

AGRICULTURAL EXPERIMENT STATION

KANSAS STATE AGRICULTURAL COLLEGE

DEPARTMENT OF CHEMISTRY

ANALYSES OF INSPECTION SAMPLES OF FERTILIZERS, 1917

J. T. WILLARD, C. O. SWANSON, AND R. C. WILEY

EXPLANATORY STATEMENT

THIS circular gives a statement of the results of the analyses of inspection samples of fertilizers collected in the spring and fall of 1917. Results found which are more than one-fifteenth below the guarantee are printed in bold-faced type. The small number of such figures shows that the manufacturers are in good faith attempting to conform to the provisions of the law.

A departure of one-fifteenth, or in some cases slightly more, is not regarded as evidence of fraudulent intent. The low results in some cases are probably due to inevitable error in sampling or mixing. It should be noted also that a number of samples show results higher than the guarantee. One outstanding criticism is that a large number of brands contain chlorine varying from 0.10 percent to 0.80 percent, and the guarantee would lead the user to believe that none is present. While this no doubt is not the result of fraudulent intent, nevertheless the manufacturer is liable to the user for damages. A few brands in which there was a large deficiency in potassium in the samples collected in the spring showed a marked improvement in this respect in those samples collected in the fall.

The quantities of fertilizers sold in Kansas during the last 10 years can be seen from the following figures :

Year	Tons	Year	Tons
1908..	2,386	1913..	7,380
1909.	2,190	1914.	9,460
1910..	2,420	1916..	7,600
1911..	3,000	1916..	7,640
1912..	3,900	1917..	12,900

These figures are based on the sale receipts of tax tags. This shows a constant increase, except for the temporary drop in 1916 and 1916. The amount used in 1917 was from five to six times the amount used eight or ten years ago.

Commercial fertilizers are valuable because they contain the elements nitrogen, phosphorus, and potassium in forms quickly available for plant use. A soil which contains in 1 acre, 7 inches deep, 2,000 to 3,000 pounds of nitrogen, 500 to 800 pounds of phosphorus, and 20,000 to 30,000 pounds of potassium, may respond to the application of a few hundred pounds of fertilizers. This is because these elements in the fertilizers are in a form more quickly available than the forms in which they are present in the soil.

The principal sources of nitrogen in fertilizers sold in Kansas are: Slaughter house products, such as bone, blood, tankage; sodium nitrate; ammonium sulphate; and animal manures. In compounds like sodium nitrate and ammonium sulphate, the nitrogen is available at once without any chemical change. In slaughter house products, the nitrogen is rapidly made available because these substances decay and undergo nitrification very quickly when put in the soil. The nitrogen in such animal manures as are put in fertilizers is no more quickly available than the nitrogen in the manure from the farmer's barnyard, unless these manures have been subjected to the "base mix" process. In this process inert nitrogenous materials are mixed with the acid phosphate at the time of manufacture. The heat and sulphuric acid act on the inert nitrogenous materials in such a way as to make the nitrogen more quickly available. Ordinarily, animal manures are not treated this way in the manufacture of fertilizers.

The method of determining nitrogen in fertilizers does not make any distinction between the different forms. The figures as given in the tables represent the total. In most of the fertilizers the source of nitrogen is slaughter house products. In a large number, dried animal manure is used as a filler. When this is done the manure also serves as a source of nitrogen.

The sources of phosphorus in fertilizers are bone meal, tankage, and acid phosphate. Acid phosphate is made from rock phosphate by treatment with sulphuric acid. Generally speaking, 1 ton of finely ground rock phosphate is mixed with 1 ton of sulphuric acid and this gives 2 tons of acid phosphate. If

the rock phosphate contains 14 percent phosphorus the resulting acid phosphate would contain 7 percent phosphorus. The cost of the sulphuric acid, the cost of manufacture, the cost of added transportation, and the interest on the investment add to the cost of the phosphorus in acid phosphate. This additional cost must be met by the quicker returns from acid phosphate as compared with rock phosphate. Whether this will be done has been the subject of a great deal of controversy, and the relative merits are not discussed here.

In the manufacture of acid phosphate a little less sulphuric acid is used than is needed to convert all the phosphorus in the rock phosphate to soluble forms. This is necessary in order to get a product that can be handled in transportation and subsequent use in the field. Because of this, the phosphorus in acid phosphate is found in three different forms; namely, insoluble, reverted, and water-soluble. The insoluble is the form in which phosphorus is found in the original rock phosphate. The water-soluble is the form produced when the action in sulphuric acid has been carried to completion. This is the most available form. In the reverted form the action has not gone so far as in the water-soluble, but phosphorus in this form is available for the use of crops. Some think that this form is as valuable as the water-soluble. By many fertilizer men the water-soluble and the reverted are classed together and called available. When this is done the "available" is simply the difference between the insoluble and the total.

Phosphorus in bone and other slaughter house products is in a form that is quickly available. Raw bone contains fat and nitrogenous material. This is removed by water and heat. The resulting bone is very friable and can be ground to a very fine powder. In this form the phosphorus is quickly available. For this reason bone products are usually analyzed for total phosphorus only.

Before the present war the source of potassium was the potash salts from Germany. These were usually the sulphate, chloride, and kainit. Kainit is a mixture of several salts. The one common and important quality of the form of potassium in all of these salts is solubility in water. This is so important that no potassium is considered of value in fertilizers unless it is soluble in water. Since the outbreak of the war fertilizer manufacturers have had difficulty in obtaining materials con-

taining potassium in suitable forms. Because of this difficulty the formula of a large number of brands has been changed so as to contain less potassium. Wood ashes and manure ashes are often used as sources of potassium. Such materials vary a great deal in composition. Nine samples of the fertilizers reported in this circular show a percent of potassium lower than the required minimum, while twenty-seven samples show a higher percent. This may be due to the difficulty of obtaining potassium-carrying materials of uniform composition.

