

GEORGE SEVERANCE



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THESIS

Feeding Pigs

Geo. Severance.

1901

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THESIS.

EXPERIMENT IN FEEDING  
PIGS.

By

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Michigan Agricultural College.

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### Object of Experiment.

It is generally conceded that corn is deficient in muscleforming elements but much fewer feeders recognize the fact that corn is so deficient in bone making elements that its long continued use without being balanced by some muscle and bone making feeds will result in very weak bones. Furthermore, the comparative cheapness of corn as a grain ration induces many feeders to overlook its deficiencies, even in the feeding of breeding stock in which good development of bone and muscle is absolutely essential to the highest success in breeding, and by its excessive use weaken their herds and flocks far more than they realize.

To demonstrate, if possible, the marked inferiority of corn to a balanced ration for production of bone and muscle, it was determined to conduct an experiment in which one lot of pigs would be fed a pure corn ration and another lot a balanced ration and results compared; then to determine whether or not the bone making elements might be supplied at almost no cost by the addition of wood ashes, another lot was fed a corn ration with a continual supply of ashes in addition and results compared with results of other rations.

The plan of the experiment in detail was as follows:

1. Selection and arrangement of feeding stock.

A thrifty, even litter of eight pigs, five barrows and three sows, was selected to experiment on. The pigs were a cross between a Tamworth sow and a Duroc Jersey boar and showed many



characteristics of each parent. With the exception of one barrow, No. 158, which was a square, blocky hog, they were considerably more inclined to be longbodied, longnosed, and longlegged than the Duroc Jersey sire, while on the other hand they were much blockier than a typical Tarworth.

The pigs were divided into four lots of two pigs each and the lots numbered I, II, III, and IV with each pig numbered with an ear label. Nos. 93 and 179, Lot I; Nos. 158 and 153, Lot II, and No. 141, Lot IV were barrows; Nos. 34 and 159, Lot III; and No. 176, Lot IV were sows.

It was hoped that the weakness of the experiment due to limited numbers permitting individuality to play an important part would be partly overcome by feeding pigs from the same litter, as they would be more apt to have like inherent tendencies in strength of constitution and early maturing and feeding qualities. At the time of commencing the experiment, Jan. 20, the pigs were 163 days old and in good healthy growing condition, ranging in weight from 82 to 117 lbs.

## 2. General conditions.

With the exception of the last seventeen days when the pigs were kept in a barn, they were kept during the entire length of the experiment in grassless paddocks 100 by 40 ft. in size sloping to the south. Each paddock was provided with a small cot made of matched lumber and provided with a floor. All the pigs were allowed free access to the soil.





## 3 Feeding and care.

Previous to the opening of the experiment the pigs had been kept together in one of these paddocks and fed about three fourths bushel of ear corn and thirty-five pounds of separator skim milk daily. January 16th they were divided into four lots as before indicated, and as gradually as possible in four day's time they were changed to the experimental rations.

Following are the rations fed during the experiment:

Lot I--Corn Meal.

Lot II--Corn meal, ashes in side box.

Lot III--Three parts corn meal plus eight parts middlings by weight, plus ashes, first eight weeks.

One part corn meal plus two parts middlings by weight plus ashes, following twenty-seven weeks.

Five parts corn meal plus eight parts middlings by weight plus ashes the remainder of the experiment.

Lot IV-- Exactly the same as Lot III with the addition of what clover hay and sugar beets the pigs would eat during the first five months of the experiment.

All the pigs were furnished with salt and were watered daily. They were fed three times ~~per~~ day the first half of the experiment and twice per day the last half, feeding at the same time each day as nearly as possible. All grain was ground and moistened with water. The feed was not weighed out each meal but was measured out as feeders ordinarily measure it out and the quantity varied whenever the appetites of the pigs seemed to demand a change.



#### 4. Records.

The pigs were weighed individually every two weeks from January 20 to July 21, then weighed September 1, November 10, and November 27, and weights recorded together with the weight of feed eaten per pen during the same period for which the weights were recorded. Any conditions that arose from time to time that would influence results were recorded.

