MISSOURI

Agricultural College Experiment Station

BULLETIN No. 7.

GREEN VERSUS DRY STORAGE OF FODDER.

HON. JOHN HINTON,

President Board of Curators University of Missouri and Agricultural College :

I hereby submit to you the following data, gathered at the Experiment Station in storing fodder in both the green and dry state.

ENSILAGE is food preserved in a condition as near its native green state as present information will permit us to, in a receptacle called a silo. In such a condition of native greenness, it is not as yet preserved. This bulletin, and the succeeding one, will endeavor to answer for our farmers of Missouri, who are now in an enquiring frame of mind upon the subject, the oft repeated question: "Is the new process of preserving food in a silo, or by any method involving the silo principle, superior to the old one of air drying?" So far as the confused state of affairs at the College and Station during the past year has permitted the inquiry to extend, I shall contrast the system of green with dry storage, and the results thereof throughout to its final result in live weight growth.

It is evident, without debate, that the cost of the crop up to the point of harvest whether, for the silo or for dry storage, will be the same, provided that the food grown by the best system for the silo, can be air dried sufficiently for dry storage in bulk. The present method of growing corn for ensilage, which places a plant every 6 to 8 inches in the row, is very nearly as thin as I care to grow my field corn, which is one stalk to every twelve inches. I shall consider this matter later on.

COST OF BUILDING.

The College Farm Silo was built by contract work, in digging, masonry, and carpenter-work, and at as low a rate as any one here can procure the work done. It is 16 feet deep, and constructed half under ground. The excavation is in very solid earth, and cost $35. Its walls of masonry 1½ feet thick, 14 feet high, 16 feet wide, by 24 feet long, outside measure, at $2.50 a perch, cost $152; the end touching the cellar wall, being constructed as a part of the cellar wall of the barn, to which it was attached. On top of the wall the Silo extended two feet higher in wood and was covered by a wood roof, with a door and window; cost $175; drainage $7.00. The cementing of the sides and bottom cost $83.90. Total cost $452.90. Cutting the fodder five-eighths of an inch long, it held 85 tons of ensilage when full, without weighting. The amount a silo will hold depends upon the degree of the maturity of the plant. The more mature, the less the weight that will be carried. Ninety tons would be the utmost limit of the capacity of this silo, provided the corn is cut at the right degree of maturity. If cut too early it will hold a considerable more. Size of silo, inside measure, 16x22x16 feet high; number of cubic feet, 5,632; cost of silo per ton of fodder held, $5.03. Ordinary lumber costs $18 per 1000 here. Number of pounds of ensilage held per cubic feet of entire silo capacity, 32.

At twenty tons per acre, now agreed to be a good crop, and which the weight of last year assures me to be a good crop, the cost of silo capacity for an acre of ensilage, would be $100, a sum which makes the cost far more than the cost of the farm, and where interest account is $6.00 a year, aside from wear, a constant cost.

The above cost is for a stone silo, and complete in its details. While its cost will astonish many, yet it is as cheap as it can be constructed at this point in its complete form, which is not elaborate, but solid.

It is claimed that a silo is a cheaper protection than a barn is for dried fodder. This untenable view grows out of the comparison of gross weights, in which the weight of water is put against that of dried fodder.

The frequent heavy studs of the wood silo, with its double boards and locked corners and braced roof, are far more costly than the simpler protection for dry fodder, having little outward pressure.

To make this matter conclusive for our farmers, I engaged a local contractor to figure up the cost of the silo made of wood, of the size of the stone silo of the farm. He gives me the following figures as the cheapest that he could or would build such a silo of wood for:

SILO 16x20, 16 FEET LONG, BUILT ABOVE GROUND.

