TO WHAT EXTENT DOES A STEER GROW DURING THE PROCESS OF FATTENING

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TO WHAT EXTENT DOES A STEER GROW DURING THE PROCESS OF FATTENING.

From the stock feeders point of view the question of how much flesh can be put on a steer in a given length of time is all important. Every pound of gain a steer makes means money to the feeder.

During the early life of a steer he grows very rapidly in all parts. The bones and muscles lengthen out and increase in size, the internal organs increase and from a birth-weight of less than one-hundred pounds, in twelve months the animal has increased to several hundred pounds.

This is but the result of nature and if properly fed and nourished to it's full capacity the steer attains the full size heredity intended it to have. A beef steer is usually considered marketably mature when it is from two to three years old. The bones, muscles and organs are then approximately normally developed. After this however, the muscles may be increased in size, fat may be deposited and a general filling out of the body take place when a sufficient ration is fed. This extra increase then is termed fattening. The fattening or finishing process is done for the demands of the market which require a well marbled meat. This can only be done by the extra fattening process, feeding the steer all he will eat for a length of time.

The amount of feed required during the growth of the animal in size is used for maintenance purposes and for growth.

When the growth and maintenance requirements are satisfied the next use of the food is to store up fat in various parts of the body for future needs. This fat may be stored up in many places. Fat may be layed on the outside of the muscles, between the muscles, in between the muscle fibers themselves, around the internal organs and in the skeleton.

With a steer which has had only enough feed to supply the maintenance requirement and that of growth we would expect to find little if any fat deposited in those various places.

DESCRIPTION OF THE STEERS AND PLAN OF THE EXPERIMENT.

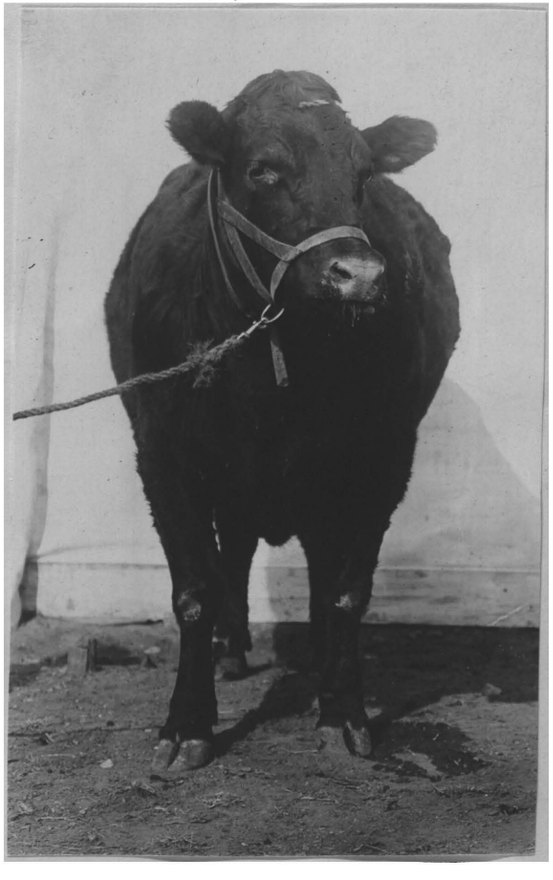
Three steers, numbered 18, 121, and 48 were chosen from the group of regular maintenance steers, on an experiment at the University of Missouri to find out the uses to which an animal puts it's food.

These three steers were taken as being about the same age, two and a half to three years, and therefore were considered as mature as steers generally are when marketed. They were all treated alike previous to the time they were started on this experiment. From the first of February 1907, they were fed varying amounts of feed so that at the time they were all alike in condition and weight they could be started on the experiment. They were all grade Shorthorns and were good representatives of a poor feeding type. Since all three steers were very nearly mature, about the same type and breed and

STEER No. 18.
WEIGHT 755.5 LBS.
MAINTENANCE
CHECK
ANIMAL

STEER No. 121.
WEIGHT 1255.5 LBS.
FULL FED
HALF FAT

STEER No. 48.
WEIGHT 1785. LBS.
FULL FED.
VERY FAT



about the same weight they might be considered as one animal fattened to different degrees. It was therefore thought desirable to study the extent a steer might grow during the process of fattening, the age factor thus being eliminated.

Steer No. 18 was chosen as the check animal or starting point to measure the growth of the other two steers, 121 and 48.

Steer No. 18 lived about two years and eight months. He was slaughtered November 12, 1907 having been on a strictly maintenance ration since July 1st, at which time steer No. 48 was put upon full feed. Steer No. 121 was put upon full feed July 11th, when his condition was judged to be the same as the others on July 1st. At this time the weights of the steers was as follows; No. 18, 755 pounds, No. 121, 770 pounds and No. 48, 850 pounds.

Steer No. 18 was kept on a maintenance ration one-hundred and thirty-five days, the final weight taken the morning of the slaughtering was 755.5 pounds. He had had no water since the afternoon before but had had his morning feed. This steer was used to base the measurement of growth of the other two steers, his weight having been practically constant all this period.

Steer No. 121 lived about thirty-seven months. He was fed one-hundred and fifty-three days on this experiment and on a fattening ration. He was slaughtered December 11, 1907 the initial weight of this steer was 770 pounds. After one-

STEER No. 18.

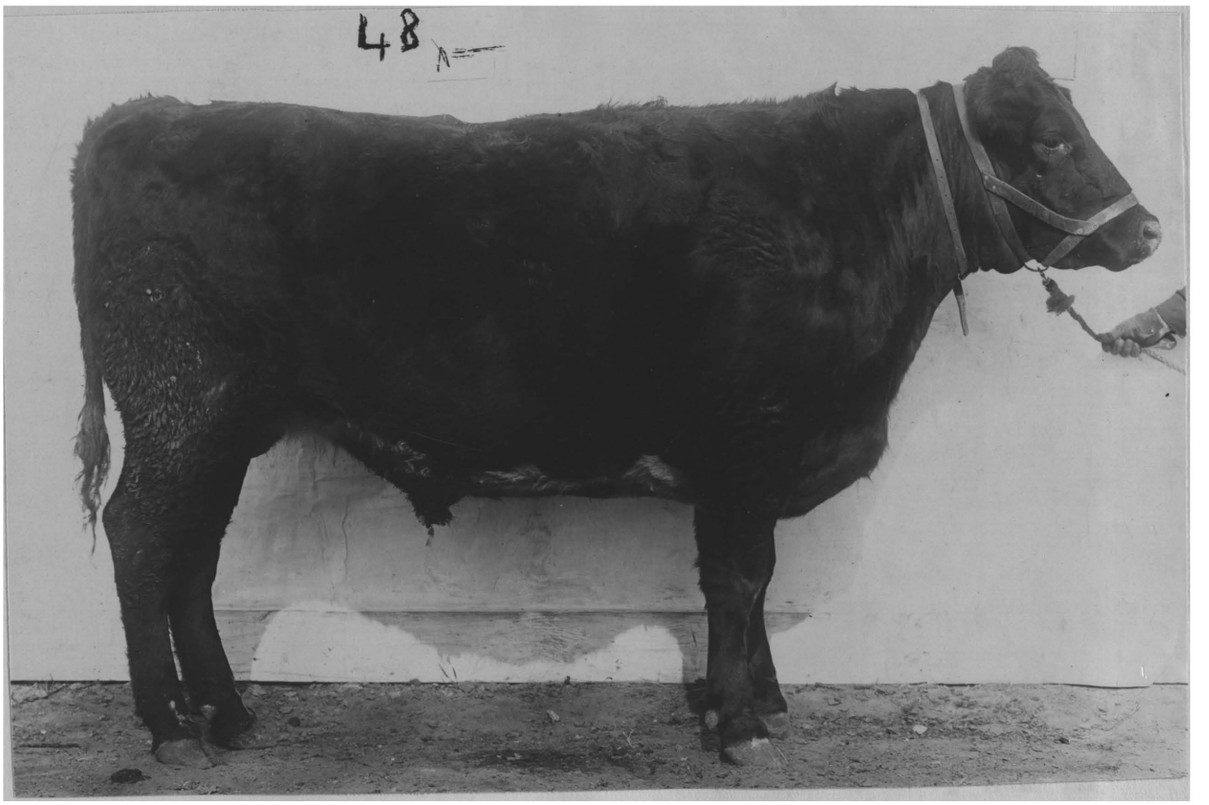
STEER No. 121.

hundred and fifty-three days feeding he gained 485.47 pounds. His final weight the morning of slaughtering was 1255.47 pounds. The gain of weight was due to the amount of ration fed, (see Table No. 1). This steer is considered to be the same as No. 18 would have been if fed to the same degree.

Steer No. 48 can be considered to be about the same as steer No. 18 would have been if fed to the same degree and as No. 121 if fed to the same degree. He was some heavier at the beginning of the full feeding, but in about the same condition. This steer No. 48 lived about four years and ten months. He was slaughtered January 18, 1909 having been fed five-hundred and sixty-eight days. During this time he gained 935 pounds. His initial weight was 850 pounds and the final weight the morning of slaughtering was 1785 pounds.

The gain in weight, grain and hay fed and consumed are given in Table No. 1. The grain fed in all cases was corn chop, eight parts and linseed meal one part, and the hay, alfalfa which was always 0.4 as much as the grain. One-half the grain and all the hay was fed at night. The balance of the grain was fed in the morning. The animals had free access to salt and water during the entire day after the morning feed and weights were taken, until the night feed.

STEER No. 48.



STEER No. 48.

CROSS SECTION OF RIB BETWEEN 5th & 6th RIBS. LOOKING AT 6th. CHUCK END.