The increased use of fertilizers in 1917 over previous years is gratifying in that it shows an added effort in food production. But a word of warning should be given, not to discourage this increased use of fertilizers, but to encourage the full use of materials on the farm. A ton of alfalfa hay contains approximately 50 pounds of nitrogen, 50 pounds of potassium, and 3 pounds of phosphorus. A ton of average barnyard manure contains 10 pounds of nitrogen, 8 pounds of potassium, and 2 pounds of phosphorus. These materials also contain humus-forming material. This is absent in commercial fertilizers. A continued use of commercial fertilizers without the use of humus-forming materials, such as straw, barnyard manure, and crop residues, leads to the depletion of the humus present in the soil, and the result is lessened production because of the bad physical condition which always follows humus depletion.¹

1. For further information regarding fertilizers the reader is referred to Bulletin 204, "Fertilizers and Their Uses," and Bulletin 220, "Soil Fertility," of the Kansas Agricultural Experiment Station, Manhattan, Kan. Copies will be sent on request.

TABLE I.—RESULTS OF ANALYSES OF INSPECTION

BRANDS AND MANUFACTURERS	Name of seller, and place sampled	Minimum percent of total nitrogen	
		Found	Guaranteed
Spring, 1917			
ARMOUR FERTILIZER WORKS			
444 Armour's Ammoniated Phosphate	Hadley Milling Co., Olathe.....	1 71	1 65
445 Armour's Ammoniated Phosphate	J. N. Stewart, McCune.....	1 86	1 65
446 Armour's Ammoniated Phosphate	Chetopa Grain Co., Chetopa.....	1 81	1 65
447 Armour's Ammoniated Phosphate	Pittsburg Modern Milling Co., Pittsburg	1 63	1 65
458 Armour's 1-8-1 Fertilizer	Keiso Grain Co., Columbus.....	.83	.82
454 Armour's 1-8-1 Fertilizer	J. N. Stewart, McCune.....	.77	.82
450 Armour's 1-12-1 Fertilizer	Pittsburg Modern Milling Co., Pittsburg	.73	.82
451 Armour's 1-12-1 Fertilizer	Chetopa Grain Co., Chetopa.....	.77	.82
452 Armour's 1-12-1 Fertilizer	Keiso Grain Co., Columbus.....	.81	.82
439 Helmet Brand Fine Ground Beef Bone	Chetopa Grain Co., Chetopa.....	2 40	2 47
449 Helmet Brand No. 2-8-2 Fertilizer	Hadley Milling Co., Olathe.....	1 60	1 64
448 Helmet Brand 16% Phosphate..	J. W. Taylor, Edwardsville.....		
COCHRANE PACKING CO.			
434 Cochrane Champion Grain Grower.....	Chanute Grain Co., Chanute.....	2 38	1 65
SWIFT & CO.			
455 Swift's Ammoniated Bone Phosphate and Potash.....	Libby Bros., Altamont.....	1 57	1 64
456 Swift's Ammoniated Bone Phosphate and Potash.....	J. F. Shields, Chetopa.....	1 51	1 64
457 Swift's Ammoniated Bone Phosphate and Potash.....	Labette Co. Farmers' Coop. Merc. Union, Parsons	1 61	1 64
458 Swift's Ammoniated Bone Phosphate and Potash.....	Pittsburg Elevator Co., Pittsburg	1 61	1 64
442 Swift's Bone Flour.....	Labette Co. Farmers' Coop. Merc. Union, Parsons	1 30	
466 Swift's Clay Soil Special.....	Labette Co. Farmers' Coop. Merc. Union, Parsons	1 30	1 77
460 Swift's Diamond "K" Grain Grower.....	Labette Co. Farmers' Coop. Merc. Union, Parsons	.77	.82
461 Swift's Diamond "K" Grain Grower.....	Union Hardware and Implement Co., Independence.....	.91	.82
462 Swift's Diamond "K" Grain Grower.....	Pittsburg Elevator Co., Pittsburg.....	.81	.82
463 Swift's Diamond "K" Grain Grower.....	Olson Bros., Edna.....	.94	.82
440 Swift's Ground Steamed Bone....	Olson Bros., Edna.....	1 95	1 64
441 Swift's Ground Steamed Bone....	J. F. Shields, Chetopa.....	1 74	1 64
465 Swift's High Grade Phosphate..	I. E. Clark, Walnut.....		
432 Swift's Pure Bone Meal.....	Libby Bros., Altamont.....	2 07	2 47
433 Swift's Pure Bone Meal.....	I. E. Clark, Walnut.....	2 40	2 47
435 Swift's Pure Bone Meal.....	E. B. Davis, Columbus.....	2 09	2 47
436 Swift's Pure Bone Meal.....	Labette Co. Farmers' Coop. Merc. Union, Parsons.....	2 17	2 47
437 Swift's Pure Bone Meal.....	J. F. Shields, Chetopa.....	2 31	2 47
438 Swift's Pure Bone Meal.....	Olson Bros., Edna.....	1 88	2 47

(a) This includes the water-soluble.