Excavation one foot deep—16 yards at 25 cents		$ 4 00
Foundation of stone, one foot high—16 perch at $2.50		15 00
2 pieces, 4x10, 19 feet plates	127 ft.	
2 pieces, 4x10, 23 feet	153 ft.	
63 pieces, 2x16, 16 feet studding	1685 ft.	
2 pieces, 2v10, 20 feet plates	80 ft.	
2 pieces, 2x10, 24 feet plates	80 ft.	
24 pieces, 2x6, 14 feet rafters	336 ft.	
24 pieces, 1x6, 14 feet ties	168 ft.	
	2615 ft at $1.75	45 76
1300 feet roof boards at $2.00		26 00
1400 feet B boards at $2.50		35 50
600 feet R sheathing		10 50
6000 shingles, $3.50 M		21 00
90 3-8 posts, 16 feet long		10 20
200 feet C selects		6 50
300 pounds tarred paper		9 00
Hardware and tin		22 00
Carpenters work		100 00
		$291 46

The ensilage put into our silo contained 19.87 tons of dry matter. Our Timothy hay contains 89.76 per cent. of organic matter. The organic matter measures the value of a food, and not the amount of water which it contains. The organic matter found in our silo would be furnished in 22.11 tons of timothy hay. At 500 cubic feet of space for one ton, a building 20 feet wide, 26½ feet long, and posts 20 feet high, would cover the 22.86 tons above found. The cost would be as estimated by the above named carpenter, A. M. Crouch, as follows:

10 posts, 6x6, 22 feet long	660 feet	
56 rafters, 2x6, 16 feet long	1056 feet	
2 rafters, 2x6, 20 feet long	66 feet	
	1782 feet at $1.75	$31 18
600 feet sheathing boards at $1.75		0 30
7000 shingles at $3.50 per M		24 50
200 feet B. Boards at $2.50		5 00
Bolts and nails		12 00
Lumber		80 00
		163 18

If boarded down on the sides it would require 2240 feet more of lumber, costing $40.32, and a small sum extra to work, the carpenter says $20.00, which seems large for so plain work, or total cost when sided up of $223.50 or $11.23 per ton of dry matter, while the wood silo would cost $14.66 for the storage of a ton of dry matter. A building for the dry storage of a pound of organic matter in the dry form costs less than in the green form.

I know it is said that a silo can be constructed in the corner of a barn. We have not got the barns in Missouri, and had we, it is a grossly absurd method of begging favors in calculating the real cost of an enterprise to start out with robbing another business of its capital and adding it to the new enterprise without charge. It will be seen that the cost of a wooden silo is not a cheap affair in this section, where ordinary lumber is $17.50 per thousand feet. The cost per ton of storage of green food is $3.40, or for an acre of 20 tons, $68. At the degree of maturity of the ensilage housed in my trial, 20 tons will be realized only in rare cases, 15 tons being a more probable acreage. But whatever the yield per acre, the wood silo is a more costly affair than popularly estimated. Objections can be raised against the estimate of Mr. Crouch, but I prefer to leave his own estimate as a builder, as he made it from cuts furnished, the figures for Columbia conditions, and for the most of Missouri, cannot be far out of the way. It will be understood by our farmers that the wooden silo is one that will rot out quickly, being brought in contact with hot, moist food.

The building for dry storage, notwithstanding popular assertions to the contrary, is undoubtedly materially cheaper in first cost, but far more enduring, and, therefore, ultimately far cheaper, than the silo for a pound of food material covered.

DRY STORAGE.

The assumption is often made that it is impracticable to store corn fodder in the dry state, on account of the difficulties of drying it. Upon the assumption that fodder corn cannot thus be stored, silos are advocated for our Missouri farmers upon the ground that corn is a far more productive crop than other foods, the silo enabling us to grow it with freedom, thereby enlarging our capacity to feed stock. It is also said that we can save our wasting corn fodder. I put 140 of corn fodder into the barn last fall, and it has kept most admirably.