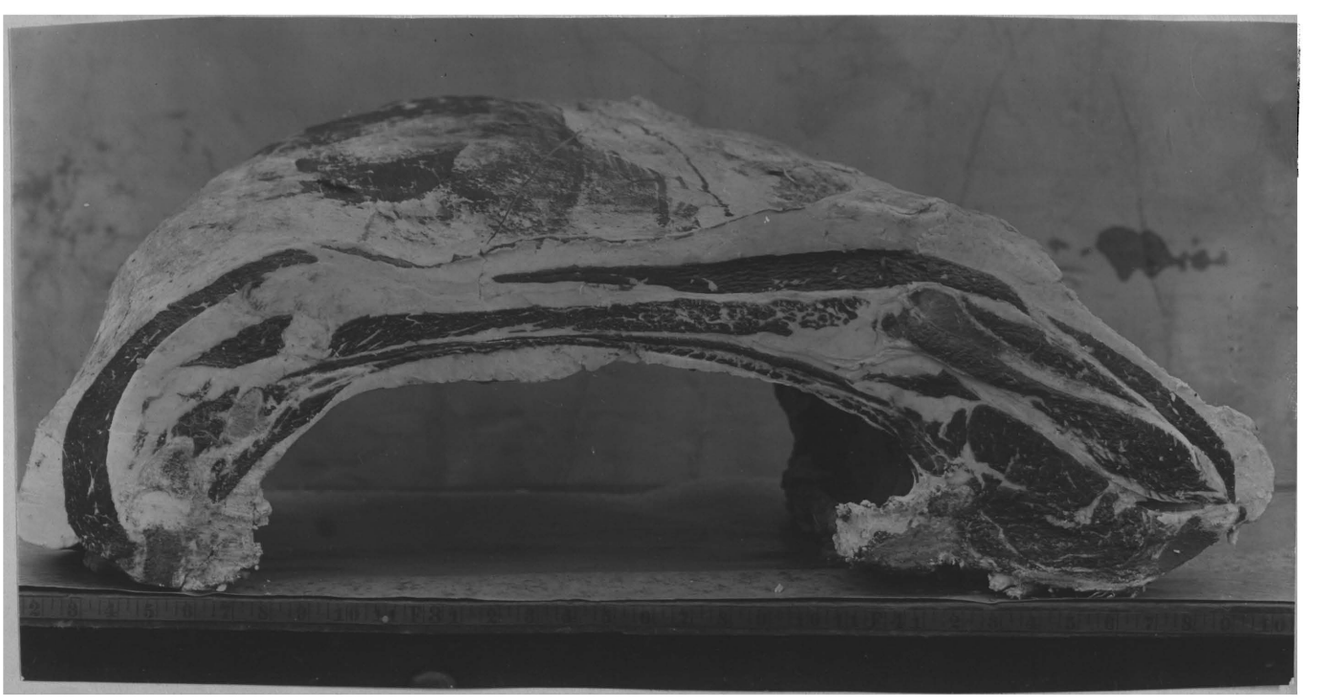


TABLE NO. 1.

o. f teer	Initial weight pounds	Final weight pounds	No. of days fed	Total gainin weight for period pounds	Total grain fed in the period pounds	Total grain consumed in the period pounds	Total hay fed in the period pounds	Total hay consumed in the period pounds
18	755.0	755.5	135	0.5	706.5	706.5	286.0	286.0
121	777.0	1255.5	153	478.5	2888.7	2817.7	1167.0	1104.3
48	850.0	1785.0	568	935.0	7537.7	7277.4	2986.9	2953.0

It will be noticed that with steer No. 18, five pounds of grain and two pounds of hay were required to keep him in maintenance. Therefore all feed above this amount must be used to increase the body parts or to be laid on in the form of fat.

Steer No. 121 consumed 18.42 pounds of grain and 7.22 pounds of hay per day and gained 478.47 pounds in weight for the one-hundred and fifty-three days or 3.12 pounds gain in live weight per day.

Steer No. 48 consumed about 12.81 pounds of grain per day and 5.20 pounds of hay per day. This steer made an average gain of 1.65 pounds per day. The total gain made was 935 pounds. This total gain required a very long time to be put on this animal. It was not an economical gain at all and the steer would have been slaughtered long before if he could have been gotten into the desired condition. He was sick and

had a bad cough after coming out of the digestion trial all of which showed up badly on his average gain per day.

To understand where this growth takes place and in what form is the object of this investigation.

METHODS EMPLOYED.

The slaughter house was thoroughly cleaned and the animals slaughtered on the cement floor so that any loss in handling could easily be recovered. An expert butcher from Kansas City did all the slaughtering and dressing of the carcass and another expert from the same place did all the cutting up of the carcass. This insured uniformity in the parts when weighed. All weights were taken as quickly as possible to prevent loss by evaporation.

The animal was killed, the bleeding done at once and the blood caught in a pan and weighed at once. The offal parts were then removed and after being cleaned were ground up as soon as possible in the meat grinder. The second day after the slaughtering, the chilled carcass was cut up into the wholesale market cuts. The weights were taken as soon as possible and then separated into lean, fat and bone by hand. The weights of each of these separated parts was also taken. In several cases the different samples have been composited and ground up together, the sample for analysis being taken from this composite.

The weights of the different cuts are found on Table No.2.

TABLE NO. 2.

Cut or Organ	Steer No. 18 Weight Pounds	Steer No. 121 Weight Pounds	Steer No. 48 Weight Pounds	Gain of No. 121 over No. 18. Pounds	Gain of No. 121 over No. 18. Percent	Gain of No. 48 over No. 121 Pounds	Gain of No. 48 over No. 121. %	Gain of No. 48 over No. 18. Pounds	Gain of No. 48 over No. 18. Percent
Live Animal	755.50	1255.47	1785.00	499.97	66.18	529.53	42.18	1029.50	136.27
Shanks	17.75	20.73	25.48	2.98	16.79	4.75	22.91	7.73	43.55
Rounds	85.00	129.68	168.62	44.68	52.56	38.94	30.03	83.62	98.38
Rumps	15.50	26.29	43.24	10.79	69.61	16.95	64.47	27.74	178.97
Loins	73.00	135.50	211.66	62.50	85.62	76.16	56.21	138.66	189.95
Flanks	10.79	19.20	56.28	8.41	77.94	37.08	193.12	45.49	421.59
Kidney and Kidney Fat	7.01	18.45	40.56	11.44	163.20	22.11	119.83	33.55	478.60
Sum equals Hindquarters	209.05	349.85	545.84	140.80	67.35	195.99	56.02	336.79	161.10
Ribs	41.50	76.60	129.40	35.10	84.58	52.80	68.93	87.90	211.81
Chucks	117.50	174.76	262.00	57.26	48.73	87.24	49.92	144.50	123.98
Necks	7.00	7.96	10.66	0.96	13.71	2.70	33.92	3.66	52.29
Shins	23.00	33.99	35.16	10.99	47.78	1.17	3.44	12.16	52.87
Plates	49.00	118.02	160.60	69.02	140.83	42.58	36.08	111.60	227.76
Sum equals Forequarters	237.99	411.33	597.82	173.34	72.83	186.49	45.34	359.83	151.20
Head meat	7.50	8.90	9.56	1.40	18.67	0.66	7.42	2.06	27.47
Brain	0.92	0.94	0.98	0.02	2.17	0.04	4.26	0.06	6.52
Tongue Marketable	3.29	4.11	5.24	0.82	21.88	1.13	27.49	1.95	59.27
Heart	3.30	4.69	5.67	1.39	42.12	0.98	20.90	2.37	71.82
Liver	5.79	15.51	18.00	9.72	167.88	2.49	16.05	12.21	210.88
Sweetbread	----	2.45	2.58	----	-----	0.13	5.31	----	------
Tail	1.42	1.63	1.82	0.21	14.93	0.19	11.66	0.40	28.17
Offal fat	12.57	60.35	136.33	47.78	380.11	75.98	125.73	123.76	984.57
Hide	56.60	65.39	90.75	8.79	14.53	25.36	38.78	34.15	60.34
Sum equals miscellaneous	91.39	163.97	270.93	72.58	79.42	106.96	65.23	179.54	196.45
Marketable Carcass	538.43	925.15	1414.59	386.72	71.82	489.44	52.90	876.16	162.72

METHODS EMPLOYED IN CHEMICAL ANALYSES.

Determination of Moisture and Fat in Samples of Meat.

1. Preparation of the Sample.

The cut or cuts from which the sample was taken were weighed in tared containers, cut in small pieces and ground in the Enterprise meat grinder through three or four different sized plate holes. Samples were mixed very thoroughly between each grinding and quartered down if the sample was large. After many mixings to secure a fairly uniform sample a pint to a quart of the meat was placed in a glass jar and after proper labeling sent to the laboratory or the cooler until needed.

2. Preparation of the Moisture and Fat Tubes.

(a) S & S extraction shells were filled about one-third full of ignited sea sand and absorbent cotton was then stuffed in until the tube was about three-fourths full. Each tube was numbered. The dry tubes were then placed in an electric oven at 100° to 150° C for five hours. These were then transferred to a vacuum desiccator which was then exhausted and allowed to stand for twenty-four hours with occasional ratation of the desiccator. The vacuum was then reduced by bubbling air through sulphuric acid. The desiccator was then opened and all the tubes were immediately transferred to the special tared weighing bottle as weighed.

(b) The glass extraction tubes were then fitted up for the fat samples by covering the bottom of the tube with hardened filter paper and wiring it on with a piece of aluminum wire. In the bottom of the tube was placed a small piece of absorbent cotton and sand and absorbent cotton above this as described above for S. & S. extraction tubes.

3. Weighing out the Sample.

The sample was very thoroughly mixed again and two weighing bottles nearly filled. An aluminum spatula was placed in each weighing bottle and the sample weighed out in triplicate. The extraction shells or glass tubes were assigned, three to each sample. Five grams of the sample was weighed out and placed in an evaporating dish, carefully mixed with the sand from the tube until the mass was homogenous. This was then transferred back to the tube and every particle of sand or sample left in the dish was wiped up clean with parts of the top plug of cotton that was in the tube. This was all put back into the tube again.

