

THESIS

The Use of Iron in the Control of
Cotton-seed Meal Poisoning

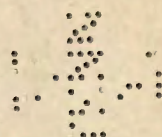
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INTRODUCTION

The use of cotton-seed and cotton-seed products as a feed for live stock began sometime about the close of the War between the States. The scarcity of feed in the South at this time made it necessary that cattle and hogs be given ^{should} what had heretofore been considered a worthless by-product, and had been dumped into the stream nearest the gin house. The hog, more than any other animal is responsible for finding out that cotton-seed products could be used as a feed and that these products contained certain toxic principles. There are instances in which injurious effects have followed the use of cotton-seed meal with other classes of animals and for the past forty years this subject had demanded a great deal of attention from the Experiment Stations throughout the United States. The losses which have followed cotton-seed meal feeding, especially with swine and young calves have detracted greatly from the use which ~~could be~~ made of this exceptionally rich material and have ~~made~~ ^{might have been} a better understanding of its physiological effects ^{rendered} a matter of great importance, especially to the southern farmer. During the past twenty-five years a great deal of investigational ^{to} work has been done by the Experiment Stations with a view ~~of~~ determining if possible the character of this toxic body. This work has been taken up from the standpoint of the chemist, the veterinarian, and

the animal husbandman. The chemical investigations have been made with a view ^{to} of determining the character of the toxic principle and the various extracts have been examined as to their composition and toxicity. The symptoms of sick animals and the post-mortem examinations of those that have died from cotton-seed meal poisoning have been extensively observed, and a large number of feeding tests have been made with different mixtures and under different methods of feeding in an effort to get a clue ~~as~~ to the nature of the poison and to ^{find} revise some practical way of preventing it. The difficulty has been ascribed to the oils, the lint, to a toxalbumin or *variously* toxicalkaloid, to chlorin and betain, to the high protein content of cotton-seed meal, to decomposition products, to resin present in the meal, to a compound of phosphoric acid and to fungous diseases of cotton. Though the work on this subject has been very extensive, the cause and nature of the toxicity was not discovered until recently. Such things as ^{the} individuality of experimental animals and the variation in ^{the} the toxicity of different lots of meal have served to make the problem more difficult. For some time it has been agreed that by certain methods of treatment, such as fermenting the cotton-seed meal before feeding and by heating to a high temperature, the toxicity could be decreased, but no one was ever able to give a satisfactory remedy for the trouble until recently.

Summary of Tests with Cotton-Seed Meal
at Other Experiment Stations.

The first experimental work to determine the feeding value and the effect of feeding cotton-seed meal was done at the Kentucky Experiment Station in 1889. The results showed that cotton-seed meal was unprofitable and unsatisfactory.

In 1892, G.W. Curtis of the Texas Experiment Station conducted some experiments to determine the effect of cotton-seed meal and soaked, boiled and roasted cotton-seed meal on pigs and to compare the above named feeds with corn as a pork producing feed. The results show that seventeen out of the thirty-five pigs died within ten weeks after feeding was begun with cotton-seed meal and cotton-seed. In every case the corn alone proved a cheaper feed than either the cotton-seed meal or the cotton-seed, ~~not considering~~ deaths due to the *even if the* *are left out of the* *account* cotton-seed meal.

What? The next report comes from the North Carolina Station with the result that two ninety pound pigs were fed the same ration, except the one received corn meal and the other an *that* equal amount of cotton-seed meal and wheat bran. One-fourth pound per day was fed for the first twenty days, then one and one-fourth pound per day for the next twenty days and all was consumed, but when the cotton-seed meal was increased to two pounds per day the animal refused to eat and became sick but recovered on a corn ration. When the pigs were

slaughtered the corn fed pig weighed twenty-five pounds more than the cotton-seed meal fed pig and dressed out two per cent more.

In 1895, the Kansas Station fed four pigs a ration of five-sixths corn meal and one-sixth cotton-seed meal and all died within six weeks after the beginning of the experiment. The experiment was continued with two sows *who were given* getting a ration of three-fourths corn meal and one-fourth cotton-seed meal. After forty-five days feeding the experiment was discontinued with both sows in good condition and showing no symptoms of disease. The conclusions were that cotton-seed meal is poisonous if fed for any length of time but can be used to advantage for short periods when feeding hogs for market.

In 1901, F.C. Burton of the Oklahoma Station in two trials found that good results could be obtained by feeding pigs cotton-seed meal for short periods, separated by periods in which none was fed. *to them* The experiment was carried on for sixty-seven days, during forty-seven of which the pigs were fed cotton-seed meal and for twenty-seven consecutive days with no loss. Four of the pigs were continued on the cotton-seed meal forty-seven days longer and one was lost. In a second test sixteen were fed without any loss. He concluded that the death rate was so small that the gain from feeding cotton-seed meal greatly over-balanced it.

In another report the Oklahoma Station fed sixteen pigs for one hundred and twenty-seven days, four got cotton-seed meal and corn meal, one-fourth, three-fourths. Four got

the same ration with an alternate ration of corn meal, four got corn meal and four corn meal and wheat bran. Three cotton-seed meal pigs died shortly after the first month, but the others finished very satisfactorily. The pigs getting cotton-seed meal made better gains per pound of feed, hence, cheaper gains than the corn meal lot, or corn meal and wheat middling lot. Burtis recommended feeding cotton-seed meal with an alternate ration and advised the use of forage crops along with this.

J. F. Duggar of the Alabama Station reported in 1902 four tests in which cotton-seed meal was fed to pigs. First, when twenty to twenty-five per cent of the ration was cotton-seed meal the pigs ate very little and made poor gains. In two other experiments in which the same ration was given only 3.84 pounds and 4.68 pounds respectively were required to make one pound of gain. Daily doses of one-fourth to one-half pound of cotton-seed meal per hundred pounds of live weight caused sickness or death in thirty-four to thirty-eight days, while in a test conducted another year, three-fourths of a pound of cotton-seed meal daily per hundred pounds live weight of pig fed for thirty-one days to one hundred and forty-three pound hogs gave no bad results. "Evidently the younger the pigs the more susceptible they are to cotton-seed meal poisoning".

R. R. Dinwiddie of the Arkansas Station reported in 1903-4, an experiment with twelve pigs weighing from thirty to fifty pounds. Nine of the animals died in thirty-four

to sixty-four days when given a daily allowance of six to eight-tenths of a pound of cotton-seed meal. In a later test fourteen pigs were given a ration of cotton-seed meal, wheat bran, wheat chops and cut cowpea hay for a period of six months without any harmful effects. The quantity of cotton-seed meal averaged from eight-tenths to one and four-tenths per cent of the body weight, or from four-tenths to seven-tenths pounds. However, this ration was badly balanced and wasteful. In one test cotton-seed meal was fed to a sow during the last eighty days of the period of pregnancy without any harm to either mother or progeny.

In 1905, the Texas Station reports a test of "The Allison Method" of feeding cotton-seed meal, that is, thoroughly souring the meal before feeding. Forty hogs were divided into four lots of ten each and fed as follows: Lot I, corn chops, Lot II, corn chops fermented, Lot III, one-third cotton-seed meal and two-thirds corn chops fermented and Lot IV, one-half corn chops and one-half cotton seed meal fermented. The results indicate that cotton-seed meal may be used in larger quantities and for longer periods of time when fermented than when fed without being fermented. Green fed^e in connection with cotton-seed meal lessens the danger from poisoning. The hogs receiving a part of their ration cotton-seed meal showed less fat and more lean meat than the corn fed hogs.

J.G. Fuller of the Wisconsin Station reports the result of feeding ten pigs (in 1905) in two lots of five each.

To the one lot he gave

One a ration of equal parts corn meal and cotton-seed meal made into a slop and the other the same mixture soaked in water forty-eight hours before feeding so that it would be thoroughly soured. For the first ten weeks the gains were satisfactory, but during the last four weeks they lost in weight and two of each lot died. In a similar experiment the pigs gained well for six weeks. At that time one died and the others were in such a condition that the experiment was discontinued. From the experiment Fuller concluded that there is no encouragement for the farmer to feed cotton-seed meal to swine.

Don T. Gray, Alabama Station, 1908-9, reports that when corn was fed alone to hogs it was unprofitable in every case, but when cotton-seed meal was added to the ration the daily gains and the financial outcome were satisfactory. Four deaths occurred as a result of the use of cotton-seed meal, but these did not occur while the animals were eating the meal. All of the deaths occurred soon after the animals were taken off the cotton-seed meal ration and put on rations containing no cotton-seed meal. He says this suggests the idea that cotton-seed meal may be stimulating in its effect --similar to the action of certain drugs and when it is suddenly removed from the animal death may occur through depression. In 1911, Gray reports that cotton-seed meal and tankage are about equal in feeding value as supplements to corn in dry lots.

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has L. Mamache attributes the poisoning ~~properties~~ *in the case of* which have been observed ~~from~~ *feeding* cotton-seed meal to be due to carelessness on the part of the feeder, ignorance in the use of cotton-seed meal, or lack of cleanliness.

R. S. Curtis of the North Carolina Station, 1909, reports an experiment conducted to determine the amount of fermented cottonseed meal that can be fed safely to hogs. The conclusions were that farmers could feed fermented cotton-seed meal to *pigs ranging from* seventy-five to ninety pound *in weight* pigs (one-fifth to one-eighth ration) with very gratifying results for a limited period of time, ~~which he said was~~ seventy-five to ninety days. The best method of feeding would be to give this cotton-seed meal alone with grazing crops.

In the summer of 1893, Fietze investigated several cases in which the death of calves nine to twelve months old was attributable to the use of cotton-seed meal. These calves receiving three heaping liters (more than quarts) of cotton-seed meal daily, in addition to *and* skim milk, hay and linseed cake.

From a review of these experiments you will observe that the reports from the different Stations from time to time show quite different results, some even contradictory. One Station reports that the greater proportion of the ration, that is cotton-seed meal, the quicker the hogs will die, but Curtis of the North Carolina Station says that in every case but one the pigs getting the smaller

ration of cotton-seed meal died in a shorter period of time. The Oklahoma Station reported that the older the hogs the more susceptible to poisoning, while the Alabama Station finds the reverse. Such problems as these, along with many others, have added complexity to the investigations from time to time and it is no wonder that we have been so long in determining the poisonous factor in cotton-seed meal.

Until about four years ago practically all of the work that had been done with cotton-seed meal had been carried on from ^{the} standpoint of the animal feeder. At this time, however, the nature of the experimental work changes^d somewhat and the chemists at the various Stations and in the Department of Agriculture undertook some work with a view to determining the cause of the toxic principle of cotton-seed meal and the reasons for variations ~~when~~ shown under different conditions. Dr. A.C. Crawford working in the Bureau of Animal Industry, reported in 1910 that the cause of cotton-seed meal poisoning had been found to be a salt of pyrophosphoric acid. He also stated that sea-island cotton-seed contained very little of the poisonous principle and was practically harmless but on heating the poisonous principle is developed. He concluded from this that heating cotton-seed cake in the process of manufacture increases the poisonous principle of cotton-seed meal. This statement is not upheld by any other work, but on the contrary experiments at other Stations have shown

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that heating cotton-seed meal decreased the toxic principle.

Soon after Dr. Crawford's theory came out the North *was published*
 Carolina and Louisiana Stations undertook some experiments
 with a view ~~of~~ confirming or disproving Crawford's work. At *to*
 both Stations it was found that cotton-seed meal with the
 phosphoric acid extracted was poisonous, while when more
 than the usual amount of pyro-phosphoric acid in cotton-
 seed meal was fed death did not always result. The conclus-
 ions from both Stations are that pyro-phosphoric acid is
 not the cause of the toxic principle in cotton-seed meal.
 The Louisiana Station also did some work to determine whether
 or not the fungous diseases of cotton caused poisoning. It
 was found that meal made from cotton affected with anthrac-
 nose, cotton wilt and black root was no more toxic than meal
 from the seed of undiseased cotton plants. This Station
 found that heating reduced the toxicity and that fermenting
 did more than any other treatment to reduce the poison but
 this simply lengthened the period required to kill the ani-
 mal.

For an explanation of the cause and method of pre-
 venting the poisonous effect we are indebted to Dr. W.A.
 Withers and J.S. Brewster, chemists of the North Carolina
 Station. The first work done by these men was to disprove
 Dr. Crawford's pyro-phosphoric acid theory, then the search
 for some other plausible explanation was begun. It was

noted that the symptoms of animals dying from cotton-seed meal poisoning was similar to those of an animal dying from sulphide poisoning. They ascribe the toxic principle of cotton-seed meal to a constituent group of the protein molecule containing loosely bound sulphur, and the toxic effect of meal to the action of this group upon the iron of the blood.