The experiment with ensilage against dry fodder now being related, was conducted as follows: A given number of alternate rows of fodder were put into the silo and the same number into the barn after drying. The fodder that we had to deal with was mostly planted by Dr. Schweitzer while director after the old method, or rows 16 inches apart and exceedingly thick in the row, probably 6 to ten times as much as is now used. It was poor stuff to deal with for food and was badly down, but had to be saved. Every alternate ten rows were put into the silo and the next ten into small shocks such as one or two men could handle when dry. This material was sugar corn, a difficult fodder to keep, and planted in a manner difficult to preserve. 28,144 pounds were put into the silo, August 28, and the like number of pounds before drying into the barn loft September 10, area 1$\frac{4}{5}$ acre passing out of dough state. Air dried section stood 13 days in field and received one small shower. Weight at housing, 17,243 pounds.

CORN PLANTED.

7961 pounds of listed field corn planted even distance, was put into the silo August 29, and the like amount September 11, from the shocks where it had dried since August 29. Weight at housing 4670 pounds. Cut when passing out of dough state. August 29, also put into silo 14984$\frac{1}{2}$ pounds of corn planted by the writer for field corn purposes. It was past the roasting stage. September 11, drew other half to barn, weighing 6336 pounds. This fodder had fallen off in weight from the period of its greenest stage in the maturing process. The green weight of fodder begins to fall off soon after bloom, while its dry weight is all of the time increasing. Area 1.3 acres.

The account will be seen in the following table. For analysis of all foods, see tables in appendix, where also will be found a more elaborate table of ingo and outgo :

	PUT IN		TAKEN OUT		Per cent. loss of Total Weight.	Per cent. loss in Dry Matter.
	Total Weight.	Dry Matter	Total Weight. Pounds.	Dry Matter Pounds.		
Sugar Corn Ensilage.............	28,144	6,329	25,072	5,195	10 81	17 5
Sugar Corn, Dried......	*17,240	6,031	6,703	† { 5,427	61 11	10 0
				{ 5,697	14 54	20 6
Listed and Field Corn, Ensilage.	22,955	5,724	19,617	†4.545		1 13
Listed and Field Corn, Dried	11,006	5,724	6,701	5,660	39 11	

† 1,320 pounds more of green sugar corn was put into the silo than into the shocks for drying. The second set of figures under the column headed dry matter under dried corn fodder, represent the amount of dry matter that would have been there if an equal weight had been put up, or 1,320 pounds more.

The dried sugar corn on account of its method of growth and general character or reputation, as a difficult plant for dry storage, affords an unfair test for the probable result of dry storage against green storage in the silo, of field corn grown field corn system. Unfortunately I cannot place absolute reliance on the figures of loss of dry matter, as the chemist did not at once ascertain the water contents of the sample sent. I did not ascertain this fact until too late to secure another sample that I regarded as representing the water contents of the mass. Had the sample on being finally sent been tested for moisture at once, I have little doubt that the field corn would have shown more water, and hence a greater loss of dry matter. This unfortunate uncertainty is relieved by the fact that at feeding time, as a future bulletin, No. 8, will show, the dry stored fodder actually lasted longer than the silo stored corn. Storage trials with hay and field fodder, or stover, leads me to believe that this corn fodder was, and that it can be, stored for decidedly less loss of dry matter, than that in the silo lost, not counting that ruined in the silo.

The sweet corn warmed up to such an extent as to make it mouldy and impaired the relish of cattle for it as a food, yet it lost less than the ensilage sweet corn, and was fairly eaten. I have no doubt at all that it can be grown rightly and housed dry successfully. This was the first sweet corn that I have housed dry, and housed it a little too soon.

The field corn kept admirably, and was eaten with relish. The loss shown is phenomenally low. By oversight the sample of the dry stored field fodder corn was left in a tight glass jar by the assistant chemist over a month before analysis and the moisture contents may be a fraction low, though it could not vary much.

The ensilage corn above considered was in the center of the silo, and therefore met with less loss than the average loss of the silo, while the corn fodder was in a mass by itself and all weighed. It had therefore more relative surface exposure. It shows the great success with which fodder may be stored.

