

FACTORS IN BEEF PRODUCTION *o o o*



MUMFORD

CIRCULAR OF INFORMATION NO. 12.

University of Missouri,

College of Agriculture and Mechanic Arts.

Agricultural Experiment Station.

COLUMBIA, MISSOURI, APRIL, 1902.

Factors in Beef
Production.

Reprint from April Bulletin Missouri State Board of Agriculture, 1902.

Factors in Profitable Beef Production.

By Frederick B. Mumford, Professor of Agriculture University of Missouri.

- I. CONFORMATION OR TYPE OF FEEDERS.
- II. AGE.
- III. FEEDING METHODS.

The ultimate profit from feeding any class of farm animals will depend primarily upon two fundamental factors. These are the conformation or type of the animal and the age at the time of fattening. It matters not whether we feed animals until ripe and thoroughly finished or whether we dispose of them in a half fat condition, these two factors will determine more than any others, the profit.

I. CONFORMATION OR TYPE OF FEEDERS.

In order that we may more intelligently discuss the kind of steer that brings the highest price on the market today it will be helpful to study the methods of cutting up beef carcasses, the relative proportions of the various butcher's cuts and the retail prices per pound for the various cuts. The following diagram is most instructive for the feeder, the breeder and the consumer of beef.

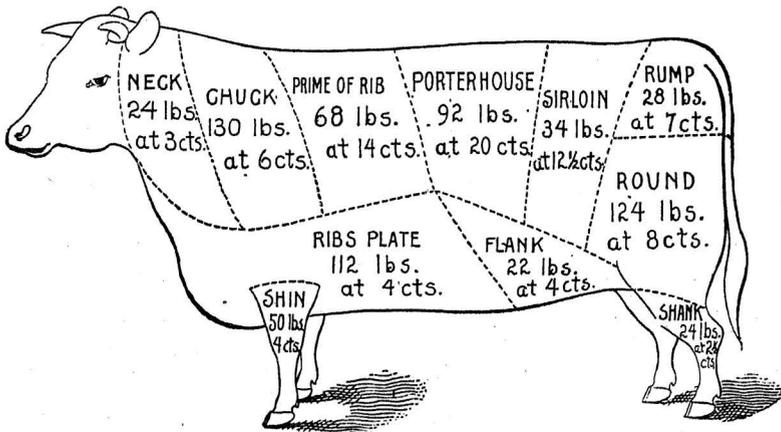


FIG. 1.

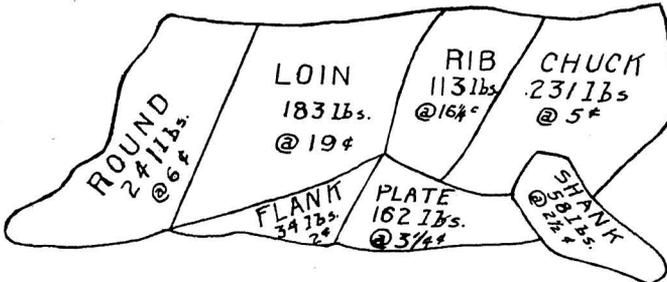
The carcass of a well fattened grade steer is cut up by the Chicago butchers, giving retail price per pound for the different cuts. A good 1200 pound steer dresses about 900 pounds, and of this 708 pounds is marketable meat. Notice that all the best cuts are taken

from ribs, loin and hind-quarters. These valuable cuts together weigh 346 pounds, and at the above prices sell for \$44.55. The less valuable cuts from the fore-quarters, belly and flank, weigh 362 pounds, and bring only \$16.48.

NOTE.—This cut was prepared for F. B. Mumford, through the courtesy of Mr. E. F. Swift and S. T. White of Chicago, in 1896. It has been widely copied by periodicals and live stock text books.

It will be at once apparent that the high priced and valuable cuts are all found on the back and loin of the animal. The meat from the porter house cut is worth twenty cents per pound while that from the ribs plate is valued at only four cents. In other words one pound of porter house steak is as valuable to the butcher as five pounds of ribs plate. The latter cut sells at retail for less than the buyer pays for the animal per pound live weight. A difference of forty pounds in the weight of the animal, if this difference is caused by an increased weight of ribs plate, makes only \$1.60 difference in the ultimate value of the animal; but if this difference of forty pounds is the result of a greater development of the porter house cut, then the increased value of the animal amounts to \$8 instead of \$1.60. It is of the very greatest importance then, that in selecting animals for feeding we should insist upon securing those having broad, thickly fleshed backs.

FIG. 2. (Farmers' Bul. 71, U. S. Dept. Agr.)



Showing method of cutting up beef for wholesale with prices per pound.

Experience has taught us that the desirable qualities of our domestic animals are closely related and we cannot therefore develop certain parts of an animal without at the same time influencing for good or ill many other characters. This correlation of parts makes it possible for us to accurately judge of an animal's utility by an examination of its external form. Some excellent judges maintain that by merely examining the head of a steer they can forecast his value as a profitable feeder. Without going too much into detail we will discuss some of the really essential characters which should receive the closest sort of attention by prospective feeders.

GENERAL FORM OF A FEEDER.

