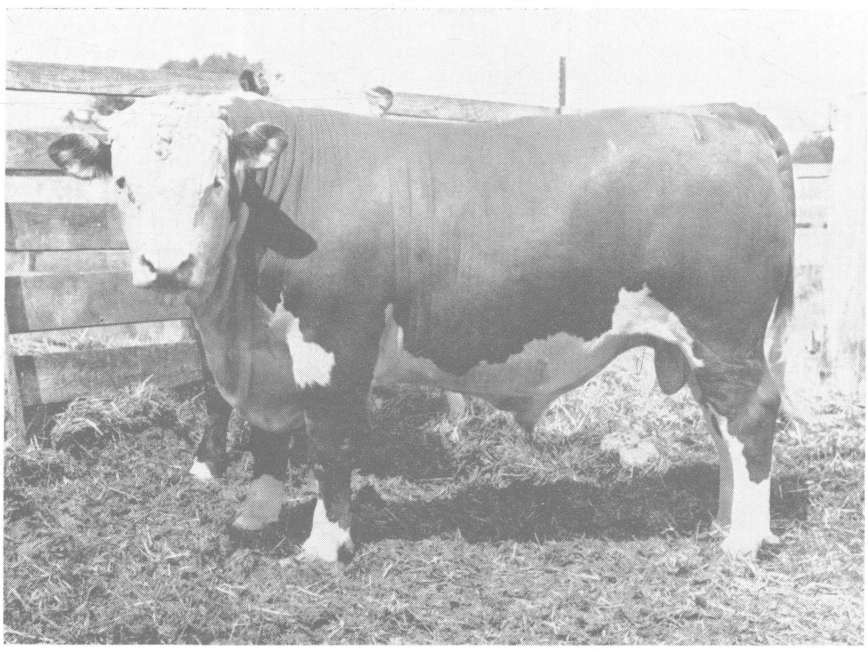
RESEARCH BULLETIN 802 APRIL 1958

# Influence of Sex Hormones

## upon feed lot performance and carcass quality of fattening cattle

Earle W. Klosterman – V. R. Cahill
L. E. Kunkle – A. L. Moxon



OHIO AGRICULTURAL EXPERIMENT STATION - - WOOSTER, OHIO

# CONTENTS



Manuscript Completed May 1957

# INFLUENCE OF SEX HORMONES UPON FEED LOT PERFORMANCE AND CARCASS QUALITY OF FATTENING CATTLE

EARLE W. KLOSTERMAN, V. R. CAHILL, L. E. KUNKLE
A. L. MOXON

Hormones are chemical regulators produced by endocrine or ductless glands. The term hormone literally means "to stir up" but these regulators are known to inhibit various physiological functions as well as stimulate them. There are numerous endocrine or ductless glands in the animal body, each secreting one or more hormones. Endocrine organs may function only in the secretion of hormones or they may perform other duties as well.

The sex hormones are produced by the male and female sex organs, namely the testicle and the ovary. The appearance or secondary sex characteristics of an animal are controlled by these sex hormones. These secondary sex characteristics include differences in growth rate, tendency to fatten and many others between the two sexes. Castration, removal of the sex glands, causes marked changes in the secondary characteristics of both sexes. Male and female castrates tend to develop toward a common or neutral type.

In addition to the sex hormones produced in the normal animal there are a number of synthetic compounds which have the properties of the natural hormones. The most common of these is diethylstilbestrol, often merely referred to as stilbestrol, which is a synthetic product and does not occur in nature but performs the same functions as the female hormone, estradiol.

The experiments reported in this bulletin were conducted to study the effects of age of castration and the effects of naturally occurring and synthetic hormones upon the feed lot performance and carcass quality of fattening cattle.

# I

## EFFECTS OF AGE OF CASTRATION AND STILBESTROL IMPLANTATION IN FATTENING BULLS AND STEERS

Experiments conducted at the Arizona Agricultural Experiment Station (1946-1947) showed that fattening bulls made more rapid and economical gains than steers. In one experiment the bulls realized a considerably greater net profit and in a second experiment, a slightly smaller profit than the steers; the bulls produced carcasses of a very satisfactory grade.

Burris, Bogart and Oliver (1953) have shown that weekly intermuscular injections of one milligram of testosterone per kilogram of body weight significantly increased the rate of gain of steers and heifers.

The subcutaneous implantation of stilbestrol promotes fattening in poultry (Sykes **et al.** 1953) but tends to lower the carcass grade of steers and heifers (Dinusson, Andrews and Beeson, 1950; Sykes **et al.** 1953; Clegg and Cole, 1954). The effect of stilbestrol implantation upon the growth and fattening of bull calves has not been reported.

### PROCEDURE

#### 1950–1951 and 1951–1952 Experiments

The Hereford calves used in these experiments were obtained from a rancher in Nebraska. One-third of the calves were castrated at about one month of age. The other two-thirds were allowed to remain as bulls until weaning at which time they were shipped to the Ohio Agricultural Experiment Station. Upon arrival, a second group of one-third was castrated and the remainder were fed as bulls. The three lots were hand, full fed a standard ration in dry lot.

In the second experiment, the birth and weaning weights of each individual calf were obtained. Thus, a limited amount of information was secured on the influence of castration upon rate of gain to weaning age.

At the close of the feeding experiments an appraised market value was placed on each animal by experienced cattle buyers. All of the cattle were slaughtered through the Meats Laboratory where detailed slaughter and carcass data were obtained.

#### 1952–1953 Experiment

A carload of high quality Hereford bull calves was purchased in Texas for this experiment. Eight head were castrated on October 16 and fed as a lot of control steers. Five bulls were fed for 98 days, castrated, and then fed for an additional 98 days. Five other bulls were

implanted subcutaneously in the neck region with 84 mg. of stilbestrol, fed for 98 days, given a second implantation of 132 mg. of stilbestrol and fed for an additional 84 days. Ten bulls were fed for 98 days, implanted with 132 mg. of stilbestrol and fed for an additional 98 days. Ten other bulls were fed without castration or other treatment for the entire experiment.

### 1953–1954 Experiment

Two lots of 10 steers and two lots of 10 bulls each were fed in this experiment. The bulls and steers were obtained from the same source as those fed in the previous experiment. One lot of each of the bulls and steers was implanted with 84 mg. of stilbestrol per head on December 16, 1953, and again with the same dosage on March 12, 1954. The implantations were made subcutaneously in the mid-portion of the ear.

All the cattle fed in the 1952-1953 experiment and five representative animals from each lot in the 1953-1954 experiment were slaughtered through the Meats Laboratory at Ohio State University. Those animals in the second experiment which were not sent through the Meats Laboratory were slaughtered by a Columbus packing company where carcass grades and dressing percentages were obtained. In the 1953-1954 experiment, weights of pituitary, thyroid and adrenal glands were taken.

### 1954–1955 Experiment

This experiment was conducted at the Northwestern Substation of the Ohio Agricultural Experiment Station and in conjunction with a study of the housing requirements of fattening cattle. One lot each of steers and bulls were fed in a barn without access to outside lots and one of each in a narrow, open-sided shed with outside lots. Of the 12 animals in each lot, 6 were treated with stilbestrol implants and 6 were untreated. On November 16 the steers were implanted with 60 milligrams and the bulls with 84 milligrams of stilbestrol in the ear. The bulls were retreated with an additional 120 milligrams on February 4. At the conclusion of the experiment all animals were slaughtered through a local packing plant where dressing percentages and carcass grades were obtained.

## RESULTS

### Average Daily Gains

The results obtained in these experiments are presented in Tables 1, 2 and 3 and Appendix Tables 1 through 7.

In the 1951-1952 experiment, the birth date, birth weight, and weaning weights of each individual calf were obtained. When the weaning weights were adjusted to a standard age of 190 days it was

found that the calves which had been castrated weighed an average of 15.8 pounds less than the bull calves. The calves castrated after arrival at Wooster were retarded by a very similar amount so that the average weights of the two lots of steers were nearly identical at the start of the feeding experiment.

**TABLE 1.—Daily Gains, Feed Requirements and Carcass Grades of Bulls and Steers with and without Stilbestrol Implants and Late Castrated Steers**

| Experiment | | Bulls | Bulls stilbestrol implant | Steers late castrates | Steers early castrates | Steers stilbestrol implant |
|---|---|---|---|---|---|---|
| | | Average Daily Gain | | | | |
| 1950–1951 | | 2.23 | | 2.00 | 2.00 | |
| 1951–1952 | | 2.43 | | 1.94 | 1.96 | |
| 1952–1953 | Period 1 | 2.36 | 2.62 | 2.03 | | |
| | Period 2 | 2.34 | 2.67 | 2.01 | | |
| 1953–1954 | | 2.76 | 2.96 | | 2.31 | 2.79 |
| 1954–1955 | Inside | 2.47 | 2.54 | | 2.10 | 2.59 |
| | Outside | 2.60 | 2.76 | | 2.06 | 2.55 |
| | | Feed per Hundredweight Gain | | | | |
| 1950–1951 | Concentrates* | 538 | | 581 | 575 | |
| | Roughage† | 140 | | 157 | 157 | |
| 1951–1952 | Concentrates* | 500 | | 609 | 614 | |
| | Roughage† | 177 | | 214 | 212 | |
| 1952–1953 | Concentrates, 1* | 402 | 364 | 484 | | |
| | Roughage, 1† | 193 | 170 | 223 | | |
| | Concentrates, 2* | 532 | 504 | 584 | | |
| | Roughage, 2† | 173 | 148 | 185 | | |
| 1953–1954 | Concentrates* | 455 | 481 | | 564 | 481 |
| | Roughage† | 189 | 176 | | 224 | 186 |
| 1954–1955 | (Controls and stilbestrol implants fed together) | | | | | |
| | | Carcass Grade‡ | | | | |
| 1950–1951 | | 2.23 | | 1.03 | 0.83 | |
| 1951–1952 | | 2.78 | | 1.44 | 1.43 | |
| 1952–1953 | | 2.01 | 1.86 | 1.33 | | |
| 1953–1954 | | 2.47 | 2.03 | | 1.37 | 1.62 |
| 1954–1955 | | 1.97 | 1.91 | | 1.20 | 1.25 |

*Ground ear corn, soybean oil meal and minerals.

†Corn silage requirement divided by 3 plus hay requirement.

‡Carcass grade factor: Prime 0.0, 0.4, 0.7
Choice 1.0, 1.4, 1.7
Good 2.0, 2.4, 2.7

Age of castration, whether shortly after birth or at weaning time, had no influence upon subsequent rate of gain in the fed lot. The rates of gain of early and late castrated steers were identical in the first experiment and nearly so in the second. In both experiments the bulls gained at a significantly faster rate than either lot of steers. In the first experiment the three lots were fed for the same length of time and the bulls gained 0.23 lb. per head daily faster than the steers. In the second experiment, the steers were fed for a longer period in an attempt to reach the same final weight as the bulls. Thus, the steers were fed later into warmer weather and to a higher finish than the bulls and their average daily gain for the entire period averaged 0.48 lb. less than the daily gain of the one lot of bulls.

The appraised selling prices given in Appendix Table 1 and 2 are averages of market evaluations placed on each individual animal at time of slaughter. These evaluations were made by regular experienced cattle buyers from the Columbus yards. It will be noted from these data that, if the steers and bulls from these experiments had been sold on the open market, the steers would have sold for approximately $4.00 per cwt. more than the bulls.

In the first 98-day period of the 1952-1953 experiment the average daily gain of all untreated bulls was 2.36 lb., which was 0.33 lb. per day faster than the steers. The five stilbestrol-treated bulls gained 0.26 lb. per head daily faster than the average of all untreated bulls.

During the second period of this experiment the two lots of steers gained at the average rate of 2.01 lb.; the bulls, 2.34 lb., and the bulls treated with stilbestrol, 2.67 lb. per head daily. These differences, 0.33 lb. in both instances, proved to be statistically highly significant. Castration of the five bulls on January 29 retarded their gains for a time so that their average daily gain for the last period was 0.28 lb. slower than that of the lot of steers castrated prior to the start of the experiment.

The differences in average daily gain between the bulls and steers and between the stilbestrol treated and untreated animals in the experiment were significant at the one percent level. The implantation of stilbestrol brought about a greater increase in daily rate of gain of the steers, 0.48 lb., than of the bulls, 0.20 lb. The stilbestrol-treated steers gained at much the same rate as the untreated bulls.

In the 1954-1955 experiment, stilbestrol implantation increased the average daily gains of the steers by 0.52 lb. and the bulls, 0.11 lb. The implanted steers, on the average, gained slightly faster than the untreated bulls and nearly as fast as the bulls which had been implanted with stilbestrol.

## Carcass Data

All of the animals fed in the first three experiments and one-half of the animals fed in the fourth experiment were slaughtered in the Meats Laboratory at Ohio State University. The right side of each carcass was separated into bone, fat trim and edible portion. The edible portion of the carcass is designated as edible meat with no more than three-eighths inch layer of fat on any surface. In the first two experiments shell-loin steaks, taken from the left side of the carcass, were broiled and used to determine palatability and tenderness by a taste panel. The organoleptic tests were patterned after the techniques of Deatherage and Reiman (1946). A summary of the carcass grades obtained are presented in Table 1 and the percentages of edible portion in Table 2. Detailed slaughter and carcass data obtained in the first two experiments are given in Appendix Table 3.

Statistical analyses of the data in Appendix Table 3 show no significant differences between lots in weight of head as percent of live weight or in amount of bone, expressed as percent of carcass weight. The differences in dressing percentage were significant at the 5 percent level with the bulls having the lower dressing percentage. The following differences were significant at the one percent level. The bulls had heavier hides, a lower carcass grade, heavier forequarters and lighter hindquarters, lighter weight flanks and kidney knobs. The bull carcasses also had less fat trim and a greater percentage of edible portion.

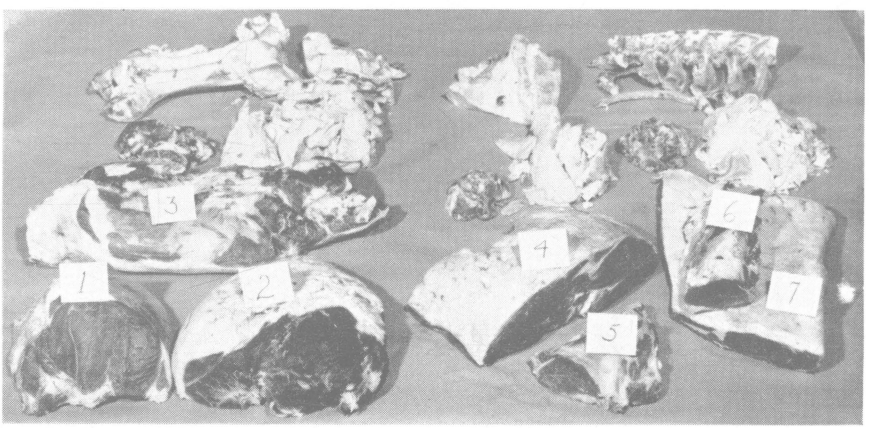



**Fig. 1.—Thick cuts of the closed hindquarter separated into edible portion, fat trim and bone. 1, knuckle; 2, inside round; 3, outside round; 4, sirloin butt; 5 and 6, tenderloin; 7, strip loin.**

There was no significant difference in tenderness rating between the bull and steer carcasses in the 1950-1951 experiment but there was a highly significant difference in the 1951-1952 experiment.

