THE USE OF HORMONES FOR EARLIER LAMBS

by

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INTRODUCTION

Fall lambs are desired by a large proportion of commercial lamb producers in Kansas. The fall lambing program allows the utilization of cheap winter wheat pastures, allows the lamb to grow and develop during the cool part of the year when internal parasites are at a minimum, and the lambs go to market in the spring of the year when fat lamb prices are usually the highest. Unfortunately not all of the ewes in most flocks will breed for fall lambs, since the normal breeding season for sheep is in the fall with the lambs being dropped in the spring.

Percentages of ewes lambing before December 1st in flocks bred for fall lambing may vary from a low of five or ten per cent up to possibly 90 to 95 percent. Practical sheep men have varying ideas concerning the factors which influence or determine this early lambing behavior. It is believed that temperature plays an important role and that the ewes will breed more readily if the season is cool. In some areas of the United States the rams are not turned in with the ewes until the first hard frost.

The practice of "flushing" or feeding the ewes well preceding the breeding season is regarded as a desirable practice by most practical sheep men. While there is some experimental evidence to show that "flushing" may increase the number of twins, evidence is far from conclusive that extra feed will bring about earlier breeding activity. Some sheepmen believe a rest period between the time the lamb is weaned and the start of the breeding

season is necessary for early conception. Others believe the ewes will breed just as readily with their lamb still nursing.

Australian sheepmen turn vasectomized rams in with the ewes a month or six weeks before they want to start the breeding season, believing that the ewes come in heat and breed more readily because of their association with the vasectomized rams. This sexual response is known to exist in case of the female apes and possibly in some other animals.

It has been known for many years that light plays a very important role in reproductive activity and a practical application of this fact is employed in poultry production. In recent years research workers have shown that ewes will respond sexually to varying proportions of light and darkness and ewes have been brought from an inactive state into breeding activity by gradually reducing the proportion of light to the proportion of darkness received by the ewes each day. While such measures have been fairly successful, practical application appears limited.

Hormones of different kinds and types have been used experimentally as well as in commercial flocks for a number of years in an effort to secure earlier and more uniform lamb crops. While some initial studies have produced glowing accounts of possible success, no hormone or hormone combination has yet been found that will uniformly cause ewes to conceive earlier than normal. Recent reported success of progesterone-pregnant mare serum therapy promoted the study with these materials reviewed in this

thesis. Additional work was done with an estrogenic material, ECP, in an effort to learn more of its effect upon the reproductive activity of ewes.

The study of hormonal treatment to induce estrus in anestrus ewes would not be complete without some knowledge of the female reproductive cycle and the part that hormones play in that cycle.

The anterior pituitary gland initiates the process when the ewe is of sufficient maturity to breed. It sends out a hormone whose function is to stimulate the ovary to prepare an egg for further fertilization. The hormone is aptly termed the follicle stimulating hormone or FSH. Under its stimulation one or more eggs begin to form and as they develop a cavity, the follicle, is formed around the egg. The follicle is filled with a fluid rich in the female hormones, namely estrogen produced by the ovaries. The hormones produced take over several functions of the reproduction cycle such as preparing the uterus for possible implantation, development of the mammary system and to produce the characteristics of heat or estrus. When the level of the hormones reaches a certain height it suppresses the further production of the FSH. This level is reached at about the same time as the time that the egg reaches maturity.

When the production of FSH is inhibited the anterior pituitary produces another hormone called the leutinizing hormone or the LH which causes the egg in the ovary to be expelled. Another important function of the LH is to cause the growth of a new

ductless gland in the follicle or the cavity in the ovary where the egg had been. This cavity and its fluid is sometimes called the yellow body or corpus luteum. According to some authors, upon stimulation from another hormone of the anterior called the luteotropic hormone or LTH the corpus luteum produces a hormone, progesterone. This hormone completes the development of the uterus which was started by the female hormone, thusly there are estrogens, progesterone, and gonadotrophic hormones involved.

It would appear logical that by the use of one of the hormones mentioned or by using chemical substances with like properties, it would be possible to launch the reproductive cycle during the anestrus period. Unfortunately, the task is much more difficult than it seems. Much work has been done along this line but at present the results are not too encouraging. It has been possible to induce estrus with estrogenic materials and to induce ovulation with Pregnant Mare Serum independent of each other but very little success has been accomplished in obtaining both simultaneously.

LITERATURE CITED

One of the first reports of work done in the attempt to induce estrus in anestrus ewes was done by Cole and Miller (1933). Sixty-one ewes were injected with the gonad-stimulating hormones of Pregnant Mare Serum in an attempt to bring about estrus and ovulation during anestrum. Ovulation was produced by a single injection of 50 rat units or more of gonad-stimulating hormone.

However, the ewes did not come into estrus. Further, if injections were made on several consecutive days the ewes did not exhibit estrus, but if a second injection followed the first after an interval of 16 days both ovulation and estrus were produced. A high percentage of fertile matings resulted from this procedure. In another group in which the second injection was made 14 days instead of 16 days after the first, only two out of 15 ewes came into estrus. A third injection 16 days after the second resulted in eight out of 13 ewes coming into estrus on the second day following injection. The evidence leads one to believe that the cyclic phenomina associated with the estrus cycle are activated by a single injection of gonad-stimulating hormone, but that the second stimulus must be applied after a specific time interval in order that all the events associated with estrus may be manifested. Therefore, the results show that the administration of sufficient amounts of the gonad-stimulating hormone at proper time intervals will result in estrus, ovulation and conception following breeding during the anestrus period.

Despite the apparent success of this work, Cole, et al (1946) attempted to condition the ewes with estrogen sufficiently long before the injection of the PMS to avoid the inhibitory effect on ovulation. In another experiment Cole, et al (1946) found that estrogen and PMS were not successful in producing estrus and ovulation or a normal estrus. When the dose of estrogen was too low (100 to 400 r.u.) heat was not regularly induced whereas if the estrogen level was too high ovulation was

inhibited. The two were used in combination, one group of ewes being injected with 100 r.u. of estrogen daily for 15 days and then PMS for six days after the last injection of estrogen and another group receiving identical treatment except that the dose of estrogen was 400 r.u. daily. Six of 10 ewes came into estrus during the estrogen treatment but only one after the injection of PMS, when ovulation would be expected. Five of these ewes were force bred 72 hours after the injection of PMS but none became pregnant. The five remaining ewes were sacrificed and only one had ovulated. Two ewes receiving 400 r.u. of estrogen daily had no evidence of ovarian activity whereas one of three receiving 100 r.u. had ovulated and the other two had ripe follicles present.

