs of scours when comparing the two prelambing lots. This difference is especially noticeable in lambs from the early lambing mature ewe group. In the total of all groups, six more lambs from the Aureomycin supplemented lot showed signs of scours when compared to the control lot. The majority of scours were noted within the first two to three days after birth.

Death losses

Table VIII presents a summary of death loss both within the first week and after the first week. Here again, as in the incidence of scours, the greatest difference in death losses between Lot 1 and Lot 2 is found in twin lambs within the first week after birth with the difference being most noticeable in twin lambs from the early lambing mature ewe group. Eight

Table VIII. Death loss of lambs at Fort Ellis by periods

Ration number	1	2
Aureomycin	0	50 mg/day
Death loss within first week	Number	Number
Singles		
Group 1	1	1
Group II	1	1
Two-year-old ewes	2	2
Total	4	4
Twins		
Group I	0	5
Group II	3	1
Two-year-old ewes	0	2
Total	3	8
Triplets		
Group I	0	3
Group II	0	0
Total	0	3
Total loss within first week	7	15
Death loss after first week	Number	Number
Singles		
Group I	0	0
Group II	2	2
Two-year-old ewes	1	1
Total	3	3
Twins		
Group I	1	1
Group II	0	0
Two-year-old ewes	0	0
Total	1	1
Triplets		
Group I	0	0
Group II	0	0
Total	0	0
Total loss after first week	4	4
Total of all groups	11	19
Percentage death loss for entire period	11.0	17.6

Table IX. Death loss and autopsy reports of lambs at Fort Ellis 1/

	Lamb number	Age at death, days	Ewe ration Prelamb	Ewe ration Postlamb	Autopsy reports
Singles:	7215T	24	1	2	Pneumonia
	7614T	25	1	3	Rumen impaction
	7006K	2	1	5	Starvation
	7406K	10	1	5	Unknown, possibly toxemia
	No tag	0	1	-	Stillborn 2/
	7417K	7	1	1	Physical injury
	7219T	17	2	3	Physical injury
	7801T	6	2	4	No visible lesions
	7809T	2	2	5	Enteritis
	No tag	0	2	-	Cardiac anomaly 2/
	No tag	0	2	-	Froze to death 2/
Twins:	7612T	2	1	8	Navel ill and starvation
	7613T	2	1	8	Starvation
	7221K	3	1	7	Starvation
	7403T	11	2	7	Pneumonia
	7606T	2	2	8	Enteritis
	7810T	1	2	7	No visible lesions
	No tag	0	2	-	Stillborn 2/
	No tag	0	2	-	Cardiac anomaly 2/
	7414K	1	2	7	Pneumoenteritis
	7416K	5	2	8	Starvation
	No tag	0	2	-	Froze to death 2/
	No tag	0	2	-	Froze to death 2/
Triplets:	7211T	1	2	-	Uremia 2/
	7212T	2	2	-	Enteritis 2/
	7213T	3	2	-	Enteritis 2/

1/ Only those lambs where autopsy reports were available are included.

2/ Lamb died before ewe had benefit of postlambing feed.

more lambs were lost from the Aureomycin supplemented lot than from the control lot during the first week after birth. There was no difference in losses from each prelambing lot after the lambs were one week old. Table IX shows the causes of death as determined by autopsy.

In the case of lambs from prelamb Lot 1, starvation was the biggest cause of death. The dams of three of the lambs which died from this cause were receiving the pellet containing Aureomycin at the time of death while in the other case the dam was receiving the control pellet. Enteritis was the largest single cause of death in lambs from prelamb Lot 2. Two of the mothers of lambs which died from this cause were receiving the Aureomycin supplement at that time and the mother of the other two lambs had not had benefit of a postlambing feed other than alfalfa hay. Of the two lambs which died from pneumonia, one of their mothers had not received Aureomycin before lambing but had received it after lambing while the reverse was true for the mother of the other lamb. One lamb from each of the two prelamb lots was stillborn. Where a cardiac anomaly was the cause of death, both lambs were from ewes which had received the antibiotic supplement prior to lambing. There seems to be no definite connection with feed treatment in the other causes of death. One ewe from Lot 2 had a difficult time lambing and died two days later. The cause of death in this case was diagnosed as peritonitis.