4. Determination of the Moisture.

(a) Six inch vacuum desiccators were used with tight joints all around. A medium heavy grease was used to seal the joints. About 200cc of c. p. sulphuric acid was placed in the bottom of each desiccator. Only one tube of any one sample was placed in the same desiccator. The air was then exhausted with a Geryk pump. At intervals of two or three hours the desiccators were rotated to mix the acid and water

but not so as to spatter it upon the plate or tubes. In forty-eight to sixty hours the vacuum was released and the tubes transferred to a desiccator which had fresh acid. After rotating every two or three hours for about two days the first dry weight was taken. The weighing was done as described under 2a.

The weighed tubes were then placed in a desiccator containing fresh acid and the above process repeated. The second weighing usually brought a loss of not more than five milligrams. If this was the case they were called dry and constant, if not the drying and weighing was continued until the loss was not more than five milligrams of the preceding weight.

5. Determination of the Fat.

After the tubes were dried to constant weight in the determination for moisture they were transferred to the Soxhlet extractor and extracted for sixteen to twenty-four hours with ether distilled over sodium. The ether was placed in the flask. When the extraction was complete the Soxhlet was drained and the tube transferred to the electric oven and dried at 50° C for an hour. The tubes were then placed in a vacuum desiccator and dried for twenty-four hours. The weight was then taken and the drying continued until the weight was constant. The loss in weight represents the amount of fat or ether soluble material present.

The Determination of Nitrogen in the Fresh Sample of Meat.

1. Preparation of the Sample.

The sample was prepared the same as for moisture and fat. See above.

2. Weighing out the Sample.

After the moisture and fat sample was weighed out of the weighing bottle, it was used at once for weighing out the samples for nitrogen. Triplicate samples of one gram each were weighed out in the case of lean meat and five grams if fat. Each was wrapped in a #595 S.& S. filter paper and transferred to a properly labeled nitrogen flask.

3. Digestion of the Sample.

As soon as possible after weighing out the sample, 25cc of c.p. sulphuric acid and 0.7 grams of mercury was added. The flask was put on the frame and digested until all frothing had ceased when about seven grams of nitrogen free potassium sulphate was added. The digestion was continued about two hours or until the liquid was colorless. The flasks were then cooled for fifteen to twenty minutes, the necks of the flasks rinsed down with distilled water after which they boiled for one hour more.

4. Distillation and Titration.

(a) Reagents.

1. Standard hydrochloric acid about tenth normal with factor expressed in weight of nitrogen represented

by one cubic centimeter.

2. Standard ammonium hydroxide about tenth normal expressed in terms of the hydrochloric acid.

3. Neutral alcoholic solution of cochineal for indicator.

4. Alkali solution containing 40 pounds Green Bank sodium hydroxide, 375 grams of potassium sulphide and thirty liters of nitrogen free distilled water.

(b) Distillation.

About 25cc of the standard HCL was drawn in 500cc wide mouth titrating flasks. About the same amount of distilled water added and one-half a cc of the cochineal indicator. The flask was then connected up with the condenser after recording the amount of acid used. The tube must dip into the acid. The nitrogen flask was filled about two-thirds full, of distilled water mixed thoroughly and a small piece of granulated zinc and a thin piece of paraffin added. Eighty-five cc of the sodium hydroxide mixture was then poured carefully down the neck of the flask and the flask then immediately connected up with the condenser. The flask was shaken and the burner lighted at once.

(c) Titration.

When the distillation was complete (volume about 250cc) the tube was disconnected and the burner turned out at the same time. The tube was rinsed out with distilled water into the receiving flask and with the standard ammonium hy-

droxide titration was made to the end reaction of orange to purple.

(d) Calculation of the Results.

Titration to get the factor of the ammonia in terms of the acid was done every day in triplicate. Multiply the cc of ammonia used by the factor to convert it into HCL equivalent.

Blank determinations were run on all the reagents. The amount of HCL neutralized by the blank is added to the HCL equivalent of the ammonia and the sum subtracted from the HCL used by titration. This difference represents the cc HCL consumed by the nitrogen as ammonia, in the sample. Multiply this number of cc by the weight of nitrogen represented by one cc to determine the weight of nitrogen in the sample. Multiply this weight by 100 and divide by the weight of the sample to determine the per cent of nitrogen.

Determination of the Ash and Total Phosphorus in Meat.

1. Preparation of the Sample.

This was done as described under moisture and fat.

2. Preparation of the Crucibles.

Porcelain crucibles (No. 1 for fat samples and No. 0 for lean samples) were numbered and ignited and weighed in advance.

3. Weighing of the Samples.

The second weighing bottle of the sample prepared for moisture and fat was used for this. Ten grams of lean, fifteen grams of fat were weighed out by difference into the crucibles. Triplicate weighings were made on all samples. As soon as possible the crucibles were placed in the electric oven and thoroughly dried at not exceeding 120° C (only 80° the first two hours).

4. Estimation of the Ash.

The dried sample was charred in the air with a Bunsen burner at low heat for several hours. The heat was gradually increased until the organic matter was completely oxidized. The heat never exceeded a dull red and the ash was not fused. The crucibles and ash were then placed in a desiccator, cooled and weighed. The per cent of ash was calculated to the fresh weight of sample.

5. Estimation of the Total Phosphrous.

After the ash work was completed each crucible was placed in a 200cc Jena Beaker properly marked. Enough nitric acid was added (sp. gr. 1.42) to fill the crucible, when 10cc of concentrated HCL was added and the beaker then heated on the water bath for two hours adding a little water. The ash was usually dissolved by this time, if not further digestion was required. The crucible was then rinsed off with distilled water. The contents of the beaker were neutralized with concentrated ammonium hydroxide. If the

volume was more than 100cc it was concentrated. A slight excess of concentrated HNO_3 and 100cc of ammonium molybdate were added and it was then heated to 65° C for one hour in an open water bath. It was then allowed to stand about two hours in a warm place. This was then filtered through Swedish filter paper and washed by decantation with a solution of 10 per cent ammonium nitrate. The original beaker containing part of the yellow precipitate was placed under the funnel and the precipitate on the funnel dissolved with 2.5 per cent strong ammonia and hot water.

The ammoniacal solution of the ammonium phospho-molybdate should not exceed 75cc. This was made nearly neutral with HCL. It was cooled and about 15cc of magnesia mixture were slowly added stirring continually. Twelve cc of concentrated ammonium hydroxide were added when it stood two or more hours. It was then filtered and washed with 2.5 per cent ammonia solution until free from chlorides. The filter paper containing the residue was put in the crucibles, dried and ignited to whiteness. This was then cooled and weighed as magnesium pyro-phosphate ($Mg_2P_2O_7$). The per cent of phosphorus was then calculated using the $Mg_2P_2O_7$ factor.

Determination of the Total Solids.

1. Total solids estimated by subtracting the moisture from one-hundred.

Method of Handling the Bone Samples.

1. Securing the Samples.

At the slaughter house as the wholesale cuts of meat were made the lean, fat and bone were separated out and the bones were collected for the sample upon which the analyses was to be made. Weights of the bones were obtained at once and then chopped up with a cleaver to such a size as was best for the bone grinder. The broken pieces of bone were then placed in the bone grinder and ground as completely as possible. The ground bone was then thoroughly mixed and quartered down mixed again and about a quart taken for analysis and placed in the cooler until ready to use.

2. Weighing out the Samples.

The sample from the quart jar was then mixed again and immediately three small, tared evaporating dishes were filled and rapidly weighed. The sample should be between thirty and fifty grams.

3. Determination of the Moisture in the Bone.

The evaporating dishes containing the weighed samples were placed in vacuum desiccators and the moisture determined as under moisture in meat. The dishes could not be placed in closed containers while weighing so they were weighed as rapidly as possible to a milligram.

4. Fat Determination in the Bones.

The Soxhlet extractors were fitted up with a small piece of absorbent cotton in the bottom and a piece of tightly fitting filter paper on top of this. The bone was

then transferred to the extractor taking care not to lose any. The dish and spatula used in this operation were cleaned with ether and this poured into the extractor also. A tared and numbered Erlenmeyer flask with a tightly fitting ground glass top was filled about one-third full of good dry fat free ether. The flask was then connected with the extractor and the bone extracted for about twenty to twenty-four hours. The ether was then allowed to siphon off and the bone taken out and placed in a properly labeled jar. The extractor was again connected up and the ether distilled off from the flask and removed from the extractor before it could siphon back. In this way the ether was removed and the fat extracted was left below.

This fat and flask was then dried in vacuuo as previously described. The fat was thus weighed directly. The per cent of fat was then calculated from the original weight of sample.

5. Analysis of the Extracted Bone.

The triplicate samples were combined after extraction. They were finely ground so that it would pass through a 1 m.m. sieve. Moisture, nitrogen, ash and phosphorus were then determined in the usual way on this dry fat free bone. The per cents were calculated to a moisture free basis.

DISCUSSION OF RESULTS.

As would be expected, it is found that all the cuts of meat in the carcass, loin, round, chuck, plate, flank and so on, have gained in weight in the case of the steers Nos. 121 and 48. Steer No. 121 being considerably heavier than steer No. 18 and steer No. 48 than steer No. 121. The hindquarters of the carcass of No. 121 were 140.8 pounds heavier than those of No. 18. This is a gain of 67.35 per cent. Similarly the hindquarters of No. 48 weighed 196 pounds more than those of No. 121. This is a gain over No. 121 of 56.02 per cent, or a gain of No. 48 over No. 18 of 336.8 pounds, equal to 161.1 per cent. The forequarters of the carcass of No. 18 weighed 237.99 pounds while those of No. 121 weighed 411.33 pounds. A gain of 173.34 pounds or 72.83 per cent while the same parts in steer No. 48 weighed 597.82 pounds, a gain of 186.49 pounds or 45.34 per cent over No. 121. The forequarters of No. 48 weighed 359.83 pounds more than those of No. 18, a gain of 151.2 per cent.

