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# Carcass Comparisons of Mature and Immature Steers

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## ABSTRACT

Carcass studies of a mature, nine-year-old steer and an immature one-year-old steer, are here reported. These include detailed physical comparisons of wholesale cuts, retail cuts, cutting tests and a separation of the various cuts into lean, fat and bone. Chemical analyses were made from composite samples of each wholesale cut. The economy of the various cuts as a source of edible meat, protein and calories was determined. A palatability test was made by cooking a roast comprising the ninth, tenth and eleventh ribs from each carcass.

## ACKNOWLEDGMENTS

The author wishes to express his appreciation to E. A. Trowbridge, Professor of Animal Husbandry for suggesting this project, and to A. G. Hogan, Professor of Agricultural Chemistry, for his helpful suggestions and advice in the preparation of this paper.

This bulletin is a contribution from the Agricultural Experiment Station of the University of Missouri on the national cooperative project, "A Study of the Factors Which Influence the Quality and Palatability of Meat." The cooperating agencies are: National Livestock and Meat Board, United States Department of Agriculture, and the State Agricultural Experiment Stations.

# Carcass Comparisons of Mature and Immature Steers

M. T. FOSTER

Differences in the physical composition of carcasses of steers in different degrees of fatness were observed and measured by A. T. Edinger\* of the Missouri Experiment Station in 1922. A review of the literature on the subject was presented with his observations.

Under the cooperation of the United States Department of Agriculture and several state agricultural experiment stations, a national project of which this work is a part, has been planned for the following purposes:

- (a) Fixing more definite standards by which to judge the quality of meats;
- (b) Determining the factors influencing the quality of meat products; and
- (c) Making recommendations to producers, packers, retailers, and consumers, with the purpose of improving the quality of meat, particularly in respect to palatability.

The work reported here was undertaken as a preliminary to a more extensive study of the cooperative project. "A Study of the Factors Which Influence the Quality and Palatability of Meat."

## OBJECT

The object of this project was a comparative study of the carcass of a mature marketably fat steer and an immature marketably fat steer with respect to the following:

1. Physical composition;
2. Chemical composition of certain organs and parts;
3. Economy and nutritive value of similar cuts of meat; and
4. Quality and palatability of similar cuts of meat when cooked.

## PLAN OF EXPERIMENT

Two animals were used, a mature and an immature steer. The mature steer was nine years old and weighed 1590 pounds; the immature steer was twelve months old and weighed 852 pounds. They were fasted for twenty-four hours, weighed, then slaughtered and dressed. After slaughtering, the carcasses of these steers were held in a cooler for 48 hours at a temperature ranging from 30 to 38 degrees F., and then weighed. These weights were used as the dressed weight of the carcasses. The right half of each carcass was then divided into the standard wholesale cuts, and the weight of each recorded. The wholesale cuts were then divided into the regular retail cuts. These were weighed individually,

\*A. T. Edinger:—Missouri Agricultural Experiment Station Research Bulletin 83.

separated into lean, fat, and bone, and these weights recorded. From these data the physical composition of the wholesale cuts was calculated.

The protein, fat, and total energy of the various portions were determined from the analysis of composite samples made at this station. Current market prices were used in determining the relative economy of the different cuts.

### DESCRIPTION OF STEERS

The mature steer was a purebred Hereford that had been used in an experiment to determine "The Factors Influencing the Normal Rate of Growth in Domestic Animals and the Permanency of the Effects of Arrested Development." He was calved in May, 1917, started on this experiment in August of that year, and kept on a low plane of nutrition from August, 1917, until January 31, 1924. After this date he was full-fed until March, 1925. He was well fed from March, 1925, until slaughtered on May 17, 1926.

This steer possessed fair to good quality and was a large framed animal. He was in medium condition, had prominent hip bones and was somewhat heavy about the sheath. He lacked depth in the rear flank and on account of his great depth through the forequarter, appeared to lack full development of hindquarter. He was graded as a medium steer.\*

The immature steer was a purebred Shorthorn that had been raised on the University farm. He was calved May 12, 1925, and slaughtered May 17, 1926, making him twelve months and one week old. This steer had received unusually good care and would have compared very favorably with the steers that are marketed and classified as Baby Beef. He had access to a grain creep in addition to suckling his mother, and after being weaned he was continued on full feed until slaughtered. He showed quality in hide, hair, and bone, and was nearly as fat as a steer of his age could be made. He was somewhat high at the hip bones and drooped slightly to the tail head. He also lacked depth in the flank and appeared to lack maximum development of hindquarter. He was graded as a choice steer.

### METHOD OF CUTTING THE CARCASSES

The carcasses were divided into the wholesale cuts according to "the so-called 'Chicago method', which is the most prevalent, and leaves one rib on the hindquarter. One or more ribs on the hindquarter serve to hold the flank distended, give the hind a full or rounded appearance in the region of the flank, and facilitate the circulation of air over the inner walls."<sup>6</sup>

\*The steers and carcasses were graded by A. T. Edinger, a meat grading specialist in the employ of the Federal Department of Agriculture.

6. Davis-Whalin—U. S. D. A. Bulletin 1246, page 30.

“In the Chicago method, sides are quartered in such a way as to leave about 48 per cent of the weight in the hindquarter and 52 per cent in the forequarter. The loin, round, rump, shank and flank are obtained from the hindquarter, whereas the rib, chuck, plate, brisket and foreshank or shin come from the forequarter.”<sup>6</sup>

In cutting the hindquarter, the flank is the first cut removed, starting at the cod and cutting down over the round and continuing forward so as to remove 4 or 5 inches of the tip end of the rib left on the hindquarter. The loin is removed from the round by beginning at the fourth vertebra in the rump, cutting about ½ inch in front of the pelvic bone to a point just in front of the stifle joint, and removing a small piece of bone from the round bone in the hip joint. The rump is removed from the round by cutting immediately below and parallel to the pelvic bone. The shank is not removed until the round is cut down to the “heel”. In the forequarter, the plate and brisket are removed from the chuck and ribs by starting at a point where the meat is thinnest on the twelfth rib, usually 8 to 11 inches from the backbone, and continuing forward to a point just below the point of the shoulder. The ribs and chuck are separated by cutting between the fifth and sixth ribs, and the plate and brisket are divided by continuing this cut downward to the underline of the carcass. The shank is then removed from the brisket. The neck is removed from the chuck where it tends to become shallow.

**THE FORE AND HIND QUARTERS OF THE CARCASS**

The carcasses were held in the cooler for 48 hours, where the temperature ranged from 30 to 38 degrees F. The shrinkage during this time is shown in Table 1.

TABLE 1.—WARM AND CHILLED WEIGHTS OF THE CARCASSES

Carcasses	Immature steer		Mature steer	
Warm weight (lbs.)	481.8		965.3	
Chilled weight (lbs.)	476.5		947.9	
Shrinkage (lbs.)	5.29		17.37	
Per cent shrinkage	1.10		1.80	

The carcasses were divided into fore and hind quarter by cutting between the twelfth and thirteenth ribs. The weights and percentages of these main wholesale cuts are given in Table 2.