The following table gives the total amount put into the silo and taken out with details that explain themselves :

	Put in. Total.	Dry Matter put in.	Taken out. Totatal Weight.	Dry Matter taken out.	Loss of Dry Matter. Per cent.	Spoiled pounds.	Dry Matter Spoiled.	Total pounds Dry Matter lost.	Total loss Dry Matter. Per cent.	Loss from 20 tons.	Loss from 20 tons by dry storrage of Field Corn.
Field corn, top layer..	17992	4475	6960	3357	24.9	2854	1375	2493	53.4		
Sorghum 2nd layer..	39386	8936	32455	8455	5.4	8538	2287	2768	30.9		
Field corn, 3d layer...	22955	5724	19617	4545	20.6	3448	834	1798	35.18		
Sugar Corn, 4th layer..	28144	6329	25072	5195	17.5	7111	1941	3075	48.6		
Sorghum 5th layer..	32793	7506	29612	6728	10.4	2189	499	1277	17.1		
Whole cane, ½ of one end at bottom.	29689	6795	23479	5334	21.5	4856	952	2413	35.51		
Total.. ...	170959	39939	137195	33614		29016	7888	13824		7 tons	67 t'n

Total shrinkage in weight 19.16 per cent. Shrinkage in weight and spoiled ensilage, 36.6 per cent. Shrinkage in dry matter 15.41 per cent. Total shrinkage in dry matter, in loss of weight and in spoiled ensilage, 34.3 per cent. By spoiled ensilage, I mean that which stock would not eat at all. The loss by the silo is 10.4 times as great as by dry storage. These figures will astonish many or most. They are correct as to total weights and must be approximately so as to dry matter, as the loss of dry matter in per cent. is less in ratio to water loss than shown by some other investigators, and the loss in pounds of weight when compared with those published by Prof. Henry, and the few other data at hand, shows that our ensilage was preserved with more than full ordinary success. As few other data are published touching the loss by spoiling, I rightfully assume that my loss is not above the average except as below specified. Since writing the above, Prof. Johnson's trial came to hand showing 24.7 per cent. loss from spoiling, or considerably more than my loss of spoiled ensilage. It must be remembered that a few inches on the outside and top of a silo covers a large space, and that the loss of exposed ensilage while feeding is to be added. In the latter regard, as we were feeding experimentally, the surface daily exposed, in small quantities, over a large area, gave more loss than the ordinary feeder would need to expect. With due allowance for this factor, I cannot see how I could have avoided a loss of 30 per cent. or more.

To test the claim that a stone silo is necessarily a bad silo, I lined with boards and papers one end of it. It must be remembered that this formed a double lining, and a dead air space would probably be better than a simple wood silo. The loss against it was 14.3 per cent. for the corn and corn layers (two layers all that was weighed) while these same layers lost for the other three sides, and on exposed surface while feeding 16.04 per cent., or that against the boards must have lost as much or more than that against the wall. My loss of ensilage was less than that of Prof. Henry with a wood silo, which was 26.06 per cent. of dry matter put in.

I should have said before that we were 9 days in filling the silo, owing to breakage and delays, and covered the silo with tarred paper and straw. December 14th, temperature of ensilage 2 inches deep, was 78 °; 14 inches deep, 110 °; 69 inches deep, one foot from wall, 98 °; and in center, between walls, 69 inches deep, 128 °. The ensilage was what is popularly known as sweet ensilage, but which is one of the fictions of the new process. It was well eaten, and the whole ensilage, which alone was left in April, was pronounced by Col. T. D. Curtiss, who was here, as being a very nice sample. It will be observed that the whole ensilage did not keep nearly as well as the corresponding layer of cut corn, while it occupies more room and is difficult to handle in winter. I should prefer to cut the food.

By an unfortunate oversight the top layer of ensilage was not analyzed. The loss of 25 per cent. of dry matter for the top layer used in the table is assumed, but is an amount very surely within the actual loss as it went through a degree of heat unbearable to the hand, and was, when fed, as dry as chips, and light as feathers for the first 12 inches. While the loss will be more than named, it is the best side to err on and in any event, the error will not be seen in the result, as it is only $\frac{1}{10}$ of the amount put in.