A heavier hindquarter is desired because of the larger amount of high priced meat in that region such as the loin and round. Therefore the heavier the hind quarter the more economical the animal is to the butcher.

It is possible that the hindquarter increases more in weight than the forequarter the longer an animal is fed but more data would be required to substantiate this.

The miscellaneous parts such as the brain, tongue, liver, and so on are given in Table No. 2 also, although they are not part of the carcass proper they are salable. All these parts also show a gain in weight. No. 121 over No. 18 and No. 48 over No. 121.

The total weight of marketable parts for steer No. 18 was 538.43 pounds against 925.15 pounds for steer No. 121 and 1414.59 pounds for steer No. 48. This means a gain for No. 121 over No. 18 of 386.72 pounds or 71.82 per cent in one-hundred fifty-three days more feeding. Also that steer No. 48 gained 489.44 pounds or 52.9 per cent over steer No. 121 in four-hundred and fifteen days more feeding. He gained over steer No. 18 in five-hundred and sixty-eight days more feeding, 876.16 pounds or 162.72 per cent. This is gain in salable portion of the carcass only.

Referring to Table No. 3 it is noticed that the offal parts, including blood, hide, circulatory system, respiratory system, nervous system, and digestive system total, had increased in total weight from 153.20 pounds for steer No. 18 to 228.13 pounds with steer No. 121 and to 276.16 pounds for steer No. 48. A total gain in these parts for steer No. 121 over steer No. 18 of 74.93 pounds or 48.91 per cent and of No. 48 over No. 121 of 48.03 pounds or 21.05 per cent. These weights however include the hide. This is salable and has grown from 56.60 pounds in No. 18 to 65.39 pounds with No. 121 while

No. 48 has grown to 90.75 pounds.

The total skeleton excluding the horns, hoofs and teeth, weighed 128.76 pounds with steer No. 18 and 145.58 pounds with steer No. 121. A gain of 16.82 pounds or 13.06 per cent. The skeleton of steer No. 48 weighed 174.67 pounds a gain over No. 121 of 29.19 pounds or 20.05 per cent.

The weight of blood would be expected to increase also with the increase in size and live weight. This is found to be the case. The weight of blood with steer No. 121 was 53.86 pounds while the blood of No. 18 weighed 34.39 pounds. A gain of 19.47 pounds for No. 121. This gain was equal to 56.61 per cent. The blood of No. 48 weighed 56.51 pounds a gain of only 2.65 pounds or 4.92 per cent over No. 121. These weights of blood were taken by weighing the blood immediately after the bleeding ceased. It was caught in a pan held under the incision in the jugular vein in the neck.

The circulatory system consisting of the heart, heart fat, pericardium, large arteries and veins in the cavity of the thorax, had increased in weight in the proportion expected. In steer No. 18 it weighed 5.72 pounds. In steer No. 121 it had gained 3.70 pounds or 64.69 per cent weighing 9.42 pounds. In steer No. 48 it had gained 5.53 pounds or 58.70 per cent over No. 121 weighing 14.95 pounds.

These increases in weight are probably due to the amount of fat stored up around the heart rather than to such a large increase in the weight of the organs themselves.

TABLE NO. 3.

Description of sample.	Steer No. 18 weight of cut or organ. Pounds.	Steer No. 121 weight of cut or organ. Pounds.	Steer No. 48 weight of cut or organ. Pounds.
Blood	34.39	53.86	56.61
Hide	56.60	65.39	90.75
Circulatory System	5.72	9.42	14.95
Respiratory System	6.79	10.21	24.18
Nervous System	1.59	1.57	1.71
Digestive & Excretory Sys. less Liver, & Kidneys	40.64	69.75	67.35
Liver	5.79	15.51	18.00
Kidneys	1.68	2.42	2.71
Total offal	153.20	228.13	276.16
Shin, shank, head, tail Lean and fat	26.69	40.82	34.16
Round and Rump Lean and Fat	84.34	136.04	189.35
Loin, Lean and Fat	59.86	119.36	191.76
Flank & Plate Lean and Fat	48.08	123.15	201.07
Rib, Lean& Fat	30.36	63.27	114.01
Chuck & Neck Lean and Fat	97.02	153.12	235.79
Offal Fat	12.57	60.35	136.33
Kidney Fat	5.39	16.03	37.85
Skeleton	128.76	145.58	174.67

The nervous system is not found to grow much showing that the storage of fat in the body probably does not effect the size of the brain and spinal cord.

The digestive and excretory system has grown a great deal with No. 121. The weight of this system in No. 18 was 48.11 pounds and that of No. 121 was 87.68 pounds a gain of 39.57 pounds or 82.25 per cent but that of No. 48 did not grow proportionately. It was slightly more than that of No. 121 being 88.05 pounds or a gain of only 0.37 pounds. It would be natural to suppose that No. 48 would show a marked increase in size or weight of the digestive and excretory system but perhaps this is the maximum limit of growth in these organs, about 88 pounds.

The difference in the total weight of the digestive and excretory system of the two steers No. 121 and No. 48 is very small indeed. But now if we should add to this total weight of the system, the hand separated offal fat, the weight of the digestive and excretory system for No. 121 would be 148.04 pounds and for No. 48 it would be 224.38 pounds. This means, if we would consider the fat and all, No. 48 would show an increase over No. 121 of 76.34 pounds which is equal to 51.57 per cent a very striking gain, but almost this entire gain is fat. But now if we should deduct the entire fat, which was determined by analysis in the case of No. 121 amounts to 68.46 pounds and for No. 48, 138.84 pounds. If we do this

then, we would get as a result the true weight of the digestive and excretory system without it's fat. If we do this we find that the weight of this system in No. 121, then is 79.58 pounds and in No. 48, it is 85.54 pounds. The difference between these weights then shows the actual gain in this system less it's fat. This gain is 5.96 pounds or 7.49 per cent. Thus instead of No. 48 showing practically no gain at all (0.37 pound) in his digestive and excretory system, excluding the fat which the system contained, No. 48 gained 5.96 pounds or 7.49 per cent over No. 121. The gain in actual analytical fat amounted to 102.80 per cent.

The gain was mostly fat then, and amounted to 51.57 per cent (if we consider the hand separated fat in the weight). Leaving out the fat, the gain amounted to 7.49 per cent which probably measures the actual increase in the substance making up this system exclusive of fat. The difference in the percentage gain of the analytical and hand separated fat was probably in part due to incomplete separation.

For the sake of comparison with this digestive and excretory system we may take the loin. The following figures show the weights of the loin, lean and fat and analytical fat in each of No. 48, and No. 121.

No. 48.	Weight of cut pounds	Weight of fat Ether Sol. pounds	No. 121	Weight of cut pounds	Weight of fat Ether Sol. pounds
Loin lean	95.14	17.37	Loin lean	74.26	8.46
Loin fat	96.62	81.89	Loin fat	45.10	39.62
Sum equals entire cut less bone	191.76	99.26	Sum equals entire cut less bone	119.36	48.08
Lean and fat less Ether Soluble.	92.50		Lean and fat less Ether Soluble	71.28	

This shows that the lean and fat (hand separated) in No. 48 weighed 191.76 pounds of which 99.26 pounds was pure fat or other soluble material. The difference between these two figures then show that the loin cut, less the bone and ether soluble fat, weighed 92.50 pounds. The same kind of results are figured for No. 121, which shows that he had 71.28 pounds of non fat material in the loin cut (excluding bone). This means a gain of No. 48 over No. 121 of 60.7 per cent in the lean and fat cut but the gain in non fat material was 29.7 per cent, about one-half. That is to say that when the gain in the lean and fat is considered, it is about twice the gain in the lean substance and tissues. The actual gain of the pure ether soluble fat, No. 48 over No. 121 amounted to 106.4 per cent.

This shows that at the condition of No. 48, the lean meat substance or non fat material grows not more than half as much as the fatty material considering the entire cut (less the bone). The pure ether soluble fat had increased over one-hundred per cent.

The above data shows that even though the digestive and excretory organs increased 7.49 per cent in actual non fat material in the case of No. 48 over No. 121, still the non fat (mostly lean meat) material in the loin cut had increased 29.7 per cent.

The total length of intestines in steer No. 121 was 188 feet, while the length in steer No. 48 was 184 feet.

Taking up the comparison of the weights of the livers of the three steers, the liver of No. 18 weighed 5.79 pounds while that of No. 121 was 15.51 pounds. A gain of 9.27 pounds. The liver of steer No. 48 weighed 18.00 pounds a gain over No. 121 of 2.49 pounds. This seems a rather small gain for this organ in such a large animal.

The kidneys show practically the same thing. Those of No. 18 weighed 1.68 pounds against 2.42 pounds with No. 121 and 2.71 pounds with No. 48. The gain is marked between No. 18 and No. 121 but between No. 121 and No. 48 it is hardly appreciable. Individual variation could have easily accounted for it.

The shin, shank, head and tail lean and fat were all com-

bined into one sample. They represent the cheapest parts of the animal.

It will be noticed in the first column of Table No. 3 the shin and shank head and tail sample weighed 26.69 pounds in the case of No. 18 and with steer No. 121 the weight was 40.82 pounds (Table 3 second column) a gain in weight of 14.13 pounds while the same sample in No. 48 weighed 34.16 pounds (see Table 3 third column). This a loss for steer No. 48 compared to No. 121 of 6.66 pounds. This loss cannot be accounted for except that No. 48 was a more leggy animal.

The round and rump lean and fat sample in the case of steer No. 18 weighed 84.34 pounds and with steer No. 121 it weighed 136.04 pounds a gain in weight of 51.70 pounds while with steer No. 48 it weighed 189.35 pounds a gain over No. 121 of 53.31 pounds.