TABLE 2.—WEIGHTS AND PERCENTAGES OF FORE AND HIND QUARTERS

Quarters	Pounds		Per cent	
	Immature steer	Mature steer	Immature steer	Mature steer
Fore-right	122	250	25.60	26.37
Fore-left	125	247	26.23	26.06
Hind-right	114	223	23.92	23.53
Hind-left	115	228.9	24.13	24.15

6. Davis-Whalin—U. S. D. A. Bulletin 1246, page 30.

### WHOLESALE CUTS OF BEEF

The right half of each carcass was reduced to the smaller wholesale cuts as illustrated in Fig. 1. The weights and percentages of these cuts are recorded in Table 3, which shows that the immature carcass produced 2.22 per cent more round than the mature carcass; also, that the mature carcass produced 1.95 per cent more chuck than did the immature

TABLE 3.—WEIGHTS AND PERCENTAGES OF WHOLESALE CUTS

Cuts	Weight		Per cent	
	Immature steer	Mature steer	Immature steer	Mature steer
Round	56.50	102.75	23.94	21.72
Loin	40.00	75.75	16.95	16.01
Rib	21.50	46.63	9.11	9.86
Flank	14.81	27.38	6.28	5.79
Plate	26.76	54.00	11.34	11.41
Chuck	58.00	125.50	24.58	26.53
Fore shank	10.75	16.69	4.56	3.53
Neck	4.06	7.81	1.72	1.65
Kidney fat	2.00	16.56	1.21	3.50
Loss	1.62	-----	.25	-----
Entire side	236.00	473.06	100.00	100.00

carcass. The most significant fact brought out in Table 3 is that the immature carcass produced only 2 pounds of kidney fat while the mature carcass produced 16.56 pounds. Some of the kidney fat was unintentionally removed from the immature carcass, immediately after the steer was slaughtered, in an attempt to perfuse the left hind leg with a saline solution.

**Physical Composition of Wholesale Cuts.**—The wholesale cuts were divided into the retail cuts as practiced in the average retail markets, and these were then separated into lean, fat, and bone. From these data the amount of lean, fat and bone in the wholesale cuts was calculated. The amount and percentage of lean, fat, and bone in these cuts is shown in Tables 4 to 13 inclusive.

The chuck, neck and flank from the two carcasses showed considerable variation in composition. These variations might have been due to differences in the manner of cutting. During the cutting process a small loss occurred, due to evaporation of moisture, the loss of small particles of bone and flesh, and also, to slight inaccuracies in weighing.

TABLE 4.—LEAN, VISIBLE FAT, AND BONE, IN FORE AND HINDQUARTERS IN POUNDS AND PERCENTAGES

	Pounds				Per cent			
	Lean	Fat	Bone	Total	Lean	Fat	Bone	Total
Fore quarter								
Immature steer.....	63.20	36.95	19.93	120.08	52.63	30.77	16.60	100.00
Mature steer.....	144.99	59.41	44.82	249.22	58.18	23.84	17.98	100.00
Hind quarter								
Immature steer.....	64.72	36.40	13.84	114.96	56.30	31.66	12.04	100.00
Mature steer.....	114.95	77.39	29.28	221.62	51.87	34.92	13.21	100.00

TABLE 5.—LEAN, VISIBLE FAT, AND BONE IN WHOLESALE CUTS EXPRESSED IN POUNDS

Wholesale cuts	Immature steer				Mature steer			
	Lean	Fat	Bone	Total	Lean	Fat	Bone	Total
Loin.....	23.55	11.93	3.88	39.36	46.49	18.93	10.14	75.56
Rib.....	10.94	7.02	3.10	21.06	24.02	13.96	8.33	46.31
Round.....	36.42	12.59	9.96	57.17	59.52	23.93	18.86	102.31
Round—R and S off* .....	25.51	6.27	3.63	35.41	41.29	10.91	5.42	57.62
Shank .....	2.09	2.82	3.95	8.86	2.98	4.33	8.08	15.39
Rump.....	7.02	3.50	2.38	12.90	15.25	8.69	5.36	29.30
Chuck.....	33.91	14.95	9.69	58.54	83.38	19.00	22.41	124.79
Neck.....	2.72	.66	.60	3.98	4.91	2.06	.66	7.63
Plate.....	10.58	12.63	2.95	16.16	24.23	22.08	7.76	54.07
Brisket.....	4.27	4.86	1.25	10.38	7.99	7.59	2.95	18.53
Navel.....	6.31	7.77	1.70	15.78	16.24	14.49	4.81	35.54
Fore shank.....	5.05	1.69	3.59	10.33	8.45	2.31	5.66	16.42
Flank.....	4.75	3.88	-----	8.63	8.94	11.72	.28	20.94
Cod fat.....	-----	6.00	-----	6.00	-----	6.25	-----	6.25
Kidney fat.....	-----	2.00	-----	2.00	-----	16.56	-----	16.56
Loss.....	-----	-----	-----	2.77	-----	-----	-----	2.76
Entire side.....	127.92	73.35	33.77	236.00	259.93	137.80	74.10	473.00

\*Rump and shank off

TABLE 6.—LEAN, VISIBLE FAT, AND BONE IN WHOLESALE CUTS EXPRESSED IN PERCENTAGES

Wholesale cuts	Immature steer				Mature steer			
	Lean	Fat	Bone	Total	Lean	Fat	Bone	Total
Loin.....	59.83	30.31	9.86	100.00	61.53	25.05	13.42	100.00
Rib.....	51.95	33.33	14.72	100.00	51.87	30.14	17.99	100.00
Round.....	60.56	22.02	17.42	100.00	58.18	23.39	18.43	100.00
Round—R and S off .....	72.04	17.71	10.25	100.00	71.66	18.93	9.41	100.00
Shank .....	23.59	31.83	44.58	100.00	19.36	28.14	52.50	100.00
Rump.....	54.42	27.13	18.45	100.00	52.04	29.66	18.29	99.99
Chuck.....	57.93	25.54	16.55	100.02	66.82	15.23	17.96	100.00
Neck.....	68.34	16.58	15.08	100.00	64.35	27.00	8.65	100.00
Plate.....	40.44	48.28	11.28	100.00	44.81	40.84	14.35	100.00
Brisket.....	41.14	46.82	12.04	100.00	43.12	40.96	15.92	100.00
Navel.....	39.99	49.24	10.77	100.00	45.69	40.77	13.53	99.99
Fore shank.....	48.89	16.36	34.75	100.00	51.46	14.07	34.47	100.00
Flank.....	55.04	44.96	-----	100	42.69	55.97	1.34	100.00
Cod fat.....	-----	100.00	-----	100.00	-----	100.00	-----	100.00
Kidney fat.....	-----	100.00	-----	100.00	-----	100.00	-----	100.00
Loss.....	-----	-----	-----	.41	-----	-----	-----	.25
Entire side.....	54.20	31.08	14.31	99.59	54.95	29.13	15.67	99.73

PHYSICAL COMPOSITION OF RETAIL CUTS

The wholesale cuts were reduced to retail cuts as illustrated in Fig. 2. It is a practice in a great many retail markets to trim the retail cuts of excess fat and bone before they are sold, but in this project no trimming was done. An effort was made to have the corresponding retail cuts come from exactly the same part of the carcass, but due to the great difference in size of the two carcasses this was not always achieved.

