PORK PRODUCTION

SMITH

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L. H. Bailey *Editor*

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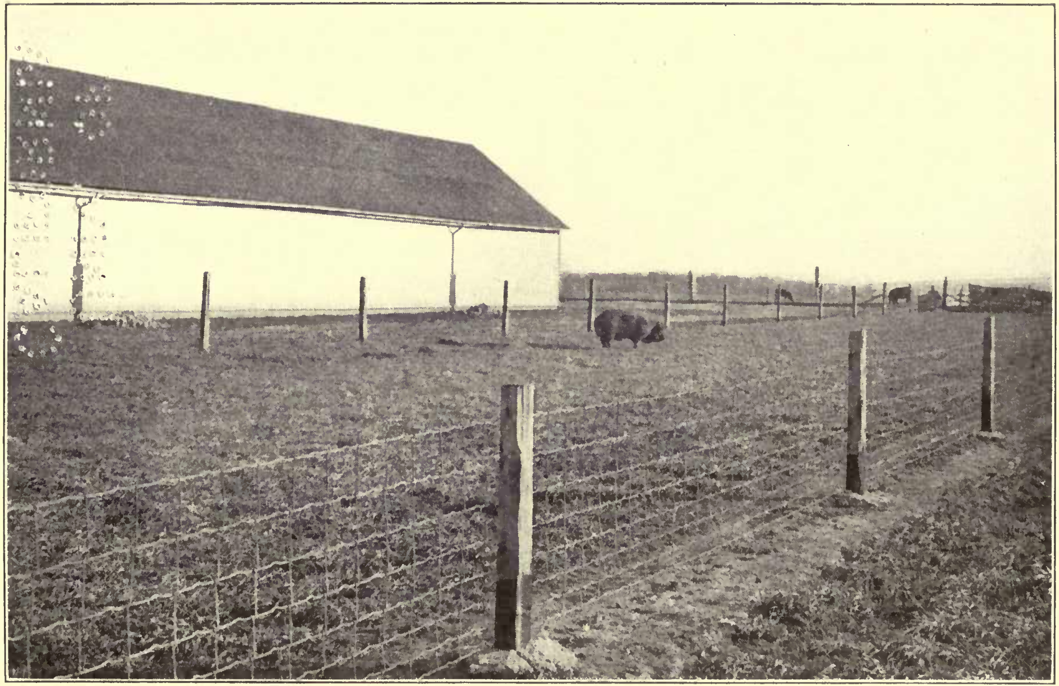

Plate. I. — Suitable conditions for the breeding boar.

PORK-PRODUCTION

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WITH A CHAPTER ON

THE PREVENTION OF HOG DISEASES

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PREFACE

The material in this book has been drawn from three sources: from practical experience; experimental studies, particularly of feeding questions; and the results of research in the field of chemistry and biology. The discussion on general care and herd management is chiefly a statement of the methods that have proved most successful in practical experience. That part of the book dealing with questions of feeding is largely the result of a careful analysis and summary of the mass of experimental data available on this subject. The discussion of breeding problems has for its foundation the approved methods of the constructive breeders and the important facts recently discovered in the field of genetics which have a bearing on the practical questions related to animal breeding.

In its preparation the author has sought and received many facts and suggestions from hog men, commission salesmen, experiment station workers, packing-house officials, and animal husbandry teachers, without which the book in its present form would not have been possible. For the help thus received he wishes to express grateful acknowledgment. For much of the data presented in chapter five he is indebted to W. J. Carmichael formerly of Illinois University and now secretary of the National Swine Growers Association. To the members of the Animal Husbandry staff of Purdue University he wishes to express his appreciation of their kindly criticisms, encouragement, and help.

W. W. Smith

Purdue University,
January 1, 1920

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PORK PRODUCTION

CHAPTER I

GENERAL VIEW

THE important position which the hog occupies on the American farm is shown by the fact that 37 per cent of the world's supply of pork (not including China) is produced in the United States. More hogs are raised in this country than in any other three countries combined, and more than double the number than in any other single country.

Swine are usually most numerous in those countries in which the population is relatively dense. Their geographic distribution in the United States is most closely related to the distribution of the acreage of Indian corn. In the European countries the number follows closely the production of potatoes and the number of dairy cows.[1] For statistics on the distribution of swine, see Figs. 1 and 2.

Hogs are raised in every county of the United States, but about one-half is produced in the seven corn-belt states, Iowa, Illinois, Missouri, Nebraska, Kansas, Indiana, and Ohio. North of the corn-belt proper and in the eastern states, the number of hogs is largely conditioned on home consumption needs and the development of the dairy industry. In these districts, barley and mill feeds

[1] "Geography of the World's Agriculture," 1917, U. S. Dept. Agr., Off. Farm Management.

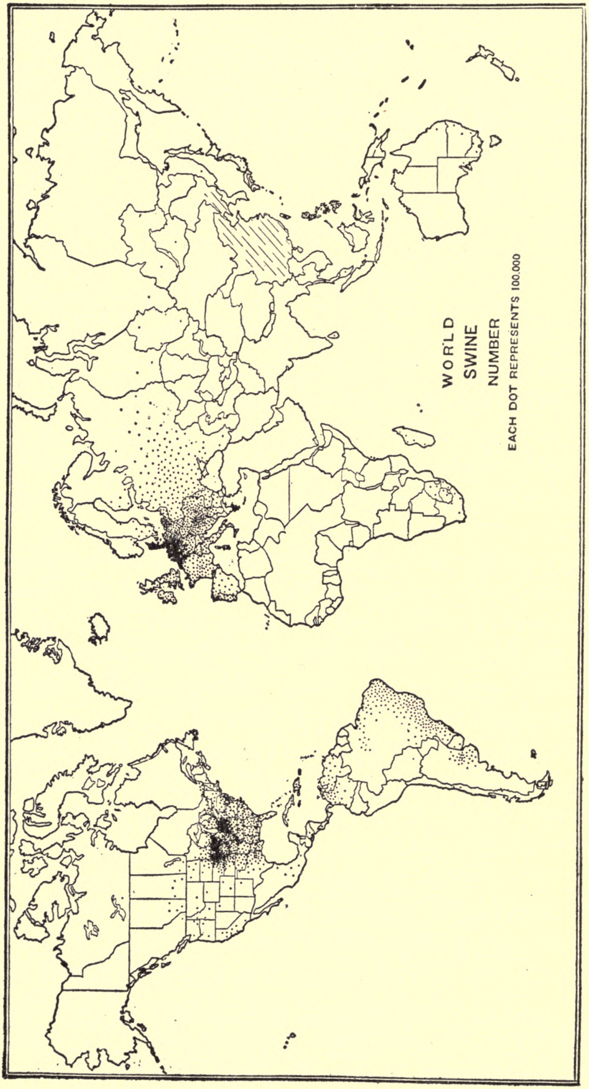


Fig. 1.—World's distribution of swine.

with skim-milk, buttermilk, and whey constitute the chief feeds. Large feeding plants which depend chiefly on garbage collected from the large cities are an important recent development in the East. Few hogs are raised in the arid plains region of the West because the simple digestive apparatus of the pig is not adapted to the consumption of bulky feeds alone. Not enough hogs are produced here to supply the demand for pork products. The production in the South has not yet reached a point where home needs are supplied; but with the necessity of adopting a more diversified system of management to maintain production, the cotton farmer promises to use his great natural advantages to increase the number of hogs.

Pork production is an essential part of practically every type of farming in America. Even in districts which are exclusively grain-growing, the hog performs the important function of saving the wastes of the grain fields and in utilizing the offal from the kitchen and milk-room, as well as in supplying the home demand for fresh and cured pork products. The average general farm is never without some hogs for the same reasons. Dairy-farming cannot be conducted along the most efficient and profitable lines without a sufficient number of hogs to utilize the skim-milk, buttermilk, or whey which may be available for feeding, and the undigested grain in the dropping of the cows. It is doubtful whether any system of farming can as easily satisfy all the tenets of good farm management as a properly conducted dairy business which depends on its output of cream or butter and pork for its principal revenue.

Hogs are essential to successful beef-production. The pork produced from the undigested grain from cattle in lot or pasture is clear gain and one of the most important profit-determining factors in cattle-feeding. For every bushel of corn fed shelled or on the ear to steers, the hogs following will produce from one to two pounds of pork on the average; when the grain is fed crushed or as meal, from a quarter to a half pound of pork will be produced.

In crop production the yield of grain in proportion to roughage is greater than necessary to meet the feed requirements of cattle or sheep and horses. This leaves a surplus of grain, much of which, in the case of corn especially, can be marketed more profitably as pork than in the raw condition. The value of small grain which has been damaged seriously by frost, hot winds, or elevator fire is very largely determined by its use in pig-feeding. The ability of the hog profitably to use corn which is so soft as to be practically unmarketable has made him popular on farms which do not ordinarily produce many hogs.

The important position which the hog occupies on the American farm has been gained through his inherent ability to render a profit above the costs of production. These profits are due largely to certain advantages which the hog enjoys as a producer of human food; these advantages are separately enumerated in the following paragraphs:

1. The demand for pork is wide and insistent. Excepting dairy products, no animal food is so necessary in the diet or so universally used. In this country more pork is consumed than any other meat. Statistics collected by the United States Food Administration[1] show the following relative to the total per capita consumption of

[1] "Production of Meat in the United States," Stephen Chase, 1919.

the different meats for the years from 1911 to 1918, inclusive:

TABLE I. — PER CAPITA CONSUMPTION OF PORK COMPARED WITH OTHER MEATS

	1911	1912	1913	1914	1915	1916	1917	1918	Av.
	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
Pork	93	88	91	88	92	96	72	86	88
Beef	81	75	74	72	73	76	75	79	76
Sheep and Lamb .	8.46	8.84	8.36	8.25	6.94	6.77	5.03	5.38	7.25
Veal	6.67	6.53	5.20	4.53	4.72	7.83	10.71	11.27	7.18

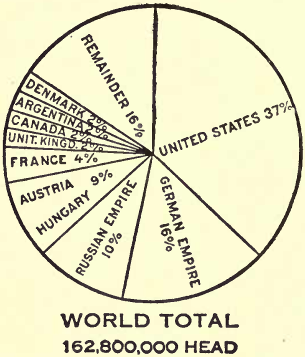
The demand for fat in this country and Europe is supplied chiefly by pork. The responsibility for meeting the world shortage of fat developed by the War rested most heavily, therefore, on the American pork-producer. On the average, the yield of lard constitutes about 11 per cent of the hog's live weight.

No meat is preserved so successfully or transported so cheaply as pork. Pork products may be held in storage for long periods without sacrificing palatability or food value.

2. Hogs sell at relatively high prices. This is one of the results of the broad and insistent demand for pork products. The figures given in the following tabulation represent the average prices paid on the Chicago market for the different classes of live-stock for the twelve-year period from 1905 to 1916 inclusive:

Native beef steers (not including butcher stock)	\$7.05 per cwt.
Native and western sheep	5.29 " "
Yearling sheep	6.26 " "
Native and western lambs	7.38 " "
Hogs (all classes)	7.26 " "

These figures indicate that, taking it from year to year, hogs outsell sheep and lambs or cattle. The larger proportion of dressed to live weight in the yield of hogs and the demand for lard are the principal reasons why higher prices are warranted.



3. Pork is produced economically. No other meat-producing animal on the farm produces human food as economically as the pig, despite the fact that concentrated

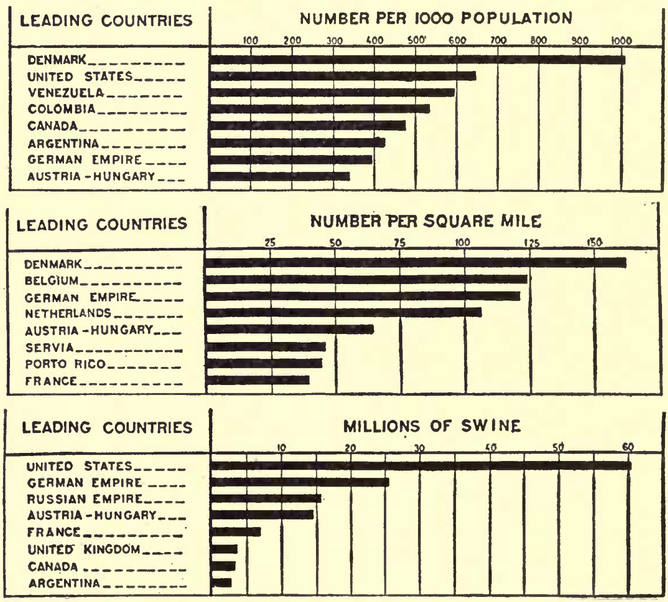


FIG. 2.—Number of swine in leading countries.

foods necessarily make up the major part of his ration. The initial cost of the pig at birth is much less than it is for the calf or lamb, and the cost of the subsequent gains, whether measured in pounds of digestible nutrients or in dollars and cents, is in favor of the pig. The figures given below represent the average amount of feed required to produce 100 pounds of gain during the market-finishing period of steers, lambs and pigs:

1000-lb. Fattening steer . .	800 lb. grain and 475 lb. legume hay.
65-lb. Fattening lamb . .	400 lb. grain and 500 lb. legume hay.
200-lb. Fattening pig . .	450 lb. grain and no hay.

When to this is added the ability of the pig rapidly to convert into pork kitchen garbage, the undigested corn in the droppings of cattle, damaged grains, and dairy by-products, a still stronger statement of his efficiency and economy could be made.

4. It does not require much time to get a start in the hog business. The large number of pigs produced in each litter, the relatively short gestation period, the possibility of raising two litters annually, and the rapidity with which the gilts attain breeding age contribute to this result. The initial investment in starting a herd of hogs is less than with other classes of stock because fewer females will suffice. The length of time between periods of heavy and light production is shorter for hogs than for cattle or sheep. A shortage of meat consequently can be met more promptly with pork than with other meats.

5. Pigs can be sold at weights anywhere from 175 to 350 pounds with little sacrifice in price. This means that the feeder is comparatively free to take advantage of a

good market by selling early or of feeding to heavier weights when the prospects of a better market are good. In the case of steers and lambs, the situation is entirely different. A variation of $1.00 to $1.50 a hundredweight in the selling price of cattle due to variation in finish or condition is common; in the case of lambs also the variation in price is such that the feeder is restricted to a very narrow range of time and weight in marketing.

6. The market value of old sows which have done service in the breeding herd is higher than it is for cows or ewes. Heavy packing sows sell during the fall within 50 to 75 cents of the top of the market for prime fat barrows, according to pre-war quotations, and during the spring from 25 to 50 cents of the top. On the same markets the difference in price between choice to prime cows and the top for fat steers would exceed $3.00, and between choice ewes and prime fed lambs the spread would be $3.00 or more. Although sows are subject to a dock in some markets of twenty to forty pounds, frequently they sell for more after finishing a long career in the breeding herd than they cost at the beginning. This is an item of no small importance in the more economical production of pork.

7. The necessary equipment for the successful handling of a herd of hogs is not extensive nor expensive. This is particularly true when early pigs are not attempted. Suitable shelter must be provided for early-farrowing sows, but it need not be of a kind which would mean a burdensome overhead expense. Hogs are more susceptible to extreme heat than any other farm animal, but the cost of appropriate shades is little more than the time required to erect them.

8. The labor-cost of producing pork is low. Excepting beef cattle, no other farm animal requires so little labor in proportion to the value of the animals handled. With the more general use of forage crops in growing the pigs, the wide use of the self-feeder for feeding pigs intended for an early market, and the increasing popularity of the practice of hogging-down corn, labor costs are materially reduced.

These facts have not been stated with the view of minimizing the hog raiser's responsibility in the proper care and management of his herd. It does not pay to raise hogs if their feeding and care are not given intelligent thought and consideration. Pigs cannot be raised successfully if the sows at farrowing time are allowed to shift for themselves. Clean dry quarters and balanced rations are necessary if the growing shotes make either rapid or economical gains. The money spent for a few good brood sows is well invested only if they are given the proper feeds, plenty of exercise, and sanitary quarters. It does not require much time to start in the hog business, provided the pigs are saved and properly developed; but if systematic measures are not adopted for the control of lice, worms, plague, and cholera, the business will soon become a failure.

CHAPTER II

FEEDING AND HANDLING THE HERD IN THE BREEDING SEASON

THE feeding, care, and general management of the herd during the breeding season determine in large measure the results at farrowing time. The treatment received by the sows and boar at this time affects the size and evenness of the litters and the strength and activity of the pigs at birth. In addition, it is usually desirable to have the sows farrow about the same time, which is only possible by proper feeding and systematic attention to the details of care and management.

FEEDING THE SOWS

The immediate objects which the feeder should seek are the prompt appearance of heat in the sows, their susceptibility to impregnation, and the production by each sow of a large number of vigorous eggs during the heat period. The fundamental essential in securing these results is a vigorous condition of health on the part of the sows during the breeding season.

In order that the sows may be at the maximum of breeding thrift, it is necessary that special attention be given their feeding and care several weeks before mating. Mature sows which are thin in the fall as the result of plenty of grass and exercise and little or no grain, are in ideal condition for this preliminary treatment. Sows which have weaned fall litters are also in good condition to respond favorably.

This treatment, known among shepherds as 'flushing,' consists in feeding the sows so as to cause them to gain from three-quarters to a pound daily two weeks before the opening of the breeding season and until they are safely in pig. The practical effect of such feeding seems to be to stimulate all the vital functions, and among them the breeding function, to greater activity. When it is remembered that the size of the litter is limited by the number of eggs produced by the sow, the importance of such a condition is magnified. It has also been observed that sows when gaining in flesh and thrift tend to come in heat promptly and to be more susceptible to impregnation when bred.

To respond favorably to the treatment suggested above, the sows must be thin in condition at the beginning. Sows that are already as heavy as is consistent with vigor and activity should be stimulated, if possible, by supplying plenty of range and exercise with access to green feed. With show sows or those very high in condition, it is usually necessary to reduce in flesh before they will breed. This should be done without subjecting them to any sudden change in diet, by withdrawing the grain from their rations gradually, and by stimulating exercise by allowing them the freedom of a good pasture. To establish regular breeding habits in a sow that has been highly fitted is as reliable a test of good feeding as is the ability to bring her up to the bloom of show condition.

Rations.

No single ration is best for bringing about the condition of breeding thrift sought at this time. Conditions as regards feed supply vary from year to year and from place to place, while variations in the maturity and condition of the sows require modifications in the rations. The best treatment of the sows by the feeder must be determined for each particular farm and region, and should take account especially of the age and flesh of the sows, and the feeds which are available and cheapest.

If there is considerable variation in the herd in regard to age and condition of the sows, they should be graded. If only those sows of the same maturity and general condition are together at feeding time, the rations can be measured more accurately to their needs. The average farm can well afford the facilities which will make practicable the separation of the gilts which are intended for breeding from the mature sows.

Thin mature sows should be fed so that they will be gaining a week or more before the opening of the breeding season. A most practical and satisfactory combination for the corn-belt is corn and a run of some green feed of a leguminous nature. Corn and alfalfa, or clover, or soybean, or cowpea forage make an ideal diet. Where these crops are not available, as in the North when breeding in November and December, fall-sown rye, bluegrass, or the ordinary tame pastures, will be valuable. Free access to a legume hay fed in racks will help to make up for the loss of green feed when the latitude and season make these unavailable. In those sections which regularly grow roots there is available a succulence which is much relished and of value in bringing about the condition of breeding thrift desired. With non-leguminous green feeds, a small amount of some protein feed should be given along with the corn, the proportion of which should be determined in each case by the quality of the pasture.

Approximately one part of tankage or meat-meal, or two parts of linseed oil meal, or five to six parts of wheat shorts or middlings, to twelve parts of shelled corn will make a balanced ration. Outside of the corn-belt, the available grains should take the place of corn, and be fed, when supplemented with a purchased protein feed, in practically the same proportions.

When it is necessary to feed grain to sows that are already in strong condition, or when reducing show sows, the above suggestions as to kind of rations are appropriate. With good forage crops or pasture or roots available, however, little grain will be necessary. The rations most suitable for the gilts should contain more protein than those for mature sows, because a large proportion of their food is used for growth. About one-half more shorts, tankage, or other protein feed should be given than in the proportions recommended above for older sows.

Amount to feed.

The best and most practical guide in determining how much to feed the sows at this time is the condition of flesh they are in. It is probably true that the amount fed must be subjected to more variation than the character of the ration or the combination of feeds. The necessity for grading is largely due to the ill effects of feeding the fat sow as liberally as the thin one. A mature sow in breeding condition can be maintained without loss of weight, as a rule, by a little less than $1\frac{1}{4}$ pounds of average grain daily for each 100 pounds weight. Also, a mature sow will nearly maintain her weight on good blue-grass, and will make some gain when on a suitable forage crop, if medium to thin in condition. These facts are useful in estimating the quantity of grain to feed in the beginning, or the necessity of feeding any grain at all. Afterwards, close observation of the gains and condition of the sows should be relied on to indicate whether too much or too little is being fed.

Thin mature sows should receive, on the average, from one-half to two-thirds a full grain ration. This will be sufficient, especially with green feed, to insure the gain desired. A full ration, or all they will eat, should not be given because of the probability of their becoming too fat and the necessity of a sudden reduction in the ration later, which is always to be avoided. Sows already in fair condition of flesh should receive little or no grain, depending largely on the kind of green feed available. Gilts intended for breeding should be fed liberally. A little less grain than they will eat is generally desirable so as to encourage exercise and the use of green feed, and to avoid too high condition. They should be kept thrifty and growing.

FEEDING THE BOAR

The boar has large and responsible duties to perform in the breeding season. His breeding condition is as important as that of the entire female herd considered collectively. To be dependable, he must be a ready server and a sure breeder. Vigorous health, activity, and a medium condition of flesh usually reflect virility and breeding capacity. Such a state is influenced largely by the amount and kind of feeds which he has to eat.

Demands.

The boar should be given a ration in keeping with his needs. During this time a mature boar requires more nitrogenous material, or protein, and more mineral matter than are necessary when not in breeding service. The demands on his energies, in addition to the requirements of maintenance, are largely of a nitrogenous nature, and this loss, which is considerable with each service, must be made good if his breeding powers are preserved. Two weeks before the breeding season opens, the mature boar should be in rather thin condition and active. He should then be brought up to the breeding season in an improving condition, without allowing him to become fat, or to impair his activity. Young boars require a growing ration, and when used for breeding the effort should be to satisfy both demands by a ration that is not deficient in mineral matter and protein.

Rations.

Probably the worst ration that can be fed is straight corn in the dry lot. If an unlimited supply of this cereal is available and exercise is limited, the evil effects will be still more certain. Experience has shown that sure and reliable breeding qualities cannot be maintained when corn constitutes the sole feed in the ration. Access to a green feed of some kind will enable the boar to acquire much that corn lacks and will promote a fairly loose condition of the bowels which is essential to good health. However, when used heavily, the boar should not be expected to receive a very large part of his nourishment from this source. Too much green feed, in fact, is considered by some to be detrimental to his breeding qualities. Some one or more of the supplemental feeds suggested for the sows at this time should be fed with the corn or other home-grown grains.

The boar should have about the same combination of feeds as the growing gilts intended for the breeding herd.

If the service is heavy, he should have a wider variety and a smaller proportion of corn. Corn alone is so bad that many breeders recommend that it be entirely excluded from the ration of the boar when in service. A variety of home-grown grains, with a little green feed, skim-milk or roots, with some shorts or tankage, or some such protein supplement added, will give the best results in breeding service. The immature boar should receive approximately the same combination of feeds that is best for the mature hog when performing heavy service.

Amount to feed.

The amount of grain that should be fed to the boar will depend: first, on the intensity of his breeding service; second, on his age and condition; and third, on the amount of nourishment obtained from such feeds as forage crops, grass, or roots. A mature boar in good condition at the beginning of the breeding season will ordinarily lose weight when used to the normal limit of his breeding capacity. If heavily used he will require practically a full ration. In all cases, however, the guide should be to determine the amount given by his condition rather than his appetite, the effort being to maintain his weight. If just right at the beginning of the breeding season, this method will insure the maximum of breeding service. The immature boar should be fed so that he will experience no material check in his growth and development. A full ration, or all that he will clean up, should ordinarily be given him.

Exercise.