The loin lean and fat sample shows an increase also. With No. 18 it weighed 59.86 pounds and with No. 121 it was 119.36 pounds a gain of 59.50 pounds. With No. 48 it weighed 191.76 pounds a gain in weight over No. 121 of 72.40 pounds. This is indeed a gratifying result for the loin is such an expensive cut.

It is found that the flank and plate lean and fat sample had also increased in weight but a greater amount although this is a cheap piece of meat. In No. 18 it weighed 48.08 pounds and with No. 121 it weighed 123.15 pounds a gain of

75.07 pounds while with No. 48 it weighed 201.07 pounds a gain over No. 121 of 77.82 pounds.

The chuck and neck also gained the same though not so much with No. 121. It weighed 97.02 pounds with No. 18 and 153.12 pounds with No. 121 a gain of 56.10 pounds and with No. 48 it weighed 235.79 pounds a gain of 82.67 pounds over No. 121.

The offal fat including the fat around the intestines, stomach and caul weighed 12.57 pounds with No. 18 and with No. 121, 60.35 pounds a gain of 47.78 pounds or 380.11 per cent. It weighed with No. 48, 136.33 pounds a gain over No. 121 of 75.98 pounds, which is equal to 125.73 per cent. No. 48 gained over No. 18, 123.76 pounds which is equal to 984.57 per cent.

The kidney fat, one of the great storage places for fat in the body, weighed in No. 18 only 5.39 pounds as trimmed out in the wholesale market. In No. 121 it weighed 16.03 pounds a gain of 10.64 pounds or 198.14 per cent, and with No. 48 it weighed 37.85 pounds a gain over No. 121 of 21.82 pounds or 136.03 per cent. No. 48 gained over No. 18, 32.46 pounds which is equal to 602.23 per cent.

Referring again to Table No. 2, the fifth column shows the actual percentage gains in the carcass cuts of steer No. 121 over No. 18 and the seventh column of No. 48 over No. 121. This shows that with the exception of the shanks, flanks, chucks, necks, brain, tongue and hide, the percentage increase

in the weights of the cuts is decreased in steer No. 48 over No. 121. Generally speaking then, the percentage gain in the weight of the wholesale market cuts and salable portion of the carcass tends to decrease after a certain period in the fattening process is reached. The ninth column shows the actual percentage gain of No. 48 over No. 18. The seventh and ninth columns then, show the increase due to feed consumed.

In Table No. 4 is given first, the percent of the wholesale market cut or organ to the live weight of the animal, steer No. 18. The second and fourth columns are theoretical percentages. The second shows by means of the increase in weight of No. 121 over No. 18, what percentage of the body weight this weight of cut would have been if steer No. 18 had attained the proportions of steer No. 121. The third column shows the amount of increase this would be in per cent. Since we are considering all three of these steers as one and the same but fattened to different degrees, we can show how much increase we might expect in the different length of feeding period and amount of grain fed. The fourth column shows the same thing for No. 48 calculated to No. 18 as a basis of gain. The fifth column shows what this increase would amount to if No. 18 had been fed five-hundred and sixty-eight days.

It will be noticed that with No. 48 with five-hundred and sixty-eight days more feeding than No. 18, the hindquarter would gain nearly 45 per cent and the forequarter nearly 48 per cent and the miscellaneous parts about 24 per cent. This

would make a total gain that we might expect for the marketable carcass about 116 per cent with the five-hundred and sixty-eight days feeding. However it is observed that with steer No. 121 which had only one-hundred and fifty-three days feeding the gains we might expect are nearly one-half those of No. 48 on five-hundred and sixty-eight days feeding.

It was found that No. 18 dressed out 59.68 per cent. That is, the carcass was that per cent of the live weight. Steer No. 121 dressed out 60.50 per cent and steer No. 48 dressed out 63.97 per cent. This is about 3.5 per cent better than No. 121 and about 5 per cent better than No. 18.

It has been shown that the hind and forequarters and the miscellaneous parts of the body have grown in size and volume with steers Nos. 121 and 48. Steer No. 48 however not as a general rule increasing so much over No. 121 as the latter did over No. 18. The carcass itself is the important part of the animal and the increase in this part has been shown for weights of cuts and percentage increases on Table No. 2. Now to learn what part of the animal has increased, the weights of the hand separated lean, fat and bone in each cut were taken and calculated to percentage of increase as shown in Table No. 5.

It is found in No. 18 that the lean meat (hand separated) amounted to 297.87 pounds or 39.43 per cent of the body weight. With steer No. 121 the lean meat weighed 446.42 pounds or 35.56 per cent and with No. 48, 536.83 pounds or 30.07 per cent of the body weight. On the basis of 1000 pounds live

TABLE NO. 4.

THEORETICAL PERCENTAGE OF GAINS.

Cut or organ entire.	No. 18 per cent of cut in body. Live weight 755.5#	No. 121 % of cut calculated to No. 18 as basis of gain	Per cent gain of cut of 121 compared to No. 18	No. 48 % of cut calculated to No. 18 as basis of gain	Per cent of gain of cut of: No. 48 compared to No. 18:
Shanks	2.35	2.73	0.38	3.40	1.05
Rounds	11.25	17.16	5.91	22.32	11.07
Rumps	2.05	3.48	1.43	5.72	3.67
Loins	9.66	17.94	8.28	28.02	18.36
Flanks	1.43	2.54	1.11	7.45	6.02
Kidneys and kidney fat	0.93	2.44	1.51	5.37	4.44
Sum equals Hindquarter	27.67	46.31	18.64	72.25	44.58
Ribs	5.49	10.14	4.65	17.13	11.64
Chucks	15.55	23.13	7.55	34.68	19.13
Necks	0.93	1.05	0.12	1.41	0.48
Shins	3.04	4.50	1.45	4.65	1.61
Plates	6.49	15.62	9.13	21.26	14.77
Sum equals Forequarter	31.50	54.44	22.94	79.13	47.63
Head Meat	0.99	1.18	0.19	1.27	0.26
Brain	0.122	0.124	0.002	0.130	0.008
Tongue	0.44	0.54	0.10	0.69	0.25
Heart	0.44	0.62	0.18	0.75	0.31
Liver	0.77	2.05	1.28	2.38	1.61
Tail	0.19	0.22	0.03	0.24	0.05
Offal fat	1.66	7.99	6.33	18.04	16.38
Hide	7.49	8.66	1.17	12.01	4.52
Sum equals Miscellaneous	12.10	21.70	9.60	35.86	23.76
Total Marketable Carcass	71.27	122.46	51.19	187.24	115.97
Blood	4.55	7.13	2.58	7.48	2.93

NOTE. This table compares with Table No. 2 regarding weights of cuts

weight for each steer No. 121 will contain 9.81 per cent less lean meat than No. 18. Similarly No. 48 would have on basis of 1000 pounds live weight 15.44 per cent less lean than No. 121 and 23.44 per cent less lean than No. 18.

This shows as did Table No. 2 that the longer the animal was fed the percentage of the lean meat in the cut decreased.

Table No. 6 shows the weight of the hand separated fat in the different cuts of the right half of the steers and the percentage increase of this fat during the process of fattening. This table shows that the fat in the body excluding the offal fat for steer No. 18 weighed 55.46 pounds or 7.34 per cent of the live weight. With steer No. 121 the fat weighed 207.89 pounds or 16.56 per cent of the live weight and steer No. 48 the total fat excluding the offal fat weighed 468.69 pounds or 26.26 per cent of the live weight. This means an increase of fat of No. 121 over No. 18 of 274.85 per cent and an increase with No. 48 over No. 121 of 125.46 per cent and over No. 18 of 745.10 per cent. Calculated on basis of 1000 pounds live weight No. 121 had gained 125.61 per cent over No. 18. No. 48 had gained 58.57 per cent over No. 121 and 256.40 per cent over No. 18. Every cut has gained from 131 per cent to 423 per cent in weight of fat with steer No. 121 over No. 18. With steer No. 48 there is a gain over No. 121, with two or three exceptions, of less than No. 121 gained over No. 18. There seems to be a general decline in

TABLE NO. 5.

WEIGHT OF HAND SEPARATED LEAN MEAT
IN THE DIFFERENT CUTS.
(Right half only)

Cut or Organ (right)	Steer No. 18 pounds.	Steer No. 121, pounds.	Steer No. 48 pounds.	No. 121 actual % increase over No.18	No. 48 actual % increase over No.121	No. 48 actual % increase over No. 18.
Shank	2.74	2.91	3.94	6.20	35.40	43.80
Round	33.60	46.79	55.43	39.26	18.47	64.97
Rump	3.98	5.88	7.81	47.74	32.82	96.23
Loin	25.01	37.13	47.57	48.46	28.11	90.20
Flank	3.08	4.44	7.44	44.16	67.57	141.56
Kidney	0.81	1.21	1.35	49.38	11.57	66.67
Rib	13.60	23.41	26.73	72.13	14.18	96.54
Chuck	41.95	55.10	77.06	31.35	39.85	83.69
Neck	2.52	2.16	2.76	-14.29 (loss)	27.78	9.52
Shin	5.16	8.87	4.39	71.90	-50.51	-14.92 (loss)
Plate	12.97	31.80	30.52	145.18	- 4.03 (loss)	135.31
Total right half	145.42	219.49	264.90	50.94	20.69	82.16
Total in Carcass	290.84	438.98	529.80	50.94	20.69	82.16
Head Entire	6.54	6.88	6.61	5.20	-3.92 (loss)	1.07
Tail Entire	0.49	0.56	0.42	14.30	-25.00 (loss)	-14.29 (loss)
Total in Body	297.87	446.42	536.83	49.80	20.25	80.22
Per cent in Body	39.43	35.56	30.07			

TABLE NO. 6.