For his test Dr. Withers selected rabbits for the reason that rabbits are easy to handle under laboratory conditions, they die quicker than hogs from poisoning, and are cheaper.* In all cotton-seed meal was fed to twenty-two rabbits averaging in weight a little more than 1.5 kilograms. As a rule the rabbits ate well for the first three days and made gains in weight but soon began to refuse part of all the feed and died thereafter in a few days. All lost in weight and all died in an average of thirteen days after the experiment was begun. The average amount of cotton-seed meal consumed by each rabbit was about 15 grams daily. In connection with this test they were feeding some rabbits on the residue left after feeding cotton-seed meal in the cold with an aqueous solution of sodium carbonates. Each rabbit was receiving the equivalent of 15 grams of meal daily. On the fourteenth day two of the rabbits were dead, one was sick, and all had lost in weight. They then began to supply in addition to the feed a solution of citrate of iron and ammonia. The sick rabbit recovered at once and

Residue,

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after the first day all of the rabbits consumed all of the meal given them and gained in weight for the next fourteen days, at which time the experiment was completed. This experiment indicates that iron would overcome the toxic effects of cotton-seed meal where they have already appeared. To continue the work six rabbits were given a ration of whole cotton-seed meal (15 grams daily) with 3 grams of citrate of iron and ammonia added. From the beginning each of the rabbits consumed all the feed allowed them and all gained in weight as long as the meal was fed. All were alive and normal on the fifty-eighth day of feeding. This was more than twice as long as the heartiest rabbit lived when getting meal without iron and more than four times as long as the average number of days that the twenty-two rabbits lived that did not get iron. This indicates that iron is very efficient as an antidote for cotton-seed meal poisoning.

To test the efficiency of iron as an antidote for cotton-seed meal poisoning with swine Dr. Withers took twelve pigs weighing on an average of fifty pounds each and placed in two separate lots, each in a pen to himself. A daily ration of one-half pound cotton-seed meal and one and one-half pounds corn meal was given each animal and in addition one-half of the animals received a solution of iron sulphate or copperas. Thirteen weeks after the beginning of the experiment four of the six pigs not receiving iron were dead and the other two had made an average gain of only

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thirty-five pounds, while on the other hand the six pigs receiving iron had made an average gain of fifty-two pounds, (nearly twice as much as the two not receiving iron) and all were in the best of condition. Twenty-two weeks after the beginning of the experiment five of the six pigs not getting iron were dead but the six receiving iron were still doing well and in good condition. This experiment indicates that iron is very efficient as a preventative of cotton-seed meal poisoning of hogs.

*Reprint from Journal of Biological Chemistry, Vol. XV., No. 1, July 1913.

Plan of Experiment.

This experiment was undertaken at the invitation of Dr. Withers to all of the Experiment Stations to join him in testing and confirming the value of iron as an antedote for cotton-seed meal poisoning, because of the economic value that would be derived from such knowledge by the farmers throughout the South.

Ten of the pigs of this experiment were purchased from a nearby farmer. These pigs were cross-bred Berkshire and Chester Whites, averaging in weight about sixty pounds. All were exceptionally vigorous and hearty. The other five shoats were selected from a lot in the Station herd. Three were pure-bred Duroc Jerseys and two pure-bred Berkshires. These shoats were also very vigorous and hearty. In order that each pig might be started on the experiment in as near the same condition as possible, all were turned together, and fed a preliminary ration of corn and barley for ten days. Then individual weights were taken for three consecutive days and the pigs divided into five groups of three each, all groups weighing as nearly the same as we could get them. The following were the group weights at the beginning of the test:

Group I.	210 lbs.	Group II.	194 lbs
"	III. 194 "	"	IV. 202 "
Group V. 212 lbs.			

Each group was placed in a pen, eight by ten, with

concrete floor and trough and each had the run of a dry lot ten by forty. Cinders were kept in the dry lot at all times, and a comfortable bed was made in the pens of either straw or sawdust. These beds were renewed every day or two.

Description of Each Group.

Group 1, was composed of one pure-bred Berkshire, Fig No. 1, weighing seventy-nine pounds and two cross-breeds, Berkshire and Chester Whites, one black and white Fig No. 2, the other white, Fig No. 3, weighing respectively sixty-one and seventy pounds.



Fig. 1, Showing Pigs in Group No. 1 at Beginning of Test

Group II., was composed of two pure-bred Duroc-Jersey pigs, weighing sixty-one and seventy-two pounds, and one cross-bred Berkshire Chester White, weighing sixty-one pounds. The latter pig was number four in the experiment and was white.



Fig. 2, showing pigs in Group II at the beginning of the test.

Group III. was composed of one pure-bred Berkshire, Pig No. 9, weighing eighty-five pounds and two cross-bred Berkshire Chester White pigs weighing fifty-four and fifty-five pounds. Both of the latter were white.



Fig. 3, showing pigs in Group No. III, at the beginning of test.

Group IV, was composed of three cross-bred Berkshires Chester White pigs weighing seventy-three, sixty-six and sixty-three pounds respectively. The latter two were white and the other was black.



Fig. 4. showing pigs in Group No. IV. at the beginning of the test.

Group V. was composed of one pure-bred Duroc-Jersey shoat, pig No. 4, weighing eighty-eight pounds and two cross-bred Berkshire Chester White pigs, weighing sixty-two pounds each. One of the cross-bred pigs was white, pig No. 15, and the other black, pig No. 13.



Fig. 5, showing pigs in Group V. at the beginning of the test.

In planning this experiment it was thought best to test two of the cheaper forms of iron, ^{and} iron chloride and iron sulphate were selected. ^{accordingly} Also two proportions of cotton-seed meal ^{Moreover,} were fed; ration number one, consisting of four parts corn meal to one part cotton-seed meal, which we think is about the ^{right} proportion ^{for} that this feed ~~should be fed~~. ^{to} Ration number two, consisting of two parts corn meal to one part cotton-seed meal. This ^{second} ration contained an excess of cotton-seed meal but was fed intentionally with a view ^{to} of making the ration more deadly and ~~to~~ ~~make~~ the test of the iron more severe. The following is an outline of the ration:

Outline of rations.

Lot No.	Ration.	No. of head.
1	1 pt. cotton-seed meal 4 " corn meal	3
2	1 pt. cotton-seed meal 4 " corn meal iron chloride	3
3	1 pt. cotton-seed meal 4 " corn meal iron sulphate or copperas	3
4	1 pt. cotton-seed meal 2 " corn meal	3
5	1 pt. cotton-seed meal 2 " corn meal iron chloride	3

Method of Feeding.

Groups I, II and III, received a ration of four parts corn meal and one part cotton-seed meal during the entire experiment. In addition to this Group II was given iron chloride at the rate of one pound to each fifty pounds of cotton-seed meal fed. Group III received iron sulphate or copperas at the same rate as above. Group I was the check group, no iron. To make the test more severe, groups III and IV were fed a ration of two parts corn meal to one part cotton-seed meal. Group IV was the check lot in which no iron was fed, while Group V received iron

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chloride at the rate of one pound to fifty pounds of cotton-seed meal. For the first four weeks the iron salt was weighed daily and mixed with feed enough for one day's ration, but after the loss of one pig in each of the iron groups (which we could not explain at that time) the method was changed at the suggestion of Mr. W. H. MacIntire, Associate Chemist of the Station. The iron salts were dissolved in water at the rate of one pound to fifty gallons of water and one gallon of this water was used for each pound of cotton-seed meal in the ration.

During the entire experiment it was the policy of the writer to give each group all of the feed that was cleaned up readily, ^{the} daily ration being increased or decreased as the appetites demanded. All groups were started on the same amount of feed, seven pounds, as a daily ration and changes made when necessary. The feed was given in the form of a thin slop twice daily, about 6:30 on the morning and 4:30 in the afternoon. No other feed was given at any time during the experiment. The amount fed each day was regulated according to the appetite, the aim being to keep each group on a full feed.

experimenter

Method of Keeping Records.

Each group was weighed for three consecutive days at the beginning of the experiment and the average of these weights was taken as the initial weight of the group. Individual weights were also kept. On Saturday of each week individual and group

weights were made and recorded in a book which was kept only for information regarding the experiment. A feed sheet for keeping account of the feed given each lot was tacked up in the feed room and at the end of each period was replaced by a new sheet in order that a copy of the old sheet might be made for a permanent record. Loose leaves were kept to note any changes from time to time, and these sheets were filled with other records of the experiment. Post-mortem examinations were made of each pig that died and a complete record of the same kept on file. Notes were made on the symptoms as shown by the sick hogs from time to time, and these also were filed. At the close of one hundred days a three days weight was made of all the pigs and they were then turned over to the Station. The experiment was continued, however, thirty-three days longer under the same system as had been carried out during the previous one hundred days.

The data obtained during this time ~~is~~ also included in this thesis. At the close of the experiment the shoats in lots one and four were turned together and started on a ration of cotton-seed meal with double the amount of iron that had been used with lots two, three and five. This was done with a view to determining if iron will restore a sick hog to normal condition. The results of this will be added in a postscript. Hogs number five, eight, fourteen and fifteen were sold to the butcher for eight dollars and seventy-five cents (\$8.75) per

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say nos. 6 and 9, and so on
throughout.

hundred-weight. Hogs numbers six and nine have been retained for breeding sows, as they were very good individuals and pure-bred animals.

During the fourth week of the experiment it was noticed that the feces in all lots were hard and we thought it advisable to give a laxative in the feed. On the recommendation of the Animal Husbandman it was decided to give a mixture of equal parts salt and glaubers salt as we did not think there was anything in this mixture that would affect the experiment. Unfortunately, however, ~~due~~ to an error on the *part* of the feeder, the salt was given in the feed instead of being put in a small box in the pen and too much of this mixture was given. In the morning of December 23rd, pig number seven in group three died. Pig number 13 in Group V, died the afternoon of the same day and pig number 4 in Group II died two days later, December 25th. Pig number 15 in Group V was very sick and when all hope of recovery was lost his tail was cut off to get some blood for the purpose of vaccinating some other pigs to test for hog cholera. After this treatment the sick pig recovered and at the close was one of the best porkers in the experiment. It was estimated that about one-fifth of a pound of common salt and an equal amount of glaubers salt was given per pig five consecutive times. This amount, upon investigation * proved to be

* Kellner's Feeding Farm Animals. Page 237.

about ten times as much salt as required by the pigs. No ^{was} pigs were lost in the groups not getting iron, but this is probably due to the fact that these groups did not eat their food as well as the other groups on account of ^{what does} appetite, hence did not get as much of the salt mixture. ^{This mean?} All the pigs that died at this time showed about the same symptoms and post-mortem lesions. All had convulsions and two died a few hours after ~~taking~~ sick. The third died ^{falking} within two days. The convulsions with this latter one seemed hardly as severe as with the others. Pig number 15 that recovered showed the same symptoms as those that died. The post-mortem showed slightly inflamed stomach, inflamed intestines, congested lungs and bladder and congested brain in those examined. No symptoms of cotton-seed meal poisoning were shown in any of the cases. The Chemist suggested that death was possibly due to the method of giving the iron and the change already mentioned was made.

On January the 19th four other pigs, two Berkshires and two Duroc-Jerseys, averaging about sixty pounds in weight, were started on a ration of corn meal and cotton-seed meal, with iron, as given under the new method. This was done to test whether or not the ~~said~~ mixtures, the method of giving the iron, or the cotton-seed meal was responsible for the deaths just described. About the same amount of the salt mixture was given as in the first experiment and at exactly the same time in the experiment. The mixture was first

given to two of the pigs, but neither was lost, probably because they did not eat very much of the ration. Then the other two were given the mixture, beginning on February 23rd. Six days later one of the pigs was found dead after eating a hearty meal. This one showed the same post-mortem as others that died as a result of eating the salt mixture.

From the results of this test we feel certain that the salt mixture was responsible for the deaths of those animals getting iron. First, because the symptoms and post-mortem lesions of the pig that died in this check group were similar to those shown by the pigs that died in Groups II, III and V. Second, the pigs that were not taken sick at this time continued to eat the same rations as they had been given before and did well throughout the entire experiment. Third, about the same length of time was necessary for death to take place.