In addition to untreated controls for the above group, there were four ewes which received estrogen alone for the same time interval: two at the 100 r.u. and two at the 400 r.u. levels with autopsy 13 days after the injection. All had quiescent ovaries. Thus ovarian activity was not stimulated by the injection of estrogen as has been done in the rat. Five untreated controls were sacrificed at the same time. One ewe had a corpus luteum in one ovary but none had shown evidence of estrus during the experimental period even though estrus smears were maintained over the injection interval. On autopsy all showed quiescent ovaries. Four other ewes received the same dosage of PMS alone on the same dates. Three of the four showed sexual receptivity within 96 hours after the second injection of PMS and all had corpora lutea

on autopsy. Of four untreated controls, none came into estrus but two had corpora lutes in their ovaries on autopsy. Clearly the injection of estrogen inhibited ovarian function under the conditions of this experiment.

Of interest are the conclusions drawn from Cole, (1935) in which they state that with repeated injections of 100 r.u. of PMS, ovulation and sometime estrus can be induced. The combination of estrogen and PMS does not result in a combination of their effects, although they proved that estrus can be induced with PMS collected between the 200 and 300th day of pregnancy of the mare. This would tend to disprove Lopyrin, and Loginova (1939). They obtained their best results with PMS from mares between the 53rd and 68th days of pregnancy. They also found the PMS from different mares had different effects. Some was ineffective in all cases, some was effective in 3 cc. injections and some was effective in 8 cc. injections. Best results were obtained by injecting 14 days after estrus and again at the start of estrus.

The object of this experiment was not to induce estrus but to attempt to get a higher lambing percentage. The injected ewes had a 195.9 lambing percentage against 151.2 for a control group. Of interest is the extremely high mortality rate of the lambs and ewes reported.

Since large amounts of estrogen seem to depress the activity of the pituitary in its production of the gonad-stimulating hormone and small amounts seem to stimulate it, varying doses

have been tried in the attempt to find the right amount to set the cycle in motion. Frank, and Appleby (1943) used stilbesterol and PMS injected subcutaneously. Eleven of twelve ewes showed estrus when treated with 2 mg. on the first day and 1 mg. on the following day. Most ewes showed signs of estrus around 48 hours after the first injection. Six ewes were teased with the ram every day for 20 days during which time no injections were made to determine if spontaneous estrus would occur. Five of the six had had estrus induced. It was found that none occurred spontaneously and was assumed that ovulation did not occur. Laparotomies were not performed, however. All ewes showing signs of estrus did so within 96 hours after the first injection.

In another group the ovaries were stimulated directly by injections of PMS. Five ewes were injected with 5 to 10 cc. of PMS and killed on the third day. One or two follicles in the ovaries of each ewe appeared to be stimulated slightly as judged by their size, but ovulation had not occurred.

Six ewes were each given a single injection of 5 cc. of PMS. All of these ewes were force bred on the second, fourth and fifth days. One ewe came into estrus and was bred on the sixth day. On the eighth day, laparotomy was performed on two ewes. Ovulation had occurred in both animals. Pregnancy was not induced in either case.

Since estrus did not evidence itself with large doses of PMS it was thought that smaller doses might bring it about. Three ewes were given amounts of smaller daily doses. The first

dose was 2½ cc. each. Beginning on the 3rd day, each was given 1 cc. daily. In two ewes, daily injections were continued for six days but estrus was not induced. One of these had ovulated when laparotomy was performed. Another ewe was given daily injections for three days at which time she came into estrus and was bred. Ovulation was induced, as was found later upon laparotomy, but she did not become pregnant.

There have been a number of experiments that have substantiated the induction of estrus and ovulation although not many have obtained the two at the same time.

Van Der Moot, et al (1946) worked with several extracts in an attempt to induce mating and lambing in anestrus ewes. Of a total of 177 ewes injected with PMS alone 77 per cent came into estrus and mated, 12 per cent after an initial injection and 64 per cent after a second injection, which was usually made 16 days after the first. Only 39 per cent of the treated ewes lambed. The results of the several groups are variable. On the basis of the number of ewes injected, the percentage of those mating varied from 61.9 to 100 and the percentage of those lambing varied from 20 to 100. On the basis of the number of injected ewes that mated the percentage of those lambing varied from 27.7 to 100 per cent.

Horse-pituitary extracts were used by Frank, and Appleby (1943). Three doses were given to 14 ewes which were killed 53 hours or more after injection and only one had not certainly ovulated. The lowest dosage that induced ovulation being 15 mg.

The one animal that did not ovulate had a large corpus luteum which was probably derived from a follicle luteinized without ovulating. Of five animals which received progesterone and horse-pituitary extract, four had ovulated upon killing three days later. Ovulations were obtained from three ewes that received chorionic gonadotropins from pregnancy urine following horse-pituitary. The authors stated that the ovulations probably occurred before the U. P. was given.

All of five ewes ovulated three days after receiving 1/2 or more mg. of estradiol benzoate or stilbesterol dipropionate. Of six killed four or more days after injection two had not ovulated. Free stilbesterol given by mouth or vagina induced no ovulation within 77 hours in four ewes.

In addition to the above work the same authors did work on estrogen in which they found that all of 15 animals which had received PMS and 0.5 to 1.0 mg. of estrogen had ovulated.

Twenty-nine ewes received one to three injections of prolan varying from 20 to 40 and 200 to 300 m.u. with 21 or 70 per cent coming into heat and 19 or 65.5 per cent lambing. Another 29 ewes were injected from two mares with 20 to 100 cc. of PMS, with 25 coming into heat and 17 lambing. The lowest dose was the optimum, giving 100 per cent incidence of heat and 80 per cent fertility as reported by Litovcenko, I., (1936).

Bell, et al (1941) using PMS induced ovulation in seven of eight ewes. None of the ewes showed signs of estrus. Ovulation was produced in two of four ewes receiving PMS followed by

Progynon-B, three ovulated and one of these came into heat. The other ewe neither came into heat nor ovulated. Five of eight ewes receiving Progynon-B alone came into heat. All of four ewes ovulated when treated with sheep anterior pituitary extract.

Other work by Bell, et al (1941) resulted in 21 of 22 spayed yearling ewes, following injections of 1000 r.u. of Estradiol, coming into heat.

The results of Robinson (1950) substantiates the previous work.

In another experiment the same authors treated thirty-six ewes with testosterone propionate alone and in conjunction with PMS.

In those treated with 35 mg. of testosterone followed by 800 i.u. of PMS they found that heat occurs usually without ovulation. When both occur it results in cystic ovaries in almost all cases.

When testosterone was injected with or after PMS a high percentage of cystic ovaries resulted. In some cases ovulation without heat occurred before the inhibitory mechanism came into force.

They also theorized that the lack of fertilization was not due to the inability of the sperm to reach the fallopian tubes but in some cases at least, is due to faulty timing of service.

At the present time there seems to be an excellent chance that progesterone may be able to accomplish the job of inducing estrus with ovulation and with resultant conception and lambing.