Analyses of Samples of Fertilizers

SAMPLES OF FERTILIZERS, 1917

Minimum percent of phosphorus in phosphates								Minimum percent of potassium in compounds soluble in water		Maximum percent of chlorine in compounds soluble in water	
Soluble in water		Reverted (a)		Insoluble		Total		Found	Guar-anteed	Found	Guar-anteed
Found	Guar-anteed	Found	Guar-anteed	Found	Guar-anteed	Found	Guar-anteed	Found	Guar-anteed	Found	Guar-anteed
.....	4.18	4.37	.57	.22	4.75	4.59	.....	.....	.....	.....
.....	4.10	4.37	.65	.22	4.75	4.59	.....	.....	.....	.....
.....	3.99	4.37	.71	.22	4.70	4.59	.....	.....	.....	.....
.....	4.13	4.37	.52	.22	4.65	4.59	.....	.....	.....	.....
.....	3.44	3.49	.46	.22	3.90	3.71	.24	.83	.10	.....
.....	2.97	3.49	.16	.22	3.13	3.71	1.01	.83	.25	.....
.....	5.08	5.24	.27	.22	5.35	5.46	1.05	.83	.20	.....
.....	4.81	5.24	.22	.22	5.03	5.46	.31	.83	.20	.....
.....	4.97	5.24	.18	.22	5.15	5.46	.31	.83	.25	.....
.....	2.62	11.92	.....	.00	7.86	11.92	10.48	.....	.....	.....	.....
.....	3.64	3.49	.56	.....	4.20	3.49	1.57	1.66	.55	1.65
.....	6.45	6.99	.20	.22	6.65	7.21	.....	.....	.....	.....
.....	5.00	4.37	1.10	.22	6.10	4.59	.65	.88	.80	.....
.....	4.38	4.37	.30	.20	4.68	4.57	.73	.41	.65	1.50
.....	4.13	4.37	.43	.20	4.56	4.57	.43	.41	.50	1.50
.....	4.17	4.37	.36	.20	4.53	4.57	.59	.41	.40	1.50
.....	4.50	4.37	.28	.20	4.78	4.57	.37	.41	.25	1.50
.....	13.65	.....	.....	.....	.....	.....
.....	3.64	5.68	5.24	.50	.22	6.18	5.46	.....	.....	.....	.43
.....	5.57	5.24	.38	.20	5.95	5.44	1.06	.88	.65	1.50
.....	5.02	5.24	.24	.20	5.26	5.44	1.08	.88	.95	1.50
.....	5.29	5.24	.26	.20	5.55	5.44	1.07	.88	.70	1.50
.....	5.44	5.24	.28	.20	5.72	5.44	.70	.88	.55	1.50
.....	8.67	8.74	.....	.....	.....	.....
.....	9.10	8.74	.....	.....	.....	.....
.....	6.65	.....	.23	.....	6.98	7.42	.....	.....	.....	.....
.....	11.30	10.48	.....	.....	.....	.....
.....	11.05	10.48	.....	.....	.....	.....
.....	11.45	10.48	.....	.....	.....	.....
.....	11.52	10.48	.....	.....	.....	.....
.....	11.15	10.48	.....	.....	.....	.....
.....	9.59	10.48	.....	.....	.....	.....

TABLE I.—

BRANDS AND MANUFACTURERS	Name of seller, and place sampled	Minimum per cent of total nitrogen	
		Found	Guaranteed
SWIFT & Co.—continued			
443 Swift's Pure Raw Bone Meal	E. B. Davis, Columbus	4 32	3.75
459 Swift's Tomato and Vegetable Fertilizer	Pittsburg Elevator Co., Pittsburg	1 35	2.46
464 Swift's Truck Fertilizer	E. B. Davis, Columbus	1 65	2.46
Fall, 1917			
ARMOUR FERTILIZER WORKS.			
497 Armour's Ammoniated Phosphate	Jacqueth & Gilman, Baxter	1.83	1.65
498 Armour's Ammoniated Phosphate	L. B. Van Slyke, Altamont	1.76	1.65
500 Armour's New Record Brand	Jacqueth & Gilman, Baxter . . . . .	.87	.82
499 Armour's New Record Brand	Woodson Co. Grain Co., Yates Center	1 12	.82
496 Armour's 1-8-1 Fertilizer	Cherokee Co. Mill & Elevator, Columbus	1.15	.82
495 Armour's 1-8-1 Fertilizer	Dickinson Bros., Humboldt	1.08	.82
491 Armour's 1-12-1 Fertilizer	Pittsburg Modern Milling Co., Pittsburg	1 11	.82
492 Armour's 1-12-1 Fertilizer	L. B. Van Slyke, Altamont	1 21	.82
481 Helmet Brand Fine Ground Beef Bone	Cherokee Co. Mill & Elevator, Columbus	2 56	2.47
480 Helmet Brand Fine Ground Beef Bone	Jacqueth & Gilman, Baxter	3.09	2.47
479 Helmet Brand Fine Ground Beef Bone	Pittsburg Modern Milling Co., Pittsburg	2 68	2.47
478 Helmet Brand Fine Ground Beef Bone	L. B. Van Slyke, Altamont	2 72	2.47
COCHRANE PACKING CO.			
493 Cochrane's Champion Grain Grower	M. C. Everett, Wellsville	1.05	1 65
494 Cochrane's Champion Grain Grower	Labette Co. Farmers' Coop. Merc. Union, Parsons	1 14	1.65
490 Cochrane's Champion Grain Grower	Oswego Milling Co., Oswego	2.40	1.65
486 Cochrane's 1-8-1 Brand	Oswego Milling Co., Oswego	1.11	.....
484 Cochrane's Pure Bone Meal	A. W. Bugley, Paola	2.42	2.47
483 Cochrane's Pure Bone Meal	Labette Co. Farmers' Coop. Merc. Union, Parsons	2 64	2.47
482 Cochrane's Pure Bone Meal	D. S. Lantz, Wagstaff	2.52	2.47
489 Cochrane's Special Grain Producer	John Downs, Wagstaff	1.15	.82
487 Cochrane's Special Grain Producer	J. F. Matthews, Paola	1 06	.82
488 Cochrane's Special Grain Producer	C. S. Nevins, Chiles	1 00	.82
EMPIRE CARBON WORKS			
512 Bone Black No. 2	J. E. Laubaugh, Columbus	2.09	2 06
511 Bone Black No. 2	Thomas Lenahan, Bucyrus	2 04	2.06
510 Empire Farmers' Favorite	Thomas Lenahan, Bucyrus . . . . .	.89	.82
MORRIS & Co.			
485 Steamed Bone Meal	Cherokee Co. Mill & Elevator, Columbus	1.08	.82
SWIFT & Co.			
508 Swift's Ammoniated Bone Phosphate and Potash	Blaker Lumber Co., Fontana	1.76	1.64
504 Swift's Ammoniated Bone Phosphate and Potash	Labette Co. Farmers' Coop. Merc. Union, Parsons	2.09	1.64

(a) This includes the water-soluble.