The other three pigs in the check lot were continued on the cotton-seed meal ration until the close of the experiment and all were in good condition at the close and all had made good gains. Feeders should be careful not to force hogs to eat too much salt, as it is a dangerous practice.

Tables 1, 2, 3, 4 and 5, give complete records of each lot by weeks.

Table I

Showing Weekly Accounts of Weights and Gains in

Pounds of Group No. I

Date	Pig 1	Pig 2	Pig 3	Total Wt.	Gain	Average Wt.	Gain of Lot	Avg. Daily Gain of Lot	Avg. Daily Gain of Pig	C.M.	Feed Consumed C.S.M.	Iron	Total
Nov 23	79	61	70	210	--	70	--	1.43	.48	28.00	7.00		35.00
29	85	61	71	220	10	73	10	1.64	.55	38.00	9.50		47.50
Dec 6	85	71	77	223	13	78	23	1.64	.55	38.00	9.50		47.50
13	90	68	85	243	10	81	32	1.57	.52	36.00	9.00		45.00
20	95	70	85	250	7	83	40	1.43	.54	28.00	7.10		35.50
27	97	70	91	258	8	86	48	1.37	.54	36.00	9.00		45.00
Jan 3	98	78	102	278	20	93	68	1.62	.52	42.60	10.65		53.25
10	101	84	105	290	12	97	80	1.63	.51	44.00	11.00		55.00
17	105	80	112	297	7	99	87	1.56	.48	44.60	11.20		56.00
24	110	75	121	306	9	102	96	1.52	.41	35.20	8.80		44.00
31	105	77	103	305	-1	102	95	1.36	.46	37.20	9.30		46.50
Feb 7	95	82	128	305	0	102	95	1.33	.38	39.60	9.90		49.50
14	92	79	131	302	3	101	92	1.09	.31	30.40	7.60		38.00
21	93	75	143	315	13	105	105	1.15	.33	34.00	8.50		42.50
28	84	75	143	302	13	101	92	.94	.35	29.60	7.40		37.00
Mar 7	83	68	164	315	13	105	105	1.00	.37	30.40	7.60		38.00
14	93	66	167	328	13	109	118	1.04	.39	34.00	8.50		42.50
21	88	76	176	342	14	114	132	1.10	.43	29.80	9.80		49.00
28	92	78	180	350	8	117	140	1.18		42.00	10.60		53.00
Apr 4	98	86	190	374	24	125	164	1.30		44.40	11.10		55.50

Table 2.

Showing Weekly Accounts of Weights and Gains in

Pounds of Group II

Date	Pig 1	Pig 2	Pig 3	Total Wt.	Avg. Gain	Avg. Gain Wt. Gain	Gain of Lot from Nov 24	Avg Daily Gain of lot From Nov 24	Avg. Daily Gain of Pig From Nov 24	Feed Consumed			Total	
										C.M.	C.S.M.	Iron		
Nov 23	61	61	72	194	--	65	---	----	----	----	----	----	----	
29	64	67	76	207	13	69	4	13	1.86	.62	28.00	7.00	.14	35.00
Dec 6	69	72	83	224	17	75	6	30	2.15	.72	39.20	9.80	.19	49.00
13	71	79	84	234	10	78	3	40	1.90	.63	44.80	11.20	.22	56.00
20	71	76	95	242	8	81	3	48	1.71	.57	44.80	11.20	.22	56.00
27	dead	82	100	182	111	91	5.5	59	1.40	.57	44.80	11.20	.22	56.00
Jan 3		92	102	194	12	97	6.0	71	1.46	.70	40.60	10.15	.22	50.75
10		97	111	208	14	104	7.0	85	1.54	.73	39.80	9.95	.20	49.75
17		104	118	222	14	111	7.00	99	1.58	.77	44.00	11.00	.22	55.00
24		114	122	236	14	118	7.0	113	1.64	.79	51.60	12.90	.26	64.50
31		119	126	245	9	123	4.5	122	1.60	.82	48.40	12.10	.24	60.50
Feb 7		125	130	255	10	138	5.0	132	1.58	.80	47.60	11.90	.24	59.50
14		125	140	265	10	133	5.0	142	1.58	.79	44.00	11.00	.22	55.00
21		140	145	285	20	143	10.0	162	1.68	.79	50.80	12.70	.26	63.50
27		150	148	298	13	149	6.5	1.75	1.68	.84	53.20	13.30	.27	66.50
Mar 7		160	154	314	16	157	8.0	191	1.72	.84	50.00	12.50	.25	62.50
14		165	175	340	26	170	13.0	217	1.84	.86	50.00	12.50	.25	62.50
21		175	176	351	11	176	5.5	228	1.84	.92	56.00	14.00	.28	70.00
28		177	191	368	17	184	8.5	245	1.86	.92	56.80	14.20	.28	71.00
Apr 4		187	206	393	25	192	12.5	270	1.96	.93	58.80	14.70	.29	73.50
										.98	64.00	16.00	.32	80.00

Table 3

Showing Weekly Accounts in Weight and Gains in

Date	Pig 1	Pig 2	Pig 3	Total Wt. Gain	Avg. Wt. Gain	Gain of Lot from Nov 24	Avg Daily Gain of lot From 24
Nov 23	55	54	85	194	---	65.0	---
29	60	55	88	203	9	68.0	3 9
Dec 6	62	60	96	128	15	73.0	8 24
13	70	62	105	237	19	79.0	6.33 43
20	72	66	107	245	8	82.0	2.66 51
27		68	117	185	12	92.5	6.00 63
Jan 3		78	127	205	20	102.5	10.00 83
10		84	136	220	15	110.0	7.50 98
17		90	140	230	10	115.0	5.00 108
24		97	148	245	15	122.5	7.50 123
31		101	154	255	10	127.5	5.00 133
Feb 7		106	151	267	12	133.5	6.00 145
14		109	166	275	8	137.5	4.00 153
21		115	170	285	10	142.5	7.50 163
28		120	176	296	11	148.0	5.50 174
Mar 7		141	190	331	35	165.5	17.50 209
14		155	196	348	17	174.0	8.50 226
21		150	217	367	19	183.5	9.50 245
28		155	227	382	15	191.0	7.50 260
Apr 4		165	231	396	14	198.0	7.00 274

Pounds of Group III

Avg. Daily Gain of Pig From Nov 24	C.M.	Feed Consumed C.S.M.	Iron	Total
.43	28.00	7.00	.14	35
.57	39.20	9.80	.19	49
.68	44.80	11.20	.22	56
.61	44.80	11.20	.22	56
.655	36.80	9.20	.18	46
.785	39.20	9.80	.19	49
.825	44.00	11.00	.22	55
.810	50.80	12.70	.25	63.5
.840	47.60	11.90	.24	59.5
.830	44.80	11.20	.22	56
.830	41.60	10.40	.21	52
.805	40.40	10.10	.20	50.5
.800	52.40	10.60	.21	63
.800	44.80	11.20	.22	56
.915	51.60	12.90	.26	64.5
.933	49.60	12.40	.25	62
.955	56.00	14.00	.28	70
.965	58.00	14.50	.29	72.50
.970	60.80	15.20	.30	76.00

Table 4.

Showing Weekly Accounts of Weights and Gains in

Pounds of Group IV

Date	Pig 1	Pig 2	Pig 3	Total Wt.	Avg Gain	Avg Wt.	Gain of lot	Avg. Daily Gain of Lot from Nov 24	Avg. Daily Gain of pig From Nov 24	C. M.	Feed Consumed C.S.M.	Iron	Total
Nov 23	73	66	63	202	1	67	---	---	---	---	---	---	---
29	77	68	67	212	10	71	3	10	1.47	.49	23.34	11.66	35.00
Dec 6	84	71	70	225	13	75	4	23	1.64	.55	30.00	15.00	45.00
13	86	77	72	235	10	78	3	33	1.57	.52	25.00	12.50	37.5
20	87	79	78	244	9	81	3	42	1.50	.50	23.67	11.83	35.5
27	89	81	83	253	9	84	3	51	1.46	.49	25.50	12.75	38.25
Jan 3	86	89	87	262	9	87	3	60	1.43	.48	31.00	12.50	46.50
10	94	93	94	281	19	94	6	79	1.61	.54	34.00	17.00	51.00
17	96	102	98	296	15	99	5	94	1.68	.56	37.33	18.66	56.00
24	97	103	dead	200	2	100	1	96	.97	.49	22.33	11.17	33.50
31	dead	107	dead	107	4	107	4	100	.59	.59	17.00	8.50	25.50
Feb 7		112		112	5	112	5	105	.59	.59	12.33	6.17	18.50
14		107		107	5	107	5	100	.49	.49	9.00	4.50	13.50
21		112		112	5	112	5	105	.51	.51	12.67	6.33	19.00
28		115		115	3	115	3	108	.50	.50	9.34	4.66	14.00
Mar 7		118		118	3	118	3	111	.49	.49	12.00	6.00	18.00
14		132		132	14	132	14	125	.59	.59	17.34	8.66	26.00
21		137		137	5	137	5	130	.59	.59	15.67	7.83	23.50
28		145		145	8	145	8	138	.63	.63	18.67	9.33	28.00
Apr 4		136		136	-9	136	9	129	.52	.52	13.33	6.66	20.00

Table 5.

Showing Weekly Accounts of Weights and Gains in

Pounds of Group V

Date	Pig 1	Pig 2	Pig 3	Total Wt.	Gain	Avg. Wt.	Gain	Gain of Lot from Nov 24	Avg. Daily Gain of lot From Nov 24	Avg. Daily Gain of Pig From Nov 24	C. M.	Feed Consumed C.S.M.	Iron	Total
Nov 23	62	88	62	212	---	71	---	---	---	---	---	---	---	---
29	66	89	67	222	10	74	3	10	1.43	.44	23.34	11.66	.233	35.00
Dec 6	65	99	76	240	18	80	6	28	2.00	.66	32.67	16.33	.326	49.00
13	80	102	70	252	12	84	4	40	1.90	.63	37.34	18.66	.373	56.00
20	84	108	75	267	15	89	5	55	1.96	.65	37.84	18.66	.373	56.00
27	dead	114	71	185	2	93	5	57	1.08	.64	24.00	12.00	.240	36.00
Jan 3		126	90	216	31	108	15.5	88	1.58	.79	27.73	13.92	.278	41.75
10		136	95	231	15	116	7.5	103	1.66	.83	46.00	23.00	.460	69.00
17		148	107	255	24	128	12.0	127	1.83	.94	44.67	22.33	.446	67.00
24		154	111	256	10	133	5.0	137	1.98	.99	40.00	20.00	.400	60.00
31		157	120	277	12	139	6.0	149	1.82	.91	43.34	21.66	.433	65.00
Feb 7		160	130	290	13	145	6.50	162	1.74	.91	36.67	18.33	.366	55.00
14		162	135	297	7	149	5.5	169	1.82	.87	40.67	20.33	.406	61.00
21		173	142	315	18	158	9.0	187	1.88	.91	45.67	22.83	.556	68.50
28		183	152	335	20	173	10.0	207	1.98	.94	51.34	25.66	.513	77.00
May 7		201	156	357	22	179	5.0	229	2.06	.99	55.34	27.66	.553	83.00
14		211	169	380	23	190	11.5	252	2.02	1.03	56.00	28.00	.560	84.00
21		225	175	400	20	200	10.0	262	2.18	1.01	56.00	28.00	.560	84.00
28		238	187	425	25	213	12.5	297	2.10	1.09	56.00	28.00	.560	84.00
Apr 4		236	192	428	3	214	1.5	300	2.10	1.05	56.00	28.00	.560	84.00

The following table gives the average gain per pig for the entire feeding period of one hundred and thirty-three days, the amount of cotton-seed meal consumed, the amount of iron salt consumed and notes on the general condition of the pigs at the close of the test.

Table No. 6,

Showing Comparison of Toxicity of Cotton-seed Meal.

				with and Without Iron	
				Avg. Amt Iron Consumed in lbs.	Condition of Animal at close of the experiment.
Wt. Begin in lbs.	Wt. End in lbs.	Avg. Gain in lbs.	Avg. Amt. C.S.M. Consumed in lbs.		
Lot I					
No. 1	79	98			
2	61	86			
3	70	190			
Total	210	374	54.66	58	
Lot II					
4	61				
5	61	187			
6	72	206			
Total	194	393	130.00	107.5	
Lot III					
7	55				
8	54	165			
9	85	231			
Total	194	396	128.50	102.5	
Lot IV					
10	73				
11	66	136			
12	63				
Total	202	136	65.33	112.52	
Lot V					
13	62				
14	88	236			
15	62	192			
Total	212	428	139.00	189.6	

1. Very unthrifty and weak, shows plainly symptoms of poisoning
2. Same as 1, though hardly as bad
3. Normal as far as can be told.