Casida (1953) stated:

> The work certainly needs to be checked, but if it works I would suspect that the use of progesterone to prevent quiet ovulations for a time before treatment with PMS is one of the main factors in its success. This is based on the demonstrated facts that functional corpora lutea will prevent behavioral estrus, but not ovulation when gonadotrophs are injected and that they will also prevent fertilization.

On the other hand Malbandov (1953) reported that on analysis of his data the analysis was less encouraging than they had originally thought. Both plan to continue the study with progesterone and PMS as a means of inducing estrus in the anestrus ewe.

Early work done by Dempsey, et al (1936) indicated that after conditioning with estrogen, estrus is caused by the action of progesterone, produced under the influence of the luteinizing hormone during the preovulatory enlargement of the follicle. This work was in opposition to the previous theory that progesterone inhibited the onset of estrus. Dempsey and associates stated that progesterone and estrogen act synergistically to produce estrus. It is conceivable that the suppressing action of the corpus luteum might be due to another hormone of the corpus luteum other than progesterone.

Cole, et al (1946) studied the effect of progesterone with PMS. In a previous study they had found the ovaries of ewes injected with PMS to be smaller than the normal and thought it might be due to the inadequacy of progesterone secretion by the corpus luteum formed as a result of a first injection. Eleven ewes were injected with PMS and progesterone. The dosage being 250 to 600 i.u. of PMS and 10 to 30 mg. of progesterone. The

injections were made simultaneously. Three of the 11 ewes came into heat within 72 hours but the results were inconclusive since two ewes which received PMS alone also came into heat or showed sexual receptivity.

Eleven other ewes were given similar doses but the progesterone was given either one or two days after the injection of PMS. The object of this delay in the administration of progesterone was to allow time for the priming action of estrogen to occur; the estrogen to be formed as the result of the PMS injection. The results were comparable to ewes receiving PMS alone as only two of the injected ewes came into estrus. From this, indications are that PMS supplemented with progesterone is slightly more effective than PMS alone.

These workers also studied that action of PMS supplemented with both progesterone and estrogen. Their first work indicated that 400 r.u. of estrogen inhibited ovulation and estrus when given with progesterone and when it was not given with progesterone. Progesterone seemed to have no effect on either ovulation or estrus. The results were difficult to evaluate because three of four ewes receiving PMS alone came into estrus.

In other work Cole and associates (1933) injected progesterone in one large dose. Three of seven ewes came into estrus when given two injections of PMS alone. About the same number of ewes responded when progesterone was given with PMS. When 500 r.u. of estrogen were given 16 days and 300 mg. of progesterone 13 days before the initial PMS injection six of eight

ewes came into heat.

It appears that the effect of PMS was enhanced by the prior injection of these hormones. The fact that only one of six ewes bred in this group became pregnant is of note. This experiment, like the preceding one, provides little evidence regarding the synergistic action of estrogen and progesterone in producing sexual receptivity in the ewe.

Dutt, (1952) working with Hampshire-cross western ewes obtained excellent results with five injections of progesterone followed by PMS. This work, along with many other reports, establishes the fact that estrus can be induced with estrogenic substances and in some cases ovulations can be brought about at the same time. The question now arises as to why estrus and ovulation can not be induced simultaneously by the use of hormones in all cases. It would seem that mating and conceptions could be obtained by injections if the two were syncronized properly.

Lopyrin, and Loginova (1940) studied the motility of spermatozoa in the genital tract of the ewe. They found that two hours and five minutes after breeding motile sperm was in all parts of the uterine horn but not in the fallopian tube. Sperm did enter the tube eight hours and 40 minutes after copulation. Indications from their report are that the fallopian tube becomes pervious to spermatozoa after a definite period which falls 15 to 17 hours before ovulation. They found from this study that the corpus luteum of the induced ewe is not the same as a normal corpus luteum. Removal of the corpus luteum in nine sheep caused an

onset of heat and reduced the interval between two cycles by 5 to 11 days. They also stated that induced corpus luteum does not disturb normal periodicy. This latter statement may be subject to controversy.

Anderson, (1938) injected 113 suckling ewes intramuscularly with estradiol benzoate and 84 or 74.3 per cent came into heat within 21 days. The maximum response was to 5000 to 6000 i.u. and those responding resumed a normal estrus cycle.

Variable results were obtained with injections of estrogens alone or given with gonadotropins and gonadotropins or estrogens given during the natural breeding season as reported by Philip, et al (1945). In some cases there was no increase in fertility while in other instances there was an increase in the per cent of conceptions and birth rate. In those animals in which estrus was induced there was an erratic induction of estrus with ovulation and a lower percentage of conception in animals induced. There was also a lower percentage of conception in those ewes force-bred after injection than those bred during the normal estrus.

It is difficult to estimate the percentage of low fertility due to no conceptions and that due to uterine death of the embryo. Casida, et al (1944) conducted experiments in which 25 ewes were treated with follicle stimulating and luteinizing extracts of sheep pituitary. Treatment started on the 12th day of the estrus cycle and terminated on the day of normal estrus five days later. The ewes were mated or artificially bred and later

checked for superovulation.

The viability of the artificially induced multiple pregnancies was checked by observations on different animals at two to five days, 14 to 27 days and 30 to 37 days. The number of ewes found to be pregnant were six of seven in the first group, 3.4 in the second group and 0.8 in the last one. In the latter group many dead and degenerating embryos were found. The number of corpora lutea for the three groups was approximately the same being 20.8, 23.2 and 24.6, leading to the belief that the initial ovulation and fertilization rates were comparable.

The authors advanced two possible theories as to the cause of the embryonic deaths. One, that there was inadequate uterine environment due either to a direct or an indirect effect of treatment; or two, that the rapid maturation of the follicles induced abnormalities in the ova.

An effort was made to obtain additional information on the cause of uterine death by transplanting fertilized ova from induced ewes to the uteri of normal ewes at a comparable time in the estrus cycle. Only three of these survived long enough to interrupt the estrus cycle of the host ewes. No conclusions can be accurately drawn from this work because the efficiency of the transplantation technique is unknown.

In other work done by Casida, et al (1944) the fact was established that in some cases at least the ewes can maintain pregnancy without the presence of corpora lutea after the 55th day of gestation.

The potential fertility of ova from ewes treated with gonadotropins was investigated by Murphee, et al (1944). The proportions of corpora lutea represented by recovered eggs were lower in the luteal and anestrus animals than in the follicular animals. It is suggested that this indicated a greater tendency toward entrapment of the ova in the first two groups of ewes.

MATERIAL AND METHODS

In this study four flocks of sheep were utilized. Part of three flocks were injected with progesterone in conjunction with pregnant mare serum and pregnant mare serum alone. Part of the fourth flock was treated with Ethylene Cyclic Propionate (E.C.P.) which is a chemical compound having estrogenic properties.