**TABLE 2.—Percent Edible Portion of Bull and Steer Carcasses with and without Stilbestrol Implantation**

| Experiment | Bulls | Bulls stilbestrol implant | Steers, late castrates | Steers, early castrates | Steers, stilbestrol implant |
|---|---|---|---|---|---|
| 1950–1951 | 77 7 | | 74 1 | 73 7 | |
| 1951–1952 | 77 5 | | 74 4 | 74 1 | |
| 1952–1953 | 77 1 | 76 6 | 73 2 | | |
| 1953–1954 | 76 1 | 75 0 | | 69 9 | 72 0 |

Many of the differences noted between steer and bull carcasses were undoubtedly influenced by the difference in amount of finish present on these carcasses. The carcass grade, dressing percentage, amount of fat trim and percent of edible portion would be directly influenced by the degree of finish of the animals when slaughtered. The steer carcasses had significantly heavier hindquarters but also had significantly heavier kidney knobs than bull carcasses. When the weights of kidney and surrounding fat were subtracted from the hindquarters, analysis of variance showed that the variance due to differences in percent of hindquarter between lots was less than one-half the variance found when the kidney fat was not removed. In addition, the steer carcasses had a larger amount of waste fat in the flank cut than bull carcasses. Thus, the proportions of fore- and rearquarters were also influenced by the degree of finish. The results of these experiments indicate that there is very little difference between steers and fat, young bulls in proportion of valuable, edible meat in the rearquarter. There was also a highly significant correlation between carcass grade and tenderness score. The carcasses with the higher grade of finish tended to be more tender.

There were no significant differences in any of the slaughter or carcass determinations between steers castrated shortly after birth or those castrated at weaning age.

It will be noted in Appendix Table 3 that when the cost of edible portion is based on the appraised selling price, the bull carcasses supplied a pound of edible meat for ten to twelve cents less than the steer carcasses. This difference is somewhat less, five to seven cents, when the cost of edible portion is based upon the market price of graded carcass beef.

The dressing percentages, carcass grades and percentages of edible portion obtained in the 1952-1953 and 1953-1954 experiments are presented in Appendix Tables 5 and 6. In these experiments there were no significant differences in dressing percentages between the various lots.

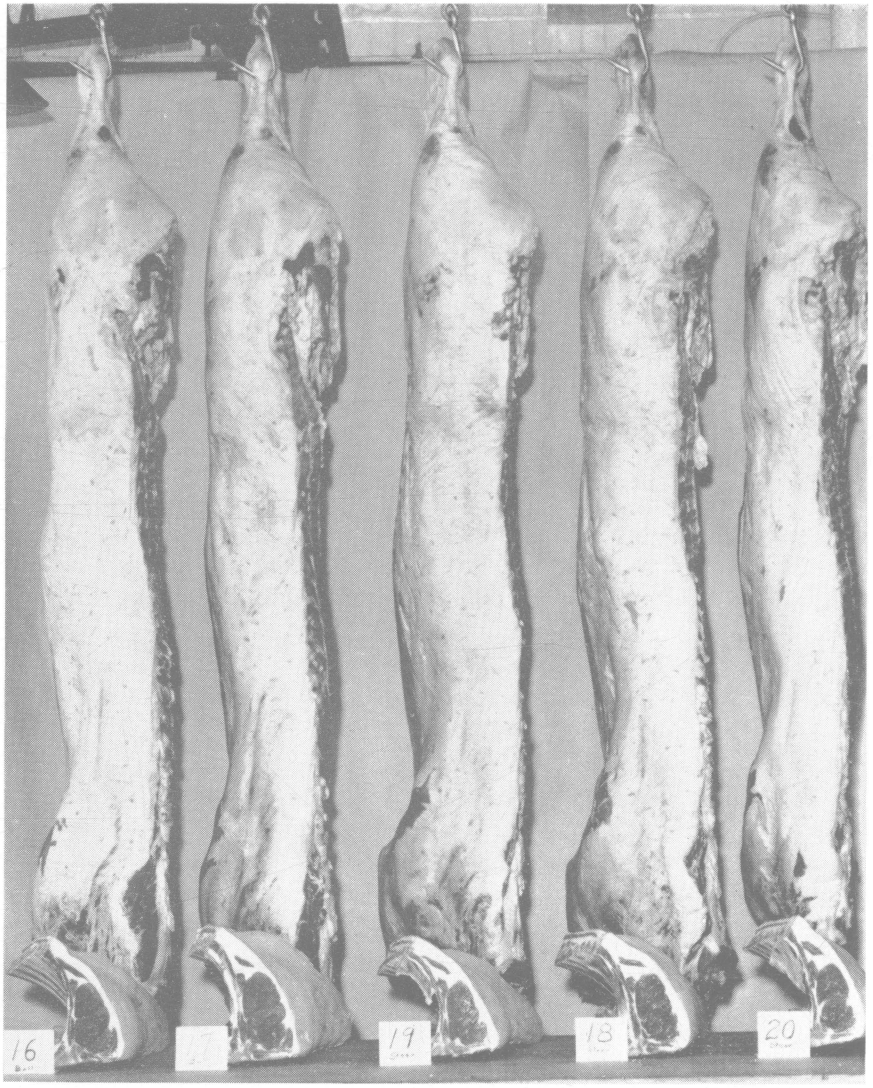



**Fig. 2.—Steer and stilbestrol implanted bull carcasses. Numbers 16 and 17, stilbestrol implanted bulls; numbers 18, 19 and 20, steer carcasses.**

As noted in the previous studies, the bull carcasses produced in these experiments graded significantly lower than the steer carcasses. The carcass grades as presented in Appendix Table 5 are averages for the lots. The animals, however, were not all slaughtered at the same time, and some of the differences were actually greater than appear in these averages. This was especially true in the comparison of untreated bulls and the bulls which had received two implantations of stilbestrol. The average difference between these two groups was 0.37 of a grade. However, the carcass grades of five untreated bulls averaged 0.72 of a grade lower than the five stilbestrol-treated bulls which were slaughtered at the same time.

The lowest carcass yield in the first experiment was from the steers which had been castrated in January. Their carcasses also graded approximately half a grade lower than the other lot of steers.

Analysis of variance of the carcass grades obtained in the 1953-1954 experiment showed a highly significant difference between steers and bulls, with the bulls having the lower grade. There was also a significant interaction between castration and stilbestrol treatment. The implantation of stilbestrol significantly increased the carcass grade of the bulls 0.44 of a grade, but lowered the grade of the steer carcasses by one-fourth of a grade.

As noted in the previous comparisons of steers and bulls, the bull carcasses in these experiments produced the higher percentage of edible portion. These differences were significant at the one-percent level. In the 1953-1954 experiment there was a significant interaction between castration and stilbestrol treatment. The implantation of stilbestrol increased the amount of edible meat in the steer carcasses but reduced it in the bull carcasses. This relationship is the direct opposite of what was found in carcass grade, and shows the influence of degree of finish of a carcass upon its yield of edible portion.

A study of wholesale cuts obtained in the 1953-1954 experiment is presented in Table 3. That the percentage of chuck in bull carcasses is highly significantly greater than in steer carcasses is no new discovery but only confirmatory. It should be noted that in the case of chucks, implantation seemed to have a converse effect on steers and bulls. Attention may also be directed to the very similar pattern exhibited by the rounds. Although not statistically significant, the percentage of loin ends, short loin and rib from implanted carcasses was higher for both bull and steer lots. In addition, the percentage of short loin was greater in steers than in bulls, independent of treatment, to the point of being significant at the 1% level.

**TABLE 3.—Percent of Chilled Carcass Weight Represented by Five Selected Wholesale Cuts**

**1953–1954 Experiment**

| | Bulls | Bulls stilbestrol implant | Steers | Steers stilbestrol implant |
|---|---|---|---|---|
| Chuck | 29.7 | 28.9 | 26.7 | 27.6 |
| Round | 24.9 | 24.6 | 23.7 | 24.0 |
| Loin | 14.4 | 14.7 | 15.0 | 15.4 |
| Flank | 5.1 | 5.7 | 6.6 | 5.8 |
| Kidney knob | 1.6 | 1.9 | 2.7 | 1.9 |

Considering the steers alone, the carcasses from implanted steers cut a higher percentage in all five of the more desirable wholesale regions than did carcasses of untreated steers. This 1.66% advantage is very nicely counterbalanced by a 1.61% decrease in the two least desirable wholesale cuts known as kidney knob and flank. One concluding observation is the wide variance in percentage of flank and kidney knob in untreated bulls versus untreated steers and the proximity of these percentages in implanted bulls and implanted steers resulting from the apparent reverse effect of diethylstilbestrol implants on the groups of animals. Based on percentage of carcasses, the bull flanks were highly significantly lighter than the flanks of the other three lots of cattle. Data concerning the kidney (organ) indicated little difference among the groups.

## Endocrine Glands

A study of endocrine glands revealed that the pituitary glands in the bulls and steers of the 1953-1954 experiment were very similar in weight per unit weight of live animal. The pituitaries of steers and bulls weighed 0.208 gm. and 0.210 gm., respectively, per 100 lb. live purchase weight. Corresponding figures for implanted steers and implanted bulls were 0.226 gm. and 0.227 gm. per 100 lb. live purchase weight. Thyroid glands of these bulls were very significantly heavier than those of steers (2.752 gm. and 1.530 gm. per 100 lb. live purchase weight). Statistical analysis of the thyroid gland weights also indicates that the thyroids from the implanted bulls were significantly lower in weight than the normal bulls while thyroids of the implanted steers vary from the steers only slightly.

A comparison of adrenal glands shows practically the same weight in both steer and bull lots with a significant increase from the bulls, 1.610 gm. per 100 lb. live purchase weight to the 1.821 gm. of the implanted bulls. A similar difference occurred between the steers and implanted steers.

**Pelvic Measurements**

Investigation was made of the apparent effect of diethylstilbestrol implantation upon the structure of the skeleton in the pelvic region. Of considerable note is that the angle formed by the lumbar and sacral sections of the vertebrae was identical in measurement for the average of each of the untreated groups. This angle was of lower magnitude in the implanted groups and the difference was significant at the 1% level. The more acute angles and higher tail heads were confirmed also by visual observation of the carcasses. This change in conformation did not appear to alter the sale value of the carcasses merchandised through the packing house cooler.

**Sexual Development and Behavior**

Under the conditions in which the animals were fed in these experiments, there was no noticeable difference between the various lots in amount of restlessness in the feed lot or in handling the animals during feeding and weighing. Although stilbestrol brought about some definite changes in appearance of the animals it did not noticeably affect their activity.

The implantation of stilbestrol in weanling bull calves caused some retardation in sexual development. Although there was individual variation in response, the treated bulls generally did not develop as heavy a crest or as masculine a head as the untreated bulls. There was also some depression of testes growth and stimulation of teat development in the treated bulls. The implantation also caused an elevation of the tail head in both bulls and steers. Some of these changes are illustrated in Figure 4. Pictured is a representative bull from the lot which received two implantations of stilbestrol in the 1952-1953 experiment. The picture was taken 154 days after the start of the experiment. During this period this bull gained 2.60 lb. daily which was only slightly under the average for that lot.

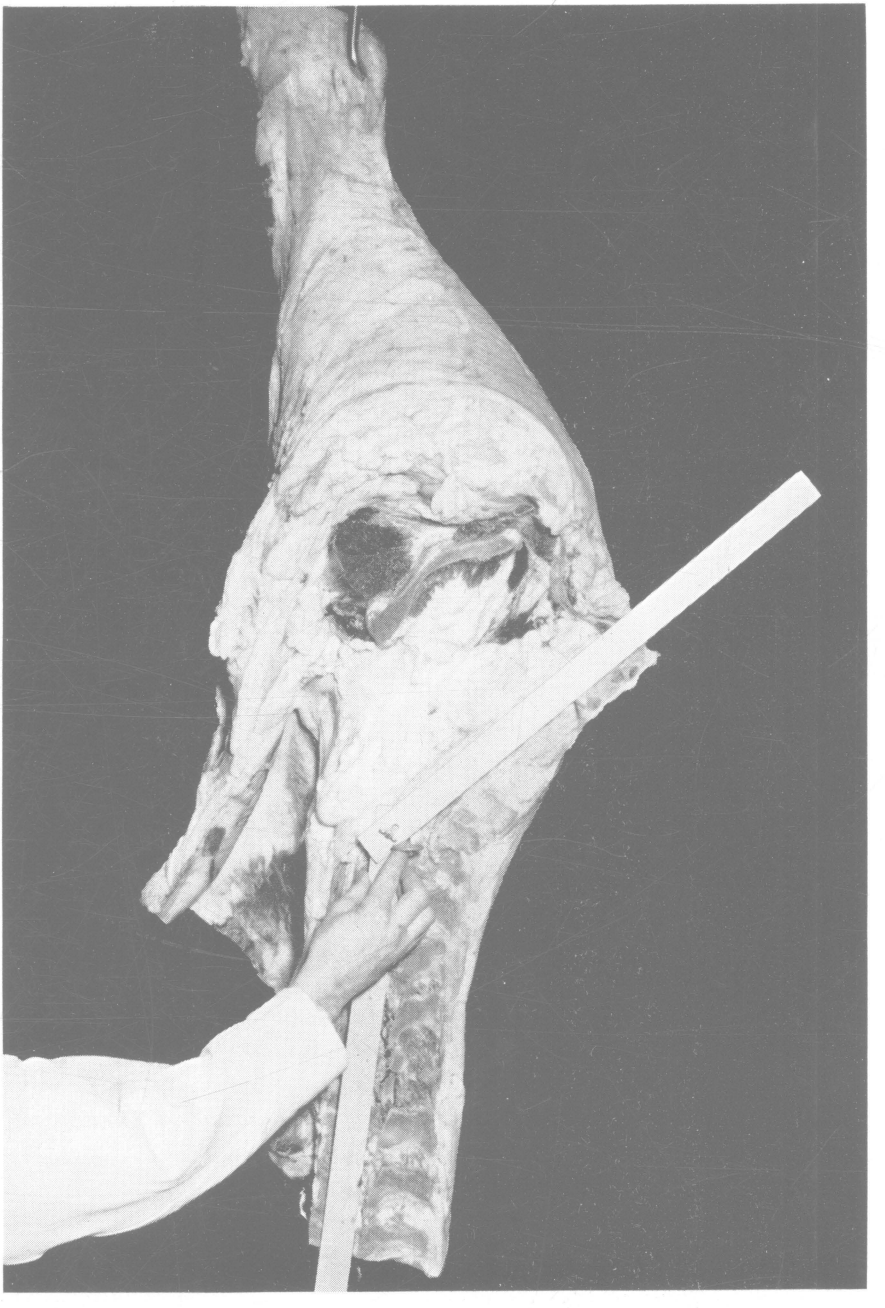


Fig. 3.—Measurement of angle formed by lumbar and sacral sections of the vertebrae.