Aureomycin assay of colostrum and milk

Results of assay for Aureomycin content in the colostrum and milk samples are given in Table X. Only three of the colostrum samples from Aureomycin supplemented ewes showed traces of the antibiotic, whereas none of the samples from ewes which had been fed the control ration showed a detectable amount of Aureomycin. In the case of milk, however, almost all the samples from ewes which were receiving the antibiotic at that time showed positive results. For the samples from ewes which had received Ration 2 prior to lambing and had shown a transfer of Aureomycin into colostrum, the milk sample did not contain the antibiotic in detectable amounts unless the ewe had continued to receive Aureomycin in her postlambing ration. The highest Aureomycin content was found in the milk of two-year-old ewes which had been receiving a ration providing 100 milligrams of the antibiotic per day.

Table X. Aureomycin assay of colostrum and milk samples

Prelambing ration Aureomycin	1 0	2 50 mg/day
Colostrum samples, number	22	17
Samples showing Aureomycin, number	0	3
Avg. assay, mcg./ml. of sample 1/	0	0.030

Postlambing ration Aureomycin	1 0	2 50 mg.	3 0	4 0	5 100 mg.	6 0
Milk samples, number	7	8	6	6	3	2
Samples showing Aureomycin, number	0	7	0	0	2	0
Avg. assay, mcg./ml. of sample 1/	0	0.051	0	0	0.100	0

1/ Aureomycin content was reported as micrograms of chlortetracycline per milliliter of sample. A biological method was used for assay.

The findings of Bassett (1957), who conducted a similar trial, generally agree with these results. His report, however, showed a greater number

Table XI. Average weights and weight gains of single lambs from mature ewes at Fort Ellis

Group I

Postlamb lot	1		2		3	
Aureomycin	0		50 mg/day		0	
Prelamb lot	1	2	1	2	1	2
Number of lambs	5	4	5	4	5	3
Average weights, lbs.						
Birth	11.0	10.0	8.6	11.0	10.2	11.4
May 3						
Weight	21.6	17.2	16.8	18.3	18.1	18.6
Gain	10.6	7.2	8.2	7.3	7.9	7.2
Daily gain	0.76	0.61	0.57	0.63	0.56	0.60
June 24						
Weight	53.6	49.2	48.2	53.0	53.4	57.6
Gain	42.6	39.2	39.6	42.0	43.2	46.2
Daily gain	0.65	0.62	0.60	0.66	0.66	0.72

Group II

Postlamb lot	1		2		3	
Aureomycin	0		50 mg/day		0	
Prelamb lot	1	2	1	2	1	2
Number of lambs	6	7	6	6	7	5
Average weights, lbs.						
Birth	9.9	10.6	11.5	11.8	10.3	12.2
May 20						
Weight	22.2	22.9	26.7	26.6	22.6	26.2
Gain	12.3	12.3	15.2	14.8	12.3	14.0
Daily gain	0.58	0.59	0.74	0.68	0.61	0.71
June 24						
Weight	43.5	42.3	46.2	47.4	42.0	43.2
Gain	33.6	31.7	34.6	35.6	31.7	31.0
Daily gain	0.57	0.58	0.62	0.63	0.60	0.56

of colostrum samples having detectable traces of Aureomycin and all of his average assay values were higher than those found in this experiment.

Average weight gain of lambs

Average weight gain of lambs is another measure used in this experiment to determine the effect of Aureomycin when fed to ewes. All lambs were weighed at the end of the supplemental feeding period just prior to being moved to the range and again on June 24 after they had been on the range for some time. Table XI presents the average weights and weight gains of single lambs from mature ewes for the two different weigh periods.

There were no statistically significant differences in the average daily gain of lambs at either of the weigh periods that could be attributed to postlambing feed treatment or time of lambing. No analysis was run on differences between prelambing lots because such an analysis was considered to be too complex for purposes of this paper. There was, however, a significant interaction ($P < .05$) between postlambing feed treatment and time of lambing at the end of the supplemental feeding period, but the trend was not consistent. In other words, the same feed treatment did not affect the lambs in both groups the same way. This significant interaction did not carry over into the next weigh period. The difference in average daily gain between early and late lambs at the second weigh period approached significance at the 5 percent level.