Carcasses and wholesale cuts of beef are graded to conform with certain standards. The factors which determine the grade of a carcass

TABLE 7.—LEAN, VISIBLE FAT, AND BONE IN RETAIL CUTS OF LOIN IN POUNDS AND PERCENTAGES

Retail cuts of loin	Pounds				Per cent			
	Lean	Fat	Bone	Total	Lean	Fat	Bone	Total
<b>Immature steer</b>								
Sirloin steak								
Butt end.....	1.84	.63	.22	2.69	68.40	23.42	8.18	100.00
Wedge bone.....	1.97	.59	.16	2.72	72.43	21.69	5.88	100.00
Round bone.....	1.22	.52	.09	1.83	66.66	28.42	4.92	100.00
Round bone.....	1.48	.66	.16	2.30	64.35	28.70	6.96	100.00
Double bone.....	1.16	.44	.16	1.76	65.91	25.00	9.09	100.00
Double bone.....	1.52	.50	.16	2.18	69.72	22.94	7.34	100.00
Double bone.....	1.03	.59	.36	1.98	52.02	29.80	18.18	100.00
Double bone.....	1.26	.44	.33	2.03	62.07	21.67	16.26	100.00
Hip bone.....	.61	.36	.11	1.08	56.48	33.33	10.19	100.00
Hip bone.....	.88	.44	.19	1.51	58.28	29.14	12.58	100.00
Porterhouse steak.....	.89	.38	.25	1.52	58.55	25.00	16.45	100.00
Porterhouse steak.....	.91	.26	.24	1.41	64.54	18.44	17.02	100.00
Porterhouse steak.....	.81	.58	.17	1.56	51.92	37.18	10.90	100.00
Porterhouse steak.....	.76	.47	.08	1.31	58.02	35.88	6.10	100.00
Porterhouse steak.....	.76	.49	.10	1.35	56.30	36.29	7.41	100.00
Porterhouse steak.....	.59	.41	.09	1.09	54.13	37.61	8.26	100.00
Porterhouse steak.....	.47	.28	.10	.85	55.29	32.94	11.76	99.99
Porterhouse steak.....	.63	.33	.14	1.10	57.27	30.00	12.73	100.00
Porterhouse steak.....	.73	.31	.13	1.17	62.39	26.50	11.11	100.00
Porterhouse steak.....	.56	.35	.08	.99	56.57	35.35	8.08	100.00
Porterhouse steak.....	.56	.41	.09	1.06	52.83	38.68	8.49	100.00
Porterhouse steak.....	.69	.41	.11	1.21	57.02	33.88	9.09	99.99
Porterhouse steak.....	.59	.36	.04	.99	59.60	36.36	4.04	100.00
Porterhouse steak.....	.36	.46	.04	.86	41.86	53.49	4.65	100.00
Club steak.....	.39	.38	.08	.85	45.88	44.71	9.41	100.00
Club steak.....	.47	.44	.14	1.05	44.76	41.90	13.33	99.99
Club steak.....	.41	.44	.06	.91	45.05	48.35	6.59	99.99
Entire loin.....	23.55	11.93	3.88	39.36	59.83	30.31	9.86	100.00
Loss.....	---	---	---	.64	---	---	---	---
<b>Mature steer</b>								
Sirloin steak								
Butt end.....	2.50	.75	.17	3.42	73.10	21.93	4.97	100.00
Wedge bone.....	2.03	.63	.13	2.79	72.76	22.58	4.66	100.00
Round bone.....	2.69	.78	.28	3.75	71.73	20.80	7.47	100.00
Round bone.....	3.75	1.06	.19	5.00	75.00	21.20	3.80	100.00
Double bone.....	3.16	1.44	.28	4.88	64.75	29.51	5.74	100.00
Double bone.....	3.13	1.25	.41	4.79	65.34	26.10	8.56	100.00
Double bone.....	2.23	1.13	.66	4.02	55.47	28.11	16.42	100.00
Double bone.....	3.02	.77	.91	4.70	64.26	16.38	19.36	100.00
Hip bone.....	2.09	.81	1.14	4.04	51.73	20.05	28.22	100.00
Hip bone.....	2.00	.56	.84	3.40	58.82	16.47	24.71	100.00
Porterhouse steak.....	1.44	.72	.44	2.60	55.38	27.69	16.92	99.99
Porterhouse steak.....	1.48	.67	.31	2.46	60.16	27.24	12.60	100.00
Porterhouse steak.....	1.97	.75	.45	3.17	62.15	23.66	14.19	100.00
Porterhouse steak.....	1.52	.56	.44	2.52	60.32	22.22	17.46	100.00
Porterhouse steak.....	1.38	.63	.34	2.35	58.72	26.81	14.47	100.00
Porterhouse steak.....	1.22	.42	.30	1.94	62.89	21.65	15.46	100.00
Porterhouse steak.....	.88	.36	.22	1.46	60.27	24.66	15.07	100.00
Porterhouse steak.....	.97	.36	.22	1.55	62.58	23.23	14.19	100.00
Porterhouse steak.....	1.02	.50	.25	1.77	57.63	28.25	14.12	100.00
Porterhouse steak.....	1.06	.58	.28	1.92	55.21	30.21	14.58	100.00
Porterhouse steak.....	.88	.58	.19	1.65	53.33	35.15	11.52	100.00
Porterhouse steak.....	.97	.50	.19	1.66	58.43	30.12	11.44	99.99
Porterhouse steak.....	.78	.51	.19	1.48	52.70	34.46	12.84	100.00
Porterhouse steak.....	.96	.58	.17	1.71	56.14	33.92	9.94	100.00
Porterhouse steak.....	1.13	.57	.23	1.93	58.55	29.53	11.92	100.00
Porterhouse steak.....	.70	.41	.22	1.33	52.63	30.83	16.54	100.00
Club steaks.....	.53	.39	.16	1.08	49.07	36.11	14.81	99.99
Club steaks.....	.71	.25	.19	1.15	61.74	21.74	16.52	100.00
Club steaks.....	.29	.41	.34	1.04	27.88	39.42	32.69	99.99
Entire loin.....	46.49	18.93	10.14	75.56	61.53	25.05	13.42	100.00
Loss.....	---	---	---	.19	---	---	---	---



**The Loin.**—Two standard wholesale cuts are secured from the loin by making a separation immediately in front of the hip bone. Porterhouse or T-bone, and club steaks are secured from the short loin or rib end of the loin. Sirloin steaks or roasts are secured from the loin end or rump end of the loin. The loin from the immature steer was thick and well shaped. It was also well covered with fat, showed a very desirable color, and graded as No. 1. The loin from the mature steer was greater in size and was well proportioned. It was better marbled than the loin from the immature steer, but it was not as thickly covered with fat. The lean meat in this loin was a dark brick red in color, and on account of its color and lack of external fat as shown in the loin from the immature carcass, this loin graded as No. 2.

The actual weight of lean, fat and bone in the individual retail cuts from the loin and the per cent of lean, fat and bone in these cuts is expressed in Table 7.

It is difficult to make comparisons of similar cuts as given in Table 7 under pounds on account of the great difference in size of the two loins. The percentage columns afford a better basis for comparisons. It is evident that the sirloin steaks contained more lean and less fat than did the porterhouse or club steaks.

**The Ribs.**—The rib is considered the second most valuable cut of the carcass and supplies the most desirable roasts. Ribs are graded upon the basis of thickness, covering, and quality. The rib from the immature steer graded as No. 1, while the rib from the mature steer graded as No. 2. Table 8 shows the weights and percentages of lean, fat and bone in the rib roasts.