#### 5. Determinations sought.

- (1) To determine influence of rations on the strength of bones.
- (2) To determine influence of rations on the size of vital organs.
- (3) To determine influence of rations on the distribution of fat and lean.
- (4) To determine the effect of rations on the per cent of dressed weight.
- (5) To determine the cost per pound of producing pork with the different rations.



The following tables show the feed eaten by each lot with the corresponding gains made by the pigs.

Table I.

Lot I.					
Tag No.	93	95	179	179	
Date	Weight	Gain	Weight	Gain	Corn Meal
Jan. 20	98		100		
Feb. 3	107	9	109	9	115
Feb. 17	117.5	10.5	122	13	122
Mar. 3	134	16.5	137	15	150.5
Mar. 17	141.5	7.5	146.5	9.5	140.5
Mar. 31	153	11.5	162	15.5	143
Apr. 14	165	12	179	17	152
Apr. 28	175.5	10.5	193	14	166
May 12	196	20.5	210	17	181.5
May 26	207.5	11.5	238	28	184.5
June 19	215	7.5	243	5	176.5
June 23	230	15	262	19	178.5
July 7	239	9	288	26	167
Sept. 1	306	67	361	73	841
Nov. 10	339	33	410	49	822
Nov. 27.	352	13	437	27	286
Totals		254		337	3826

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Lot II.						
Tag No.	158		8	153		
Date	Weight	Gain	Weight	Gain	Corn Meal	
Jan. 20	87		99			
Feb. 3	99	12	109	10		117
Feb. 17	111	12	123	14		126
Mar. 3	122	11	138	15		150
Mar. 17	136.5	14.5	150	12		154.5
Mar. 31	152	15.5	168	18		144
Apr. 14	165	13	179	11		154.5
Apr. 28	177	12	197	18		163.5
May 12	196	19	219	22		182.5
May 26	207.5	11.5	240	21		186
June 9	217.5	10	254	14		191
June 23	228	10.5	270	16		181
July 7	248	20	291	21		167
Sept. 1	329	81	362	71		685
Nov. 10	384	55	400	38		800
Nov. 27	400	16	418	18		287
Totals		313		319		3389

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## Lot III.

Tag No!	34		159			
Date	115	Gain	Weight	Gain	Corn Meal	Middling
Jan. 20	115		94			
Feb. 3	128	13	106.5	12.5	35.5	95
Feb. 11	140.5	12.5	120	13.5	33	89.5
Mar. 3	157	16.5	133.5	13.5	39	102.5
Mar. 17	169.5	12.5	148.5	15	43	114
Mar. 31	189	19.5	165	16.5	53.5	107
Apr. 14	203	14	177	12	57	113.5
Apr. 28	222	19	193	16	59.5	119
May 12	237	15	208.5	15.5	63	125
May 26	254	17	223	14.5	65	130
June 9	270	16	229	6	65	131
" 23	293	23	251	22	69	138
July 7	316	23	275	24	73	146
Sep. 1	378	62	335	60	299	597
Nov. 10	454	76	411	76	366	589
Nov. 27	485	31	429	18	113	182
Totals		370		335	1433.5	2778.5

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## Lot IV.

Tag No.	141		176					
Date	Weight	Gain	Weight	Gain	Corn Meal	Mid- lings	Beets	Clover Hay
Jan. 20	82		117					
Feb. 3	106	24	129.5	12.5	33	89	4.5	3
Feb. 17	113	7	140	10.5	27	73.5	22.5	3.5
Mar. 3	131.5	18.5	155.5	15.5	36	96	24	4
Mar. 17	142.5	11	167	11.5	37	99.5	30.5	5
Mr. 31	160	17.5	189.5	22.5	49	98	34.5	3.5
Apr. 14	180.5	20.5	206	16.5	55	111	39.5	4
Apr. 28	203	22.5	229	23	60	121	44	5.5
May 12	219	16	250	21	61	121	42	3.5
May 26	245.5	26.5	262	12	66	131	52	4
June 9	254	8.5	273	11	63	127	51.5	3.5
" 23	290	36	296	23	69	138	33	
July 7	304	14	316	20	73	147	43	
Sept. 1	371	67	384	66	302	604	29	6.5
Nov. 10	435	64	463	79	357	572		
Nov. 27	447	12	473	10	113	182		
Totals		335		356	1401	2710	455	43