A good feeder, (see Fig. 3,) has a strong back and a straight top line. The underline should also be approximately straight and especially should it be carried back by a low flank. In judging this point in a lean animal we should give due credit to a deep expanded paunch which is indicative of great capacity. Above all things in connection with straight, uniform and parallel lines, insist upon a deep and broad frame giving the general appearance of a low set and blocky form. This type is particularly valuable in producing baby beef, but care should be taken that we do not over estimate this characteristic. Extreme pony-built animals as well as rangy ones should be avoided. A certain elasticity of movement and vigorousness of action, giving the animal a stylish appearance is a valuable character. Coarseness, and lack of smoothness indicate inferior feeding qualities. (See Fig. 4.)

QUALITY IN FEEDERS. .

An animal possessing a coat of fine, bright, silky hair ; a loose, pliable skin of medium thickness and a fine, dense, smooth bone, is said to possess quality. These characters are invariably associated with early maturity and rapid fattening. The possession of these valuable qualities does not necessarily imply greater gains on the same food but it does imply that an animal of good quality can be finished earlier and consequently on less food than would be required for animals that are covered with a hard, papery skin which clings tightly to the carcass, and that are distinguished by coarse large heads, large bone and a general lack of harmony in the development of parts.

How important the quality of early maturity is in practical feeding operations may be seen from a study of the following experiments. In this connection, however, it must always be remembered that early maturity means both that an animal may be finished at a comparatively young age and also that at any given period of development he may be satisfactorily fattened during a shorter feeding period and therefore with a smaller absolute amount of food. The shorter the feeding period the less food will be required to produce a pound of gain. This is clearly shown by the following table from Kansas Bulletin No. 34.*

TABLE I.
Cost of Gain Greater in Long Feeding Periods.

	Feed for 100 lbs. gain.	Increase of feed required.
Up to 56 days steers required	730 lbs. grain.	
Up to 84 days steers required	807 lbs. grain	10 per cent.
Up to 112 days steers required.....	840 lbs. grain.	15 per cent.
Up to 140 days steers required.....	901 lbs. grain.	23 per cent.
Up to 168 days steers required.....	927 lbs. grain.	27 per cent.
Up to 182 days steers required.....	1000 lbs grain	37 per cent.

*Henry's "Feeds and Feeding," page 369.

It will be seen from this table that it requires 37 per cent more grain to produce a pound of gain at the close of the feeding period than at the beginning. In other words if these animals could have been finished in three months instead of six months the resulting profit would have been largely increased.

QUALITY IN THE FAT ANIMAL.

The quality of fat animals in general is indicated by the same characters as in the feeders. But in addition we are called upon to distinguish in the actual qualities of the flesh itself. Excessive fatness is not a necessary indication of high quality in a fat animal. The qualities most desired in a finished animal are a carcass that possesses a small per cent. of offal or waste parts and a high per cent of edible meat and of this edible portion an especially large development of the porter house, sirloin and prime of rib cuts. (See Fig. 1) In addition, high quality demands that the flesh when exposed for sale shall exhibit a well marbled appearance resulting from alternate layers of fat and lean and in particular a good distribution of fat directly intermingled with the muscular fibers. Such meat possesses a flavor, a tenderness and juiciness that commends itself to the most exacting palate.

The process of fattening an animal develops and improves all the foregoing desirable characters. A fat animal dresses a much higher per cent of edible beef and a less per cent of offal or waste. A fat animal also furnishes a better flavor, more tender and more juicy flesh than a lean one. We fatten animals then to improve their quality.

The above considerations have primarily to do with the dressed carcass. But we are from necessity compelled to determine by an examination of the living animal whether or not the particular individual before us possesses the qualities so desirable on the butcher's block.

What are the indications of prime quality in a finished fat steer? "Desirable quality in flesh is indicated by a firm yet mellow and springy consistency of the flesh at the crops, along the back, at the loins and even on the side, beneath the gentle pressure of the outstretched hand."* Undesirable quality on the other hand is indicated by a large head, coarse bone, unevenly distributed and patchy flesh, particularly about the base of the tail where in over-fat steers or those of inferior quality we frequently see bunches or rolls of fat.

It might be inferred from the above that the feeding or fattening process was altogether responsible for the quality, but above and beyond the influence of feeding stands the influence of the individual and his inherited tendencies.

HIGH QUALITY FROM HIGH BREEDING.

No proposition in the whole realm of live stock husbandry has been more definitely demonstrated than that high quality comes from feeding well bred animals. There are horses that can eat a bushel of oats and in some way extract energy therefrom sufficient to trot a mile in a shade more than two minutes. There are other horses that may consume the same amount of food and may even have the advantage of the same training, but can never succeed in extracting more than enough energy to trot the same mile in five minutes. There are cows that when fed a certain amount of food will easily produce 200 pounds of butter in one year, while there are others that will produce only 100 pounds of butter annually, although fed exactly the same food in kind, quality and amount.

It is as true also that among beef cattle some are capable of consuming a certain definite amount of food and producing therefrom a fine quality of flesh which sells readily for six cents live weight while other cattle fed on the same food under the same conditions are slow sale at four cents per pound. This great difference is not due primarily to the feeding but to the breeding of the animal. At the Iowa Experiment Station cattle of various breeds were fed for nine months. The gains made were approximately the same and the food required to produce a given gain was about equal with all breeds. But when these cattle were offered for sale in the Chicago Yards the strictly beef bred animals brought \$2.22½ per hundred more than others not specifically bred for their beef qualities. The Shorthorn, Aberdeen Angus and Hereford steers easily brought the highest price of the day while the Jerseys and Holsteins were sold for scarcely enough to pay for their feeding and

*Circular No. 38 Illinois Experiment Station.

shipping. Director Curtis says: "The Jersey took on flesh rapidly, and was exceedingly fat and well finished. He was as good as it was possible to make a Jersey steer, yet, when he went to market he had to sell \$2.12½ below top quotations, while the Hereford was one of a car load to sell ten cents above the top for any other cattle on the market."*

In a very carefully conducted block test at the Missouri Station reported in Bulletin No. 24 some data are published from which the writer has deduced the following table. The table shows the development of the high priced cuts in the pure bred Shorthorn, Hereford and Aberdeen Angus steers as compared with scrubs:

TABLE II.

