



EXPERIMENT STATION  
OF THE  
KANSAS STATE AGRICULTURAL COLLEGE,  
MANHATTAN.

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BULLETIN No. 112 — JUNE 1902.  
(Issued September 1902.)

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**FARM DEPARTMENT.**

H. M. COTTRELL, M. S., Agriculturist.  
J. G. HANEY, B. S., Assistant in Field and Feeding Experiments.

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***FATTENING STEERS WITHOUT HOGS TO FOLLOW.***

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WITH the old methods of feeding, the steer was fed half a bushel of corn daily and a limited amount of whatever roughness was convenient, the chief and often the only profit in fattening steers came from the gain made by the hogs that picked up the droppings. In many places in the West hogs cannot be kept with fattening steers on account of losses from hog-cholera. Where these conditions prevail, it is necessary to adopt some method of feeding by which the steers will digest a greater proportion of the grain eaten than they did when fed the old way. This experiment was undertaken to test the value for this purpose of grinding feed and cutting hay and feeding roughage and grain together in fattening steers.

Eighty head of steers were used in this experiment. They were purchased for the College in the Kansas City stock-yards by the Trower Bros. Commission Company, and were part natives and part branded Southwestern cattle of fair quality.

The steers were divided into four lots of twenty head each. One lot was fed shelled corn and whole alfalfa hay, one lot shelled corn and alfalfa hay cut in one-inch lengths, one lot corn-meal and whole alfalfa hay, and one lot corn-meal and alfalfa hay cut in inch lengths. With all lots the hay was thrown in the bottom of the grain boxes,

the grain placed on the hay, and the two carefully mixed. Salt and water were kept before the steers all the time.

The experiment began February 13, 1900, when the average weight of the eighty head was 1036 pounds per steer. The steers were fed 116 days, and were then ready for market, averaging 1307 pounds each, an average gain of 271 pounds each, or an average daily gain of 2.34 pounds per steer.

The gains for the different lots were as follows:

FEED.	Gain per steer.	Daily gain per steer.
Shelled corn, whole hay . . . . .	262 lbs.	2.26 lbs.
Shelled corn, cut hay . . . . .	257 "	2.21 "
Corn-meal, whole hay . . . . .	273 "	2.35 "
Corn-meal, cut hay . . . . .	293 "	2.52 "
Average . . . . .	271 lbs.	2.34 lbs.

The feed required for 100 pounds of gain was as follows:

FEED.	Grain.	Hay.
Shelled corn, whole hay . . . . .	789 lbs.	409 lbs.
Shelled corn, cut hay . . . . .	771 "	387 "
Corn-meal, whole hay . . . . .	756 "	401 "
Corn-meal, cut hay . . . . .	680 "	345 "
Average . . . . .	747 lbs.	385 lbs.

The pounds of gain from each bushel (56 pounds) of grain eaten and the amount of hay consumed with each bushel of grain are as follows:

FEED.	Gain per bus. (56 lbs.) of gram eaten.	Hay consumed with each bush. of grain.
Shelled corn, whole hay . . . . .	7.1 lbs.	29.0 lbs.
Shelled corn, cut hay . . . . .	7.3 "	28.0 "
Corn-meal, whole hay . . . . .	7.4 "	29.7 "
Corn-meal, cut hay . . . . .	8.2 "	28.4 "
Average . . . . .	7.5 lbs.	28.8 lbs.

The steers were sent to the Armour Packing Company, Kansas City, for slaughter test, and their report is as follows: "The steers cost us \$5.15 per hundred alive, weighed an average of 1302 pounds each when bought, and dressed out an average of 764 pounds, or 59.3 per cent. The yield of fat was 6.7 per cent. The beef cut bright, and was of a good color on the outside. The cattle seemed to have been fed hardly long enough, but made good, clean, bright-looking, well covered beef. Our buyers consider that ground corn and alfalfa is the best feed for cattle."

THE SOY-BEAN EPISODE.