Flock Number One[1]

This farm flock consisted of forty-seven white faced ewes and was located three miles northwest of Wamego, Kansas. The treated ewes were selected by marking every third one with a red paint brand on the shoulder. Those ewes acting as controls were branded in the middle of the back, and those ewes receiving one injection of PMS were branded on the rump. It was felt that this would serve as a double check since each ewe could be identified by the brand number and also by the position of the brand. No bias was shown as to the condition of the ewe and any one

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[1]Appendix, Table 1.

specific treatment.

All ewes branded on the shoulder were given 30 mg. of progesterone in each of five injections three days apart and one injection of 500 i.u. of PMS three days after the last progesterone injection. The ewes branded on the shoulder were injected intramuscularly in the rump on May 19, 22, 26, 28 and 31 with progesterone, and on June 3 with PMS injected sub-cutaneously. Those ewes branded on the rump were given one injection of 500 i.u. of PMS at the same time that the progesterone treated ewes received PMS, on June 6. Those ewes branded in the middle of the back served as controls.

Two Hampshire rams, each equipped with a marking harness, were turned in with the flock on June 3. An observation was made on June 13 for those ewes which were marked as bred.

Flock Number Two[1]

This flock consisted of a mixture of 93 white and black faced crossed ewes. Some ewes were still lactating. The farm is located about 12 miles northeast of Wamego, Kansas.

Twenty ewes were selected from this group, care being taken that white faces and black faces were proportionately divided and also that wet and dry ewes were evenly divided. These twenty ewes were given 30 mg. of progesterone per injection on May 19, 22, 26, 28 and 31. Three days after the last progesterone in-

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[1]Appendix, Table 2.

jection they were given a single injection of 500 i.u. of PMS on June 3. In addition thirty ewes were selected and marked on this day after receiving PMS in the amounts as the other treated ewes. Twenty of these ewes received the 500 i.u. of PMS in the form of 10 cc. of solution while ten of the ewes received 500 i.u. of PMS in concentrated one-half cc. solution.

Two rams were harnessed and turned in with the flock which consisted of twenty ewes, branded with red on the back, thirty ewes branded with blue on the back and forty-three ewes unmarked to serve as controls. Ten days after turning the rams in the flock was checked for ewes marked as bred.

Flock Number Three[1]

The third farm flock used in this work consisted of two hundred and seventeen white and black faced southwestern ewes. The farm is located about seven miles southeast of Clebourne, Kansas.

Ninety-nine ewes were branded with blue paint in the following manner: number 1 ewe branded on the shoulder, number 2 ewe branded in the middle of the back, number 3 ewe branded on the rump, number 4 ewe branded on the shoulder, and so forth until all 99 had been branded. Those ewes with a shoulder brand received 30 mg. of progesterone per injection in a series of five injections on June 4, 7, 10, 13, and 16th and 500 i.u. of PMS on

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[1]Appendix, Tables 3, 4, and 5.

June 19th. Those ewes branded on the rump received 500 i.u. of PMS at the same time as the progesterone treated ewes received PMS. Those ewes branded in the middle of the back acted as controls.

Eighty-two ewes were branded the same as the above ewes except red paint was used instead of blue paint. The amounts and time of the treatment were the same as the treatment of the blue branded ewes.

In addition 30 ewes were branded on the shoulder with a black number and also with a red 7. This was done so that no difficulty would be encountered in differentiating between blue and black shoulder markings. These ewes received a total of 120 mg. of progesterone in four injections on June 7, 10th, 13th, and 16th, and 500 i.u. of PMS on June 19th. Six ewes received no brand and were delegated as control ewes.

Seven rams were harnessed and turned in with the flock on June 19th and a check was made on June 26th for those ewes marked as bred.

Flock Number Four[1]

This flock was owned by Kansas State College and consisted of thirty-six purebred Rambouillet ewes. The ewes were numbered from one to thirty-six and the even numbered ewes received 1 mg. of E.C.P. in a 1/2 cc. solution. Observations were made twice

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[1]Appendix, Table 4.

daily for evidence of heat as demonstrated by the interest of the ram. From the day of the injections, June 2, to July 3, a vasectomized ram was utilized. After July 3, intact rams were used; one being put with the flock on July 3, and the other put with the flock on August 14. A record of signs of heat was maintained up to August 31.

RESULTS

FLOCK NO. 1

Eleven of sixteen ewes treated with progesterone and PMS came into heat following the injections. Three of the progesterone treated ewes did not lamb; however, one of the three died and another one was reported as barren prior to the start of the experiment. Seven of the fifteen ewes receiving PMS alone exhibited heat as shown by the marking of a harnessed ram. One had not lambed by the base date on January 12, 1954. Only one of sixteen ewes which received no treatment showed heat within a period of ten days after the rams were turned in with the flock. Of these sixteen ewes two had not lambed by January 12, 1954.

The progesterone treated ewes had more variable lambing dates with the average date being November 29. The first lambs were from the progesterone ewes but the last lambs were from progesterone treated ewes also. The PMS treated ewes and the control ewes had the same average lambing date, November 24. There was an interval of eighteen days, Nov. 14 to Dec. 2, in which no progesterone treated ewes lambed. This was not apparent

in the PMS treated group nor the control group.

The lambing percentages for the progesterone treated group was 81 per cent as compared with 93 1/3 per cent for the PMS treated group and 87 1/2 per cent for the controls.

FLOCK NO. 2

Eighteen of twenty ewes that received progesterone and PMS were marked as bred by harnessed rams within a ten day period after the PMS injection. Of the two that were not marked, one was dry and one was wet. Seventy-five per cent of progesterone treated ewes had lambed by Nov. 20, as compared to forty-three per cent for the PMS treated ewes and thirty per cent for the controls on the same date.

The progesterone treated ewes lambed at an earlier date on the average, the date being Nov. 16 as compared with Nov. 25 for the controls and Dec. 5 for the PMS treated ewes. All three groups of ewes showed little activity from Dec. 11 to Dec. 29.

The lambing percentages for the progesterone group was 95 per cent, that of the PMS treated group 93 1/3, and that of the controls 88 per cent.