It will be noticed that the loss in dry matter in the silo was 15.4 per cent. and by dry storage 5.54 per cent. Those familiar with Prof. Geo. H. Cook's and Prof. Henry's experiments will recall that each got as much loss by the air drying system as by the silo. The former, it will be recalled, allowed the fodder to remain in the shock for months and virtually did not house it at all. The latter handled his over and finally stood it up in separate bundles around the sides of his storage loft. This free access of air is undesirable and sure to result in the loss of dry matter. I had over 100 tons of stover bulked together in one large lot in our new barn, and it has kept in admirable order. If this could not be done, then the silo would be inevitable. My test fodder by dry storage was put in a small lot by itself and suffered more exposure than necessary.

COST OF HARVESTING GREEN VERSUS DRY FODDER.

I shall consider only the 25.55 tons of green fodder drawn one-third of a mile through two gates, and the equivalent dried down to 14.12 tons, drawn and stored dry. That cut for ensilage cost—engine, engineer, cutter, and interest with risk and wear of engine two days, at $8 per day ; two teams at $2 ; two men at cutter and silo ; three cutting of fodder and loading, and two teamsters, or a total cost for harvesting and filling of $34 or $35. This sum is, however, an unreasonable cost, for we had to cut up the very prostrate corn, sown very thick in drills, every 16 inches apart making a severe cost. Also we were experimenting and weighed and gave attention to details that in our case necessarily hindered us.

After watching closely the working of every detail, I do not see how a cost of less than 75 cents per ton can safely be reckoned upon, when the cost of engine for running days on the farm, its wear, breakage, interest, the same on the cutter, and all costs are fairly considered. Not one man in a thousand fairly considers all of the elements of cost. The machinery cost is great.

$600 engine, 20 per cent. interest, wear, and breaks, 40 days' use, per day.	$3 00
$80 cutter, 20 per cent. interest, wear, breaks, 8 days' use, per day	2 00
Engineer	1 50
Wood or coal and oil	1 50
Total	$8 00

If only twenty tons are cut in a day, it costs 40 cents a ton alone for machinery. Good crops cannot be successfully grown year after year on the same ground, and necessarily some must be drawn from a distance. More fodder thus harvested will cost over 75 cents a ton for harvesting than less. That our farmers may know how to value their college farm data touching labor, allow me to say in their interest, that until twenty-nine years I led daily in the hardest of farm labor as hardy a body of laborers as are rarely seen, and therefore know what a day's labor is. The very cheap results seen going the rounds are fictions based upon incomplete estimates.

The cost of housing the half air dried was two teams 1.16 days, two men as pitchers, one man in the loft, one at the horse fork, and eight days cutting and shocking. Total cost $17.28. This sum could be reduced on corn planted as now done, and as is my custom by four or five dollars, or to $12 to $13.

The cost of cutting this fodder in the barn will be about $1.00 a ton, and if cut and crushed as we fed ours, $1.50 a ton, although I have no exact data. That put in barn dried down to 6.7 tons, and the cost would be according to method of cutting, $6 to $10. This added to $17.28 makes $23.98 to $27.28.

These figures of cost are unfair to ensilage as the conditions under which each load of ensilage had to be weighed were unfavorable. When both methods are pursued at best advantage, the balance is somewhat in favor of dry storage. Drying will save about the draft of ten tons per acre out of 20 tons yield, but requires shocking and mowing away. A fair account is as follows:

One acre of 20 tons, for ensilage, 75 cents a ton for harvesting........		$15 00
One acre for dry storage, shocking, two men...........	$2 00	
Four men and two teams, four-fifths days drawing....................	6 40	
Cutting 53 tons in winter for feeding..............................	5 30	$13 70
Gain..		$ 1 30

The above figures are the most favorable that can be made for green versus dry storage. If the corn fodder is not cut in the dry state the balance is heavily in favor of dry storage in cost of handling.