For eleven weeks the steers ate well and gained well. At the end of that time they were getting in good flesh, and not a single steer

was off feed or scouring. The feed eaten and the gains made for these eleven weeks are as follows:

FEED.	Gain per steer.	Gain per bus. (56 lbs.) grain eaten.	Gain per 100 lbs. gain.	Hay per 100 lbs. gain.
Shelled corn, whole alfalfa . . . . .	210 lbs.	8.5 lbs.	657 lbs.	426 lbs.
Shelled corn, cut alfalfa . . . . .	199 "	8.6 "	653 "	411 "
Corn-meal, whole alfalfa . . . . .	199 "	8.3 "	678 "	453 "
Corn-meal, cut alfalfa . . . . .	219 "	9.4 "	597 "	381 "
Average . . . . .	207 lbs.	8.7 lbs.	646 lbs.	418 lbs.

Beginning with the twelfth week, we began feeding soy-bean meal with the other grain, to put on a fine finish. The soy-bean is a richer feed than oil-meal, has about the same characteristics as a feed, gives an animal the same glossy coat as linseed-meal, and can be raised on a Kansas farm at a cost of thirteen to eighteen dollars per ton. It is one of our best drought-resisters, and is not touched by the chinch-bug.

The soy-bean meal was scattered over the other grain in the boxes and the steers were given one-half pound per head the first day. This was slowly increased, until at the end of ten days the steers were getting four pounds per head daily, with a slight reduction in the amount of corn fed. The steers began to show excessive looseness, and the amount of soy-bean meal was dropped to one pound per head per day. As soon as the steers again got in proper condition the amount of soy-bean meal fed was slowly increased, but after any considerable increase the steers would begin to scour badly again, and again the amount of soy-bean meal fed would be dropped.

The attempt to feed soy-bean meal was continued for twenty-six days, when it was dropped entirely. The reason the attempt was continued for so long was because, in every other trial with hogs, dairy cows, and other cattle, soy-beans had been found especially valuable.

During the time that the soy-bean meal was fed the weather was quite variable, and storms seemed to increase the laxativeness of the steers. We also fed fourth cutting of alfalfa, while previously we had been feeding earlier cuttings, which are less laxative. We do not know, therefore, to what extent the soy-beans were responsible for the steers' scouring; but we do know that a combination of soy-bean meal, fourth-cutting alfalfa hay and spring rains will not secure good gains with fattening steers.

The test of soy-beans was an expensive one, as the following table shows:

Average daily gain per steer . . . . .	1.16 lbs.
" grain per 100 pounds gain . . . . .	3,079 "
" hay for 100 pounds gain . . . . .	787 "

After the soy-bean meal was dropped the weather also became better and the steers made good gains and improved rapidly in appearance. While the soy-bean meal was exceedingly detrimental to gains, it was beneficial in other directions. It induced the steers to shed early and seemed to give them new vigor, especially with the poorer animals, so that they ate better and exhibited more life after the soy-bean meal had been dropped than they did before it was fed.

#### MIXING GRAIN AND ROUGHAGE TOGETHER.

The first thing that a practical feeder notices when he goes into a feed-lot where steers are fed grain and roughage mixed is the absence of scouring. One of the writers of this bulletin has just inspected 270 head of year-old calves that were being forced for baby beef. These calves were eating three pounds of cottonseed-meal each per day, in addition to a heavy ration of corn-meal. The grain was thoroughly mixed with cut alfalfa hay when put in the feed-boxes. Not a single calf was found that showed any signs of looseness, and the droppings were of the most desirable character. An inspection of 1800 head of fattening steers that were being rapidly forced for 100 days' feeding showed the same condition of bowels—no scouring, and normal condition of the droppings.

The stockman who is feeding his fattening steers grain and roughage thoroughly mixed finds that, with ordinary care in feeding, his steers not only do not have the scours, but that an animal is seldom off feed. Why?

Average corn contains seventy-two per cent. of starch. Starch in feed is not absorbed into the system and used in building up the body and sustaining life until it is changed to sugar. When changed to sugar it is readily absorbed and used in the body. The saliva of the mouth has the power to make this change while the juices of the stomach do not. It follows, then, that the method of preparing the feed that will induce the steer to chew it the most thoroughly and for the longest time will secure the greatest amount of saliva mixed with the feed and the greatest amount of starch changed to a form that will build up the steer's body.