Average daily gain of twin lambs from mature ewes was also analysed statistically for differences due to postlambing feed treatment and time of lambing. These values for the two weigh periods are given in Table XII. No significant differences were found due to either of these variables at any

Table XII. Average weights and weight gains of twin lambs from mature ewes at Fort Ellis

	Group I			
Postlamb lot	7		8	
Aureomycin	0		100 mg/day	
Prelamb lot	1	2	1	2
Number of lambs	15	3	10	12
Average weight, lbs.				
Birth	8.8	8.9	8.9	9.7
May 3				
Weight	15.8	14.7	17.0	17.1
Gain	7.0	5.8	8.1	7.4
Daily gain	0.47	0.34	0.48	0.46
June 24				
Weight	40.6	38.7	38.5	43.8
Gain	31.8	29.8	29.6	34.1
Daily gain	0.47	0.43	0.43	0.50

	Group II			
Postlamb lot	7		8	
Aureomycin	0		100 mg/day	
Prelamb lot	1	2	1	2
Number of lambs	4	6	4	6
Average weight, lbs.				
Birth	8.4	11.1	9.9	9.2
May 20				
Weight	17.1	23.6	18.2	19.5
Gain	8.7	12.5	8.3	10.3
Daily gain	0.46	0.51	0.46	0.43
June 24				
Weight	30.2	38.0	32.5	34.9
Gain	21.8	26.9	22.6	25.7
Daily gain	0.40	0.45	0.43	0.44

period. There was a significant interaction ($P < .01$) between feed treatment and time of lambing at the end of the first weigh period. The trend was not consistent and the significant interaction disappeared at the second weigh period. Differences in average daily gain due to time of lambing were greater, though not significant, on June 24 than at the end of the supplemental feeding period. This particular relationship was also noted in single lambs from mature ewes which may indicate that the effect of time of lambing requires a longer period after the end of supplemental feeding to assert itself. Both single and twin early lambs from mature ewes showed higher average daily gains to June 24 than did the late lambs.

Table XIII. Average weights and weight gains of single lambs from two-year-old ewes at Fort Ellis

Postlamb lot	4		5		6	
Aureomycin	0		100 mg/day		0	
Prelamb lot	1	2	1	2	1	2
Number of lambs	6	7	5	6	6	6
Average weights, lbs.						
Birth	10.0	8.4	10.6	8.7	8.9	9.8
May 20						
Weight	29.1	23.8	27.5	25.8	25.1	27.0
Gain	19.1	15.4	16.9	17.1	16.2	17.2
Daily gain	0.66	0.62	0.67	0.61	0.66	0.61
June 24						
Weight	44.8	38.4	45.6	44.7	40.7	42.1
Gain	34.8	30.0	35.0	36.0	31.8	32.3
Daily gain	0.55	0.50	0.58	0.57	0.53	0.51

Because two-year-old ewes were not separated into early and late lambers, differences in average daily gain of the lambs due to postlambing feed treatment is the only variable on which a statistical analysis was applied.

Table XIII shows a summary of average weights and weight gains of single lambs from two-year-old ewes by weigh periods. The differences in average daily gain among the three postlambing feed treatment groups are very small and not statistically significant. These differences did increase, however, from the end of the supplemental feeding period to the next weigh period.

The average daily gain for all lots of lambs decreased when they were put out on the range as compared to the average daily gain during the time their mothers were on supplemental feed. It was also noted that the delayed supplemental feeding of ewes with single lambs for a period of 10 days after birth of their lamb caused decreased average daily lamb gains in some cases, but did not seem to have any great detrimental effect on the final weight of the lambs.

Average weight gain or loss of ewes

All ewes were weighed on April 10 before lambing began and again at the end of the supplemental feeding period before they were moved to the range. Average prelambing weights as well as average weight gain or loss to the end of the postlambing feeding period for mature ewes with single lambs are presented in Table XIV.

There appears to be consistent trend in these averages, but they indicate that the ewes had probably gained back some of the weight which had been lost when the lamb was born. In both early and late lambing ewes, the lot which had received the control ration lost more weight than the Aureomycin supplemented lot. In the case of the delayed feeding lots, the early lambing ewes lost the least weight as compared with the other two lots while the late lambing ewes which had been on the delayed feeding treatment lost the most weight when compared in the same way.

Table XIV. Average weights and weight gain or loss of mature ewes with single lambs to end of feeding period at Fort Ellis

Group I

Postlamb lot	1		2		3	
Aureomycin	0		50 mg/day		0	
Prelamb lot	1	2	1	2	1	2
Number of ewes	5	4	5	4	5	3
Average weights, lbs.						
April 10	158.0	159.8	146.6	147.5	153.8	165.0
Gain or loss to May 3	-8.6	-10.3	-6.8	-8.2	-5.2	-7.0

Group II

Postlamb lot	1		2		3	
Aureomycin	0		50 mg/day		0	
Prelamb lot	1	2	1	2	1	2
Number of ewes	6	7	6	6	7	5
Average weights, lbs.						
April 10	138.7	151.6	147.3	156.2	146.1	141.6
Gain or loss to May 20	-8.0	-6.0	-2.8	-7.0	-10.4	-8.8