Analyses of Samples of Fertilizers

CONTINUED

Minimum percent of phosphorus in phosphates								Minimum percent of potassium in compounds soluble in water		Maximum percent of chlorine in compounds soluble in water	
Soluble in water		Reverted (a)		Insoluble		Total		Found	Guar-anteed	Found	Guar-anteed
Found	Guar-anteed	Found	Guar-anteed	Found	Guar-anteed	Found	Guar-anteed	Found	Guar-anteed	Found	Guar-anteed
						9.66	10.04				
		.00	3.49	.80	.20	5.10	3.69	.78	.41	.45	1.50
		.00	3.49	.82	.20	4.65	3.69	1.29	.88	.50	1.50
		4.87	4.87	.57	.22	4.94	4.59			0.35	
		4.78	4.37	.56	.22	5.39	4.59			0.30	
		4.19	4.37	.13	.22	4.32	4.59	.93	.88	0.28	
		4.85	4.37	.59	.22	4.94	4.59	.85	.88	0.55	
		3.39	3.49	.18	.22	3.57	3.71	.78	.88	0.28	
		3.24	3.49	.23	.22	3.47	3.71	.98	.88	0.25	
		4.88	5.24	.38	.22	5.21	5.46	1.05	.88	0.20	
		4.80	5.24	.25	.22	5.05	5.46	.98	.88	0.30	
						11.65	10.48				
						10.20	10.48				
						10.70	10.48				
						11.73	10.48				
		4.79	4.37	.95	.22	5.74	4.59	.80	.88	0.24	
		5.85	4.37	1.16	.22	6.01	4.59	.75	.88	0.17	
		4.20	4.37	1.71	.22	5.91	4.59	.72	.88	0.78	
		4.47		.74		5.21		.77		0.24	
						12.19	10.48				
						11.08	10.48				
						11.69	10.48				
		4.45	5.24	.62	.22	5.07	5.46	.33	.88	0.20	
		4.48	5.24	.48	.22	4.96	5.46	.76	.88	0.20	
		5.21	5.24	.62	.22	5.83	5.46	.81	.88	0.22	
		3.73	3.49	.74	.27	4.47	3.76			0.18	
		3.39	3.49	.94	.27	4.33	3.76			0.10	
		4.43	5.46	.72	.42	5.15	5.89	1.03	.88	0.48	
						14.73	13.97				
		4.19	4.37	.55	.20	4.74	4.57	.76	.41	0.39	1.50
		4.40	4.37	.52	.20	4.92	4.57	.58	.41	0.30	1.50

TABLE 1.—

BRANDS AND MANUFACTURERS	Name of seller, and place sampled	Minimum percent of total nitrogen	
		Found	Guaranteed
<i>SWIFT & Co.—continued</i>			
505 Swift's Ammoniated Bone Phosphate and Potash	C. L. Wilson, La Harpe	1 51	1 64
507 Swift's Diamond "K" Grain Grower	M. C. Everitt, Wellsville	1.03	.82
501 Swift's Diamond "K" Grain Grower	Labette Co. Farmers' Coop. Merc. Union, Parsons	.96	.82
509 Swift's Diamond "K" Grain Grower	Pittsburg Elevator Co., Pittsburg	90	82
506 Swift's Diamond "K" Grain Grower	E. M. Stice, Oswego	1.12	.82
502 Swift's Diamond "K" Grain Grower	Union Hardware and Implement Co., Independence	.91	.82
508 Swift's Diamond "K" Grain Grower	Walbert & Timberlake, Girard	.98	.82
469 Swift's 1.5-30 Bone Meal	D. L. Barret, Beagle	1.40	82
476 Swift's 1.5-30 Bone Meal	O. W. Batdorf, Wellsville	1.40	.82
472 Swift's 1.5-30 Bone Meal	Blaker Lumber Co., Fontana	1.28	82
471 Swift's 1.5-30 Bone Meal	I. E. Clark, Walnut	1.22	.82
473 Swift's 1.5-30 Bone Meal	M. C. Everett, Wellsville	1.15	.82
475 Swift's 1.5-30 Bone Meal	F. W. Hays, Osawatomie	1.28	.82
470 Swift's 1.5-30 Bone Meal	B. V. Kirby, Bucyrus	1.10	.82
474 Swift's 1.5-30 Bone Meal	Pittsburg Elevator Co., Pittsburg	1 10	.82
467 Swift's 1.5-30 Bone Meal	R. S. Williar, Chiles	1.05	.82
468 Swift's Pure Raw Bone Meal	E. M. Stice, Oswego	4 35	3.75
477 Swift's Raw Bone Meal	Labette Co. Farmers' Coop. Merc. Union, Parsons	4.32	3.75

(a) This includes the water-soluble.