WEIGHT OF HAND SEPARATED FAT IN THE DIFFERENT CUTS.
(Right half only)

Cut or Organ (right)	Steer No. 18 pounds	Steer No. 121, pounds	Steer No. 48 pounds.	No. 121 actual % increase over No.18	No. 48 actual % increase over No. 121	No. 48 actual % increase over No. 18
Shank	0.49	1.40	1.59	185.71	13.57	224.59
Round	3.12	11.02	21.52	349.36	95.28	589.74
Rump	1.47	4.33	9.92	194.56	129.10	574.83
Loin	4.92	22.55	48.31	358.33	114.24	881.91
Flank	2.21	5.11	20.62	131.22	303.52	833.03
Kidney Fat	2.70	8.02	18.93	198.14	136.03	602.23
Rib	1.57	8.22	29.77	423.56	262.17	1796.18
Chuck	4.04	18.67	36.45	362.13	95.23	802.23
Neck	none	0.87	1.62		86.21	
Shin	0.96	2.23	2.10	132.29	-5.83 (loss)	118.75
Plate	5.78	20.23	41.96	250.00	107.41	625.95
Total right half	27.25	102.65	232.79	276.70	126.78	754.28
Total in Carcass	54.50	205.32	465.58	276.70	126.78	754.28
Head Entire	0.96	2.44	2.95	154.17	20.90	207.29
Tail Entire	none	0.13	0.16		23.08	
Total in Body	55.46	207.89	468.69	274.85	125.46	745.10
Per cent in Body	7.34	16.56	26.26			

TABLE NO. 7.

WEIGHT OF HAND SEPARATED BONE IN THE DIFFERENT CUTS.
(Right half only)

Cut or Organ (right)	Steer No. 18: pounds	Steer No. 121: pounds.	Steer No. 48: pounds	No. 121 actual % increase over No.18	No. 48 actual % increase over No. 121	No. 48 actual % increase over No. 18
Shank	5.47	5.99	7.19	9.51	20.03	31.44
Round	5.61	5.95	6.96	6.07	16.97	24.05
Rump	2.10	2.92	3.88	39.05	32.88	84.76
Loin	6.23	7.53	10.33	20.87	37.18	65.81
Flank	0.10	0.04	0.09	-60.00 (loss)	125.00	-10.00 (loss)
Rib	5.19	6.57	8.04	26.59	22.37	54.91
Chuck	12.37	13.18	16.85	6.55	27.85	36.22
Neck	0.86	0.94	0.95	9.30	none	10.47
Shin	5.25	5.80	6.62	10.48	14.14	26.10
Plate	5.49	6.77	7.56	23.32	11.67	37.70
Total right half	48.67	55.69	68.47	14.42	22.95	40.68
Total in Carcass	97.34	111.38	136.94	14.42	22.95	40.68
Head Entire	17.38	18.72	19.70	7.71	5.24	13.35
Tail Entire	1.02	0.95	0.62	-6.86 (loss)	-34.74 (loss)	-39.22 (loss)
Total in Body	115.74	131.05	157.26	13.23	20.00	35.87
Per cent in Body	15.32	10.44	8.81			

in percentage of gain after a certain limit is reached in the fattening process. The last column shows the gain of No. 48 over No. 18. This is a very large amount, notice especially the rib with 1796.18 per cent. It would seem that the ribs hold in reserve the most fat.

Table No. 7 shows the weights and percentages of gains in the hand separated bone in the cuts. It was found that the bone in the body excluding the feet weighed with No. 18, 115.74 pounds or 15.32 per cent of the body weight. With steer No. 121 the corresponding weight of bone was 131.05 pounds or 10.44 per cent of the body weight. With steer No. 48 the similar weight of bone was 157.26 pounds or 8.81 per cent of the body weight.

These weights of bone in the body show that No. 121 had increased over No. 18, 13.23 per cent and No. 48 over No. 121, 20 per cent having grown in size that amount which may be attributed to the excess of food supply and the longer feeding. But even deducting the fat in the skeletons which in No. 121 amounted to 30.94 pounds and in No. 48, 37.66 pounds, the percentage increase of No. 48 over No. 121 was 19.43 per cent.

The ash constituents of the skeleton of No. 48 have increased, from 37.90 pounds with No. 121, to 47.57 pounds with No. 48, an amount equal to 25.51 per cent.

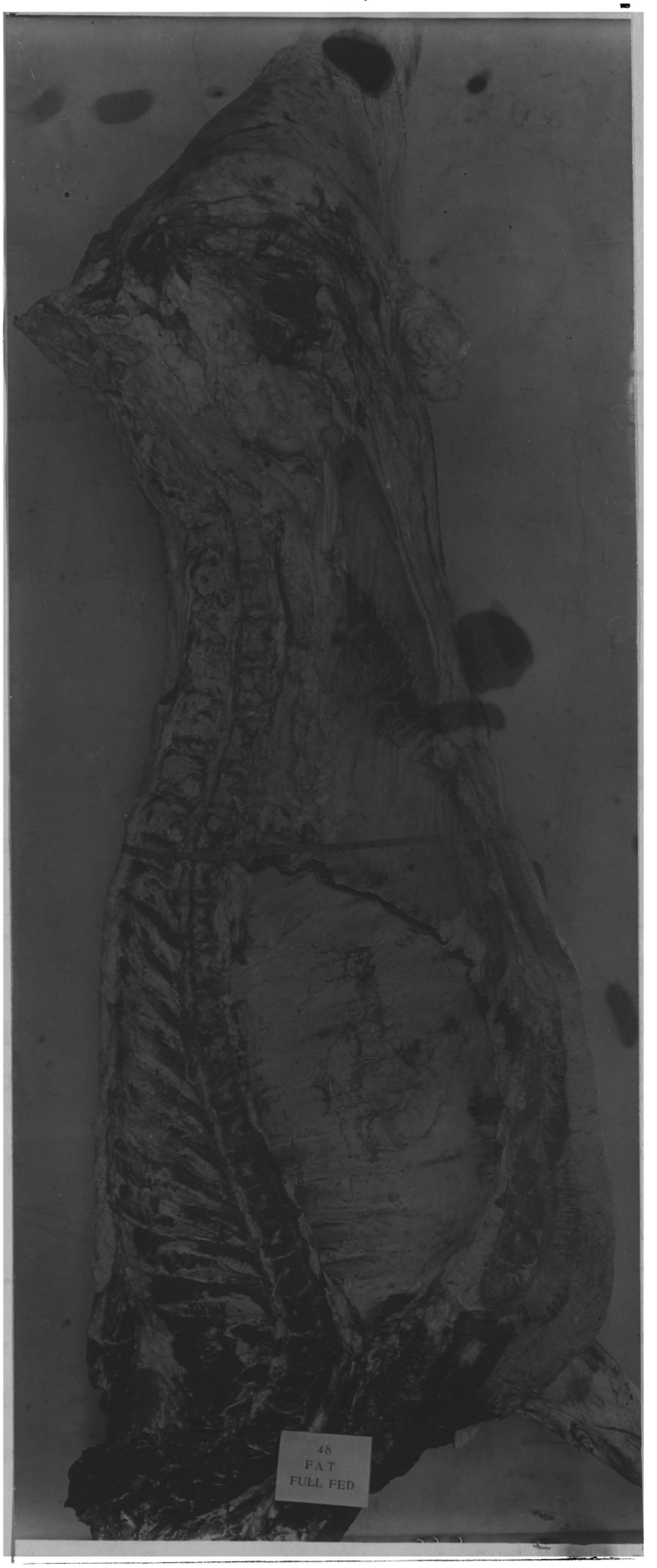
The protein content of the skeleton of No. 48, had increased 100.10 per cent over that of No. 121. The weight of

STEER No. 18.

INSIDE VIEW OF CARCASS (RIGHT HALF)

STEER No. 121.
INSIDE VIEW OF CARCASS (RIGHT HALF)

STEER No. 48.
INSIDE VIEW OF CARCASS (RIGHT HALF)



protein in No. 48 being 59.61 pounds and in No. 121, 29.79 pounds.

TABLE NO. 8.

SUMMARY OF LEAN, FAT AND BONE.
(hand separated.)

	Steer No. 18.	Steer No. 121	Steer No. 48
Per cent of Lean in Body	39.43	35.56	30.07
" " " Fat " "	7.34	16.56	26.26
" " " Bone " "	15.32	10.44	8.81

Table No. 8 is a summary showing the per cent of lean, fat and bone in the bodies of the three steers.

The following figures show the weight of bone, lean and fat in three steers and the gain in weight of these parts.

Steer No.	No. 18	No. 121	Gain of No. 121 over No. 18	No. 48	Gain of No. 48 over No. 121	Gain of No. 48 over No. 18
Weight of Skeleton, pounds	138.76	145.58	16.82	174.67	29.09	45.91
Weight of Lean pounds	297.87	446.42	148.55	536.82	90.41	238.96
Weight of Fat pounds	55.46	207.89	152.43	468.69	260.80	413.23

Since steer No. 121 gained over No. 18, 148.55 pounds of lean meat and 152.43 pounds of fat while he was gaining 16.82 pounds of skeleton; for every pound of skeleton gained there

was a gain of 8.83 pounds of lean meat and 9.06 pounds gain in fat.

Similarly since No. 48 gained over No. 121, 90.41 pounds of lean meat and 260.80 pounds of fat while he was gaining 29.09 pounds of skeleton; for every pound of gain in skeleton, there was a gain of 3.11 pounds of lean meat and a gain of 8.97 pounds of fat, while the gain of No. 48 over No. 18, in lean meat was 238.96 and the fat 413.23 pounds. The skeleton had increased 45.91 pounds. This means that for every pound gain in weight of bone No. 48 increased over No. 18, 5.20 pounds of lean and 9.00 pounds of fat.

This shows that up to the condition of No. 121, the gain in lean and fat per pound of bone was very close together being 8.83 pounds and 9.06 pounds respectively. With steer No. 48 the increase over No. 121 in lean, had dropped to almost a third of what it was in No. 121 while the fat was the same. With No. 48 the gain over No. 18 in lean per pound of bone had risen to over one-half and the fat remained the same.