Table XV shows the average weight gain or loss for mature ewes with twin lambs. The most unexpected condition as shown by this chart is the tremendous weight loss of the late lambing ewes. This situation cannot be readily explained because the ewes which lambed after April 23 had been on the prelambing supplemental feeding longer than the ewes which lambed before that date. This extra prenatal feeding should have caused the Group II ewes to be in better condition than the Group I ewes and consequently cause them to lose less weight during lactation. Also, all ewes with twins received twice as much supplemental feed as did the mature ewes with single lambs. It must be kept in mind, however, that very few numbers were involved in the late lambing ewes which had twin births.

Table XV. Average weights and weight gain or loss of mature ewes with twin lambs to end of feeding period at Fort Ellis

Group I				
Postlamb lot	7		8	
Aureomycin	0		100 mg/day	
Prelamb lot	1	2	1	2
Number of ewes	7	2	5	6
Average weights, lbs.				
April 10	153.6	146.0	153.6	159.7
Gain or loss to May 3	-11.7	-10.0	-13.2	-11.2

Group II				
Postlamb lot	7		8	
Aureomycin	0		100 mg/day	
Prelamb lot	1	2	1	2
Number of ewes	2	3	2	3
Average weights, lbs.				
April 10	164.5	130.0	132.5	136.7
Gain or loss to May 20	-33.0	-48.0	-29.0	-28.3

In general, the ewes which lambed after April 23 were lighter in weight on April 10 than those which lambed before April 23. This condition would probably be expected since the Group I ewes were carrying heavier fetuses at that weigh date.

The average weight gain or loss for two-year-old ewes with single lambs is given in Table XVI. This is the only class of ewes in which any group gained weight from April 10 to the end of the supplemental feeding period. This result indicated that the one pound of supplemental ration they received per day during the postnatal period was probably sufficient for them to lactate and also to continue growing. The ewes which were fed the Aureomycin supplement gained the most weight. This relation was also noted in comparable groups of mature ewes with single lambs. The delayed fed ewes lost the most weight.

Table XVI. Average weights and weight gain or loss of two-year-old ewes with single lambs to end of feeding period at Fort Ellis

Postlamb lot	4		5		6	
Aureomycin	0		100 mg/day		0	
Prelamb lot	1	2	1	2	1	2
Number of ewes	6	6	5	6	6	6
Average weights, lbs.						
April 10	132.3	134.3	138.0	135.3	121.3	134.8
Gain or loss to May 20	-2.2	+1.8	+3.2	+1.3	-3.3	-6.0

Rowe Ranch data

During the same period when the foregoing information was being collected at Fort Ellis, lambing was also being carried on at the Rowe Ranch. The first lamb was dropped on April 11. The ewes had been separated into two lots each morning and fed their respective prelambing rations for a period of 17 days prior to that time. Results of lambing, weight gains of lambs and death losses of lambs by periods are summarized in Table XVII.

Slightly more ewes from Lot 1 than from Lot 2 lambed by May 9. The to-

Table XVII. Lambing data, weight gains and death losses of sheep at the Rowe Ranch

Ration number	1	2
Aureomycin	0	50 mg/day
Ewes on experiment, number	245	243
Ewes lambing by May 9, number	222	211
Percentage ewes lambing by May 9 1/	90.6	86.6
Lambs born, dead or alive		
Singles, number	140	123
Twins, number of lambs	162	170
Triplets, number of lambs	3	9
Total	305	302
Lambing percentage	137.4	143.1
Average birth weight, pounds		
Singles	10.7	11.0
Twins	9.4	9.4
Triplets	8.7	6.9
Total	10.0	9.9
Average weight gains to June 24, pounds		
Singles	37.2	38.6
Twins	29.6	29.8
Average daily gain to June 24, pounds		
Singles	0.62	0.65
Twins	0.49	0.49
Death loss		
Within first week		
Singles	2	4
Twins	6	10
Triplets	0	3
Total	8	17
After first week		
Singles	10	5
Twins	14	6
Triplets	0	5
Total	24	16
Total death loss	32	33
Percentage death loss	10.5	10.9

1/ Data from those ewes lambing after May 9 are not included because the ewes from Fort Ellis were mixed with these on that date.

tal lambing percentages from the two lots were very similar. The greatest difference in type of birth was in Lot 1 where 17 more ewes had single births than did ewes in Lot 2.