Analyses of Samples of Fertilizers

CONCLUDED

Minimum percent of phosphorus in phosphates								Minimum percent of potassium in compounds soluble in water		Maximum percent of chlorine in compounds soluble in water	
Soluble in water		Reverted (a)		Insoluble		Total		Found	Guar-anteed	Found	Guar-anteed
Found	Guar-anteed	Found	Guar-anteed	Found	Guar-anteed	Found	Guar-anteed	Found	Guar-anteed	Found	Guar-anteed
.....	4.33	4.37	.61	.20	4.94	4.57	.61	.41	0.48	1.50
.....	5.87	5.24	.39	.20	6.26	5.44	1.16	.88	0.50	1.50
.....	5.28	5.24	.32	.20	5.60	5.44	1.28	.88	0.60	1.50
.....	5.67	5.24	.40	.20	6.07	5.44	1.29	.88	0.40	1.50
.....	5.49	5.24	.43	.20	5.92	5.44	1.36	.88	0.48	1.50
.....	4.55	5.24	.38	.20	4.93	5.44	.99	.88	0.40	1.50
.....	5.27	5.24	.53	.20	5.80	5.44	1.16	.88	0.79	1.50
.....	18.18	12.66	.....	.....	.....	.....
.....	18.42	12.66	.....	.....	.....	.....
.....	18.43	12.66	.....	.....	.....	.....
.....	18.79	12.66	.....	.....	.....	.....
.....	18.34	12.66	.....	.....	.....	.....
.....	18.55	12.66	.....	.....	.....	.....
.....	18.85	12.66	.....	.....	.....	.....
.....	18.15	12.66	.....	.....	.....	.....
.....	18.89	12.66	.....	.....	.....	.....
.....	9.95	10.04	.....	.....	.....	.....
.....	9.85	10.00	.....	.....	.....	.....

APPENDIX

FINANCIAL STATEMENT—FERTILIZER FEES

(July 1, 1916, to June 30, 1917)

RECEIPTS

	<i>1916</i>	Balance July 1, 1916.....	\$1,716.81
171	July 20	Continental Fertilizer Company, Chicago, Ill., reg. fee.....	25.00
172	Aug. 12	Empire Carbon Works, St. Louis, Mo., tax tags.....	250.00
173	Aug. 12	Armour Fertilizer Works, Kansas City, Kan., tax tags.....	100.00
174	Aug. 29	Cochrane Packing Company, Kansas City, Kan., reg. fees....	100.00
174	Aug. 29	Cochrane Packing Company, Kansas City, Kan., tax tags....	25.00
175	Aug. 31	Wilson & Co., Kansas City, Kan., reg. fees.....	100.00
176	Sept. 5	Swift & Co., St. Joseph, Mo., tax tags.....	375.00
177	Sept. 9	Wilson & Co., Kansas City, Kan., tax tags.....	100.00
178	Sept. 11	Armour & Co., Kansas City, Kan., tax tags.....	100.00
179	Sept. 11	Cochrane Packing Company, Kansas City, Kan., tax tags....	50.00
180	Sept. 14	Morris & Co., Kansas City, Kan., tax tags.....	25.00
181	Sept. 18	Morris & Co., Kansas City, Kan., tax tags.....	100.00
182	Sept. 22	Armour & Co., Kansas City, Kan., tax tags.....	100.00
183	Sept. 26	Armour & Co., Kansas City, Kan., tax tags.....	100.00
184	Oct. 4	Swift & Co., So. St. Joseph, Mo., tax tags.....	125.00
185	Oct. 5	Armour & Co., Kansas City, Kan., tax tags.....	50.00
	<i>1917</i>		
186	Jan. 20	Empire Carbon Works, St. Louis, Mo., reg. fee.....	25.00
187	Jan. 25	Swift & Co., So. St. Joseph, Mo., tax tags.....	125.00
188	Mar. 5	Armour & Co., Kansas City, Kan., tax tags.....	50.00
189	Mar. 10	Swift & Co., So. St. Joseph, Mo., tax tags.....	125.00
190	April 6	Swift & Co., So. St. Joseph, Mo., tax tags.....	125.00
191	April 14	Armour Fertilizer Works, Chicago, Ill., reg. fee.....	25.00
192	June 6	Cochrane Packing Company, Kansas City, Kan., tax tags....	25.00
193	June 13	Armour & Co., Kansas City, Kan., tax tags.....	100.00
194	June 26	Wilson & Co., Kansas City, Kan., reg. fees.....	125.00
Total receipts			\$4,166.81

DISBURSEMENTS

	<i>1916</i>		
	July	Employees' payroll	\$42.86
	July	C. O. Swanson, Manhattan, Kan., traveling expenses.....	27.01
	July	C. O. Swanson, Manhattan, Kan., traveling expenses.....	14.49
	July	Eimer & Amend, New York, N. Y., glassware.....	48.64
	July	Eimer & Amend, New York, N. Y., glassware.....	34.85
	July	Grasselli Chemical Company, St. Louis, Mo., acid.....	3.35
	Aug.	Employees' payroll	75.73
	Aug.	Braun Corporation, Los Angeles, Cal., pulverizer.....	100.00
	Aug.	Eimer & Amend, New York, N. Y., magnesium powder.....	16.42
	Aug.	B. R. Hull, Manhattan, Kan., soil tube.....	1.50
	Aug.	J. T. Lardner, Topeka, Kan., freight and express.....	8.25
	Aug.	J. T. Lardner, Topeka, Kan., freight.....	22.79
	Aug.	Pictorial Printing Company, Aurora, Ill., stamps for fertilizers.....	18.38
	Aug.	E. H. Sargent & Co., Chicago, Ill., sodium hydroxide.....	16.86
	Aug.	Standard Calorimeter Company, East Moline, Ill., gaskets for calorimeter,	.78
	Aug.	C. O. Swanson, Manhattan, Kan., traveling expenses.....	21.74
	Aug.	W. J. Tennant, Manhattan, Kan., belt lacing.....	1.00
	Aug.	Manhattan Gas Company, Manhattan, Kan., gas.....	32.60
	Aug.	Webb Bros. Belting Company, Kansas City, Mo., belting.....	5.70