Perhaps one of the first things noticed in the above table by one not accustomed to keeping accurate accounts of gains of live stock is the irregularity of gain from week to week by each pig. It is seen that a given amount of feed will vary considerably in the amount of pork it produces during different periods of equal length when fed to the same lot of pigs. The minor variations seem to be due to slight changes in the weather or other conditions over which the feeder has no control, or the effects of which he cannot entirely overcome by artificial means. The more marked variations, however, are usually traceable to causes over which the feeder has direct control. For example, during the two weeks from March 3rd to March 17th, Lot I gained seventeen pounds as compared to 31.5 pounds gained the preceding two weeks. The decreased gain in this case was due to throwing the pigs off feed by over-feeding with the clear corn meal. The same cause operated on the same lot during the two weeks from May 26th to June 9th, when No. 179 would eat very little for two or three days. These observations illustrate two important facts. First, that a great deal of feed may easily be thrown away by a little carelessness in feeding. Second, that it is much harder to keep an animal feeding well when confined to a single unbalanced ration than when given a variety. (No other lot went off feed. Lot I had nothing but corn meal. Lot II had corn meal with an addition of ashes, and the others had a balanced ration.)

Another very noticeable result shown by the above table is that the lots fed corn meal as a grain ration made

数据库系统由数据库、数据库管理系统、数据库管理员、数据库用户等几部分组成。数据库是存储在计算机中、按一定组织方式存储的数据集合。数据库管理系统是位于用户和数据库之间的一层数据管理软件。数据库管理员是负责数据库系统运行、维护和管理的人员。数据库用户是数据库系统的最终使用者。

数据库系统的主要功能包括：数据定义、数据操作、数据控制、数据查询、数据维护、数据安全和数据备份等。数据库系统的主要特点包括：数据共享、数据独立性、数据完整性、数据安全性、数据一致性、数据冗余和数据恢复等。

数据库系统的发展经历了三个阶段：文件系统阶段、数据库系统阶段和数据库系统阶段。数据库系统的发展使得数据的管理和使用更加高效、安全和可靠。

数据库系统的应用非常广泛，包括：企业管理、科学研究、教育、医疗、金融、政府管理等。数据库系统的应用使得数据的存储、管理和使用更加便捷和高效。

数据库系统的未来发展趋势包括：大数据、云计算、人工智能、区块链等。数据库系统将朝着更加智能化、集成化和安全化的方向发展。

数据库系统的学习和应用对于从事计算机相关工作的人员来说是非常重要的。通过学习数据库系统，可以更好地理解和应用数据库技术，提高工作效率。

数据库系统的学习和应用需要掌握一定的理论和实践知识。通过学习和实践，可以更好地理解和应用数据库技术，提高工作效率。

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practically as rapid gains up to September 1, as those <sup>that</sup> given a well balanced ration but for the next ten weeks there was a decided falling off in gain by all the corn fed pigs. During a considerable part of this last period they were not eager for their feed. This simply emphasizes the importance of a balanced ration for growing pigs if fed for a long time but that for a comparatively short period the balanced ration may be ignored.

The greatly increased gain by the corn fed pigs during the last seventeen days of the experiment was due to changed conditions. November 10 the pigs were moved into a comparatively warm barn, washed in buttermilk and zenoleum, and allowed to remain in the barn the remaining seventeen days.

The following table shows the amount of feed required and the cost per pound of gain for the total period and for shorter periods as indicated in the table. Corn meal is reckoned at \$16 per ton, middlings at \$15 per ton, clover hay at \$6 per ton, and sugar beets at \$4 per ton.