To develop and maintain a vigorous condition of breeding thrift in the boars and sows, exercise is as important as good feeding. Without exercise the foundation of good health is impossible. The most practical and desirable method of supplying exercise is to give plenty of range. Ordinarily, if the boar and sows are in the best flesh for breeding purposes, they will take all the exercise needed if given the opportunity. In the case of the boar particularly, it too often happens that his range is limited to a narrow pen where insanitary conditions and lack of exercise combine in reducing his health and vigor. Exercise is sufficiently important for the breeding boar to warrant the time and attention necessary to take him out and drive him a half-hour twice in the day, if it cannot be given by some other method.

GENERAL CONSIDERATIONS

The period of sexual excitement known as "heat" should be understood. The significance of heat is that the sow is secreting, or preparing to secrete, the ripened eggs or ova. The appearance of heat is supposed to precede by a day or two the production of these eggs or germ-cells which, on fertilization by their union with the male germ-cells, produce the embryo pigs.[1] The heat period lasts about three days, and is the only time during which a normal sow will accept service from the boar.

A sow comes in heat every twenty or twenty-one days, on the average, during the breeding season, if not bred. The exceptions to this are sows which lack breeding condition or thrift and those which are nursing pigs. It frequently happens, however, that a sow will come in heat a few days after farrowing, usually the third day,

[1] MacKenzie and Marshall: "Journal of Agricultural Science," 1912.

and again before the litter is weaned. The natural breeding seasons seem to be the early summer or late fall, although a vigorous sow when gaining will come in heat at other times, even in the hottest summer months.

Researches by L. L. Lewis of the Oklahoma Experiment Station on the vitality of germ-cells indicate that the ripened eggs or ova are not discharged from the ovaries until the latter end of the heat period.[1] These studies also revealed that the sperm-cells of the boar do not, as a rule, retain their vitality in the body of the sow for a longer period than sixteen hours after service. These observations would seem to support the theory that successful impregnation is most certain when the sow is bred in the latter stages of the heat period. So far, general observations in practice, however, have shown no advantage for early or late breeding so far as either may affect complete fertilization or the size of the resulting litter.

Length of gestation period.

The time elapsing between breeding and farrowing is known as the gestation period. During this time each of the fertilized eggs develops into an embryo pig, and with the completion of the pigs' embryonic development, birth takes place. Normally, the gestation period is just long enough to make possible full embryonic development of the pigs and to accommodate those physiological adjustments in the sow which are preliminary to parturition or farrowing.

Gestation tables which have been worked out for the convenience of breeders are calculated on the basis of 112 days, or 16 weeks, as the time elapsing between breed-

[1] L. L. Lewis: Bull. 96, Okla. Exp. Sta.

ing and farrowing. Recent accumulations of data, however, indicate that the average time is more nearly 114 days than it is 112. Breeding and farrowing records of 488 litters in the Illinois University herd[1] showed $114\frac{3}{4}$ days to be the average time which the sows carried their pigs, the longest observed being 124 days and the shortest 98 days. A study of these records did not reveal any tendency for mature sows to carry their pigs longer than did gilts. The average length of seventy-seven gestation periods in the Purdue University farm herd was $113\frac{1}{2}$ days. In this herd, sows with their first litter went, on the average, 113.2 days; those with their second litters, 113.4 days; those with their third, 114.5 days; and with the fourth, 113.6 days. It is the common opinion among breeders that gilts and old sows lacking thrift farrow a few days earlier than the average, while mature vigorous sows tend to carry their pigs a few days longer.

Age to breed the gilt.

A gilt should take her place in the breeding herd as soon as her growth has reached the stage where the demands of maternity will not materially affect her own development or her future usefulness in the breeding herd. Just where this stage is in the life of the gilt is a question of development rather than of age. The gilt that is well grown is more reliable as a future mother when bred at seven months of age than the gilt of ten months whose development has been retarded by insufficient nourishment.

Experience has established the important fact that reasonably early breeding tends to establish reliable breeding habits, while late breeding frequently results

[1] W. J. Carmichael: Master's thesis, Univ. Ill., 1916.

in the reverse. Furthermore, early breeding, other things being equal, reduces the cost of the pigs at birth. The earlier the gilt can be made a producer, the larger will be the saving in feed, interest, and risk. On the other hand, the practice of depending on undeveloped gilts for the production of the entire pig crop, as is frequently done, cannot be condemned too strongly. The immediate loss is expressed in small litters and imperfect nourishment of the pigs. Gilts intended for showing usually are not bred until after they are twelve months old. Showing practice necessitates the postponement of breeding even though the future value of the gilt as a producer may be, and often is, sacrificed.

As a general rule, the gilt that is well developed may be bred safely to farrow when from twelve to fourteen months of age. When an active gilt has reached the weight of 200 pounds, she may be bred without danger of sacrificing full development at maturity, provided she is properly fed afterwards.

Using the young boar.

Most of the statements made above in regard to the proper breeding age of a gilt apply with equal emphasis to the young boar. To be fit for even limited service in November or December, the boar pig must have been farrowed early, in February or March, he must be well grown for his age, and he should possess a good constitution and natural vigor. With all of these, he must be used judiciously. Experience shows that if the boar pig is used to excess, the probabilities are that his breeding powers will be permanently injured and the pigs produced will have a tendency to weakness and small size. Ordinarily, the boar should not be allowed to make more than two or three services in a single week during the breeding season. As a rule and under average conditions, it is unwise to use the pig before he is a year old. The careful conservation of his breeding powers until he is fairly well developed will insure larger size at maturity and an extension of breeding vigor in later life. Experience has shown the practice of depending entirely on pigs for sires to be disastrous.

Early or late pigs.

The question of the best time for the sows to farrow must be determined for each farm according to its location, the facilities which it affords in the way of quarters for handling early pigs, and in accordance with the purposes of the farmer and his plan of management. Throughout the corn-belt, and farther north, February or March farrowing necessitates warm barns or houses and special attention to all the details of care and handling. When the pigs are not finished for market until the following spring or summer, as is still the practice on some farms, the very early pigs have no advantage over the late ones.

The advantages urged for early pigs are: first, that they have the size which enables them to make a larger and more satisfactory use of forage crops during the summer, — they can make a larger proportion of their growth from green feeds and hence reduce the amount of grain required in their growth, while the expensive finishing period is shortened; the second advantage, and perhaps the most important one, is that the early pigs find the early market, and this is ordinarily the best market. As a rule, average pigs throughout the corn-belt are marketed in December or January, and, as a rule, prices are lowest during these months. Furthermore, during September the supply is generally the lowest of the year and the prices highest. Although there are exceptions to these average conditions, the prices for hogs usually fall from September on until the middle of the winter. From year to year, the producer of early pigs will be in a position to profit by a better market. (See Chapter XVI.) A third advantage often urged for the early pigs is that they seem to do better, grow faster, be more healthy and better able to stand the extreme heat of early summer. Experience generally supports these claims.

On the other hand, it must be remembered that finishing pigs for the September or October market in the corn-belt necessitates the use of old corn which must be carried over, or, if bought, purchased at a relatively high price. Also, the practice of hogging-down corn which is growing in favor could not be followed to the same extent as with pigs that do not go to market until later. Pigs intended for following cattle during the winter should come early and be well grown and active. Late pigs are usually too small to be satisfactory for this purpose.

The breeder of pedigreed hogs ordinarily finds it to his advantage to breed early pigs. In addition to the gratification and advertising value of having pigs which are large for the season, they can be disposed of as prospective breeders more promptly and satisfactorily. The buyer generally favors early purchases, and is particular about size and growthiness. The early pig will commonly sell before November first, while the late pig will often remain to be an expense to the farm and a drag on the market the next season. Pigs intended for show should come as soon after the first of March or the first of September as possible, since these dates determine in most classifications whether the pig shall show in the junior or senior class.

MATING

Two general systems are followed in the handling of sows at mating time. The first is to bring each sow as she comes in heat to the boar for service hand-coupling; the second, that of allowing the boar to run with the sows.

Systems.

The best system to follow will be determined by the conditions. The farmer who has only eight to ten sows to breed finds the practice of turning the boar out with the sows to be satisfactory, as a rule. The chief advantages of this system are that it does not require the individual attention and time of a man when each sow is bred; and secondly, the boar is under conditions which permit him to take plenty of exercise. It is sometimes urged, also, that the chances of missing a sow when she comes in heat and not getting her bred are reduced to a minimum in this system. When the number of sows to be bred is well within the number which the boar is capable of breeding in a given season, and when it is not considered essential to know the exact date when each sow is bred, there is little in the practice to condemn.

When the number of sows in the herd is larger than can be taken care of safely by one boar, it is doubtful whether this is the best system, unless there is a surplus of boars of equal merit available. Too often the tendency is to expect the boar to get as many sows in pig under this system as could be done with safety when the services are regulated by hand-coupling. The results are that the sows are not settled promptly and the energies of the boar are unnecessarily sapped. When running with the sows, the boar should not be expected to breed many more than one-half the number which under the other system he would be able to take care of. Even when records are not a necessity, it is commonly better to arrange to turn the sows in to the boar. In this way the number of services of the boar can be controlled and his energies conserved. The result is that a maximum number of sows can be gotten in pig in a given time. With convenient arrangement of the lots and the practice of breeding the sows at feeding time, or just before, very little extra time will be required.

In pure-bred herds where an accurate record of the breeding of each pig is necessary, any other system than that of bringing the sows to the boar is practically out of the question. In pedigreed herds, the number to be bred is frequently large, also, and several boars are usually in service at the same time, and it is desirable that each sow be bred to a particular boar. The importance of getting each sow successfully bred the first time she comes in heat and the desirability of maintaining the vigor of the boar at a high pitch, are so great as to warrant the time and attention required to breed the sows individually, under most conditions.

With the opening of the breeding season, the sows should be watched closely for evidences of heat. While, as a rule, a sow in heat is sufficiently demonstrative in her behavior to make detection easy, yet in every herd there are ordinarily a few sows which show few of the usual symptoms. The practice of having the boar and sows in adjacent fields facilitates observation. When in heat, the sow will be found along the fence next the boar and away from the remainder of the herd. From the standpoint of the boar's welfare, however, this arrangement, although productive of exercise, is usually too disquieting to be without serious criticism. This is especially true if the demands on the boar are heavy. The boar should ordinarily be away from all such exciting influences. The practice of having a "teaser," or a boar to which only a few sows are to be bred, in the lot or pasture next the sows is a good solution of the problem.

Time in the day to breed the sows.

A convenient time during the day to breed the sows is, as a rule, just before feeding. The boar at this time, also, will be in the best condition to make a prompt and satisfactory service. When full of feed the boar is naturally sluggish, and his inclination to lie down after eating should be encouraged rather than disturbed. In no case should the boar be used for a period of two hours after feeding. When two sows are in heat at the same time and it is necessary to breed them to the same boar, the plan of breeding one in the morning and the other in the evening will insure the best results and have a minimum effect on the vitality of the boar.

After being bred, the sow should be put into a pen by herself where she should remain until after going out of heat. It is believed that she will be more certain to conceive if her activity is somewhat restricted and she is kept quiet and away from other sows.

The breeding-crate.

The breeding-crate is practically a necessity when mature heavy boars are to be bred to gilts, or when it is desired to breed the boar pig to rather rangy sows. Even when the boar and sows are the same general size and type, many breeders prefer using it. They claim that a satisfactory service is much more certain with the crate than without it and that it is much less wearing on the boar, which is undoubtedly true. The boar, however, has to be taught to use the crate, and with some individuals considerable patience is necessary before this is accomplished. Boars that have formed the habit of breeding under natural conditions are especially slow about learning to use it, while some refuse altogether. Farmers, as a rule, do not favor the use of the breeding-crate, largely because of the time and individual attention required by such a method, and also because they have had no experience in using it. Some believe that the sow is more liable to miss conception when bred under such artificial conditions. If she is thoroughly in heat it is difficult to see, however, how this could have anything to do with the successful union of the sperms with the eggs, which probably occurs some time in the next forty-eight hours.

Number of sows which the boar can breed.

Under given conditions, the number of sows which the boar can breed safely will depend mainly on the following factors: age, natural vigor or fertility, the length of the breeding season, and the distribution of the services. With a careful distribution of the services, a mature vigorous hog may be expected to take care of thirty sows, under good conditions. For a herd of that size, however, it would be wise to provide a second hog to be employed in emergencies. As a rule, one service a day may be permitted, and occasionally two when following a day or two of idleness. The yearling boar ordinarily should breed from fifteen to twenty sows in a season of six weeks or two months. It is safer, however, not to force him to the limit of his powers. As already stated, it is usually better not to use the pig until he is a year old. If well developed, however, he may be allowed two or three services a week when eight months of age. If used to excess when young, the effect is seriously to retard development and to injure the future breeding powers.

Some boars are naturally more vigorous than others and can settle twice the number of sows in a breeding season. Boars from prolific mothers are believed to be more fertile than those selected from sows which do not produce large litters. The way the boar has been fed, the amount of exercise he has had during the season when he was not in service, the sanitary conditions under which he has been kept, have a great influence on his performance during the breeding season. For these reasons, good judgment is the only reliable guide in determining the extent to which the boar can be used with safety.

A careful distribution of the services is important. Nothing is gained by allowing the boar two services when the sow is bred. If the first service is a good one, millions of male germ-cells, called sperms, will be present to fertilize the female germ-cells, or eggs, of the sow. Since one sperm only is required to fertilize each egg, it is obvious that the practice of giving the sow a double service is not only unnecessary, but a waste of the energies of the boar. An important fact to remember at this point is that the successful union of the male and female germ-cells depends to a large extent on the vigor and activity of the male cells. It is usually necessary for these male germ-cells to travel a considerable distance in the uterus and Fallopian tubes of the sow before reaching the female germ-cells or eggs. This they are able to do by the movement of a tail-like appendage. If the boar is not vigorous, as the result of over-use, or is too fat or in a run-down condition, experiments indicate that the sperms which he produces will themselves lack in vigor and activity. The thing to seek, therefore, is vigorous lively germs, and these can be produced only by a vigorous boar whose services have been regulated carefully. (See page 122.)

Records.

The breeder of market hogs does not, as a rule, make a record of the date each sow is bred. When the sows are bred early, however, and the farrowing season is in February or March, a knowledge of the time each sow is due will make possible that preparation and individual attention at farrowing time which are necessary to save the pigs in cold weather. Without a knowledge of the date of service, it will be necessary to depend on careful observation and judgment to indicate when the sows are due. Even with the most careful supervision, the experienced hog raiser makes many bad guesses, and as a consequence a number of the sows farrow with the general herd and under conditions not favorable to the survival of the pigs. Such experiences suggest that it might be practical for the producer of market hogs, especially when early pigs are attempted, to have his sows tagged and a record made of the time of breeding. In any case, a definite record should be made of the first and last services.

With pure-bred herds, breeding records are a practical necessity. When more than one boar is in service, as is commonly the case, the record must be depended on in writing the pedigrees of the pigs later, as well as to indicate when each sow is due to farrow. Before the breeding season begins, the boar to which each sow is to be bred should be determined so far as possible. Each sow must wear an ear-tag bearing her number, a breeding sheet should be made out containing the name or number of each sow, the name of the boar which it is proposed to breed her to, with spaces for recording the date of service. The knowledge of the sire and dam of each sow is important, also, to guard against the possible use of a too closely related sire. If this sheet is posted in some convenient place in the hog-barn, the entries can be made promptly. With the close of the breeding season, the date of service and the name of the boar bred to should be transferred to the permanent record.

The following record form embodying these features has proved practical and convenient to use:

Breeding Record — Fall 1915

Name or Number of Sow	Sire and Dam	Boar Bred to and Date of 1st Service	Boar Bred to and Date of 2d Service	Remarks

TABLE II. — GESTATION TABLE

Nov. (Service)	Feb. (Due)	Dec.	Mar.	Jan.	Apr.	Feb.	May	Mar.	June	Apr.	July	May	Aug.	June	Sept.	July	Oct.	Aug.	Nov.	Sept.	Dec.	Oct.	Jan.
1	22	1	24	1	24	1	25	1	22	1	23	1	22	1	22	1	22	1	22	1	23	1	22
2	23	2	25	2	25	2	26	2	23	2	24	2	23	2	23	2	23	2	23	2	24	2	23
3	24	3	26	3	26	3	27	3	24	3	25	3	24	3	24	3	24	3	24	3	25	3	24
4	25	4	27	4	27	4	28	4	25	4	26	4	25	4	25	4	25	4	25	4	26	4	25
5	26	5	28	5	28	5	29	5	26	5	27	5	26	5	26	5	26	5	26	5	27	5	26
6	27	6	29	6	29	6	30	6	27	6	28	6	27	6	27	6	27	6	27	6	28	6	27
7	28	7	30	7	30	7	31	7	28	7	29	7	28	7	28	7	28	7	28	7	29	7	28
8	Mar. 1	8	31	8	May 1	8	June 1	8	29	8	30	8	29	8	29	8	29	8	29	8	30	8	29
9	2	9	Apr. 1	9	2	9	2	9	30	9	31	9	30	9	30	9	30	9	30	9	31	9	30
10	3	10	2	10	3	10	3	10	July 1	10	Aug. 1	10	31	10	Oct. 1	10	31	10	Dec. 1	10	Jan. 1	10	31
11	4	11	3	11	4	11	4	11	2	11	2	11	Sept. 1	11	2	11	Nov. 1	11	2	11	2	11	Feb. 1
12	5	12	4	12	5	12	5	12	3	12	3	12	2	12	3	12	2	12	3	12	3	12	2

13	6	13	5	13	6	13	6	13	4	13	4	13	3	13	4	13	3	13	4	13	4	13	3
14	7	14	6	14	7	14	7	14	5	14	5	14	4	14	5	14	4	14	5	14	5	14	4
15	8	15	7	15	8	15	8	15	6	15	6	15	5	15	6	15	5	15	6	15	6	15	5
16	9	16	8	16	9	16	9	16	7	16	7	16	6	16	7	16	6	16	7	16	7	16	6
17	10	17	9	17	10	17	10	17	8	17	8	17	7	17	8	17	7	17	8	17	8	17	7
18	11	18	10	18	11	18	11	18	9	18	9	18	8	18	9	18	8	18	9	18	9	18	8
19	12	19	11	19	12	19	12	19	10	19	10	19	9	19	10	19	9	19	10	19	10	19	9
20	13	20	12	20	13	20	13	20	11	20	11	20	10	20	11	20	10	20	11	20	11	20	10
21	14	21	13	21	14	21	14	21	12	21	12	21	11	21	12	21	11	21	12	21	12	21	11
22	15	22	14	22	15	22	15	22	13	22	13	22	12	22	13	22	12	22	13	22	13	22	12
23	16	23	15	23	16	23	16	23	14	23	14	23	13	23	14	23	13	23	14	23	14	23	13
24	17	24	16	24	17	24	17	24	15	24	15	24	14	24	15	24	14	24	15	24	15	24	14
25	18	25	17	25	18	25	18	25	16	25	16	25	15	25	16	25	15	25	16	25	16	25	15
26	19	26	18	26	19	26	19	26	17	26	17	26	16	26	17	26	16	26	17	26	17	26	16
27	20	27	19	27	20	27	20	27	18	27	18	27	17	27	18	27	17	27	18	27	18	27	17
28	21	28	20	28	21	28	21	28	19	28	19	28	18	28	19	28	18	28	19	28	19	28	18
29	22	29	21	29	22	29	22	29	20	29	20	29	19	29	20	29	19	29	20	29	20	29	19
30	23	30	22	30	23			30	21	30	21	30	20	30	21	30	20	30	21	30	21	30	20
		31	23	31	24			31	22			31	21			31	21	31	22			31	21

The preceding table has been calculated on the basis of 113 days for the gestation period. To use the table, the date of service is found in the left of the double column, and the date on the right will be the time due. For example, if a sow is bred on November eighteenth, the date to the right shows that she will be due to farrow March eleventh; if bred May twelfth, she will be due September second, and so on.

CHAPTER III

THE MANAGEMENT AND FEEDING OF THE BREEDING HERD IN THE WINTER

It is during the winter, in most of the pork-producing sections, that the problems of housing and management, sanitation, exercise, and feeding, become of more than usual importance. With cold weather, frozen ground, and dry feeds, the breeding herd is under conditions which make it more difficult to maintain good health. The problems involved in the successful management of the herd during the winter directly affect the results in economy of maintenance and in the number and quality of the pigs produced.

GENERAL MANAGEMENT

An item of first importance in the winter management of the breeding herd is its proper grading. Only those individuals whose requirements for feed and general care are the same should be together. The effects, for example, of allowing the pregnant sows to run with the fattening shotes is to jeopardize greatly the chances of a good pig crop in the spring. Hogs that are being fattened for market do well in restricted quarters, and with full fattening rations. It is impossible for the pregnant sows under these conditions to produce healthy, vigorous pigs or to nurse them properly after birth. The sows demand a special ration and plenty of exercise. Open and bred gilts should likewise be separated from the mature sows, for they require a more liberal ration and one containing more bone and muscle-building ingredients especially during the first half of the winter. With advanced pregnancy, the gilts which are bred should be separated from the open gilts when the facilities make this possible. The practice of allowing the pregnant sows to run with the cattle is objectionable if separate sleeping quarters are not provided and their consumption of corn is not carefully guarded. Horses and hogs do not get along well together, and when the hogs are compelled to seek the same shed for shelter the chances of injury are greater than one can afford to take. Although the number of divisions necessary in the proper grading of the herd may present some difficulties on the general farm where other usual classes of stock must be provided for, experience has demonstrated that it is a matter of prime importance.

The mature boars should, of course, occupy independent quarters from the boar pigs. The boar is often allowed to run with the bred sows, which is not objectionable so long as he behaves himself. It will facilitate his care and generally improve his opportunity for needed exercise. Old boars may in most cases be turned together after removing their tusks, but their initial encounters should be supervised closely to prevent any serious injury to either. After supremacy has been decided, they will be contented and will do better together than if kept separate.

Housing.

The hog is more or less sensitive to the extremes of heat and cold. In the northern latitudes, warm houses are necessary during the winter in order to maintain thrift and save feed. All the classes of hogs must have comfortable quarters in order to do well. This is a principle in live-stock management which no farm can afford to ignore. The financial loss which results from undue exposure and chill is more than would be sufficient to provide suitable structures. The hog-house must be warm without being close, and the beds must be clean and dry and free from much dust.

The question as to the best type of house must be determined by the conditions. From the standpoint of the hog, any house which is rain and wind-proof, adequately ventilated without being drafty, and which has a dry floor, is satisfactory if kept clean. Provision should be made for admitting to the interior as much direct sunlight as possible, for light is one of the most potent means of destroying disease germs and helps to maintain dryness. Such a house need not be elaborate nor expensive. In order to make the proper grading of the herd possible, the use of several houses is desirable under most conditions. If these are portable, they may be so placed in the pasture or lots as to encourage exercise, an added advantage for this type of shelter.

Sows which are heavy in pig should not be allowed to sleep together in large numbers, for they may be injured by crowding and the tendency to pile up badly in the coldest weather. High door-sills are dangerous for pregnant sows, frequently causing sprains and lameness, and occasionally abortion. The fall pigs should have the warmest quarters available. A low shed partly open on the south and connected with a cement feeding floor makes a satisfactory and practical arrangement for the fattening shotes.

Sanitation.

One of the conditions of good health is sanitary surroundings. In the winter management of the breeding herd, the sleeping quarters should be the chief concern in the effort to maintain healthful conditions. No hog can thrive if his bed is damp or dusty. Rheumatism, bad colds, coughs, and pneumonia are the ailments most commonly the result of overcrowded dusty sleeping quarters. Such conditions not only cause irritation to the nasal and bronchial passages and induce colds and rheumatism, but the dust particles may carry the germs of disease like cholera and tuberculosis. There should be enough air to prevent steaming and the quarters should be cleaned with sufficient frequency to keep them clean and free from dust.

The frequency with which the bedding should be changed and the quarters cleaned depends chiefly on the weather and the character of the floors. When the weather is cold and things are frozen up tight, it is much easier to keep the quarters dry and sanitary than when the weather is warm and the ground soft. Likewise, well-constructed buildings with tight floors require much less work to keep clean than do poorly constructed houses with leaky roofs and dirt floors. As a rule, the houses should be cleaned thoroughly once a week. When the bedding has been removed, it is a good plan to lay the dust by sprinkling with crude oil. An occasional spraying with a strong disinfectant is desirable, also, to keep the quarters from harboring lice and disease germs. When the weather is cold, bedding should be supplied in liberal quantities; when very warm, the less bedding the better if the dust is kept down and the floors are dry.

Water.