Analyses of Samples of Fertilizers

<i>1916</i>	
Sept. Employees' payroll	\$30.50
Sept. Central Scientific Company, Chicago, Ill., glassware.....	23.64
Sept. Eimer & Amend, New York, N. Y., burettes.....	5.20
Sept. Heat & Power Dept., K. S. A. C., Manhattan, Kan., repair apparatus...	4.31
Sept. J. T. Lardner, Topeka, Kan., freight and express.....	1.44
Sept. Employees' payroll	107.19
Oct. J. T. Lardner, Topeka, Kan., freight.....	1.24
Oct. Heat & Power Dept., K. S. A. C., Manhattan, Kan., repair gas pipe....	2.16
Oct. J. T. Baker Chemical Company, Phillipsburg, N. J., sodium peroxide...	.66
Oct. J. Bishop & Co., Malvern, Pa., repair platinum crucibles.....	55.28
Oct. Chemistry Dept., K. S. A. C., Manhattan, Kan., chemicals.....	.97
Oct. L. R. Eakin, Manhattan, Kan., jars.....	2.00
Oct. Heat & Power Dept., K. S. A. C., Manhattan, Kan., repair still.....	.45
Oct. E. H. Sargent & Co., Chicago, Ill., sodium hydroxide.....	67.20
Oct. C. O. Swanson, Manhattan, Kan., traveling expenses.....	7.60
Oct. Employees' payroll	16.88
Nov. Employees' payroll	8.98
Nov. J. T. Lardner, Topeka, Kan., freight and express.....	4.11
Nov. R. C. Wiley, Manhattan, Kan., traveling expenses.....	68.45
Nov. Employees' payroll	59.18
Nov. Central Scientific Company, Chicago, Ill., glassware.....	1.08
Nov. Central Scientific Company, Chicago, Ill., glassware.....	51.84
Nov. L. R. Eakin, Manhattan, Kan., Mason jars.....	5.50
Nov. Heat & Power Dept., K. S. A. C., Manhattan, Kan., repair tank.....	.60
Nov. J. T. Lardner, Topeka, Kan., pay to John C. Wood.....	38.00
Nov. J. T. Lardner, Topeka, Kan., freight.....	5.97
Nov. E. B. Purcell Trading Company, Manhattan, Kan., matches.....	3.75
Dec. Employees' payroll	18.76
Dec. Central Scientific Company, Chicago, Ill., glassware.....	9.30
Dec. Heat & Power Dept., K. S. A. C., Manhattan, Kan., repair pipe.....	1.09
Dec. J. T. Lardner, Topeka, Kan., freight.....	1.49
Dec. Shop Practice Dept., K. S. A. C., Manhattan, Kan., table.....	3.02
Dec. Shop Practice Dept., K. S. A. C., Manhattan, Kan., repair bombs.....	18.35
Dec. Shop Practice Dept., K. S. A. C., Manhattan, Kan., place pulley.....	.86
Dec. Shop Practice Dept., K. S. A. C., Manhattan, Kan., repair tube.....	.48
Dec. Employees' payroll	38.32
Dec. L. E. Knott Apparatus Company, Cambridge, Mass., rubber tubing.....	5.13
Dec. L. E. Knott Apparatus Company, Cambridge, Mass., rubber stoppers...	2.20
Dec. Manhattan Gas Company, Manhattan, Kan., gas.....	22.50
Dec. Printing Dept., K. S. A. C., Manhattan, Kan., paper.....	4.40
<i>1917</i>	
Jan. Employees' payroll	5.18
Jan. Medart Patent Pulley Company, St. Louis, Mo., pulley.....	5.45
Jan. Employees' payroll	46.31
Feb. Employees' payroll	31.97
Feb. Eimer & Amend, New York, N. Y., burettes.....	12.25
Feb. General Repair Dept., K. S. A. C., Manhattan, Kan., shelves.....	3.08
Feb. Grasselli Chemical Company, St. Louis, Mo., acid and ammonia.....	26.20
Feb. Officers' payroll	125.00
Feb. General Repair Dept., K. S. A. C., Manhattan, Kan., fuses.....	1.25
Feb. Grasselli Chemical Company, St. Louis, Mo., acid.....	46.70
Feb. Manhattan Gas Company, Manhattan, Kan., gas.....	11.00
Mar. Officers' payroll	125.00
Mar. Eimer & Amend, New York, N. Y., absorption tubes.....	3.02
Mar. J. T. Lardner, Topeka, Kan., freight and express.....	12.35
Mar. Employees' payroll	68.83
Mar. Heat & Power Dept., K. S. A. C., Manhattan, Kan., fan connections...	1.01
Mar. Shop Practice Dept., K. S. A. C., Manhattan, Kan., repair bombs.....	3.70