When grain and roughage are mixed together the steer eats slowly, giving much time for the food to become saturated with the saliva and for the saliva to act on the starch. When the food is swallowed it goes from the mouth to the paunch. When the food reaches the paunch the finer portions, such as grain fed alone, are forced directly into the third stomach and onward. The coarse food and the grain mixed with it, when the grain is thoroughly mixed with the roughage, is held for quite a while in the paunch, where the saliva and the water which the steer drinks makes it very soft and moist and the saliva

continues to change the starch to sugar. After the coarse feed has remained in the paunch until it is thoroughly softened it is brought back to the mouth and rechewed as the cud; this allows more saliva to be mixed with it, which in turn changes more starch into sugar, and the rechewing reduces the food to a greater fineness. The second time the food is swallowed it passes to the paunch and the fine particles go to the third and fourth stomachs, where the action of the saliva ceases.

When the grain is fed separately from the roughage, the animal chews it but little swallows it quickly, it stays but a short time in the paunch, and but a small portion or none is brought up with the cud and remasticated. This allows for slight action only of the saliva. The starch which forms seventy-two per cent. of corn is not acted on by the gastric juice of the stomach, and the large proportion, which has not been changed by the saliva, passes to the intestines undigested. Some of the juices of the intestines change the starch to sugar, but what remains unchanged irritates the intestines, producing looseness and scouring.

Mixing the grain with the roughage compels the steer to spend more time in chewing his ration than when the grain is fed alone. The mixed grain and roughage is held in the paunch, where most of the water drunk by the steer is stored, and the water thoroughly softens the mixed feed. The lengthening of the time needed to chew the feed and the holding in the stomach gives the saliva a longer time in which to change starch to sugar. After the mixed feed has become soft it is returned to the mouth as the cud, and the chewing of the cud grinds the grain to greater fineness, putting it in such shape that the digestive juices of the stomach and intestines can better act on it. The result is that a larger portion of the grain is made of use in building up the body of the steer; a less portion of the grain is undigested. The steer gains more for each bushel of grain eaten, better digestion keeps his body in better health, and scouring is avoided. The result is shown in this experiment, where, with the most thorough method of mixing grain and roughage tried, 100 pounds of gain were made with 680 pounds of grain, as against 1245 pounds of grain required for 100 pounds of gain at this Station when ear corn was fed separately from the roughage.

It is obvious that the best results will be obtained where the feed is so well mixed that every mouthful which the steer takes is part grain and part roughage.

DID GRINDING PAY?

The records made by the four lots were as follows:

	Gain per steer.	Grain for 100 lbs. gain.	Hay for 100 lbs. gain.
Shelled corn, whole hay . . . . .	262 lbs.	789 lbs.	409 lbs.
Shelled corn, cut hay . . . . .	257 "	771 "	387 "
Average . . . . .	260 lbs.	780 lbs.	398 lbs.
Corn-meal, whole hay . . . . .	273 lbs.	756 lbs.	401 lbs.
Corn-meal, cut hay . . . . .	293 "	680 "	345 "
Average . . . . .	283 lbs.	718 lbs.	373 lbs.

This shows that the steers having ground corn gained an average of twenty-three pounds per head more than those fed whole corn, and required sixty-two pounds less grain and twenty-five pounds less hay for each 100 pounds gain. Stated in another way, the steers having corn-meal made 8.8 per cent. more gains and ate 7.95 per cent. less grain and 6.28 per cent. less hay than those fed whole corn. The saving made by grinding in this experiment was as follows:

Cost of corn per bushel.	Saved in grain by grinding.
20 cents . . . . .	1.59 cents.
25 " . . . . .	1.99 "
30 " . . . . .	2.39 "
35 " . . . . .	2.78 "
40 " . . . . .	3.18 "
45 " . . . . .	3.57 "
50 " . . . . .	3.98 "
55 " . . . . .	4.37 "
60 " . . . . .	4.77 "

The feeder can determine from the cost of his corn and the cost of grinding whether it will pay him to grind or not. Besides the saving in grain made by grinding there was a slight saving in hay, but at ordinary prices this saving would not be sufficient to consider.