The average birth weights according to type of birth were also very similar when comparing the two lots except in the case of triplets; however, very few numbers were involved in the latter. No statistical analysis was done on the triplet data because of the small numbers, and none of the other differences between lots were statistically significant.

There was very little difference between lots in average daily gain to June 24. For single lambs from Aureomycin supplemented ewes, the gain was slightly higher than for single lambs from control ewes but not statistically significant. There was no difference in average daily gain of twin lambs between lots.

In the case of death loss, it may be noted that, during the first week after birth, nine more lambs from Aureomycin supplemented ewes than from control ewes were lost, whereas after the first week, the mortality trend was reversed with the control ewes losing eight more lambs than the Aureomycin supplemented ewes. The totals for both lots over the entire period, however, were almost identical. In all cases more twin lambs died than did single lambs. Table XVIII shows the causes of death as determined by autopsy.

Pneumonia was a very prevalent cause of death. Of the nine lambs which died due to this condition, four were from control ewes, whereas five were from mothers which had been supplemented with Aureomycin. The four lambs which were stillborn came from Aureomycin supplemented ewes. Where a cardi-

Table XVIII.—Death loss and autopsy reports of lambs at the Rowe Ranch 1/

	Lamb number	Age at death, days	Ewe ration	Autopsy report
Singles:	3023H	1	1	No visible lesions
	6028H	20	1	Pneumonia
	8056H	6	1	Pneumonia
	7651T	19	1	Physical injury
	206D	1	2	Gastritis
	7040H	5	2	Toxemia from infected tail stump
	8052H	5	2	Pneumonia
	9333H	5	2	Pneumonia
	7052K	39	2	Pneumonia
	7441K	16	2	Cardiac anomaly
Twins:	3026H	8	1	Pneumonia
	5034H	4	1	Cardiac anomaly
	8024H	3	1	Pneumonia
	207D	1	1	Unknown
	9432H	6	1	Unknown, possibly toxemia
	7644T	7	1	Tetanus
	205D	0	1	Stillborn
	3005H	3	2	Cardiac anomaly
	No tag	0	2	Stillborn
	5054H	3	2	Pneumonia
	5061H	1	2	Cardiac anomaly
	7016H	2	2	Navel ill
	7437T	4	2	Enterotoxemia
	7033K	2	2	Pneumonia
	7253K	27	2	Physical injury
Triplets:	No tag	0	2	Stillborn
	No tag	0	2	Stillborn
	No tag	0	2	Stillborn

1/ Only those lambs where autopsy reports were available are included.

ac anomaly was the cause of death, the mother of one lamb had received the control ration and the mothers of the other three lambs had received the Aureomycin ration. Only one case of enterotoxemia was noted. This was in a lamb from a ewe which had received the Aureomycin pellet prior to lambing. The same was the case of the one lamb which died because of navel ill. One lamb also died as a result of tetanus. The mother of this lamb had not received an antibiotic supplement.

SUMMARY

The purebred ewe band of the Montana Agricultural Experiment Station was divided into two groups and managed at two separate locations during this experiment. Half of the ewes at each location were fed a pelleted ration providing 50 milligrams of Aureomycin per head per day, whereas the other half were fed the same ration without Aureomycin. This feeding was conducted over a period of approximately a month prior to lambing and was the complete treatment for the ewes at the Rowe Ranch. The ewes at Fort Ellis, however, were again divided into eight feeding lots after lambing and the mature ewes were separated into early and late lambers.

Average birth weights differed very little between prelambing lots. They were slightly heavier in favor of the Aureomycin lot at Fort Ellis, whereas the trend was in the other direction at the Rowe Ranch. Strength scores at birth and evidence of scours were tabulated for the Fort Ellis lambs. Strength scores were similar for each of the prelambing lots. In the case of scours, six more lambs from the Aureomycin lot than from the control lot showed signs of this disorder. The Aureomycin supplemented lot showed a greater total death loss than the control lot at both locations. The causes of death did not appear to be directly associated with the type of feeding.

The results of biological assay for Aureomycin content of colostrum and milk samples showed very little transfer of the antibiotic into colostrum; however, almost all of the milk samples from ewes which were being fed Aureomycin at that time contained traces of the antibiotic. There appeared to be no carry-over of Aureomycin into the milk of ewes which had

received the antibiotic prior to lambing but not after. The greatest amounts of Aureomycin were found in the milk of two-year-old ewes which were receiving an average of 100 milligrams of the antibiotic per day. No Aureomycin was found in samples from ewes which were not being fed an Aureomycin ration at the time the sample was collected.