While I found 34.3 per cent. loss in the silo, I will suppose that under a less prolonged exposure than I necessarily gave it in experiment feeding, that this could be reduced to 30 per cent. of loss in the silo. We then have the cost of handling 30 per cent. of 20 tons, or six tons per acre drawn into the silo, and two tons of rotten matter carried out in a basket to charge to the fourteen tons of food left. We paid 75 cents per ton to get it into the silo, or $6.90, and must add forty cents more for raising and manuring for six tons and the cost of carrying out two tons of waste at 75 cents, or $7.65 of non-productive cost to charge to the 14 tons left. This fourteen tons will contain about 2.8 tons of dry matter. This dry matter could be bought in 3.11 tons of timothy hay. This could be bought for $18.66 on an average throughout the state. The $7.65 lost in handling six tons of waste matter leaves $11.01 as the net result of the silo with reference to the average Missouri conditions.

But the silo will rot out, say in ten years. This cost will at least be double the storage room cost of dry fodder, or on the basis of one-tenth the storage room cost of a wooden silo for 20 tons ensilage at $68, will amount to an extra charge for the 20 tons of space occupied of $3.40 yearly.

On the other hand, dry storage loses by shrinkage 5.56 per cent. Stating the cost of dry storage matter left to feed out on 30 per cent. loss, we meet with the following figures: Sound, dry matter for 20 tons of 20 per cent. dry matter in the green state per acre, will be given of silage per acre, 5600 lbs., cost per ton at acre cost of $23 for growing and harvesting, $8.21. Sound, dry matter by dry storage, 7,555 lbs. Cost of as above at $21.80 per acre, after cutting in winter, $5.77. Cost of silo system above that of dry storage system, $2.44 per ton or 42.3 per cent. To this should be added the extra cost of silo room over and above the cost of dry storage room.

Annual cost per ton dry, sound matter, taken from silo with interest of silo and wear—10 years use or 10 per cent. wear—$6.08, interest, $4.08, total, $10.88 for 20 tons green fodder, or for 5600 lbs dry matter, (2.8 tons) $3.93 per ton. To this add the cost of gathering of $8.31, and we get the discouraging total of $12.24 per ton, dry matter, or about twice the cost of the same amount when bought outright, and yet we have only discussed cost, the profit is yet to come in. Cost per ton of dry matter, dry stored, for storage at 5 per cent. depreciation of building and 6 per cent. interest, $1.27. This cost of storage, annual cost of interest and wear of $3.93, per ton dry matter for the silo and $1.27 for dry storage, is due to the greater cost of silo, greater wear, but more fully to the fact that less tons get through the winter upon which to divide cost. I have made my figures upon the tons of sound fodder found in either system in the spring of the year.

The above considered foods were fed to both cows and steers. The result will be reported in a future bulletin at an early date. The station is now prepared to publish its bulletins regularly and as often as funds will permit.

CONDENSED STATEMENT OF PRACTICAL DATA.

I.	Storage power for a ton of Ensilage, costs in wooden silo.........	$ 3 40
II.	Storage room for acre or 20 tons of Ensilage, costs in wooden silo	68 00
III.	Storage room for acre or 20 tons of Ensilage, costs in stone silo..	100 00
IV.	Storage room for as much dry matter in hay as in an acre of corn Ensilage of 20 tons, cost	49 59
		POUNDS.
V.	Total food material lost in 100 pounds of corn Ensilage and spoiled	34 3
VI.	Total food material lost in 100 pounds dry stored field corn.......	5.56

		TONS.
VII.	Field corn properly grown can be successfully dry stored.	
VIII.	Sorghum yielded per acre in drills 16 inches apart..	23.66
IX.	Sorghum yielded per acre of dry matter, planted as above	5.39
X.	Sugar corn yielded per acre, planted in drills 16 inches apart.....	14.6
XI.	Sugar corn yielded per acre, planted in drills 16 inches apart, dry matter....	3.00
XII.	Field corn, planted 2x4 feet, yielded in tons per acre.	11.5
XIII.	Field corn, planted 2x4 feet, yielded in dry matter................	2.87

(This corn was grown on the sixth year of corn after corn. Most of it virtually unmanured and not over two-thirds to three-fourths of a full crop.)