TABLE 8.—LEAN, VISIBLE FAT, AND BONE IN RETAIL CUTS OF RIB IN POUNDS AND PERCENTAGES

Retail cuts of rib	Pounds				Per cent			
	Lean	Fat	Bone	Total	Lean	Fat	Bone	Total
Immature steer								
Roast								
11th-12th ribs.....	2.24	2.06	.67	4.97	45.07	41.45	13.48	100.00
9th-10th ribs.....	2.92	1.79	.88	5.59	52.24	32.02	15.74	100.00
8th rib.....	1.47	.89	.50	2.86	51.40	31.11	17.48	99.99
6th-7th ribs.....	4.31	2.28	1.05	7.64	56.41	29.84	13.74	99.99
Entire rib.....	10.94	7.02	3.10	21.06	51.95	33.33	14.72	100.00
Loss.....	-----	-----	-----	.44	-----	-----	-----	-----
Mature steer								
Roast								
11th-12th ribs.....	5.19	4.59	1.90	11.68	44.43	39.30	16.27	100.00
9th-10th ribs.....	5.72	3.59	2.25	11.56	49.48	31.06	19.46	100.00
8th rib.....	4.47	1.56	1.40	7.43	60.16	21.00	18.84	100.00
6th-7th ribs.....	8.64	4.22	2.78	15.64	55.24	26.98	17.77	99.99
Entire rib.....	24.02	13.96	8.33	46.31	51.87	30.14	17.99	100.00
Loss.....	-----	-----	-----	.32	-----	-----	-----	-----

**The Round.**—Three wholesale cuts for the fresh meat trade are made from the round, the buttock, rump, and shank. On the average, about 60 per cent of the entire weight is buttock, 20 per cent rump, and 20 per cent shank.<sup>10</sup> The buttock is cut almost exclusively into steaks; the rump is used for roasts and boiling meat; and soup bones are secured from the shank. The round from the immature steer graded No. 1; the round from the mature steer graded No. 2.

TABLE 9.—LEAN, VISIBLE FAT, AND BONE IN RETAIL CUTS OF ROUND IN POUNDS AND PERCENTAGES

Retail cuts of round	Pounds				Per cent			
	Lean	Fat	Bone	Total	Lean	Fat	Bone	Total
Immature steer								
Rump roast.....	7.02	3.50	2.38	12.90	54.42	27.13	18.45	100.00
Round steak								
Cut 1.....	1.72	.38	.22	2.32	74.14	16.38	9.48	100.00
Cut 2.....	1.73	.31	.16	2.20	78.64	14.09	7.27	100.00
Cut 3.....	1.55	.22	.05	1.82	85.16	12.09	2.75	100.00
Cut 4.....	1.66	.31	.09	2.06	80.58	15.05	4.37	100.00
Cut 5.....	1.91	.31	.08	2.30	83.04	13.48	3.48	100.00
Cut 6.....	1.84	.41	.08	2.33	78.97	17.60	3.43	100.00
Cut 7.....	2.03	.48	.09	2.60	78.08	18.46	3.46	100.00
Cut 8.....	1.84	.50	.09	2.43	75.72	20.58	3.70	100.00
Cut 9.....	2.33	.47	.06	1.86	71.51	25.27	3.23	100.01
Cut 10.....	1.48	.44	.06	1.98	74.75	22.22	3.03	100.00
Cut 11.....	1.38	.46	.07	1.91	72.25	24.08	3.66	99.99
Cut 12.....	1.38	.41	.16	1.95	70.77	21.03	8.21	100.01
Cut 13.....	1.09	.25	.40	1.74	62.64	14.37	22.99	100.00
Cut 14 (Last).....	1.02	.28	.22	1.52	67.11	18.42	14.47	100.00
Pot roast—Heel of round.....	3.55	1.04	1.80	6.39	55.55	16.28	28.17	100.00
Hock soup bone.....	.58	.98	1.08	2.64	21.97	37.12	40.91	100.00
Knuckle soup bone.....	.21	1.13	1.39	2.73	7.69	41.39	50.92	100.00
Soup bone.....	.92	.13	.38	1.43	64.34	9.09	26.57	100.00
Soup bone.....	.38	.58	1.10	2.06	18.45	28.16	53.40	100.01
Entire round.....	34.62	12.59	9.96	57.17	60.56	22.02	17.42	100.00
Mature steer								
Rump roast.....	15.25	8.69	5.36	29.30	52.04	29.66	18.29	99.99
Round steak								
Cut 1.....	2.22	.39	.17	2.78	79.86	14.03	6.11	100.00
Cut 2.....	2.71	.53	.25	3.49	77.65	15.19	7.16	100.00
Cut 3.....	1.52	.38	.22	2.12	71.70	17.92	10.38	100.00
Cut 4.....	2.25	.38	.13	2.76	81.52	13.77	4.71	100.00
Cut 5.....	2.72	.61	.06	3.39	80.24	17.99	1.77	100.00
Cut 6.....	2.84	.75	.11	3.70	76.76	20.27	2.97	100.00
Cut 7.....	2.83	.69	.11	3.63	77.96	19.00	3.03	99.99
Cut 8.....	2.44	.69	.13	3.26	74.85	21.17	3.99	100.01
Cut 9.....	2.31	.69	.13	3.13	73.80	22.04	4.15	99.99
Cut 10.....	2.25	.86	.13	3.24	69.44	26.54	4.01	99.99
Cut 11.....	2.14	.72	.13	2.99	71.57	24.08	4.35	100.00
Cut 12.....	2.34	.72	.16	3.22	72.67	22.36	4.97	100.00
Cut 13.....	2.06	.50	.13	2.69	76.58	18.59	4.83	100.00
Cut 14.....	2.34	.56	.25	3.15	74.29	17.78	7.93	100.00
Cut 15 (Last).....	2.16	.75	.56	3.47	62.25	21.61	16.14	100.00
Pot roast—Heel of round.....	6.16	1.69	2.75	10.60	58.11	15.94	25.94	99.99
Hock soup bone.....	.63	1.58	2.72	4.93	12.78	32.05	55.17	100.00
Knuckle soup bone.....	.28	1.78	2.50	4.56	6.14	39.04	54.82	100.00
Soup bone.....	1.38	.19	.89	2.43	56.79	7.82	35.39	100.00
Soup bone.....	.69	.78	2.00	3.47	19.88	22.48	57.64	100.00
Entire round.....	59.52	23.93	18.86	102.31	58.18	23.43	18.43	100.00

Table 9 shows the amount and percentages of lean, fat, and bone contained in the retail cuts of the round.

**The Chuck.**—The chuck, secured from the forequarter, is the largest wholesale cut, and is not high priced. Steaks, roasts, and boiling meat are secured from it. The chuck from the immature steer was plump, covered with fat, and graded as No. 1. The chuck from the mature steer was not as well covered with fat, and the lean meat was not bright enough in color. It graded as No. 2. The amount and the percentages of lean, fat, and bone in the retail chuck cuts is given in Table 10.