Feeding an Aureomycin supplement after lambing or delaying supplemental feeding for a period of 10 days after birth of the lambs at Fort Ellis had no statistically significant effect on average daily lamb gain as compared to feeding a supplement without Aureomycin. Time of lambing also had no statistically significant effect on average daily gain even though the early lambs showed somewhat higher gain to June 24 than did the late lambs. A significant interaction between time of lambing and type of feeding was noted both in single and twin lambs from mature ewes at the first weigh period, but the trend was not consistent and the significant interaction did not carry over into the second weigh period. In almost all cases, the average daily gain of the lambs was less when they were on the range as compared to the average daily gain during the time their mothers were on supplemental feed.

The Rowe Ranch lambs were weighed only once after birth and this was on June 24. The average gains between prelambing lots to that date were similar and the differences were not statistically significant.

Ewe weight gain or loss to the end of the postlambing supplemental feeding period at Fort Ellis was also tabulated. All Aureomycin supplemented ewes with single lambs lost less or gained more weight during this period that did comparable ewes being fed in different ways. The only class of ewes in which any group on the average gained weight was two-year-old ewes with single lambs. Delayed feeding did not seem to have a very harmful effect on the ewes as indicated by average weight loss.

The results of this experiment would have been enhanced if weights had been taken on the ewes which had not yet lambed when Group II was started. This procedure would have given a more accurate estimate of weight gain or loss of ewes in Group II during the supplemental feeding period. Estimates of actual milk production of ewes receiving each feed treatment would have been helpful in determining if any difference in lamb rate of growth was due to the direct effect of Aureomycin in the milk or if it was due to an effect of the antibiotic on milk production. Graduated levels of Aureomycin would have resulted in more information concerning effects of this antibiotic when fed to ewes at different levels.

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Appendix A. t test--birth weight of lambs at Fort Ellis

Description	Calculated t-value	Significant t-value at P = .05	Degrees of freedom
Singles			
Group I	0.961	2.064	24
Group II	1.275	2.021	40
Two-year-old ewes	0.103	2.036	33
Total	1.325	1.984	101
Twins			
Group I	1.456	2.002	58
Group II	1.633	2.064	24
Total	0.889	1.986	94

Appendix B. Analysis of variance--average daily gain of single lambs from mature ewes at Fort Ellis

Source of variation	Degrees of freedom	Sum of squares	Mean square	F ratio
End of feeding period at Fort Ellis				
Among treatments	2	0.0205	0.0102	....
Between groups	1	0.0101	0.0101	....
Treatments X groups	2	0.1433	0.0716	3.36*
Error	57	1.2167	0.0213	
June 24				
Among treatments	2	0.0093	0.0046	0.41
Between groups	1	0.0367	0.0367	3.20
Treatments X groups	2	0.0263	0.0132	1.15
Error	57	0.6549	0.0115	

* Significant at $P < .05$

Appendix C. Analysis of variance--average daily gain of twin lambs from mature ewes at Fort Ellis

Source of variation	Degrees of freedom	Sum of squares	Mean square	F ratio
End of feeding period at Fort Ellis				
Between treatments	1	0.0000	0.0000	....
Between groups	1	0.0007	0.0007	....
Treatments X groups	1	0.0196	0.0196	12.98**
Error	57	1.0848	0.0015	
June 24				
Between treatments	1	0.0001	0.0001	0.01
Between groups	1	0.0175	0.0175	1.94
Treatments X groups	1	0.0000	0.0000	0.00
Error	57	0.5141	0.0090	

** Significant at $P < .01$

Appendix D. Analysis of variance--average daily gain of single lambs from two-year-old ewes at Fort Ellis

Source of variation	Degrees of freedom	Sum of squares	Mean square	F ratio
End of feeding period at Fort Ellis				
Among treatments	2	0.0002	0.0001	0.0008
Error	32	0.4161	0.1301	
June 24				
Among treatments	2	0.0179	0.0090	1.29
Error	31	0.2151	0.0069	

Appendix E. t test--birth weight of lambs at the Rowe Ranch

Description	Calculated t-value	Significant t-value at P = .05	Degrees of freedom
Singles	1.259	1.970	251
Twins	0.395	1.967	330

Appendix F. t test--weight gain to June 24 of lambs at the Rowe Ranch

Description	Calculated t-value	Significant t-value at P = .05	Degrees of freedom
Singles	1.373	1.971	235
Twins	0.386	1.972	200