4. Dead
5. Excellent condition.
6. Excellent condition

7. Dead
8. Excellent condition
9. Excellent condition

10. Dead
11. Alive but not thrifty
12. Dead

13. Dead
14. Excellent condition except lame leg caused by external injury
15. Excellent condition

It is interesting to note that the pigs getting iron in the groups that received a ration of one part cotton-seed meal to four parts corn meal ate practically twice as much cotton-seed meal as those not getting iron, yet not one showed any signs of sickness or poisoning that received iron, while of the three not getting iron, two were sick more than one-half of the feeding period. In the lots receiving the ration of two parts corn meal to one part cotton-seed meal, the iron fed group consumed nearly twice as much cotton-seed meal, none were sick and all made an average daily gain of a little more than one pound throughout the entire test. However, in the non-iron group, two pigs were lost from cotton-seed meal poisoning and the other made a poor average gain.



Fig. 6, Showing Group I at Close of Experiment.



Fig. 7, Showing Group II at Close of Experiment.



Fig. 8, Showing Pig No. 1, at Close of Experiment.



Fig. 9, Showing Pig No. 9, at Close of Experiment, litter mate to Pig, No 1, above.



Fig. 10, Showing Group V at Close of Experiment.



Fig. 11, Showing Pig No. 11 at Close of Experiment

Discussion of the Work.

Figures 1, 2, 3, 4 and 5, pages 15, 16, 17, 18, 19, show group pictures of each of the groups at the beginning of the experiment. These were taken in the afternoon of the day the pigs were put on cotton-seed meal rations. *that*

During the first week of the test all lots consumed practically the same amount of feed but after this time the iron groups always ate more and were always more eager to get their feed. The daily ration was gradually increased as the pigs would take the increase and the pigs in the iron groups never failed to clean up readily their daily feed until the second day the salt mixture was given. They *consume?* did not eat very well for two or three days just at this time but as soon as this disturbance was over, all were very hearty and gradually took an increase in ration until the close of the experiment. On account of the weather conditions the ration would be increased for two or three days while it was very cold then decreased when warmer weather set in. The pigs in the groups not getting iron were very irregular in their eating. They would clean up all given them *consume?* for a while then at times would not take one-half of the usual ration. Pig No. 3, the large white pig shown in Fig. 6, though in the group not getting iron was always very hearty and made good gains throughout the entire experiment. Pig No. 2, in Group 1, refused to eat on January 16th, and from that time on until the close of the experiment ate very little

and made practically no gain. This pig would eat but very well for a week, and made some gain, but would refuse to eat very much the next week^K and would lose in weight. Pig No. 1 in Group I refused to eat two weeks after Pig No. 2, and from that time until the close of the experiment passed through about the same as has been said of Pig No. 2. Pig No. 1 was a litter mate to Pig No. 9 and at the beginning of this test there was only six pounds difference in their weights. At the end of the experiment there was one hundred and thirty-three pounds difference in their weights, Pig No. 1, having made nineteen pounds gain and Pig No. 9 one hundred and forty-six pounds gain. Figures 8 and 9 show these two at the close of the experiment.

Pig No. 10, Group IV, first refused to eat during the eighth week of feeding and consumed very little feed until death during the tenth week. When first taken sick he refused to eat at all for three or four days, then seemed to get better and began to eat, but soon became very sick and died within three days. Pig No. 12 died very suddenly during the ninth week. This pig had shown no signs of being sick and ate heartily in the morning of the day it died. Post-mortem showed cotton-seed meal poisoning. Pig No. 11, Group IV, did not ~~take~~^{become} seriously sick during the test but was very irregular about eating. Towards the close of the test this pig began to eat heartily, but the last week of the test showed the result of this eating. He lost very

materially in weight and showed signs of cotton-seed meal poisoning.

Pig No. 15, Group V, was very sick from the effect of the salt mixture but recovered and was one of the heartiest pigs in the entire experimental group and made excellent gains throughout the test exclusive of the week sick.

Figures, 7, 10 and 11, pages 33 and 35, show Groups II, IV and V respectively at the close of the experiment.

It will be noted from the weekly weights that Pig No. 15, Group V, did not gain very much during the last week of the experiment. This was due to the fact that she was crippled. Pig No. 8, Group III, lost in weight during the seventeenth week, ~~due~~^{owing} to external injury about ears and neck. The discussion of deaths in the iron group and the causes of death have already been taken up.

From the results of this test it is evident that iron is a most efficient antidote for cotton-seed meal poisoning.

Symptoms of Poisoning.

The pigs in Groups 1 and IV that became sick, (with the exception of Pig No. 12, which died suddenly) first refused to eat and would lie on belly and breath short and rapidly. Signs of blindness were shown, also a material weakening of the muscles of the legs and a rough coat of hair. ~~Also~~ an anemic condition which shows in the paleness of the skin of the mouth. The post-mortem examinations are included in the appendix, under the heading "Notes kept on this experiment".

their bellies

appeared still further

Curves Showing Gain and Feed Consumed.

The curves shown in the following plates show the relative gains made and feed consumed by individual pigs and by groups for each week of the experiment. Plates I, II, III, IV and V represent the weekly gains made by the pigs in Groups 1, 2, 3, 4 and 5 respectively. Plate number VI shows in the curves the average gain for each group by weeks and Plate VII shows the average amount of feed consumed by groups for each week.

no. VI

Explanation of Method of Plotting Curves.

Beginning at the lower left hand corner and numbering along the lower border from one to seventy, each of the half inch squares ~~made to~~ represent one week. Then on numbering up from 0 to 300, each of the smallest squares are made to represent two pounds. Then the curves are started with the original weight of the pigs and go up or down as the animals

gain

or lose in weight. The method for Plate VII is somewhat different to the other six. The large squares ~~are made to~~ represent week gains and each of the one-fourth inch squares ~~are made to~~ represent four pounds of feed.

Curves Showing Gains Made by Pigs in Group No. I.

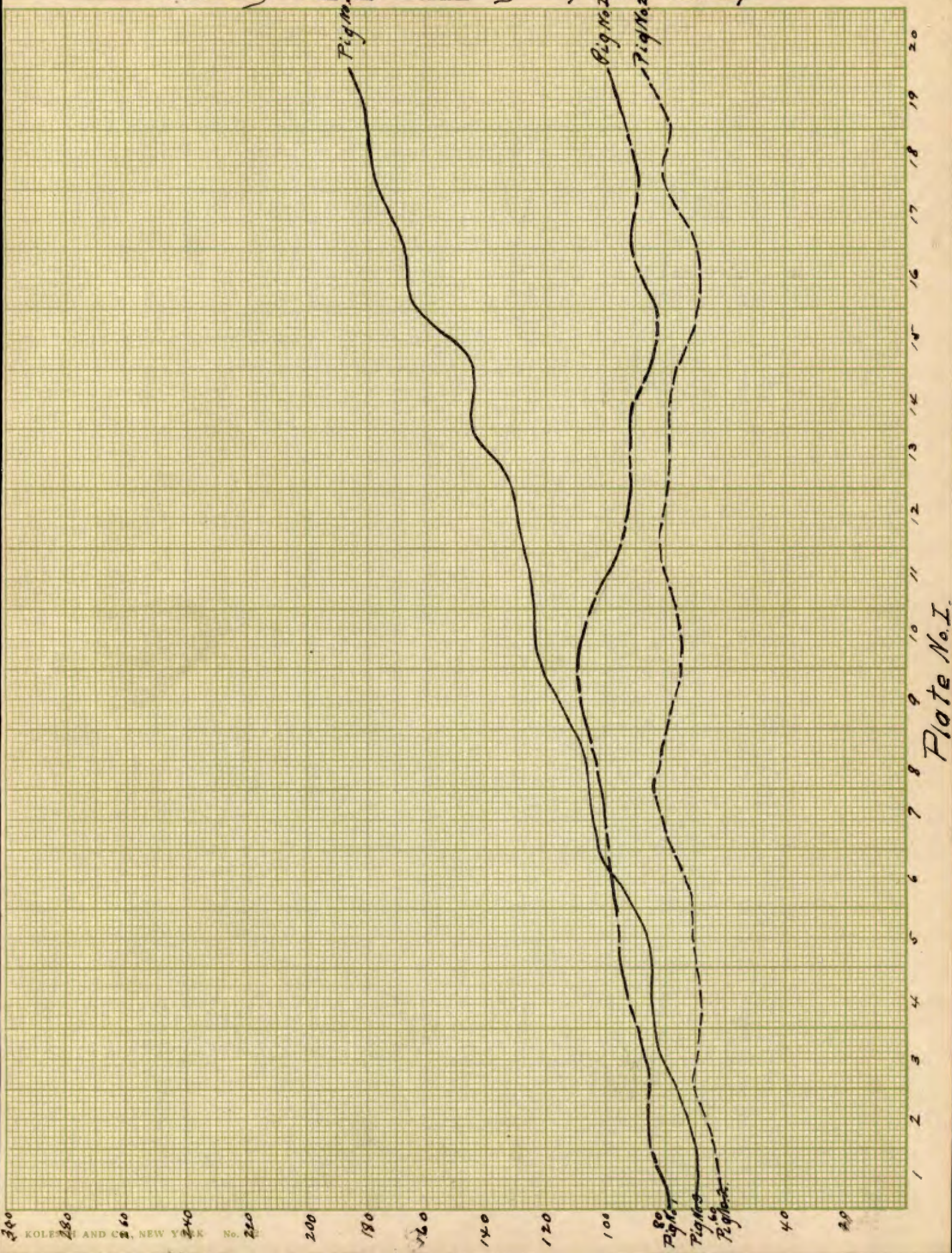


Plate No. I.

Curves Showing Gain made by Pigs in group No. 2.