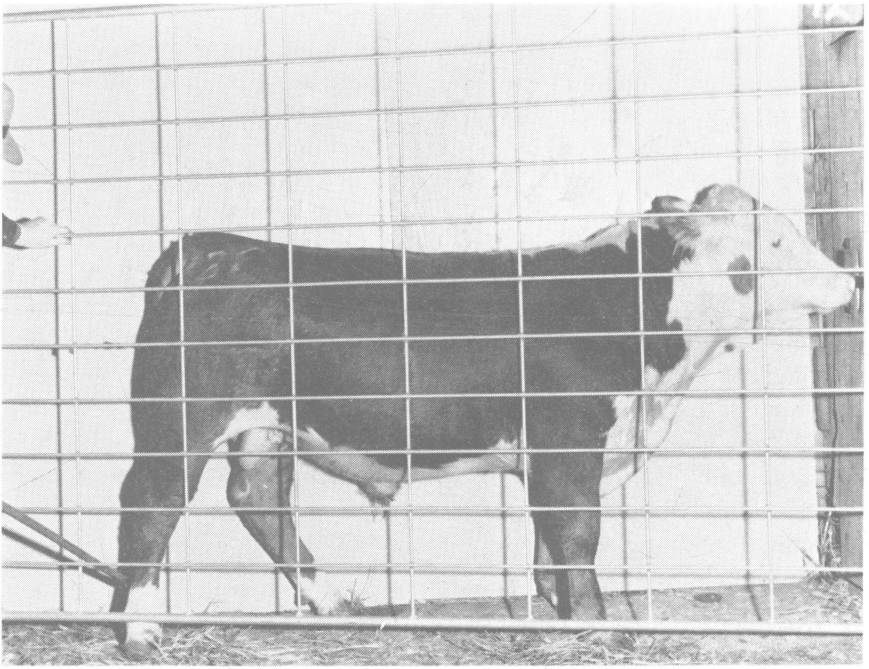


**Fig. 4.—Representative bull from group which received two implantations of stilbestrol, 1952-1953 experiment. Note elevated tail head, teat development, and subnormal development of crest and masculinity of head.**

## DISCUSSION

The results of two experiments show no significant differences between early and late castrated steers in rate or economy of gain in the feed lot, dressing percentage, or carcass quality. Bull calves were heavier at weaning but their gains were sufficiently retarded immediately following castration that their weight was very similar to the early castrated steers when the two groups were started on feed. Castration at the heavier weights is more difficult and likely to be more hazardous. However, for the breeder who wishes to retain a portion of his male calves for breeding purposes, the advantages of a more accurate selection at weaning time would seem to exceed any disadvantages of late castration.

It is possible that the male hormones produced by normal bulls have a definite stimulus to growth. This was shown by the fact that even though bulls gained significantly faster than steers they were not as fat at time of slaughter. Due largely to a smaller amount of fat trim, the bull carcasses produced a larger proportion of edible meat than the steer carcasses. This difference between castrated and uncastrated males is in agreement with experiments conducted with sheep and swine. Hunt, Meade and Carmichael (1938) found no significant differences in rate of gain made by rams and wethers but ram carcasses had a higher percentage of lean in the rib cuts than wether carcasses. Bratzler and co-workers (1954) found that boars and late castrated barrows had less backfat and a higher percentage of lean than early castrated barrows.

The beef produced by steer carcasses was slightly more tender than that from bulls. Beef produced by bull carcasses was of very acceptable quality and no undesirable flavor or aroma was detected. This is in agreement with results from rams (Hunt **et al.**, 1938) but not from boars (Bratzler **et al.**, 1954).

The results of these experiments show that bull calves will make more rapid gains than steer calves when fattened in dry lot. They will also produce more lean meat of comparable quality with less feed per unit of gain.

Due to a greater stimulus for growth, bulls are slower to fatten to the higher grades than steers. In these experiments the bulls and steers were fed in an open shed with relatively small outdoor lots. Under these conditions, very little difference was noted between bulls and steers in amount of restlessness in the feed lot or in handling the animals during feeding and weighing.

Whether or not it would be an economical practice to fatten bulls rather than steers would depend upon the degree of finish desired and the discrimination of the market where the animals were sold. The amount of discrimination would undoubtedly be influenced by the supply and demand for beef of a particular grade.

Numerous reports (Clegg and Cole, 1954 and Andrews **et al.**, 1954) have indicated a lowering of carcass grade as a result of subcutaneous treatment of steers with diethylstilbestrol. Dinusson **et al.** (1950) and Andrews **et al.** (1950) noted no significant difference in carcass grade or dressing percentage.

It is of interest to note carcass grade comparisons in these data. Implantation resulted in one-third grade lower steer carcasses but actually raised the bull carcasses from average good to high good. In a

review of diethylstilbestrol work, Winchester and Andrews (1953) conclude that lower carcass grade results from reduced subcutaneous fat. Conversely, it is the increased subcutaneous fat on implanted bull carcasses along with the excellent muscular development that qualifies them for the higher grade. The tendency for more fat to be deposited internally and subcutaneously on implanted bull carcasses is reflected by the weight of flank and kidney knob. A second effect of implanting bulls is a retarding of the development of secondary sex characteristics. This is evidenced by the decrease in weight of testicles, penis and hide. Perhaps a combination of these effects and the increase in flank and kidney knob are responsible for the decrease noted in percent chuck of implanted bull carcasses.

Consideration of endocrine gland weights of domestic animals apparently has received little attention. Christian (1953) observed a wide divergence in adrenal weights with respect to body weight between captive and wild rats and that confinement of wild animals frequently leads to relative adrenal atrophy. However, data gathered on many species showed that the adrenal gland weights follow a definite logarithmic relationship to body size for all species examined and this relationship parallels that of a single species over a wide age and weight range.

In this experiment the pituitary and adrenal glands from cattle treated with stilbestrol were larger than those from untreated animals. This is in agreement with Clegg **et al.** (1951) who reported similar results. Stilbestrol treatment resulted in a decrease in weight of thyroid glands and this change was especially significant in the case of bulls.

Explanation of the cause of increased rate of gain apparently is not fully understood. Clegg and Cole (1954) indicated that no significant difference in the content of the growth hormone and ACTH in the pituitaries of treated steers was found. Histological studies of the pituitary glands from this project, made by the Department of Anatomy at The Ohio State University, indicate that the basophil count varies inversely with rate of gain.

Although performed on only a limited number of animals in the 1952-1953 experiment, castration during the middle of the feeding period does not appear to be a practice to be recommended. Castration at this time markedly reduced the rates of gain, increased feed costs and produced carcasses very similar to those from bulls.

## SUMMARY

In dry lot fattening trials, bulls gained more economically and significantly faster than steers. There were no significant differences in feed lot performance or carcass quality between steers castrated at approximately one month of age and those castrated after weaning at approximately seven months of age. Bulls were not as well finished as steers at time of slaughter, which influenced the carcass characters studied. Bull carcasses graded significantly lower, had less fat trim and a higher proportion of edible meat. The subcutaneous implantation of stilbestrol significantly increased the rate of gain—this increase being greater in steers than in bulls. Stilbestrol treatment significantly increased the grade of bull carcasses but reduced slightly the grade of steer carcasses. Slightly heavier pituitary glands and significantly heavier adrenal glands were obtained from the implanted cattle. Thyroid glands of the implanted bulls were significantly lighter in weight than the same gland of the untreated bulls but treatment of steers had little effect on the weight of this gland. Measurements of the carcasses in the pelvic region showed a much more acute lumbo-sacral angle in carcasses from implanted cattle. This is a definite measure of the higher-tail head observed in the live animals. There appeared to be no advantage in feeding bulls for a period, castrating ,and finishing as steers.

# II

## IMPLANTATION OF STILBESTROL AND TESTOSTERONE IN FATTENING STEERS AND HEIFERS

Numerous feeding experiments have been conducted to compare the gains, carcasses and returns of fattening steers and heifers. These experiments have been summarized by Morrison (1956). Heifers generally do not make as rapid gains as steers but fatten at earlier ages and lighter weights. When fed to a similar degree of finish there has been little difference in rate of gain or amount of feed required per unit of gain. When fed for the same length of time, steers have shown a marked advantage in rate and economy of gain.

Even when fed to a similar degree of finish, heifer carcasses are likely to contain more waste fat than steer carcasses. Kunkle **et al.** (1955) have determined the percentages of edible portion, fat trim and bone in carcasses of similarly bred and fed steers and heifers. In this

experiment steer carcasses contained 1.4 percent more edible portion and 1.5 percent less fat trim than heifer carcasses. When calculated from the percentage of edible portion, dressing percentage and a value of $40.00 per cwt. for choice grade carcasses, the difference in live value of choice grade steers and heifers was $0.61 per hundredweight.

Experiments conducted to compare the performance of open and spayed heifers have shown very little difference between the two. Considering the cost of the operation and possible death loss, spaying heifers does not appear to be an economical practice.

Burris **et al.** (1953) showed that weekly intramuscular injections of one milligram of testosterone per kilogram of body weight increased the average daily gain of heifers by 0.53 pound. Experiments reported in Part I of this bulletin show that bulls make more rapid gains than steers and that stilbestrol implantation further stimulates the growth rate of bulls. These results suggested an additive effect of the female and male hormones—that is of the synthetic product, stilbestrol and testosterone as produced in uncastrated males. For this reason experiments were initiated to study the effects of implantation of stilbestrol, testosterone and combinations of the two in fattening steers and heifers.

## PROCEDURE

### 1954–1955 Experiment

In this experiment only a limited number of cattle were available for preliminary observations. A total of 12 Hereford heifers and 11 Hereford steers were included in this experiment. Due to feed lot facilities available, all steers were fed in one lot and all heifers in a second. Thus, feed consumption and requirements were not obtained for the various hormone treatments. Three animals were included in each treatment except for the control steers where only two were available.

The control animals received no hormone treatment. The stilbestrol treated animals were all implanted with 36 mg. on December 15; on March 23 the heifers were retreated with an additional 36 mg. and the steers with an additional 60 mg. All testosterone-treated animals were implanted with 120 mg. on December 15 and retreated with an additional 120 mg. on March 23. The stilbestrol and testosterone-treated animals were implanted with both hormones at the same time and dosages as used for the singly-treated animals. The stilbestrol was implanted in pellet form and the testosterone in a paste-type carrier.

All animals were fed 1.5 pounds of soybean oil meal, 5.0 pounds of corn silage, and 2.7 pounds of mixed hay per head daily, and were self-fed salt and minerals. The heifers ate 10.8 pounds and the steers, 11.3 pounds of ground ear corn per head daily.

The heifers used in this experiment were later used in a reproduction study so that no carcass data were obtained.

### 1955–1956 Experiment

This experiment was conducted at the Northwestern Substation of the Ohio Agricultural Experiment Station in conjunction with a study of the housing requirements of fattening cattle. Hereford feeder calves were used in this experiment. One lot of 16 heifers and one of 16 steers were fed in a barn with similar groups fed in outside lots. One-fourth of the animals in each lot received no hormone treatment, one-fourth stilbestrol implants, one-fourth testosterone implants and one-fourth both stilbestrol and testosterone. Implantations of 36 milligrams of stilbestrol and 120 milligrams of testosterone were made at the start of the experiment and again 85 days later. The stilbestrol was implanted in pellet form and the testosterone in a paste-type carrier. The average daily rations fed are given in Appendix Table 9. The heifers were marketed on June 19 and the steers on July 10. All cattle were slaughtered through packing plants where carcass grades and weights were obtained.

## RESULTS

### Average Daily Gains

The results of the first experiment are shown in Appendix Table 8. The average daily gain of all steers was 0.14 pound faster than that of the heifers. Stilbestrol implantation increased the average daily gains of the heifers by 0.18 pound and the steers, 0.36 pound. Testosterone, however, produced a greater increase in average daily gain of the heifers, 0.21 pound, than of the steers, 0.06 pound. Average daily gains of cattle implanted with both stilbestrol and testosterone were no greater than those implanted with stilbestrol alone. These observations were made from only a limited number of animals.

A comparison of feeding two lots of heifers and two lots of steers under varying housing conditions is given in Appendix Table 9. The heifers gained on the average 0.10 pound per head daily slower than the steers. This difference, however, was not statistically significant and was influenced by the hormone treatments, as shown in Table 4.

**TABLE 4.—Average Daily Gains and Carcass Data of Steers and Heifers by Hormone Treatments**

**1955–1956 Experiment**

| | Untreated | Stilbestrol | Testosterone | Stilbestrol and testosterone |
|---|---|---|---|---|
| | Average Daily Gains | | | |
| Inside heifers | 1.82 | 2.10 | 1.96 | 2.24 |
| Outside heifers | 1.82 | 2.09 | 1.88 | 2.24 |
| Average, all heifers | 1.82 | 2.09 | 1.92 | 2.24 |
| Inside steers | 1.95 | 2.41 | 1.78 | 2.48 |
| Outside steers | 1.84 | 2.37 | 1.86 | 2.28 |
| Average, all steers | 1.89 | 2.39 | 1.82 | 2.38 |
| | Carcass Data | | | |
| Heifers: | | | | |
| Carcass grades | 1 ch.+<br>5 ch.<br>2 gd. | 7 ch.<br>1 gd. | 5 ch.<br>1 gd.+<br>2 gd. | 1 ch.+<br>5 ch.<br>2 gd. |
| Dressing percentage | 60.8 | 62.5 | 60.9 | 62.3 |
| Live value per cwt. | $21.11 | $21.76 | $21.03 | $21.62 |
| Steers: | | | | |
| Carcass grades | 1 ch.+<br>7 ch.<br>1 ch.— | 5 ch.<br>2 ch.—<br>1 gd.+ | 1 ch.+<br>5 ch.<br>2 gd. | 1 ch.<br>2 ch.—<br>5 gd. |
| Dressing percentage | 61.5 | 62.5 | 61.4 | 61.8 |
| Live value per cwt. | $22.17 | $22.39 | $21.96 | $21.64 |

In this second experiment implantations of a total of 72 milligrams of stilbestrol per head in two treatments increased the average daily gains by 0.27 pound and 0.50 pound in heifers and steers, respectively. The combination of stilbestrol and testosterone produced an additional, significant increase of 0.15 pound per head daily in heifers but no increase in steers. Heifers implanted with testosterone alone gained 0.10 pound per head daily faster than the untreated heifers but this hormone did not increase the gains of the steers.

## Carcass Data

Carcass grades and dressing percentages were obtained from the cattle fed in the 1955-1956 experiment. There were some variations in carcass grade but these differences did not appear consistent between hormone treatments. Stilbestrol implantation appeared to increase

slightly the grade of the heifer carcasses and reduce the grade of the steer carcasses. In this experiment the implantation of stilbestrol tended to increase the dressing percentage of both the steers and heifers.

The live values given in Table 4 are not appraised prices but were calculated from actual carcass grades, weights and carcass prices. The carcass prices used in these calculations were as follows: for steers—high, average and low choice, $36.50, $36.00, $35.75; high, average and low good, $35.00, $34.50, $34.00; and heifer carcasses $1.00 per cwt. lower for each grade.

## DISCUSSION

In these two experiments the implantation of stilbestrol increased the growth rate of steers more than it did that of heifers. These increases for the two experiments were 0.18 pound and 0.27 pound per head daily in heifers and 0.36 pound and 0.50 pound in steers. The effects of testosterone, however, were just the opposite, with 0.21 and 0.10 pound increases per head daily in heifers and no increase in steers. The combination of the two hormones was more effective than stilbestrol alone when implanted in heifers but not in steers.

These results are in agreement with those of Andrews and coworkers (1950, 1954) and Dinusson, Andrews and Beeson (1950). In these investigations intramuscular injections of a total of 82.5 milligrams of testosterone or the subcutaneous implantation of a 50 milligram pellet of testosterone produced a temporary growth stimulus in heifers. Implantations of either 180 or 255 milligrams of testosterone in pellet form had no effect on gains of steers (Andrews, **et al.**, 1950, 1954). Burris **et al.** (1953, 1954) obtained growth increases in both steers and heifers from injections of testosterone. They administered testosterone intramuscularly and used a much larger dose of one milligram per kilogram of body weight each week. They also obtained a greater increase in growth in heifers than in steers.