EXPLANATION OF PLATE I

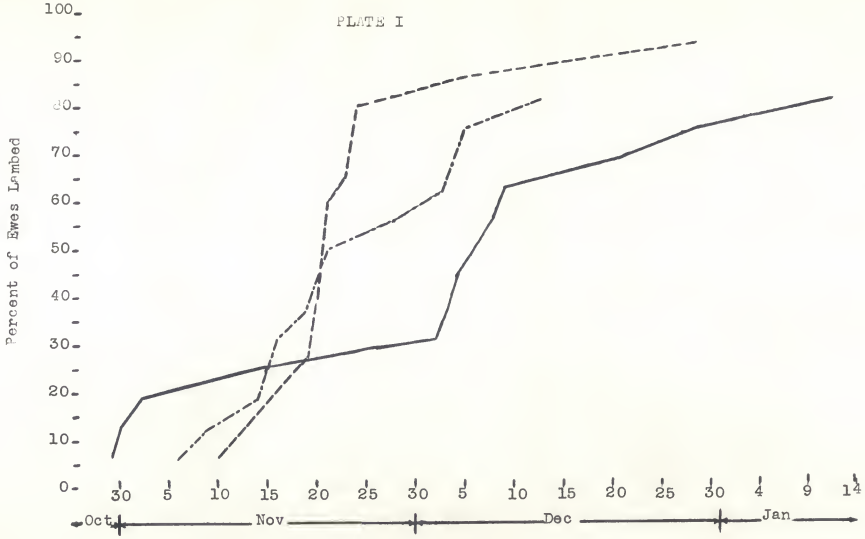
Graph of Lambing Percentages for Flock Number One

_____ Ewes treated with progesterone and PMS

---------- Ewes serving as controls

. . . . . Ewes treated with PMS alone

PLATE I


Percent of Ewes Lambed
100
90
80
70
60
50
40
30
20
10
0
30 5 10 15 20 25 30 5 10 15 20 25 30 4 9 14
Oct
Nov
Dec
Jan
Lambing Date

EXPLANATION OF PLATE II

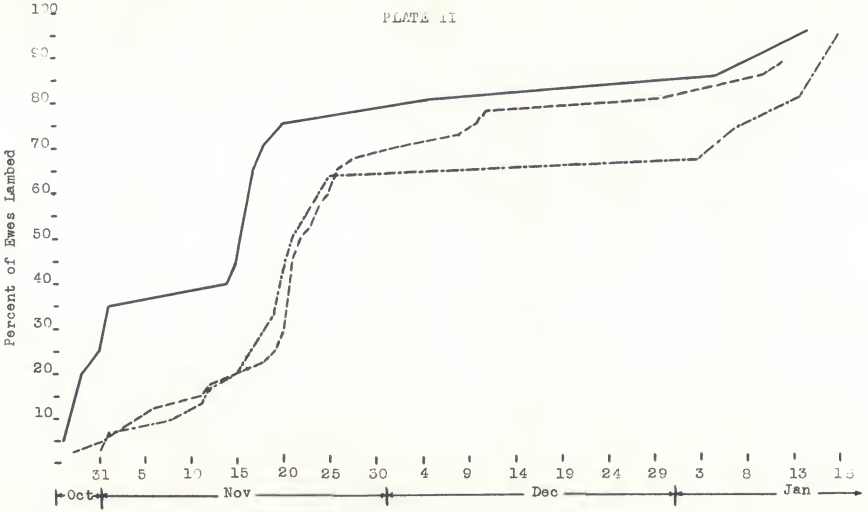
Graph of Lambing Percentages for Flock Number Two

_____ Ewes treated with progesterone and PMS

--------- Ewes serving as controls

--------- Ewes treated with PMS alone

PLATE II


100
90
80
70
60
50
40
30
20
10
Percent of Ewes Lambed
31
5
10
15
20
25
30
4
9
14
19
24
29
3
8
13
18
Oct
Nov
Dec
Jan
Lambing Date

FLOCK NO. 3

Twenty-six of sixty-one ewes were marked as being bred on June 26 following five injections of progesterone and one of PMS. Those ewes receiving four injections of progesterone and one of PMS had a higher percentage than those receiving five injections, as fifteen out of thirty ewes were marked as bred. Only five of sixty ewes that received PMS alone were marked as bred and only two of sixty-six control ewes were marked as bred.

An average of all ewes in this flock treated with progesterone followed by PMS gives an average lambing date of Dec. 10, as compared to Dec. 17 for the controls and Dec. 16 for the ewes treated with PMS alone.

The progesterone treated ewes had two periods of thirteen days each in which no lambing occurred. The other two groups did not show this leveling off period.

The lambing percentages were seventy-nine per cent for the progesterone treated ewes, seventy-three per cent for the controls, and eighty per cent for those ewes that received PMS alone.

A composite of all three flocks gives an overall average lambing date for the progesterone treated ewes of Dec. 3, as compared to Dec. 6 for those ewes receiving PMS alone and Dec. 9 for the untreated ewes. The lambing percentages were 82 per cent for progesterone treated ewes, 86 per cent for PMS alone and 80 per cent for untreated ewes.

EXPLANATION OF PLATE III

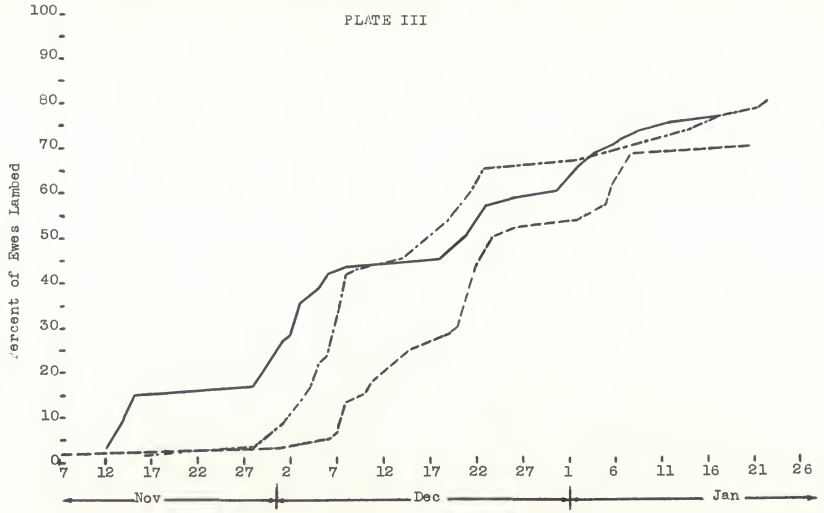
Graph of Lambing Percentages for Flock Number Three

_____ Ewes treated with progesterone and PMS

--------- Ewes serving as controls

.-.-.-.-. Ewes treated with PMS alone

PLATE III


Percent of Ewes Lambed
100
90
80
70
60
50
40
30
20
10
0
7
12
17
22
27
2
7
12
17
22
27
1
6
11
16
21
26
Nov
Dec
Jan

FLOCK NO. 4

Sixteen of eighteen ewes came into heat within three days after being injected with 1 mg. of E.C.P. The two ewes that did not show heat indications immediately after treatment did so twenty-one and forty-two days later. The average length of the heat periods were ninety-four and one-half hours. Nine of the sixteen ewes that came into heat immediately after the injections came into heat again on an average of twelve days after the end of the first induced heat period. These periods lasted for an average of thirty-three hours. Three of the injected ewes did not lamb as compared to one of the non-treated ewes.