Table Showing that Heaviest High Priced Cuts are Found on Beef Bred Animals.

	Weight of all cuts	Weight of porterhouse and sirloin	per cent of porterhouse and sirloin to total
Shorthorn	1046 lbs	127 lbs	12.1 per cent
Hereford	1007 "	109 "	10.7 " "
Angus	980 "	109 "	11.1 " "
Scrub	824 "	82 "	9.1 " "

It is shown in the above table that a wide difference in the per cent of highly valuable meat may exist between beef bred and scrub or native cattle. But scrub as used here does not mean inferiority in general health, condition, or ability to gain well on a given amount of feed. The term scrub in this bulletin was used merely to designate an animal of no special breeding as opposed to those of the beef breeds. As a matter of fact in the experiment here quoted the scrub was preeminently the most thrifty and made better gains than some of the pure bred steers. This only emphasizes again the incontrovertible fact that mere ability to eat well and gain well does not accurately measure a steer's value as a profitable feeder. The main thing is to feed animals of the right type and thus place on the market a product of greater value.

The above citations are convincing. The results of carefully conducted experiments, of the practical feeder, of the great packing houses and the final and decisive test of the butcher's block all agree in pronouncing the well bred animal the most profitable one. And these well bred beef animals are most profitable because they fulfill the requirements as to conformation.

We hear it frequently stated that pure bred animals are more prof-

*Farmers Bulletin No. 71, U. S. Department of Agriculture.

itable because they are able to produce more gain from a given amount of food. This statement cannot be substantiated. The experiments all point to the fact that the well bred animals are more profitable because, as shown above, they produce a much more valuable product and not because they are able to produce a greater bulk on the same amount of food.

FIG. 3.

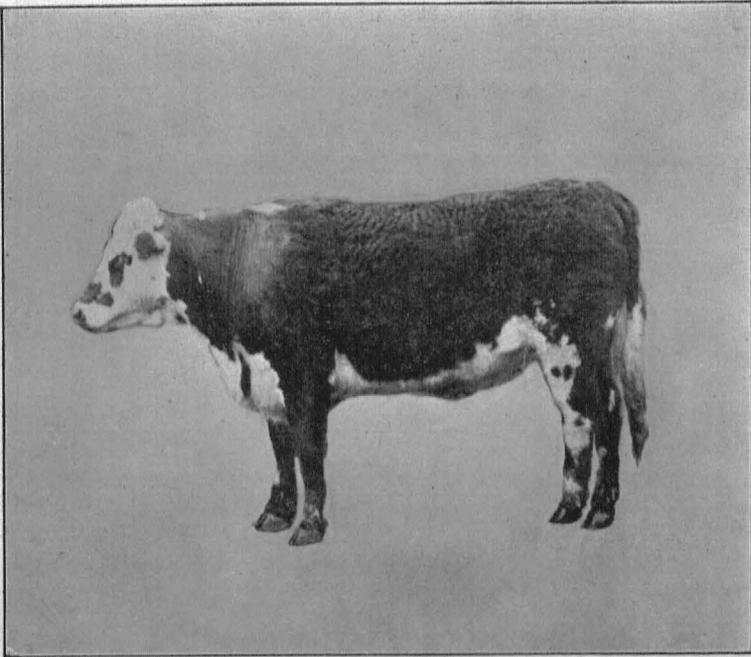


Fig. 3 represents a good type for profitable feeding. This engraving is from a photograph taken April 1st, 1902. The steer was at that time 23 months old and during the winter from Dec. 24th, 1901, had received only six pounds of corn daily and 17 pounds of cow pea hay. He had gained an average of 1.3 pounds per day for the period named. Notice particularly, the uniform, straight lines; the short neck and general thick set appearance. The back is broad and thick fleshed and spring of the rib is exceptionally good. The legs are short and of medium fineness and the head is short and not lean. This steer was placed first in a pen of 11 by 16 out of 21 agricultural students competing for stock judging prizes in the winter course.

FIG. 4.