Growth rates of fattening cattle, especially heifers, can be increased by the administration of testosterone. The amount of this natural male hormone required, however, is much greater than the amount of stilbestrol required to produce a growth stimulus.

The effects of administering both testosterone and stilbestrol in the same animal requires further study. Certain synthetic testosterone materials are now being produced experimentally. Some of these products are reported to be more potent than the naturally-occurring

testosterone. Investigations are being continued at this Station to study one of these compounds and to further study the combination of natural or synthetic testosterone with stilbestrol.

## SUMMARY

Subcutaneous implantations of stilbestrol increased average daily gains of steers and heifers with the increases being greater in steers than heifers. Testosterone implantations stimulated the growth rate of heifers but not that of steers. In one experiment a combination of stilbestrol and testosterone implanted in heifers produced gains greater than those obtained from stilbestrol alone. Stilbestrol implantation tended to lower the grade of steer carcasses but did not appear to effect the grade of heifer carcasses. Investigations are under way to study further these hormone relationships.

# III

## SUBCUTANEOUS AND ORAL ADMINISTRATION OF STILBESTROL

Research discussed in Parts I and II of this bulletin and references referred to therein have shown that the subcutaneous implantation of stilbestrol markedly increases the growth rate of fattening cattle. It has also been shown that an oral administration of approximately 10 mg. of stilbestrol per head daily gave a similar growth response (Burroughs **et al.**, 1954; Culbertson **et al.**, 1954; Perry **et al.**, 1955).

The feeding of stilbestrol to beef cattle was approved by the Food and Drug Administration in November, 1954. About a year later approval was granted for the marketing of stilbestrol pellets to be implanted subcutaneously in fattening cattle. Thus, stilbestrol may be used in either of these ways. When administered orally a premix containing stilbestrol is generally mixed with a protein supplement in such amounts that the feeding of one to two pounds of that supplement will supply the desired amount of stilbestrol per head daily.

The present experiments were conducted to compare, under similar conditions with similar cattle, the subcutaneous implantation and oral feeding of stilbestrol.

## PROCEDURE

### 1954–1955 Experiment

The Hereford steers used in this experiment were steers which had been used in a corn silage feeding experiment. At the conclusion of the silage experiment the steers were divided into uniform lots, based on body weight and amount of gain which they had made during the 112 days on corn silage. The steers weighed approximately 725 pounds initially and were fed for 126 days. All lots were fed good quality mixed hay, a full feed of ground ear corn and allowed free access to salt and to a mineral mixture of two parts steamed bone meal, two parts ground limestone and one part salt. Three levels of protein were fed—no supplement, 0.75 pound or 1.5 pounds of soybean oil meal per head daily. These levels of protein were fed without additional treatment, with stilbestrol implanted or with stilbestrol fed.

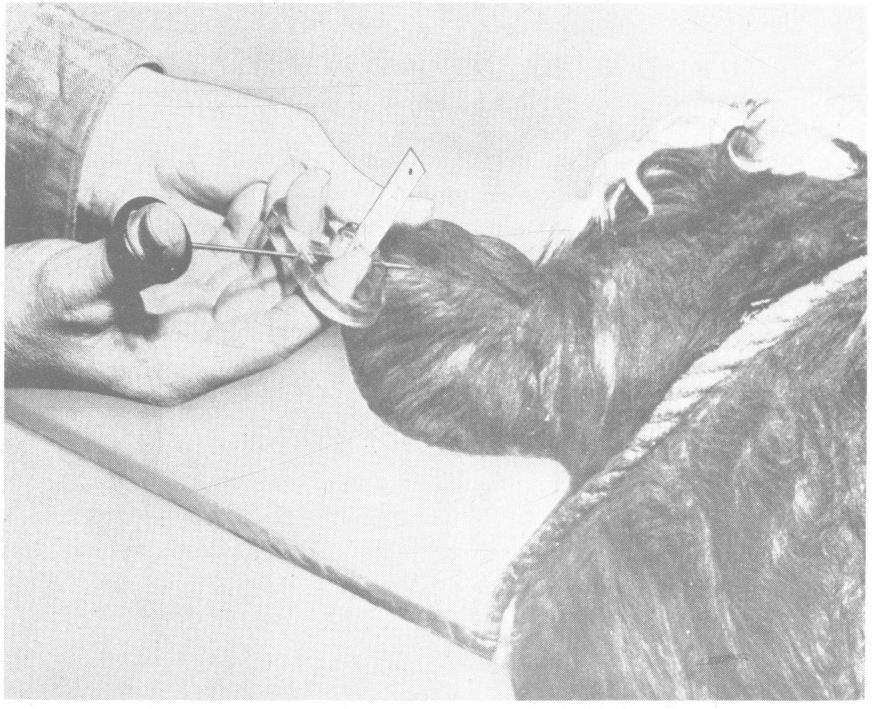


**Fig. 5.—Site of implantation of stilbestrol pellets.**

The cattle which were implanted with stilbestrol were implanted with five 12 milligrams pellets in the ear on March 1, when the experiment was started. Where fed, stilbestrol was fed at the rate of 10 milligrams per head per day. The stilbestrol was obtained as a premix and was mixed with ground ear corn so that two pounds supplied the recommended daily amount of stilbestrol.

At the conclusion of the experiment the cattle were slaughtered through a packing plant where carcass data were obtained. Shrink to market was determined by holding the cattle off feed and water over night, weighing at 6:00 A. M., trucking approximately 95 miles and weighing the cattle off the trucks.

### 1955–1956 Experiment

This experiment was designed to compare the subcutaneous implantation of stilbestrol to feeding stilbestrol and to feeding a combination of stilbestrol and an antibiotic (terramycin). The 40 heaviest of a shipment of 160 head of high quality Hereford feeder steer calves were used in this experiment. They were divided at random within weight groups into four equal lots. Lot 1 served as the control or check lot and received no treatment. The steers in Lot 2 were implanted in the ear with 36 mgs. of stilbestrol at the start of the experiment. Lot 3 was fed 10 mgs. of stilbestrol per head daily and Lot 4 was fed 10 mgs. of stilbestrol and 80 mgs. of terramycin per head daily. Where fed, the daily allowances of stilbestrol and terramycin were mixed with two pounds of ground ear corn.

The ration fed for the first 98 days included only a limited amount of corn and a full feed of corn silage. During the remainder of the experiment the corn silage was limited and ground ear corn was full fed. The steers remained in the same lots with the same treatments for the entire 238 day experiment. These cattle were also slaughtered through a packing plant, where slaughter data were obtained.

## RESULTS

### Average Daily Gains

The results obtained in these experiments are summarized in Tables 5 and 6 while the detailed results are presented in Appendix Tables 10, 11 and 12.

As reported previously, the implantation or feeding of stilbestrol significantly increased rates of gain and reduced the amount of feed required per unit of gain. In the 1954-1955 experiment, when the average of the three lots on each treatment are considered, stilbestrol implantation increased the average daily gain by 0.25 pound and the

feeding of stilbestrol 0.34 pound. This difference between feeding and implantation was not statistically significant. The increase in rate of gain from stilbestrol in these comparisons was not as great as generally obtained; however, their response was influenced by the amount of protein fed. This relationship will be discussed in a later section of this bulletin.

In the 1955-1956 experiment, the cattle implanted with stilbestrol gained 0.37 lb. per head daily faster than the controls when fed the high silage, limited corn ration, while those fed stilbestrol or stilbestrol and terramycin gained at much the same rate as the control steers. During the second phase, with a full feed of corn, the increases in daily gains were 0.32 lb., 0.52 lb. and 0.36 lb. for the stilbestrol implanted, stilbestrol fed and stilbestrol and terramycin fed steers, respectively. The gains made during the second phase were most likely influenced by the gains made during the first phase. The results for the entire 238 days, as given in Table 6, show little difference in rate of gain between steers implanted and those fed stilbestrol. In this one comparison, no advantage in rate or cost of gain was realized from the addition of terramycin to the ration.

### Shrink to Market

This information was obtained in the 1954-1955 experiment only. Although these shrinkages were relatively small and within the three percent generally expected under similar shipping conditions, the differences between treatments were consistent and proved significant at the 5 percent level. The cattle fed stilbestrol shrank significantly more than the controls or those implanted with stilbestrol. The shrink to market also increased as the amount of protein fed increased. The variance due to level of protein fed was greater than that due to stilbestrol treatment. In an attempt to understand these differences the shrink to market was correlated with the average daily feed consumption during the experiment. A correlation coefficient of $+0.42$ was found which with 7 degrees of freedom did not prove significant. No measure of water consumption was made during the experiment.

### Carcass Data

In the 1954-1955 experiment the implantation of stilbestrol lowered the carcass grade about one-fourth grade while carcasses from cattle fed stilbestrol were intermediate between the controls and the implanted cattle. These differences, however, did not prove statistically significant. Differences in dressing percentage were variable and not significant, with the stilbestrol fed cattle tending to yield slightly lower.

## TABLE 5.—A Comparison of the Implantation of Stilbestrol and Feeding Stilbestrol with Three Levels of Soybean Oil Meal

### 1954–1955 Experiment

| | Control | Stilbestrol implant | Stilbestrol fed |
|---|---|---|---|
| No soybean oil meal: | | | |
| Average daily gain, lb. | 1.75 | 1.72 | 1.83 |
| Feed per cwt. gain, lb. | 1019 | 1003 | 925 |
| Shrink to market, % | 2.40 | 2.08 | 2.69 |
| Dressing percentage | 60.3 | 62.3 | 59.3 |
| Carcass grade* | 1.61 | 1.96 | 1.66 |
| Live value per cwt. † | $23.02 | $23.28 | $22.44 |
| Lumbo-sacral angle, degrees‡ | 127 | 119 | 125 |
| 0.75 lb. soybean oil meal/head/day: | | | |
| Average daily gain, lb. | 2.06 | 2.32 | 2.51 |
| Feed per cwt. gain, lb. | 879 | 857 | 742 |
| Shrink to market, % | 2.53 | 2.52 | 2.91 |
| Dressing percentage | 62.3 | 60.8 | 61.5 |
| Carcass grade | 1.43 | 1.71 | 1.61 |
| Live value per cwt. | $23.78 | $23.01 | $23.28 |
| Lumbo-sacral angle, degrees | 127 | 120 | 125 |
| 1.50 lb. soybean oil meal/head/day: | | | |
| Average daily gain, lb. | 2.10 | 2.63 | 2.59 |
| Feed per cwt. gain, lb. | 917 | 699 | 739 |
| Shrink to market, % | 2.79 | 2.87 | 3.08 |
| Dressing percentage | 62.3 | 62.7 | 61.4 |
| Carcass grade | 1.34 | 1.49 | 1.23 |
| Longissimus dorsi, sq. in. § | 12.69 | 13.17 | 12.95 |
| Live value per cwt. | $23.97 | $24.14 | $23.64 |
| Lumbo-sacral angle, degrees | 128 | 120 | 124 |
| Average: | | | |
| Average daily gain, lb. | 1.97 | 2.22 | 2.31 |
| Feed per cwt. gain, lb. | 938 | 853 | 802 |
| Shrink to market, % | 2.58 | 2.51 | 2.90 |
| Dressing percentage | 61.6 | 61.9 | 60.8 |
| Carcass grade | 1.46 | 1.72 | 1.50 |
| Live value per cwt. | $23.59 | $23.48 | $23.12 |
| Lumbo-sacral angle, degrees | 127 | 120 | 125 |

*Carcass grade factor: choice=1, 1.4, 1.7—good=2, 2.4, 2.7.

†Based on carcass grade, weight and prices as follows: choice, $38.50—good, $36.00.

‡Angle formed by lumbar and sacral vertebrae as measured from carcass hanging in cooler.

§Determined on three lots only in this experiment.

**TABLE 6.—Stilbestrol, Implanted or Fed to Fattening Steers**
**1955–1956 Experiment**

| | Control | Stilbestrol implanted | Stilbestrol fed |
|---|---|---|---|
| Number of steers | 10 | 10 | 10 |
| Average daily gain, lb. | 2.05 | 2.39 | 2.36 |
| Feed per cwt. of gain, lb. | 953 | 846 | 888 |
| Dressing percentage | 61.7 | 61.6 | 61.5 |
| Carcass grade | 1.20 | 1.59 | 1.68 |
| Live value per cwt. * | $22.43 | $22.05 | $21.87 |
| Lumbo-sacral angle, degrees | 128 | 122 | 123 |

*Calculated from carcass grade and prices as follows: high, average and low choice, $36.50, $36.00 and $35.75; average good, $34.50.

When live value per hundredweight was calculated from carcass grade and weight there was very little difference between the control, stilbestrol implanted and stilbestrol fed cattle.

Both stilbestrol implantation and stilbestrol feeding tended to lower the carcass grade in the second experiment and to a similar degree. There were very small differences between treatments in dressing percentage. As will be found in Appendix Table 12, the highest carcass yield was obtained from the cattle fed the combination of stilbestrol and terramycin.

## Side Effects

The implantation of stilbestrol has generally been reported to cause a dropping of the loin, elevation of the tail head and increased teat length. There has been some disagreement in published reports relative to the development of these side effects in cattle fed stilbestrol.

In the experiments reported here there was considerable variation between individual animals in the development of side effects as a result of stilbestrol treatment.

Elevation of the tail head is one of the side effects most commonly noted. This observation is difficult to measure in the live animals. It can be more accurately measured in the carcass by the angle formed by the lumbar and sacral vertebrae as the carcass hangs on the rail in the cooler. This measurement is presented in Tables 5 and 6. In the 1954-1955 experiment the implantation of stilbestrol produced a significantly more acute angle than that found in the controls. The lumbo-sacral angle in the carcasses from the stilbestrol fed cattle was not

significantly different from the controls. However, neither was it significantly different from those which had been implanted with stilbestrol. Although the differences were small in the 1955-1956 experiment, all three lots which received stilbestrol seemed to be slightly affected and to a similar degree.

## DISCUSSION AND SUMMARY

Results of these two experiments show very little difference in response from stilbestrol whether implanted or fed to fattening steers. In the first experiment, when a 60 milligram implant was used, the stilbestrol fed cattle gained slightly faster and their carcasses graded slightly higher. The elevation of the tail head also seemed to be slightly greater in the implanted steers. In the second experiment the effect on rate of gain and carcass grade was just the opposite with no apparent difference between the two in elevation of the tail head as measured by the lumbo-sacral angle of the carcass. An implanation of 36 milligrams of stilbestrol was used in the second experiment.

Beeson and co-workers (1956) have reported an experiment in which different levels of stilbestrol implantation were compared with feeding 10 milligrams per head daily in dry lot. Steers implanted with 36 milligrams gained 0.13 pound per head daily faster than those fed 10 milligrams. This difference was considerably greater in cattle fed on pasture. No difference was reported in the side effects between feeding and implanting in either experiment. Increased teat length was the only side effect reported.

With a choice available between feeding or implantation, there appear to be some advantages to either method of stilbestrol administration. When it is mixed with the feed, it is not necessary to handle the cattle and the side effects may be less noticeable. However, when a low level of implantation is used, 36 mgs. per head, any differences in side effects are likely to be small. When implanted subcutaneously and no charge is made for handling the cattle, the cost of the stilbestrol is less. Also, it can be used at much lower cost under certain conditions (cattle on pasture) or with certain rations (limited grain and legume forage) which do not require the purchase of a commercial supplement. When implanted, it is certain that each animal is getting the intended dosage and that they may be fed in the same lot with breeding cattle or hogs.