WHOLE HAY OR CUT HAY?

The alfalfa for the lots fed cut alfalfa in this experiment was run through a power Tornado ensilage cutter set to cut one inch. The hay was dry and brittle and broke rather than cut, but was in good shape for feeding. It cost thirty cents per ton for the labor of cutting and handling, besides the use of power and machinery.

The records made by the four lots were as follows:

	Gain per steer.	Grain for 100 lbs. gain.	Hay for 100 lbs. gain.
Whole hay, shelled corn . . . . .	262 lbs.	789 lbs.	409 lbs.
Whole hay, corn-meal . . . . .	273 "	756 "	401 "
Average . . . . .	268 lbs.	773 lbs.	405 lbs.
Cut hay, shelled corn . . . . .	257 lbs.	771 lbs.	387 lbs.
Cut hay, corn-meal . . . . .	293 "	680 "	345 "
Average . . . . .	275 lbs.	726 lbs.	366 lbs.

This shows that the steers fed cut hay gained on an average 7 pounds per head more than those fed whole hay, and ate 47 pounds less grain and 39 pounds less hay for each 100 pounds of gain.

The steers fed cut hay made 2.6 per cent. more gains and ate 6.08 per cent. less grain and 9.63 per cent. less hay for each 100 pounds of gain than those fed whole hay. This indicates that if the feeder has the machinery it will pay to cut the hay, but for a small lot of steers it will not pay to buy cutting machinery to be used only for cutting hay for the steers.

SAVING BY IMPROVED METHODS.

The poorest combination of feeds used in this trial was better than that used by the average feeder, and better than average returns were secured. It is greatly to be regretted that conditions were such that we could not have fed at least one lot of steers in the ordinary way, to compare with the methods of feeding used in this trial.

Prof. W. A. Henry, in his book, "Feeds and Feeding," (a book that should be in the hands of every Kansas farmer,) says that in general it may be stated that about 1000 pounds of grain will be required for 100 pounds of gain with well-fattened steers, on the average, besides 500 pounds of coarse feed in the shape of hay, stover, etc.

Prof. C. C. Georgeson, at this Station, made feeding tests in fattening steers, using ordinary methods, the roughage in each case being fed whole, and fed separately from the grain. He obtained the following results:

	Grain for 100 lbs. gain.	Cattle fed. days.
*Ear corn (Bulletin 34) . . . . .	1,245 lbs.	140
*Ear corn ( " 39) . . . . .	917 "	129
*Ear corn ( " 60) . . . . .	1,242 "	147
Shelled corn ( " 47) . . . . .	1,106 "	150
Corn-meal ( " 34) . . . . .	1,334 "	140
Corn-meal ( " 60) . . . . .	911 "	147
Corn-meal ( " 67) . . . . .	997 "	175
	Grain for 100 lbs. gain.	
Averages. . . . .	1,135 lbs.	
*Ear corn. . . . .	1,106 "	
Shelled corn . . . . .	1,081 "	
Corn-meal . . . . .		

The records given by Professor Henry and Professor Georgeson were made with the ordinary methods used in giving feed to fattening steers, roughage fed whole and separately from the grain. Compare these with results obtained in the feeding trial detailed in this

\*Weight of grain where ear corn was used is calculated as the weight of the actual grain, the estimated weight of cob, fourteen pounds per bushel, being deducted.

bulletin. With the corn ground and the hay cut, and both mixed so that every mouthful eaten by the steers was part grain and part hay, it required only 680 pounds of grain to make 100 pounds of gain. This low record includes the loss from feeding soy-bean meal. The best method of feeding used in this experiment required from twenty-five to forty per cent. less grain to make 100 pounds of gain than was required in careful experiments made with ordinary methods of feeding. Does not this indicate that by careful study the average feeder can make a large saving by improving his methods of feeding?

#### WATER.

The eighty steers were watered at two tanks, the tanks so arranged that each tank could be used by two yards. The steers had free access to water at all times. During the cold weather the water in each tank was warmed by a tank-heater, manufactured by the United States Wind Engine and Power Company, Batavia, Ill. The water was kept at a temperature of about fifty degrees, the temperature of cool well-water. The tanks stood in open lots, uncovered and unprotected, and the heaters were satisfactory in every particular.