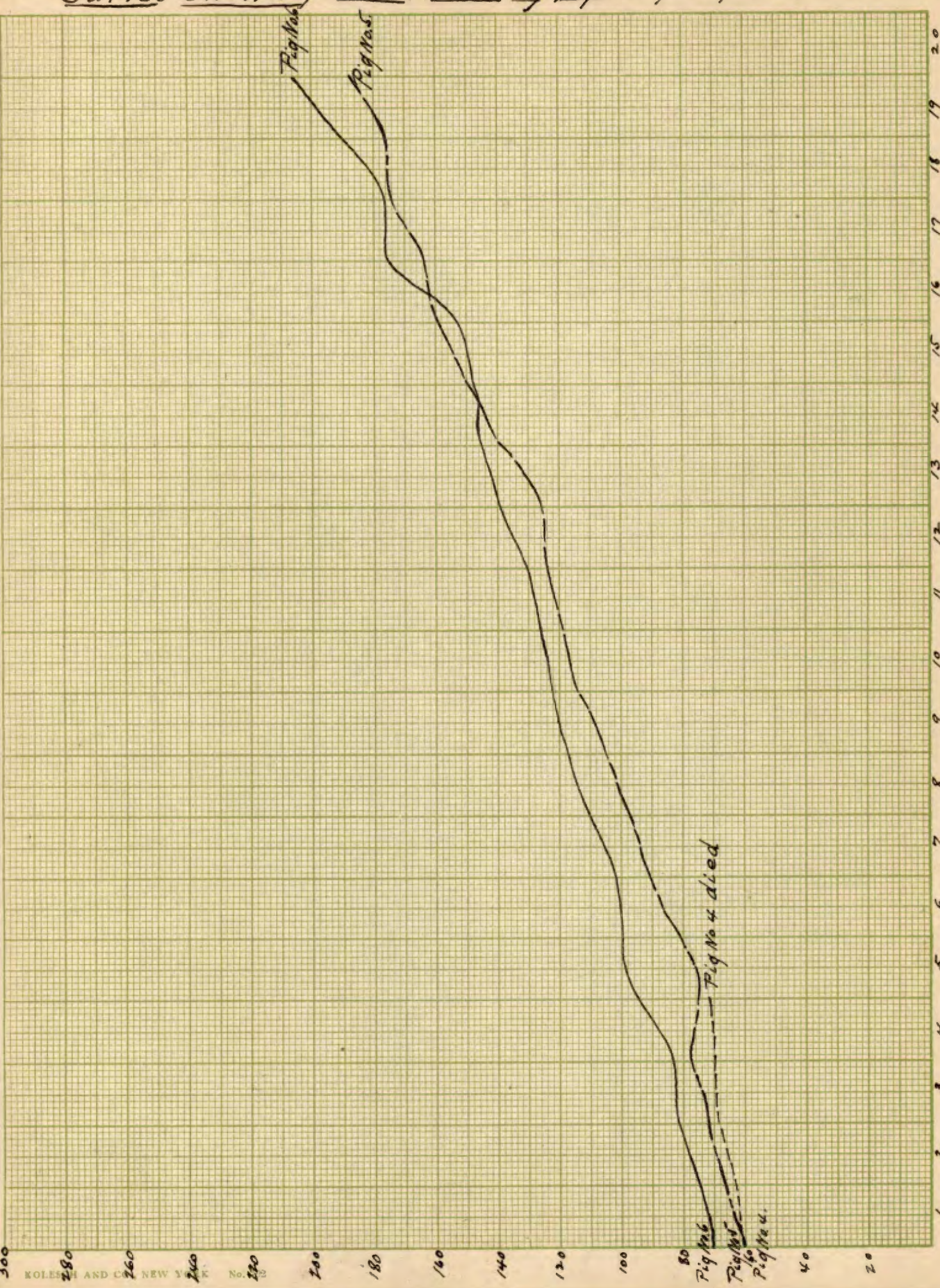
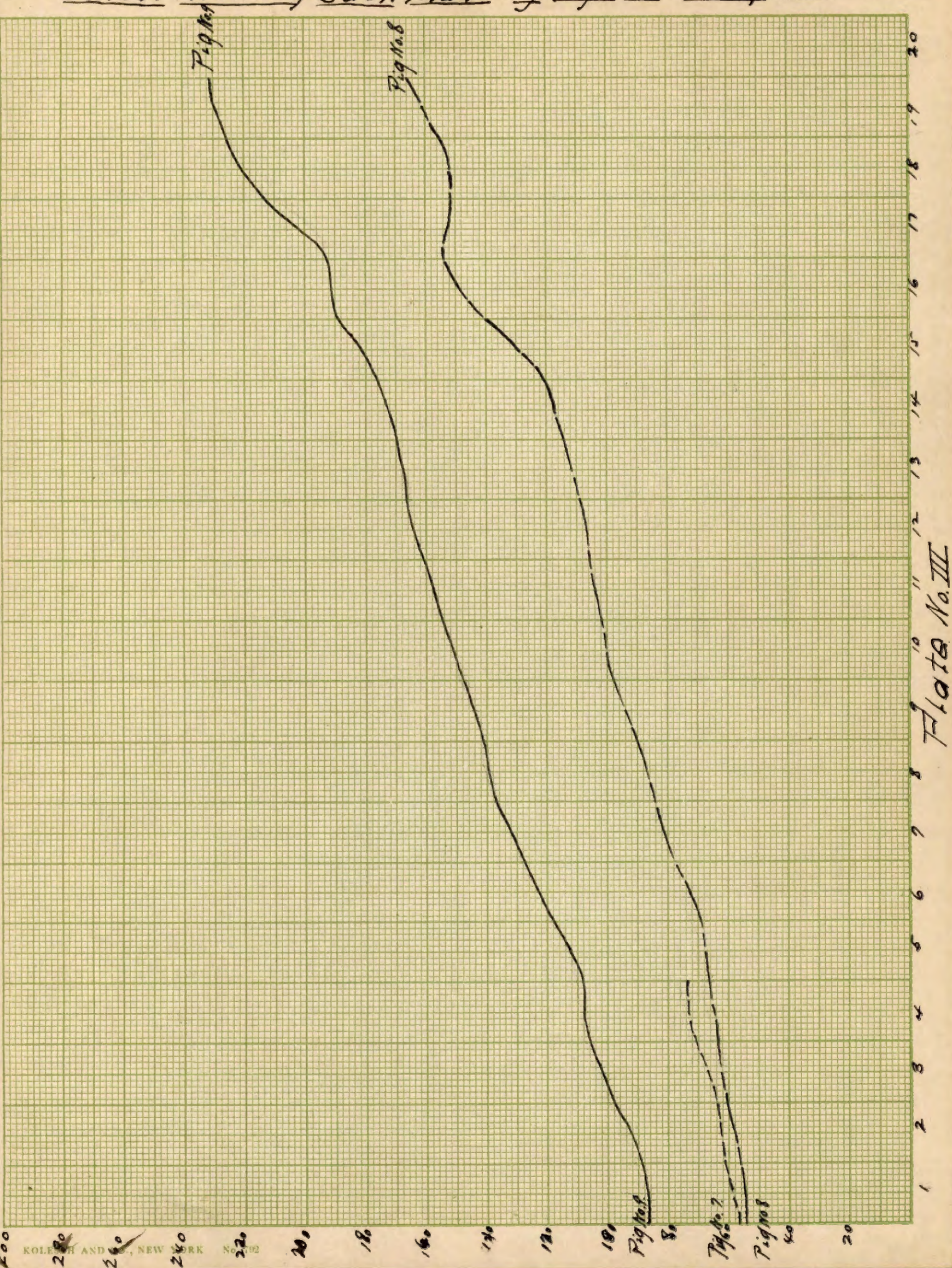
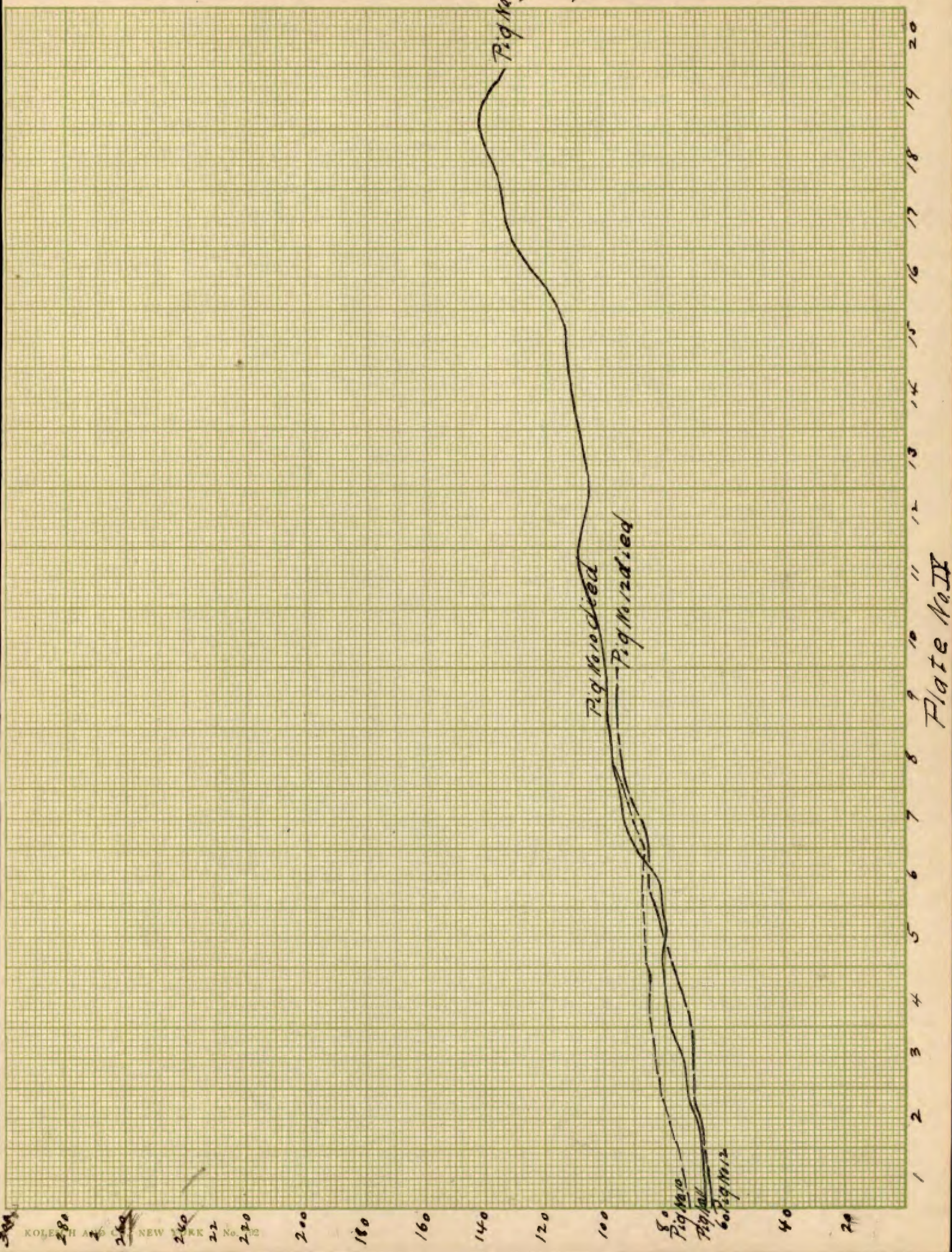


Plate No. II

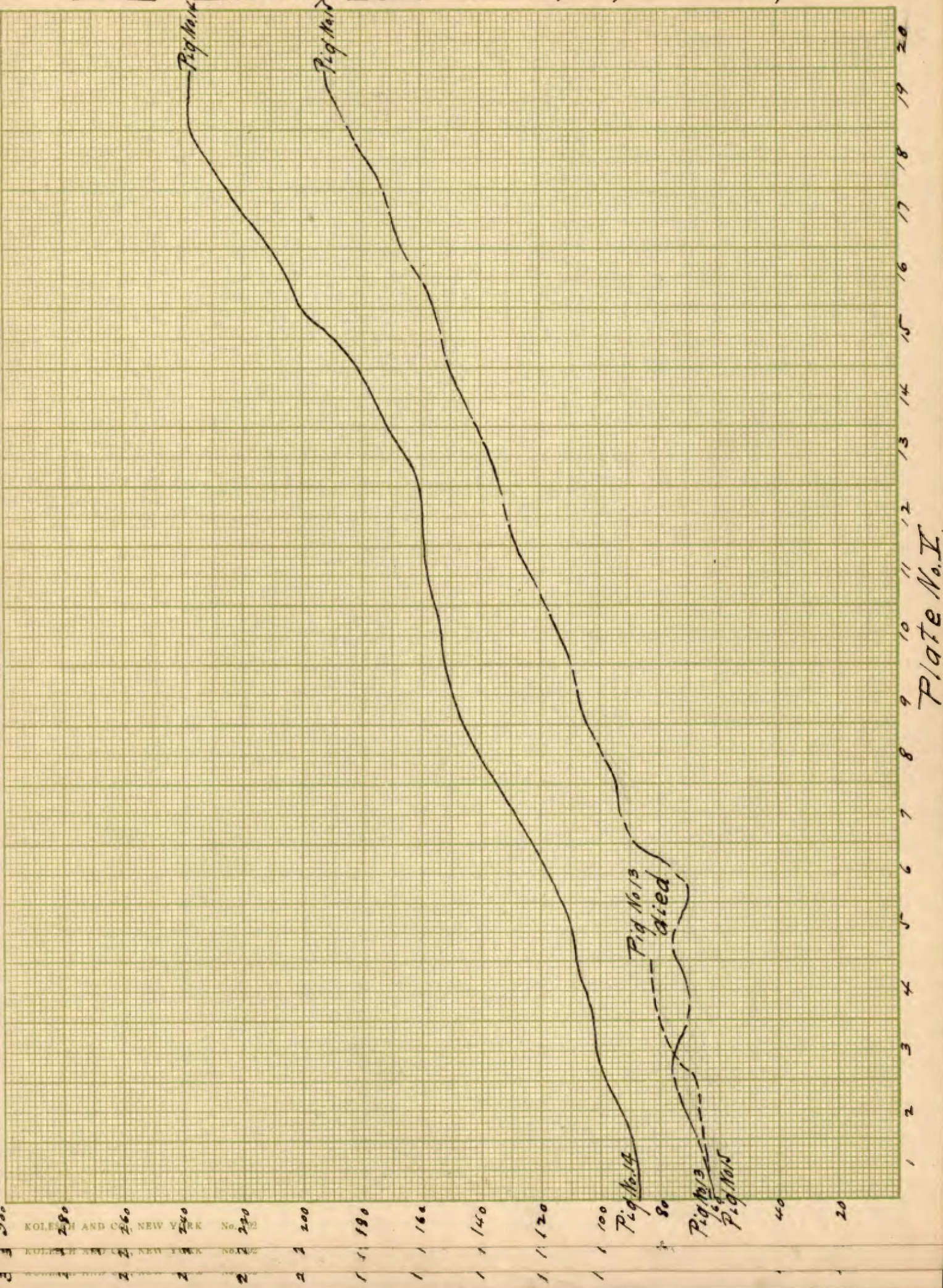
Curves Showing Gain Made by Pigs in Group No. 3.