Numerous experiments have been conducted by a number of experiment stations to study the value of adding an antibiotic to rations for fattening cattle. Some experiments have shown an advantage and

others no advantage from such additions. No conclusions should be drawn from the one experiment in which an antibiotic was included in this report.

# IV

## EFFECT OF AMOUNT OF PROTEIN IN THE RATION UPON RESPONSE FROM STILBESTROL

Nitrogen balance studies reported by Clegg and Cole (1954) have shown that steers implanted with stilbestrol retained or stored considerably more protein than untreated steers fed the same ration. Thus, stilbestrol appears to have a definite influence upon protein metabolism. This could be a direct effect upon protein utilization or an indirect one resulting from the growth stimulus of stilbestrol. It, thus, seems possible that stilbestrol might have an influence upon the amount of protein required in the ration. If stilbestrol directly improved protein utilization it might lower the amount needed in the ration. On the other hand, if the increased nitrogen retention was a result of increased growth rate it might possibly increase the amount required. It is also possible that the increased requirements for growth might improve the efficiency of utilization so that stilbestrol would have no effect upon the protein requirement.

Two experiments have been conducted to study the protein requirements of fattening steers and to study any possible relationship between stilbestrol feeding or implantation and protein requirements.

### PROCEDURE

#### 1954–1955 Experiment

In this experiment three levels of protein were fed without stilbestrol, with 10 mg. fed per head daily or with an implantation of 60 milligrams per head. The detailed procedure of this experiment has been discussed in Part III of this bulletin.

#### 1955–1956 Experiment

Six lots of high quality Hereford steers were used in this experiment. These steers had been used on another 98 day corn silage feeding experiment. At the close of the silage experiment, the steers were allotted at random within weight groups and according to the gain they had made. All lots were fed good quality mixed hay, a full feed of ground ear corn and allowed free access to salt and minerals. The different lots were fed no supplement, 1.0 lb. or 2.0 lb. of soybean oil meal per head daily without stilbestrol and with stilbestrol implantation.

The stilbestrol-treated cattle were implanted in the ear with 48 milligrams at the start of the experiment. This experiment was conducted for a 140-day period.

In both experiments composite samples of the feeds fed were analyzed for crude protein (N × 6.25).

## RESULTS

The results of these experiments are presented in Table 7 and Appendix Tables 10 and 13.

### Average Daily Gains

Statistical analyses of the average daily gains obtained in the 1954-1955 experiment, Table 7, showed a highly significant difference between protein levels and stilbestrol treatment and a significant interaction between level of protein and stilbestrol. There was a highly significant difference in average daily gain between steers fed the low and medium protein rations with all three treatments. The difference between the medium and high levels of protein was significant only for the steers which had been implanted with stilbestrol. There were no significant differences between the gains made by steers implanted with or fed stilbestrol at any of the three levels of protein.

There was a significant interaction between level of protein and stilbestrol treatment. The response in daily rate of gain from stilbestrol, average of both methods of administration, was 0.51 lb., 0.36 lb. and 0.03 lb. when 1.5, 0.75 and no soybean oil meal, respectively, was fed per head daily. These results indicate that stilbestrol does not decrease the amount of protein that needs to be fed and that cattle are unable to respond to stilbestrol treatment when fed a protein deficient ration.

In the 1955-1956 experiment, there was a highly significant difference in average daily gains between levels of protein and stilbestrol treatment. There was a highly significant difference between the gains made by the steers fed the low level of protein and those fed the medium level but no significant difference between the medium and high levels. Stilbestrol implantation increased the daily gain with all three levels of protein but was significant at the medium level only.

The response in average daily gain from stilbestrol in this second experiment, Appendix Table 13, was 0.16 lb., 0.43 lb. and 0.23 lb. when 2.0 lb., 1.0 lb. and no soybean oil meal, respectively, was fed per head daily. These results do not appear to be in agreement with the previous experiment where practically no response was obtained from stilbestrol when no soybean oil meal was fed. However, both the

ground ear corn and hay used in this experiment were somewhat higher in protein than those fed the year before. The total protein content of the ration without supplement in this experiment was 9.5 percent as compared to 8.3 percent in the first experiment. In fact, the protein content of this experiment's hay-corn ration was nearly equal to the 9.7

**TABLE 7.—Effect of Level of Protein in the Ration upon Response from Stilbestrol when Implanted or Fed to Fattening Steers**

**1954–1955 Experiment**

| | Control | Stilbestrol implant | Stilbestrol fed | Average |
|---|---|---|---|---|
| No soybean oil meal: | | | | |
| Percent total protein | 8.3 | 8.3 | 8.3 | 8.3 |
| Average daily gain, lb. | 1.75 | 1.72 | 1.83 | 1.77 |
| Feed per cwt. gain, lb. | 1019 | 1003 | 925 | 982 |
| Shrink to market, % | 2.40 | 2.08 | 2.69 | 2.39 |
| Dressing percentage | 60.3 | 62.3 | 59.3 | 60.6 |
| Carcass grade* | 1.61 | 1.96 | 1.66 | 1.74 |
| Live value per cwt. † | $23.02 | $23.28 | $22.44 | $22.91 |
| Lumbo-secral angle, degrees‡ | 127 | 119 | 125 | 124 |
| 0.75 lb. soybean oil meal/head/day: | | | | |
| Percent total protein | 9.7 | 9.6 | 9.7 | 9.7 |
| Average daily gain | 2.06 | 2.32 | 2.51 | 2.30 |
| Feed per cwt. gain, lb. | 879 | 857 | 742 | 826 |
| Shrink to market, % | 2.53 | 2.52 | 2.91 | 2.65 |
| Dressing percentage | 62.3 | 60.8 | 61.5 | 61.5 |
| Carcass grade | 1.43 | 1.71 | 1.61 | 1.59 |
| Live value per cwt. | $23.78 | $23.01 | $23.28 | $23.36 |
| Lumbo-sacral angle, degrees | 127 | 120 | 125 | 124 |
| 1.50 lb. soybean oil meal/head/day: | | | | |
| Percent total protein | 11.0 | 11.2 | 11.0 | 11.1 |
| Average daily gain, lb. | 2.10 | 2.63 | 2.59 | 2.44 |
| Feed per cwt. gain, lb. | 917 | 699 | 739 | 785 |
| Shrink to market, % | 2.79 | 2.87 | 3.08 | 2.91 |
| Dressing percentage | 62.3 | 62.7 | 61.4 | 62.1 |
| Carcass grade | 1.34 | 1.49 | 1.23 | 1.35 |
| Longissimus dorsi, sq. in. § | 12.69 | 13.17 | 12.95 | |
| Live value per cwt. | $23.97 | $24.14 | $23.64 | $23.92 |
| Lumbo-sacral angle, degrees | 128 | 120 | 124 | 124 |

*Carcass grade factor: choice=1, 1.4, 1.7—good=2, 2.4, 2.7.

†Based on carcass grade, weight and prices as follows: choice, $38.50—good, $36.00.

‡Angle formed by lumbar and sacral vertebrae as measured from carcass hanging in cooler.

§Determined on three lots only in this experiment.

percent total protein of the ration which included 0.75 lb. soybean oil meal in the previous study. When compared on the basis of the total protein content of the rations fed rather than on the basis of the amount of soybean oil meal added, the results of the two years are in good agreement.

### Carcass Data

In the first experiment, stilbestrol tended to lower the carcass grade but the differences were not statistically significant. Also, the stilbestrol implanted cattle yielded a slightly higher percentage of carcass than the untreated steers. In the second experiment, the carcasses of the cattle which were implanted with stilbestrol graded about one-third grade lower than those of the untreated steers. Carcass yield was also lower for the treated steers. The decrease in dressing percentage became greater as the amount of protein in the ration decreased.

Carcass grade was considerably lower for the cattle fed the low protein ration in both experiments. In 1955-1956, when the higher levels of protein were fed, there was little difference in carcass grade between cattle fed the medium or high levels of protein.

### Side Effects

The side effects of stilbestrol have been discussed previously. However, it is of interest to note, Table 7, that the average elevation of the tail head, as measured by the lumbo-sacral angle, was identical for all three levels of protein fed. This was true even though there was no difference in rate of gain of the cattle fed the low protein ration with or without stilbestrol. The lumbo-sacral angle was also very similar for all of the stilbestrol implanted cattle in the 1955-1956 experiment, Appendix Table 13.

## DISCUSSION

The average daily gains and responses to stilbestrol obtained in the two experiments are summarized in Table 8.

These results indicate that the percentage of total protein required in a ration for fattening cattle, averaging approximately 800 pounds in weight, is somewhere between 9.7 and 11.2 percent. This is in quite good agreement with present recommendations but also indicates that present recommendations are fully adequate. It is also indicated that the protein requirement is not greatly influenced by the use of stilbestrol. Apparently the increased requirement for growth stimulated by stilbestrol is offset by an improved efficiency of utilization.

**TABLE 8.—Effect of Level of Protein in the Ration upon Response to Stilbestrol**

**Average Daily Gains, Lb.**

| Percent total protein in ration | Control | Stilbestrol | Response |
|---|---|---|---|
| 8.3* | 1.75(7) | 1.78(14)† | 0.03 |
| 9.5 | 1.79(7) | 2.02( 7)‡ | 0.23 |
| 9.7* | 2.06(7) | 2.42(14)† | 0.36 |
| 11.1* | 2.10(7) | 2.61(14)† | 0.51 |
| 11.2 | 2.10(7) | 2.53( 7)‡ | 0.43 |
| 12.9 | 2.28(7) | 2.44( 7)‡ | 0.16 |

( ) Number of steers.

*Three levels fed in 1954-1955 experiment, other three levels fed in 1955-1956 experiment.

†Average of 7 steers implanted with 60 mgs. and 7 steers fed 10 mg. per head daily.

‡Steers implanted with 48 mgs.

A maximum response from stilbestrol is dependent upon a ration adequate in protein, i.e., stilbestrol will not replace an essential nutrient, such as protein. These results also show that the response from stilbestrol is not likely to be increased by feeding more than the presently recommended amount of protein.

The results are not in agreement with those of Culbertson **et al.** (1956) who concluded that stilbestrol reduced the amount of protein required by fattening cattle. However, they compared a ration essentially adequate in protein, 10.5 percent, to a higher level, 13.5 percent. Their results are in agreement with those reported in this bulletin in that the feeding of 10 milligrams of stilbestrol did not improve a high protein ration more than one adequate in protein.

## SUMMARY

Two experiments were conducted in which stilbestrol was administered, orally or subcutaneously, with rations which contained three levels of protein. The response in rate of gain from stilbestrol decreased as the amount of protein in the ration decreased. The percentage of total protein required in the ration did not appear to be greatly affected by stilbestrol. The maximum response from protein was attained at much the same level—approximately 11 percent, whether fed with or without stilbestrol.

# V

## VALUE OF STILBESTROL IMPLANTATION IN STEERS GRAZED AND THEN FED GRAIN ON PASTURE

The amount of information on the effect of stilbestrol is much more limited for cattle fattened on pasture than in dry lot. Clegg and Cole (1954) reported no significant increase in rate of gain from stilbestrol implantation when steers and heifers were grazed on irrigated pastures in California without supplementary feeding. However, an increase in gain was obtained from stilbestrol when rolled barley and hay was fed in addition to the pasture. O'Mary and Cullison (1956), from the Georgia Station, have reported two experiments of approximately 70 days duration in which the implantation of 24 milligrams of stilbestrol per head in steers grazed without supplemental feeding increased the average daily gain by 0.69 lb. and 0.58 lb. Burroughs (1956) has summarized results of three pasture experiments conducted at Iowa, Nebraska and Illinois in which 10 milligrams of stilbestrol was fed per head daily. During the grazing period the response to stilbestrol was 0.14 lb., 0.25 lb. and 0.30 lb. per head daily, respectively. For the grazing plus dry-lot finishing period the increases in average daily gains due to stilbestrol were 0.15 lb., 0.16 lb. and 0.17 lb., respectively. Beeson **et al.** (1956) reported no increase from feeding stilbestrol but a significant increase in rate of gain from the subcutaneous implantation of stilbestrol in steers fed on pasture.

For three summers, research has been conducted at the Madison County Farm of the Ohio Agricultural Experiment Station to determine the influence of stilbestrol implantation upon rate of gain and carcass quality of steers grazed for a period without grain and then fed ground ear corn on pasture.

### PROCEDURE

The cattle used in these experiments were heavy Hereford calves purchased in the fall and wintered to gain a pound to a pound and a quarter per head daily. They were grazed without grain for approximately 60 days and were then fed ground ear corn on pasture and marketed about October 1. The pastures used in these experiments were mixed seedings of grasses and legumes but contained a high proportion of legumes.

In the 1954 experiment, ten head of steers were implanted in the ear with 60 milligrams of stilbestrol per head on May 21st and again with the same dosage on August 9th. A comparable group of 11 steers served as controls. Ten steers were untreated in the 1955 experiment

and ten were given one implantation of 60 milligrams of stilbestrol per head on April 15th. In the third experiment 12 steers served as controls and 11 steers were implanted with 36 milligrams of stilbestrol per head on April 30th.

The stilbestrol treated and untreated steers were grazed and fed together in the 1954 experiment. In the 1955 and 1956 experiments the treated and untreated steers were grazed together until corn feeding was started. They were then separated and fed in groups so that corn consumption by treatments could be obtained. Approximately 15 bushels of corn were fed per head. In 1955 the stilbestrol treated steers ate 82 pounds more, and in 1956, 35 pounds more ground ear corn per head than the untreated steers.

## RESULTS

### Average Daily Gains

The average daily gains obtained for the three years for the grazing period and for the entire grazing and feeding period are given in Table 9.

**TABLE 9.—Influence of Stilbestrol Implantation upon Gains of Steers when Pastured and when Fed Corn on Pasture**

| | Pasture only | | | Entire period Pasture and pasture plus corn | | |
|---|---|---|---|---|---|---|
| | Days in period | Control | Stilbestrol implanted | Days in period | Control | Stilbestrol implanted |
| 1954 | 35 | 1.82 | 2.94 | 127 | 1.93 | 2.52 |
| 1955 | 62 | 2 54 | 3.38 | 158 | 2.18 | 2.74 |
| 1956 | 56 | 2.19 | 2.73 | 131 | 2.29 | 2.80 |
| Average | | 2.18 | 3.02 | | 2.13 | 2.69 |

A very marked increase in rate of gain was obtained from stilbestrol implantation during the period when the steers were grazed without supplementary feeding. This increase averaged 0.84 lb. per head daily for the three years. This was for a relatively short period, however, and at the time when the pastures were in their spring and early summer peak of production. It is doubtful if such an average would be maintained over a longer grazing period.

The average increase in daily gain for the entire feeding period, pasture and pasture plus corn feeding, was 0.56 lb. for the three years. These increases in growth rate are fully equal to those generally obtained from the use of stilbestrol with steers fattened in dry lot.

### Carcass Data

At the close of each experiment the cattle were sold through packing plants where carcass grades and weights were obtained. These data are given in Table 10.

**TABLE 10.—Influence of Stilbestrol Implantation upon Slaughter Data of Pasture Fed Steers**

| | 1954 | 1955 | 1956 | Average |
|---|---|---|---|---|
| | | Carcass Grade* | | |
| Control | 7.82 | 9.00 | 9.17 | 8.66 |
| Stilbestrol | 7.80 | 8.25 | 8.64 | 8 23 |
| | | Dressing Percentage | | |
| Control | 57.7 | 58.2 | 56.8 | 57.6 |
| Stilbestrol | 58.9 | 58.6 | 56.8 | 58.1 |
| | | Average Chilled Carcass Weight | | |
| Control | 498 | 552 | 559 | 536 |
| Stilbestrol | 550 | 602 | 603 | 585 |

*Low, average and high good=7, 8 and 9, respectively.