<i>1918</i>		
Mar.	Shop Practice Dept., K. S. A. C., Manhattan, Kan., belting.....	\$1.26
April	Officers' payroll	125.00
April	Employees' payroll	20.69
April	General Repair Dept., K. S. A. C., Manhattan, Kan., shelves.....	4.78
April	R. C. Wiley, Manhattan, Kan., traveling expenses.....	49.80
April	Employees' payroll	71.88
April	Palace Drug Company, Manhattan, Kan., rubber gloves.....	.75
April	Shop Practice Dept., K. S. A. C., Manhattan, Kan., bomb.....	2.48
May	Employees' payroll	11.32
May	J. T. Lardner, Topeka, Kan., freight.....	1.00
May	Manhattan Gas Company, Manhattan, Kan., gas.....	13.90
May	Snyder & Black, New York, N. Y., soil survey maps.....	290.22
May	Employees' payroll	75.25
June	Employees' payroll	3.12
June	General Repair Dept., K. S. A. C., Manhattan, Kan., table and shelving..	11.08
June	J. T. Lardner, Topeka, Kan., freight.....	6.92
June	Manhattan Gas and Electric Company, Manhattan, Kan., gas.....	12.80
June	Williams & Wilkins Company, Baltimore, Md., Journals A. O. A. C....	7.50
June	Employees' payroll	60.00
June	Employees' payroll	78.94
June	Bettendorf Oxygen Hydrogen Company, Bettendorf, Iowa, hydrogen gas,	20.00
June	W. S. Elliott, Manhattan, Kan., soil sample case.....	4.50
June	General Repair Dept., K. S. A. C., Manhattan, Kan., repair apparatus..	1.90
June	Grasselli Chemical Company, St. Louis, Mo., acid.....	47.60
June	Heat & Power Dept., K. S. A. C., Manhattan, Kan., sheet iron, etc.....	20.00
June	Heat & Power Dept., K. S. A. C., Manhattan, Kan., move filter.....	2.24
June	Heat & Power Dept., K. S. A. C., Manhattan, Kan., repair condenser...	3.16
June	Manhattan Gas and Electric Company, Manhattan, Kan., gas.....	13.30
June	Shop Practice Dept., K. S. A. C., Manhattan, Kan., punches.....	.58
June	W. M. Stingley Company, Manhattan, Kan., repair exhaust pipe.....	14.60
Total disbursements		\$2,681.80

FINANCIAL STATEMENT—FERTILIZER FEES

(July 1, 1917, to June 30, 1918)

RECEIPTS

<i>1917</i>	Balance July 1, 1917.....	\$1,484.51
195	July 25 Morris & Co., Kansas City, Kan., tax tags.....	100.00
196	July 31 Swift & Co., St. Joseph, Mo., tax tags.....	125.00
197	July 31 Armour & Co., Kansas City, Kan., tax tags.....	100.00
198	July 31 Cochrane Packing Company, Kansas City, Kan., tax tags....	25.00
199	Aug. 6 Armour Fertilizer Works, Kansas City, Kan., tax tags.....	100.00
200	Aug. 7 Wilson & Co., Kansas City, Kan., tax tags.....	250.00
201	Aug. 7 Empire Carbon Works, St. Louis, Mo., tax tags.....	250.00
202	Aug. 11 Armour & Co., Kansas City, Kan., tax tags.....	100.00
203	Aug. 14 Cochrane Packing Co., Kansas City, Kan., tax tags.....	50.00
204	Aug. 16 Armour & Co., Kansas City, Kan., tax tags.....	100.00
205	Aug. 29 Wilson & Co., Kansas City, Kan., tax tags... ..	50.00
206	Aug. 30 Swift & Co., St. Joseph, Mo., tax tags.....	250.00
207	Sept. 10 Armour & Co., Kansas City, Kan., tax tags.....	100.00
208	Sept. 13 Swift & Co., St. Louis, Mo., tax tags.....	250.00
209	Sept. 15 Armour & Co., Kansas City, Kan., tax tags.....	100.00
210	Sept. 18 Swift & Co., St. Joseph, Mo., tax tags.....	250.00
211	Sept. 22 Armour & Co., Kansas City, Kan., tax tags.....	100.00
212	Oct. 1 Swift & Co., St. Joseph, Mo., tax tags.....	250.00
218	Oct. 10 Swift & Co., St. Joseph, Mo., tax tags.....	125.00

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1918			
214	Jan. 3	The Pulverised Manure Company, Chicago, Ill., reg. fee.	\$25.00
215	Jan. 21	Cochrane Packing Company, Kansas City, Kan., reg. fees.	50.00
216	Feb. 7	Swift & Co., St. Joseph, Mo., tax tags.	125.00
217	Feb. 9	Armour & Co., Kansas City, Kan., tax tags.	100.00
218	Feb. 12	Cochrane Packing Company, Kansas City, Kan., reg. fee.	25.00
219	Feb. 14	Pulverized Manure Company, Kansas City, Kan., tax tags.	10.00
220	Feb. 14	Swift & Co., St. Joseph, Mo., tax tags.	125.00
221	Feb. 19	Leavenworth Desiccating Company, Leavenworth, Kan., tax tags	5.00
222	Feb. 19	Leavenworth Desiccating Company, Leavenworth, Kan., reg. fee	25.00
223	Mar. 8	Armour & Co., Kansas City, Kan., tax tags.	100.00
224	Mar. 30	Swift & Co., St. Joseph, Mo., reg. fees.	75.00
225	April 9	Cochrane Packing Company, Kansas City, Kan., tax tags.	25.00
226	May 31	Swift & Co., St. Joseph, Mo., tax tags.	125.00
227	June 5	Virginia-Carolina Chemical Company, Montgomery, Ala., reg. fees	100.00
228	June 28	Virginia-Carolina Chemical Company, Montgomery, Ala., tax tags	125.00
229	June 29	Swift & Co., St. Joseph, Mo., tax tags.	250.00
Total receipts			\$5,449.51