Table II.

Lot I.

Periods	Pounds corn per lb. gain	Cost per lb. gain
1st 8 weeks, Jan. 20--Mar. 17,	5.87	4.69 cents
2nd 8 weeks, Mar. 17--May 12,	5.44	4.36 "
3rd 8 weeks, May 12--July 7,	5.84	4.67 "
4th 8 weeks, July 7--Sept. 1,	6.01	4.81 "
10 weeks, Sept. 1--Nov. 10,	10.02	8.02 "
17 days, Nov. 10--Nov. 27,	7.15	5.72 "
32 weeks, Jan. 20--Sept. 1,	5.79	4.62 "
Jan. 20--Nov. 27,	6.47	5.18 "



The following table shows the results of the experiment. The first column is the number of trials, the second column is the number of correct responses, and the third column is the percentage of correct responses. The data shows that the percentage of correct responses increases as the number of trials increases, indicating that the subject is learning the task.

Number of Trials	Number of Correct Responses	Percentage of Correct Responses
10	5	50%
20	12	60%
30	18	60%
40	25	62.5%
50	30	60%
60	35	58.3%
70	40	57.1%
80	45	56.25%
90	50	55.56%
100	55	55%

The results of the experiment show that the subject's performance is stable around 55-60% correct responses. This suggests that the subject has reached a level of learning and is performing the task consistently.

## Lot II.

Periods	Pounds corn eaten per lb. gain	Cost per lb. gain
1st 8 weeks, Jan. 20--Mar. 1,	5.45	4.36 cents
2nd 8 weeks, Mar. 17--May 12,	5.02	4.01 "
3rd 8 weeks, May 12--July 7,	5.85	4.68 "
4th 8 weeks, July 7--Sept. 1,	5.82	4.66 "
10 weeks, Sept. 1--Nov. 10,	8.60	6.66 "
17 days, Nov. 10--Nov. 27,	8.44	6.75 "
32 weeks, Jan. 20, Sept. 1,	5.55	4.44 "
Jan. 20--Nov. 27,	6.15	4.92 "

## Lot III.

Periods	Pounds corn eaten per lb. gain	Pounds middlings per lb. gain	Cost per lb. gain
1st 8 weeks, Jan. 20--Mar. 1,	1.37	3.65	3.83 cents
2nd 8 weeks, Mar. 17--May 12,	1.84	3.64	4.19 "
3rd 8 weeks, May 12--July 7	2.30	3.75	4.65 "
4th 8 weeks, July 7--Sept. 1	2.45	4.89	5.63 "
10 weeks, Sept. 1--Nov. 10,	2.41	3.83	4.83 "
17 days, Nov. 10--Nov. 27,	2.31	3.71	4.63 "
32 weeks, Jan. 20--Sept. 1,	1.89	3.96	4.50 "
Jan. 20--Nov. 27,	2.03	3.94	4.58 "

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. This is essential for ensuring the integrity of the financial statements and for providing a clear audit trail.

2. The second part of the document outlines the various methods used to collect and analyze data. These methods include direct observation, interviews, and the use of statistical techniques. Each method has its own strengths and limitations, and it is important to choose the most appropriate one for the specific situation.

3. The third part of the document describes the process of data analysis. This involves identifying patterns, trends, and anomalies in the data. It also involves testing hypotheses and drawing conclusions based on the results.

4. The fourth part of the document discusses the importance of reporting the results of the analysis. This involves preparing clear and concise reports that summarize the findings and provide recommendations for action.

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## Lot IV.