TABLE 10.—LEAN, VISIBLE FAT, AND BONE IN RETAIL CUTS OF CHUCK IN POUNDS AND PERCENTAGES

Retail cuts in chuck	Pounds				Per cent			
	Lean	Fat	Bone	Total	Lean	Fat	Bone	Total
<b>Immature steer</b>								
5th rib roast.....	3.25	1.75	1.25	6.25	52.00	28.00	20.00	100.00
4th rib roast.....	3.19	1.94	1.91	7.04	45.31	27.56	27.13	100.00
1st pot roast.....	4.56	2.31	.69	7.56	60.32	30.56	9.13	100.00
2nd pot roast.....	5.88	3.66	1.78	11.32	51.94	32.33	15.72	99.99
1st roast.....	5.06	1.19	1.44	7.69	65.80	15.47	18.73	100.00
2nd roast.....	4.78	.97	1.09	6.84	69.88	14.18	15.94	100.00
3rd roast.....	4.03	1.13	.88	6.04	66.72	18.71	14.57	100.00
4th roast.....	3.16	2.00	.65	5.81	54.39	34.43	11.19	100.00
Neck.....	2.72	.66	.60	3.98	68.34	16.58	15.08	100.00
Entire chuck.....	36.63	15.61	10.29	62.53	59.02	25.15	16.58	100.00
Loss.....	-----	-----	-----	†.46	-----	-----	-----	†.74
<b>Mature steer</b>								
5th rib roast.....	7.60	2.38	1.84	11.82	64.30	20.14	15.56	100.00
4th rib roast.....	7.19	2.91	1.97	12.07	59.57	24.11	16.32	100.00
1st Pot roast.....	11.69	3.44	2.03	17.16	68.12	20.05	11.83	100.00
2nd Pot roast.....	9.13	4.03	2.56	15.72	58.08	25.64	16.28	100.00
1st roast.....	11.00	1.23	2.66	14.89	73.88	8.26	17.86	100.00
2nd roast.....	13.89	1.56	3.41	18.86	73.65	8.27	18.08	100.00
3rd roast.....	9.44	2.86	4.66	16.96	55.16	16.86	27.47	99.99
4th roast.....	13.44	1.59	3.28	18.31	66.82	15.23	17.96	100.01
Neck.....	4.91	2.06	.66	7.63	64.35	27.00	8.65	100.00
Entire chuck.....	88.29	21.06	23.07	132.42	66.23	15.80	17.31	99.34
Loss.....	-----	-----	-----	.89	-----	-----	-----	.66

**The Plate.**—The plate is one of the cheaper cuts of the carcass that is used largely for stews, hamburger, corned beef, and for boiling purposes. Its value and grade depend upon the thickness of the cut, proper proportion of lean and fat, and quality of the bone.<sup>11</sup> The plate from the immature carcass graded No. 1, and the plate from the mature carcass graded No. 2. The amount and per cent of lean, fat, and bone in these cuts is shown in Table 11.

**The Flank.**—The value and grade of the flank depends chiefly upon the thickness and quality of the lean and fat. The flanks from these carcasses graded No. 1. Table 12 shows the amount and per cent of lean, fat, and bone found in them.

11. Hall—Illinois Agricultural Experiment Station Bulletin 147, page 205.

**The Shank.**—The shanks are used largely for soup bones, or the meat may be trimmed from the bone and used as stews, or hamburger. As a rule shanks are not graded. The composition of the shank is shown in Table 13.

TABLE 11.—LEAN, VISIBLE FAT, AND BONE IN PLATE EXPRESSED IN POUNDS AND PERCENTAGES

Plate cuts	Pounds				Per Cent			
	Lean	Fat	Bone	Total	Lean	Fat	Bone	Total
Immature steer								
Brisket end.....	4.27	4.86	1.25	10.38	41.14	46.82	12.04	100.00
Navel end.....	6.31	7.77	1.70	15.78	39.99	49.24	10.77	100.00
Entire plate.....	10.58	12.63	2.95	26.16	40.44	48.28	11.28	100.00
Mature steer								
Brisket end.....	7.99	7.59	2.95	18.53	43.12	40.96	15.92	100.00
Navel end.....	16.24	14.49	4.81	35.54	45.69	40.77	13.53	99.99
Entire plate.....	24.23	22.08	7.76	54.07	44.81	40.84	14.35	100.00

TABLE 12.—LEAN, VISIBLE FAT, AND BONE IN FLANK EXPRESSED IN POUNDS AND PERCENTAGES

Retail cuts in flank	Pounds				Per cent			
	Lean	Fat	Bone	Total	Lean	Fat	Bone	Total
Immature steer								
Stew meat.....	2.28	3.88	-----	6.16	37.01	62.99	-----	100.00
Flank steak.....	2.47	-----	-----	2.47	100.00	-----	-----	100.00
Trimmings.....	-----	6.00	-----	6.00	-----	100.00	-----	100.00
Entire flank.....	4.75	9.88	-----	14.63	32.47	67.53	-----	100.00
Mature steer								
Stew meat.....	5.44	11.72	.28	17.44	31.19	67.20	1.61	100.00
Flank steak.....	3.50	-----	-----	3.50	100.00	-----	-----	100.00
Trimmings.....	-----	6.25	-----	6.25	-----	100.00	-----	100.00
Entire flank.....	8.94	17.97	.28	27.19	32.88	66.09	1.03	100.00

TABLE 13.—LEAN, VISIBLE FAT, AND BONE IN SHANK EXPRESSED IN POUNDS AND PERCENTAGES

Retail cuts in shank	Pounds				Per cent			
	Lean	Fat	Bone	Total	Lean	Fat	Bone	Total
Immature steer								
Top shank.....	2.33	.97	1.04	4.34	53.69	22.35	23.96	100.00
Elbow joint.....	1.58	.30	.98	2.86	55.24	10.49	34.27	100.00
Soup bone.....	1.12	.17	.36	1.65	67.88	10.30	21.82	100.00
Soup bone.....	.02	.25	1.21	1.48	1.35	16.89	81.76	100.00
Entire shank.....	5.05	1.69	3.59	10.33	48.89	16.36	34.75	100.00
Mature steer								
Top shank.....	3.12	1.04	1.46	5.62	55.52	18.51	25.98	100.01
Elbow joint.....	2.14	.49	1.54	4.17	51.32	11.75	36.93	100.00
Soup bone.....	2.61	.06	.72	3.39	76.99	1.77	21.24	100.00
Soup bone.....	.58	.72	1.94	3.24	17.90	22.22	59.88	100.00
Entire shank.....	8.45	2.31	5.66	16.42	51.46	14.07	34.37	100.00

## CHEMICAL COMPOSITION

The analytical work on these beef carcasses was done by the Department of Agricultural Chemistry.

In preparing the samples the wholesale cuts were separated into lean, fat, and bone. The lean and fat were finely chopped, and mixed thoroughly with a meat cutter. The analyses, made from composite samples prepared in the above manner, are recorded in Table 14.

TABLE 14.—CHEMICAL COMPOSITION OF IMMATURE STEERS EXPRESSED IN PERCENTAGES

Name of Cut	Moisture	Fat	Protein (Nx6.25)	Ash	Moisture	Fat	Protein (Nx6.25)	Ash
Lean and fat of shin, shank, head and tail.....	53.956	28.728	17.063	0.756	57.877	23.645	18.000	0.799
Lean and fat of round....	66.165	14.757	18.750	0.957	62.780	19.583	16.875	0.866
Lean and fat of rump....	55.434	30.384	14.813	0.771	46.243	39.722	12.813	0.703
Lean and fat of loin....	52.373	31.191	15.188	0.779	47.779	37.806	13.125	0.720
Lean and fat of flank....	27.885	64.481	8.063	0.414	28.971	62.327	8.000	0.403
Lean and fat of ribs....	44.039	42.059	12.500	0.672	42.104	50.679	11.188	0.629
Lean and fat of plate....	38.907	50.271	10.750	0.514	38.827	49.024	11.063	0.552
Lean and fat of chuck....	55.625	28.519	14.000	0.713	56.818	26.490	15.125	0.774
Lean and fat of neck....	57.746	23.269	17.375	0.986	59.533	21.359	18.625	0.967

**Fuel Value.**—Meat is considered a desirable food, because of the protein, fat, and minerals or ash, which it contains. Protein plays a dual role in nutrition, in that it serves as building material (its chief function), and as a source of energy after being catabolized in the body. "Protein tissues and their substances must be built up in the growing animal and maintained in the mature one, and for this purpose only proteins or their cleavage products can be utilized, and their presence in the feed is indispensable."<sup>12</sup>

"In the case of fats the energy-bearing function is the predominant and obvious one. Fats are a concentrated form of fuel, containing much more energy per unit than any of the other nutrients. They supply much energy in a small bulk and are, therefore, well adapted for the storage of reserve energy in the body."<sup>13</sup>

The ash ingredients "introduce practically no available energy into the organism but, on the other hand, they are not only essential structural components of the body tissue but likewise supply and maintain certain conditions indispensable to the performance of the bodily functions."<sup>14</sup>

Table 15 shows the cost per pound of boneless meat, cost per pound of protein, fuel value or energy per pound of boneless meat, and the cost of 1000 calories in boneless meat. The energy values assigned to fat and protein by Lusk<sup>15</sup> were used in determining the calorific content of a pound of meat.