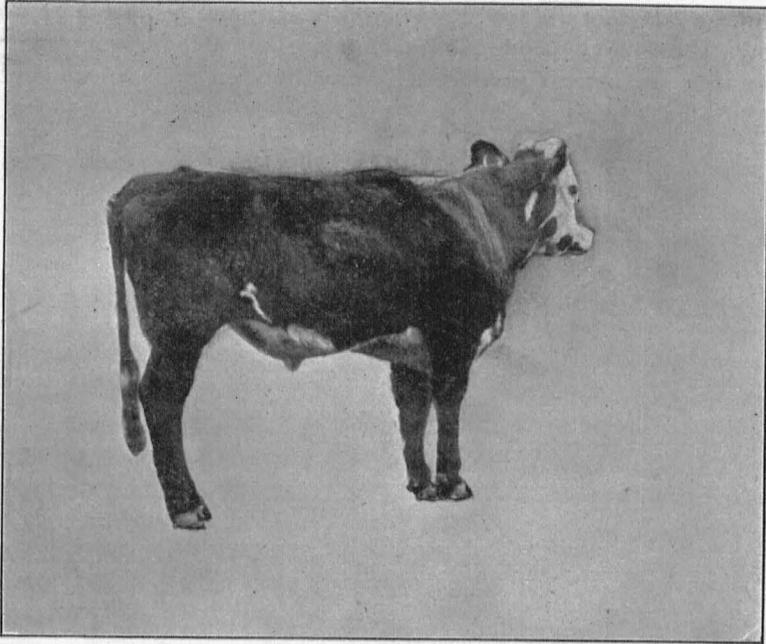


Fig. 4 represents the poorest feeder in a large bunch in the experimental feed lots at this station. This steer is of the same age as Fig. 3. He has had the same grain ration and cow pea hay and sorghum for roughage. He has gained 1.1 pounds daily. This steer will require long feeding to properly finish. Notice the entire lack of straight, even and uniform lines. The head is large the neck long and thin and the shoulders coarse. The legs are too long and the body too shallow. The rangy appearance of this animal is intensified by sharp hips and pin bones, rather long, narrow back and flat ribs. His girth is very deficient and no part of him can be called thick fleshed. He has had the same amount of corn daily as Fig. 3 and all the cow pea hay he could eat. A close comparison of these two figures (3 and 4) will be very helpful to the young student of animal types.

DETAILED DESCRIPTION OF A GOOD FEEDER.

Head and Neck.—There is a right way to examine an animal and if we follow in this way, after carefully examining the general appearance of an animal including a close scrutiny of the form and quality we

will next turn our attention to a detailed study of the head and neck. The head should be moderately fine with a broad, full and high forehead indicating a generous brain which will suggest a well developed nervous system and strong vitality. A short face and not lean is an ever present character in a beef steer of prime quality. A broad muzzle with nostrils wide and open is seldom associated with a poor feeder. A clear full eye shows good health, and a quiet temperament. Above all things shun a steer with a small contracted "pig" eye. The head should be well carried on a short, full, thick neck. It is here that the butcher and feeder are somewhat at odds because the butcher looks upon the neck as so much beef of an inferior quality that must be sold at a reduced price; but the feeder long ago learned that a short thick neck is invariably associated with thickness of flesh and gives assurance of an animal's ability to lay up fat on the loin, back and rib.

Forequarter.—Passing back from the head and neck we observe next the shoulder vein which as indicated by the chart, lies just in front of the shoulder blade. This region should be characterized by fullness. The shoulder of a good beef steer is compact and well covered with flesh, with no tendency to coarseness or angularity. The condition of the animal at the time will of course materially influence this point and should be given due weight.

The chest, which includes that region of the trunk in which the vital organs—the heart and lungs—are found, is of the highest significance as indicating the existence or non-existence of qualities fundamental to the usefulness, gradual development and final profit of the beef animal. A broad, deep and full chest is a very valuable character. Such a chest is *prima facie* evidence of large heart and lung room and other things being equal a good development of these supremely important organs. When we remember that the efficiency of the blood is directly dependent upon the respiratory processes of the lungs and that this blood is the chief agent in bringing about the assimilation of the large quantities of food consumed by the fattening animal, and that this life giving fluid is pumped by the heart to the most remote extremities, we can form some idea of the necessity of well developed organs in a spacious chest. The forelegs may indicate quality and sometimes by their placing under the body suggest a narrow chest. The desirable conformation is a straight leg set firmly at the corners of the body with a smooth, moderately fine and dense shin or cannon bone. Coarse bones, big joints, and rough, scaly hoofs are objectionable.

Body.—The girth or as it is sometimes called the heart girth is frequently so small as to be a very serious defect. A desirable beef animal has a large girth. A large girth is associated with many other funda-

mentally essential characters such as full crops, well filled fore flanks, well sprung ribs, and a wide, deep chest. No amount of feeding can ever correct a marked deficiency in the girth of an animal, we must therefore insist strongly upon this highly important essential.

The importance of an arched, well sprung rib is very often overlooked by those who insist too strongly upon a straight underline. By an arched, well sprung rib we mean a rib which leaves the back bone almost horizontally and carries the width of the back well out to the side, dropping with a graceful curve downward and outward and extending well down, making a deep and capacious abdomen. An animal possessing such a rib will frequently show a somewhat pendant or disproportionately large paunch, when in a lean condition, while the same animal fattened may possess an almost ideal bottom line. However, a pendant paunch is not in itself always desirable but when associated with a broad back and caused by a deep, well sprung rib, it does become an important and desirable characteristic.

With the well formed rib we must have a broad straight back moderately short and well covered with flesh. Excessively long backs seem to be uniformly present in late maturing animals. The loin carrying as it does the very highest quality of flesh to be found in the animal is justly regarded by feeders, butchers and consumers alike as the one most important part of the entire animal. A good loin is broad, full and thickly fleshed. Firm, thick flesh is especially to be desired as it may happen that while an animal may possess a broad back it may be so sparsely covered with flesh as to make him an undesirable butcher's beast.

The flank that is low, thick and full is always found with a straight underline and thick deep quarters and these are found with other desirable qualities in all good beef forms.

Hindquarters.--The hips are first to attract our attention in the hindquarters of an animal and when these are wide apart, smooth and well proportioned to the rest of the body all the requirements for beef excellence are fulfilled. The rump of the good beef animal is long, level and wide and entirely free from any suggestion of bunchy or patchy fat at the base of the tail. A long rump is considered by many practical breeders as a highly valuable quality.