The average for the three years shows that stilbestrol tended to lower the carcass grade. This reduction averaged less than one-fifth of a grade and varied from practically no difference in 1954 to one-fourth of a grade in 1955. The average dressing percentage was slightly higher for the cattle which had been implanted with stilbestrol. This average difference was 0.5 percent and varied from no difference in 1956 to 1.2 percent in 1954.

## DISCUSSION

There was a wide range in the amount of stilbestrol implanted in these three experiments. A total of 120 milligrams per head was implanted in the 1954 experiment, 60 milligrams in 1955 and only 36 milligrams in 1956. The results indicate that the lower dosage used gave much the same increase in gain as the higher levels of implantation. It appears that one implantation of 36 milligrams is adequate for cattle fed on pasture or in dry lot.

Pastures high in legumes were grazed each of the three years. No difficulty from bloat was encountered in the 1954 experiment. In 1955 there were numerous cases of bloat and two steers died. Although it is not known whether there is any relationship between stlibestrol implantation and bloating, both of the steers which were lost had been

implanted. It may be possible that silbestrol stimulated the appetite of the steers which caused them to eat more of a forage which had a tendency to produce bloat. On the other hand, this may have only been a coincidence. Even though the only animals lost from bloat had been implanted, the bloating was not confined to the treated steers.

Although more information is needed, the results of these experiments and those reported by others (Burroughs, 1956, Beeson **et al.** 1956, and Baird and Sell, 1957) suggest that stilbestrol implantation may give a greater growth stimulus than the oral administration of stilbestrol when used with pasture-fed steers. Also, steers may be fed on pasture most of the season without the need of a protein supplement. If a supplement is purchased only for the stilbestrol it contains, the oral administration of stilbestrol becomes much more expensive than subcutaneous implantation.

With an increase in gain and some reduction in carcass grade it is difficult to calculate the exact returns which might be realized from the implantation of stilbestrol in steers fattened on pasture. This is true because of the considerable variation in relative value of the various grades of beef which may occur in different years. In these experiments the steers implanted with stilbestrol consumed an average of 58 pounds more ground ear corn per head and produced 49 pounds more chilled carcass beef. The greatest reduction in carcass grade which occurred in the three years was one-fourth of a grade. Under most conditions the increased pounds of beef produced are likely to more than offset the cost of the extra corn consumed and the reduction in grade which may occur.

## SUMMARY

Stilbestrol implantation increased the average daily gains of steers grazed and then fed grain on pasture by 0.56 lb. in an average of three experiments. Implantation decreased the carcass grade less than one-fifth of a grade which varied from practically no difference to one-fourth of a grade in different experiments. Stilbestrol treatment did not decrease carcass yield.

# VI

## GENERAL DISCUSSION

For discussions of the various comparisons made in this bulletin the reader is referred to those particular sections of the bulletin.

The sex hormones, male and female, have a definite effect upon growth rate and feed requirements of fattening cattle. Although vary-

ing in degree, the effects of the two appear to have some similarities. At the present time the use of the female-like hormones have the most practical application.

It has been shown that bull calves gain significantly faster and more economically than steer calves. Stilbestrol implantation further stimulated the gains of the bulls and raised their carcass grade. With the current feed and beef supplies available in this country, the practical application of this information may be questionable. However, in areas where meat supplies are limited, or if a shortage should develop in this country in the future, it seems quite clear that the supply of good to choice quality beef could be very quickly and markedly increased by the elimination of castration and by the use of stilbestrol to further increase production and improve quality.

When used in steers, stilbestrol tends to lower the carcass grade. The carcass grades and yields of all of the cattle from which these data were obtained in these experiments are summarized in Table 11. It will be noted that in steers stilbestrol lowered the carcass grade an average of approximately one-fifth of a grade. There was no consistent effect on carcass yield.

In these experiments stilbestrol did not influence the grade of heifer carcass. This observation was made with only a limited number of animals. However, it is in agreement with a report by Dinusson **et al.** (1950).

A wide range in amount of stilbestrol implanted was used in these experiments. The degree of development of side effects in the live animal is definitely influenced by the level of implantation. This would indicate, although not definitely shown in these experiments, that carcass grade would also be more likely to be influenced by higher levels of implantation.

The effects of stilbestrol implantation upon carcass quality are generally considered to be deleterious. This is because of the tendency to lower the grade, due largely to smaller accumulations of external and intramuscular fat. However, it is well known that the general public does not desire a large amount of external fat. Wierbicki **et al.** (1955) also found that the relationship between intramuscular fat, or marbeling, and degree of tenderness is not as close as might generally be expected. Results presented in this publication show that stilbestrol implantation increased the percentage of edible portion in steer carcasses. It was also found that implantation increased the proportion of five of the more desirable wholesale cuts (chuck, rib, round, loin end and short loin) and decreased the percentage of the two least desirable cuts (kidney knob and flank).

## TABLE 11.—Summary of Carcass Yield and Grade of Control and Stilbestrol Treated Bulls, Steers and Heifers

| Experiment | Number of Animals | | Dressing Percentage | | Carcass Grade* | |
|---|---|---|---|---|---|---|
| | Control | Stilbestrol | Control | Stilbestrol | Control | Stilbestrol |
| Bulls: | | | | | | |
| 1952-1953 | 10 | 5 | 58.8 | 59.6 | 2.01 | 1.64 |
| 1953-1954 | 10 | 10 | 61.2 | 61.6 | 2.47 | 2.03 |
| 1954-1955 | 12 | 12 | 61.9 | 61.3 | 1.97 | 1.91 |
| Total | 32 | 27 | 181 9 | 182 5 | 6.45 | 5.58 |
| Average | | | 60.6 | 60.8 | 2.15 | 1.86 |
| Steers: | | | | | | |
| 1953-1954 | 10 | 9 | 61.5 | 61.3 | 1.37 | 1.62 |
| 1954-1955 | 12 | 12 | 61.7 | 60.6 | 1.20 | 1.25 |
| 1954-1955 | 7 | 7 | 60.3 | 62.3 | 1.61 | 1.96 |
| | | 7† | | 59.3 | | 1.66 |
| | 7 | 7 | 62.3 | 60.8 | 1.43 | 1.71 |
| | | 7† | | 61.5 | | 1.61 |
| | 7 | 7 | 62.3 | 62.7 | 1.34 | 1.49 |
| | | 7† | | 61.4 | | 1.23 |
| 1955-1956 | 7 | 7 | 61.5 | 59.4 | 1.99 | 2.36 |
| | 7 | 7 | 62.3 | 60.6 | 1.51 | 1.94 |
| | 7 | 7 | 61.9 | 61.3 | 1.57 | 1.89 |
| 1955-1956 | 10 | 10 | 61.7 | 61.6 | 1.20 | 1.59 |
| | | 10† | | 61.5 | | 1.68 |
| 1955-1956 | 9 | 8 | 61.5 | 62.5 | 1.39 | 1.55 |
| | 8 | 8 | 61.4 | 61.8 | 1.60 | 2.10 |
| 1954 | 11 | 10 | 57.7 | 58.9 | 2 43 | 2.45 |
| 1955 | 10 | 10 | 58.2 | 58.6 | 2.00 | 2.30 |
| 1956 | 12 | 11 | 56.8 | 56.8 | 1.97 | 2.15 |
| Total | 124 | 151 | 851.1 | 1092.9 | 22.61 | 32.54 |
| Average | | | 60.8 | 60.7 | 1.62 | 1.81 |
| Heifers: | | | | | | |
| 1955-1956 | 8 | 8 | 60 8 | 62.5 | 1.60 | 1.52 |
| | 8 | 8 | 60.9 | 62.3 | 1.72 | 1.60 |
| Total | 16 | 16 | 121.7 | 124.8 | 3.32 | 3.12 |
| Average | | | 60.8 | 62.4 | 1.66 | 1.56 |
| Grand total | 172 | 194 | 1154.7 | 1400.2 | 32.38 | 41.24 |
| Grand average | | | 60.8 | 60.9 | 1.70 | 1.79 |

*Carcass grade factors: High, average and low good=2.0, 2.4, 2.7.
High, average and low choice=1.0, 1.4, 1.7.

†Stilbestrol fed, all others implanted.

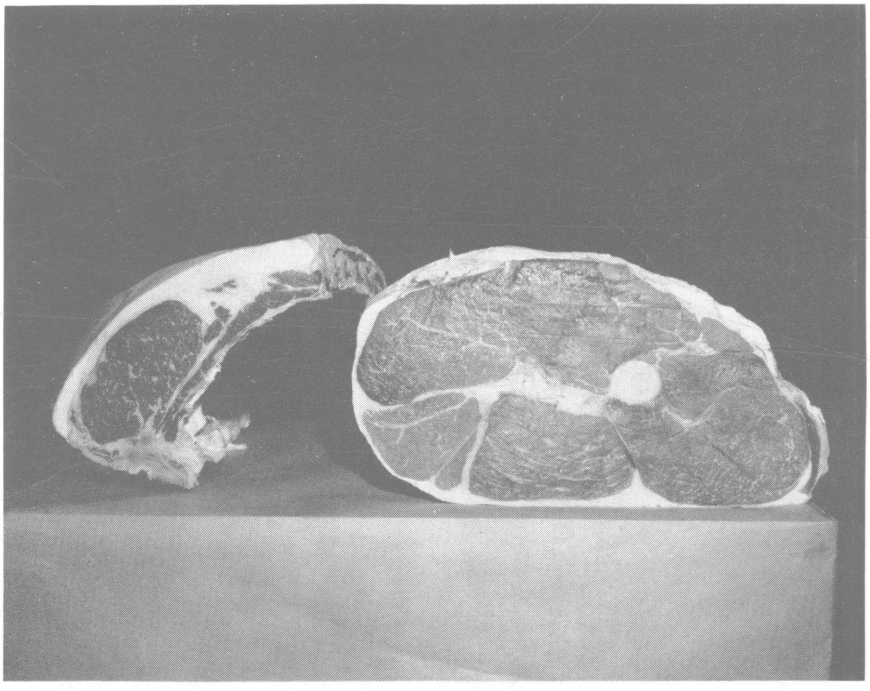


**Fig. 6.—Although not from any of the animals used in these experiments, this figure is presented as a near ideal standard for beef production. This steer carcass has sufficient conformation and quality, including marbling, to grade prime with only a limited amount of external waste fat.**

In steers stilbestrol stimulates growth and not fattening. Therefore, the most definite effect of stilbestrol upon carcasses of a given grade is carcass weight. Carcasses from steers which have been fed or implanted with stilbestrol will be heavier than from similar steers which did not receive stilbestrol. This may or may not be an important factor in evaluating the live animal, depending upon the supply and demand for beef of a particular grade and weight.

Whether the effects of stilbestrol upon carcass quality, irrespective of carcass weight, are desirable or undesirable to the consumer they are relatively small as compared to a number of other factors. Such items as age of animal slaughtered, quality of cattle and ration fed, length of feeding period and carcass ageing will have a much greater effect on beef quality.

# REFERENCES


Andrews, F. N., W. M. Beeson and F. D. Johnson. 1950. The effect of hormones on the growth and fattening of yearling steers. J. Animal Sci. 9: 677.

Andrews, F. N., W. M. Beeson and F. D. Johnson. 1954. The effects of stilbestrol, dienestrol, testosterone and progesterone on the growth and fattening of beef steers. J. Animal Sci. 13: 99.

Andrews, F. N., Martin Stob, T. W. Perry and W. M. Beeson. 1956. The oral administration of diethylstilbestrol, dienestrol and hexestrol for fattening calves. J. Animal Sci. 15: 685.

Annual Report. 1946. The effect of castration and hormone administration upon carcass beef production. Fifty-sixth Annual Report, Ariz. Agr. Exp. Sta., pp. 28-30.

Annual Report. 1947. The effect of castration and hormone administration upon carcass beef production. Fifty-seventh Annual Report, Ariz. Agr. Exp. Sta., pp. 33-35.

Baird, D. M. and O. E. Sell. 1957. Oral and implanted stilbestrol for growing-fattening beef cattle on winter pasture and in dry lot. Georgia Agr. Exp. Sta. Mimeo. Series N.S. 32.

Beeson, W. M., F. N. Andrews, Martin Stob and T. W. Perry. 1956. The effect of oral estrogens and androgens singly and in combination on yearling steers. J. Animal Sci. 15: 679.

Beeson, W. M., T. W. Perry, F. N. Andrews, W. H. Smith and Martin Stob. 1956. The comparative effect of oral and subcutaneous implantation of diethylstilbestrol for fattening steers on dry lot and pasture. J. Animal Sci. 15: 1240.

Bratzler, L. J., R. P. Soule, Jr., E. P. Reineke and Pauline Paul. 1954. The effect of testosterone and castration on the growth and carcass characteristics of swine. J. Animal Sci. 13: 171.

Burris, Martin J., Ralph Bogart and A. W. Oliver. 1953. Alteration of daily gain, feed efficiency and carcass characteristics in beef cattle with male hormones. J. Animal Sci. 12: 740.

Burris, M. J., Ralph Bogart, A. W. Oliver, A. O. Mackey and J. E. Oldfield. 1954. Rate and efficiency of gains in beef cattle. I. The response to injected testosterone. Oregon Agr. Exp. Sta. Tech. Bul. 31.

Burroughs, Wise, C. C. Culbertson, R. M. McWilliams, Joseph Kastelic and William Hale. 1954a. Hormone feeding (diethylstilbestrol) to fattening cattle. I. Iowa State College, A.H. Mimeo. Leaflet 188.

Burroughs, Wise, C. C. Culbertson, Joseph Kastelic, W. E. Hammond and Edmund Cheng. 1954b. Hormone feeding (diethylstilbestrol) to fattening cattle. II. Iowa State College, A.H. Mimeo. Leaflet 189.

Burroughs, Wise, C. C. Culbertson, E. Cheng, W. H. Hale and P. Homeyer. 1955. The influence of oral administration of diethylstilbestrol to beef cattle. J. Animal Sci. 14: 1015.

Burroughs, W. 1956. Stilbestrol and hormone feeding to cattle and other livestock. Feedstuffs 28: No. 30, p. 38.

Christian, J. J. 1953. The relation of adrenal weight to body weight in mammals. Science 117: 78.

Clegg, M. T., H. H. Cole and H. K. Guilbert. 1951. Effect of stilbestrol on beef heifers and steers. J. Animal Sci. 10: 1074.

Clegg, M. T. and H. H. Cole. 1954. The action of stilbestrol on the growth response in ruminants. J. of Animal Sci. 13: 108.

Clegg, M. T., Reuben Albaugh, H. Strang and H. H. Cole. 1954. The use of stilbestrol in fattening cattle. Calif. Agr. Exp. Sta. Circ. 441.

Culbertson, C. C., W. Burroughs, R. Preston, J. Staley, P. Homeyer and E. A. Kline 1956. Amount of stilbestrol needed by high-gaining and low-gaining steer calves fed medium-protein and high-protein fattening rations. Iowa State College, A.H. Mimeo. Leaflet 211.