The heaters were kept running sixty-eight days, when the weather became so warm that there was no further use for them. The two heaters in the sixty-eight days consumed 2545 pounds of coal. At four dollars per ton, this cost \$5.09 — less than one-tenth of a cent. a day for each steer. The care of the heaters was no more than was necessary to keep the ice out of other tanks where heaters were not used. The warmed water was palatable to the steers, and we regard the tank-heater as profitable in cold weather in every feed-yard.

#### SALT.

Salt boxes were placed in each feed-lot and were kept filled with loose barrel salt. The steers had access to the salt at all times. The steers fed shelled corn and whole hay ate an average of .44 of an ounce of salt per steer per day. The steers in the other three lots ate an average of .46 of an ounce of salt per steer daily.

#### MINOR THINGS.

“CONTENTMENT IS FAT,” and every little thing that adds to the comfort of the steer or makes him more contented increases the gains which he makes from each bushel of grain. For this reason we mention some of the minor things connected with this experiment that may have influenced the results from feeding.

Each car-load of steers ( twenty head ) was kept in a yard 100 by 280 feet. At the north end of each lot was a shed fifty feet long, fourteen feet wide, closed on the north, open to the south. The lots sloped to the south and were well drained, so that there were very few



days when the steers could not lie down comfortably on dry ground. A steer makes the greatest gain when he spends the most time lying down comfortably chewing his cud, and he will not spend enough time lying down to make good gains when the lots are muddy.

The feeds were mixed and fed dry. Experience since this experiment was completed indicates that it would have paid us to have dampened the hay before the grain was mixed with it. The best results are obtained where each stalk and leaf has grain adhering to it, and where there is no loose grain. The more concentrated the grain, the greater the advantage of this close mixing. Several feeders the past winter have succeeded in feeding as high as eight pounds of cottonseed-meal a steer per day for several months, in addition to a good ration of corn, by dampening the roughage and mixing the grain with it so thoroughly that every small particle of grain was attached to a piece of roughness. Where only two or three car-loads of steers are fed, the dampening of the roughness can be done in a few minutes each day by using a common watering-pot.

The steers were fed twice each day, at seven A. M. and five P. M., and the feeding was done exactly to the minute each day. The steers were watched closely and were given all that they would eat up clean within three hours after feeding. With this method the steers knew exactly when to expect their feed, they were always ready for the next feed, and did not lose in weight by fretting, as steers do when fed at irregular times. The hours of feeding were so arranged that the steers did all the work of eating by daylight. All our experience goes to show that this is an important help in making the best gains. By giving the steers just enough feed so that they would eat it up clean within three hours after feeding, they had fresh feed each time they came to the feed-boxes, and their appetites were not cloyed by having to work up left-over feed that had been mussed over at the previous feeding. Six hours a day was all the time the steers were allowed to spend in eating and most of them spent considerably less. This allowed many hours each day for chewing the cud and working up the feed, so that the greatest amount would be absorbed by the body and go to increase the steer's weight. The steers were handled quietly, not a loud word was spoken in the feed-lots, and the steers soon became so tame that they paid little attention to the many visitors that came to the yards.

The feed-boxes were sixteen feet long, three and one-half feet wide at the top, two feet wide at the bottom, one and one-half feet in depth, and were two and one-half feet from ground to top. They were made tight and were portable, so that they could be kept in the driest part of the yard. The steers were fed in the open air. One feed-box was

required for each ten steers, and the grain and roughage were mixed and fed together in the same feed-box.

When the steers began to shed their hair in the spring they threatened to rub the sheds and fences down. Trees twenty-five to thirty feet in length were cut and taken to the feed-lots. One end of the tree was set in the ground the other end was raised above the ground so that it just cleared the back of the tallest steer. The tree was held in place by being bolted to well-set and anchored posts. The steers seemed to know what these trees were for before the work of setting out was completed. They spent hours of enjoyment in rubbing themselves on these trees; the rubbing seemed to have the same effect as grooming, and after the trees were set we had no further trouble with the steers rubbing either sheds or fences.