XIV. A limestone silo preserves Ensilage as well as wood.

XV. The loss of dry cut Ensilage was much the greatest and the quality similar, the cattle preferring the cut fodder.

XVI. The cane seems to have lost no more than corn in the silo.

XVII. The sugar corn losing in all 48.3 per cent., kept the poorest having much spoiled.

XVIII. .46 per cent. acid was formed in cut cane, and .18 per cent. in uncut cane in silo. While the amides of sweet and field corn Ensilage increased in silo from 8.69 per cent. to 18.94 per cent., a distinctive loss.

XIX. The lower layer had but about one-fourth the spoiled cane of the upper layer. The second layer of cane, however, was of another variety, and coming into dough state, while the bottom layer was in the dough state.

XX. Loss per cent. of total Ensilage in silo by weight, 19.6 per cent.

XXI. Loss per cent. of dry matter in silo 15.4 per cent.

XXII. Cost of harvesting green fodder for silo is more than for dry storage.

XXIII. The dry matter preserved from twenty tons of Ensilage could be raised in 3.16 tons of hay and at less money.

XXIV. The silo insures against the liable leaching effects of rains, but swaps it for the certain destructive effects of the silo.

XXV. Up to the point of feeding Ensilage dry storage is the better method according to the teachings of the above data.

APPENDIX.

The scientific data fall far short of my designs and that secured is not wholly satisfactory. The chemist of the station, Dr. Schweitzer, was without an assistant for some time and the work submitted was restricted. Samples of ensilage and of the same foods dry stored were sent to the laboratory in glass jars, but before they were analyzed stood so long that the water shrinkage became so great that it represented, when actually analyzed by the chemist, a greater loss of water by far than the total shrinkage of the layer of ensilage involved. They should have been air dried on receipt, as will be readily understood. For these two layers in question I am forced to use the ash contents for the estimate of their shrinkage. This would be a secure basis if the average of several analyses were used. The sampling was made in several spots to obtain an average sample.

A critical study of the figures will not show a complete consistency. Among other noticeable fluctuations will be those in the varying shrinkage of the different layers. Those shrinkages do not accord at all with those of gross weight. The samples were taken with care by mixing many selections and taking to the laboratory at once and before changes in moisture or other changes could occur. I will give the analyses of the foods involved first, and then a table based upon those analyses and of the weight of food put in and taken out, before observing further details. H. J. Waters, B. A. S., a graduate of the Agricultural College, has had charge of the experiments in their daily details. It gives me pleasure to state that they have been both intelligently, zealously and most industriously prosecuted.

	Acid, per cent.	Water.	Ash.	Ether Extract. Fat.	Crude Fibre.	Crude Protein.	Carbo-hydrates.	Total Nitrogen.	Non-albuminoid Nitrogen.
....	....	77.11	0.89	0.34	5.52	1.44	14.70		
1. Amber Sorghum, green........	.....	77.31	1.30	0.33	5.32	1.94	13.71	.....	.....
2. Sorghum, green..............	....	.....	.....	.....	.....	.....	....	....	.....
....	.....	.....	.....	.....	.....	.....	.....	.....	....
4. Sweet corn, green............	.....	77.51	1.12	1.01	4.58	1.75	14.03	.....	.....
5. Field corn, green.............	.....	75.06	1.22	0.65	6.73	2.13	14.21	.....	.....
7. Field corn, dry stored........	.....	15.53	2.77	0.18	17.31	1.75	62.46	... .	.....
8. Sweet corn, dry stored......	.....	19.07	3.35	2.34	27.27	9.49	38.48	1.52	.10
8a. Whole corn, Ensilage, ...	.....	80.39	1.05	0.39	6.54	1.56	10.07	....	.....
9. Field corn Ensilage	.40	64.11	2.14	1.06	9.06	3.40	20.23	0.54	.08
10. Sweet corn Ensilage	.51	79.27	1.10	0.91	5.04	1.79	11.88	0.29	.07
12. Amber Sorghum Ensilage....	.36	77.28	1.14	0.41	6.98	1.08	13.11	0.17	.01
13. Sorghum	.60	63.88	2.33	0.71	9.06	2.55	11.47	0.41	.03
1. The above dry	....	.....	3.88	1.48	24.14	6.37	64.13	.....	.. .
2. " "	.....	.. ..	6.12	1.46	23.43	8.62	60.37	.....	.....
4. " "	. ...	.....	5.00	4.50	20.36	7.81	62.83	.....	.....
5. " "	.....	. ...	4.89	2.6	26.98	8.54	56.97	.....	.....
7. " "	.....	.....	3.28	2.23	20.49	7.75	66.23	.....	.....
8. " "	.....	.....	3.68	2.57	29.99	10.44	53.32	1.67	.11
8a. " "	.....	....	5.36	1.98	33.38	8.06	51.22	....	....
9. " "	.....	... .	5.97	2.95	25.24	9.50	56.34	1.52	.23
10. " "	.....	.....	5 31	4.36	24.28	8.62	57.43	1.38	.32
12. " "	.....	.....	5.02	1.82	30.73	4.75	57.68	0.76	.26
13. " "	.....	.....	6.45	1.96	25.09	7.06	59.44	1.13	.14