The water supply should be clean and fresh and easily accessible. Pregnant sows and young pigs especially require considerable water to satisfy their needs. When the water is ice-cold, the tendency is for hogs to drink less than they need. Furthermore, that which is drunk must be raised to the temperature of the body, which necessitates the sacrifice of considerable food energy when the weather is cold. When the water is given with the feed, it will pay to heat it. Ordinarily, the effort should be made to get them to take as much water as they will. Patented watering devices should be cleaned frequently, for they sometimes become contaminated and may prove a constant source of infection. The water in such devices should be kept as warm as possible by banking manure about them or by the use of heaters.

Exercise.

The amount of exercise which the pregnant sows receive during the winter bears an intimate relationship to the strength and activity of the pigs which they produce in the spring, to the ease of pigging, and the promptness of their recovery, and to their general thrift and health during the gestation period. The reliability of the boar during the breeding season is conditioned on his opportunity for taking exercise throughout the seasons when he is not in breeding service. Neglect of this during the winter is often responsible for disappointing results in the breeding season. The young gilts and boars must have exercise if they are to attain the healthy development required for successful lives in the breeding herd. The experiences of hog-men are so unanimous on these points that no experimental proof is necessary to establish them as important facts.

Weak pigs may be caused by several factors, but that limited exercise is one of them cannot be doubted. When the winter is severe and the snowfall heavy, the spring pig crop is generally short. Under these conditions the sows stay close to their beds and take little or no exercise, with the result that the mortality among the pigs at birth is abnormally high and trouble is more frequently experienced with the sows in giving birth to their pigs. Exercise promotes a loose open condition of the bowels and does much to maintain a healthful functioning of the other organs of elimination. Exercise contributes strength and vitality, reduces the chances of disease, costs nothing, and is an indispensable factor in the maintenance of health and breeding thrift.

As a rule, the breeding hogs will take sufficient exercise if given the opportunity. With plenty of range, access to pastures, stubble land, or stock fields, the sows and gilts will be out most of the time if their rations are properly restricted. When their range is limited because of deep snow or ice or for other reasons, the practice of scattering on the ground some grain, sheaf oats, barley, or legume hay for them to work over will encourage exercise by keeping them out and on their feet. By having the sleeping quarters placed at the far end of the pastures or lots, they will be compelled to exercise at feeding time. Although exercise is imperative, sows heavy in pig should not be compelled to push their way through snowdrifts in order to get to their feed or sleeping quarters. Icy places should be made safe by covering with straw, ashes, or litter of some kind.

FEEDING PREGNANT SOWS AND GILTS

Two principal objects should be sought in the winter feeding of sows due to farrow in the spring: first, complete nourishment for the sows and their developing pigs in embryo; and second, economy.

On the completeness of nourishment depend in large part the general vigor and strength of the sows at farrowing time, the development and strength of the pigs at birth, and the capacity of the sows for milk secretion after the pigs are born. Good feeding also requires that the rations shall be cheap as well as balanced. The cost of feeding sows during the pregnancy period represents an important item in the cost of the individual pigs at birth, and the initial cost of the pigs is an important factor in determining the cost of pork production.

Demands.

Before discussing specific feeds and rations, it will be profitable to consider the physiological requirements of the sows during this period. Mature sows, those past two years of age, require food for two purposes: to maintain and provide for the upkeep of their own bodies; and second, to supply the material for growing the embryo pigs. Successful feeding of the mature sows during the gestation period must provide the nourishment to satisfy these two fundamental needs.

The amount of feed required to meet the demands for maintenance is constant. The requirements for the growth of the embryo pigs, on the other hand, increase more or less gradually with advancing pregnancy. Approximately 75 per cent of the growth of the fœtal litter takes place in the last month of the gestation period. As pregnancy advances, therefore, an increasing proportion of the rations is needed to nourish the developing pigs.

The kind of food materials which will satisfy maintenance is likewise different from that required to meet the needs of embryonic growth. The demands for maintenance are met by food materials which will supply the heat and energy to run the body machine and make good the repair of body waste. To meet the needs of the growing pigs in embryo there is demanded, in addition, material which will produce bone and muscle. The first is largely met by the carbohydrates of the ration, while the latter can only be derived from the supply of protein and mineral matter. A ration which will satisfy both these demands in proportion is, therefore, a balanced one.

Young sows and gilts carrying their first litters must be fed with reference, also, to a third demand, for their own growth and development. The first need of the immature sow is food for maintenance, then for the growth of her pigs in embryo. If any food remains after these demands are satisfied, it may be used for the increased growth of her own body. If the supply of feed is insufficient to supply all three requirements, the last is the one to suffer. The maternal instinct of the sow is so strong as to cause her to sacrifice, in the absence of sufficient nourishment, her own energy and body tissue that the fœtal litter may have the substance for growth.

Corn alone as a feed for pregnant sows.

In the corn-belt the central question is to what extent it is safe or advisable to make use of corn in the ration of the pregnant sows. Outside the corn-belt, likewise, the question is to what extent the home-grown grains

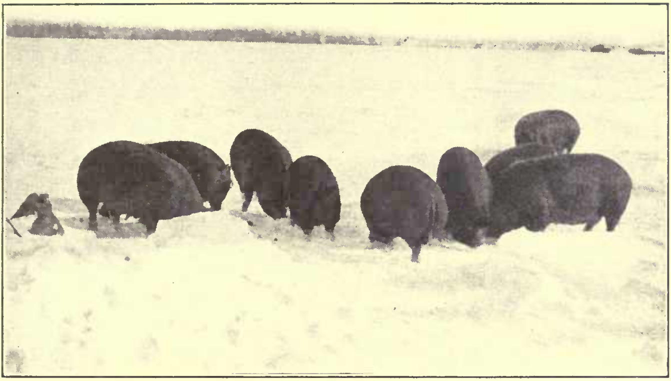


PLATE II. — *Above*, Pregnant sows should have range during the winter; *below*, A practical method of feeding alfalfa hay.

can be used. The answers to these questions should also suggest economical and satisfactory methods of supplementing these cereals with home-grown or purchased feeds.

In the present state of our knowledge of hog-feeding problems, no fact is more clearly established than that corn alone for pregnant sows is not a good feed. This is especially true during the latter part of the gestation period and for immature sows and gilts. The combined experience of practical feeders and the results of a few carefully planned studies at the experiment stations supply strong evidence on this point. The train of evils for which exclusive corn feeding is, in large part, held responsible is the following: a tendency for the pigs at birth to be weak and under-developed; a larger proportion of dead pigs; a feverish irritable condition of the sow at farrowing time; more frequent trouble in giving birth to their pigs; greater tendency of the sows to develop the pig-eating habit; inability to secrete a normal supply of milk for their pigs after birth, all of which means a smaller number of pigs raised.

A sow cannot grow a strong thrifty litter of pigs on a diet of straight corn. It does not possess enough of the materials which make blood, bone, and muscle. A pregnant sow so fed is certain to approach the farrowing season in an impoverished state of health, low in vitality, and in poor condition to bear the strain of pigging or the later demands of milk production. This, with the weak under-developed pigs, is the fundamental reason for the disastrous results just enumerated.

The conclusions of practical experience regarding the effects of exclusive corn-feeding to bred sows are supported by recent experimental feeding trials. The results of studies made by John M. Evvard, of the Iowa Experiment Station, are extremely pointed and full of practical instruction in this connection. Following is a tabulated statement of the results secured when corn alone was compared with corn plus different kinds of commercial supplements when fed during the pregnancy period to yearling sows:

TABLE III. — STRAIGHT CORN VERSUS CORN AND A SUPPLEMENT (Iowa Experiment Station). TEN YEARLING SOWS IN EACH LOT[1]

AVERAGE DAILY RATION FED EACH SOW	4.97 LB. CORN	4.11 LB. CORN .50 LB. MEAT-MEAL OR TANKAGE	4.06 LB. CORN 1.13 LB. LINSEED-OIL MEAL
Average daily gain, each sow	.59 lb.	.78 lb.	.67 lb.
Average weight, each litter	17.06 lb.	24.42 lb.	19.50 lb.
Average number pigs farrowed	9.2	10.1	8.8
Average birth weight, pigs	1.85 lb.	2.42 lb.	2.22 lb.
Vigor of pigs:			
Strong, per cent	41	85	76
Medium, per cent	35	5	15
Weak, per cent	20	5	5
Dead, per cent	4	5	4
Condition, or fatness of pigs:			
Prime to choice, per cent	26	37	48
Good to medium, per cent	62	56	47
Fair to inferior, per cent	12	7	5

[1] Proc. American Society of Animal Production, 1913.

All three lots of sows were kept under identical conditions as regards shelter, exercise, and the like. At the beginning of the experiment, the ten sows in each lot were as nearly like the sows of the other lots as it was possible to make them. Variations in the results, especially the weight, vigor, and condition of the pigs at birth, were chiefly due, therefore, to the rations fed.

These results speak for themselves. The birth weight of the pigs from sows fed straight corn was nearly a half pound lighter than that of the pigs from sows getting in addition either meat-meal or linseed-oil meal. Chemical analyses have revealed the deficiencies of corn in bone- and muscle-building constituents, and the results of this experiment are a striking demonstration of the same fact. The starvation to which the embryo pigs in the corn-lot were subjected was expressed not only in their small size at birth, but also in the smaller proportion of strong pigs and their thin condition of flesh. These differences are especially significant since the size and value of a pig crop for any year are limited by the thrift and vigor of the pigs at birth.

Although corn for pregnant sows is too fattening to be safe when fed alone, or economical in the end, this does not mean that it is not a desirable feed when properly supplemented. It is the abuse of corn in the hands of careless feeders, rather than its legitimate use, that has caused many hog-men to condemn it for breeding stock.

Other grains for pregnant sows.

Outside the corn-belt, larger use is made of such grains as oats, barley, emmer, and wheat, as the basis of the sow's rations during the winter. Although these grains possess a little more bone and muscle-building constituents than corn, they are not satisfactory when fed alone to pregnant sows. Oats is, no doubt, the safest single grain that could be selected. The grain sorghums, kafir and milo, are very similar to corn in composition, but are not so palatable. Rye is not considered a good feed for pregnant sows unless ground and fed in limited quantities with other more bulky concentrates. Kafir, milo, and wheat should be ground, and usually more satisfactory results will be obtained if they are fed mixed with other and lighter feeds. Oats, barley, and emmer also give better results when ground.

Value of legume hays for pregnant sows.

The legume hays, clover, alfalfa, cowpea, soybean, field pea, vetch, lespedeza, when of fine quality, offer one of the most valuable means of supplementing corn or other home-grown grains. Not only is hay of this class commonly available on every farm, but it supplies three important elements in the brood sow ration; viz., bulk, protein, and lime or mineral matter. Furthermore, these hays generally possess the desirable quality of being laxative in their effects.

At the North Platte, Nebraska, sub-station, considerable data of value have been accumulated showing the value of alfalfa as a supplement to corn or other grains when fed in various ways to pregnant sows and gilts. In the following table is presented a brief statement of the results of feeding gilts one part of chopped alfalfa hay mixed with two to three parts of grain. As much of this mixture was fed as the gilts would clean up. When the gilts showed evidence of becoming too fat, the proportion of grain was reduced and the alfalfa increased.

TABLE IV. — WINTERING BRED GILTS ON GRAIN AND ALFALFA [1]

YEAR DATE	1909–'10 Nov. 9– March 15	1910–'11 Nov. 8– March 14	1911–'12 Nov. 14– March 19	1912–'13 Nov. 4– April 1	1913–'14 Nov. 4– March 25	AVERAGE 5 YEARS
Rations Fed	Corn, Barley, Chopped Alfalfa Hay	Corn, Barley, Rye, Wheat, Chopped Alfalfa Hay	Corn, Chopped Alfalfa Hay	Corn, Chopped Alfalfa Hay	Wheat, Chopped Alfalfa Hay, Alfalfa Hay in Rack	
Number gilts in lot	25	25	25	20	25	24
Number days in experiment .	126	126	126	148	141	133
Pounds grain fed each gilt during the winter	519	501	513	694	650	575
Pounds alfalfa fed each gilt during the winter . . .	161	253	207	237	234	218
Pounds grain fed daily per 100 lb. weight of gilt	1.90	1.52	1.75	1.90	1.90	1.79
Pounds grain fed daily per gilt .	4.12	3.98	4.07	4.69	4.61	4.29
Pounds alfalfa fed daily per gilt	1.28	2.01	1.64	1.60	1.66	1.64
Average first weight of gilt .	156.	201.	188.	181.	166.	178.
Average gain per gilt	121.	122.	88.	130.	153.	123.
Cost [2] of feed for wintering the gilt	$ 5.20	$ 6.04	$ 5.36	$ 7.02	$ 8.74	$ 6.47

[1] W. P. Snyder. Bull. 147, Neb. Exp. Sta.

[2] Corn, per bushel, $.47; wheat, per bushel, $.70; barley, per bushel, $.40; rye, per bushel, $.56; chopped alfalfa hay, $10 per ton; alfalfa hay, $8 per ton.

The system of feeding followed in these tests insured large gains and the gilts were in rather heavy flesh at farrowing time. The results were satisfactory both from the standpoint of economy and the number and quality of the pigs. Rather large litters of healthy pigs were produced and no trouble occurred at farrowing time.

The figures showing the cost of wintering the gilts are high for these experiments because of the rather large rations fed. If the gilts had been credited with as much of the gain in weight as remained after they had farrowed and weaned their pigs, at the market price of pork, the cost would have been considerably reduced. On the other hand, the prices of the feeds should be increased to bring the results more nearly in harmony with present conditions.

Methods of feeding alfalfa hay.

The question of the best method of feeding alfalfa hay to bred sows in the winter was also studied by W. P. Snyder of the North Platte, Nebraska, sub-station. Table V gives a summary of four years' work with special reference to the cost of maintenance.

Lot I was fed shelled corn in a trough or on clean ground and alfalfa in a rack. The sows in this lot were given all the hay they would eat. Lot II was fed ground corn mixed with an equal weight of chopped or cut alfalfa. This mixture was moistened with water at feeding time. Both lots had access to a small field of fall-sown rye.

In each of the four years the cost of wintering the sows was lower in the lots fed the alfalfa in racks than when it was chopped and the sows compelled to eat as much hay as they were given grain. The average annual saving in the cost of keep was $1.63 for each sow. The effect on the resulting pig crops was not reported and it is assumed the results were satisfactory in both lots.

TABLE V. — WINTERING YEARLING AND MATURE SOWS [1]

CHOPPED ALFALFA VERSUS ALFALFA IN RACKS

TIME	AVERAGE 4 YEARS 1910–1914	
Rations Fed	I Shelled Corn, [2] Alfalfa Hay in Rack	II Ground Corn, [2] Chopped Alfalfa, ½
Average number sows in each lot	10	10
Average number days in experiment	121	121
Average number bushels grain fed each sow	9.90	8.84
Average pounds alfalfa fed each sow	86.	495.
Average pounds grain fed daily each sow	4.43	3.99
Average pounds alfalfa fed daily each sow	.70	4.05
Average pounds grain fed daily each 100 pounds weight sow	1.14	1.04
Average beginning weight of each sow	341 lb.	337 lb.
Average gain each sow	93 lb.	96 lb.
Average cost [3] of feed for each sow	$ 5.29	$ 6.92

As the result of this study, the author of the experiment draws the following conclusion: "Feeding a very light grain ration and letting the sows eat alfalfa at will from a rack proved a better practice than mixing the grain and chopped alfalfa in equal proportions and thereby compelling the sows to eat a pound of alfalfa with each pound of grain." The important observation is also

[1] Bull. 147, Neb. Exp. Sta.

[2] In the 1913– 14 test, ground wheat was fed instead of shelled corn.

[3] Prices of feeds, same as those given in Table IV.

made that when hogs are fed alfalfa hay in a rack it is very important that it be of fine quality.

In Table VI are given some unpublished results of further feeding tests conducted at the North Platte, Nebraska, sub-station by W. P. Snyder. It is an interesting comparison of pregnant sows fed straight alfalfa hay with no grain, sows fed a mixture of equal parts of corn silage and cut alfalfa hay with access to alfalfa in a rack, and sows fed approximately 1 per cent of their weight in corn daily with alfalfa fed in a rack.

Table VI. — A Comparison of Rations for Pregnant Sows (mostly mature) During 70 Days in Winter, 1914–15, 1915–16.

Rations Fed	1% Shelled Corn, Alfalfa Hay in Rack	No Corn, Alfalfa Hay in Rack	Equal Parts Chopped Alfalfa Hay and Corn Silage, and Alfalfa Hay in Rack
Average feed eaten by each sow daily	4.04 lb. corn, 2.18 lb. alfalfa	4.91 lb. alfalfa	4.15 lb. corn silage 4.15 lb. chopped alfalfa 2.22 lb. alfalfa from rack
Average initial weight of sows, Dec. 25	345 lb.	349 lb.	362 lb.
Average gain or loss in weight per sow, 70 da.	32 lb. gain	21 lb. loss	21 lb. loss
Average birth weight of each litter	25.1 lb.	21.4 lb.	21.2 lb.
Average birth weight per pig	2.30 lb.	2.23 lb.	2.26 lb.
Average number of pigs raised per litter to 50 lb.	6.8	5.7	4.7

It would appear from these results that pregnant sows are unable to maintain themselves and provide for the nourishment of their embryo pigs on bulky feeds alone. This is also the conclusion of practical experience. In both lots where no grain was fed, the sows lost in the seventy days an average of twenty-one pounds, and the number of pigs raised to the litter was below that of the sows fed some corn. Regarding the ration containing corn silage, the author of the experiment states that a considerable proportion of the feed in this lot was wasted. The sows picked out the corn in the silage, but ate very little of the fodder. Close observation of the sows during the progress of the experiment thoroughly convinced him that nothing was to be gained by feeding corn silage to pregnant sows.

Additional testimony of the value of a legume hay to supplement home-grown grains for wintering pregnant sows is supplied by tests made by W. H. Peters at the North Dakota Experiment Station. One group of sows was fed a grain mixture of two parts crushed barley and one part of bran, by weight, fed as a thick mash with warm water. The second group was fed the same mixture, but had in addition free access to alfalfa hay fed in cheaply constructed racks. The amount of the mash fed in each group was determined by the condition of the sows, the effort being made to secure the proper gains in both lots.

In Circular No. 13 the author makes the following observations:

"Close observation of the sows during the winter months and during the month of March, while they were farrowing, leads to the following conclusions:

1st. "It was possible to replace one-third of the grain ration for brood sows with alfalfa hay.

2nd. "It required 1.04 pounds of alfalfa hay to replace 1 pound of grain.

3rd. "The feeding of alfalfa afforded an excellent means of getting the sows to take more exercise than they do when fed grain alone.

4th. "No trouble at all was experienced by any of the sows in farrowing.

5th. "The sows fed alfalfa hay farrowed just as large, strong, and uniform litters of pigs as did the sows not receiving it.

6th. "The sows fed alfalfa appeared to milk better and nurse their pigs a little better than did those not receiving hay.

7th. "The results obtained in this trial indicate that it is practical and advisable to feed as much alfalfa hay to brood sows in winter as they will eat, regulating the additional grain ration so as to keep the sows in the proper condition."

Methods of balancing corn for pregnant gilts.

In Table VII are reported results of further investigations by Evvard of the Iowa Experiment Station. In this experiment a study was made of the relation of the rations fed pregnant gilts during the winter to the weight, vigor, and condition of the pigs produced.[1]

The corn fed in each ration was ear corn with the exception of the lot receiving cut clover, when it was shelled to facilitate mixing. The meat-meal fed was the best grade, containing 60 per cent protein and 14 per cent mineral matter. The quantity of corn fed was estimated on the shelled basis. The clover was of only fair quality,

[1] Vols. VII and VIII, A. B. A.

TABLE VII. — SUPPLEMENTS FOR CORN FOR WINTER FEEDING BRED GILTS

(Iowa Experiment Station)

FIVE GILTS IN EACH LOT

Average Daily Ration Fed Each Gilt	Average Daily Gain Each Gilt	Average Wt. Each Litter	Average Number Pigs Farrowed Each Litter	Average Birth Wt. Pigs	Vigor of Pigs				Condition, or Fatness, of Pigs		Average Number Pigs Saved at Weaning Time
					Strong	Medium	Weak	Dead	Prime to medium	Medium to inferior	
	lb.	lb.		lb.	%	%	%	%	%	%	
I. 3.65 lb. corn	.35	13.20	7.6	1.74	68.42	15.79	15.79	0	61.8	38.2	5.2
II. 3.21 lb. corn 0.13 lb. meat-meal . . .	.58	14.89	7.4	2.01	91.89	5.41	2.70	0	91.9	8.1	6.2
III. 2.75 lb. corn 0.43 lb. meat-meal . . .	.62	19.62	8.8	2.23	93.18	4.55	2.27	0	87.5	12.5	7.0
IV. 2.73 lb. corn 1.07 lb. meal mixture[1] .	.35	19.50	10.6	1.84	83.02	5.66	5.66	5.66	74.5	25.5	7.4
V. 3.78 lb. corn 1.56 lb. cut clover 0.26 lb. molasses . . .	.58	15.32	7.0	2.19	85.71	0	11.43	2.86	81.4	18.6	4.6
VI. 3.67 lb. corn 0.30 lb. clover in rack .	.53	14.17	6.4	2.21	83.75	0	6.25	0	71.9	28.1	5.6
VII. 3.74 lb. corn 1.11 lb. alfalfa in rack .	.63	17.41	7.6	2.29	89.47	7.89	0	2.63	85.5	14.5	6.4

[1] Meal mixture made up of 3 parts oats, 3 bran, 3 middlings, and 2 linseed-oil meal.

but quite leafy, while the alfalfa was of the third and fourth cuttings and choice in grade. The hay fed in racks was in the long condition. The molasses used was ordinary black strap, which was fed by diluting and sprinkling on the cut clover. The gilts selected were in a thrifty growing condition, and averaged approximately 210 pounds at the beginning of the experiment. The test covered a period of 140 days, beginning with the start of the breeding season and continuing to the middle of the farrowing season.

The best rations fed in this experiment, as measured by the vigor and condition of the pigs farrowed and the weight of the pigs at birth, were in lots, II, III, and VII, the first two receiving with their corn meat-meal in different proportions, and the last alfalfa hay in a rack. The gilts in these lots also made the most rapid gains. The feed cost of each pig at birth was lowest in the lots receiving meat-meal.

The disastrous results of exclusive corn feeding to bred gilts are here demonstrated, and also, different methods of balancing this corn. The benefits derived from feeding a small amount of high grade meat-meal or tankage, as shown in this and other tests, are due to the extreme richness of these meat products in flesh and bone-forming substances. It is also a matter of considerable practical importance to know that clover or alfalfa fed in a rack, if of fine quality, will be eaten in sufficient amounts apparently to balance the corn or other grains.

Other protein supplements.

In addition to tankage or meat-meal and linseed-oil meal, other commercial feeds of the same class are extensively used to balance home-grown rations for pregnant sows during the winter. For the amount of dry matter carried, skim-milk occupies a position next to the packing-house products in its content of protein. When available and fed with judgment, pasteurized skim-milk is one of the cheapest amd most desirable supplements. Buttermilk, when not diluted, is practically identical with skim-milk in feeding value. Whey is a carbohydrate feed, very thin, and of little value as a means of balancing the grains. Wheat middlings, shorts, and bran are standard hog-feeds and extensively used by most feeders. Although containing, on the average, no more than one-fourth as much protein as high-grade tankage, or one-half as much as linseed-oil meal, they are valuable as a part of the grain ration when their price does not exceed their value.

The value of succulence.

When available, green crops and roots constitute a desirable element in the ration of the brood sows during the winter. When supplied as additions to the regular fare, they furnish, with some food, the property of succulence conducive to the maintenance of breeding thrift and a healthful condition of the digestive system. In the South green crops may be depended on for the main support of the brood sows during the first part of the winter. In Canada and the northern states, roots are frequently used as a large part of the daily ration, fed sliced, pulped, or in the whole condition. In Denmark, England, Scotland, and Ireland, roots in some form are considered as practically an essential part of the ration for pregnant sows.

In the corn-belt and similar latitudes, as much use should be made of green feeds like fall-sown rye, blue-grass, tame pastures, clover, and alfalfa, as the weather and other conditions make possible. The use of corn silage, clover, and alfalfa silage, and pea-cannery waste has been favorably reported on for pregnant sows when the feeds were of good quality. When fed with care and with the main purpose of supplying succulence, they may be used in limited amounts with safety. Corn silage is so bulky, however, as practically to exclude it from the list of hog-feeds. As a rule, such provisions for the breeding herd will mean more exercise, cheaper cost of maintenance, and a more vigorous condition of health.