The pin bone should be wide and sufficiently high to carry the back line out straight to the base of the tail. These bones should not be too prominent and should be smooth and free from any indications of patchiness.

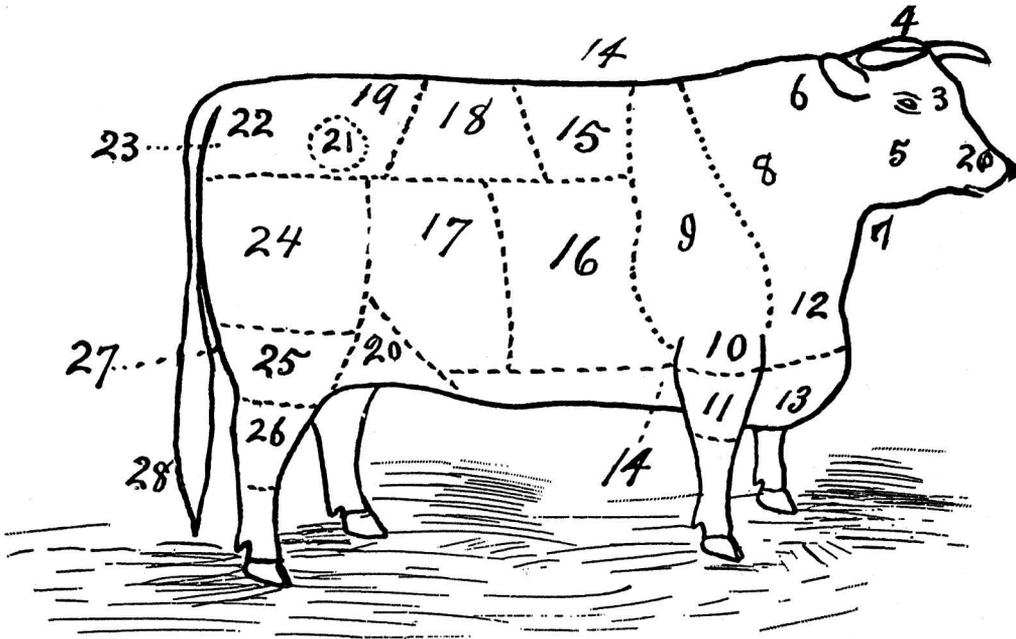
The tail if terminated by a switch of fine hair and composed of moderately fine bone may be a valuable indicator of good quality and early maturity, especially so when all other indications mentioned in the

preceding paragraph point to the same conclusion. The tail must be well set on, neither too high nor too low, it should hang exactly at the angle of the body and hang straight down in a graceful manner.

The full, thick and well fleshed thigh will not be overlooked and with such a thigh the twist will extend well down giving the general appearance of very short legs when the animal is viewed from behind.

The following score card contains in a condensed form the description of typical beef animals. It has been found to be a very useful outline in the introduction to the study of beef cattle at this institution.

FIG. 5.



- | | | | |
|--------------------|------------------|----------------|-------------------|
| 1. Muzzle. | 2. Nostrils. | 3. Face. | 4. Poll. |
| 5. Jaws. | 6. Neck. | 7. Throat. | 8. Neck Vein. |
| 9. Shoulder. | 10. Arm. | 11. Forearm. | 12. Chest. |
| 13. Brisket. | 14. Heart Girth. | 15. Crops. | 16. Fore Ribs. |
| 17. Back Ribs. | 18. Back. | 19. Loins. | 20. Flank. |
| 21. Hips or Hooks. | 22. Rump. | 23. Twist. | 24. Hindquarters. |
| 25. Thighs. | 26. Hocks. | 27. Pin Bones. | 28. Switch. |

UNIVERSITY OF THE STATE OF MISSOURI.
COLLEGE OF AGRICULTURE AND ME-
CHANIC ARTS.

DEPARTMENT OF AGRICULTURE.

Score Card A.—Beef Cattle. Steers.

SCALE OF POINTS.

Perfect.

General Appearance.

Form , square, broad, blocky, straight top and bottom line.....	8
Quality , fine hair; mellow, loose, pliable skin of medium thick- ness; bone medium fine and dense; flesh firm and even.....	8
Temperament , quiet.....	3
	<u>19</u>

Head and Neck.

Muzzle , clean cut, broad; mouth large; nostrils wide and open....	2
Face , short, not lean.....	3
Eyes , full, bright, clear.....	1
Forehead , broad, full, high.....	1
Ears , medium size, fine texture, covered with fine hair.....	1
Horn , waxy, fine texture, medium size.....	1
Neck , thick, short, set firmly on shoulders; throat clean.....	3
	<u>12</u>

Forequarters.

Shoulder Vein , full.....	3
Shoulder , compact, well covered with flesh.....	3
Chest , full, deep, thick through the heart.....	5
Brisket , deep, moderately projecting; breast wide.....	1
Forelegs , straight, short, wide apart, strong, smooth bone, arm, full.....	3
	<u>15</u>

Body.

Girth , large.....	4
Crops , full.....	3
Ribs , well sprung, arched and deep, thickly fleshed.....	5
Back , broad, straight, short.....	5
Loin , full, broad, and thickly fleshed.....	6
Flank , full, low and thick, making underline straight.....	4
	<u>27</u>

Hindquarters.