Curves Showing Gain made by Pigs in Group No. 4.



Curve Showing Gains Made by Pigs in Group No. 5



Discussion of Curves.

It will be noted that the solid curved line on Plate I, makes a continual upward movement. This represents the gain made by pig No. 3, which gained steadily throughout the test, even though eating cotton-seed meal without iron. The curves representing pigs No. 1 and 2, show first a gain, then a loss in weight and close with a very small gain for the feeding period.

The curves on Plate II, show a steady gain for the pigs in Group II, getting iron chloride.

The curves on plate III, show about the same upward trend as those on Plate II. These pigs received iron sulphate and gained steadily.

Plate IV, represents group 4 and the curves show a small gain and two pigs dead after the eighth week. Pig No. 11, the only survivor in this lot lost several pounds during the last week as shown in the curves.

The curve representing pig No. 14, on Plate V, shows a steady gain. Until the last week during which time the pig was crippled. Pig No. 15, was sick during the fourth week, hence lost in weight as indicated in the curve.

On Plate VI, it is interesting to note that the average gain for the iron group steadily increased and ran very close together while the average gain for the non-iron fed groups was very little.

Plate No. VII, shows more uneven curves but the general ~~idea to be obtained~~ is about the same as that in Plate No. VI. The iron fed group consumed more feed and with a great deal more regularity. The non-iron fed pigs would eat for a few days, then ~~quit~~ eating for several more. This is clearly brought out in the curves plotted.

*result**stop*

Table No. 7

Table Showing Gains and Feed Eaten in
Periods of Four Weeks.

First Period of Four Weeks.

Lot	Total Gain lbs	Average Gain lbs.	Average Amt of Feed. lbs.
1	40	13 $\frac{1}{2}$	54-1/3
2	48	16	65-1/3
3	51	17	65-1/3
4	42	14	51.0
5	55	18-1/3	65-1/3

Second Period of Four Weeks

1	47	15-2/3	67 $\frac{1}{2}$
2	51	26.5	10.5 $\frac{1}{2}$
3	57	28.5	10.5 $\frac{1}{2}$
4	52	17-1/3	68.9
5	72	36	106.9

Third Period of Four Weeks

1	5	1 -1/3	59-1/3
2	43	21.5	119- $\frac{1}{2}$
3	45	22.5	109.0
4	5	4	84
5	42	21	120- $\frac{1}{2}$

Fourth Period of Four Weeks.

1	26	8-2/3	53-1/3
2	75	37.5	130- $\frac{3}{4}$
3	73	36.5	122- $\frac{3}{4}$
4	20	20.0	78.0
5	65	32.5	156- $\frac{1}{2}$

Fifth Period of Four Weeks.

1	46	15-1/3	52- $\frac{1}{2}$
2	53	26.5	112- $\frac{1}{2}$
3	48	24.0	109- $\frac{3}{4}$
4	4	4	71 $\frac{1}{2}$
5	48	24	126

The gains and feed consumed per pig were practically the same for all lots during the first four weeks, but during the second period of four weeks the pigs in the iron groups consumed more feed and made much better gains. With the beginning of the third four weeks period ~~is the time~~ we find the non-iron fed pigs losing and the iron fed pigs still gaining well. The fourth period of four weeks shows the iron fed pigs to still better advantage and the same is continued throughout the last four weeks.

The following table shows the amount of feed consumed, the cost per pound gain, and the average daily gain per pig for the five lots. It is interesting to note the marked difference in the average daily gain of the pigs that received iron and those that did not get iron. The average gain for the four pigs not getting iron was .44 pounds per day while the six pigs getting iron made an average daily gain of .96 pounds per day, two and one-half times as much.

Table No. 8

Table Showing Gain Per pig, Cost of Gain, Pound feed per Pound Gain, etc.

No of Pigs	Wt. in Begin lb	Wt at Close lbs	Total gain in lbs	Total gain per lot in lb	Total feed con sumed by lot in lbs	#s feed per # gain	Avg. Cost per # gain for group	Avg. daily gain in lbs
1	79	98	19					
2	61	86	25		867.75	5.30	\$.0794	.14
3	70	190	120	164				.19
								.90
4	61	71	10					
5	61	187	126		1140.50	4.22	\$.0634	.95
6	72	206	134	270				1.00
7	55	72	17					
8	58	165	111		1081.50	3.58	\$.0592	.83
9	85	231	146	274				1.10
10	73	97	24					
11	66	136	70		584.26	4.53	\$.0679	.53
12	63	98	35	129				
13	62	84	22					
14	88	236	148		1215.25	4.05	\$.0607	1.11
15	62	192	130	300				.97

The average cost per pound gain for the pigs not getting iron was \$.0737, while the average cost per pound gain of the iron fed groups was \$.0611. The difference in cost is a little more than one cent per pound and from a quick glance at the table it would seem that this is very little, but upon a careful study of the tables we find that the pigs in all groups gained practically the same amount during the first four or five weeks of the experiment, and pigs No. 2 and 12 in Lot 4, died before losing any of the gain made during the period already mentioned. Pigs No. 1 and 2, did not gain very much after the first four or five weeks, but at the same time they did not consume very much feed, hence did not require more feed to make a pound gain. The large gains made by the pigs in the iron fed groups, even under favorable conditions, makes this part of the experiment profitable financially, but the gains made by the non-iron fed pigs fall far below the others and we see that it is unprofitable as well as dangerous to feed cotton-seed meal to swine without iron.

It is interesting to note the profit made by those pigs getting iron salt with the cotton-seed meal *that received* ration. This showed that cotton-seed meal is a very cheap source of protein for the southern farmer to use as a supplement to corn for swine. The feeding value

of cotton-seed meal is about two-thirds that of tankage (and one author has found it equal to tankage in swine feeding) yet tankage will cost nearly twice as much as cotton-seed meal.

Table No. 9

Financial Statement of Profit or Loss

No of Pigs	First cost	Cost of feed	Total cost	Receipts from sales	Profit or loss
1	\$7.90				
2	6.10				
3	7.00	\$13.02	\$34.02	\$32.72	-\$2.30
*4	6.10				
5	6.10				
6	7.20	16.13	29.43	34.39	1 4.96
*7	5.50				
8	5.40				
9	8.50	15.14	29.14	34.65	1 5.14
10	7.30				
11	6.60				
12	6.30	8.76	28.96	11.90	-17.06
*13	6.20				
14	8.80				
15	6.20	17.25	32.25	37.45	1 5.20

* Pigs dying from other causes than cotton-seed meal poisoning not considered.

All of the pigs in the iron fed lots were fed at a profit, while the pigs in the check groups were fed at a loss and especially those of Group IV. In making this table all of the living pigs were figured at \$8.75 per hundred pounds, the price obtained for iron fed hogs; the corn was charged at 85 cents per bushel and the cotton-seed at \$30.00 per ton. As a matter of fact, two of the pigs in Group I were practically worthless and to put their proper value on them would show this lot more on the minus side.

Cost of Feed with Iron Sulphate.

Iron sulphate can be bought for about .02 per pound and forty pounds would be required to feed with one ton of cotton-seed meal. This would add only eighty cents to the cost of a ton of meal. The additional cost for the trouble incurred in feeding would be very small, ~~and~~ with this added *to Even* ~~the cost of cotton-seed meal this~~ would still be the cheapest concentrated feed on the market.

Recommendations for Feeding.

The most practical way of feeding ~~will be~~ *is* to keep a twenty-five or fifty gallon barrel in the feed house and in each barrel of water dissolve iron sulphate at the rate of *to*

one pound to fifty gallons of water. Then when feeding make a thin slop, using one gallon of the iron sulphate solution for every pound of cotton-seed meal in the ration. For young growing pigs a ration of two parts corn meal to one part cotton-seed meal should be used. For fattening purposes a wider ration could be used. ¹⁰ ~~One~~ part cotton-seed meal to four or five parts corn meal. It will be good practice to have grazing crops for the stock to run on while getting the cotton-seed meal ration.

Information from Sources other than Experiment Stations.

Mrs. A. G. Corley, now of Knoxville, Tennessee and recently of Texas, says that she always fed her hogs cotton-seed meal when she lived on a farm in Texas. ~~Enquiring as~~ ^{Further inquiry} ~~to the method~~ brought out the fact that she had fed copperas water along with the ration. She always gave the copperas water but she did not know why she did so. She was surprised to learn that cotton-seed meal would kill swine. Other farmers she said had been feeding cotton-seed meal as she had.

W. M. Burns of East Chattanooga, Tennessee, read Dr. Wither's article on "The Use of Iron as a Preventative of Cotton-seed Meal Poisoning" in the Progressive Farmer sometime ago, and decided he would try the method recommended ^{that} by Dr. Withers. He took six pigs at one month old, weighing

about twenty-five pounds and gave a ration of cotton-seed meal and corn meal as near half and half as he could get, with an addition of alfalfa hay. He fed a copperas solution, one pound copperas to fifty gallons of water, with his ration, and fed these pigs three months. They dressed out one hundred pounds each and sold for \$11.00 per hundred pounds. He feels sure that copperas will prevent poisoning.

Summary.

The results of this experiment give sufficient evidence that it is safe to feed cotton-seed meal to swine when an iron salt is added to the ration at the rate of one pound to fifty pounds of cotton-seed meal.

This experiment, along with many others, indicates that cotton-seed meal can be fed safely without iron for a period of not more than six or seven weeks, but pigs do not eat as much feed without iron as those that get the iron and do not make as large or as economical gains. The extra trouble of feeding the iron and the cost of the same is paid for several times over in the excess gains and the surety of not killing the animal.

The seventh week seems to be the turning point with pigs getting cotton-seed meal without iron. All gained very well to this time, then in a few days two had died and

all of the others, except one, were losing in weight. The pigs getting the greater proportion of their rations cotton-seed meal were taken sick first and died. Though no pigs were lost in Group I two were taken sick during the last ten and twelve weeks of the test and at times refused to eat at all for a few days, then would recover slightly and eat sparingly for another few days.

That occasionally you will find a pig that will do well on cotton-seed meal rations without iron was clearly demonstrated by Pig No. 3 in this experiment. At no time did this pig show signs of sickness and at the close had made practically as good gains as any pig in the experiment. This is exceptional, however, and in practice iron should be given to all hogs getting cotton-seed meal. *pigs*

The group receiving iron sulphate made the most economical gains, ~~not taking~~ into consideration the cost of the iron, and since this salt is much cheaper than iron chloride, copperas is the best iron compound to use in feeding cotton-seed meal. *even if we do not take*

This experiment also indicates that cotton-seed meal is a very valuable supplement to corn for feeding swine and that with the danger from poisoning prevented by feeding copperas this should make the most economical ration for swine at the command of the Southern farmer.

Appendix.

This appendix includes the Bibliography and all of the data and notes kept on the experiment, such as daily feed sheets, weekly weights, general notes and post-mortem examination. The post-mortem examinations were made by Dr. M. Jacob and Dr. W. G. Shaw.

Table Showing Group and Individual Weights by Weeks.