Periods	Pounds 'corn 'eaten 'per lb 'gain	Pounds 'Middl- 'ings 'per lb 'gain	Pounds 'roots 'per lb 'gain	Pounds 'clover 'hay 'per lb 'gain	Cost per lb. gain
1st 8 wks, Jan. 20-Mar. 17	'1.11	'3.24	' .74	' .14	' 5.58 cents
2nd 8 wks., Mar 17-May 12	'1.41	'2.85	'1.00	' .10	' 3.48 "
3rd 8 wks., May 12-July 7	'1.79	'3.60	'1.22	' .05	' 4.39 "
4th 8 wks., July 7-Sep. 1	'2.24	'4.47	' .21	' .07	' 5.21 "
10 wks., Sept. 1-Nov. 10	'2.50	'4.00	'	'	' 5.00 "
17 days, Nov. 10-Nov. 27	'5.14	'8.27	'	'	'10.31 "
32 wks., Jan. 20-Sept. 1	'1.67	'3.52	' .82	' .009	' 4.17 "
Jan. 20- Nov. 27,	'1.94	'3.76	' .63	' .007	'4.52 "



From the above table it will be seen that Lot II fed corn meal with free access to ashes made somewhat cheaper gains than Lot I fed corn meal with no ashes but it is questionable whether much of this difference is attributable to the addition of ashes, for by consulting Table No. I it will be seen that No. 93 was decidedly inferior pig in his ability to consume and utilize grain readily. It would be unsafe to draw a definite conclusion without duplicating the experiment several times. Comparing Lot III fed a balanced ration with Lots I and II fed corn rations we see quite a decided cheapening of production by the balanced ration. Lot IV fed the same ration as Lot III with the addition of some sugar beets and clover hay part of the time produced pork considerably cheaper than Lot III when getting the beets and hay but more expensively when both lots were confined to corn meal and middlings. This makes it seem very probable that the reduced cost of production when feeding beets and hay was due to the addition of these feeds giving the needed succulence and bulk rather than being due to the individuality of the pigs. The whole experiment emphasizes the importance of variety and proper succulence and bulk in feeding.

Another principle of feeding illustrated in the above table is that the cost of gain increases as the length of the feeding period increases. The rise was not invariable but the general tendency was upward so that the average cost per lb. for the whole period as shown in the last line was in every case considerably greater than for the first two



months as shown in the first line. For the closing period, from Nov. 10 to Nov. 27, there was a decrease in cost of gain for the first three lots but an abnormal increase in cost of gain for Lot IV. These variations are believed to be due to changing the pigs from their cots to the barn and washing in Zenoleum and butter milk as before stated.

An interesting fact seen in the above table is that while on the whole the pigs fed balanced rations made considerably cheaper gains than the corn fed pigs, the corn fed pigs made considerably the cheapest gains during July and August, the two hottest months in the year. This result seems contrary to what would be expected since from the heating nature of corn it is believed to be especially suited for winter feeding.





Table III is to show the influence, if any, of

Table III			
	No. of pig.	Live Weight	Dressed Weight
Lot I fed pure corn meal	93	356 lbs.	310 lbs.
	179	435 lbs.	365 lbs.
Lot II fed corn meal and ashes	158	397 lbs.	339 lbs.
	153	410 lbs.	358 lbs.
Lot III fed corn meal and middlings	34	471 lbs.	410 lbs.
	159	446 lbs.	391 lbs.
Lot IV fed meal, middlin- gs, sugar beets, and clover hay	141	465 lbs.	408 lbs.
	176	465 lbs.	408 lbs.

the different rations on various parts of the animal body.

% of dressed weight	Weight of heart	Liver	Lungs	Intestinal fat	Pounds present required to break down
87%	1.25 lbs.	3.5 lbs.	2 lbs.	6 lbs.	
83.9%	1.625 lbs.	3.5 lbs.	1.875 lbs.	9.5 lbs.	462
85.4%	1.25 lbs.	3. lbs.	1.375 lbs.	8.75 lbs.	552
87.3%	1.75 lbs.	3.5 lbs.	1.625 lbs.	8.25 lbs.	402
87 %	1.625 lbs.	3.625 lbs.	2.25 lbs.	10.75 lb.	414
87.6%	1.5 lbs.	3.75 lbs.	2.25 lbs.	6.5 lbs.	
87.7%	1.625 lbs.	3.75 lbs.	2.25 lbs.	10.5 lbs.	660

1. The first part of the document discusses the importance of maintaining accurate records of all transactions and activities. It emphasizes that proper record-keeping is essential for transparency and accountability, particularly in financial matters. This section also highlights the need for regular audits and reviews to ensure that all data is up-to-date and correct.