Deans, R. J., W. J. VanArsdell, E. P. Reineke and L. J. Bratzler. 1956. The effect of progesterone-estradiol implants and stilbestrol feeding on feed lot performance and carcass characteristics of steers. J. Animal Sci. 15: 1020.

Deatherage, F. E., and Walter Reiman. 1946. Measurement of beef tenderness and tenderization of beef by the Tenderray Process. Food Research 11: 525.

Dinusson, W. E., F. N. Andrews and W. M. Beeson. 1950. The effect of stilbestrol and testosterone, thyroid alteration and spaying on the growth and fattening of beef heifers. J. Animal Sci. 9: 321.

Dukes, H. H. 1947. The physiology of domestic animals, Sixth Edition. Comstock Publishing Co. Ithaca, N. Y.

Hunt, Wells E., DeVoe Meade and B. E. Carmichael. 1938. Effect of castration of lambs on their development and quality of meat. Maryland Agr. Exp. Sta. Bul. 417.

Kastelic, Joe, P. Homeyer and E. A. Kline. 1956. The influence of the oral administration of diethylstilbestrol on certain carcass characteristics of beef cattle. J. Animal Sci. 15: 689.

Kunkle, L. E., V. R. Cahill and E. W. Klosterman. 1955. The relative value of steer and heifer carcasses. Ohio Agr. Exp. Sta., An. Sci. Mimeo Series 94, p. 24.

Morrison, F. B. 1956. Feeds and Feeding. 22nd Edition. Morrison Publishing Co., Ithaca, N. Y.

O'Mary, C. C. and A. E. Cullison. 1956. Effect of low level implantation of stilbestrol in steers on pasture. J. Animal Sci. 15: 48.

O'Mary, C. C., E. P. Warren, T. J. Davis and H. H. Pierce, Jr. 1956. Effects of low level implantations of stilbestrol in steers fattened on dry lot rations. J. Animal Sci. 15: 52.

Perry, T. W., W. M. Beeson, F. N. Andrews and Martin Stob. 1955. The effect of oral administration of hormones on growth rate and deposition in the carcass of fattening steers. J. Animal Sci. 14: 329.

Perry, T. W., W. M. Beeson, M. T. Mohler, Martin Stob and F. N. Andrews. 1956. Oral stilbestrol vs. levels of implanted stilbestrol, with and without aureomycin. Purdue University, A.H. Mimeo. 165.

Sykes, J. F., F. N. Andrews, F. W. Hill, F. W. Lorenz, J. W. Thomas and C. F. Winchester. 1953. Hormonal relationships and applications in the production of meats, milk and eggs. National Research Council Pub. 266.

Wierbicki, E., V. R. Cahill, L. E. Kunkle, E. W. Klosterman and F. E. Deatherage. 1955. Effect of castration on biochemistry and quality of beef. J. Agr. and Food Chem., 3: 244.

# APPENDIX

## TABLE 1.—Feed Lot Performance of Early and Late Castrated Steers and Bulls

### 1950–1951 Experiment

| Lot | | 1 | 2 | 3 |
|---|---|---|---|---|
| | | Steers castrated May 11, 1950 | Steers castrated Oct. 31, 1950 | Bulls |
| Number in lot | | 10 | 10 | 10 |
| Initial weight, Nov. 7, 1950, | lb. | 378.0 | 370.0 | 368.0 |
| Final weight, July 17, 1951, | lb. | 879.0 | 870.0 | 930.0 |
| Average daily gain, 252 days, | lb. | 2.00 | 2.00 | 2.23 |
| Average daily ration: | | | | |
| Corn and cob meal, | lb. | 9.9 | 9.9 | 10.4 |
| Soybean oil meal, | lb. | 1.5 | 1.5 | 1.5 |
| Hay, | lb. | 1.4 | 1.4 | 1.4 |
| Silage, | lb. | 5.0 | 5.0 | 5.0 |
| Minerals, | oz. | 1.1 | 1.0 | 1.1 |
| Salt, | oz. | 5 | .7 | .5 |
| Feed required per cwt. gain: | | | | |
| Corn and cob meal, | lb. | 495.0 | 500.0 | 467.0 |
| Soybean oil meal, | lb. | 75.0 | 76.0 | 67.0 |
| Hay, | lb. | 73.0 | 73.0 | 65.0 |
| Silage, | lb. | 251.0 | 252.0 | 224.0 |
| Minerals, | lb. | 3.0 | 3.0 | 3.0 |
| Salt, | lb. | 2.0 | 2.0 | 1.0 |
| Appraised selling price per cwt. | | $34.02 | $34.38 | $30.40 |

## TABLE 2.—Feed Lot Performance of Early and Late Castrated Steers and Bulls

### 1951–1952 Experiment

| Lot | | 1 | 2 | 3 |
|---|---|---|---|---|
| | | Steers castrated early | Steers castrated Nov. 9, 1951 | Bulls |
| Number in lot | | 12/3* | 12/3* | 12 |
| Initial weight, Nov. 15, 1951, | lb. | 365.0 | 366.0 | 384.0 |
| Final weight, | lb. | 848.0 | 844.0 | 894.0 |
| Average daily gain, | lb. | (247 days) 1.96 | (247 days) 1.94 | (210 days) 2.43 |
| Average daily ration: | | | | |
| Corn and cob meal, | lb. | 10.5 | 10.2 | 10.6 |
| Soybean oil meal, | lb. | 1.5 | 1.5 | 1.5 |
| Hay, | lb. | 2.5 | 2.5 | 2.6 |
| Silage, | lb. | 5.0 | 5.0 | 5.0 |
| Minerals, | oz. | .2 | .2 | .3 |
| Salt, | oz. | .4 | .4 | .5 |
| Feed per cwt. of gain: | | | | |
| Corn and cob meal, | lb. | 535.0 | 529.0 | 436.0 |
| Soybean oil meal, | lb. | 77.0 | 78.0 | 62.0 |
| Hay, | lb. | 127.0 | 128.0 | 108.0 |
| Silage, | lb. | 255.0 | 258.0 | 206.0 |
| Minerals, | lb. | 1.0 | 1.0 | 1.0 |
| Salt, | lb. | 1.0 | 1.0 | 1.0 |
| Appraised selling price per cwt. | | $33.42 | $33.35 | $29.00 |

*Three steers from Lots 1 and 2 sent to slaughter on July 3, July 10, July 24 and August 7.

Average daily gain calculated on actual steer days on experiment.

## TABLE 3.—Slaughter and Carcass Data of Early and Late Castrated Steers and Bulls

| Item | 1950-1951 Experiment | | | 1951-1952 Experiment | | |
|---|---|---|---|---|---|---|
| | Steers castrated early | Steers castrated at weaning | Bulls | Steers castrated early | Steers castrated at weaning | Bulls |
| Number of cattle | 10 | 10 | 10 | 12 | 12 | 12 |
| Average slaughter weight, lb. | 853.9 | 848.8 | 916.2 | 816.8 | 822.8 | 848.1 |
| Dressing percentage | 60.9 | 61.2 | 59.8 | 59.6 | 60.1 | 59.2 |
| Head, percent of live weight | 3.13 | 3.09 | 3.20 | 3.12 | 3.07 | 3.20 |
| Hide, percent of live weight | 8.11 | 8.48 | 9.67 | 8.29 | 8.08 | 9.58 |
| Average carcass grade* | 0.83 | 1.03 | 2.23 | 1.43 | 1.44 | 2.78 |
| Forequarter, percent of carcass | 52.2 | 51.5 | 53.8 | 51.5 | 51.5 | 53.4 |
| Hindquarter, percent of carcass | 47.8 | 48.5 | 46.2 | 48.5 | 48.5 | 46.6 |
| Kidney knob, percent of carcass | 2.50 | 2.55 | 1.48 | 2.30 | 2.51 | 1.83 |
| Bone, percent of carcass | 15.4 | 15.6 | 16.2 | 16.1 | 16.2 | 16.4 |
| Fat, percent of carcass | 10.4 | 10.0 | 5.4 | 9.8 | 9.4 | 5.7 |
| Edible portion, percent of carcass | 73.70 | 74.10 | 77.70 | 74.10 | 74.40 | 77.50 |
| Tenderness score† | 8.10 | 7.60 | 7 60 | 7.60 | 7.70 | 6.90 |
| Cost of edible portion per cwt. based on appraised selling price | $75.79 | $75.82 | $65.43 | $75.67 | $74.58 | $63.21 |
| Average carcass value per cwt.§ | $41.22 | $40.58 | $38.00 | $39.89 | $39.90 | $37.30 |
| Cost of edible portion per cwt. based on av. carcass value‖ | $55.93 | $54.76 | $48.91 | $53.83 | $53.63 | $48.13 |

*Carcass grade factor—Prime=0, 0.4, 0.7
Good=2, 2.4, 2.7
Choice=1, 1.4, 1.7
Commercial=3, 3.4, 3.7

†Tenderness score—10 extremely tender—one extremely tough.

‡Appraised selling price/dressing percentage/percent edible portion.

§Based on wholesale beef carcass prices as follows: Prime, $42.00; Choice, $40.00; Good, $38.00; Commercial, $35.00.

‖Carcass value/percent edible portion.

## TABLE 4.—Feed Lot Performance of Steers, Bulls and Stilbestrol Implanted Bulls

### 1952–1953 Experiment, Period 1, Oct. 22, 1952 to Jan. 28, 1953

| Items | | Steers | Bulls | Bulls | Bulls, stilbestrol implant, 10/22/52 | Bulls |
|---|---|---|---|---|---|---|
| Number in lot | | 8 | 10 | 10 | 5 | 5 |
| Weight, Oct. 22, 1952, | lb. | 410.00 | 414.00 | 421.00 | 417.00 | 422.00 |
| Weight, Jan. 28, 1953, | lb. | 608.50 | 649.00 | 647.00 | 674.00 | 654.00 |
| Average daily gain, 98 days | | 2.03 | 2.40 | 2.31 | 2.62 | 2.36 |
| Average daily ration: | | | | | | |
| Corn and cob meal, | lb. | 8.2 | 8.0 | 8.2 | 8.0 | 7.6 |
| Soybean oil meal, | lb. | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| Hay, | lb. | 2.8 | 2.9 | 2.9 | 2.8 | 2.8 |
| Corn silage, | lb. | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Minerals, | oz. | .6 | .5 | .5 | .5 | .5 |
| Salt, | oz. | .6 | .5 | .5 | .5 | .5 |
| Feed per cwt. of gain: | | | | | | |
| Corn and cob meal, | lb. | 406.0 | 332.0 | 355.0 | 305.0 | 322.0 |
| Soybean oil meal, | lb. | 74.0 | 62.0 | 65.0 | 57.0 | 64.0 |
| Hay, | lb. | 140.0 | 121.0 | 128.0 | 106.0 | 117.0 |
| Silage, | lb. | 248.0 | 210.0 | 218.0 | 192.0 | 213.0 |
| Minerals, | lb. | 2.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| Salt, | lb | 2.0 | 1.0 | 1.0 | 1.0 | 1.0 |

## TABLE 5.—Feed Lot Performance of Steers, Bulls and Stilbestrol Implanted Bulls

### 1952–1953 Experiment, Period 2, Jan. 28, 1953 to May 6, 1953

| Items | | Steers | Bulls, stilbestrol implant 1/29/1953 | Bulls | Bulls, stilbestrol implant 10/22/1952 and 1/29/1953 | Steers castrated 1/29/1953 |
|---|---|---|---|---|---|---|
| Number in lot | | 8 | 10 | 10 | 5 | 5 |
| Number days on experiment | | 98 | 98 | 98 | 84 | 98 |
| Weight, Jan. 28, 1953, | lb. | 608.5 | 649.0 | 647.0 | 674.0 | 654.0 |
| Final weight, | lb. | 816.0 | 907.0 | 877.0 | 904.0 | 834.0 |
| Average daily gain, | lb. | 2.12 | 2.63 | 2.34 | 2.75 | 1.84 |
| Average daily ration: | | | | | | |
| Corn and cob meal, | lb. | 10.8 | 11.7 | 10.9 | 12.2 | 10.4 |
| Soybean oil meal, | lb. | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| Hay, | lb. | 2.3 | 2.4 | 2.4 | 2.2 | 2.2 |
| Corn silage, | lb. | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Minerals, | oz. | .4 | .6 | .6 | .8 | .7 |
| Salt, | oz. | .4 | 5 | .5 | .8 | .7 |
| Feed per cwt. of gain: | | | | | | |
| Corn and cob meal, | lb. | 511.0 | 445.0 | 465.0 | 446.0 | 567.0 |
| Soybean oil meal, | lb. | 71.0 | 57.0 | 64.0 | 55.0 | 81.0 |
| Hay, | lb. | 106.0 | 91.0 | 102.0 | 81.0 | 119.0 |
| Corn silage, | lb. | 236.0 | 190.0 | 213.0 | 182.0 | 270.0 |
| Minerals, | lb. | 1.0 | 1.0 | 2.0 | 2.0 | 2.0 |
| Salt, | lb. | 1.0 | 1.0 | 1.0 | 2.0 | 2.0 |
| Dressing percentage | | 59.5 | 60.0 | 58.8 | 59.6 | 58.2 |
| Average carcass grade* | | 1.33 | 2.09 | 2.01 | 1.64 | 1.82 |
| Edible portion, percent of carcass | | 73.2 | 77.3 | 77.1 | 75.8 | 73.9 |

*Carcass grade factor—Choice, 1, 1.4, 1.7. Good, 2, 2.4, 2.7.

## TABLE 6.—Effect of Stilbestrol upon the Feed Lot Performance of Steers and Bulls

### 1953–1954 Experiment

| Items | | Bulls, stilbestrol implant | Bulls | Steers, stilbestrol implant | Steers |
|---|---|---|---|---|---|
| Number in lot | | 10 | 10 | 9 | 10 |
| Average weight, Dec. 16, 1953, | lb. | 532.00 | 529.00 | 555.00 | 555.00 |
| Average weight, June 2, 1954, | lb. | 1028.00 | 992.00 | 1021.00 | 943.00 |
| Average daily gain, 168 days, | lb. | 2.96 | 2.76 | 2.79 | 2.31 |
| Average daily ration, lb.: | | | | | |
| Corn and cob meal | | 12.6 | 11.0 | 11.8 | 11.5 |
| Soybean oil meal | | 1.5 | 1.5 | 1.5 | 1.5 |
| Corn silage | | 10.0 | 10.0 | 10.0 | 10.0 |
| Hay | | 1.9 | 1.9 | 1.9 | 1.9 |
| Minerals, | oz. | .4 | .4 | .4 | .4 |
| Salt, | oz. | .4 | .4 | .4 | .4 |
| Feed per cwt. of gain, lb.: | | | | | |
| Corn and cob meal | | 428.00 | 399.00 | 425.00 | 497.00 |
| Soybean oil meal | | 51.00 | 54.00 | 54.00 | 65.00 |
| Corn silage | | 338.00 | 363.00 | 357.00 | 433.00 |
| Hay | | 63.00 | 68.00 | 67.00 | 80.00 |
| Minerals | | 1.0 | 1.0 | 1.0 | 1.0 |
| Salt | | 1.0 | 1.0 | 1.0 | 1.0 |
| Dressing percentage | | 61.6 | 61.2 | 61.3 | 61.5 |
| Average carcass grade* | | 2.03 | 2.47 | 1.62 | 1.37 |
| Edible portion of carcass† | | 75.0 | 76.1 | 72.0 | 69.9 |

*Carcass grade factor—Choice 1, 1.4, 1.7. Good 2, 2.4, 2.7.