Lots & Pig Nos.	Nov 23	Nov 29	Dec 6	Dec 13	Dec 20	Dec 27	Jan 3	Jan 10	Jan 17	Jan 24
Lot I										
Total	210	220	233	243	250	258	278	290	297	306
I	79	85	85	90	95	97	98	101	105	110
II	61	64	71	68	70	70	78	84	80	75
III	70	71	77	85	85	91	102	105	112	121
Lot 2										
Total	194	207	224	234	242	182	194	208	222	236
IV	61	64	69	71	71					
V	61	67	72	79	76	82	92	97	104	114
VI	72	76	83	84	95	100	102	111	118	122
Lot 3										
Total	194	203	218	237	245	185	205	220	230	245
VII	55	60	62	70	72					
VIII	54	55	60	62	66	68	78	84	90	97
IX	85	88	96	105	107	117	127	136	140	148
Lot 4										
Total	202	212	225	235	244	253	262	261	296	200
X	73	77	84	86	87	89	86	94	96	97
XI	66	68	71	77	79	81	89	93	102	103
XII	63	67	70	72	78	83	87	94	98	
Lot 5										
Total	212	222	240	252	267	185	216	231	255	265
XIII	62	66	65	80	84					
XIV	88	89	99	102	108	114	126	136	148	154
XV	62	67	76	70	75	71	90	95	107	111

by Weeks

Jan	Feb	Feb	Feb	Feb	Mar	Mar	Mar	Mar	Apr
31	7	14	21	28	7	14	21	28	4

305	305	302	315	302	315	328	342	350	374
105	95	93	93	84	83	93	88	92	98
77	82	99	78	75	68	68	78	78	86
123	128	131	144	143	164	147	176	180	190

245	255	265	285	298	314	340	351	368	393
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119	125	125	140	150	160	165	175	177	187
126	130	140	145	148	154	175	176	191	206

255	267	275	285	296	331	348	367	382	396
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101	106	109	115	120	141	165	150	155	165
154	161	166	170	176	190	193	217	227	231

	112	107	112	115	118	132	137	145	136
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107	112	107	112	115	118	132	137	145	136
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277	290	297	315	335	357	380	400	425	428
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157	160	162	173	183	201	211	235	238	236
120	130	135	142	152	156	169	175	187	192

Daily Feed Sheet for Pigs.

Date	Lot 1		Lot 2		Lot 3		Lot 4		Lot 5	
	Morn	Eve	Morn	Eve	Morn	Eve	Morn	Eve	Morn	Eve
Nov										
24		$3\frac{1}{2}$		$3\frac{1}{2}$		$3\frac{1}{2}$		$3\frac{1}{2}$		$3\frac{1}{2}$
25	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$
26	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$
27	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$
28	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$
29	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$
30	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$
Dec										
1	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	3	$2\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$
2	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	2	$2\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$
3	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$
4	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	3	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$
5	$3\frac{1}{2}$	3	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$
6	$2\frac{1}{2}$	$2\frac{1}{2}$	$3\frac{1}{2}$	4	$3\frac{1}{2}$	4	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	4
7	$2\frac{1}{2}$	$2\frac{1}{2}$	4	4	4	4	$2\frac{1}{2}$	$2\frac{1}{2}$	4	4
8	3	$3\frac{1}{2}$	4	4	4	4	2	2	4	4
9	4	4	4	4	4	4	$1\frac{1}{2}$	2	4	4
10	4	$4\frac{1}{2}$	4	4	4	4	$3\frac{1}{2}$	3	4	4
11	$3\frac{1}{2}$	$3\frac{1}{2}$	4	4	4	4	$3\frac{1}{2}$	4	4	4
12	$3\frac{1}{2}$	2	4	4	4	4	4	2	4	4
13	$2\frac{1}{2}$	2	4	4	4	4	$2\frac{1}{2}$	2	4	4
14	2	2	4	4	4	4	2	2	4	4
15	2	2	4	4	4	4	2	2	4	4
16	2	$2\frac{1}{2}$	4	4	4	4	2	$2\frac{1}{2}$	4	4
17	3	3	4	4	4	4	3	3	4	4
18	3	3	4	4	4	4	3	3	4	4
19	3	3	4	4	4	4	3	3	4	4
20	3	4	4	$4\frac{1}{2}$	4	$4\frac{1}{2}$	3	4	4	$4\frac{1}{2}$
21	4	$3\frac{1}{2}$	$4\frac{1}{2}$	$4\frac{1}{2}$	$4\frac{1}{2}$	$4\frac{1}{2}$	4	2	$4\frac{1}{2}$	$4\frac{1}{2}$
22	$3\frac{1}{2}$	3	$4\frac{1}{2}$	$4\frac{1}{2}$	$4\frac{1}{2}$	$4\frac{1}{2}$	2	$2\frac{1}{2}$	$4\frac{1}{2}$	4
23	3	3	$4\frac{1}{2}$	$2\frac{1}{2}$	$4\frac{1}{2}$	$2\frac{1}{2}$	3	$1\frac{1}{2}$	$3\frac{1}{2}$	$2\frac{1}{2}$
24	3	3	3	3	3	3	3	2	2	2
25	3	3	3	3	3	3	3	3	2	$2\frac{1}{2}$
26	3	3	3	3	3	3	3	3	$1\frac{1}{2}$	$1\frac{1}{2}$
27	3	$3\frac{1}{2}$	3	$3\frac{1}{2}$	3	$3\frac{1}{2}$	3	4	$1\frac{1}{2}$	2
28	$4\frac{1}{2}$	$4\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	4	$4\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{2}$
29	$4\frac{1}{2}$	$4\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	4	4	4	$4\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{2}$
30	$4\frac{1}{2}$	$4\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	4	4	4	$3\frac{1}{2}$	$2\frac{1}{2}$	3
31	4	4	4	$3\frac{1}{2}$	4	$3\frac{1}{2}$	3	$2\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$
Jan										
1	3	3	$2\frac{1}{2}$	$2\frac{1}{2}$	$3\frac{1}{2}$	$3\frac{1}{2}$	$2\frac{1}{2}$	$2\frac{1}{2}$	$3\frac{1}{2}$	4
2	$2\frac{1}{2}$	3	$3\frac{1}{2}$	3	3	3	2	2	4	4

Date	Lot 1		Lot 2		Lot 3		Lot 4		Lot 5	
	Morn	Eve	Morn	Eve	Morn	Eve	Morn	Eve	Morn	Eve
Jan										
3	3	3 $\frac{1}{2}$	3	3 $\frac{1}{2}$	3	3 $\frac{1}{2}$	2	2 $\frac{1}{2}$	4	4 $\frac{1}{2}$
4	3 $\frac{1}{2}$	4	3 $\frac{1}{2}$	4	3 $\frac{1}{2}$	4	2 $\frac{1}{2}$	3	4 $\frac{1}{2}$	5
5	4	4	4	4	4	4	3 $\frac{1}{2}$	3 $\frac{1}{2}$	5	5
6	4	4	4	4	4	4	4	4	5	5
7	4	4	4	4	4	4	4	4	5	5
8	4	4	4	4	4	4	4	4	5	5
9	4	4	4	4	4	4	4	4	5	5
10	4	4	4	4	4	4	4	4	5	5
11	4	4	4	4 $\frac{1}{2}$	4	4 $\frac{1}{2}$	5	4	5	5
12	4 $\frac{1}{2}$	4 $\frac{1}{2}$	5	5	5	5	3 $\frac{1}{2}$	3 $\frac{1}{2}$	5	5
13	4 $\frac{1}{2}$	4 $\frac{1}{2}$	5	5	4 $\frac{1}{2}$	4 $\frac{1}{2}$	3 $\frac{1}{2}$	3 $\frac{1}{2}$	5	5
14	4 $\frac{1}{2}$	4 $\frac{1}{2}$	5	4 $\frac{1}{2}$	4	4	5	4	5	5
15	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4	4	4	4	5	5
16	4	*2	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4	4	4	4	4	4
17	2	2	4 $\frac{1}{2}$	4	4	4	4	4	4	4
18	2	2	4 $\frac{1}{2}$	4	4 $\frac{1}{2}$	4	4	**2 $\frac{1}{2}$	4	4
19	2	2 $\frac{1}{2}$	4	4	4	4	1 $\frac{1}{2}$	2	4	4
20	3	3	4	4	4	4	2	2	4	4
21	3 $\frac{1}{2}$	4	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	2	2	4 $\frac{1}{2}$	4 $\frac{1}{2}$
22	4	4	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	2 $\frac{1}{2}$	2 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$
23	4	4	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	2 $\frac{1}{2}$	2 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$
24	4	4	5	5	4	4	1 $\frac{1}{2}$	1 $\frac{1}{2}$	5	5
25	4	3 $\frac{1}{2}$	5	4	4	4	2	3	5	5
26	3 $\frac{1}{2}$	3	4	4	4	4	3 $\frac{1}{2}$	3 $\frac{1}{2}$	5	5
27	3	3	4	4	4	4	3 $\frac{1}{2}$	1 $\frac{1}{2}$	5	5
28	3	3	4	4	4	4	1	1	5	5
29	3	3	4	4	4	4	1	**1	5	4
30	3 $\frac{1}{2}$	3 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4	4	1	1	4	4
31	3 $\frac{1}{2}$	3 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4	4	1	1	4	4
Feb										
1	3 $\frac{1}{2}$	3 $\frac{1}{2}$	4 $\frac{1}{2}$	4 $\frac{1}{2}$	4	4	1	1 $\frac{1}{2}$	4	4
2	3 $\frac{1}{2}$	3 $\frac{1}{2}$	2	4 $\frac{1}{2}$	2	4	1 $\frac{1}{2}$	1 $\frac{1}{2}$	4	4
3	4	4	4	4	4	4	1 $\frac{1}{2}$	1 $\frac{1}{2}$	4	4
4	4	4	4	4	4	4	1 $\frac{1}{2}$	1 $\frac{1}{2}$	4	4
5	4	4	4	4	4	4	1 $\frac{1}{2}$	1 $\frac{1}{2}$	4	4
6	4	4	4	4	4	4	1 $\frac{1}{2}$	1 $\frac{1}{2}$	4	4
7	2	2	4	3	4	2	1 $\frac{1}{2}$	1 $\frac{1}{2}$	4	3
8	2	2	4	4	4	4	1	1	4	4
9	3	3	4	4 $\frac{1}{2}$	4	3 $\frac{1}{2}$	1	1 $\frac{1}{2}$	4	4 $\frac{1}{2}$
10	3	3	4 $\frac{1}{2}$	4 $\frac{1}{2}$	3 $\frac{1}{2}$	3 $\frac{1}{2}$	1	1	4 $\frac{1}{2}$	4 $\frac{1}{2}$
11	3	2	4 $\frac{1}{2}$	4 $\frac{1}{2}$	3 $\frac{1}{2}$	3 $\frac{1}{2}$	1	1	4 $\frac{1}{2}$	4 $\frac{1}{2}$
12	3	3	3	3	3 $\frac{1}{2}$	3 $\frac{1}{2}$	1	1	4 $\frac{1}{2}$	4 $\frac{1}{2}$
13	3	3	3	3	3 $\frac{1}{2}$	3 $\frac{1}{2}$	1	1	4 $\frac{1}{2}$	4 $\frac{1}{2}$
14	3	3	3	3	3 $\frac{1}{2}$	3 $\frac{1}{2}$	1	1	4	4