The first day of the experiment the steers were fed at the rate of five pounds of corn and eight pounds of alfalfa hay per day per steer, and all the prairie hay they would eat. They ate an average of eight pounds of prairie hay each the first day. The alfalfa was increased gradually, and the steers themselves reduced the amount of prairie hay consumed until at the end of thirty days the prairie hay was dropped entirely, and the steers were given all the alfalfa hay they would eat clean. We have found that when stock has not been accustomed to eating alfalfa hay, full-feeding of it induces scours. We usually take thirty days to get either horses, steers or dairy cows on full feed of alfalfa hay, and when this is done there is no trouble in feeding it. While getting stock on full feed of alfalfa, either prairie or timothy hay or straw may be fed.

An increase of one-half pound of corn per steer per day was made for 24 days; then the amount of increase was slightly dropped. At the end of 35 days of feeding each steer was receiving daily 19.4 pounds of grain. From this time on each lot was fed twice daily all that they would eat up clean in three hours, but it was seldom that they ate more than 19 or 20 pounds of grain and 10 to 12 pounds of hay daily per steer. After 30 days the steers began dropping slowly in the amount of hay consumed.

Feeders are divided as to whether this system of taking thirty to forty days to get steers on feed is the one to use, or whether steers should be put on full feed in one or two weeks. No accurate experiments have been made to test this matter, but this experiment, as well as all our feeding experience, indicates that good gains may be made with small quantities of grain when the fattening animal is put on feed slowly.

The following table shows the progressive gains and feed required

by the steers fed corn-meal and cut alfalfa hay up to the time the soy-bean meal interfered with the work.

DAYS FED.	Average daily gain per steer.	Feed required for 100 lbs. gain.	
		Grain.	Hay.
Up to 7.....	6.42 lbs.	101 lbs.	281 lbs.
“ “ 21.....	3.98 “	251 “	425 “
“ “ 35.....	3.41 “	382 “	429 “
“ “ 49.....	3.19 “	467 “	405 “
“ “ 63.....	2.98 “	541 “	400 “
“ “ 77.....	2.84 “	593 “	381 “

The steer is naturally a grass-feeding and fattening animal, and will make good gains during the early part of the fattening period on a good quality of roughness with but little grain. Such gain is made cheaply, and the digestive apparatus of the animal is not thrown out of balance, as it is when the steer is put on full feed quickly.

INDIVIDUAL GAINS.

The steers were fed 116 days and the gains made by individual steers varied widely.

FEEED.	Greatest gain for single steer.	Least gain for single steer.
Shelled corn, whole alfalfa.....	460 lbs.	145 lbs.
Shelled corn, cut alfalfa.....	360 “	115 “
Corn-meal, whole alfalfa.....	385 “	165 “
Corn-meal, cut alfalfa.....	460 “	180 “

The eighty head of steers were selected for evenness in size at the beginning: the lightest weighed 885 pounds and the heaviest 1230 pounds. Especial pains were taken to get the four lots as equal in size, weight and feeding quality as possible, and yet there was great variation in the gains made by individual steers. A careful study failed to give an explanation in every case of the cause of these variations.

CONCLUSION.

The best results obtained in this experiment was an average gain of 100 pounds for 680 pounds of grain, or 8.2 pounds of gain for each bushel (56 pounds) of grain eaten. This was made with the car-load of steers fed corn-meal and cut alfalfa hay. This gain was obtained by grinding the corn, cutting the hay, feeding the grain and hay mixed, keeping the steers in well-drained yards, feeding them regularly with fresh, palatable feed, giving them comfortable shelter and kind care, and having clean, ice-free water always within their reach.

This shows a saving in grain of from twenty-five to forty per cent. over the usual methods of fattening steers. This experiment was out first in developing methods of fattening steers that would save grain,

and it is improbable that the method that will make the greatest saving was discovered at the first trial. It is reasonable to consider that further trials will develop even more economical methods. It is almost certain that a mixture of grains will give better results than corn alone.