The necessity of feeding salt to hogs has not been clearly established, but it is the belief of the best hog-men that it is beneficial, especially for sows in pig. When the sows are given the opportunity to eat salt at will, they do not take more, apparently, than their systems need. To make certain that the needs of the sows for other minerals are also satisfied, it is a good practice to give them constant access to a self-feeder containing a mixture of the mineral elements most frequently lacking in the ration. A combination of 12 parts charcoal, 3 parts of air-slacked lime, ground bone, or ground rock phosphate, and 1 part common salt will be eaten with relish and apparent benefit. The addition of wood-ashes in the same quantity as the lime would probably improve the combination.

Conclusions.

Summarizing the foregoing, the following fundamental facts may be set down as practical guides in compounding rations for pregnant sows:

First, Every ration must be balanced; *i.e.,* should contain more muscle and bone-forming material than is contained in corn and most of the other grains. This is particularly true for gilts and for older sows during the last six weeks of pregnancy.

Second, The supply of protein necessary to balance the ration should be obtained largely from home-grown legumes. If this hay is of fine quality, access to purchased supplements like tankage, linseed-oil meal, and shorts or bran will be unnecessary, in most instances, until the later stages of the gestation period.

Third, Every brood sow ration should contain some bulky material, such as hay, and the amount eaten should ordinarily be left to the judgment, or instinct, of the sows themselves.

Fourth, When possible, there should always be the opportunity for the sows to get some green or other succulent feeds, largely because of their tonic and regulative effects, and

Fifth, As a rule, the most economical ration is the one most largely made up from home-grown sources.

The experimental facts presented in the preceding chapter and the principles deduced from them will help in formulating specific rations. In the table on the following page different groups of standard hog-feeds are shown, from which may be selected the ration which is available and cheapest for a given set of conditions.

Any of the rations recommended in this table for mature sows during the last six weeks of pregnancy will be appropriate for bred gilts.

An extremely large number of combinations may be selected from these groups. From Group I, for example, the following ration for the corn-belt may prove the most economical and suitable for some conditions: First ten weeks, corn, with fine quality clover hay fed in a rack;

Last six weeks, 12 parts corn and 1 part tankage (8 per cent), by weight, with fine quality clover hay fed in a rack.

TABLE VIII. — SUGGESTED WINTER RATIONS FOR MATURE PREGNANT SOWS [1]

FIRST 10 WEEKS	LAST 6 WEEKS
Group I Home-grown grain + fine quality legume hay	Home-grown grain + 6 to 8% best grade tankage or meat-meal, by weight; or, (12 to 16% linseed-oil meal), or, (30 to 40% middlings or shorts), or, (65 to 75% skim-milk or buttermilk), + fine quality of legume hay.
Group II Home-grown grain + green crops	Home-grown grain + one of the commercial supplements given in Group I + green crops or roots.
Group III Home-grown grain + 5 to 6% tankage or meat-meal, or, (10 to 12% linseed-oil meal), or, (25 to 30% shorts or middlings or bran).	Home-grown grain + 7 to 10% tankage or meat-meal, or, (14 to 20% linseed-oil meal), or, (40 to 50% shorts or middlings or bran).

With oats or barley in place of corn, as in the West and North, and fine quality of alfalfa hay instead of clover, the amount of tankage required would be less, and

[1] The percentages given apply to the entire concentrated part of the ration, including the supplement. For example, 6 per cent of tankage means 94 parts corn and 6 parts tankage, rather than 100 parts corn to 6 of tankage.

6 per cent might be better than 8. Furthermore, the supply of protein in the Northwest might be purchased more cheaply in mill feeds than in tankage, in which case 12 per cent linseed-oil meal or 25 per cent middlings or shorts should be used. In dairy districts, where only cream or butter are sold, skim-milk or buttermilk would probably supply the necessary protein in cheaper form than any of the other supplements listed. In the South, where the hog-man may have the advantage of forage crops a good part of the winter, a ration selected from Group II would probably most nearly fit his conditions. In Group III are suggested combinations for those conditions when good hay, roots, or other succulent feeds are not available. Instead of using a single grain, the conditions may warrant a combination of two or more. When the cost is the same, a mixture is commonly to be preferred.

A ration more rich in protein is required by mature sows during the latter stages of the gestation period because the bone and muscular tissues of the young pigs are being formed more rapidly than in the earlier stages. There is an increasing and more or less regular demand for these growing constituents from breeding to farrowing time. If the ration used during the first part of the winter is gradually changed to the one selected for the last six weeks, the actual demands of the mature sow will be met approximately.

Bred gilts under a year old and yearling sows need a larger proportion of protein in their rations than recommended in the above table for mature sows. Particularly is this true for the first part of the pregnancy period. The gilt, in addition to the requirements for maintenance and the growth of her embryo litter, must have food for her own growth if the effects of the early breeding are not to prove detrimental to her future development. During the last six weeks, the need for protein supplements is believed to be practically the same for the gilts as for the mature sows. The reasons for this are that the older sows are fed a lighter ration for their weight, while the demands made on them by the growing litter in utero is larger because of its size.

Amount to feed.

In feeding pregnant sows, the purpose should be to feed just that amount which will bring each sow to the farrowing season in the condition of flesh which will best enable her to perform for her pigs her full duty as a mother. Even with a balanced ration, plenty of exercise, and comfortable quarters, it is possible by careless feeding to ruin or greatly reduce the chances of a good pig crop. At least one-half of the successful feeding of breeding stock is in the careful regulation of the amount fed. The sows must be neither too fat nor too thin. The extremely fat sow is a pig killer and a poor milker, and, as a result of her usual indisposition to take sufficient exercise during the previous months, her pigs at birth are weak and low in vitality. On the other hand, an extremely thin half-starved condition should be avoided, for such a sow will lack the reserve energy necessary for the proper nourishment of her pigs both before and after birth. The ideal is to have the sow at farrowing time in what is known as a strong, but active, breeding condition.

If the mature sow is in a thin active condition at the beginning of the breeding season in the fall, she should be fed to gain during the winter from 75 to 85 pounds. From the standpoint of economy, as well as in the results obtained, she should gain as much during the breeding and gestation periods as she loses in farrowing and the subsequent nursing period. The loss of weight during these times will depend chiefly on the number of pigs farrowed and the ability of the sow as a milker, and cannot be predicted. The most prolific and heavy milking sow in the herd, however, will usually make a gain during the previous months considerably in excess of the average.

It is probably true that every brood sow, as well as every other breeding animal, has a best weight which varies during the year according as the nature of her work as a producer changes. The diagram in Fig. 3 represents what is believed to be the best approximate weight curve for a sow a little above the average in prolificacy and weighing 325 pounds in thin flesh at the beginning of the breeding season. The variations in weight shown from breeding to weaning time are based on average figures obtained from a study of the weight records of a herd of twenty sows through several breeding seasons. This study has led to the conclusion that the herd of mature sows that is thin to start with will, if made to gain 75 to 85 pounds during the breeding and gestation periods, be approximately of the same weight and condition of flesh at the time of weaning their pigs as they were when the breeding season began, when properly fed.

According to this curve, the sows should make most of their gains during the last six weeks of the pregnancy period. This is natural, for the reason that the pigs in embryo make practically 75 per cent of their growth during this time. If the sows make a gain, on the average, of one-third of a pound daily for the first sixty days of pregnancy, one pound daily in the next thirty days, and

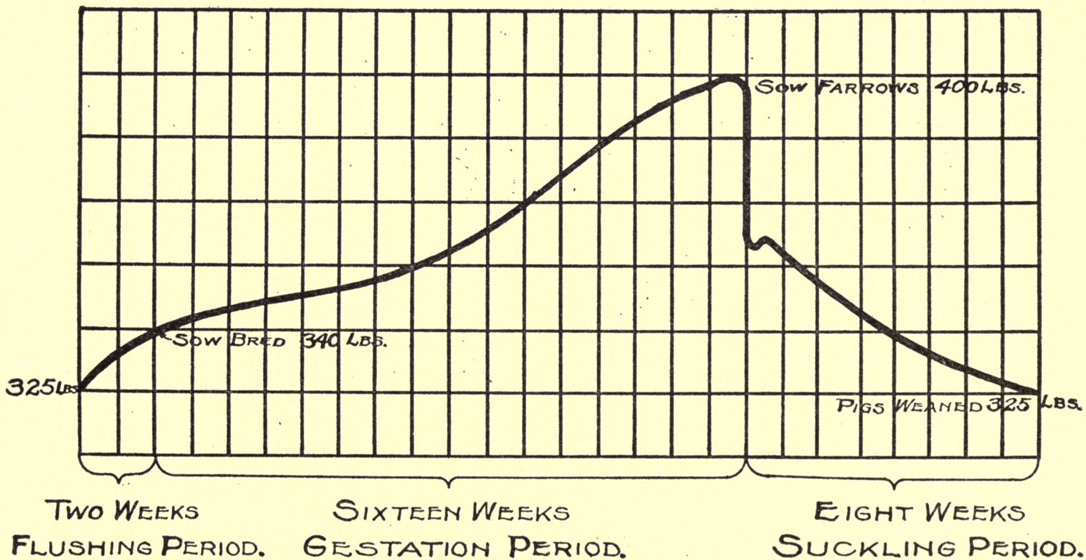


Fig. 3. — Curve showing desirable variations in weight of a mature sow during the breeding, gestation, and nursing periods.

one-half pound daily during the last three weeks, the rate of gain will closely approximate that shown in the diagram.

The amount of concentrates necessary to secure this ideal condition will vary chiefly with the kind of concentrates fed and the availability and quality of the hay, grass, or other succulent feeds which may be supplied in addition. It will also be influenced largely by the weather and the type and disposition of the sows in the herd.

In Table IX is the summarized record of the average weight, the gains made, and the concentrates fed each hundredweight for 101 mature sows, 40 yearling sows, and 155 gilts. Most of the data on which these averages are based have been reported previously in this chapter. (See Tables III, IV, V, and VII.) In twelve of the nineteen rations fed these sows, alfalfa or clover hay was given in addition to the concentrates. Most of the rations fed were well balanced.

Table IX. — Amount of Concentrates Fed Pregnant Sows in Winter

Age of Sows	Average Weight of Sows	Average Gain Each Sow	Concentrates Fed Daily Each 100# Weight
	lb.	lb.	lb.
Average for 101 mature sows	387	90	1.07
Average for 40 yearling sows	306	84	1.62
Average for 155 gilts	243	94	1.61

These figures show that when mature sows have access to alfalfa, a daily ration equal in amount of concentrates to 1 per cent of their weight was approximately sufficient to secure an adequate gain during the pregnancy period. In view of the fact that they will eat treble this amount if given the opportunity, the folly of measuring the amount fed by the appetite is apparent. In practice, the only safe rule to follow is to measure the amount by the condition and weight of the sows.

The gilts were fed, on the average, 1.61 pounds of concentrates daily for each hundredweight, and made the average gain of 94 pounds during the pregnancy period. The gilts fed at the North Platte, Nebraska, station received chopped alfalfa hay with their grain, while those at the Iowa station were not given any roughage.

Gilts must be fed more heavily during the pregnancy period than mature sows because in addition to the demands for maintenance and the developing pigs, their own requirements for growth should be provided for. Although their loss of weight at farrowing time and during the suckling period is less than with mature sows, their gains may safely be made larger. In actual practice, the purpose should be to keep the young sows thrifty and growing without endangering their activity by allowing them to become too fat.

The extent to which early breeding of gilts may result in a permanent check to their development is largely determined by the kind and amount of the rations fed during the first gestation period. As with mature sows, the best guide to follow in feeding pregnant gilts is to limit the amount by their condition.

Preparation of feeds and method of feeding.

It seems to make little difference whether the sows are fed their concentrates in a wet or a dry condition, although many still maintain that the feeding of slops is essential, especially during the last weeks of pregnancy. When feeding meals and supplements like shorts, bran, tankage, or oil-meal, it is often thought better to feed as a slop, as less is wasted or blown away. It is often most convenient, also, to water the sows with their feed, and when the weather is extremely cold heating the water and feeding the slop warm is beneficial. However, more and more hog raisers are being converted to the dry-feeding method. That the sows will do equally well and that the system requires less work and bother than slop feeding, is the verdict of those who have tried both methods.

Cooking is a detriment rather than a benefit with the usual hog-feeds. The effect of grinding and soaking is slight and of doubtful value in practice, except with small hard grains like rye, wheat, kafir, and very dry corn. With pregnant sows whose rations are limited to no more than one-half the amount they are capable of eating, special methods of preparation for the purpose of insuring greater palatability are not justified.

The self-feeder method of feeding pregnant sows and gilts during the winter would appear to be safe when handled under favorable conditions by a careful feeder. With good quality of alfalfa or clover hay cut fine or ground and mixed with ground corn and the proportion of hay so regulated that the consumption of corn will not exceed the amount necessary to maintain the proper condition and weight, good results may be secured. However, great care must be exercised that the consumption of corn is not excessive. In the hands of a careless feeder, the indiscriminate use of the self-feeder would prove disastrous. Under general conditions it is doubtful whether this method of feeding will ever prove generally successful for feeding sows in pig.

FEEDING THE MATURE BOAR

It is as important that the mature boar be properly fed during the winter as that he have a reasonable amount of exercise and sanitary quarters. His energy and breeding capacity in May will be conditioned largely on the care exercised in his feeding during the winter. Practically the same combination of feeds recommended for the mature sows during this time is suitable for the boar. However, since under average conditions his quarters are more restricted and his opportunity for grazing more limited than the sows', his ration should contain a larger variety. In the absence of some legume hay or succulent feed, wheat-bran or linseed-oil meal should be added to forestall any tendency to constipation. The amount of feed should be limited to practically a maintenance ration. Nine out of every ten mistakes in feeding the mature boar arise from supplying him too liberally and allowing him to become too fat. This means not only a waste of feed but a serious handicap on his future breeding powers. The amount fed should, therefore, be determined by his condition and weight and any gain deferred to just before the opening of the next breeding season.

FEEDING THE OPEN GILTS AND YOUNG BOARS

The prime object in feeding young prospective breeding stock is to secure a strong and reasonably rapid development. With this end in view, the gilts which are not bred and boars of the same age should receive rations during the winter which will promote growth rather than the production of fat. Their demands for bone and muscular development should be supplied and a tendency to over-fatness and inactivity opposed. However, a reasonable amount of fat is an evidence of growth and thrift and should not be received as a danger signal and with starvation rations. The nice point in feeding hogs of this class is to give them just the amount of feed that will secure good growth, yet not enough to permit them to become too fat. The experienced judgment of the practical feeder is the most valuable asset in obtaining this result.

The best ration to feed will depend on the conditions, especially the supply and price of feeds. In practice, the same ration fed the bred gilts will be suitable and most practical for the open gilts and young boars. During much of the winter, in fact, the gilts may be fed in the same troughs.

THE FEED COST OF WINTERING PREGNANT SOWS

The cost of feeding a pregnant sow during the winter is subject to wide fluctuations, largely due to variations in the price of feeds and also to the opportunity and judgment of the feeder in the selection of the rations. Variations in the weather and other natural conditions are also influences which cannot be estimated. It is believed, however, that the practical need for basal figures on the cost of producing pork is great enough to warrant study at this time, even in the absence of any systematic and extended investigations on which to base the study.

Basing the calculations for mature sows on the average number of pounds of concentrates and other feed required to produce, according to experimental tests, the amount of gain desired during the winter, it is possible to obtain reliable figures fairly representative of average conditions. According to the data reported earlier, a mature pregnant sow, weighing on the average 350 pounds in the middle of the winter, may be fed to gain 90 pounds during the 126 days on a daily ration, approximately, of 3.75 pounds of concentrates, mostly corn, and 1.65 pounds of alfalfa hay. (See page 61.) For a gain of 75 pounds, 3.50 pounds of concentrates and 1.50 pounds of fine quality alfalfa hay would probably be sufficient. According to the Scandinavian feed unit system,[1] 1.50 pounds of alfalfa hay is equivalent in feed value to .75 pound of concentrates like corn, wheat, shorts, or linseed-oil meal. Reducing the hay to terms of grain, or feed units, the daily ration would be 4.25 feed units for a sow averaging 350 pounds. Charging at the rates of 1 cent to 2½ cents for each feed unit, or pound of concentrates, the cost would be as represented in Table X.

TABLE X. — AVERAGE COST OF FEEDING 101 MATURE PREGNANT SOWS DURING THE WINTER

Pounds of Concentrates Fed Daily	Pounds of Alfalfa Hay Fed Daily	Total Feed Units Fed Daily	Price per Feed Unit	Total Cost 126 Days
3.50 lb. mostly corn	1.50 lb.	4.25	1 cent	$ 5.35
			1¼ cents	$ 6.70
			1½ cents	$ 8.02
			1¾ cents	$ 9.37
			2 cents	$10.71
			2½ cents	$13.39

[1] Henry and Morrison: "Feeds and Feeding." A feed unit is a pound of concentrated feed. One pound of corn, 1 pound of shorts or middlings, 1 pound of linseed-oil meal, or 1 pound of tankage, etc., is equal to one feed unit; while 1.4 pounds of bran, 1.1 pounds oats, 6 pounds of skim-milk, 12 pounds of whey, or 2 pounds of alfalfa are equivalent to one feed unit.

The rates of charges used above are practically equivalent to corn at 56 cents, 70 cents, 84 cents, 98 cents, $1.12, and $1.40 a bushel, respectively. By the use of some legume hay of fine quality and a limited use of some nitrogenous or protein supplement during the last six weeks of pregnancy, the feed cost under average conditions would be reduced about 10 per cent.

TABLE XI. — AVERAGE COST OF FEEDING 155 PREGNANT GILTS DURING THE WINTER

TOTAL AVERAGE FEED UNITS FED DAILY EACH GILT	TOTAL AVERAGE GAIN EACH GILT 126 DAYS	PRICE OF FEED UNIT	TOTAL COST 126 DAYS
4.50	94 lb.	at 1 cent at 1¼ cents at 1½ cents at 1¾ cents at 2 cents at 2½ cents	$ 5.67 $ 7.09 $ 8.50 $ 9.92 $11.34 $14.17

TABLE XII. — ESTIMATED COST OF FEEDING THE OPEN GILT 6 MONTHS DURING THE WINTER (200 to 300 lb.)

CONCENTRATES, OR FEED UNIT, REQUIRED FOR EACH 100 POUNDS GAIN	TOTAL CONCENTRATES, OR FEED UNITS, EATEN IN 180 DAYS	FEED COST FOR 180 DAYS
500 lb.	500 lb.	at 1 cent per lb. — $ 5.00 at 1¼ cents per lb. — $ 6.25 at 1½ cents per lb. — $ 7.50 at 1¾ cents per lb. — $ 8.75 at 2 cents per lb. — $10.00 at 2½ cents per lb. — $12.50

According to the data reported in Table IX, 155 bred gilts gained during the winter an average of 94 pounds on a daily ration of 1.61 pounds of concentrates for each hundredweight, with a little less than one-half pound of alfalfa hay for each sow daily. This is practically equivalent to $4\frac{1}{2}$ pounds of feed units, or pounds of concentrates, daily for a gilt weighing an average of 250 pounds during the winter. Figuring the feed units, or concentrates, at the same prices used in Table X, the results are as shown in Table XI.

CHAPTER IV

CARE AND FEEDING OF THE SOW AND LITTER

The foundations of a successful farrowing season are laid in the winter by the proper feeding and care of the sows during pregnancy, but the number of pigs saved and finally raised is largely a question of the thought and attention to details which the man in charge is disposed to give the herd during and immediately following the farrowing season.

CARE DURING THE FARROWING SEASON

An important step in preparation for the farrowing season is to see that the farrowing-pens are ready and in order. They should be given a thorough cleaning and then sprayed with a strong disinfectant. It is very important also that the floors be dry and warm. Probably the most ideal floor is concrete covered with wood, but a good dirt or clay bottom is satisfactory if kept dry and free from dust. Bare concrete or cement floors are cold and often become damp.

There should be guard rails on the sides of the pen projecting out 8 or 10 inches from the walls and about 8 inches from the floor. These frequently will save a pig from being crushed by a restless mother. In Fig. 4 is a suggestion for a pig-nest which may be placed in one corner. In very cold weather this is of value in keeping the pigs warm as well as offering a place of safety.

It is covered with loose slats on which straw is piled. The straw will absorb the dampness and reflect much of the heat from the bodies of the pigs. If kept well padded with straw below, the pigs will be cozy on the coldest days.

When the pens are thoroughly dry, they should be bedded carefully. The kind and amount of bedding to use is of considerable importance, especially the latter. Any good absorbent that is dry and will lie close to the floor is satisfactory. Rye or wheat straw is preferred to oat straw. Cut straw, shredded stover, any fine-stemmed hay, or sawdust, when available, are highly

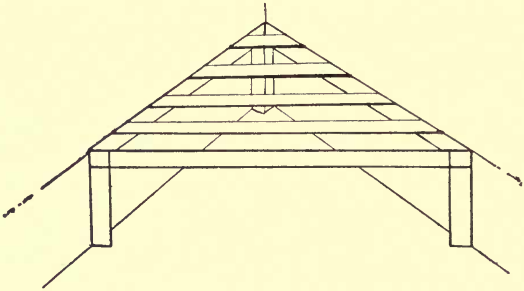


Fig. 4. — Framework in corner of farrowing pen for a pig-nest.

considered, for they interfere little with the efforts of the newborn pig to reach the mother's teat. A great pile of loose straw is an evidence of mistaken kindness. As a rule, the less bedding used the better. A very thin covering on the bare floor is sufficient, especially when the weather is not severe.

With early pigs, especially in the North, provision for the supply of artificial heat will often be desirable, even with a good piggery. An old stove or heater fixed up in one end of the hog-house may often be the means of saving the pigs in a particularly severe spell of weather.

Preliminary care and feeding.

The sow should be removed from the general herd and placed in her farrowing-pen a few days before she is expected to pig. This will enable her to become acquainted with her new quarters and will serve to make her more contented when pigging. By this procedure she will also become accustomed to the presence of the herdsman, which is important later in the case of herself and litter. An effective way to quiet a nervous sow is to give her a daily brushing. If the sow is taken out from the general quarters as soon as after the one-hundredth day as accommodations are available, the chance that she will farrow outside will be reduced to a minimum.

FARROWING RECORD

NUMBER OF SOW	DATE OF SERVICE	DATE DUE	DATE FARROWED	NUMBER AND SEX OF PIGS	EAR-NOTCH NUMBER
51	Nov. 10	Mar. 2			
36	Nov. 12	Mar. 4			
etc.					

The importance of a record of the date of service is apparent at this time, as it is impossible, with any reliable degree of accuracy, to tell by the appearance of a sow just when she will pig. The usual signs of approaching farrow are a filling of the udder and teats and a mild spirit of unrest. When she begins carrying litter or arranging her bedding for a nest, she may be expected to farrow within twelve hours. Without a record, constant observation of the sows is imperative, and even with it is still desirable. A farrowing sheet should be made out and posted in a convenient place in the barn. This should contain the number, date of service, and the date due, of each sow in the herd, with blank spaces for recording the date of farrowing, the number and sex of the pigs, and the ear-notch number of each litter.

Opportunity for some exercise should be given the sow after she has been removed to the farrowing-pen. It too frequently happens that she is shut in a pen with no liberty to move about. This is certain to aggravate the tendency to constipation as well as to make it difficult to keep her quarters in a dry sanitary condition. If a lot is not accessible to the farrowing-pen, the sows that are up should be turned together in an open yard for a part of the day to work over some clover or alfalfa hay.

It is very important that the ration of the sow be carefully regulated in the days just preceding farrowing. Two important changes should be made in her feeding; the ration must be made more laxative and the amount reduced. She will need less food under the more restricted conditions, and her recovery from farrowing will be more prompt if her digestive system is kept well cleared. Any tendency to constipation is dangerous. By feeding with the grain a quantity of wheat-bran or linseed-oil meal, her droppings will be kept in proper condition. A safe rule or practice to follow at this time is to cut her grain ration in half and add to it one-half its bulk in wheat-bran. One pound, or about a quart, of this mixture to the feed just before farrowing is sufficient.

Care at farrowing time.

The previous treatment of the sow will determine largely the results at farrowing time. If she has taken plenty of exercise during the preceding months, has been fed properly, and is in a strong active condition, she will cause little concern. With all preparations made, the attitude of the man in charge should be that of "watchful waiting." With a large number of sows to farrow, he should be at his post constantly during the day and every three hours at night, especially if the weather is severe.