2. The second part of the document focuses on the implementation of robust internal controls. It outlines various measures that can be taken to prevent fraud and mismanagement, such as separating duties, requiring approvals, and maintaining clear lines of communication. The document stresses that these controls are not just for compliance but are also crucial for the long-term success and stability of the organization.

3. The third part of the document addresses the role of technology in modern record-keeping. It discusses how digital tools and software can streamline processes, reduce errors, and provide real-time access to data. However, it also notes the importance of ensuring that these technologies are secure and that data is protected from unauthorized access or loss.

4. The final part of the document provides a summary of the key points discussed and offers recommendations for further action. It encourages organizations to regularly assess their record-keeping practices and to seek professional advice when needed. The document concludes by reiterating the importance of a strong, reliable record-keeping system for any organization looking to thrive in a competitive market.

Table IV is Table III reduced to basis of 100 lbs. live weight.

Table IV.

	'No. of ' Pig	'Heart '	' Liver '	' Lungs '	' Fat '	'Lbs. to 'break ' bone.
Lot I	' 93	' .351 lbs	' .936 lbs.	' .562 lbs.	' 1.685 lb.	'
	' 179	' .375 "	' .805 "	' .431 "	' 2.184 "	' 106.8 lb.
Lot II	' 158	' .315 "	' .756 "	' .346 "	' 2.204 "	' 139 "
	' 153	' .427 "	' .654 "	' .396 "	' 2.012 "	' 98 "
Lot III	' 34	' .345 "	' .770 "	' .478 "	' 2.232 "	' 86 "
	' 159	' .	'	'	'	'
Lot IV	' 141	' .336	' .841 "	' .504 "	' 1.457 "	'
	' 176	' .349	' .806 "	' .483 "	' 2.262 "	' 142 "



It will be noticed that the live weights given in Table III are less than those given in Table I at the close of the feeding trial. This is because the pigs were kept two weeks after the feeding trial closed during which time they went to Chicago and back and were under such adverse circumstances that they lost flesh.

It is feared that the high per cent dressed weight is due to discrepancy in weights as the live and dressed weights were taken by different persons from different scales, but as I took neither the live nor the dressed weights myself I am unable to say where the error, if any, lies.

In determining the relative strength of bones the inner metatarsal bone was used in each case. In breaking the bones each end was placed on a knife edge, an iron ring filed to have a very narrow bearing surface hung over the middle, a box suspended from the ring, and small weights gradually added to the box till the bones broke. The weight of the whole apparatus suspended from the bone was taken as the weight required to break the bone. The knife edges were firmly fixed at the same distance apart for all the bones, the bones placed exactly the same each time, and the ring hung midway between the knife edges.

In regard to the influence of different rations on the per cent of dressed weight, size of vital organs, and amount of intestinal fat, the experiment seems to give no satisfactory results. The per cents of dressed weight do not seem to favor either the pigs fed a balanced ration or those fed corn meal. By consulting table IV we find that the pig





having the smallest heart, liver, and lungs is No. 153, a corn fed pig, which is the result that would be expected. On the other hand we find that No. 153 has the largest heart, and No. 93 the largest liver and lungs, both corn fed pigs, which result is directly opposite to what would be expected. In regard to the strength of bone, the pig having the strongest bone, No. 176, and the pig having the weakest bone, No. 34, were both fed on balanced rations. The bone of No. 158, a corn fed pig, was practically as strong as that of No. 176. Unfortunately the bones of only five pigs were secured. Consulting the column of weights of intestinal fat, we see that the pig having the most intestinal fat, No. 34, and the one having the least, No. 141, were both fed on balanced rations. On the whole, then, the experiment seems to prove nothing in regard to the points exhibited in Tables III and IV.