Hips , wide apart, smooth, well proportioned.....	4
Rump , long, level, wide, not patchy.....	5

Pin Bones , not prominent, wide apart	3
Tail , base smooth, bone fine and smooth, hair of switch fine.....	3
Thigh , full, deep and wide, well fleshed.....	4
Twist , deep, well filled out	5
Hindlegs , short, straight, fine smooth bone.....	3
	27
Total	100

II. AGE.

INFLUENCE OF AGE ON COST OF GAIN.

The age and weight at which live stock is marketed today has decreased to such an extent as compared with those of former years, that present practice seems almost revolutionary. It was not a great many years ago that it was considered necessary to feed a steer until four or five years old before he could reasonably hope to satisfy the critical demands of that old time market. Hogs were fed to a weight of four to six hundred, and two and three year old wethers filled the pens of the sheep feeders. At the present day one and two year old steers are in great demand, two hundred pound hogs are the rule and not the exception and ninety pound lambs are valued at least one dollar per hundred above the price offered for two year old wethers. What influence has the change in market conditions had upon the business of the feeder? We must answer without the slightest hesitation that the changed conditions are distinctly favorable to the feeder. No proposition in the whole realm of stock feeding has been more definitely demonstrated than that the cost of gain depends directly upon the age of the animal. The younger the animal the less food is required to produce a pound of gain.

"BABY BEEF."

The daily gain of a steer on full feed has been shown to be directly dependent upon his age. Young animals gain more rapidly than older ones. This is shown by the following tables:*

TABLE III.

Age and Rate of Gain of Steers at American Fat Stock Show. Stewart.

Period	Age	Length of period	Average gain per head	Average daily gain per head
First period.....	297 days	297 days	780 pounds	2.63 pounds
Second period.....	612 days	315 days	554 pounds	1.76 pounds
Third period.....	943 days	331 days	305 pounds	.92 pounds
Fourth period.....	1283 days	340 days	299 pounds	.88 pounds

* Tables III, IV and V are adapted from "Feeds and Feeding," by Henry.

TABLE IV.

Age and Weight of Steers Slaughtered at the Smithfield (Engl'd) Fat Stock Show, 1888-95.

	No. of Animals	Age	Average daily gain	Live weight at slaughter'g	Dressed meat to live weight
		Days	Pounds	Pounds	Per cent
Shorthorn—1 year old.....	5	642	2.11	1355	66.13
2 years old.....	18	963	1.92	1842	67.48
3 years old.....	16	1321	1.70	2251	69.38
Hereford—1 year old.....	16	663	1.97	1308	65.08
2 years old.....	13	1020	1.78	1817	67.15
3 years old.....	8	1349	1.64	2218	69.18
Devon—1 year old.....	13	634	1.75	1112	66.01
2 years old.....	19	1045	1.51	1583	67.73
3 years old.....	16	1311	1.37	1796	67.32
Aberdeen-Angus—					
1 year old.....	26	668	2.04	1366	65.37
2 years old.....	21	1008	1.74	1765	66.67
3 years old.....	2	1346	1.59	2138	67.39
Sussex—1 year old.....	17	677	2.15	1452	65.42
2 years old.....	18	989	1.86	1837	68.18
3 years old.....	12	1285	1.61	2064	67.98
Red Polled—2 years old.....	12	1002	1.64	1631	65.73
3 years old.....	6	1362	1.49	2022	65.77
Galloway—2 years old.....	7	1027	1.64	1688	64.45
3 years old.....	4	1344	1.47	1969	64.84

The food consumed daily by yearling steers is considerably less than that consumed by a two year old. If the daily gain of the yearling is greater and he consumes less food then the amount of food required to make a pound of gain must be less and consequently the cost of gain must also be less on the younger steer. This is shown by the records

of the Chicago Fat Stock Show reported in the Illinois Board of Agriculture for 1884 and the experiments conducted at various stations.

TABLE V.
Cost of 100 Pounds Gain on Young and Older Steers.

	1-12 months old		12-24 months old		24-36 months old	
	No. of animals	Cost of food	No. of animals	Cost of food	No. of animals	Cost of food
Fat Stock Show '82.....	9	\$4.03	5	\$7.98	2	\$12.54
Fat Stock Show '83.....	6	3.70	4	8.12		
Michigan Station, Bulletin 44.....	10	1.87	10	7.37	10	9.57
Wisconsin Station, Re- port 1886, p. 54.....	16	4.20	11	6.13		
Massachusetts Station, Report 1891, p. 107.....			2	7.49	2	12.38

The above table clearly teaches that from birth to twelve months old the cost of producing one pound of gain is just about one-half the amount required during the period from twelve to twenty-four months old and that the cost of gain during the latter period (12 to 24 months old) is very materially less than that required when the animal reaches the third period, from 24 to 36 months of age. In the majority of these experiments the animals included in all periods were on full feed from calfhood. An exception to this is found in the experiments conducted at the Massachusetts Station where yearlings in lean condition were compared with two-year-olds also in lean condition. The results teach the same lesson precisely, namely that the younger the animal the more cheaply he can be fed and within certain limits this is true of animals in lean condition as well as those on full feed from calfhood.

It is not surprising in view of the above facts that many of the most intelligent feeders are now producing so called "Baby Beef." So long as the market requirements are satisfied by a live weight carcass of 1200 pounds and buyers willingly pay near the top prices for such animals it will be profitable to push the steers from birth to butcher's block. It may be safely maintained that an acre of corn will produce more beef when fed to steers under twelve months old than at any later period.