It is sometimes desirable to remove the pigs as they are born to a half-barrel or basket lined with straw. With a six-tined manure fork or long-handled shovel, this may be accomplished without annoyance to the sow. If the weather is very cold, a few warm bricks or a jug of hot water may be placed in the basket, or the pigs may be taken to a warmer room until dry, when they should be put back to the sow for nourishment. If the sow is nervous and irritable, it may be desirable to keep the pigs away from her for several days, giving them the opportunity to nurse every two or three hours.

Gilts which are not in good breeding condition frequently have trouble in giving birth to their pigs. As soon as it is evident that protracted labor is of no avail, help should be given promptly. A small hand and arm, thoroughly cleaned and smeared with vaseline, is the best instrument. In fact, the unskillful use of pig-extractors is usually unsuccessful and often a cause of injury to the organs of the sow. Without some knowledge of the positions of the female parts, she should have the attention of a veterinarian.

The after-birth should be removed as soon as the sow has cleaned and be burned or buried. If allowed to remain in the pen she may eat it, which many believe will encourage the development of the pig-eating vice. Dead pigs also should be removed promptly for the same reason. The next day after farrowing the pen should be cleaned thoroughly and fresh litter supplied. Air-slacked lime or gypsum scattered on the floor has a cleansing and drying effect.

Needle teeth.

By an examination of the mouths of the pigs at this time, it will be found that they are all born with the so-called needle or black teeth. In Fig. 5 is shown their appearance at birth. These teeth are normal, inclined to be flat, but with sharp edges and are generally brown in tinge at the tip. Needle teeth are not a source of trouble to the owner, but to the pig with whom he fights. These are temporary tusks and considerable laceration of the mouth and gums results in the usual course of events. These injuries become infected and a sore mouth is the result. Hog-men who give their pigs the most care believe, as a rule, in removing these teeth soon after birth. This should be done carefully with regular forceps made for the purpose, or with a pair of small pliers. The effort should be to get a clean break without leaving any jagged splinters.

Fig. 5. — Showing "needle" teeth of pig at birth.

Feeding just after farrowing.

After farrowing the sow is in a feverish state for several days, and she will want and should be offered no food for practically twenty-four hours. She should be given plenty of fresh water, however, with the chill taken off. Special care should be exercised in her feeding the first week. The promptness of her recovery and the success with which she comes to her milk-flow will be determined largely by the judgment employed. The same kind of rations should be used after farrowing as just before.

Rather thin slops of meal, containing little or no corn, will give the best results. A supply of shorts, bran, and ground oats or barley is excellent to have on hand during this time. A safe procedure to follow in feeding is the following: the first day give her plenty of water, but no feed; the second day, give her one double-handful of meal to the feed (a double-handful of meal containing a desirable proportion of bran and shorts will weigh about one-half pound); the third day, two double-handfuls to the feed; the fourth day, three; and each of the three succeeding days, four double-handfuls to the feed. This is equivalent to 1 pound the second day, 2 pounds the third, 3 pounds the fourth, and 4 pounds for each of the remaining days of the first week. The practice of giving the sow a mild physic the day after farrowing in the form of $1\frac{1}{2}$ to 2 tablespoonfuls of Epsom salts is a good one. If the sow is normal, she should be brought up to full feed during the second week by having her feed increased at the rate of $\frac{1}{2}$ to 1 pound each day.

Pig-eaters.

It is probably true that a normal well-nourished sow rarely eats her pigs. At least, sufficient protein and mineral matter in the winter ration, plenty of exercise, and light laxative feeds during the farrowing season will reduce to a minimum the loss from this vice. A sow fed in restricted quarters during the pregnancy period on a diet of straight corn is certain to have a natural craving at this time for bone and muscle foods, and the usual result is that the pig is the victim. This, after all, is simply the working out of the law of compensation, for the growth of the embryo litter on such a diet was only possible through the extensive sacrifice by the sow of the lime of her skeleton and the protein of her muscular tissues. In eating her pigs, she is merely taking back her own body substance which her maternal instinct caused her to appropriate for the nourishment of the litter during pregnancy. A balanced diet is unquestionably the best prevention, and the only successful cure for habitual cases is the fattening-pen.

Sanitation and exercise.

Clean dry beds, sunshine, and exercise are indispensable to the health and progress of the pigs the first few weeks. Damp filthy quarters are responsible for the origin and aggravation of nearly all the pigs' ailments. Sore tails, infected mouths, scours, and a general lack of thrift are the direct results of such conditions. The pigs should have the opportunity to lie in the sun as much as possible. Pigs, like plants, will not thrive in dark places. Exercise, also, seems indispensable. If the weather outside is bad, they should be given the liberty of the alley for a part of each day. Fragments of paper scattered about on the floor or a pile of loose straw will have the effect of stimulating action. Perhaps the ideal condition for the sow and litter is supplied by the single cot set in a fairly roomy yard which is set to blue-grass. Even in the colder latitudes, a well-constructed single house will be warm enough for the pigs after they are a week or two old.

Marking the litters.

In pedigreed herds, it is necessary to give each litter an identification mark so that the parentage of each pig may be determined later by reference to the herd record. In herds kept exclusively for the production of market pork, such a record is desirable to make more certain that the future brood sows shall be selected from the best litters and prolific strains. The scheme universally employed for this identification is some system of ear-notches made with a special ear-marker or an ordinary harness-punch. There is a great variety in these systems, resulting from the individual ideas of breeders and the size of the herds. The following system is commonly used when the number of litters to be marked is not large:

A Plan of Ear-Notching for Identifying Litters

Name, Mark, or Number of Sow	Notches Outer Right	Notches Outer Left	Notches Inner Right	Notches Inner Left
1	1			
2		1		
3			1	
4				1
5	1	1		
6			1	1
7	1			1
8		1	1	
9	1		1	
10		1		1
11	2			
12		2		
13			2	
14				2
15	2	1		
16	2			1
17			2	1
18		2	1	
19	2		1	
20		2		1
Etc.				

All the pigs in the litter are given the same mark. The first litter farrowed, according to the above plan, would be given the ear-notch number 1, one notch in the outer rim of the right ear, the second would be litter number 2, the third litter number 3, and the like. The notches should be broad and deep enough to be legible without catching the pig, yet not so large that the ear will be disfigured. The notches are often made larger than necessary since they increase in size with the growth of the pig.

A second plan of ear-notching is suggested by A. J. Lovejoy in his book, "Forty Years' Experience of a Practical Hog Man." According to this scheme, each notch in the outer right ear counts one, each one in the

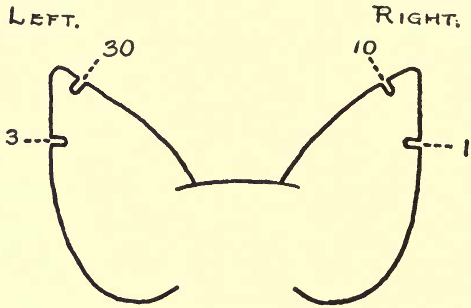


FIG. 6. — Illustrating the second plan of ear-notching.

outer left three, in the inner left thirty, and in the inner right ten, as shown in Fig. 6.

In this scheme, the number of the litter is determined by adding together the figures for which the notches stand. For example, one notch in the outer rim of the right ear would be litter number 1, while two notches in the outer right would be litter number 2 (1 + 1). Two notches in the outer left would be litter number 6 (3 + 3), and two in the outer right and one in the outer left would be litter number 5 (1 + 1 + 3). This plan of marking, shown in detail below, is particularly well adapted to large herds when the number of litters exceeds thirty or forty.

A Plan of Ear-Notching Adapted to a Large Herd

Name, Mark, or Number of Sow	Notches Outer Right	Notches Outer Left	Notches Inner Right	Notches Inner Left
1	1			
2	2			
3		1		
4	1	1		
5	2	1		
6		2		
7	1	2		
8	2	2		
9		3		
10			1	
15	2	1	1	
20			2	
30				1
40			1	1
50			2	1
60				2
70			1	2
80			2	2
90				3
100			1	3

A third plan of marking is shown in Fig. 7. By this scheme the number of the litter is determined by the position of the notch on the ear. The outer rim of the right ear is divided into three areas numbered 1, 2, 3 from the point of the ear back. A notch in the forward third would stand for litter number 1, a notch in the middle would be litter number 2, while one well back in area number 3 would be litter number 3. The outer left ear is divided into two areas, numbered 4 and 5 from front to back. A notch in the forward rim of the left ear would, therefore, be litter number 4, while one in area number five would stand for litter number 5. Each notch in the inner right ear stands for 10, while each in the inner left ear stands for 30, regardless of their position.

The number of notches required is reduced in this scheme to a minimum. Ninety litters can be numbered without necessitating more than two notches in either rim of each ear. In using this system, care must be taken to place the notch, particularly in the outer right ear,

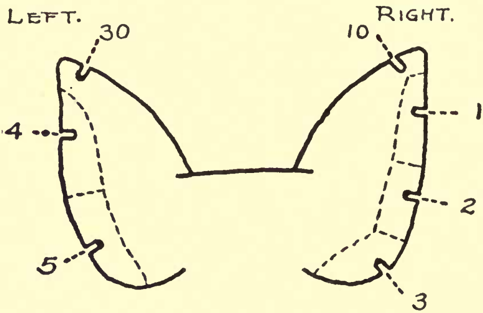


FIG 7.—A third plan of notching.

in the exact position it is intended to occupy. In examining the ear later, care must be exercised that notches in the second and third areas are not confused.

FEEDING AND CARE TO WEANING TIME

From this time on until the pigs are weaned, the primary purpose is to keep the pigs healthy and growing. In addition, economy in the selection of the ration should not be lost sight of. The thrift and development of the pigs will be conditioned on the extent to which the hogman successfully eliminates dirty insanitary conditions and provides the combination of feeds which will meet the requirements of the sow and her nursing pigs.

Feeding.

After the sow is on full feed, the best ration to give her is the one which is cheapest and most productive of a large milk flow. The importance of feeding a ration that is stimulating to milk production is so great, however, that balance should not be sacrificed to economy. A ration of straight corn would be cheap and convenient, but ruinous to the prospects of a generous flow of milk. The amount of milk a sow gives determines the rate of development of her pigs during these weeks. Furthermore, the cheapest gains which the pig will ever make are at this time. The mother's milk is an ideal food for the young pigs, and it is a matter of economy and good judgment to feed so as to stimulate the largest production.

The sow in milk should be fed very much the same kind of ration as the cow in milk. Feeds containing a sufficient supply of protein and mineral matter are necessary because milk is a muscle and bone-forming food. The ration at this time should be more concentrated and contain less fattening foods than the one used during the winter. A large proportion of bulky feeds would mean the exclusion of the necessary nutrients. Practically full rations should be fed, also, for the first six weeks. The usual home-grown grains, corn especially, do not contain enough protein and mineral matter to make satisfactory rations. Consequently, use must be made of some one of such feeds as tankage or meat-meal, linseed-oil meal, shorts or middlings, skim-milk or buttermilk. The cheapest, according to price and composition, should be utilized.

The following combinations are examples of good rations. They suggest about the proportions, by weight, in which it is desirable to use the different commercial supplements with the ordinary grains in order to have balanced rations:

(1) (4 parts corn+1 part shorts)+10% tankage or meat-meal.

(2) (4 parts corn+1 part shorts)+20% linseed-oil meal.

(3) (2 parts corn+1 part ground oats+1 part shorts)+5% tankage.

(4) (1 part corn+2 parts skim-milk or buttermilk).

(5) 3 parts corn+2 parts ground oats+10 parts skim-milk or buttermilk.

(6) $\frac{1}{3}$ ground barley, $\frac{1}{3}$ ground oats, $\frac{1}{3}$ shorts.

(7) $\frac{1}{2}$ ground barley, $\frac{1}{2}$ shorts.

(8) 1 part ground barley+1 part ground oats+2 parts skim-milk or buttermilk.

(9) $\frac{1}{2}$ ground Kafir, $\frac{1}{2}$ shorts.

(10) $\frac{1}{3}$ ground wheat, $\frac{1}{3}$ ground oats, $\frac{1}{3}$ shorts.

NOTE. — The above rations have nutritive ratios of 1 : 5.27 to 1 : 6.07.

If the sows get a bite of grass, it will be a valuable addition to the regular ration. Succulent feeds generally are good milk-producers. Blue-grass, rye, rape, clover, alfalfa, or other legumes are available in many parts of the country at this time. Sows with fall pigs should have access, if possible, to some legume, which will aid materially in properly balancing the grains fed. To make certain that the sows receive sufficient mineral matter in their diet, a mixture of charcoal, air-slacked lime, or ground rock phosphate, and salt, in about the proportions of 12 : 3 : 1, should be provided.

The results at this time will depend very much on the care and judgment of the feeder in determining the amount fed. Sows that have a normal number of pigs to nourish will ordinarily need full rations. The average sow loses weight during this period, even when given all the feed she will eat. According to actual records, sows will lose an average of about 25 or 40 pounds during the lactation period. This does not include the loss of weight in farrowing. The heaviest milking sows are, furthermore, the biggest eaters and the heaviest losers. Ordinarily, therefore, the amount fed should be regulated by the appetite, just a little less being given than will be taken at each feed. This will encourage a larger feed consumption and result in cleaner troughs. In every herd there are sometimes a few sows with only two or three pigs. These sows usually employ their feed for fat rather than the production of milk, and when their pigs are about five weeks old, begin to take on weight. Such sows should not be fed full rations, but an amount that will about maintain their weight. Sows that have large litters and are heavy milkers may be fed three times a day with advantage.

If the sow can be fed individually at this time, it will not only be an aid to good feeding, but will insure more uniformity in the pig crop. Two or three sows with pigs of approximately the same age, however, may occupy the same lot and be fed together with good results. The practice of running the sows together with pigs of all ages and sizes is the surest way to produce a large proportion of runts. If it is necessary for several sows to occupy the same quarters, those of the same temperament and with pigs of about the same age only should be put together.

The pig-creep.

When two or three weeks old, the pigs begin to take an interest in their mothers' rations. This interest should be encouraged, for pigs of this age have the teeth and digestive apparatus successfully to use small quantities of solid food. The sow produces her maximum milk flow on the average three weeks after the pigs are farrowed, and from this time on, the decreasing supply must be supplemented to meet the needs of the pigs, whose food requirements are increasing with each day. When the sows are fed individually and sufficient trough-room is supplied, a creep will be unnecessary for at least the first few weeks. When possible, however, it is advisable to have a pen constructed to which all the pigs can go and eat from low troughs at frequent intervals. A small quantity of dry shelled corn will be consumed at first with the greatest apparent relish. Later, the shelled corn should have added to it a supply of middlings or shorts or ground oats that have been sieved to remove the hulls. These may be supplied appropriately in separate compartments of a self-feeder. The mother's ration, minus such bulky feeds as oats or bran, with a little extra shelled corn, will be a suitable combination for the pigs. Pasteurized skim-milk and buttermilk are of the highest value at this time.

These pigs should not be fed carelessly. Wet feed should not be allowed to stand in the troughs, but should be cleaned up at once. Dry feed should not be supplied in such quantity that it will be in the trough longer than twelve hours. The self-feeder, when used, should be carefully adjusted and the trough frequently cleaned. These points are of special importance in eliminating one of the common causes of scours.

Scours.

Pigs that have dry clean beds and plenty of opportunity for play and exercise in the open are not subject to scours.

In addition to unhygienic conditions, however, there are many other causes of this ailment: as running in the wet grass; cold damp weather; too much succulent feed, especially when skim-milk or buttermilk is fed; irregular, careless feeding; and sour filthy troughs. Any modification of the mother's milk, resulting from feeding fermented rotten slops, or a feverish condition of the sow, is also frequently responsible for the trouble. The first step in the treatment of scours in young pigs is to remove the cause. The second is to cut down the mother's ration, and also that of the pigs. (See Chapter XXII.)

Weaning.

The pigs usually should be weaned when eight to ten weeks of age. If they have had up to this time the advantage of a creep and good rations, they will scarcely miss the mother's milk, which is secreted in rather limited amounts at this time. Those sows which are to raise fall litters should be taken from their pigs at eight weeks, since sows usually do not come in heat while suckling their pigs, and early fall litters are desirable. On the other hand, sows which are extremely heavy milkers and which it is not the intention to breed, may with profit be allowed to nurse their pigs for twelve weeks, provided they are liberally fed. A few days before the sows are removed from their pigs, their rations should be reduced materially. This precaution will tend greatly to eliminate the conditions which favor inflamed udders and caked teats at weaning time. It is commonly more convenient to remove the sows than the pigs. Some recommend that the sows be put back the next day and the pigs allowed to nurse partially. This may be desirable with individual sows, but, as a rule, it should be unnecessary. When separated, the sows should be put into a dry lot and fed only scanty rations for a few days until their udders begin to shrivel and dry up.

Gains made by pigs from birth to weaning.

The average pig in a well-managed herd should make a gain from birth to weaning time of $\frac{1}{3}$ to $\frac{1}{2}$ pound daily. When weaned at ten weeks, this will mean a weight, approximately, of 26 to 38 pounds when taken from the mother. But under the very best conditions, there is a wide variation, ranging all the way from a daily gain of .20 of a pound to over .50 of a pound.

In Table XIII are shown the weekly gains made by twelve litters of eighty-six pigs up to seventy days of age, at the Wisconsin Experiment Station. These pigs were farrowed by Berkshire, Poland China, Razorback, and cross-bred sows. Both sows and pigs were liberally fed on good growing and milk-producing rations during the suckling period.

These figures are conservative and show the remarkable capacity of the new-born pigs for growth. During each of the ten weeks of the nursing period, the pigs gained an amount considerably in excess of their original birth weight. The original weight was almost doubled in the first week. From a total weight of 227 pounds at birth, these eighty-six pigs, during the suckling period, gained a total of 2805 pounds, more than twelve times their original weight. (See Chapter V, page 107.)

The total gains made in seventy days, as shown in the column at the right, show the variation common among the different litters in every herd. A study of these figures reveals the interesting fact that the pigs in the small litters did not gain faster than the individual pigs

Table XIII. — Showing Weekly Gains from Birth to Weaning of Twelve Litters of Pigs [1]

Number Pigs in Each Litter	Gain by Litter 1st Week Lb.	Gain 2d Week Lb.	Gain 3d Week Lb.	Gain 4th Week Lb.	Gain 5th Week Lb.	Gain 6th Week Lb.	Gain 7th Week Lb.	Gain 8th Week Lb.	Gain 9th Week Lb.	Gain 10th Week Lb.	Total Gain 70 Days Lb.
10	26	31	33	35	45	22	53	43	54	24	366
10	24	34	26	21	28	36	47	43	32	51	342
6	9	8	9	17	0	18	23	8	18	28	138
6	13	19	18	20	12	23	15	17	26	11	174
5	14	20	15	20	19	15	34	21	23	42	223
8	19	22	14	16	17	25	18	46	42	40	259
9	30	31	30	42	33	38	40	29	20	59	352
7	17	23	14	18	31	35	11	25	25	50	249
6	16	13	18	20	25	−1	16	27	8	12	154
8	16	19	23	21	25	1	36	18	43	19	221
5	20	12	16	18	13	18	21	18	30	10	176
6	12	13	14	14	19	5	18	12	28	16	151
Total gain 86 pigs	216	245	230	262	267	235	332	307	349	362	2805
Weekly gain per pig	2.39	2.85	2.67	3.04	3.10	2.73	3.86	3.57	4.05	4.20	3.26
Daily gain per pig	.34	.41	.38	.43	.44	.39	.55	.51	.58	.60	.46

[1] W. J. Carlyle: Wis. Bull. 104.

in the larger litters. The average gains made by the individual pigs in the litters of different sizes were as follows: In the litters of ten, the pigs made an average gain during the seventy days of 35.4 pounds; in the litter of nine, the pigs gained an average of 39.1 pounds; in the litters of eight the average gain was 30 pounds; in the litter of seven it was 35.5 pounds; and in the litters of five pigs it was 39.9 pounds a pig. These figures bear out the theory held by many practical hog-men that the individual pigs in large, but normal-sized, litters usually grow as fast as do the individual pigs produced in small litters.

Another interesting observation on this table is that the gaining capacity of the pigs increases quite regularly from week to week during this time, although the gain for each unit of body weight is much greater in the first weeks than the last.

Castration.

Castrating the pigs should not be postponed long after the pigs are weaned. In fact, if performed before weaning, when the pigs are about six weeks old, it will require less work and the shock to the system will be less noticeable. From the standpoint of the pig, the earlier he is castrated the better.

Although this is not a dangerous nor a complicated operation, the observation of a few practical precautions will reduce the risk of possible complications. The pigs should have their morning feed withheld; one should avoid, so far as possible, getting the pigs warmed up and excited; a dry clean place, close to where the pigs are to be inclosed should be provided for the work; the knife should be sharpened thoroughly, and a whetstone put into the pocket if the number of pigs to be operated on is large; a pan or half-bucket of strong disinfectant, as a 4 per cent solution of coal-tar dip, should be at hand in which the knife is placed between operations. In performing the operation, it is important that the incision be made low enough to provide ready drainage and to prevent the accumulation of pus at the base of the pouch, the cord should be broken off well back, or drawn out and scraped. Before releasing the pig, the wounds should be washed with the disinfectant; if in fly-time some pine-tar should be applied. After the operation, the pigs should be shut away from old wallows and much-used mud-holes, so as to prevent the entrance of filth germs into the wounds. The best place for the pigs is a clean pasture. For several days they should be examined occasionally and any swollen or infected ones properly looked after.

CULLING OUT THE UNPRODUCTIVE SOWS

The best time of year to make an accounting with the sows is after they have weaned their pigs. They have individually just finished a test of performance which offers the best and most practical basis for the selection of future breeding stock. Only those sows which have produced good-sized, even litters of pigs and suckled them well should be retained for another breeding season. The prolific heavy-milking sow, though "thin as a rail" when her pigs are taken from her, is the foundation of every successful herd of hogs. Such a sow should hold her place in the breeding herd so long as there are no better ones, according to the same standard, to take her place. Mature sows which fail to raise litters of six good pigs should ordinarily be put into the fattening-pen. Although they may be smooth and good to look at, the herd from a pork-producing standpoint should be rid of them. Sows with defective teats, the cross sows with mean dispositions, the gilts which did not perform up to expectations, the pig-killers and poor milkers should go into the fattening-pen. No market-producing herd can be brought up and maintained at a high level of breeding performance without constant culling, and no herd of pedigreed stock can be made to succeed where "looks" and not performance is made the test in selection.

HERD RECORDS

In the management of a pedigreed herd, a systematic and detailed set of permanent records is imperative. The reliability of every printed pedigree rests not only on the integrity of the breeder, but also on the faithfulness and care with which the records have been kept. It is desirable, therefore, that the system of record-keeping adopted possess the following features: it should provide for the statement of all essential facts, *i.e.*, it should be complete; it should be logically and systematically arranged; it should be as simple as possible and adapted to the needs of the individual breeder; and it should be of a kind which will insure permanency.

The records may be kept either in specially made book form or on suitably ruled cards which may be indexed. Each form has its advantages. The publishers of practically all breed papers now put out private herd record books which are furnished to the breeders at a nominal cost. These have done much to encourage the systematic keeping of records and to give confidence in the results of pedigree registrations generally. These books are inexpensive, convenient to use, and are entirely satisfactory. They are especially recommended for breeders who are poor bookkeepers. Two sample pages from one of the best of these private herd registers are given on pages 92 and 93.[1]

In addition to the sow and litter divisions, a complete record system should also provide spaces for: (*a*) an extended pedigree of each boar and a list of the sows to which he has been bred during the year; (*b*) a summarized record of the individual animals bought and sold; and (*c*) an index. If such a system is supplemented by giving each sow in the herd which has produced two or more litters a page or card upon which may be recorded a summarized statement of the litters she has produced, the number of pigs farrowed and raised in each, the number retained, and the number sold and total value, it will facilitate the study of the performance records and insure a more accurate estimate of the value of each sow in the herd.

THE COST OF FEEDING THE SOW AND LITTER FROM FARROWING TO WEANING TIME

The feed cost of growing the litter of pigs to weaning time represents a necessary and important part of the cost of producing finished pork. This cost will vary widely, of course, with general conditions, herds, and feeders. The effort is here made to estimate the approximate cost for the average of good conditions. The calculations are based on the average feed consumption of twenty sows and litters, sixteen at the Wisconsin

[1] The W. B. C. Herd Register, Moore Bros. Co., Rochester Ind.