12. Armsby—Nutrition of Farm Animals, page 185.

13. Armsby—Nutrition of Farm Animals, page 186.

14. Armsby—Nutrition of Farm Animals, page 187.

15. Lusk—Science of Nutrition—Third Edition, page 42.

TABLE 15\*.—COST OF BONELESS MEAT AND FUEL VALUE OF THE VARIOUS WHOLESALE CUTS OF THE IMMATURE STEER AND MATURE STEERS

Wholesale cuts	Retail price per pound	Cost per pound of boneless meat (cents)	Cost of 1 pound of protein in boneless wholesale cuts (cents)	Calories per pound of boneless meat	Cost of 1000 calories in boneless meat (cents)
Immature steer					
Loin.....	.40	43.9	289.04	1598.204	27.4
Rib.....	.25	29.3	234.27	2006.675	14.6
Round.....	.35	38.9	207.45	971.204	40.0
Chuck.....	.225	26.9	192.14	1463.401	18.3
Flank.....	.20	20.	248.03	2870.007	6.9
Plate.....	.15	16.9	157.20	2320.544	7.2
Neck.....	.20	23.5	135.25	1304.702	18.0
Rump.....	.30	36.7	247.74	1557.194	23.5
Mature steer					
Loin.....	.40	46.2	352.00	1838.873	25.1
Rib.....	.25	30.4	271.71	1984.174	15.3
Round.....	.35	42.9	254.20	1139.913	37.6
Chuck.....	.225	27.4	181.15	1398.732	19.5
Flank.....	.20	20.2	252.49	2777.920	7.2
Plate.....	.15	17.5	158.18	2273.762	7.6
Neck.....	.20	21.8	117.04	1247.377	17.4
Rump.....	.30	36.7	286.42	1913.949	19.1

\*The above table shows that, excepting the neck and rump, the immature carcass furnished boneless meat more economically per pound than did the mature carcass. The mature carcass furnished more calories per pound of boneless meat. Assuming the same retail price per pound for the meat from the two carcasses, the mature carcass supplied calories at a lower cost.

## COOKING TEST

After an aging period of ten days, prime rib roasts comprising the 9th, 10th and 11th ribs were cut from the left side of each carcass following the outline given in the co-operative project "A Study of Factors Which Influence the Quality and Palatability of Meat" (first edition).

TABLE 16.—COOKING DATA IN COMPARISON OF COOKED PRIME RIB ROASTS FROM MATURE AND IMMATURE CARCASSES

	Immature carcass	Mature carcass
Aging period (days).....	10	10
Initial weight.....	8 lbs. 12 oz.	16 lbs. 8 oz.
Final weight.....	7 lbs. 2 oz.	11 lbs. 14 oz.
Total loss (pounds).....	1 lb. 10 oz.	4 lbs. 10 oz.
Total loss (per cent).....	18.5 per cent	28.0 per cent
Weight of drippings.....	13 oz.	2 lbs. 13 oz.
Searing temperature 1 hour.....	500°F. (260°C.)	500°F. (260°C.)
Roasting temperature.....	250°F. (121.11°C.)	250°F. (121.11°C.)
Total time for cooking.....	2 hr. 55 min.	3 hr. 55 min.
Time for cooking per pound of meat.....	20	15
Temperature of meat when placed in oven.....	35.6°F. (2°C.)	39.2°F. (4°C.)
Temperature of meat when taken from oven.....	140°F. (60°C.)	140°F. (60°C.)
Maximum internal temperature of meat after removal from oven.....	149°F. (65°C.)	158°F. (70°C.)

The roasts were cooked under as nearly identical conditions as possible. They were seared at a temperature of 500°F. (260°C.) until they attained a well-finished, golden brown appearance. After the searing was completed, the temperature of the oven was reduced to 250°F. (121.11°C.). The roasts were left in the oven until the internal temperature reached 140°F. (60°C.), then permitted to stand until the maximum internal temperature was reached. They were then carved and judged both hot and cold, without seasoning. The outline in the above report was followed in judging the quality and palatability of the meat.

The judges, two women from the Department of Home Economics and four men from the Department of Animal Husbandry were unanimous in scoring the roast from the mature carcass higher on aroma, color, flavor, and juiciness than the roast from the immature carcass. The two roasts were thought to be about equal in tenderness.

### GENERAL SUMMARY

The mature carcass produced a slightly higher percentage of forequarter, and consequently a smaller percentage of hindquarter than did the immature carcass. The forequarter of the mature carcass contain 5.55 per cent more lean, 6.93 per cent less fat, and 1.38 per cent more bone. The hindquarter of the immature carcass contained 4.43 per cent more lean, 3.26 per cent less fat and 1.18 per cent less bone.

Considering the entire carcass, the mature steer produced 0.75 per cent more lean, 2.05 per cent less fat and 1.36 per cent more bone.

The immature carcass produced a higher percentage of round, loin, and foreshank than did the mature carcass. The mature carcass produced a higher percentage of rib and chuck.

In the immature carcass the neck contained the highest percentage of lean followed in order by the round and loin. In the mature carcass the chuck produced the highest percentage of lean followed in order by the neck and loin. The plate of the immature carcass carried considerably more fat than the plate of the mature carcass. The greatest variation in the physical composition of the wholesale cuts was found in the chuck, neck and flank.

The loin from the immature carcass contained 1.70 per cent less lean, 5.26 per cent more fat and 5.56 per cent less bone than the loin from the mature carcass. On the average the sirloin steaks contained more lean and less fat than did the porterhouse or club steaks.

The ribs from the mature steer contained less fat and more bone than the ribs from the immature steer. Very little difference was found in the physical composition of the rounds from the two carcasses.

The chemical analyses showed that the carcass of the immature steer contained a higher percentage of moisture and protein and the

mature carcass contained a higher percentage of fat. The physical analyses showed that the immature carcass contained a higher percentage of fat. This difference demonstrates conclusively that the mature carcass possessed superior marbling.

Excepting the neck and rump, the immature carcass furnished boneless meat more economically per pound than did the mature carcass. The mature carcass furnished more calories per pound of boneless meat at a lower cost. The cost per pound of protein was greatest when the meat was taken from the mature carcass.

The prime rib roast from the mature carcass shrank 28 per cent when roasted and lost considerably more fat in the form of drippings than did the roast from the immature carcass which shrank 18.5 per cent.

The roast from the mature carcass was superior in aroma, color, flavor, and juiciness. The two roasts were thought to be about equal in tenderness.