The data shown in the foregoing tables demonstrates that a mature steer when receiving food beyond that required for maintenance uses the surplus for the growth of all parts of the body and for the storage of surplus fat. The skeleton growth is much less than the growth of muscle also less than the accumulation of fat. As the animal increases in fatness the relative amount of fat to lean increases.

CHEMICAL COMPOSITION.

Tables 9, 10, and 11 show the chemical composition of the parts of the steers 18, 121 and 48 respectively. The weight of the cut or organ is given in the first column and is followed by the percents of moisture, solids, ash, phosphorus, fat (ether soluble), nitrogen, and protein. The protein is calculated from the nitrogen by multiplying it by the factor 6.25.

In steer No. 18 (table 9) the skeleton is found to contain the least water (29.31 per cent) of the parts analyzed with the exception of the kidney fat and offal fat. The kidney fat contains 10 per cent of moisture and 86.96 per cent of fat (ether soluble material) in this animal. It contains 2.63 per cent of protein and 0.12 per cent of ash with 0.02 per cent of phosphorus. The offal fat compares quite closely with the kidney fat.

The skeleton (containing only 29.31 per cent of moisture) is the highest in ash and phosphorus. The ash being 24.59 per cent and the phosphorus 2.80 per cent. The ash and fat each represent about one-fourth of the weight of the skeleton.

The hide contains more moisture than might be expected, being 65.37 per cent. The ash and phosphorus are lower than we might expect. The ash being 0.87 per cent and the phosphorus 0.07 per cent. The nitrogen or protein is, on the other hand, the highest of any of the parts being 5.10 per cent nitrogen or 31.85 per cent proteid matter.

TABLE NO. 9.

STEER NO. 18. ANALYSIS OF THE PARTS.

Lab.No.	Description of Samples as used for Analysis.	Wt. of cut or organ Pounds	Per cent of Moisture in the part	Per cent of solids in Part	Per cent of Ash in Part	Per cent of Phosphorus	Per cent of Ether Sol. (fat	Per cent of Nitrogen(N)	Per cent of Proteid N x 6.25
71156	Blood total	34.39	81.29	18.71	0.69	0.02	0.43	2.91	18.18
71157	Hide and hair less toes and dew claws	56.60	65.37	34.64	0.87	0.07	2.88	5.10	31.85
71159	Total skeleton less horns, hoofs and teeth	128.76	29.31	70.69	24.59	2.80	25.48	2.93	18.32
71167	Circulatory system excluding blood	5.72	56.50	43.50	0.75	0.12	30.07	2.00	12.48
71168	Respiratory system	6.79	74.71	25.29	0.96	0.15	6.46	2.76	17.23
71161	Nervous system (brain and spinal cord)	1.59	68.83	31.17	1.76	0.42	17.63	1.75	10.94
71166	Digestive and excretory system less liver & kidney	40.64	66.51	33.49	1.63	0.13	18.13	2.09	13.08
71162	Liver less gall bladder	5.79	68.99	31.01	1.25	0.31	3.47	3.03	18.91
71189	Kidneys	1.68	75.05	24.95	1.09	0.21	8.74	2.37	14.83
71180	Shin, shank, head and tail Lean and fat	26.69	67.43	32.57	0.77	0.15	11.99	3.22	20.12
71181	Round and rump, Lean & Fat	84.34	66.50	33.50	0.88	0.17	13.26	3.11	19.44
71182	Loin,lean and fat	59.86	59.90	40.10	0.79	0.16	21.72	2.87	17.91
71183	Flank and plate,Lean & Fat	48.08	52.51	47.49	0.65	0.12	30.10	2.44	15.25
71184	Rib, Lean and fat	30.36	62.79	37.21	0.82	0.16	18.04	3.08	19.23
71185	Chuck and neck, Lean & Fat	97.02	66.48	33.52	0.82	0.15	14.07	3.02	18.87
71165	Offal fat	12.57	16.62	83.38	0.17	0.03	79.72	0.52	3.23
71190	Kidney fat	5.39	10.04	89.96	0.12	0.02	86.96	0.42	2.63

TABLE NO. 10.

STEER NO. 121. COMPOSITION OF THE PARTS.

Lab. No	Description of samples as used for Analysis.	Wt. of cut or organ pounds	Per cent of Moisture in the part	Per cent of solids in part	Per cent of Ash in part	Per cent of Phosphorus.	Per cent of Ether Sol.(fat)	Per cent of Nitrogen (N)	Per cent of Proteid N x 6.25
71250	Blood	53.86	77.97	22.03	0.25	0.03	none	3.26	20.34
71262	Hide and hair	65.39	54.42	45.58	0.76	0.06	4.97	5.53	34.59
71264	Skeleton	145.58	31.03	68.97	25.35	4.49	21.25	3.27	20.46
71255	Circulatory system	9.42	46.08	53.92	0.50	0.10	19.34	1.56	9.75
71256	Respiratory system	10.21	63.96	36.04	0.81	0.17	19.69	2.31	14.43
71257	Nervous system	1.57	68.36	31.64	1.56	0.40	19.50	1.68	10.48
71258	Digestive and excretory system less liver & kidney	69.75	66.06	33.94	0.78	0.16	20.76	1.71	10.69
71251	Liver less gall bladder	15.51	68.36	31.64	1.31	0.35	4.72	3.19	19.94
71260	Kidneys	2.42	76.58	23.42	0.95	0.23	5.56	2.74	17.11
71265	Shin, shank, headand tail Lean and fat	40.82	62.30	37.70	0.73	0.14	18.18	2.93	18.31
	Round and rump, Lean & Fat	136.04	57.42	42.58	0.78	0.15	24.52	2.68	16.76
	Loin, Lean and fat	119.36	47.11	52.89	0.66	0.13	37.84	2.11	13.19
71270	Flank and plate, Lean &Fat	123.15	40.07	59.93	0.50	0.10	47.70	1.92	12.03
	Rib, Lean and fat	63.27	47.91	52.09	0.61	0.12	37.81	2.18	13.63
71273	Chuck and neck, Lean & Fat	153.12	59.14	40.86	0.70	0.14	24.43	2.16	16.28
71259	Offal fat	60.35	9.52	90.48	0.13	0.02	88.02	0.27	1.71
71261	Kidney fat	16.03	4.48	95.52	0.07	0.01	94.67	0.18	1.13

TABLE NO. 11.

STEER NO. 48. COMPOSITION OF THE PARTS.

Lab. No.	Description of Samples as used for Analysis.	Wt. of cut or organ pounds	Per cent of Moisture in the part	Per cent of solids in part	Per cent of Ash in the part	Per cent of Phosphorus	Per cent of Ether Sol. (fat)	Per cent of Nitrogen (N)	Per cent of Proteid N x 6.25
91101	Blood	56.51	79.41	20.59	0.78	0.021	none	3.16	19.75
91112	Hide and hair	90.75	59.24	40.76	1.20	0.048	8.60	5.28	33.00
	Skeleton	174.67	28.27	71.73	26.66	4.921	21.56	5.46	34.13
91104	Circulatory system	14.95	31.23	68.77	0.32	0.059	62.26	0.99	6.19
91106	Respiratory system	24.18	49.42	50.58	0.67	0.117	37.39	1.99	12.44
91107	Nervous system	1.71	69.63	20.37	1.81	0.425	13.05	1.97	12.31
91108	Digestive and excretory systems less liver &kidney	67.35	68.42	31.58	0.87	0.174	18.12	1.81	11.31
91102	Liver less gall bladder	18.00	69.73	30.27	1.39	0.307	4.26	2.89	18.06
91111	Kidneys	2.71	70.75	29.25	1.15	0.199	12.16	2.35	14.69
91120	Shin, shank, head and tail Lean and fat	34.16	57.84	42.16	0.83	0.142	23.47	2.85	17.81
	Round and rump, Lean &Fat	189.35	50.94	49.06	0.75	0.136	33.02	2.39	14.94
	Loin, Lean and fat	191.76	37.01	62.99	0.55	0.097	51.77	1.69	10.56
91122	Flank and plate, Lean &Fat	201.07	30.15	69.85	0.42	0.064	61.11	1.31	8.19
	Rib, Lean and fat	114.01	35.23	64.77	0.48	0.082	54.60	1.49	9.31
91121	Chuck and neck, Lean &Fat	235.79	49.67	50.33	0.69	0.123	34.95	2.27	14.19
91135	Offal fat	136.33	6.22	93.78	0.09	0.012	92.09	0.18	1.13
91134	Kidney fat	37.85	3.76	96.24	0.13	0.016	94.71	0.24	1.50

The blood as would be expected, contains a high percentage of water being 81.29 per cent. It contains a goodly amount of nitrogenous matter it being 18.18 per cent protein.

The moisture in all parts excluding the blood, skeleton, offal fat and kidney fat is between 52 and 75 per cent of the weight of the cut.

Turning to Table No. 10, it is found that as was the case with steer No. 18, No. 121 is found to be lowest in the per cent of moisture in the skeleton. This was 31.03 per cent or lsightly (2 per cent) more than No. 18. The per cent of ash has increased with No. 121 about 0.8 per cent. The phosphorus content has increased quite a large amount being 1.69 per cent greater than with No. 18. The fat content has decreased about 4 per cent and the nitrogen increased about 0.34 per cent.

The skeleton of steer No. 48 shows a continued though small decrease in percentage of moisture content. The moisture, as was the case with the other two steers was least in the skeleton with the exception of the offal and kidney fats. The ash and phosphorus and nitrogen have all increased in per cent. The fat is about the same as with No. 121 but still less than in No. 18.

The moisture content of the offal and kidney fat is considerably lower in steer No. 121 than in No. 18 and the ash,

nitrogen and phosphorus slightly lower and the fat much more with No. 121. Practically the same thing is noticed for No. 48. The fat being much purer in the fat animal than in the thin one. The moisture also decreases in amount.