LITTER RECORD

PEDIGREE OF THE DAM

Ear Mark No.

Name

Farrowed

No. in Litter	No. Raised	No. Boars	No. Sows

Number Record Volume

Breeder

Town State

The Sire Far.

No.

Breeder

The Dam Far.

No.

Breeder

Pedigree of the Sire of the Litter Below

Name

Far.

Number Record Volume

Breeder

Sire's Sire

Number

Sire's Dam

Number

Bought of of Date Price

Sold to of Date Price

Bred by to No. Date

Date of Farrow of Following Litter	No. in Litter	No. Pigs Raised	Boars Raised	Sows Raised	Ear Marks of Pigs in Following Litter

No.	Sex	Name of Animal	Record Number	Sold to	Town	State	Date of Sale

Private Herd Register (Sample page 1)

LITTER RECORD

REMARKS ABOUT THIS LITTER, SIRE OR DAM:

GILTS BRED

No.	Gilts of this litter are bred to	Record No.	Date	Rebred to	Record No.	Date

DISPOSITION OF PIGS

No.	Price	Where Delivered	When Delivered	How Shipped	Shipping Value	Shipping Weight	Date Sent Pedigree

Private Herd Register (Sample page 2)

Station,[1] four at the North Carolina Station,[2] and four at Purdue University.[3] The feeds in these tests are for convenience reduced to a common basis by the use of the Scandinavian Feed Unit System. The summarized records for these twenty sows and litters are shown in Table XIV.

TABLE XIV. — RECORD OF AVERAGE FEED CONSUMPTION OF TWENTY SOWS AND LITTERS FROM FARROWING TO WEANING TIME

Average Number Days Fed	Average Number Pigs Raised per Litter	Average Weight Litters at Weaning Time	Average Weight Sows When Weaning Pigs[4]	Average Loss Weight Each Sow in Suckling Period	Average Number Feed Units Daily per Sow and Litter
		lb.	*lb.*	*lb.*	
76.6	74.5	270	318	23.75	11.32

Charging corn at 56 cents a bushel, or $1.00 a hundred, shorts at $1.50 a hundred, tankage at $2.50 a hundred, and skim-milk at 30 cents a hundred, a very satisfactory combination of these feeds would cost approximately $1\frac{1}{4}$ cents for each feed unit contained. When corn is 70 cents a bushel, and protein supplements about on a par in price with those just quoted, the cost of each feed unit would be a little less than $1\frac{1}{2}$ cents, and so on. In Table XV is given the cost of feeding the sow and litter on the basis of 1 cent, $1\frac{1}{4}$ cents, $1\frac{1}{2}$ cents, $1\frac{3}{4}$ cents, 2 cents and $2\frac{1}{2}$ cents for each feed unit.

[1] W. J. Carlyle: Bull. 104.
[2] Dan T. Gray: Circ. 25.
[3] Braxton and Jones: Purdue Univ. Thesis, 1915.
[4] Average weight of four sows estimated.

TABLE XV. — SHOWING AVERAGE COST OF FEEDING SOW AND LITTER TO WEANING TIME

PRICES OF FEEDS	AVERAGE NUMBER FEED UNITS FED DAILY	AVERAGE DAILY COST FEED, SOW AND LITTER	AVERAGE COST FEEDING SOW AND LITTER OF 7–8 PIGS, 70 DAYS
1 cent per feed unit	11.32	11.32 cents	$7.92
1¼ cents per feed unit	11.32	14.15 "	9.90
1½ cents per feed unit	11.32	16.98 "	11.89
1¾ cents per feed unit	11.32	19.81 "	13.87
2 cents per feed unit	11.32	22.64 "	15.85
2½ cents per feed unit	11.32	28.30 "	19.81

With a careful selection of the feeds, it is believed that a good feeder should be able to feed the sow and litter for considerably less than here indicated. Especially should this be true when a part of the concentrated feeds are supplemented by good forage crops. Legume forage crops should cut down the cost approximately 5 per cent. No charge is here made for the normal loss of weight of the sows during this period, because no credit was taken for the gains made during the breeding and gestation periods. She should weigh about the same at this time as at the beginning of the breeding season, so that the feed account is balanced.

The cost of feeding the gilt with her first litter during the nursing period is less than that for the mature sow. Considering the smaller size and the fewer pigs to the litter in case of the gilt, a feed charge of 10 per cent less than the figures given for the mature sow should be approximately correct.

CHAPTER V

SIZE OF LITTERS; BIRTH WEIGHT OF PIGS; MILK-FLOW OF SOWS

In the following pages some figures are given showing the influence of certain factors on the size of litters, birth weight of pigs, and the milk-flow of sows. Since the usefulness and value of a sow are largely determined by her performance in these particulars, it is thought the statistics will be of interest and value.

SIZE OF LITTERS

The ability of the sow regularly to produce large litters is the most fundamental and valuable of those traits which determine her usefulness in the breeding herd. In view of this, it is of considerable importance to learn what factors are responsible for its wide variation and the extent to which these factors are under the control of the breeder or feeder. The following have each been regarded by hog-men as important: age, feeding and condition at breeding time, cross-breeding, the boar to which the sow is mated, type, breed, and individuality.

Age of sow.

It is a matter of observation that the number of pigs produced by a sow varies from year to year throughout her breeding life. Her age is usually considered the most important factor causing this variation. In Table XVI are presented the findings made by Rommel from a study of the farrowing records of 6145 sows recorded in volume 36 of the American Poland China Record.

TABLE XVI. — SIZE OF LITTERS OF SOWS OF DIFFERENT AGES

AGE OF SOWS	NUMBER OF LITTERS	AVERAGE NUMBER OF PIGS PER LITTER
1 year	2010	6.64
2 years	2047	7.56
3 "	1157	7.88
4 "	606	8.26
5 "	325	8.40

These results show that the two-year old sows, recorded in volume 36, produced larger litters than did the yearlings, and the three-year old sows larger litters than the two-year olds. There was a regular increase in the size of litters as the age of the sows increased. It is believed that these averages are based on a sufficient number of litters to make them reliable and fairly indicative of the fertility of sows of different ages. These results should not, however, be interpreted to mean that the average sow necessarily produces an increasing number of pigs to the litter up to and including her fifth year. Ordinary herd selection would mean the elimination of the low producers at an early age and the retention of the more prolific. The older sows in the average herd are, therefore, selected individuals, while the younger ones contain many whose performance records will not entitle them later to permanent places in the breeding herd.

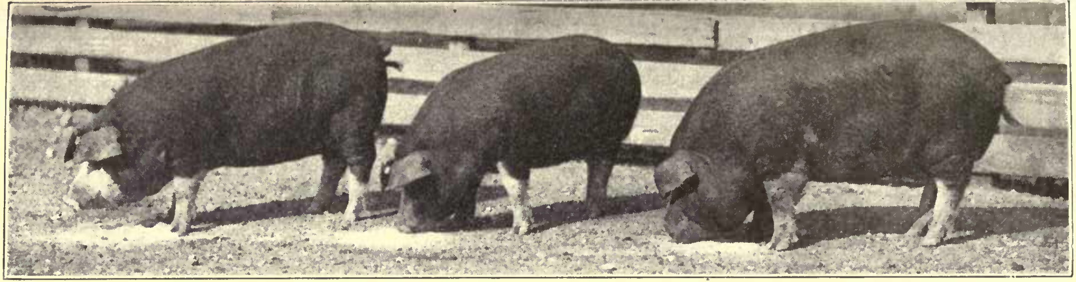
With the purpose of securing information on how age affects the fertility of the individual sow, the breeding records of ten colleges and experiment station herds were studied.[1] These records are of 1152 litters and 10,555 pigs. The tabulated data are shown in Table XVII.

TABLE XVII. — NUMBER OF PIGS AT BIRTH IN SUCCESSIVE LITTERS OF INDIVIDUAL SOWS

Number of Sows	Number of Litter	Average Number Pigs per Litter	Average Increase in Pigs per Litter
244	First litter	7.778	
244	Second "	8.922	+1.144
243	" "	8.991	
243	Third "	9.275	+0.284
176	" "	9.630	
176	Fourth "	9.857	+0.227
113	" "	10.460	
113	Fifth "	10.221	−0.239
71	" "	10.478	
71	Sixth "	10.521	+0.043
31	" "	10.870	
31	Seventh "	9.709	−1.161
18	" "	9.388	
18	Eighth "	10.111	+0.723
7	" "	11.000	
7	Ninth "	9.428	−1.572
5	" "	9.200	
5	Tenth "	8.000	−1.200

As shown in the above table, 244 sows produced in their first litters an average of 7.778 pigs. These same 244 sows in their second litters produced an average of 8.922 pigs, or 1 444 in excess of their first litters. Of these 244 sows, 243 produced their third litters, the

[1] South Dakota, Wisconsin, Michigan, Illinois, Cornell, Missouri, Nebraska, Kansas, Ohio, Purdue.



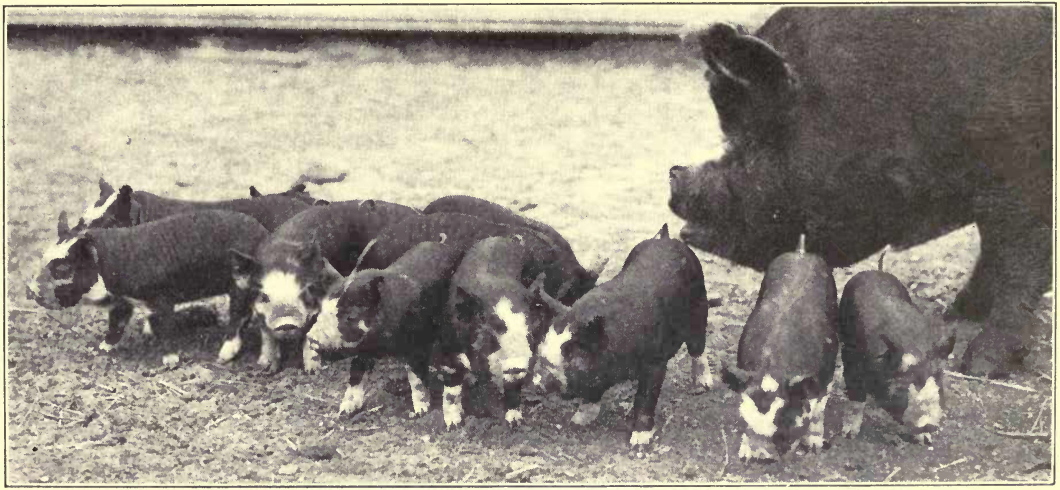


Plate III. — *Above*, Three gilts, litter mates; weights at six months — 170, 185, and 250 pounds.
Below, The evidence of good management and the promise of profits.

average size of which was 0.284 pig larger than their second litters. Of these 243 sows, 176 produced their fourth litters, the average for which was 0.227 pig larger than their third litters. In the same way, it is determined that the fifth litters were 0.239 pig smaller than the fourth, while the sixth slightly exceeded the fifth litters. The seventh litters were very much smaller than the sixth,

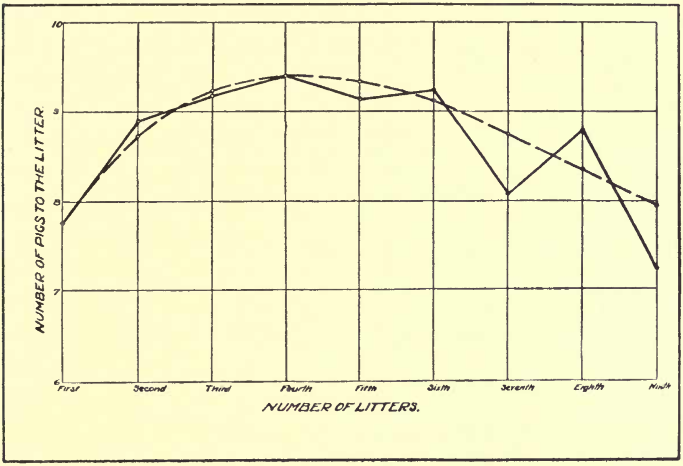


FIG. 8.—Showing variations in the number of pigs in successive litters.

while of the 18 sows producing eight litters, the eight slightly exceeded the seventh. Only 7 of these sows produced their ninth litters, and only 5 their tenth, but with these litters, there was a decided decrease in their size.

These results, expressed graphically in Fig. 8, will show more clearly the fluctuations which may be expected in the size of the successive litters of any individual sow.

According to this curve, a sow may be expected to produce an increasing number of pigs up to and including her fourth litter. From the fourth litter on, she may be expected to produce a decreasing number with each succeeding litter. The number of sows with records here of seven, eight, nine, or ten litters is too small, however, to make the averages for these litters reliable. The extreme fluctuations shown in the latter part of the curve would be made to disappear if a larger number of records of these litters was available. As a result of this limitation of numbers, the dotted line is the more reliable indication of the average performance.

No attempt was made in this study to allow for a sow producing two litters a year. It is believed, however, that she will as closely approximate the curve shown, as she would if producing but one. The large increase of the second litter over the first was probably due to the fact that few of the young sows produced their second litters without a rest of six months. The average size of all the litters here reported was slightly over nine pigs, which is probably above the record of the average herd. This, however, would not tend in any way to change the general direction of the above curve.

Feeding and condition of the sow.

That the way a sow is fed the week or two before breeding exerts an important influence on the number of eggs secreted when she comes in heat and the consequent size of the resulting litter is strongly supported by the observations of the best hog-men. It is not so much the direct effect of the feeding alone which is believed to produce this result, as it is the state of health and breeding thrift brought about by the proper combination of judicious feeding and liberal exercise. Thin active sows, when fed liberal rations before breeding, respond to the stimulating effects of the gaining condition by the secretion of a maximum number of eggs. (See page 11.)

That a low degree of fertility, or even complete sterility, may result from excessive fatness is also clearly established by experience. Sows which have been highly fitted for show, especially if maintained in this extreme condition for a considerable length of time, require skillful handling before regular breeding habits can be established. Excessive quantities of fat about the generative organs would seem to offer a mechanical obstacle to the normal nutrition of the egg-secreting ovaries, and to the free passage of the eggs after secretion down the Fallopian tubes to the uterus. When to excessive fatness is added the evil of close confinement, the breeding qualities are very likely to suffer permanent injury.

Cross-breeding.

Some hog-men claim that cross-bred litters are, on the average, larger than pure-bred ones. In the table on the following page are submitted figures which, although limited in number, will throw some light on this question. Ten pure-bred sows, nine Berkshires and one Poland China, produced a total of 36 litters, 11 of which were cross-bred and 25 pure-bred. Each sow produced both cross-bred and pure-bred litters.

Considering that only one of the 11 cross-bred litters was produced by a gilt, or sow with her first litter, while 8 of the 25 pure-bred litters were so produced, the results do not show any advantage in size for the cross-bred over the pure-bred litters. Stated in another way, 73 per cent of the cross-bred litters were produced by mature sows, while only 36 per cent of the pure-bred litters were produced by mature sows. Making allowance for the factor of age, therefore, it would seem that the difference of less than one pig is too small to justify the conclusion that cross-bred litters are larger than pure-bred ones.

TABLE XVIII. — EFFECT OF CROSS-BREEDING ON SIZE OF LITTERS

Sows	Cross-bred Litters		Pure-bred Litters	
	Number of Litters	Total Number Pigs	Number of Litters	Total Number Pigs
#1	1 (2d litter)	12	1 (1st litter)	7
#2	1 (1st ")	8	1 (2d ")	10
#3	1 (2d ")	4	3 (1st, 3d, and 4th litters)	14
#4	1 (3d ")	6	2 (1st and 2d litters)	20
#5	1 (7th ")	11	6 (1st, 2d, 3d, 4th, 5th and 6th litters)	62
#6	2 (3d and 4th litters)	20	2 (1st and 2d litters)	18
#7	1 (3d litter)	12	2 (1st and 2d litters)	11
#8	1 (5th ")	9	3 (2d, 3d and 4th litters)	20
#9	1 (4th ")	9	3 (1st, 2d and 3d litters)	23
#10	1 (3rd ")	5	2 (1st and 2d litters)	13
Averages	11 Cross-bred litters	8.72	25 Pure-bred litters	7.92

Influence of the boar.

That the boar to which the sow is mated exerts an influence on the size of the resulting litter is believed by most hog-men, and experience supplies many instances which seem to prove this claim. On the other hand, the known facts relating to the reproductive process do not seem to supply any ground on which to base this belief; in fact, they indicate that such influence under normal conditions is an impossibility. It is known, for example, that there cannot be a larger number of pigs in the litter than there are eggs produced by the sow at breeding time; also, that in normal breeding service the boar supplies a thousand sperms and more for each egg produced by the sow. Under conditions, therefore, in which the sow and boar are both vigorous, there would seem to be no chance or possibility for the number of pigs farrowed to be in any way affected by the boar.

But the sow and boar are not always vigorous, and the facts also support the view that when this is the case the union of the sperms with the eggs may be so weak that not all of them develop completely in embryo; the result is a smaller litter. A boar that is over-used during the breeding season, or is run down and out of condition, or that is lacking in normal fertility or vigor, may produce a considerable number of sperms which, although strong enough to fertilize the eggs, lack the life to insure the full embryonic development of the pigs from these unions. There is good reason for believing, therefore, that in such instances the size of the litter may be influenced below the normal by the boar with which the sow was mated. It should be understood that in no case, however, can the boar cause the number of pigs to be increased beyond that number of eggs produced at the time the sow was mated. (See p. 17.)

Type, breed, individuality.

Although breeds of the bacon type are, as a rule, more prolific than those of the lard type, the question of breed advantage within the respective types will probably never be determined satisfactorily for the reason that the various breeds are in a state of constant change, some on the whole improving and others possibly deteriorating. A statement claiming superiority for one breed over another of the same type might be a fact at this time, but when applied to the same breeds, ten years hence, might be far from the truth. Furthermore, the task of determining from the herd-book records the pig-producing abilities of two breeds for a given time would be an exceedingly tedious and laborious undertaking. The fact that the number of pigs in the litter is not yet made a matter of permanent record by all the breed associations renders such a study impossible for several of our prominent breeds. Until such records are reported and a comprehensive study is made of them, the seeker after breed information relating to this important point will be limited in his search to the observations of himself and others, and the more or less prejudiced claims of the different breed advocates.

Of the several factors which affect the breeding qualities of a sow, individuality is one of the most important. This is determined largely by the combination of hereditary qualities represented in her breeding and make-up, and which gives distinction to each of the individuals of a herd. If one breed is superior to another, it is because this breed possesses in the aggregate a larger number of prolific individuals. The prolificacy of any herd or strain of hogs, in the same way, is not a question of breed but of individuals. Every breed possesses a sufficient number of prolific individuals to reward the breeder who will correctly value and then persistently select for this quality. If to careful selection, the breeder will add intelligent feeding and care, the breeding performance of any herd can be developed and maintained at a high standard.

The number of pigs raised.

The number of pigs farrowed is not as important as the number raised. Although the most prolific sows in the herd raise more pigs, as a rule, than do those which produce smaller litters, they do not raise as large a percentage of those farrowed. This seems to be especially true when mature sows are compared with gilts.

In the following table are summarized the records made by mature sows and gilts at the North Platte, Nebraska, Experiment Station.[1] The test included 87 litters produced by gilts and 72 litters by mature sows, in 1910, 1911, 1912, and 1913. The large number of individuals studied makes the results particularly valuable.

TABLE XIX. — PERCENTAGE OF PIGS RAISED BY MATURE SOWS AND GILTS

	NUMBER OF LITTERS	TOTAL NUMBER PIGS FARROWED	NUMBER PIGS FARROWED PER LITTER	NUMBER PIGS RAISED PER LITTER	PERCENTAGE OF FARROWED PIGS RAISED
Mature sows	72	791	10.9	6.56	60
Gilts . . .	87	714	8.2	6.25	76

[1] W. P. Snyder: Bull. 147.

As bearing on the same point, the number of pigs farrowed dead or immature in litters of different sizes is also instructive. The author is indebted to W. J. Carmichael [1] of the Illinois Experiment Station for these data which are presented in Table XX.

TABLE XX. — EFFECT OF SIZE OF LITTER ON NUMBER OF DEAD OR IMMATURE PIGS

Number Pigs per Litter	Total Number of Litters	Total Number Dead or Immature Pigs	Dead or Immature Pigs per Litter	Percentage of Dead or Immature Pigs
4	39	14	.36	8.97
5	57	23	.40	8.07
6	66	25	.38	6.31
7	84	60	.71	10.71
8	86	37	.43	5.37
9	72	63	.87	9.72
10	78	56	.72	7.17
11	53	69	1.30	11.83
12	33	42	1.27	10.61
13	25	39	1.56	11.89
14	11	37	3.36	24.02
15	5	3	.60	4.00
16	3	5	1.66	10.41

Although a larger number of dead or immature pigs is farrowed in litters containing ten or more pigs than less, it would appear that in litters smaller than ten the number of pigs farrowed dead or immature is not greatly affected. When the proportion of dead or immature pigs is considered, the table does not show any greater loss in the larger litters, up to ten, than in the smaller ones. When the number of pigs to the litter exceeds ten, however,

[1] Master thesis, Univ. of Ill., 1916.

there is a regular tendency, both absolutely and relatively, for the number farrowed dead or immature to increase with the increased size of the litter.

BIRTH WEIGHT OF PIGS

Generally speaking, the heaviest pigs in the litter are the strongest and the smallest ones the weakest. The pig that is well grown and developed at birth has an advantage over his smaller litter-mate which renders him a better prospect for economical pork production. The average weight of pigs at birth is approximately $2\frac{1}{2}$ pounds, but they may range all the way from less than $\frac{1}{2}$ pound to almost 5. A number of influences are supposed to be responsible for this wide variation. Some of these influences or factors are: sex, the age of the mother, cross-breeding, the size of the litter, vigor of the sow and boar at breeding time, and nutrition during fœtal development.

Sex.

It is generally believed that boar pigs are heavier than sow pigs. It is an accepted fact that the males of colts, lambs, and calves are heavier than the females. In Table XXI are some figures interesting in this connection. In 5287 pigs farrowed in the college herds of Illinois [1] and Purdue, there were 2376 boars and 2217 sows. The average birth weight of the boars is shown in Table XXI to be 2.58 pounds, and of the sows 2.50 pounds, a difference in favor of the boars of only $\frac{2}{25}$ of a pound.

[1] W. J. Carmichael, Master thesis: Univ. of Ill., 1916.

TABLE XXI. — EFFECT OF SEX ON BIRTH WEIGHT OF PIGS

Sex	Number of Pigs Born	Total Birth Weight of Pigs	Average Birth Weight of Pigs
		lb.	*lb.*
Boars . .	2.720	7.023	2.58
Sows . .	2.567	6.431	2.50
Both sexes	5.287	13.454	2.54

All available American statistics on the proportion of the sexes in pigs would indicate a slight preponderance of males. In Circular 112, Bureau of Animal Industry, Rommel reports the results of an extensive inquiry on this point. From eighty-two breeders in twenty-four states he obtained a record of the proportion of males to females in 1477 litters containing 13,285 pigs, which was, approximately, 201 boars to 200 sows, or 6660 boars and 6625 sows. Carmichael reports in thesis studies the proportion of 2560 boars and 2420 sows. Combining both sets of data we have:

Boars	9220
Sows	9045
Ratio	100 boars to 98 sows

Age of sow.

The pigs produced by young sows or gilts in their first litters are supposed to be smaller than those borne by mature sows in their prime, when under the same conditions as to feeding and care. In the following table some figures with reference to this point are shown. The record is here given of the birth weight of pigs farrowed by young sows twelve to eighteen months of age, and the birth weight of all pigs farrowed by mature sows. The figures in the first part of the table are from the records of the Purdue University herd, while those in the last are from records kept at the North Platte, Nebraska, substation.[1]

TABLE XXII. — EFFECT OF MATURITY OF SOW ON BIRTH WEIGHT OF PIGS

LITTERS	NUMBER OF LITTERS	TOTAL BIRTH WEIGHT ALL LITTERS	AVERAGE BIRTH WEIGHT EACH LITTER	AVERAGE BIRTH WEIGHT EACH PIG
		lb.	*lb.*	*lb.*
Young sows, 1st litters	15	256.25	17.08	2.67
Mature sows	13	354.25	24.25	2.61
Gilts, 1st litters . .	87	1649.34	18.95	2.31
Mature sows	72	1898.40	26.36	2.40
AVERAGE OF ALL				
Young sows, 1st litters	102	1905.59	18.68	2.36
Mature sows	85	2252.25	26.49	2.43

The effect of the age of the sow on the birth weight of the individual pigs farrowed is shown in another way in Table XXIII. The data are the result of studies by W. J. Carmichael.[2]

It would appear from both tables that there is a tendency for the mature sows to produce slightly heavier pigs individually than the gilts. The difference, however, is very small and does not mean that the pigs from gilts are materially handicapped in their start in life.