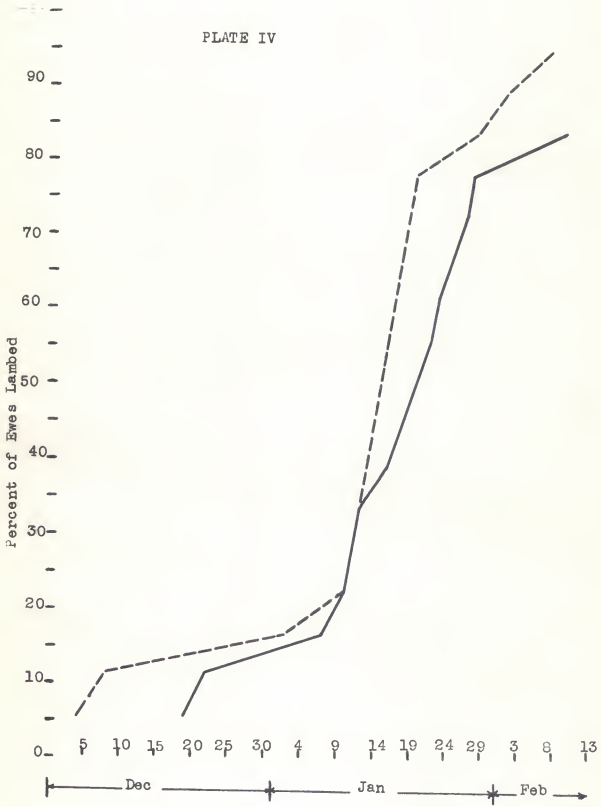
EXPLANATION OF PLATE IV

Graph of Lambing Percentages of Flock Number Four

_____ Ewes treated with E.C.P.

--------- Ewes serving as controls

PLATE IV



LAMBING DATE

CONCLUSIONS

1. Five injections of progesterone, spaced at three day intervals followed by one injection of PMS, will cause ewes to come into heat and in some cases conceive.

2. This treatment appears to group the ewe's heat periods so that most will be in heat at the same time. The inconsistent lambing dates can possibly be explained by the inability of the rams to service all the ewes in so short a time, or by the failure of the induced estrus to properly condition the reproductive tract of some of the ewes.

3. The lambing percentages of the different groups would indicate that the PMS treated ewes have a tendency towards a higher conception rate. The progesterone treated ewes showed a higher lambing percentage than did the untreated ewes.

4. The average lambing date favors the progesterone treated ewes although the margin is probably too slight to be of any economic import.

5. The E.C.P. treated ewes came in heat immediately after injection and stayed in heat for a longer time than is associated with a normal heat period. During this induced heat period a vasectomized ram was run with the flock, consequently no results were obtained as to whether the ewes ovulated. Fifteen of the eighteen treated ewes later came into heat and conceived which would indicate that E.C.P. (Ethylene Cyclic Propionate) does not have harmful after effects to the ewe.

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APPENDIX

Table 1. Lambing date-flock 1.

EWE NO.	TREATMENT	MARKED AS BRED	LAMBING DATE
1	P. & PMS.	YES	12-8-1953
2	CONTROL		
3	PMS.	YES	11-16-1953
4	P. & PMS.	YES	12-29-1953
5	CONTROL		11-19-1953
6	PMS.	YES	11-6-1953
7	P. & PMS.	YES	10-31-1953
8	CONTROL		11-21-1953
9	PMS.	YES	12-3-1953
10	P. & PMS.	YES	12-2-1953
11	CONTROL		11-19-1953
12	PMS.	YES	12-13-1953
13	P. & PMS.		10-30-1953
14	CONTROL		11-23-1953
15	PMS.		12-25-1953
16	P. & PMS.	YES	12-9-1953
17	CONTROL		11-20-1953
18	PMS.		11-16-1953
19	P. & PMS.	YES	
20	CONTROL	YES	11-24-1953
21	PMS.		11-28-1953
22	P. & PMS.	YES	11-2-1953
23	CONTROL		11-20-1953
24	PMS.		11-19-1953
25	P. & PMS.		11-14-1953
26	CONTROL		11-21-1953
27	PMS.	YES	12-4-1953
28	P. & PMS.		
29	CONTROL		1-4-1954
30	PMS.		11-21-1953
31	P. & PMS.	YES	12-6-1953
32	CONTROL		11-24-1953
33	PMS.		11-21-1953
34	P. & PMS.	YES	1-12-1954
35	CONTROL		
36	PMS.	YES	
37	P. & PMS.	YES	12-4-1953
38	CONTROL		11-10-1953
39	PMS.	YES	12-8-1953
40	P. & PMS.		
41	CONTROL		12-6-1953
42	PMS.		11-9-1953
43	P. & PMS.		12-21-1953
44	CONTROL		11-21-1953
45	PMS.		11-14-1953
46	P. & PMS.	YES	12-4-1953
47	CONTROL		11-19-1953

P. & PMS.---Progesterone and PMS.
PMS.--------PMS. alone.
CONTROL-----No treatment.
Ewe No. 40 died and ewe no. 19 was reported as barren. The other four ewes had not lambed by January 12, 1954.

Table 2. Lambing data-flock 2.

EWE NO.	MARKED AS BRED	LAMBING DATE
1	YES	11-1-1953
2		1-5-1954
3	YES	10-31-1953
4	YES	1-15-1954
5	YES	10-29-1953
6	YES	11-15-1953
7	YES	11-17-1953
8	YES	11-14-1953
9	YES	11-16-1953
10	YES	1-15-1954
11	YES	10-29-1953
12	YES	10-29-1953
13	YES	11-17-1953
14	YES	11-16-1953
15		11-20-1953
16	YES	12-5-1953
17	YES	
18	YES	10-27-1953
19	YES	11-1-1953
20	YES	11-18-1953

All ewes received five injections of progesterone and one of PMS.

EWE NO.	MARKED AS BRED	LAMBING DATE
1	YES	1-7-1954
2	YES	11-23-1953
3		1-7-1954
4		11-19-1953
5	YES	11-15-1953
6		
7	YES	1-14-1954
8	YES	11-23-1953
9		11-8-1953
10	YES	11-24-1953
11		1-14-1954
12	YES	11-16-1953
13		11-25-1953
14		11-20-1953
15		1-18-1954
16	YES	11-1-1953
17		1-16-1954
18		11-12-1953
19		1-17-1954
20		
21		11-18-1953
22		
23		11-21-1953
24		
25	YES	10-31-1953
26		11-21-1953
27		1-3-1954
28		11-18-1953
29		11-11-1953
30		1-15-1954

All ewes received PMS alone.

Table 2 (concl.). Lambing data-flock 2.

EWE NO.	MARKED AS BRED	LAMBING DATE
1		10-28-1953
2		10-31-1953
3		11-2-1953
4		11-4-1953
5		11-6-1953
6		11-11-1953
7		11-12-1953
8		11-15-1953
9		11-18-1953
10		11-19-1953
11		11-20-1953
12		11-20-1953
13		11-21-1953
14		11-21-1953
15		11-21-1953
16		11-21-1953
17		11-21-1953
18		11-21-1953
19		11-22-1953
20		11-22-1953
21		11-23-1953
22		11-24-1953
23		11-24-1953
24		11-25-1953
25		11-26-1953
26		11-26-1953
27		11-28-1953
28		12-2-1953
29		12-8-1953
30		12-10-1953
31		12-11-1953
32		12-29-1953
33		1-4-1954
34		1-10-1954
35		1-12-1954

The remainder of the control ewes had not lambed by January 18, 1954.