III. SOME FEEDING METHODS.

Grain Required to Produce 100 Pounds of Gain.—The amount of

grain required to produce 100 pounds of gain on cattle depends upon the age, (see page — and tables 3, 4 and 5), condition, method of feeding, manner of mixing the grain ration and the kind of roughage fed.

CONDITION INFLUENCES COST OF GAIN.

The cost of gain increases as the animal increases in fatness. Other things being equal the lean animal is a more economical gainer than the half fat one. On the other hand we must clearly distinguish between excessive leanness amounting to emaciation and sometimes resulting from a diseased condition, and a leanness which is normal and which comes from an insufficient supply of food to a healthy growing animal. This is shown in the following table :

TABLE VI.

Grain Required to Produce One Pound of Gain—Winter Feeding.

	Length of Feeding Period	First month of feeding period	Last month of feeding period
	days	pounds	pounds
Kan. Station—Bul. No. 34.	182	7.3	10.
Kan. Station—Bul. No. 60.	145	10.2	15.4
Mass. Stati'n—Bul No. 113.	142	7.7*	15.7*
Mich. Stati'n—Bul. No 69.	150	6.2	9.3
Average.....		7.8 pounds	12.6 pounds

*Dry matter.

In feeding periods extending from 142 days to 182 days the average amount of grain required to produce one pound of gain during the first 30 days was 7.8 pounds and during the last 30 days 12.6 pounds. A long feeding period on full feed is always expensive.

METHOD OF FEEDING DETERMINES COST OF GAIN.

The cost of gain depends, among other things, upon whether the animals are fed in the open or in the barn and whether they are fattened on pasture or fed exclusively on dry feed.

The experiments to determine the effects of shelter in winter upon fattening cattle have not been altogether convincing.

Experiments at the Kansas, Texas and Iowa stations show a considerable saving of food from confining steers in fairly warm quarters. On the other hand the results from actual feeding trials at the Ohio, Utah and Missouri stations indicate that steers are as economically fattened when given the freedom of an open shed. The results of four

years experience at the Missouri station are distinctly unfavorable to confinement in the barn, and even suggest that under certain conditions feeding in an open yard is not wasteful of food. (See article by Dean H. J. Waters, Monthly Bulletin No. 6, September, 1901, Missouri Board of Agriculture.)

GAINS OF STEERS ON PASTURE.

The cheapest gains made on cattle in the State of Missouri are made on pasture. The gains made on pasture alone, without grain, are shown in the following table, adapted from the bulletins of several stations.

TABLE VII.
Gain on Pasture—No Grain.

Station	No of animals in experiment	Age	length of time pastured	Average daily gain per head	Total gain
Illinois Bul No 1...	4	yearling	6 months	1.84 lbs	332 lbs
Illinois Bul No 1...	10	yearling	6 months	1.58 lbs	285 lbs
Illinois Bul No 1...	2	yearling	6 months	2.44 lbs	440 lbs
Iowa Bul No 28...	10	23 mos	1 month	2.0 lbs	60 lbs

Average daily gain per head 1.97 pounds.

From table 7 it will be seen that the average gain on pasture alone without grain is about two pounds per day. This gain is as great as may be expected on the average from winter feeding for a six months feeding period on full feed. In this section of Missouri the price paid for hired pasture is seventy-five cents per head per month, or \$4.50 for the six months period. If the steer gains 240 pounds in this time the cost of one pound of gain is 1.87 cents. This estimate we believe a reasonable one. Steers at this station have gained 100 pounds during the month of June on pasture alone. However, the cost of gain on pasture and the comparative profit from winter and summer feeding is always complicated by the difficulty of changing from dry feed to pasture. At the Iowa Station,* nine Angus and Shorthorn steers made a gain of 545 pounds from June 15th to July 16th. Estimating the pasture as worth \$1 per head per month the cost of one pound of gain was only 1.65 cents. Ten similar steers fed grain in the feed yards during the same time gained 640 pounds at a cost of 4.02 cents for each pound of gain. All the above cattle were pastured from August 1st to October 1st and later full fed in the yards until February 1st. Summing up all the results Wilson & Curtis conclude: "During the three months

*Bulletin No. 28.

the cattle were on pasture, the average cost of gain for all the cattle was 5.18 cents per pound; and while they were on dry feed in the yards the average cost of a pound of gain was 6.40 cents.”

TABLE VIII.

Gain on Pasture With Full Feed of Grain.

Station	No of animals in experiment	Age	length of time on pasture	Average daily gain per head	Total gain
Illinois Bul. No 1..	2	yearlings	6 months	2.81 lbs	507 lbs
Illinois Bul. No 1..	4	yearlings	125 days	2.29 lbs	284 lbs
Illinois Bul. No 1..	7	two-year olds	6 months	2.56 lbs	466 lbs
Illinois Bul. No 1..	8	two-year olds	6 months	2.11 lbs	380 lbs
Illinois Bul. No 1..	4	two-year olds	6 months	2.25 lbs	406 lbs
Iowa Bul. No 28...	10	23 months	1 month	2.13 lbs	63.9 lbs

Average daily gain 2.36 pounds.

In table 8 are given the results from feeding steers on full feed while at pasture. The average daily gain under such conditions was 2.36 pounds. The grain required to produce this gain is not recorded in the Illinois Bulletin but at the Iowa Station 490 pounds of grain was fed for each 100 pounds increase in live weight. Many of our best cattle feeders are gradually changing from winter to summer feeding and a careful examination of the results of practical feeders cannot fail to convince the unprejudiced mind that the gains made from summer feeding are cheaper than those from winter feeding. Some successful feeders are now buying yearlings in the fall, feeding a light grain (6 or 8 pounds daily) ration through the winter and finally finishing the cattle by feeding a full feed of grain with pasture. The cattle are fattened or sold for a fall or Christmas market. There is great need of further investigation to determine the economy of fattening steers on pasture with or without grain and the comparative profit from winter feeding as compared with summer feeding.