[1] W. P. Snyder: Bull. 147.
[2] Master thesis: Univ. of Ill., 1916.

TABLE XXIII. — EFFECT OF AGE OF SOW ON BIRTH WEIGHT OF PIGS

AGE OF SOW; YEARS	TOTAL NUMBER OF PIGS	AVERAGE BIRTH WEIGHT, PIGS
1	922	2.44 lb.
1½	826	2.48 "
2	899	2.56 "
2½	570	2.54 "
3	455	2.59 "
3½	299	2.66 "
4	293	2.56 "
4½	166	2.70 "
5	92	2.87 "

Cross-breeding.

As shown in Table XXIV, cross-bred pigs appear to have a heavier birth weight than do pure-breds. In this table the average birth weight of pure-bred pigs is compared with that for cross-bred pigs produced by the same sows. Although a larger proportion of the cross-bred pigs were produced by mature sows, the difference shown is suggestive. The method of feeding the sows during pregnancy was the same throughout the years in which the records were taken. (See Chapter III, page 42.)

TABLE XXIV. — EFFECT OF CROSSING ON BIRTH WEIGHT OF PIGS

	TOTAL NUMBER OF LITTERS	TOTAL BIRTH WEIGHT OF LITTERS	AVERAGE BIRTH WEIGHT OF PIGS
		lb.	*lb.*
Pure-bred pigs .	27	66.40	2.45
Cross-bred pigs	13	34.13	2.62
All pigs . . .	40	100.53	2.51

Size of litter.

In Table XXV are figures collected by W. J. Carmichael [1] on the relation of the size of the litter to the birth weight of the individual pigs. The large number of pigs involved in this study makes the data here presented especially valuable.

Table XXV. — Effect of Size of Litter on Birth Weight of Pigs

Number of Pigs per Litter	Total Number of Pigs	Average Birth Weight, Each Pig
4	134	2.78 lb.
5	249	2.78 "
6	353	2.60 "
7	495	2.65 "
8	568	2.60 "
9	579	2.45 "
10	690	2.42 "
11	533	2.45 "
12	365	2.43 "
13	225	2.44 "

According to these figures, as the number of pigs in the litter increased, the size of the individuals quite regularly decreased.

Vigor of sow and boar at breeding time.

That there is a causal relation between the vigor of the parents at breeding time and the vigor and development of their offspring is attested by the observation of stockmen and the results of laboratory experiments. Animals which are in a state of vigorous health at breeding time

[1] Master thesis: Univ. of Ill., 1916.

produce germ-cells endowed with the maximum of vigor or growth energy; while those in a run-down, weakened, or unthrifty condition produce germ-cells which lack the life necessary for the conception of vigorous young.

Sows bred immediately after weaning large litters of pigs, when "pulled down" and weakened in condition, before they have had the opportunity to recuperate, produce not only small litters but also pigs which individually are lacking in strength and development. For the same reason, sows in a state of extreme fatness at breeding time, especially if closely confined, do not produce, as a rule, strong pigs. Each pig is the product of two germ-cells, one produced by the sow and one by the boar. If the breeding condition of the boar is at low ebb at this time, as the result of insufficient or excessive feed, lack of exercise, over-use, or disease, his germ-cells, like those of the sow, will lack the life necessary to insure vigorous pigs. It is reasonable to conclude that one of the causes responsible for small weak pigs is the practice of breeding the sows when they and the boar are not in vigorous breeding condition. These observations emphasize the need of more careful attention to feeding and exercise prior to and during the breeding season.

Nutrition.

Probably the fundamental factor determining the size and development of pigs at birth is the completeness of their nourishment during embryonic development. Both the amount and kind of feed are important in determining the supply of this nourishment. When the ration is deficient in lime and protein, as is not uncommon in the corn-belt, the result is a weak and imperfect development of the pigs. In the same way, a balanced ration may be fed in such stingy portions that the pigs are not fully developed.

The effect of a diet of straight corn, in comparison with a balanced ration, on the birth weight of pigs is strikingly shown in experiments conducted at the Iowa Experiment Station, the results of which have already been noted in Chapter III, page 42. Yearling sows fed corn alone during the winter produced pigs averaging 1.85 pounds at birth, while another similar lot fed a ration of corn and meat-meal, containing sufficient lime and protein, produced pigs which weighed, on the average, 2.42 pounds. The average birth weight of pigs from gilts fed corn alone at the same station was 1.74 pounds, while pigs from another lot of gilts in the same experiment fed corn and alfalfa hay weighed, on an average, 2.29 pounds. Inadequate fœtal nourishment is, no doubt, the fundamental cause of the runt pig.

The pigs in abnormally large litters are ordinarily not so well developed as are those in normal-sized litters. (See Table XXV.) This, it seems reasonable to suppose, is due to the inability of the fœtal membranes to accommodate and properly nourish the extra number. As a rule, sows which bring forth two litters a year, also, do not produce as large pigs as they do when farrowing after a six-months rest which is probably the result of deficient nourishment.

MILK PRODUCTION OF SOWS

The amount of milk which a sow gives determines her ability to raise a large litter of pigs, and is, therefore, of first importance in determining her real value as a breeder. In every herd a few sows are always better milkers than the average, as evidenced by the weight and thrift of their litters at weaning time. The heavy milking sows are, also, the ones which lose the most weight in suckling their pigs.

TABLE XXVI. — MILK PRODUCTION OF BROOD SOWS

Sows	Age Years	Number of Pigs Farrowed	Weight of Litters at Birth	Average Daily Milk Production
Berkshire . .	2	10	28 lb.	7.30 lb.
Berkshire . .	1	5	16 "	4.18 "
Berkshire . .	4	10	22 "	7.96 "
¾ Berkshire . ¼ Razorback .	1	6	15 "	5.81 "
Poland China	2	7	20 "	5.38 "
¾ Poland China ¼ Razorback .	2	6	12 "	3.39 "
½ Poland China ½ Razorback .	2	9	27 "	6.65 "
Poland China .	5	8	30 "	4.00 "
Razorback . .	2	8	17 "	7.18 "
Razorback . .	1	6	13 "	5.38 "
Razorback . .	1	6	13 "	3.65 "
Razorback . .	3	5	14 "	4.45 "
Duroc Jersey .	3	12	35 "	7.33 "
Duroc Jersey .	3	13	26 "	6.02 "
Duroc Jersey .	3	13	28 "	4.18 "
Berkshire . .	5	10	25 "	5.70 "
Average . .		8.37	21 "	5.53 "

Carlyle[1] at the Wisconsin Experiment Station determined the milk production of twelve sows by keeping the litters and sows separate and weighing the pigs immediately before and after nursing. The milk-flow of the individual sows represented in this test is shown in the first part of Table XXVI. The records of pro-

[1] Wis. Exp. Sta. Bull. 104.

duction of the last four sows listed were determined by Braxton and Jones,[1] under the direction of the author, with sows in the Purdue University herd.

There is, apparently, as much individual variation in milk-producing capacity in a herd of brood sows as there is among the untested cows of an ordinary dairy herd. The variation shown above ranges all the way from a minimum of 3.39 pounds daily to a maximum of nearly 8 pounds. The average daily production of the sixteen sows tested was 5.53 pounds, which, for a ten-weeks suckling period, would mean an average production of 387 pounds of milk during the lactation period.

It is interesting to note, in the preceding table, that the sows which produced the most milk farrowed the largest litters. That a high degree of correlation should exist between two such intimately associated functions is natural. Fertility and milk-producing capacity are in reality expressions of a common function. To improve the milking qualities of a herd, therefore, the prolific sows should be retained. That there is sufficient opportunity for selection in any herd is indicated by the wide variations in the individual records shown in the preceding table.

The amount of milk which a sow gives is also largely conditioned on her feeding during the suckling period. In order to secrete a large amount of milk, she must have the raw materials from which to manufacture it. The ration, therefore, that is rich in milk-producing properties and that is fed in liberal amounts is the one which will stimulate and make possible the largest production which each sow, according to her individuality and breeding, is capable of.

[1] Purdue Univ. thesis, 1915.

The average composition of sow's milk as compared with cow's milk is shown in the following table:

TABLE XXVII. — THE COMPOSITION OF SOW'S MILK COMPARED WITH COW'S MILK[1]

	Total Solids	Fat	Casein and Albumin	Milk Sugar	Ash
	Per Cent	*Per Cent*	*Per Cent*	*Per Cent*	*Per Cent*
Sow's milk . .	19.00	6.70	5.90	5.40	1.00
Cow's milk. .	13.60	4.40	3.50	5.00	.70
Difference . .	5.40	2.30	2.40	.40	.30

Sow's milk is shown to be richer in all constituents than cow's milk, particularly in casein and albumin (protein), and ash. The fact that sow's milk contains less water and more protein and ash, largely explains why pigs make larger and more economical gains to a unit of milk and weight than do calves.

[1] Henry and Morrison: "Feeds and Feeding."

CHAPTER VI

THE SUMMER FEEDING AND MANAGEMENT OF THE BREEDING HERD

As a rule, the breeding herd during the summer is under more favorable conditions for the maintenance of health and breeding thrift than in the winter. With most of the farm fenced hog-tight, an adequate range, plenty of green succulent forage, shade and good water, the problems of feeding and management are practically solved. The cost of feeding and the work of handling are, furthermore, reduced to the minimum when natural rather than artificial conditions prevail.

FEEDING AND MANAGEMENT OF THE PREGNANT SOWS

Number of litters in a year.

The question of whether two crops of pigs shall be produced on the farm each year is one which involves the ability of the sow on the one hand, and the availability of the proper equipment on the other. As a general rule, the mature sow is capable of raising two litters each year. To do this regularly and farrow in season for a number of successive years, however, requires fertile and reliable breeding qualities, and also good feeding and careful management. Allowing 226 days for two gestation periods and 112 days for the time between farrowing and weaning the pigs, 27 days are left in a year of 365 days, which will give sufficient leeway to permit the sow to come in heat and be bred. If for some reason, as a weakened condition resulting from improper feeding or a lack of natural fertility, she fails to come in heat promptly or does not conceive with the first service, the chances are that she will farrow late. If she falls behind in her breeding schedule, it will be necessary to allow her to skip a period in order to prevent the pigs coming out of season.

A certain proportion of the sows in the herd can usually be depended on for two litters each year. When fall pigs are raised, the practice may be to produce a limited number. Approximately 75 per cent of the pigs raised in the corn-belt are spring farrowed. The plan of having each sow produce three litters every two years is a good one. Gilts which farrowed their first litters when from twelve to fourteen months of age should not produce their second until they are two years old. This is necessary to insure their own development, on which depends their future usefulness as breeders.

Those who raise two litters a year claim that it is faulty management to allow a mature sow to remain idle one-half of the year; that the yearly cost of feeding the sow is so great that one cannot afford to board her for six months without some return. This is an important point and in line with the growing tendency to look on the brood sow as a producer whose business it should be to work twelve months of the year instead of but six.

Success in raising fall pigs will depend largely on the equipment for properly handling them and the disposition to give them the best of care. Warm quarters are a necessity in most of the pork-producing areas if pigs are to make satisfactory growth during the winter. Fall pigs should be farrowed early so that they may make a good start in their growth before cold weather sets in. In the latitude of the central corn-belt, they should come the latter part of August or early in September. With warm quarters, a clean place to sleep, and good feed, fall pigs will do nearly as well as spring ones. Such pigs should have the growth by spring which will enable them to make excellent use of forage crops and be finished in the early or late summer, depending on the method of feeding employed and their development.

However, with the best of conditions, it is not easy successfully to raise and bring through the winter a crop of fall pigs. As a rule, they do not compare favorably at the same age with pigs farrowed in the spring. Furthermore, it is a matter of general observation that a sow does not have as many nor as strong pigs as she does when bred but once a year. Nevertheless, with proper equipment and good care, these objections are more than balanced by the smaller number of sows which it is necessary to keep in order to produce the required number of pigs for the farm.

Feeding and management.

After the sows are dried off, no time should be lost in preparing them for breeding. The early fall pig is usually a safer investment than the late one. In most sections it is desirable, as a rule, to begin breeding about May first, which will bring the first pigs the last week in August. The importance of flushing, or feeding the sows so as to cause them to gain, has already been discussed in Chapter II. The best method of feeding in the spring is the one which depends largely on legume or other good forage crops, and which supplies just enough grain in addition to secure a gain of about one pound a day for each sow until bred.

After the sows are safely in pig, they should be kept during the summer in the condition of flesh that will insure, with exercise, strong pigs and a good milk-flow after farrowing. The principles discussed in Chapter III should be followed during the summer. The sows should be permitted to gain as much as they lose in farrowing and the succeeding suckling period. This will be an average of 75 or 80 pounds for mature sows. Yearling sows should ordinarily gain more than this. During the first ten weeks of gestation, there should be a sufficient supply of good grass or forage crops to make any grain feeding unnecessary. They may, therefore, occupy during this time the same pasture and quarters as the sows which are not bred. If it is possible to maintain them on green crops alone, and it should be, it will not only mean greater economy in their feeding, but more exercise and more healthful surroundings. The beneficial effects of such conditions will be reflected later in ease of pigging, strong pigs, and a state of health that will support a good milk-flow.

Sows which raise two litters a year, however, should not be allowed to become too thin during the summer. It is important that they make the required gain in flesh, most of which should be put on in the last half of the summer. Beginning at this time and continuing until they farrow, the bred sows will ordinarily need some grain or other concentrated feeds. With legume forage crops, these should be largely home-grown. With ordinary pastures, a small amount of some protein feed like tankage, linseed-oil meal, shorts or middlings should be fed with the corn or other grains in approximately the same proportions as recommended for winter feeding on page 56. The amount of grain to feed, or the necessity of feeding grain at all, will depend entirely on conditions, and will be shown by the condition of flesh the sows are in. The judgment of the feeder, consequently, must always be relied on to determine how much to feed at any time.

Plenty of range and green feed will solve the problem of supplying exercise for the bred sows. In the absence of natural shade, which is most to be desired, artificial shades should be provided. These should be so constructed and located as to receive the greatest benefit from the breezes. In extremely hot weather, an artificial wallow or bath located in the shade will be of value in helping to keep down the temperature of the sows. If properly taken care of, kept clean, and coal-tar dip or crude oil occasionally applied, it is of value. If allowed to become filthy, it may easily become more harmful than beneficial. The sleeping quarters or shade should be kept as free from dust as possible by occasional cleaning and sprinkling with crude oil.

Sows which farrow in the fall should be given the same careful attention as regards feeding and handling during the farrowing season as that recommended for the sows which farrow in the spring. (See page 69.) The fall litters should be given every possible consideration, for a good start before cold weather begins is especially desirable. During the winter, the pigs should have the warmest quarters available, and they should never be fed less than the amount necessary to keep them in a thrifty growing condition. It is imperative, also, that their beds be kept clean and dry and opportunity for some exercise provided.

FEEDING AND MANAGEMENT OF THE OPEN SOWS

Fattening the culls.

The sows which have lost their places in the breeding herd should ordinarily be fattened before they are sent to market. Thirty days of intensive feeding will enable them to sell at sufficient advance over the average "grass-widow" to more than pay the costs. In this time a mature vigorous sow should make a gain of 60 to 90 pounds. According to the observation of men who are daily on the market, this gain will, under normal conditions, enhance the selling value of the sow by 25 cents a hundred, on the average. This gain should not cost to exceed $5\frac{1}{2}$ pounds of grain for each pound of gain, which, with the usual prices, would insure a good profit from fattening.

Sows which are to be fattened should have, if possible, access to a patch of rape or some legume forage crop to supplement their grain. Without a good supply of forage, a small quantity of some commercial supplement will be necessary for the best results. Some tankage, or linseed-oil meal, or shorts, will not only insure greater palatability for the ration and faster gains, but also cheaper gains. Fifteen parts of corn, or other grain, to 1 part of tankage or meat-meal, or 2 parts linseed-oil meal, or 5 parts shorts or middlings, by weight, will make a balanced ration. They should be placed ordinarily on full feed as soon as dried off and continued until in good condition. Just how fat they should be made will depend on the weather, the market, and the supply of feed.

Feeding and management of the open brood sows.

Mature sows which are not bred should be handled during the summer in a way that will reduce to a minimum the cost of their keep, yet maintain them in an active healthy condition. It is possible to keep a mature open sow on little or no grain, provided good forage crops are available. Furthermore, experience has shown that the most economical method of handling is to provide the crops which will enable them to get most of their living from this source. These crops should be grown in sufficient abundance so that the sows, as well as the pigs, may have an adequate supply. A thin mature sow will maintain her weight during June and July on good bluegrass alone, and on a forage crop like clover or alfalfa or rape will make some gain. Much depends, however, on her condition and previous feeding. If the sows are restricted to over-stocked pastures, they will require some grain, especially in late July and August when the ordinary pastures often become parched and bare. When grain feeding is necessary, corn or other home-grown grain is appropriate since their need for protein is limited to the requirements of maintenance, which are small. It should never be necessary to feed the sows more grain than 1 per cent of their weight daily.

In addition to economy of feed and labor, the method of feeding recommended above has the merit of providing the conditions which promote exercise and thrift. Sows that have had plenty of range during the summer and a minimum of grain are in the best possible state of health for breeding in the fall. Such conditions also provide healthful surroundings and eliminate many of the chances of disease.

Feeding the yearling sows.

Gilts that have farrowed when twelve to fourteen months of age should not, as a rule, be bred for fall litters. They need the next six months of idleness to recuperate their lost energies and to provide the opportunity for the further development necessary to make them good representatives of their breed. These young sows should not be fattened, but fed with sufficient liberality to insure good growth. For this reason, they will need some grain during the summer. This should not be straight corn, but a ration properly supplemented with some one of the common nitrogenous or protein feeds. This will not be required in large quantity, especially if the sows have access to a good forage crop. About 10 or 12 parts of corn or other grain, to 1 part tankage or meat-meal, or 2 parts linseed-oil meal, or 4 or 5 parts shorts or middlings, or 10 to 15 parts of skim-milk or buttermilk, by weight, will supply the nutrients in the correct proportions for best results. With a good legume forage, they will require less supplement than this; in fact, they will get along very well with none.

As a rule, they should be fed considerably less than the amount they will eat. The guide should be their condition, rather than their appetites. They should be compelled to do a certain amount of rustling, for in addition to the food value of succulent feeds, they will gain much in constitution and vigor as a result of the exercise taken.

COST OF SUMMER FEEDING SOWS

Bred sows.

The feed cost of keeping a pregnant sow from the time her pigs are weaned in the spring until she farrows in the fall is perhaps subject to more fluctuation than is the cost at any other season of the year. This is due to the wide difference in the types of management employed in feeding the sows and the variation in the value and price of pasture land in the different sections of the country.

The feed costs as estimated in the following tables are confessedly approximations. The effort is to represent the cost under different conditions by making three separate sets of calculations. The ability of the sow to make the proper gain during the 126 days of the breeding and gestation periods under the different conditions shown in I, II, and III is the point in the determination about which it is impossible to obtain any very definite figures.

TABLE XXVIII. — COST OF SUMMER FEEDING MATURE BRED SOWS TO TIME OF FARROWING

METHOD OF MANAGEMENT	TOTAL PASTURE OR FORAGE CHARGE 126 DAYS	TOTAL CONCENTRATES FED 126 DAYS	TOTAL COST OF CONCENTRATES	TOTAL FEED COST 126 DAYS
I Poor pasture, no special forage crops or legumes	$.60	1 per cent weight daily (350# sow) 441 lb.	at 1 ¢ per lb. —[1] $ 4.41 at 1¼¢ per lb. — $ 5.52 at 1½¢ per lb. — $ 6.61 at 1¾¢ per lb. — $ 7.72 at 2 ¢ per lb. — $ 8.82 at 2½¢ per lb. — $11.02	$ 5.01 $ 6.12 $ 7.21 $ 8.32 $ 9.42 $11.62
II Fair pasture, no special forage crops or legumes	at 30¢ per month $1.26	¾ per cent weight daily (350# sow) 331 lb.	at 1 ¢ per lb. — $ 3.31 at 1¼¢ per lb. — $ 4.14 at 1½¢ per lb. — $ 4.96 at 1¾¢ per lb. — $ 5.79 at 2 ¢ per lb. — $ 6.62 at 2½¢ per lb. — $ 8.27	$ 4.57 $ 5.40 $ 6.22 $ 7.05 $ 7.88 $ 9.53
III Specially grown forage crops or legumes	at $12.00[2] per acre 4 sows per acre $3.00	½ per cent weight daily (360# sow) last 6 weeks only 76 lb.	at 1 ¢ per lb. — $ .76 at 1¼¢ per lb. — $ .95 at 1½¢ per lb. — $ 1.14 at 1¾¢ per lb. — $ 1.33 at 2 ¢ per lb. — $ 1.52 at 2½¢ per lb. — $ 1.90	$ 3.76 $ 3.95 $ 4.14 $ 4.33 $ 4.52 $ 4.90

[1] 1 cent, 1¼ cents, 1½ cents, 1¾ cents, 2 cents, and 2½ cents a pound are equivalent, respectively, to 56 cents, 70 cents, 84 cents, 98 cents, $1.12, and $1.40 a bushel for corn.

[2] This represents cost of crops, including rent.

The figures are based largely on experience in handling sows under these conditions. One pound of concentrated feed used in these calculations is equivalent to 1 feed unit. (See page 61.)

TABLE XXIX. — COST OF MAINTAINING MATURE OPEN SOW 6 MONTHS DURING SUMMER

METHOD OF MANAGEMENT	TOTAL PASTURE OR FORAGE CROP CHARGE 180 DAYS	TOTAL CONCENTRATES FED	TOTAL COST OF CONCENTRATES	TOTAL FEED COST 180 DAYS
I Poor pasture, no special forage crops or legumes	at 15¢ per month $.90	$\frac{1}{2}$ per cent weight daily (325# sow) 180 days 292 lb.	at 1 ¢ per lb. — $2.92 at $1\frac{1}{4}$¢ per lb. — $3.65 at $1\frac{1}{2}$¢ per lb. — $4.38 at $1\frac{3}{4}$¢ per lb. — $5.11 at 2 ¢ per lb. — $5.84 at $2\frac{1}{2}$¢ per lb. — $7.30	$3.82 $4.55 $5.28 $6.01 $6.74 $8.20
II Fair pasture, no special forage crops or legumes	at 25¢ per month $1.50	$\frac{3}{8}$ per cent weight daily (325# sow) 180 days 220 lb.	at 1 ¢ per lb. — $2.20 at $1\frac{1}{4}$¢ per lb. — $2.75 at $1\frac{1}{2}$¢ per lb. — $3.30 at $1\frac{3}{4}$¢ per lb. — $3.85 at 2 ¢ per lb. — $4.40 at $2\frac{1}{2}$¢ per lb. — $5.50	$3.70 $4.25 $4.80 $5.35 $5.90 $7.00
III Specially grown forage crops or legumes	at $12.00 per acre; 4 sows to the acre $3.00	$\frac{1}{4}$ per cent weight daily (325# sow) 60 days 49 lb.	at 1 ¢ per lb. — $0.49 at $1\frac{1}{4}$¢ per lb. — $ .61 at $1\frac{1}{2}$¢ per lb. — $ .74 at $1\frac{3}{4}$¢ per lb. — $ .86 at 2 ¢ per lb. — $ .98 at $2\frac{1}{2}$¢ per lb. — $1.23	$3.49 $3.61 $3.74 $3.86 $3.98 $4.23

Open mature sows.

The cost of maintaining an open mature sow during the six months following the time her spring litter is weaned will depend chiefly on the charges made for pasture and forage crops. It is believed that the figures shown in Table XXIX are a fair approximation of the average costs under different conditions. The figures are for sows averaging 325 pounds, which are maintained at a constant weight for six months during the summer, or until the beginning of the fall breeding season.

Open yearling sows.

If the gilts weigh about 250 pounds on the average when they wean their litters in the spring, they should be able to make a gain of 75 pounds during the succeeding six months without becoming too fleshy. To make 375- to 400-pound sows in medium condition, they should gain this much. The cost of this increase, with their maintenance, will depend on the factors already discussed. With fairly good pasture, no more than four pounds of grain should be required to produce one pound of gain. With these conditions, the cost will be as shown in Table XXX. With legume forage crops, instead of only fair pasture, the cost should be about 10 per cent less than the figures given.