The hide contains 54.42 per cent moisture with No. 121 and 59.24 per cent with No. 48. Both less than No. 18. The ash content of the hide has decreased with No. 121 and increased with No. 48. The phosphorus content of the hide has decreased about 0.01 per cent for both No. 121 and No. 48. The fat content has risen perceptibly with each of the fatter steers and the protein has remained about constant.

The moisture in all parts in No. 121 excluding the blood, skeleton, offal and kidney fat is between 46 and 76 per cent. For No. 48 this amounts to between 30 and 70 per cent.

In all parts with a very few exceptions, the moisture content has decreased appreciably between No. 121 and No. 18 and between No. 48 and No. 121. It would seem that perhaps with the carcass cuts especially, the water may be replaced with fat, for as the water decreased in the ratio of No. 18, to No. 121 to No. 48, so the fat content of the parts increased in the same relation. The parts other than the carcass cuts were too variable to show any relation.

Several of the parts analyzed show that the ash content also decreases with the fatter animals but there are also several that show little change and even some gain is ash.

The phosphorus content of each of the parts shows a condition similar to that of the ash. The per cent in most of the parts has decreased with the fatter animals. There are also several which show no change and perhaps a slight increase.

The nitrogenous matter in the parts also shows a general decline except perhaps the same exceptions noted above for the other elements.

These results might tend to the conclusion that with the laying on of fat the moisture, ash, phosphorus, and nitrogenous matter is decreased. We can see a reason for this since fat is very low in moisture, ash, phosphorus, and nitrogen, when this fat is put on it then increases the weight to such an extent that the composition of the parts are decreased appreciably in many cases regarding the moisture, fat, phosphorus and nitrogen content. Again the ash, phosphorus and nitrogen show little if any change, while the moisture goes down and the fat rises.

The following tables have been calculated to show the relation of the moisture and the protein in the entire cut of lean and fat of the rib of No. 48 and No. 121 and in the gain also in the lean meat of the rib of No. 48 and No. 121 and how this relation held with the gain in moisture and protein of No. 48 over No. 121. Similarly the data has been calculated for the rib fat in the two animals. In addition

similar results have been calculated for the relation between the moisture and protein in the entire animal.

	Moisture grams	Protein grams
No. 48 Rib lean and fat	18058.83	4787.94
No. 121 " " " "	13748.44	3909.57
No. 48 gain over No.121	4310.39	878.37
No. 48 Rib lean	13788.55	4060.36
No. 121 " "	12952.15	3698.44
No. 48 gain over No.121	836.40	361.92
No. 48 Rib fat	4270.28	727.58
No. 121 " "	796.29	211.13
No. 48 gain over No.121	3473.99	516.45
No. 48 Entire body	291233.00	105860.00
No. 121 " "	239260.00	73935.00
No. 48 gain over No.121	51973.00	31925.00

The following interpretation of this data is given:-

In No. 48 the entire rib cut (excluding bone) showed that for every gram of protein present there was 3.77 grams of moisture in the cut.

In No. 121 the entire rib cut (excluding bone) showed that for every gram of protein present there was 3.52 grams of moisture in the cut.

The gain of No. 48 over No. 121 in the rib cut, composed of lean and fat, showed that for every gram of protein

present there is 3.40 grams of moisture in the lean.

With No. 121 it will be noticed that in the lean of the rib cut, for every gram of protein present there is 3.50 grams of moisture in the lean.

The gain in the lean of No. 48 over No. 121 shows that for every gram of protein gained there is 2.31 grams of moisture gained. With No. 48 the fat of this rib cut shows that for every gram of protein present there is 5.87 grams of moisture. With No. 121 the fat of the rib shows that for every gram of protein present there is 3.77 grams of moisture. The gain in the fat of No. 48 over No. 121 shows that for every gram of protein gained there is 6.73 grams of moisture gained.

With No. 48 for the entire body the data shows that for every gram of protein present there is 2.75 grams of moisture.

With No. 121 for the entire body has for every gram of protein, 3.21 grams of moisture.

The gain in protein and moisture for the entire body shows that for every gram of protein gained there is a gain of 1.63 grams of moisture.

The above data was studied to find out if possible, whether the moisture was replaced with fat.

The above data does not seem sufficient to draw conclusions.

Lawes and Gilbert in their interesting researches in the Rothamsted (England) Station took up among other things a study of the fattening of the domestic animals. The experi-

ments were begun in 1848 and continued several years. The results were not published until 1859. They undertook to find the ultimate composition of steers, sheep and pigs. The entire bodies of ten animals in each group were subjected to analysis. A summary of their findings on beef animals is given below:

		Pounds	
Fat :	In a fat calf there was	14.81	fat per 100 lbs. live weight
con-:	" a half fat ox " "	19.11	" " " " " "
tent:	" a fat ox " "	30.11	" " " " " "
Ash :	In a fat calf there was	3.81	ash " " " " "
con-:	In a half fat ox " "	4.66	" " " " " "
tent:	In a fat ox " "	3.92	" " " " " "
		Pounds	
Nitro-:	In a fat calf there was	15.21	of nitrogenous substance
genous:	In a half fat ox " "	16.6	" " "
matter:	In a fat ox " "	14.5	" " "
Water:	In a fat calf there was	63.0	water per 100 lbs. live weight
con- :	In a half fat ox " "	51.5	" " " " " " "
tent :	In a fat ox " "	45.5	" " " " " " "

The composition of the bodies of the three steers Nos. 18, 121, and 48 show results somewhat different from the above results of Lawes and Gilbert. The fat calf has no comparison with the data herein presented, although steer No. 18, the thin emaciated one, compares in some respects with the fat calf of Lawes and Gilbert, in composition. Steer No. 121 might be called an animal similar to the half fat ox of Lawes and Gilbert's and steer No. 48 the fat ox but results do not warrant too close a comparison. The results obtained here, are given below.

Per 100 Pounds live Weight.

	Fat	Ash	Nitrogenous Matter	Water	Dry Matter	Phosphorus
Steer 18 (755.5)	15.94	4.78	16.03	48.41	51.59	0.57
Steer 121 (1255.47)	26.35	3.40	12.98	42.01	57.99	0.60
Steer 48 (1785.0)	37.87	3.08	13.08	35.97	64.03	0.56

The fat content of the body is noticed to be higher in all three steers than Lawes and Gilbert showed for similar animals. Steer No. 48 was apparently much fatter than their "fat ox". The ash content shows a continual decline as the fattening process continues. Lawes and Gilbert showed that with the half fat ox the ash content was the highest.

The nitrogenous part of the body is the highest with the thin steer No. 18 and practically the same for No. 121 and No. 48. Lawes and Gilbert showed that it increased slightly with the half fat ox over the fat calf and decreased slightly for the fat ox.

The water content of the body is greatest for the thin steer No. 18, showing less for the half fat steer No. 121, and least for No. 48 the fat steer. Lawes and Gilbert showed that the water content was the highest with the fat claf and lowest with the fat ox. However the steers analyzed by them showed a higher water content than those here.

The phosphorus content of the bodies of the steers analyzed here is shown in the above summary table, but Lawes and Gilbert do not show any phosphorus in this connection. It is noticed that the phosphorus content is quite uniform through the fattening period.

Lawes and Gilbert state that there is more than two pounds of fat in the body of the fat ox, for each pound of nitrogenous matter or lean meat substance. It is found here that there is nearly three pounds of fat for one pound of nitrogenous matter. This however was with the very fat steer No. 48. Steer No. 121 however, compares very closely with the above statement of Lawes and Gilbert showing that there is about one pound of nitrogenous substance for two pounds of fat. The thin animal No. 18 shows that the lean meat substance and the fat are about equally distributed, pound for pound.

It is evident that our fat animals were much fatter than their fat oxen, for they state that nearly half the body of the fat ox is water. It is found here to be considerably less than half. However, Lawes and Gilbert's results are the results of ten analyses and these here are only for one, of a definite fatness.

It is noticed that fattening is all the term implies; laying on of fat. During the fattening the total dry matter is much increased as the water content of the body decreases.

The fat content increases much more than the nitrogenous matter.

The relative percentage of the dry matter of the body increases about 6 or 7 per cent. Similarly the relative percentage of nitrogenous matter decreases about 2 or 3 per cent in fattening up to the condition of No. 121. The ash or mineral constituents in a like manner decrease one to one and a half per cent, while the fat increases ten to twelve per cent in the very fat steer.

CONCLUSIONS.

1. The live weight increases during the process of fattening a steer.

2. The gain in live weight per day decreases the longer an animal is fed. The more feed consumed the less returns in meat pound for pound of gain. Therefore the most economical gains are not possible after a certain stage is reached in the process of fattening.

3. The hindquarter part of the carcass gains more in weight than the forequarter, the longer the animal is fed.

4. The fat from pure fat storage places such as the kidneys stomach and intestines, increases very materially the longer an animal is fattened.

5. The fat is probably stored in those places for future use when lack of food supply necessitates a demand for such material by the animal body.

6. The relative per cent of the cuts in the body to the live weight decreases the longer the fattening process continues.

7. The ratio of lean meat in the carcass to the live weight decreases the longer an animal is fattened.

8. The ratio of fat in the cuts of the carcass to the live weight increases the longer an animal is fed in the fattening process.

9. The ratio of bone in the carcass cuts to the live weight also decreases as was the case with the lean meat.

10. The bone of the animal carcass continued to grow at least in weight even when the animal was nearly five years of age on a fattening ration.

11. With the exception of the offal and kidney fat, the skeleton contains the least amount of water of any of the parts of the body analyzed. The relative percentage of the moisture decreases with the process of fattening.

12. The moisture content of the cuts decreases and the fat content increases with fattening.

13. The per cent of ash in the carcass decreases with fattening. The phosphorus content remaining apparently constant. The relative per cent of protein does not seem to increase after the condition of No. 121.

14. A mature steer grows during the fattening process in practically all parts of the body.

15. A large part of the increase takes the form of fat but the ratio of all parts decreases the longer the fattening process continues.