The amount of grain required to produce 100 pounds of gain, then, varies widely; the experiments indicating that under extremely favorable circumstances young cattle may increase 100 pounds in live weight as the result of eating 500* pounds of grain. When older cattle are fed under less favorable circumstances there may be easily required 1500† pounds of grain for each 100 pounds increase in live weight.

*Iowa Bulletin No. 20.

†Kansas Bulletin No. 34.

TABLE IX.

Grain Required For 100 Pounds of Gain For Fattening Cattle.

Station	Kind of grain fed	Age of cattle	Length of feeding period	Grain to produce 100 lbs. gain	Remarks
Kansas, Bull. 34, 60	Corn meal	3 years	6 months	1122 lbs	Roughage, corn stover
"	Ear corn	3 years	6 months	1410 lbs	Roughage, corn stover
Kansas Bull. 47.....	Dry shelled corn		5 months	1105 lbs	Roughage, corn stover
"	Shelled corn soaked		5 months	938 lbs	Roughage, corn stover
Kansas Report, '84..	Corn and cob meal		140 days	732 lbs	Steers in thin condition at beginn'g
"	Corn meal		140 days	795 lbs	Steers in thin condition at beginn'g
Kansas Report, '85..	Corn and cob meal		150 days	1260 lbs	Half fat at beginning
"	Corn meal		150 days	1166 lbs	Half fat at beginning
Kansas Bulls. 34, 39 and 60.....	Ear corn	3 years	150 days	1271 lbs	
Kansas Bulls. 34, 39 and 60.....	Mixed grains (balanced ration)	3 years	150 days	905 lbs	
N. Carolina Bull. 93.....	Raw cotton seed		100 days	224 lbs	Roughage, cotton seed hulls
Arkansas Report 3rd	Raw cotton seed		100 days	209 lbs	Roughage, cotton seed hulls
Iowa Bull. 20.....	Mixed grains	2 years	92 days	790 lbs	Nine breeds
Iowa Bull. 28.....	Mixed grains	2 years	6 months	956 lbs	Angus & shorth'n
Michigan Bull. 44...	Mixed grains	1 year	1 year	549 lbs	Six breeds
"	Mixed grains	2 years	1 year	879 lbs	Six breeds
Michigan Bull. 69..	Mixed grains	1 year	18 months	560 lbs	Five breeds
Missouri Bull. 24....	Mixed grains	1 year	18 months	685 lbs	Four breeds
Missouri (Board of Agr. Sept. 1901).....	Corn	2 years	119 days	1151 lbs	Roughage, timothy hay
"	Corn	2 years	119 days	831 lbs	Roughage, cow pea hay
"	Corn	1 year	80 days	605 lbs*	Roughage, Timothy hay
"	Corn	1 year	80 days	301 lbs*	Roughage, clover hay
"	Corn	1 year	80 days	1160 lbs*	Roughage, sorghum hay
"	Corn	1 year	80 days	445 lbs*	Roughage, clover and corn stover equal parts

*Each steer received only 6 pounds of corn daily.

Table 9 shows clearly that the amount of grain required to produce one pound of gain, and consequently the cost of one pound of gain, varies between wide limits. The factors which determine the gain as shown in the table are the age, condition, methods of feeding, kind of roughage, and character of grain ration.

No correction has been made in this table for the gains made by the hogs following the steers. The experiments so far conducted seem to indicate that the droppings of steers fed on corn meal or other finely ground meals contain a comparatively small amount of nutriment available for hogs. On the other hand whenever cattle are fed on ear corn, shelled corn or Kafir corn the droppings are very valuable for hogs. It may be said on the basis of the results already secured that under conditions which require 1000 pounds of unground corn to produce 100 pounds of gain on cattle, we may estimate that 175 to 200 pounds of corn passes the steer undigested and this is nearly all available for hogs. In other words, 1000 pounds of corn will produce 100 pounds of beef and 40 pounds of pork. Stated in another way we may say that 800 pounds of corn will produce 100 pounds of beef, and that 175 or 200 pounds of corn in the droppings will make on the average about 40 pounds of pork. Estimated in still other terms we are justified in saying that 100 pounds of shelled corn fed to steers will produce 4 pounds of pork on the hogs following. These estimates are very conservative and many feeders claim to secure more gain from hogs than these experiments show.

The cheapest gains are apparently made on young steers, while grazing. But at the Missouri Station results as favorable were secured while feeding yearlings a partial grain ration with clover hay. The costliest gains are those made from feeding three year old steers in half fat condition at the beginning of the feeding period on an unbalanced ration of corn and timothy hay, especially if fed for a long time.

Averages are perhaps of little value, but in general we may conclude that two year old steers on a short feed at pasture will gain 100 pounds for each 400 pounds of grain eaten and a long feed under the same conditions will require 600 pounds of grain for each 100 pounds of gain. A short feed in winter on dry feed exclusively will require 750 pounds of grain for 100 pounds of gain, and during a long feeding period under like conditions from 1000 to 1500 pounds of grain will make 100 pounds of gain. With yearling steers under conditions as above, less grain will be required in every instance to produce one pound of gain.