The accompanying photographs show longitudinal sections through the spinal column and cross sections just back of shoulders and through the loins of No. 179, 158, 153, 34, and 176. Through some misunderstanding with the butcher, we were unable to secure photographs of cuts from all the pigs. On the back of each photograph is the number of the pig and a statement of its feeding, otherwise they are self-explanatory. They illustrate the individuality of pigs more than they show anything in regard to the influence of rations.



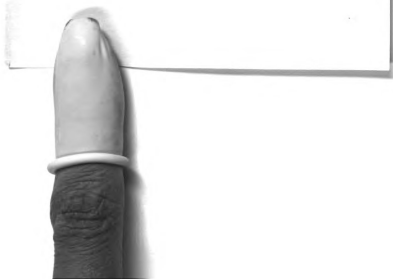
General conclusions regarding  
the experiment.

1. The results of the experiment decidedly favor variety and balance in feeding for economy.

2. In regard to influence of rations on per cent dressed weight, distribution of fat and lean, size of vital organs, and strength of bone, so few pigs were used that individuality prevented securing any decisive results, and that no conclusions can be safely drawn one way or the other from this experiment.

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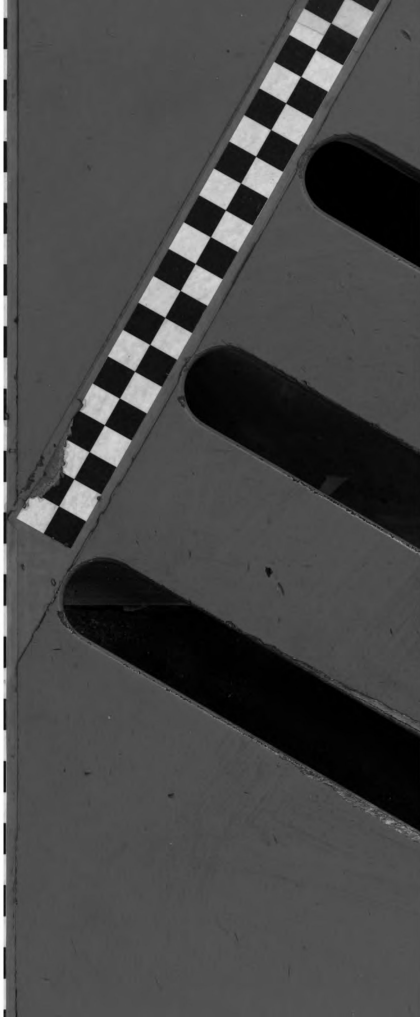
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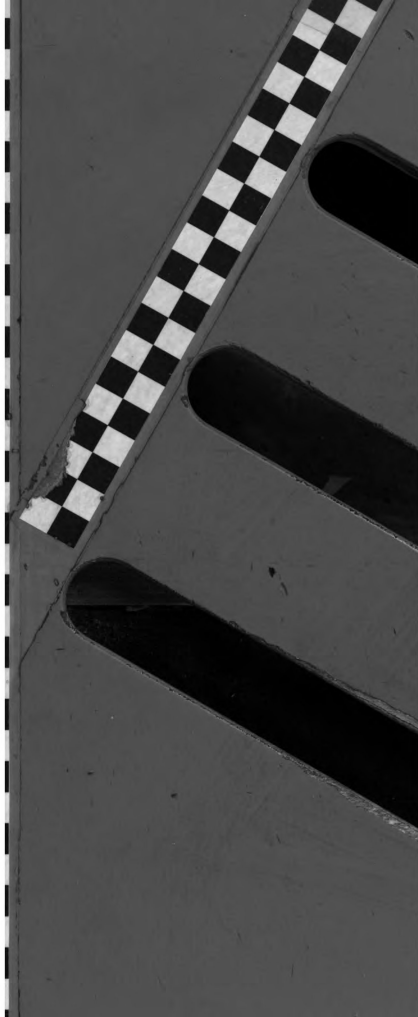


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