Table 3. Lambing date-flock 3.

EWE NO.	TREATMENT	MARKED AS BRED	LAMBING DATE
1	P. & PMS.	YES	
2	CONTROL		1-5-1954
3	PMS.	YES	12-5-1953
4	P. & PMS.	YES	
5	CONTROL		12-8-1953
6	PMS.		12-2-1953
7	P. & PMS.	YES	12-1-1953
8	CONTROL		12-22-1953
9	PMS.		12-4-1953
10	P. & PMS.		
11	CONTROL		12-25-1953
12	PMS.		
13	P. & PMS.		11-15-1953
14	CONTROL		1-7-1954
15	PMS.		
16	P. & PMS.		12-3-1953
17	CONTROL		
18	PMS.		
19	P. & PMS.		12-22-1953
20	CONTROL	YES	
21	PMS.		12-7-1953
22	P. & PMS.		1-2-1954
23	CONTROL		1-21-1954
24	PMS.		12-23-1953
25	P. & PMS.	YES	12-8-1953
26	CONTROL		
27	PMS.		
28	P. & PMS.		12-3-1953
29	CONTROL		12-11-1953
30	PMS.	YES	12-3-1953
31	P. & PMS.		11-28-1953
32	CONTROL		12-26-1953
33	PMS.-		1-14-1954
34	P. & PMS.		12-19-1953
35	CONTROL		1-2-1954
36	PMS.		12-21-1953
37	P. & PMS.		1-2-1954
38	CONTROL		
39	PMS.		
40	P. & PMS.		
41	CONTROL		12-21-1953
42	PMS.		
43	P. & PMS.		12-22-1953
44	CONTROL		12-21-1953
45	PMS.		
46	P. & PMS.	YES	12-23-1953
47	CONTROL		1-5-1954
48	PMS.		12-21-1953
49	P. & PMS.		12-1-1953
50	CONTROL		1-8-1954

Table 3 (concl.) Lambing data-flock 3.

EWE NO.	TREATMENT	MARKED AS BRED	LAMBING DATE
51	PMS.		
52	P. & PMS.		11-13-1953
53	CONTROL		
54	PMS.		1-8-1954
55	P. & PMS.	YES	11-15-1953
56	CONTROL		1-6-1954
57	PMS.		
58	P. & PMS.	YES	11-13-1953
59	CONTROL		12-8-1953
60	PMS.		12-5-1953
61	P. & PMS.	YES	
62	CONTROL		
63	PMS.		12-17-1953
64	P. & PMS.	YES	
65	CONTROL		1-8-1954
66	PMS.		12-22-1953
67	P. & PMS.		12-31-1953
68	CONTROL		1-6-1954
69	PMS.		
70	P. & PMS.	YES	12-3-1953
71	CONTROL		12-11-1953
72	PMS.		12-3-1953
73	P. & PMS.	YES	12-22-1953
74	CONTROL		
75	PMS.		12-1-1953
76	P. & PMS.	YES	12-6-1953
77	CONTROL		12-23-1953
78	PMS.		1-5-1954
79	P. & PMS.		12-2-1953
80	CONTROL		12-19-1953
81	PMS.		12-8-1953
82	P. & PMS.		
83	CONTROL		1-7-1954
84	PMS.		12-8-1953
85	P. & PMS.		12-1-1953
86	CONTROL		
87	PMS.		12-4-1953
88	P. & PMS.		
89	CONTROL		
90	PMS.		12-9-1953
91	P. & PMS.		12-4-1953
92	CONTROL		12-8-1953
93	PMS.		
94	P. & PMS.	YES	1-4-1954
95	CONTROL		12-24-1953
96	PMS.		1-22-1954
97	P. & PMS.		
98	CONTROL		12-1-1953
99	PMS.		12-21-1953

Twenty-seven ewes had not lambed by January 24, 1954.
Ewe nos. 39 and 88 died.
All brands were in blue.
P. & PMS.-------Progesterone and PMS.
PMS.------------PMS. alone.
CONTROL---------No treatment.

Table 4. Lambing date-flock 3.

EWE NO.	TREATMENT	MARKED AS BRED	LAMBING DATE
1	P. & PMS.		
2	CONTROL		12-8-1953
3	PMS.	YES	12-8-1953
4	P. & PMS.	YES	11-14-1953
5	CONTROL		
6	PMS.	YES	12-7-1953
7	P. & PMS.		12-3-1953
8	CONTROL		12-6-1953
9	PMS.		12-1-1953
10	P. & PMS.	YES	1-9-1954
11	CONTROL		12-15-1953
12	PMS.		1-16-1954
13	P. & PMS.		11-13-1953
14	CONTROL		1-8-1954
15	PMS.		1-2-1954
16	P. & PMS.	YES	1-18-1954
17	CONTROL		12-23-1953
18	PMS.		12-7-1953
19	P. & PMS.	YES	
20	CONTROL		12-7-1953
21	PMS.		12-18-1953
22	P. & PMS.		1-2-1954
23	CONTROL		12-17-1953
24	PMS.		12-1-1953
25	P. & PMS.		
26	CONTROL		12-7-1953
27	PMS.		12-17-1953
28	P. & PMS.	YES	12-28-1953
29	CONTROL		12-1-1953
30	PMS.		12-8-1953
31	P. & PMS.		12-7-1953
32	CONTROL		
33	PMS.		11-28-1953
34	P. & PMS.		
35	CONTROL		
36	PMS.		12-19-1953
37	P. & PMS.	YES	12-1-1953
38	CONTROL		12-21-1953
39	PMS.		12-10-1953
40	P. & PMS.	YES	12-1-1953
41	CONTROL		
42	PMS.		1-11-1954
43	P. & PMS.	YES	11-15-1953
44	CONTROL		12-15-1953
45	PMS.		11-16-1953
46	P. & PMS.		
47	CONTROL		12-22-1953
48	PMS.		1-17-1954
49	P. & PMS.	YES	
50	CONTROL		

Teble 4 (concl.). Lambing data-flock 3.