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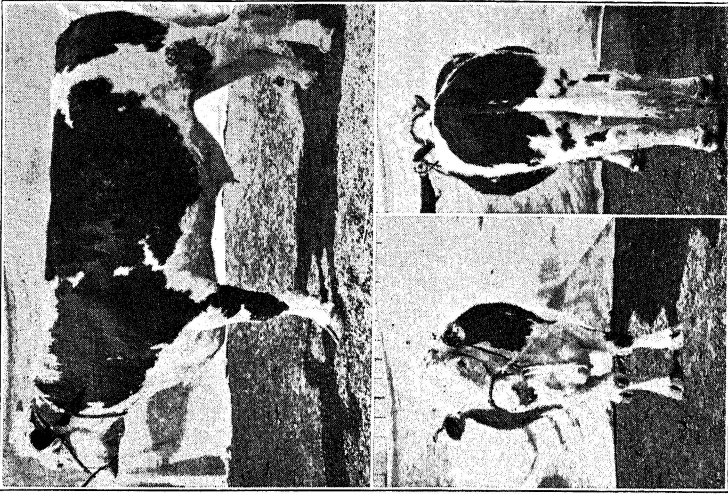


Fig. 4.—Mature steer (side, front and rear views).



Fig. 3.—Immature steer (side, front and rear views)

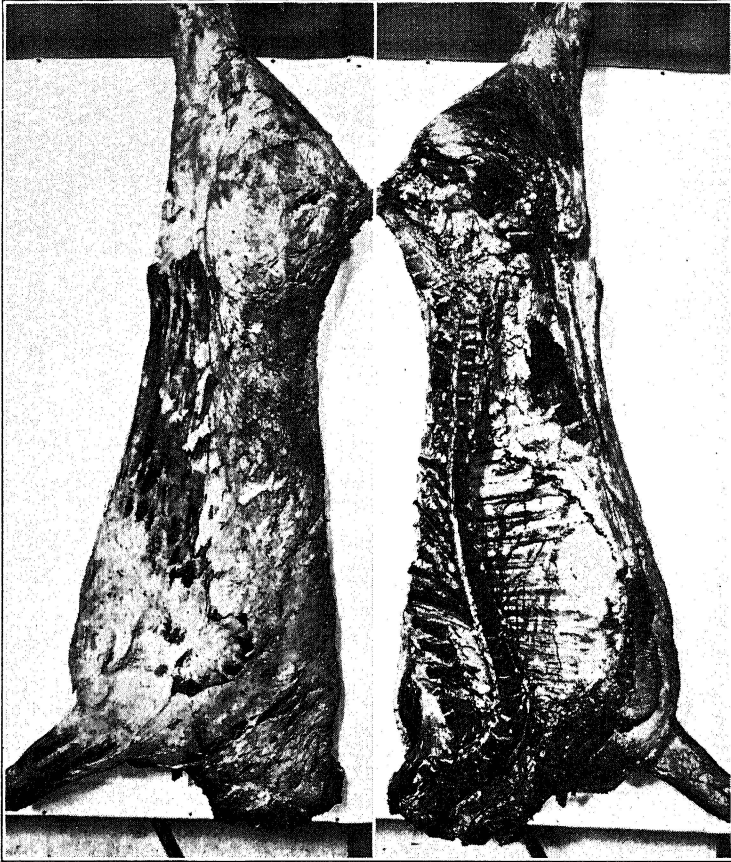


Fig. 5.—Immature carcass (outside and inside views).

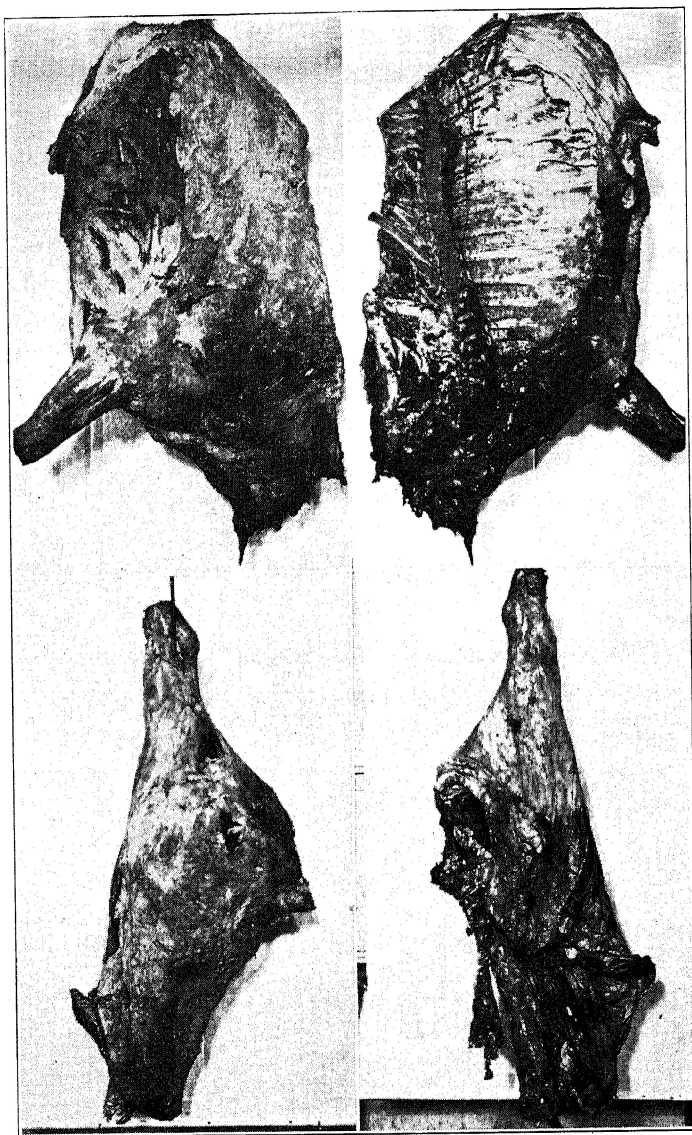


Fig. 6.—Mature carcass—outside and inside views of fore and rear quarters.



Fig. 7.—Loins of immature steer (above) and mature steer (below).

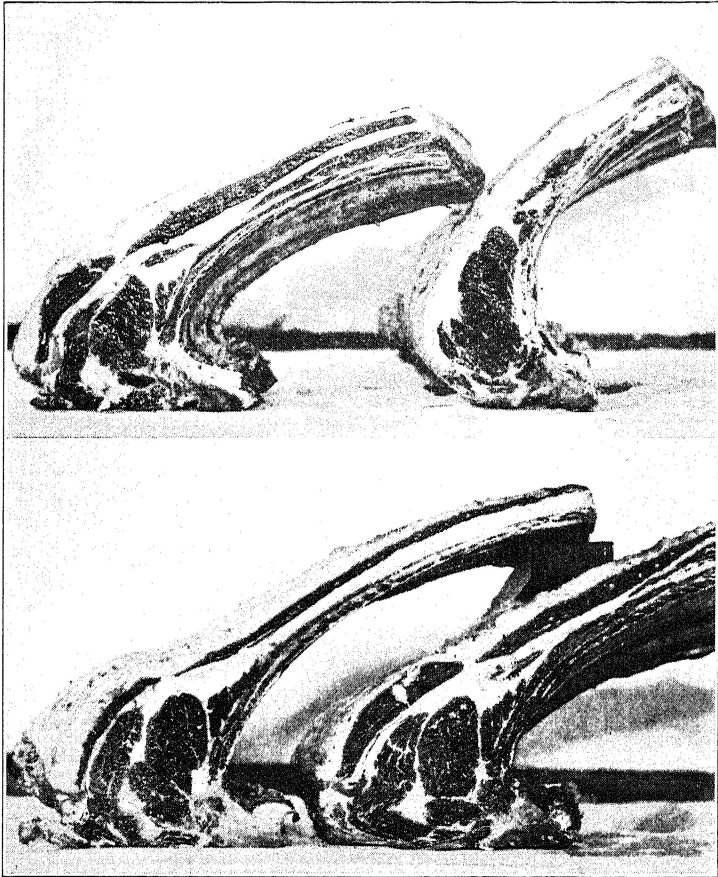


Fig. 8.—Rib cuts of immature steer (above) and mature steer (below).