†Determined on five representative carcasses from each lot.

## TABLE 7.—Feed Lot Performance of Fattening Steers and Bulls Fed in a Barn or in Outside Lots

### 1954–1955 Experiment

| | Inside bulls | Inside steers | Outside bulls | Outside steers |
|---|---|---|---|---|
| Lot number | 1 | 2 | 3 | 4 |
| Number in lot | 12 | 12 | 12 | 12 |
| Average weight, Nov. 16 | 599.0 | 543.0 | 597.0 | 543.0 |
| Average weight, May 17 | 1058.0 | 974.0 | 1084.0 | 963.0 |
| Average daily gain, 182 days | 2.53 | 2.37 | 2.68 | 2.31 |
| Average daily ration, lb.: | | | | |
| Corn and cob meal | 7.5 | 7.5 | 7.5 | 7.5 |
| Soybean oil meal | 1.0 | 1.0 | 1.0 | 1.0 |
| Corn silage | 22.3 | 20.1 | 23.2 | 20.2 |
| Hay | 3.0 | 2.8 | 3.0 | 2.8 |
| Salt, oz. | .5 | .7 | .6 | .5 |
| Minerals, oz. | .4 | .4 | .3 | .2 |
| Feed required per cwt. of gain, lb.: | | | | |
| Corn and cob meal | 297.0 | 317.0 | 280.0 | 325.0 |
| Soybean oil meal | 39.0 | 42.0 | 37.0 | 43.0 |
| Corn silage | 885.0 | 851.0 | 864.0 | 873.0 |
| Hay | 120.0 | 119.0 | 112.0 | 122.0 |
| Salt | 1.0 | 2.0 | 2.0 | 1.0 |
| Minerals | 1.0 | 1.0 | 1.0 | 1.0 |

## TABLE 8.—Gains of Cattle Treated with Stilbestrol, Testosterone or a Combination of the Two Hormones

### 1954–1955 Experiment

| | No. of animals | Average weight, Dec. 15 | Average weight, May 18 | Average daily gain, 154 days | Total feed per cwt. of gain |
|---|---|---|---|---|---|
| ALL HEIFERS | 12 | 538 | 876 | 2.19 | 913 |
| Control | 3 | 538 | 858 | 2.08 | |
| Stilbestrol | 3 | 529 | 878 | 2.26 | |
| Testosterone | 3 | 534 | 887 | 2.29 | |
| Stilbestrol and testosterone | 3 | 552 | 880 | 2.13 | |
| ALL STEERS | 11 | 538 | 896 | 2.33 | 885 |
| Control | 2 | 542 | 867 | 2.11 | |
| Stilbestrol | 3 | 538 | 919 | 2.47 | |
| Testosterone | 3 | 536 | 870 | 2.17 | |
| Stilbestrol and testosterone | 3 | 538 | 919 | 2.47 | |

## TABLE 9.—Feed Lot Performance and Carcass Yield of Fattening Steers and Heifers Fed in a Barn or in Outside Lots

### 1955–1956 Experiment

| | Inside heifers | Inside steers | Outside heifers | Outside steers |
|---|---|---|---|---|
| Lot number | 1 | 2 | 3 | 4 |
| Number in lot | 16 | 16 | 16 | 17 |
| Average weight, Nov. 14 | 492.0 | 564.0 | 492.0 | 555.0 |
| Average weight, June 18 and July 9 | 934.0 | 1082.0 | 928.0 | 1048.0 |
| Average daily gain, 217 and 238 days | 2.04 | 2.18 | 2.01 | 2.07 |
| Average daily ration, lb.: | | | | |
| Corn and cob meal | 6.9 | 7.7 | 6.8 | 7.4 |
| Soybean oil meal | 1.0 | 1.0 | 1.0 | 1.0 |
| Corn silage | 17.2 | 19.5 | 17.6 | 19.3 |
| Hay | 3.0 | 3.0 | 3.0 | 3.0 |
| Salt, oz. | .6 | .6 | .6 | .5 |
| Minerals, oz. | .2 | .5 | .4 | .5 |
| Feed required per cwt. gain, lb.: | | | | |
| Corn and cob meal | 339.0 | 355.0 | 340.0 | 358.5 |
| Soybean oil meal | 49.0 | 46.0 | 49.0 | 48.0 |
| Corn silage | 845.0 | 898.0 | 874.0 | 934.0 |
| Hay | 148.0 | 139.0 | 150.0 | 146.0 |
| Salt | 2.0 | 2.0 | 2.0 | 1.5 |
| Minerals | .5 | .1 | .1 | 1.5 |
| Carcass grades | 1 ch.+<br>11 ch.<br>1 gd.+<br>3 gd. | 9 ch.<br>2 ch.—<br>1 gd.+<br>4 gd. | 1 ch.+<br>11 ch.<br>4 gd. | 2 ch.+<br>9 ch.<br>3 ch.—<br>3 gd. |
| Dressing percentage | 61.5 | 61.9 | 61.8 | 61.8 |
| Live value per cwt.* | $21.34 | $21.99 | $21.44 | $22.09 |

*Calculated from carcass grades, weight and prices as follows:
For steers—high, average, and low choice, $36.50, $36.00, $35.75.
High, average and low good—$35.00, $34.50, $34.00
Heifers—$1.00 per cwt. lower for each grade.

**TABLE 10.—A Comparison of the Implantation of Stilbestrol and Feeding Stilbestrol with Three Levels of Protein**

**1954–1955 Experiment**

| | | Control | | | Stilbestrol implant | | | Stilbestrol fed | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Lot number | | 4 | 5 | 6 | 10 | 11 | 12 | 13 | 14 | 15 |
| Soybean oil meal per head daily | | | 0.75 | 1.5 | | 0.75 | 1.5 | | 0.75 | 1.5 |
| Percent total protein | | 8.3 | 9.7 | 11.0 | 8.3 | 9.6 | 11.2 | 8.3 | 9.7 | 11.0 |
| Number in lot | | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| Average weight, March 1, | lb. | 722.0 | 724.0 | 720.0 | 720.0 | 722.0 | 724.0 | 723.0 | 719.0 | 719.0 |
| Average weight, July 5, | lb. | 942.0 | 984.0 | 985.0 | 937.0 | 1015.0 | 1055.0 | 954.0 | 1036.0 | 1045.0 |
| Average daily gain, (126 days) | lb. | 1.75 | 2.06 | 2.10 | 1.72 | 2.32 | 2.63 | 1.83 | 2.51 | 2.59 |
| Average daily ration: | | | | | | | | | | |
| Corn and cob meal, | lb. | 15.5 | 15.1 | 15.5 | 14.9 | 16.9 | 14.5 | 14.6 | 15.6 | 15.3 |
| Soybean oil meal, | lb. | | .75 | 1.5 | | .75 | 1.5 | | .75 | 1.50 |
| Hay, | lb. | 2.3 | 2.2 | 2.2 | 2.2 | 2.3 | 2.2 | 2.2 | 2.2 | 2.2 |
| Salt, | oz. | .5 | .3 | .5 | 1.0 | .4 | .3 | .5 | .4 | .6 |
| Minerals, | oz. | .6 | .6 | .7 | 1.3 | .5 | 1.0 | .5 | .7 | 1.0 |
| Feed required per cwt. gain, | lb.: | | | | | | | | | |
| Corn and cob meal | | 886.0 | 731.0 | 736.0 | 865.0 | 726.0 | 553.0 | 798.0 | 620.0 | 590.0 |
| Soybean oil meal | | | 36.0 | 71.0 | | 32.0 | 57.0 | | 30.0 | 58.0 |
| Hay | | 129.0 | 109.0 | 107.0 | 130.0 | 97.0 | 86.0 | 123.0 | 89.0 | 87.0 |
| Salt | | 2.0 | 1.0 | 1.5 | 3.0 | 1.0 | 1.0 | 2.0 | 1.0 | 1.5 |
| Minerals | | 2.0 | 2.0 | 2.0 | 5.0 | 1.0 | 2.0 | 1.5 | 1.5 | 2.0 |

## TABLE 11.—Value of Stilbestrol, Implanted or Fed, and Terramycin with a High Silage, Limited Corn Ration

### 1955–1956 Experiment—Period 1

| | | Control | 36 mg. stlibestrol implanted Nov. 1 | 10 mg. stilbestrol per head daily | 10 mg. stilbestrol 80 mg. terramycin per head daily |
|---|---|---|---|---|---|
| Lot | | 1 | 2 | 3 | 4 |
| Number in lot | | 10 | 10 | 10 | 10 |
| Average weight, Nov. 1, | lb. | 620.0 | 620.0 | 615.0 | 617.0 |
| Average weight, Feb. 7, | lb. | 800.0 | 836.0 | 796.0 | 790.0 |
| Average daily gain, 98 days, | lb. | 1.84 | 2.21 | 1.85 | 1.77 |
| Average daily ration: | | | | | |
| Corn and cob meal, | lb. | 2.0 | 2.0 | 2.0 | 2.0 |
| Soybean oil meal, | lb. | 1.5 | 1.5 | 1.5 | 1.5 |
| Corn silage, | lb. | 22.2 | 22.3 | 22.2 | 22.2 |
| Hay, | lb. | 5.1 | 5.2 | 5.1 | 5.3 |
| Minerals, | oz. | .6 | .7 | .5 | .5 |
| Salt, | oz. | .6 | .6 | .6 | .4 |
| Feed per cwt. gain, lb.: | | | | | |
| Corn and cob meal | | 109.0 | 91.0 | 108.0 | 113.0 |
| Soybean oil meal | | 81.0 | 68.0 | 81.0 | 85.0 |
| Corn silage | | 1205.0 | 1009.0 | 1202.0 | 1257.0 |
| Hay | | 279.0 | 234.0 | 278.0 | 297.0 |
| Minerals | | 2.0 | 2.0 | 2.0 | 1.5 |
| Salt | | 2.0 | 2.0 | 2.0 | 1.5 |

## TABLE 12.—Value of Stilbestrol, Implanted or Fed, and Terramycin in Rations for Fattening Steers

### 1955–1956 Experiment

| | | Control | 36 mg. stilbestrol implanted Nov. 1 | 10 mg. stilbestrol per head daily | 10 mg. stilbestrol 80 mg. terramycin per head daily |
|---|---|---|---|---|---|
| Lot | | 1 | 2 | 3 | 4 |
| Number in lot | | 10 | 10 | 10 | 10 |
| Average weight, Nov. 1, | lb. | 620.0 | 620.0 | 615.0 | 617.0 |
| Average weight, June 26, | lb. | 1108.0 | 1189.0 | 1177.0 | 1147.0 |
| Ave'ge daily gain, 238 days, | lb. | 2.05 | 2.39 | 2.36 | 2.23 |
| Average daily ration: | | | | | |
| Corn and cob meal, | lb. | 9.3 | 9.9 | 10.7 | 9.9 |
| Soybean oil meal, | lb. | 1.5 | 1.5 | 1.5 | 1.5 |
| Corn silage, | lb. | 11.6 | 11.6 | 11.6 | 11.6 |
| Hay, | lb. | 4.9 | 4.9 | 4.9 | 5.0 |
| Minerals, | oz. | .3 | .5 | .4 | .4 |
| Salt, | oz. | .5 | .5 | .5 | .3 |
| Feed per cwt. of gain, lb.: | | | | | |
| Corn and cob meal | | 453 0 | 415.0 | 453.0 | 447.0 |
| Soybean oil meal | | 73.0 | 63.0 | 64.0 | 67.0 |
| Corn silage | | 564.0 | 485.0 | 490.0 | 520.0 |
| Hay | | 239.0 | 206.0 | 208.0 | 224.0 |
| Minerals | | 1.0 | 1.5 | 1.0 | 1.0 |
| Salt | | 1.5 | 1.0 | 1.0 | 1.0 |
| Carcass grades | | 5 ch.+<br>5 ch. | 6 ch.<br>3 ch.—<br>1 gd. | 3 ch.+<br>3 ch.<br>4 gd. | 1 ch.+<br>9 ch. |
| Dressing percentage* | | 61.7 | 61.6 | 61.5 | 62.9 |
| Live value per cwt.† | | $22.43 | $22.05 | $21.87 | $22.68 |
| Lumbo-sacral angle, degrees | | 128.0 | 122.0 | 123.0 | 121.0 |

*Hot carcass weight —2 ½ percent
Wooster weight —3 percent

†Based on carcass grade, weight and prices as follows: High, average and low choice, $36.50, $36.00 and $35.75; average good, $34.50.

## TABLE 13.—Value of Stilbestrol Implantation with Three Levels of Soybean Oil Meal

### 1955–1956 Experiment

| | Control | | | Stilbestrol implant | | |
|---|---|---|---|---|---|---|
| Lot number | 7 | 8 | 9 | 10 | 11 | 12 |
| Soybean oil meal per head daily | | 1.0 | 2.0 | | 1.0 | 2.0 |
| Percent total protein | 9.5 | 11.2 | 12.9 | 9.5 | 11.2 | 12.9 |
| Number in lot | 7 | 7 | 7 | 7 | 7 | 7 |
| Average weight, Feb. 28 | 677.0 | 674.0 | 685.0 | 675.0 | 684.0 | 680.0 |
| Average weight, July 17 | 928.0 | 969.0 | 1004.0 | 958.0 | 1039.0 | 1021.0 |
| Average daily gain, 140 days | 1.79 | 2.10 | 2.28 | 2.02 | 2.53 | 2.44 |
| Average daily ration: | | | | | | |
| Corn and cob meal, lb. | 15.3 | 16.1 | 16.0 | 15.5 | 16.3 | 16.2 |
| Soybean oil meal, lb. | | 1.0 | 2.0 | | 1.0 | 2.0 |
| Hay, lb. | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 |
| Minerals, oz. | .5 | 1.1 | .4 | 1.0 | 1.1 | .6 |
| Salt, oz. | .4 | .2 | .6 | .4 | .4 | .3 |
| Feed per cwt. of gain, lb.: | | | | | | |
| Corn and cob meal | 853.0 | 764.0 | 701.0 | 765.0 | 645.0 | 663.0 |
| Soybean oil meal | | 48.0 | 88.0 | | 40.0 | 82.0 |
| Hay | 111.0 | 95.0 | 88.0 | 99.0 | 79.0 | 82.0 |
| Minerals | 2.0 | 3.0 | 1.0 | 3.0 | 3.0 | 1.5 |
| Salt | 1.0 | 1.0 | 1.5 | 1.0 | 1.0 | 1.0 |
| Carcass grades | 1 ch.<br>1 ch.—<br>3 gd.+<br>2 gd. | 1 ch.+<br>4 ch.<br>2 gd.+ | 4 ch.<br>2 ch.—<br>1 gd.+ | 3 gd.+<br>2 gd.<br>1 gd.—<br>1 std.+ | 1 ch.<br>3 ch.—<br>1 gd.+<br>1 gd.<br>1 gd.— | 1 ch.<br>2 ch.—<br>2 gd.+<br>1 gd.— |
| Dressing percentage | 61.5 | 62.3 | 61.9 | 59.4 | 60.6 | 61.3 |
| Live value per cwt.* | $23.13 | $23.88 | $23.66 | $21.71 | $22.74 | $23.15 |
| Lumbo-sacral angle, degrees | 128.0 | 129.0 | 129.0 | 118.0 | 121.0 | 120.0 |

*Calculated from carcass grade, weight and prices as follows:

High average and low choice, $39.00, $38.50, $38.00.
High average and low good, $37.50, $36.50, $35.50.
High standard, $34.50.