Date	Lot 1		Lot 2		Lot 3		Lot 4		Lot 5	
	Morn	Eve	Morn	Eve	Morn	Eve	Morn	Eve	Morn	Eve
15	2	2	4	4 ¹ / ₂	3 ¹ / ₂	4	1 ¹ / ₂	1 ¹ / ₂	4 ¹ / ₂	4 ¹ / ₂
16	3	3	5	5	4 ¹ / ₂	4 ¹ / ₂	2	2	5	5
17	3	3	5	5	4	4	1	1	5	5
18	3	3	5	5	4	4	1	1	5	5
19	3 ¹ / ₂	3 ¹ / ₂	5	5	4 ¹ / ₂	4 ¹ / ₂	1	1 ¹ / ₂	5	5
20	3 ¹ / ₂	3 ¹ / ₂	5	5	4 ¹ / ₂	4 ¹ / ₂	1 ¹ / ₂	1 ¹ / ₂	5	5
21	3 ¹ / ₂	4	5	5 ¹ / ₂	4 ¹ / ₂	4 ¹ / ₂	1 ¹ / ₂	1	5	5 ¹ / ₂
22	4	4	5 ¹ / ₂	5 ¹ / ₂	3 ¹ / ₂	3	1	1	5	5 ¹ / ₂
23	4	2	4 ¹ / ₂	3 ¹ / ₂	4 ¹ / ₂	4 ¹ / ₂	1	1	5	5 ¹ / ₂
24	2	2	4 ¹ / ₂	3 ¹ / ₂	4 ¹ / ₂	4 ¹ / ₂	1	1	5	5 ¹ / ₂
25	2	2	4	4 ¹ / ₂	4 ¹ / ₂	4 ¹ / ₂	1	1	5	5 ¹ / ₂
26	2	2	4 ¹ / ₂	4 ¹ / ₂	4 ¹ / ₂	3 ¹ / ₂	1	1	5	5 ¹ / ₂
27	2	2	4	4 ¹ / ₂	3	3	1	1	5	5 ¹ / ₂
28	3	3	3 ¹ / ₂	4	3	3	1	1	5	5 ¹ / ₂
Me										
1	2	3	4	5	3	4	1	1	5 ¹ / ₂	6
2	3	3	4 ¹ / ₂	4	4 ¹ / ₂	5	1	1 ¹ / ₂	6	6
3	3	1 ¹ / ₂	4 ¹ / ₂	4 ¹ / ₂	5	5	1 ¹ / ₂	1 ¹ / ₂	6	6
4	1 ¹ / ₂	3	4 ¹ / ₂	5	5	5	1 ¹ / ₂	1 ¹ / ₂	6	6
5	3	3	4 ¹ / ₂	4 ¹ / ₂	5	5	1 ¹ / ₂	1 ¹ / ₂	6	6
6	3	3	4 ¹ / ₂	4 ¹ / ₂	5	5	1 ¹ / ₂	1 ¹ / ₂	6	6
7	3	3	4 ¹ / ₂	4 ¹ / ₂	5	4	1 ¹ / ₂	1 ¹ / ₂	6	6
8	3	3	4 ¹ / ₂	4 ¹ / ₂	4	4	2	2	6	6
9	3	3	4 ¹ / ₂	4 ¹ / ₂	4	4	2	2	6	6
10	3	3	5	5	4 ¹ / ₂	4 ¹ / ₂	2 ¹ / ₂	2 ¹ / ₂	6	6
11	3	3	5	5	4 ¹ / ₂	4 ¹ / ₂	2 ¹ / ₂	1 ¹ / ₂	6	6
12	3	3	5	5	4 ¹ / ₂	4 ¹ / ₂	1 ¹ / ₂	1 ¹ / ₂	6	6
13	3	3	5 ¹ / ₂	5 ¹ / ₂	5	5	1 ¹ / ₂	1 ¹ / ₂	6	6
14	3 ¹ / ₂	3 ¹ / ₂	5 ¹ / ₂	5 ¹ / ₂	5	5	1 ¹ / ₂	1 ¹ / ₂	6	6
15	3 ¹ / ₂	3 ¹ / ₂	5 ¹ / ₂	5 ¹ / ₂	5	5	1 ¹ / ₂	1 ¹ / ₂	6	6
16	3 ¹ / ₂	3 ¹ / ₂	5	5	5	5	1 ¹ / ₂	1 ¹ / ₂	6	6
17	3 ¹ / ₂	3 ¹ / ₂	5	5	5	5	1 ¹ / ₂	1 ¹ / ₂	6	6
18	3 ¹ / ₂	3 ¹ / ₂	5	5	5	5	1 ¹ / ₂	1 ¹ / ₂	6	6
19	3 ¹ / ₂	3 ¹ / ₂	5	5	5	5	2	2	6	6
20	3 ¹ / ₂	3 ¹ / ₂	5	5	5	5	2	2	6	6
21	3 ¹ / ₂	3 ¹ / ₂	5	5	5	5	2	2	6	6
22	3 ¹ / ₂	3 ¹ / ₂	5	5	5	5	2	2	6	6
23	3 ¹ / ₂	3 ¹ / ₂	5	5	5	5	2	2	6	6
24	3 ¹ / ₂	3 ¹ / ₂	5	5	5	5	2	2	6	6
25	4	4	5 ¹ / ₂	5 ¹ / ₂	5 ¹ / ₂	5 ¹ / ₂	2	2	6	6
26	4	4	5 ¹ / ₂	5 ¹ / ₂	5 ¹ / ₂	5 ¹ / ₂	2	2	6	6
27	4	4	5 ¹ / ₂	5 ¹ / ₂	5 ¹ / ₂	5 ¹ / ₂	2	2	6	6
28	4 ¹ / ₂	4	5 ¹ / ₂	5 ¹ / ₂	5 ¹ / ₂	5 ¹ / ₂	2	2	6	6
29	4 ¹ / ₂	4 ¹ / ₂	5 ¹ / ₂	5 ¹ / ₂	5 ¹ / ₂	5 ¹ / ₂	2	2	6	6
30	4 ¹ / ₂	4 ¹ / ₂	5 ¹ / ₂	5 ¹ / ₂	5 ¹ / ₂	5 ¹ / ₂	2	2	6	6
31	4 ¹ / ₂	4 ¹ / ₂	5 ¹ / ₂	5 ¹ / ₂	5 ¹ / ₂	5 ¹ / ₂	2	1	6	6
Apr										
1	4	4	5 ¹ / ₂	5 ¹ / ₂	5	5 ¹ / ₂	1	1	6	6
2	4	4	6	6	5	5	1	1	6	6
3	4	4	6	6	5 ¹ / ₂	5 ¹ / ₂	1	1	6	6
4	4 ¹ / ₂		6 ¹ / ₂		6		1		6	

* Sick ** Dead

*don't write time
of day.*

Notes Kept of this Experiment.

December 23, 1913

After the death of white pig in No. 3, the pigs were watched closely. All were apparently well until ~~three~~ ^{3.40 P.M.} forty when the black pig in No. 5, was found in a convulsion which continued until the time of its death at four-forty five. At four-forty five p.m. December 23rd, white pig, Pen 2, stupid, hump back, runs out penis, attempts to urinate, seems weak, staggers a little. At four-twenty the Chester White in the same pen, No. 5, was noticed standing with head down, appeared stupid, labored breathing, unsteady gait, occasional coughing. At eight-thirty no change in Chester White in Pen No. 5, except increased weakness. Chester White in Pen No. 4 is stupid. Ten p.m. no change in Chester White both pens 2 and 5. At eleven, Chester White in pen No. 2, temperature 102, listless, unsteady gait, depression, convulsion lasting three minutes. Chester White, pen No. 5, temperature 102.8 no change.

*Why present
tense in one
sentence and
past in
the next?*

Post-Mortem Chester White in Pen No. 2.

Found dead about twelve a.m. December 23rd. Post-mortem 4-5 p.m. Purple discoloration under throat, breast and belly. Intestines somewhat distended with gas. Ecomotic spots on both kidneys, bladder congested, urine normal, intestines show interitis, Peyer patches in colon inflamed and swollen and breaking down in center. Stomach somewhat inflamed, intestinal lymphatics are congested. Ecomotic spots on lungs.

Post-Mortem, Black Shoat, Pen 5

Died, four forty-five, December 23rd. Post-mortem ten, ten-thirty. Nothing on kidney, few spots on spleen, inflamed bladder, pneumonic spots on lungs, no lesions on liver, slight degeneration in one lobe, (later it was found to be quite a lesion). No intestinal lesions, distinct ecomotic spots on heart.

Notes, December 23rd, Ten Forty-five p.m.

White pig No. 5, temperature 102.6, normal. Chester White Pig pen 2, temperature 102.5, normal.

Notes, December 24th, Five a.m.

Chester White, pen 2, stupid but seems better than at last noting. Chester White pen 5, same as for pen 2.

Chester White, Pen 2, Seven a.m.

Convulsions lasting three minutes, after which pigs get up and walk around but with unsteady gait. Seems listless and depressed. Chester White, pen 5, does not have violent convulsions as does pig in Pen 2, but lies much of the time in pen, shakes, quivers run through the body.

Chester White, Pen 2, Nine a.m.

Convulsions lasting from three to three and one-half minutes. Chester White, Pen 5, same as at seven a.m.

Chester White, Pens 2 and 5. Eleven a.m.

Same as at nine a.m.

Chester White, Pen 2 Two-thirty-p.m.

Seems weaker, convulsions more violent and coming at about one hour intervals.

Chester White, Pen 5, weaker, no violent convulsions, but quivers worse than before. Lies in pen much of the time.

No change

Six p.m.

No change

Nine p.m.

Notes December 25th, five-thirty a.m.

Chester White, Pen 2, weaker than night previous, but no violent convulsions noted, labored breathing, depressed.

Chester White, Pen 5, appeared better than at last examination but is weak, dull, quivers, appears to be blind.

No change

Seven a.m.

Chester White,

One-forty-five p.m.

Found dead at one forty-five, was alive at eleven.

Chester White, Pen 5, slight convulsions, but lies quivering much of the time as before.

Chester White, Pen 5,

Four p.m.

Convulsions more violent, but never as violent as those pigs which had died.

Post-Mortem White Pig Pen 2.

Died between eleven a.m. and one-forty-five p.m. Post-mortem between four and five p.m. No mottling on skin, intestines inflamed, slight but general, spleen normal, left kidney normal, bladder inflamed, but no ecchymotic spots, liver cloudy, swelling, stomach distended, mesenteries somewhat inflamed, mesenteric lymphatics inflamed. Intestinal contents very dark, congested lungs, heart normal, marked cerebral congestion, considerable congestion also in the cerebellum. Stomach distended and very much inflamed at pyloric end. Walls considerably thickened.

Weights of Pigs.

	Dec. 26th	Dec. 27th.	Dec. 28th.
Small Pig	29	26	27
Large Pig	47	45	44

On the morning of the 26th, a change in technic was made. Mr. W.H. MacIntire suggested that the iron compounds used (FeCl_3 and FeSO_4), changed by oxidation, when exposed to the air, into insoluble compounds, which may have caused the death of the pigs. The feed had, previous to this time, been mixed a feed or two ahead as convenient, the iron being added at the time the mixing was done. Beginning with the morning of the 27th, the iron for each feed was weighed separately, dissolved and added at once to the feed. Beginning with the night feed of the 28th, a solution compounded as follows was used: One-half pound of iron chloride was dissolved in twenty-five gallons of H_2O and one gallon of this fed to every pound of cotton-seed meal. The FeSO_4 solution was made in the same way.

Pen 2

Pen 3

Pen 5

Dec. 29th, 9 a.m. White pig in Lot 5 seems very much better,
eats very well

6 p.m. Not as well as at 9 a.m. but eats, seems to
be blind, lies down a great deal of the time.

Dec. 30th, 6 p.m. Pig No. 6 in Lot 2 lies most of the time, eats
though does not seem to be as anxious as usual.

Dec. 30, 7 a.m. Seems a little livelier, eats very well,
but still blind. Labored breathing while
lying.

Notes on Pig No 12, Group IV

Dec. 31, p.m. Black pig No 12, in Lot IV, refuses to eat
but does not seem very sick.

Jan 1, 1914 a.m. Pig still refuses to eat, seems to be weak,
staggers slightly when walking, lies most of
the time.

Jan 1, 1914 p.m. Same conditions as above noted. Pig does not
seem to be very sick, but refuses to even try
to eat. No worse than morning.

Jan 2, p.m. Pig still refuses to eat but does not seem
any worse.

Jan 5, Pig eats for first time since Dec 31, 1913

Jan. 6 Pig still improving.

Jan 16 p.m. Black pig in Lot I refuses to eat, seems to be
pretty sick, but does not seem to be any worse.

Jan 17 Pig still sick but does not seem to be any worse
than at last writing. White pig in same lot
does not eat but does not seem sick.

Jan 18 a.m. Seems to be better but does not eat

p.m. Eats a little

Jan 19 Eats o.k. but not heartily

Post-Mortem, January 18th, 1914

White pig in Group IV died suddenly at four p.m.

Stomach and intestines very much distended with gas, folded colon somewhat congested, small intestines slightly irritated, but not distended with gas, caecum normal, stomach well filled with undigested food. Interior of stomach considerably congested, bladder normal, kidney normal. Two or three small hemorrhagic spots on the spleen, lungs slightly congested but no more than could be expected from death by asphyxiation. Found dead, foaming at mouth and stretched full length as if she or he had been struggling.

Post-mortem by Dr. W.G. Shaw.

Post-mortem of Pig No. 10, Group IV

Spleen normal, small intestines inflamed, large intestines normal, kidney normal, liver friable. Stomach distended with food, intestines comparatively empty. Pneumonia of both lungs, resembling swine plague. Heart muscles anemic and pale. Muscle tissues very pale. Brain normal.

Post-mortem by Dr. W.G. Shaw.

Post-Mortem Examination of Red Pig in Check Group.

Lymphatic glands of throat very much inflamed. Dark red color, Stomach distended, spleen dark in color, small intestines somewhat congested, glands in small intestines somewhat red and congested. Lungs normal, stomach violently congested along the greater curvature. Death due to brain trouble, reflex from stomach, brain considerably congested. Post-mortem by Dr. W.G. Shaw.

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