The table below calculates the total amount of the constituents put into the silo, save layer one, which was not analyzed, and the amounts of each taken out together with the percentage of each constituent.

The variation in the character of the layers of food, put in with its varying degrees of maturity, have its modifying influence. It is clear to me that these reasons will not account for the variations observed.

PUT IN SILO.	Water.	Organic Matter.	Ash.	Fat.	Crude Fibre.	Crude Protein.	Carbo-hydrates.
Second layer cane	30449	8937	547 47	129.97	2095.34	7640.09	5399.82
Third layer corn..	17230	5725	280.05	149.21	1564.87	488.94	3261.90
4th lay'r swe'tcorn	21814	6330	315.71	284.25	1288.99	492.52	3948.61
Fifth layer cane...	25287	7506	291.86	111.50	1810.17	472.22	4820.57
6th layer wh'le cane	22893	6795	264.23	100.94	1638.83	427.52	4364.28
Total..............	117674	35293	1698.82	775.87	8398.20	2645.29	21795.18
Taken out-2d layer	24000	8455	545.21	166.14	2120.04	596.69	5023.92
Third layer.	15072	4545	270.77	134.12	1146.35	430.19	2559.68
Fourth layer......	19874	5195	275.79	228.16	1263.63	448.79	2981.06
Fifth layer........	22884	6728	337.57	121.40	2066.80	319.81	3882.13
Sixth layer........	18145	5334	267.66	96.26	1638.83	253.57	3078.09
Total....	99975	30257	1697.	746.08	8235.65	2049.05	17524.88
Shrinkage of each	21.18	5.40	4.41	27.7	*1.10	21.9	6.9
Second layer......	*6449	482 lbs.	2.25 lbs.	36.01 lbs	24.71 lbs	167.39lbs	375.9 lbs
Third layer........	12.52 2158 lbs.	20.61 1180 lbs.	3.20 9.28 lbs	10.10 15.08 lbs	26.7 418.52.lb	12.00 58.75 lbs	21.20 702.22 lb
Fourth layer ...	8.89 1940 lbs.	18.00 1135 lsb	12.64 *39.92lbs	19.73 56.09 lbs	1.96 25.36 lbs	8.88 43.73 lbs	24.5 967.54 lb
Fifth layer........	10.7 2402 lbs.	10.36 778 lbs.	15.06 45.12 lbs	*8.08 9.91 lbs	*14.7 256 63 lb	32.20 152.4 lbs	19.40 938.44 lb
Sixth layer	20.74 4748 lbs.	21.50 1460 lbs.	1.33 3.53 lbs	3.68 3.68 lbs	....	40.69 173.95lbs	29.44 1286.19lb
Total shrinkage...	17699	5036 lbs.	1.82	29.79 lbs	162.55 lb	596.24lbs	4270.3lbs
Pr. ct.of shrinkage	15.03	14.27	1.00	3.84	1.93	22.54	19.59

*Gain.