DISBURSEMENTS

1917			
July	Employees' payroll		\$106.96
July	Central Scientific Company, Chicago, Ill., chemicals.		81.60
July	C. O. Swanson, Manhattan, Kan., traveling expenses.		38.68
July	Employees' payroll		60.00
July	Keuffel & Esser Company, St. Louis, Mo., glassware.		1.14
Aug.	Employees' payroll		118.50
Aug.	J. T. Lardner, Topeka, Kan., freight and express.		3.96
Aug.	International Equipment Company, Boston, Mass., bottles for centrifuge,		8.70
Aug.	John C. Moore & Co., Rochester, N. Y., binders.		21.50
Aug.	Shop Practice Dept., K. S. A. C., bombs.		18.39
Aug.	J. T. Baker Chemical Company, Phillipsburg, N. J., chemicals.		98.42
Aug.	C. R. I. & P. R. R., freight.		2.25
Aug.	Hall Stationery Company, Topeka, Kan., transfer cases.		4.50
Aug.	Manhattan Gas Company, gas.		17.20
Sept.	Employees' payroll		22.35
Sept.	Heat & Power Dept., K. S. A. C., repairs.		2.98
Sept.	Heat & Power Dept., K. S. A. C., repairs.		9.15
Sept.	Employees' payroll		2.86
Sept.	General Repair Dept., K. S. A. C., fuses.		4.80
Oct.	Employees' payroll		10.08
Oct.	Eimer & Amend, New York, N. Y., sodium peroxide.		40.00
Oct.	Manhattan Gas Company, Manhattan, Kan., gas.		10.80
Oct.	J. T. Lardner, Topeka, Kan., express.		1.01
Oct.	R. C. Wiley, Manhattan, Kan., traveling expenses.		56.05
Oct.	Central Scientific Company, Chicago, Ill., chemicals.		18.55
Oct.	J. T. Lardner, Topeka, Kan., freight.		4.88
Nov.	Employees' payroll		6.42
Nov.	Eimer & Amend, New York, N. Y., apparatus.		27.05
Nov.	Central Scientific Company, Chicago, Ill., magnesium powder.		7.64
Nov.	L. R. Eakin, Manhattan, Kan., jars.		9.75
Nov.	Hall Stationery Company, Topeka, Kan., folders.		8.75
Nov.	Employees' payroll		28.25
Nov.	Bausch & Lomb Optical Company, Rochester, N. Y., filter paper.		18.30
Nov.	Bausch & Lomb Optical Company, Rochester, N. Y., filter paper.		45.50

1917	
Nov. J. T. Baker Chemical Company, chemicals	\$22.48
Nov. J. T. Lardner, Topeka, Kan., freight	1.60
Dec. Employees' payroll	13.63
Dec. General Repair Dept., K. S. A. C., Manhattan, Kan., repairs	2.10
Dec. K. S. A. C. . . . .	.53
Dec. Chemistry Dept., K. S. A. C., Manhattan, Kan., chemicals and apparatus	16.05
Dec. General Repair Dept., K. S. A. C., Manhattan, Kan., repairs	3.24
Dec. J. T. Lardner, Topeka, Kan.	2.41
Dec. Shop Practice Dept., K. S. A. C., Manhattan, Kan., repairs	9.24
Dec. Shop Practice Dept., K. S. A. C., Manhattan, Kan., belting	10.80
Dec. Shop Practice Dept., K. S. A. C., Manhattan, Kan., belt lace . . . . .	.45
Dec. Employees' payroll	22.80
1918	
Jan. Employees' payroll	72.35
Feb. Employees' payroll	67.25
Feb. General Repair Dept., K. S. A. C., Manhattan, Kan., lamps	5.50
Feb. Williams & Wilkins Company, Baltimore, Md., Journal of A. O. A. C.	5.00
Feb. Henry Hell Chemical Company, St. Louis, Mo., sodium hydroxide	150.00
Feb. Dennison Manufacturing Company, Framingham, Mass., labels	3.77
Feb. General Repair Dept., K. S. A. C., Manhattan, Kan., lamps	3.72
Mar. Employees' payroll . . . . .	.95
Mar. Heat & Power Dept., K. S. A. C., Manhattan, Kan., repairs	1.51
Mar. General Repair Dept., K. S. A. C., fuses	1.80
Mar. J. T. Lardner, Topeka, Kan., freight	1.53
Mar. Manhattan Gas Company, Manhattan, Kan., gas	10.80
Mar. Employees' payroll	6.06
Mar. Shop Practice Dept., K. S. A. C., Manhattan, Kan., repairs	10.10
April Employees' payroll	50.00
April Officers' payroll	206.25
April Shop Practice Dept., K. S. A. C., Manhattan, Kan., apparatus	4.22
April E. H. Sargent & Co., Chicago, Ill., asbestos board	29.50
April R. W. Titus, Manhattan, Kan., traveling expenses	56.79
April Eimer & Amend, New York, N. Y., apparatus	6.00
April J. T. Lardner, Topeka, Kan., express . . . . .	.78
May Employees' payroll	30.60
May Officers' payroll	114.27
May Dennison Manufacturing Company, Kansas City, Mo., tags	70.00
May Central Scientific Company, Chicago, Ill., tubing	10.29
May General Repair Dept., K. S. A. C., Manhattan, Kan., repairs	1.69
May General Repair Dept., K. S. A. C., Manhattan, Kan., repairs . . . . .	.90
May J. T. Lardner, Topeka, Kan., freight . . . . .	.38
May Heat & Power Dept., K. S. A. C., Manhattan, Kan., repairs	1.25
May General Repair Dept., K. S. A. C., Manhattan, Kan., lamps	1.80
June Employees' payroll	36.67
June Employees' payroll	100.23
June Officers' payroll	54.48
June K. S. A. C. payroll	41.53
June Central Scientific Company, Chicago, Ill.	1.60
June Heat & Power Dept., K. S. A. C., Manhattan, Kan., repairs	1.25
June General Repair Dept., K. S. A. C., Manhattan, Kan., repairs	18.20
June General Repair Dept., K. S. A. C., Manhattan, Kan., switch . . . . .	.40
Total disbursements	
	\$2,179.62