EWE NO.	TREATMENT	MARKED AS BRED	LAMBING DATE
51	PMS.		1-23-1954
52	P. & PMS.	YES	11-12-1953
53	CONTROL		
54	PMS.	YES	12-8-1953
55	P. & PMS.		
56	CONTROL		10-2-1953
57	PMS.		12-18-1953
58	P. & PMS.	YES	12-23-1953
59	CONTROL		
60	PMS.		12-5-1953
61	P. & PMS.	YES	11-14-1953
62	CONTROL		12-21-1953
63	PMS.		12-22-1953
64	P. & PMS.	YES	11-16-1953
65	CONTROL		12-20-1954
66	PMS.		12-17-1953
67	P. & PMS.	YES	12-5-1953
68	CONTROL		
69	PMS.		12-12-1953
70	P. & PMS.		1-2-1954
71	CONTROL		
72	PMS.		12-6-1953
73	P. & PMS.	YES	11-12-1953
74	CONTROL		12-13-1953
75	PMS.		12-21-1953
76	P. & PMS.		12-8-1953
77	CONTROL		12-23-1953
78	PMS.		12-23-1953
79	P. & PMS.		1-12-1954
80	CONTROL		12-20-1953
81	PMS.		12-12-1953
82	P. & PMS.		1-7-1954

Ewe no. 34 died.
Fifteen ewes had not lambed by January 24, 1954.
All brands were in red.
P. & PMS.-------Progesterone and PMS.
PMS.----------PMS. alone.
CONTROL---------No treatment.

Table 5. Lembing date-flock 3.

EWE NO.	TREATMENT	MARKED AS BRED	LAMBING DATE
1	P. & PMS.	YES	10-4-1953
2	P. & PMS.	YES	12-2-1953
3	P. & PMS.		1-9-1954
4	P. & PMS.	YES	11-15-1953
5	P. & PMS.		12-3-1953
6	P. & PMS.	YES	1-10-1954
7	P. & PMS.		12-3-1953
8	P. & PMS.		12-1-1953
9	P. & PMS.		
10	P. & PMS.	YES	12-8-1953
11	P. & PMS.		12-16-1953
12	P. & PMS.	YES	12-6-1953
13	P. & PMS.	YES	12-21-1953
14	P. & PMS.	YES	11-15-1953
15	P. & PMS.	YES	12-1-1953
16	P. & PMS.	YES	1-10-1954
17	P. & PMS.		1-21-1954
18	P. & PMS.		12-16-1953
19	P. & PMS.		12-3-1953
20	P. & PMS.	YES	11-15-1953
21	P. & PMS.	YES	12-17-1953
22	P. & PMS.		12-2-1953
23	P. & PMS.	YES	12-22-1953
24	P. & PMS.		1-10-1954
25	P. & PMS.		
26	P. & PMS.		1-24-1954
27	P. & PMS.		
28	P. & PMS.		12-20-1953
29	P. & PMS.	YES	12-5-1953
30	P. & PMS.	YES	12-9-1953
none	CONTROL		12-7-1953
none	CONTROL		12-18-1953
none	CONTROL		12-3-1953
none	CONTROL	YES	11-7-1953
none	CONTROL		12-7-1953
none	CONTROL		12-13-1953

Three ewes had not lambed by January 24, 1954.
All brands were black with a red seven on the shoulder.
P. & PMS.---Progesterone and PMS.
CONTROL-----No treatment.

Table 6. Lambing date-flock 4.

EWE NO.	TREATMENT	1ST. HEAT PERIOD	2ND HEAT PERIOD	LAMBING DATE
1	CONTROL	None apparent	None apparent	1-11-54
2	E.C.P.	June 5-10	June 13	1-25-54
3	CONTROL	July 21	None apparent	1-20-54
4	E.C.P.	June 4-7	None apparent	Dry
5	CONTROL	July 21	August 7	1-16-54
6	E.C.P.	June 3-7	June 22-24	1-12-54
7	CONTROL	June 4-5	July 12	1-12-54
8	E.C.P.	June 5-8	July 20	1-23-54
9	CONTROL	August 8	None apparent	1-2-54
10	E.C.P.	June 5-7	July 27	1-27-54
11	CONTROL	None apparent	None apparent	2-2-54
12	E.C.P.	June 4-7	None apparent	1-22-54
13	CONTROL	June 6-8	June 24-25	1-14-54
14	E.C.P.	June 3-9	July 25-26	1-20-54
15	CONTROL	June 6-7	June 22-25	1-10-54
16	E.C.P.	June 3-10	June 20-22	1-12-54
17	CONTROL	None apparent	None apparent	2-8-54
18	E.C.P.	June 4-7	June 19-20	1-7-54
19	CONTROL	June 4-5	July 8	12-4-53
20	E.C.P.	June 23-24	July 16	1-20-54
21	CONTROL	June 26-27	July 15	1-16-54
22	E.C.P.	June 4-7	June 24-25	1-10-54
23	CONTROL	June 28	July 16	1-18-54
24	E.C.P.	June 4-7	June 24	12-22-54
25	CONTROL	June 12-13	June 26-28	1-29-54
26	E.C.P.	June 4-7	June 14-15	1-28-54
27	CONTROL	June 29-30	July 18	1-20-54
28	E.C.P.	June 4-7	July 28	Dry
29	CONTROL	None apparent	None apparent	Dry
30	E.C.P.	July 14	None apparent	1-16-54
31	CONTROL	July 14	None apparent	1-14-54
32	E.C.P.	June 3-7	July 9	2-10-54
33	CONTROL	June 8-9	June 27-28	1-18-54
34	E.C.P.	June 5-9	July 30	Dry
35	CONTROL	June 26-28	July 13	12-8-53
36	E.C.P.	June 4-9	June 27-28	12-19-53

E.C.P. was injected on June 2, the dose being 1 mg. in a ½ cc. solution.

THE USE OF HORMONES FOR EARLIER LAMBS

by

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ABSTRACT

In recent years much work has been done in an attempt to induce estrus in anestrus ewes. The most promising method seems to be with the use of hormones, especially the injection of progesterone followed by an injection of pregnant mare serum.

This study was made, using these two materials in an effort to bring about earlier estrus and ovulation with subsequent earlier lambing. In addition a study was made to check the effects of Ethylene Cyclic Propionate (E.C.P.) on the reproductive activity of ewes.

Three farm flocks were used which consisted of 357 ewes in all. One hundred and twenty-seven ewes were treated with either four or five injections of 30 mg. each of progesterone spaced at three day intervals, followed by one injection of 500 i.u. of pregnant mare serum in a single injection. One hundred and five ewes received 500 i.u. of pregnant mare serum in a single injection. The rest of the ewes, one hundred and twenty-five, were untreated and served as controls. In a fourth flock eighteen of thirty-six ewes were injected with 1 mg. of E.C. P. and a record maintained of their receptivity to a vasectomized ram. At a later date an intact ram was used in the flock and the resulting lambing dates recorded.

The average lambing date of the progesterone treated ewes was slightly earlier than that of the other two groups; however, some of the progesterone treated ewes were the last to lamb.

The time of the injections was such that it coincided closely with the start of the normal breeding season. The effect of the hormones seemed to group the heat periods of the ewes but evidently all were not settled during their first heat period. A higher percentage of ewes receiving PMS alone lambed.

The use of E.C.P. did not effect the reproductive ability of the ewes.