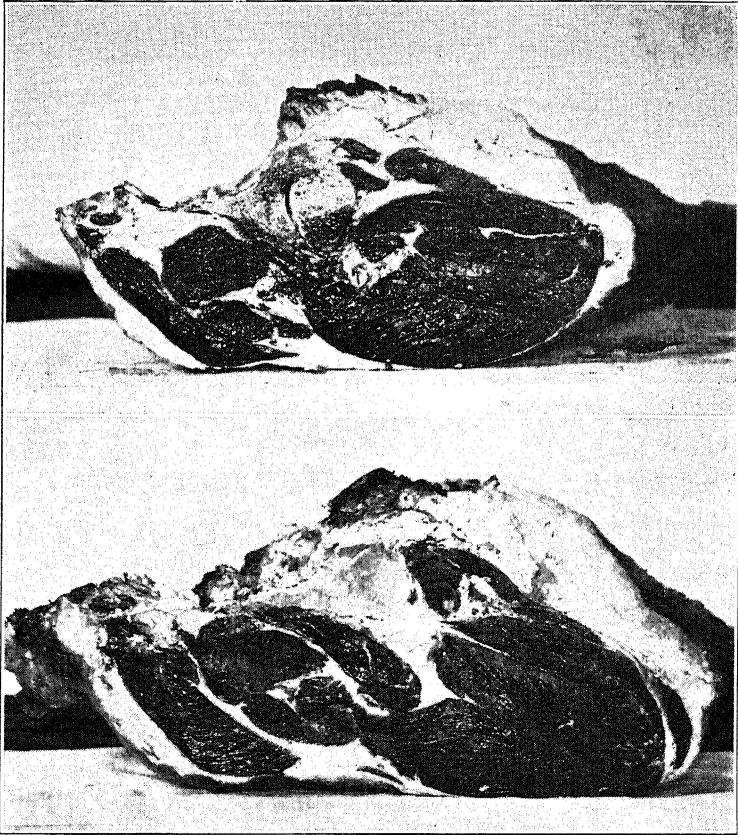


Fig. 9.—Round, R. and S. on, of immature steer (above) and mature steer (below)

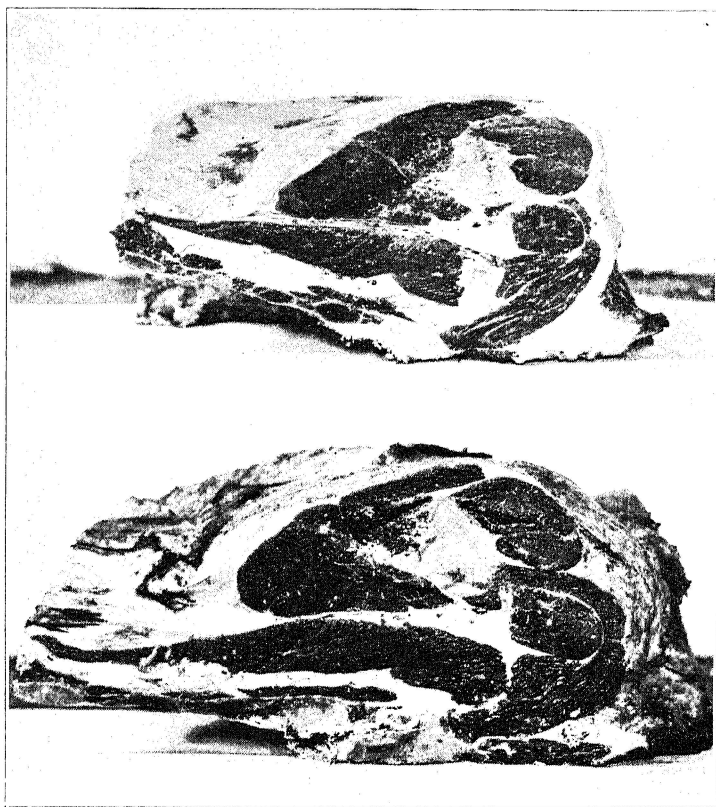


Fig. 10.—Chuck of immature steer (above) and mature steer (below).

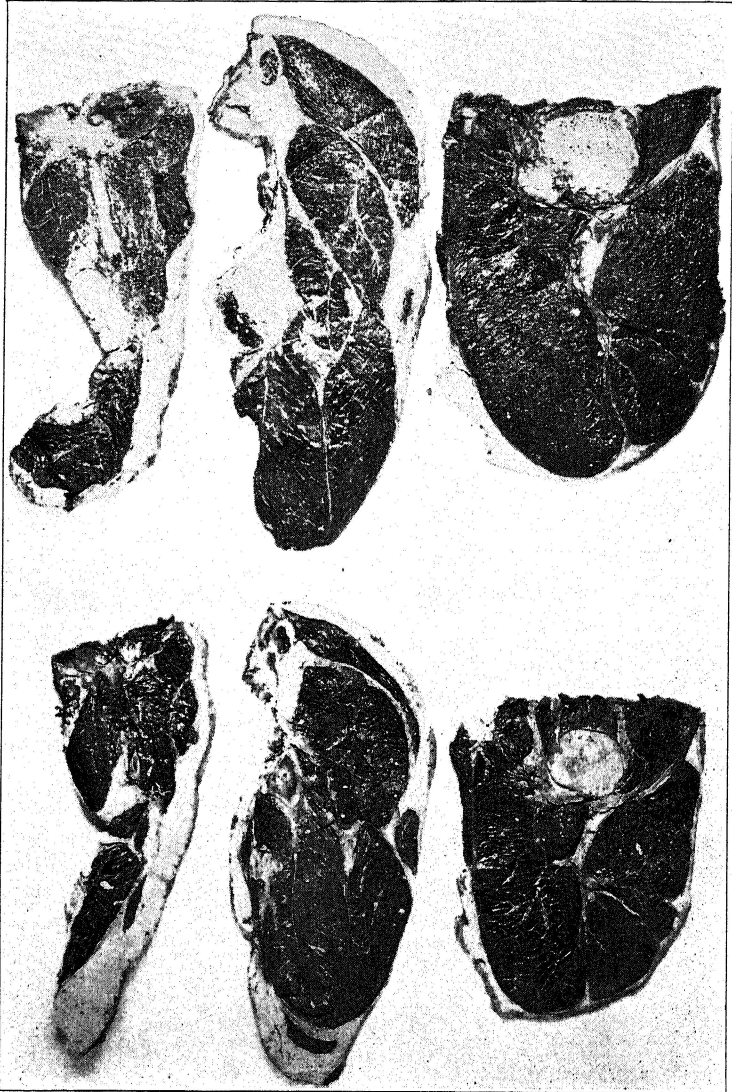


Fig. 11.—Porterhouse, sirloin, and round steaks of the immature (left) and mature (right) steers.