The business of fattening steers has reached a turning-point. With cheap land and cheap corn, the old method of shoveling half a bushel of ear corn a day to each steer and paying little attention to the roughage sometimes paid. It will not pay now. Good corn land near Manhattan, Kan., costs \$75 per acre, and farther east in the corn belt the cost rises to \$100 or even to \$150 per acre. Feeders on this high-priced land will have to do what manufacturers have already done—more thoroughly utilize the materials which they handle. With the old methods, a large portion of the corn was not digested by the steer, and this kept him in an unhealthful condition. The old methods gave four and one-half to five and one-half pounds of gain from a bushel of corn. The best method used in this experiment gave more than eight pounds of gain per bushel of corn.

The feeder should adopt methods that are along the best lines shown in this trial, and then feed well-bred cattle that produce the greatest per cent. of high-priced cuts.

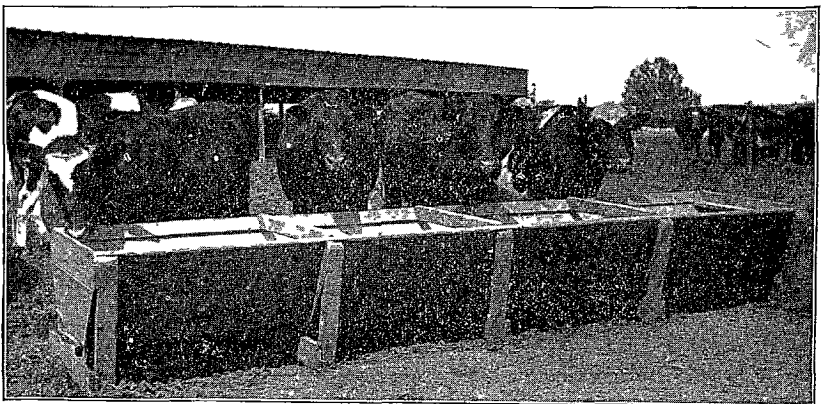


FIG. 1. Feed-box for Feeding Grain and Hay Mixed.



FIG. 2. Rubbing Pole.

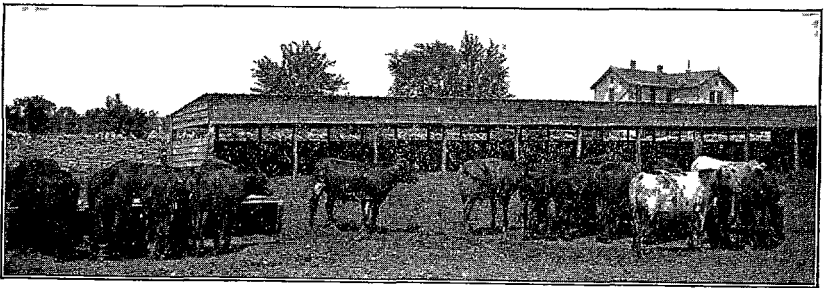


FIG. 3. Shed and Yard.

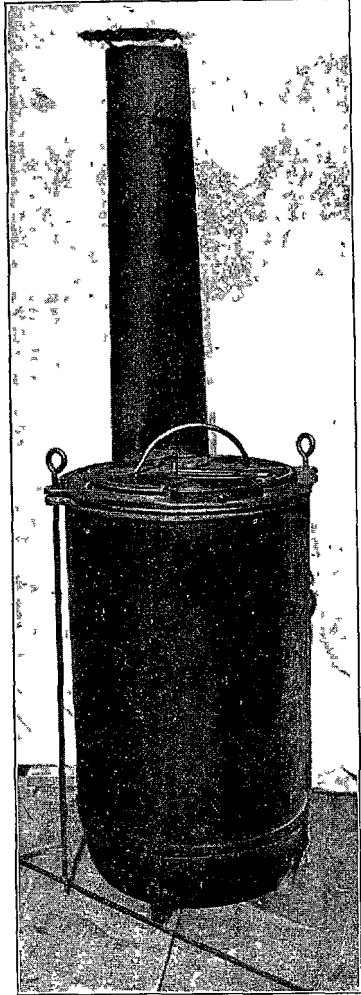


FIG. 4. Tank-heater.

This is a cast-iron stove that is set in the center of the tank and is surrounded by water, except on the top. Openings for draft and for fuel are at the top.