TABLE XXX. — COST OF FEEDING OPEN YEARLING SOW 6 MONTHS DURING SUMMER

METHOD OF MANAGEMENT	TOTAL PASTURE OR FORAGE CHARGE 180 DAYS	CONCENTRATES TO PRODUCE GAIN 75 LB.	COST OF CONCENTRATES	TOTAL FEED COST 180 DAYS
Fair pasture, no special forage crops or legumes	$1.50	300 lb.	at 1 ¢ per lb. — $3.00	$4.50
			at $1\frac{1}{4}$¢ per lb. — $3.75	$5.25
			at $1\frac{1}{2}$¢ per lb. — $4.50	$6.00
			at $1\frac{3}{4}$¢ per lb. — $5.25	$6.75
			at 2 ¢ per lb. — $6.00	$7.50
			at $2\frac{1}{2}$¢ per lb. — $7.50	$9.00

CHAPTER VII

FEEDING AND CARE OF GROWING AND FATTENING PIGS

With the pigs weaned, the problem of the feeder is to mature the crop as economically as possible under his conditions without sacrificing the weight and finish required of those which go to market or the growthiness and thrift desirable in those intended for the breeding herd.

THE WEIGHT AND TYPE OF PIG DESIRED BY THE MARKET

In the corn-belt, no single type or weight of pig sells at the top of the market in all seasons of the year. As a general rule, the market pays a premium for the weights which are most scarce. As a consequence, in the late summer and early fall when weights are the heaviest, light hogs command a premium; while in the middle of the winter and early spring when light weights predominate, the heavier hogs sell at a slight advance. (See Chapter XVI, page 387.) In recent years the tendency has been for both producer and consumer to favor the lighter weights. The farmer with higher priced land, feed, and labor has found the method of more intensive feeding and earlier marketing profitable. Likewise, changing demands during this time have been toward the lighter handier-weight cuts. This has been due to the changing tastes and requirements of the consumer, and to the improvements in methods of curing, refrigeration, and transportation of pork products.

The weight and type of hog in greatest demand by the market is not necessarily the best for the farmer to produce in a given season. When corn is cheap and hogs relatively high, it is profitable to sacrifice some on selling price a pound for heavier weights. On the other hand, when feed is high and hogs cheap, the feeder is disposed to market early and at immature weights. In general, however, the requirements of the packer and shipper coincide fairly well with the type and weight of hog which the farmers of the corn-belt find most profitable to produce. This is a hog weighing from 200 to 275 pounds and of the general lard type, what the packer calls a medium weight butcher hog. Ordinarily, it is advisable to market at a weight somewhere between these limits.

Canadian farmers cannot afford to compete with those of the corn-belt by producing the fat-back lard hog. Both their feed supply and packing interests favor the production of the type of hog that will meet the requirements of curers of the best British bacon. This means a hog of strictly bacon type, full of lean meat, and capable of producing the "Wiltshire side." (See page 401.) Pigs of this type, sometimes called "singers" on the Chicago market, weighing from 160 to 220 pounds and finished so that the layer of fat on the back and loin is no more than $1\frac{1}{4}$ to $1\frac{1}{2}$ inches in thickness, is the kind which experience has shown the great bulk of northern farmers should seek to place on the market.[1] These requirements of weight and quality are standard, and practically constant from year to year and from season to season. The price received for the finished pigs is

[1] Bull. 10, Dept. of Agr., Dominion of Canada.

more a question of the quality of bacon which they will produce than the result of any seasonal fluctuation in the number supplied.

GENERAL SYSTEMS OF HANDLING AND FEEDING

One system of feeding the spring pigs intended for market is to grow them rather slowly during the summer by the maximum use of forage crops and a minimum of grain, finishing them late the following winter or spring. Another practice of handling is that of feeding practically full rations from start to finish and having them ready for market by fall or early winter. The bulk of the hogs sold at the great central markets is produced by systems between these two extremes.

The most profitable system to follow as a policy on any particular farm must be determined by the conditions. There are many types of farming where hogs are produced, and the method of feeding should be in harmony with the plan of management of the farm, in accord with the purpose for which the hogs are produced. On many farms hogs are raised for home consumption only, in which case the problem is to have the pigs at the condition and weight when it is most appropriate and convenient for farm butchering. The most economical method of procedure under these conditions, no doubt, is to depend chiefly on forage crops, kitchen and farm wastes, reducing largely the use of grain until the last month or six weeks of feeding.

On other farms, pigs are produced mainly for the purpose of following cattle during the winter, to save the wastes of the feed yard by converting them into pork. For this use the pigs should be vigorous and growthy, and inclined more to thinness than to fatness. The amount of grain necessary to feed during the summer to produce an active, strong-boned pig which will weigh in November from 100 to 150 pounds will depend on the time of farrowing and the quality and abundance of the green feed available. With good forage crops and early farrowing, no more than half a ration, or 2 per cent of their weight daily, should be sufficient to produce this weight with pigs of the right type. With April and May pigs and no special forage crops, heavier grain feeding would be necessary. Under such conditions, it is difficult to have the pigs at satisfactory weights without making them too fat for good cattle hogs.

When hogs are produced in relatively large numbers and are the principal live-stock product of the farm, the question of intensity of feeding during the summer should be determined for any year by the availability of forage crops, the price of feed, and market conditions. Intensive feeding and early marketing in the corn-belt necessitate early farrowing and a large use of old corn. The higher cost of feed and the special attention required by early pigs at farrowing time, however, are believed by many to be more than compensated for by the better market and the shorter period of dry lot feeding necessary. (See Chapter XVI, page 387.) On the other hand, the system of feeding which finishes the pigs in the middle or late winter does not require so large a use of old corn, may rely more largely on forage crops for the summer gains, and postpones any heavy feeding until the new crop is available. As indicated by present practices in the corn-belt, the general farmer believes this system to be one well adapted to his conditions. With the increase in the practice of hogging-down corn and the need of hogs on most farms to follow cattle, the present systems of feeding and handling will probably change but little.

FOOD DEMANDS OF THE GROWING AND FATTENING PIG

The successful growing and fattening of pigs require that they be supplied with those feeds which will meet their body needs. Two general classes of feeds are required in the proper development of every young animal: first, those which produce fat and heat; and second, those which supply bone and muscle. The first is commonly called carbohydrate or fat-producing feeds, and the latter, protein or growing feeds. For the most vigorous and economical development, these constituents must be fed in the proportions which will satisfy without waste the demands of the pig for growth as well as fat production; *i.e.*, the ration must be balanced. These demands vary with the age and development of the pig. The weanling pig weighing 35 pounds requires a considerably larger proportion of growing elements than does the mature hog when being fattened. In the development of the pig from weaning to the market weight of 250 pounds, therefore, the requirements for bone and muscle-building feeds decrease very regularly, while the need and capacity for using the heat and fat-producing feeds progressively increase.

When feeds are high priced, as is now the rule, it is not possible to grow pigs successfully and with profit if attention is not given to feeding rations which are balanced. The importance of this has been repeatedly emphasized by the experiences of practice and the results of carefully conducted feeding tests at the experiment stations.

CORN AS A PIG FEED

The American farmer has no cereal equal to corn for fattening live-stock. Its unusual palatability, its concentration and richness in fat-producing qualities, its mildly laxative effects, its keeping qualities and physical texture, make it a feed unequaled for fat production. The fact that 65 per cent of the pork produced in the United States is grown in the corn-belt is largely due to the feeding qualities of this grain. The greatness of corn as a crop in this region is in part due to its extensive use in pork production. Probably no animal on the farm is capable of using so large a proportion of corn in his diet as the lard hog.

The faults of corn as a pig feed are that it lacks in protein and mineral matter (ash), which are indispensable for the growth and development of muscle and bone tissues. Corn is so over-abundantly rich in carbohydrates and deficient in protein and mineral matter that its growing properties have been sacrificed to fattening properties. Furthermore, the proteins which it does contain are inferior, for they do not supply the kinds and variety necessary to meet all the body needs. The mineral supply of corn is likewise deficient in the kind of elements supplied. Lime, or calcium, which, with phosphorus, makes up more than 80 [1] per cent of the ash of bone, is present in extremely meager amounts.

Experiments demonstrating the deficiencies of corn alone as a feed for growing and fattening pigs.

That growing and fattening pigs do not do well when restricted to a diet of straight corn is admirably demon-

[1] Jordan: "The Feeding of Animals," page 46.

strated by the results of a practical feeding test made at the Iowa Experiment Station[1] in the spring of 1906. Thirty-six shotes, averaging approximately 136 pounds, were divided equally into four lots. Lot I was fed a ration of straight corn-meal, and lots II, III, and IV rations containing corn-meal and different proportions of meat-meal. The results from the lot fed corn alone and that fed ten parts of corn and one of meat-meal, by weight, are here reported.

TABLE XXXI. — CORN ALONE VERSUS CORN AND MEAT-MEAL

(Iowa Exp. Sta., Bull. No. 91)

RATIONS FED	LOT I CORN-MEAL	LOT II 10 CORN-MEAL 1 MEAT-MEAL
Average daily ration fed	6.48# corn-meal	7.61# corn-meal .76 meat-meal
Number pigs per lot	9	9
Average initial weight per pig	134.9#	137.1#
Average final weight per pig	251.2#	322.9#
Average daily gain per pig	1.163#	1.858#
Feed required to produce 100 lb. gain	556.6# corn-meal	409.9# corn-meal 40.9 meat-meal

The test began on March 13 and closed June 31, covering a period of 100 days. The pigs used were of mixed breeding, growthy, and in rather thin flesh at the beginning of the test, which accounted in part for their rapid gains. They were confined to dry yards, 40 by 80 feet, with open sheds for shelter. Every effort was made to secure uniformity in the different lots of individual pigs, in the conditions of housing, and in the methods of feeding employed. The number of pigs in each lot, the

[1] Kennedy and Robbins: Bull. 91.

length of the experiment, and the care exercised to make all conditions identical give assurance that the results fairly show the merits of the rations fed under the conditions of this experiment. The results of this test are shown in Table XXXI.

In growing and fattening pigs for market, the value of the rations fed is determined by the rapidity of the gains, the amount or cost of feed required to produce 100 pounds of gain, and the character of the finish attained by the pigs (selling price) at the end of the feeding period. This does not consider the greater fertility value of the dropping produced by pigs fed on the better rations.

There was a marked difference in the gains on the two rations. The pigs fed the balanced ration made 59.75 per cent faster gains than did those fed the unbalanced ration. While those receiving corn alone made an average gain of 116 pounds, the pigs receiving in addition to corn .76 pound of meat-meal daily, gained 185 pounds. Assuming a uniform rate of gain, the pigs fed corn and meat-meal were as heavy at the end of 62 days' feeding as were those fed corn alone at the end of 100 days' feeding. There was, on the average, a saving of 32 days in the time required to produce 100 pounds of gain. All this means an earlier and usually a better market, and a saving in labor, interest, and risk, considerations of no little importance to the practical hogman.

The principal reason why pigs fed a balanced ration always outgain those given an unbalanced one like corn alone, is because it is eaten with greater relish and consequently consumed in larger amounts. Although corn is an unusually palatable feed, the pigs fed the balanced ration in this experiment ate 1.89 pounds more daily to each pig than those receiving corn alone, or an increase of 29 per cent.

The second and perhaps the most important difference in these two rations was that in the amount of feed required to produce a given gain. Those receiving corn alone required 556.6 pounds of feed for each 100 pounds of gain, while those fed 10 parts corn and 1 part meat-meal needed only 450.8 pounds. This is a saving of approximately 106 pounds of feed in the production of 100 pounds of gain; or, in other words, the balanced ration required 19 per cent less feed for the same gain. Expressed in another way, a bushel of corn (56 pounds) in the corn-alone lot produced 10 pounds of pork, while 56 pounds of the balanced ration produced 12.42 pounds of pork. Every pound of meat-meal fed in the balanced ration had the equivalent value of 3.58 pounds of corn fed in the corn-alone ration, in producing 100 pounds of gain. If a bushel of corn fed in lot I had a value of 56 cents, a ton of meat-meal, as fed in this experiment, would have a corresponding value of $71.60. If the corn is valued at 70 cents a bushel, the value of the meat-meal would be $81.40 a ton; with corn at 84 cents a bushel, the value of the meat-meal would be $107.40 a ton.

The corn-alone ration did not produce economical gains because corn does not contain sufficient protein or mineral matter of the kinds to satisfy the needs of the pigs for muscle and bone development. Although pigs of this age when fed to such heavy market weights are capable of using large amounts of carbohydrates, or fat-producing foods, their requirements for protein, or growth-producing foods are none the less imperative. An efficient use of the ration is possible only when the supply of growing constituents is fed in quantities above a certain minimum, or in larger amounts than are contained in corn. As a consequence, the pigs in this experiment which were restricted to a diet of straight corn were subjected to a mild form of starvation, not so acute with pigs of this development as occurs with those of younger age, the effect of which was to lower the general vitality and vigor and hence reduce their capacity and efficiency as pork-producing machines.

Both lots of pigs were appraised by market experts at the close of the experiment and valued at the same price a hundredweight. Both lots were uniformly very fat. Although the pigs which received the balanced ration were more than 70 pounds heavier and had smoother and more glossy coats of hair, those fed corn alone were practically as well finished, and representing a more popular weight, sold at the same price. A summary of all similar data from other experiments in which well-grown pigs were fed supports the conclusion that, as a rule, the feeding of a balanced ration has little effect in increasing the dressing percentage or enhancing the selling price over pigs fed corn alone. This is because the corn ration tends to check growth and stimulate or hasten fat production. The chief benefits to be derived, therefore, from feeding a nitrogenous supplement with corn to well-grown shotes which are being fattened for market are in the faster gains, the earlier market, and the saving of feed required to produce a given gain. These benefits are amply sufficient to condemn the practice of feeding corn alone.

The pigs fed in the above experiment averaged 135 pounds at the beginning of the test, and were well grown and thin in flesh. They were probably late spring pigs of the previous year. If the feeding of corn alone to pigs of this development means such waste of feed and time, one should expect the effects of such feeding on weanling pigs to be very much more pronounced or disastrous. That such is the case is the experience of every observant feeder. Investigations show that young pigs restricted to a diet of corn alone, especially when denied the opportunity of rooting, very early develop evidences of imperfect nutrition. The appetite becomes weak and depraved, and they display a craving for earthy materials, ashes, charcoal, cement, limestone, and the like. If some of these sources of ash or mineral ingredients are not supplied, especially if the water is deficient in salts, evidences of starvation become prominent. They cease to make gains, the coat becomes rough, the eyes dull, and the gait uncertain. Not only are the rate and cost of gains with young pigs out of all proportion to the results obtained from well-balanced rations, but when long-continued the effects may even result in the death of the weaker individuals.

To show the possible effects of a ration of corn alone on the size and strength of bone of growing pigs, Burnett of the Nebraska Experiment Station made studies of fundamental importance to the breeder and feeder. Twenty pure-bred Duroc-Jersey pigs, averaging 62 pounds, were divided into five equal lots of four pigs each. From August 2, 1907, to January 3, 1908, a period of 154 days, they were fed the following rations: Lot I, corn-meal alone; lot II, 75 per cent corn-meal and 25 per cent shorts; lot III, 25 per cent corn-meal and 75 per cent skim-milk; lot IV, 90 per cent corn-meal and 10 per cent tankage; lot V, 90 per cent corn-meal and 10 per cent bone-meal. During the first 84 days of the test, all the lots were on alfalfa pasture, which undoubtedly insured a better showing for the pigs in lot I than would otherwise have been possible. For the remainder of the time, they were confined to the dry lot and the above rations. The interesting results of this experiment are shown in the following table:

TABLE XXXII. — THE EFFECTS OF DIFFERENT RATIONS ON THE SIZE AND BREAKING STRENGTH OF BONE

(Neb. Exp. Sta., Bull. 107)

Rations Fed	Average Weight of Green Bones in Grams[1]	Average Circumference of Bones in Millimeters	Average Thickness of Bone Wall in Millimeters	Percentage of Mineral Matter in Green Bone	Average Breaking Strength of Bones per 100# Live Weight of Pigs
					lb.
Corn-meal, 100%	1097	73.	2.8	25.4	325
Corn-meal, 75% Shorts, 25%	1044	69.9	2.9	27.8	396
Corn-meal, 25% Skim-milk 75%	1232	71.3	3.7	32.7	509
Corn-meal, 90% Tankage, 10%	1219	73.6	3.7	35.5	580
Corn-meal, 90% Ground bone, 10%	1196	71.6	4.1	37.2	681

Several striking facts stand out in these results. The breaking strength of the bones of pigs fed skim-milk, tankage, or ground bone with corn was from 56 to 109

[1] The above figures were obtained by averaging the data for the following bones of each pig: 2 femur, 2 tibia, 2 humerus, and 2 ulna and radius.

per cent greater than for the pigs fed corn alone. This greater strength was not due to bone of larger apparent size, but to a thicker bone-wall and a denser structure of the bone itself. The figures show that the circumference of the bones was not affected by the ration, but the weight, thickness of wall, and percentage of mineral matter present was very markedly affected. The addition of 25 per cent of shorts to a corn ration would appear to have little effect on the strength or composition of the bone produced when compared with corn alone. This result seems reasonable in view of the fact that shorts contain a relatively small amount of mineral matter, particularly calcium. Other studies by Burnett and similar studies by Carlyle[1] and Forbes[2] have given results which confirm those here reported.

This experiment supplies emphatic evidence of the deficiency of corn as a bone-building feed. Chemical analyses have made it known that this is chiefly due to the extremely small amount of calcium or lime contained. The practical effect of adding tankage or skim-milk was not only to supply needed proteins, but also to furnish the calcium and other inorganic elements in which corn is so notoriously lacking. Although this experiment does not prove directly that the feeding of corn alone causes pigs to go off on their feet and legs, it supplies very strong indirect evidence that this may be the case. Other factors affect the ability of a hog to stand square and strong on his legs and feet, but that the quality or composition of the rations fed has an important influence in supplying strength or weakness cannot be questioned seriously. To develop a breeding herd noted for good

[1] Wis. Exp. Sta. Bull. 104.
[2] Ohio Exp. Sta. Bulls. 213 and 283.

legs and sound pasterns and feet requires, therefore, not only care in the selection of the breeding stock, but also the feeding of rations during the growing period which promote instead of prevent the development of strong bone.

Although wheat, rye, barley, kaffir, and milo contain somewhat more protein and ash than does corn, they are very similar in their general feeding qualities. Like corn, they have an excess of those constituents (carbohydrates) which promote fat-production and retard growth, and a deficiency of those materials (protein and ash) which stimulate muscle and bone development. The above experimental results from the feeding of corn alone may, therefore, be taken as a fairly reliable indication of the results to be obtained with any of these grains when fed singly and alone.

Realizing the necessity of feeding with corn or other home-grown grain feeds which tend to balance it by furnishing protein and mineral matter, the hog-man is confronted with the question of the most economical method of supplying these necessary materials. There are two available sources of feeds of this nature: forage crops which may be grown on the farm, and so-called nitrogenous or protein supplements which may be purchased on the market. The use of one or both of these classes of feeds in conjunction with the home-grown grain is necessary for the most rapid or the most economical growth of the pig crop.

THE ADVANTAGES OF FORAGE CROPS

The attention which has been directed in recent years by the experiment stations, extension lecturers, and the agricultural press to the merits of forage crops as means of balancing the corn ration and improving present methods of pork production has had the effect of stimulating interest and inquiry into the possibilities of these crops and the place which they should occupy in a well-organized plan of management for the hog farm. In the following pages the results of experimental feeding tests are presented together with the teachings which a careful study of these results seems to justify.

Dry lot versus forage feeding.

In Table XXXIII are presented the summarized results of eleven experiments[1] in which the dry lot method of feeding pigs was compared with that of feeding on forage. In all cases, the experiments began soon after the pigs were weaned and continued throughout most of the summer, covering an average period of 104 days. Timothy was used in three of the tests, rape in four, alfalfa in two, a mixture of rape, Canada field peas and oats in one, and soybeans in one. In each experiment the same grain rations were fed in the dry lot and on forage, except in one of the Iowa tests when the proportion of meat-meal to corn fed on forage was slightly less than that fed in the dry lot. With but one exception, the pigs in both the dry and forage lots were full fed; *i.e.* given all the grain they would eat. It should also be noted that in every comparison the ration fed in the dry lot was practically a balanced one.

In no case is there an experiment included in which corn alone was fed. In other words, each experiment included in this summary is a test of the balanced ration

[1] Iowa Exp. Sta. Bull. 91; Kans. Exp. Sta. Bull. 192; Ohio Exp. Sta. Bull. 242.

fed in the dry lot and the same ration on forage. The result of feeding as large a proportion of nitrogenous supplement in the forage as in the dry lot was to supply, in most cases, an excess of protein to the forage-fed pigs.

Table XXXIII. — Summary — Dry Lot versus Forage Feeding (Av. 11 Exps.)

	Total Number Pigs	Average Length Test	Average Daily Gain	Average Concentrates Required to Produce 100 Lb. Gain	Average Concentrates Saved per Acre Forage	Average Amount Pork Accredited 1 Acre Forage
		days	*lb.*	*lb.*	*lb.*	*lb.*
Dry lot	62	104	.85	413.25	—	—
Forage	115	104	1.17	351.29	1102.42	266.77

The summarized statement of these experiments shows that the pigs in the dry lot gained an average of .85 pound daily, while those on forage gained 1.17 pounds. This is a difference of practically $\frac{1}{3}$ pound daily for each pig. In other words, the pigs on forage were 33 pounds heavier at the end of 104 days' feeding. When rapid gains and an early market are sought by the feeder, the importance of providing green crops is shown by the fact that the pigs on forage were practically as heavy at the end of $2\frac{1}{2}$ months' feeding as were those in the dry lot at the end of $3\frac{1}{2}$ months' feeding.

The average amount of concentrates (corn + supplement) required to produce 100 pounds of gain was 413.25 pounds for the dry lots and 351.29 pounds for the forage lots. The green feed consumed by the forage lots caused an average saving of 62 pounds of concentrates in the production of each 100 pounds of gain. Whether or not the saving of this quantity of corn and supplement by the forage eaten effected a saving in the actual cost of producing a given gain may be considered more profitably in the light of the figures given in the last two spaces of the summary table.

An acre of forage in these experiments must be given credit for producing an average of 266.77 pounds of pork, or in effecting a saving of 1102.42 pounds of grain or concentrates. The pork credited to each acre of forage was determined from the original data by the following method: The total pounds of concentrates fed the forage lot was divided by the number of pounds of concentrates required to produce one pound of gain in the dry lot. This gave the number of pounds of pork which would have been produced in dry-lot feeding from the concentrates actually fed in the forage lot. Then by subtracting from the total gains made on forage the calculated gains which would have been made in the dry lot from the same concentrates, we get the gains which must be credited the forage eaten. In other words, from the same quantity of concentrates, pigs fed on one acre of forage would have produced 266.77 pounds more pork than those fed in the dry lot. The concentrates saved by an acre of forage was calculated by multiplying the number of pounds of pork credited to each acre of forage by the pounds of feed required to produce one pound of gain in the dry lot. To produce a gain of 266.77 pounds in the dry lot, there would be required, according to these figures, 1102.42 pounds of concentrates.

As a means of reducing the cost of producing gains in growing pigs during the summer, therefore, the average acre of the above forage crops had values as shown in the following table:

TABLE XXXIV. — AVERAGE VALUE OF AN ACRE OF FORAGE IN REDUCING COST OF GAINS

When 1 pound of pork was worth	5¢ $13.34	6¢ $16.01	7¢ $18.67	8¢ $21.34	9¢ $24.00
When 1 pound of concentrates cost	1¢ $11.02	$1\frac{1}{4}$¢ $13.77	$1\frac{1}{2}$¢ $16.53	$1\frac{3}{4}$¢ $19.28	2¢ $22.04
When 1 pound of pork was worth	10¢ $26.67	11¢ $29.34	13¢ $34.68	15¢ $40.01	16¢ $42.68
When 1 pound of concentrates cost	$2\frac{1}{4}$¢ $24.79	$2\frac{1}{2}$¢ $27.55	3¢ $33.06	$3\frac{1}{2}$¢ $38.57	4¢ $44.08

The above table illustrates the usual method of expressing the money value of an acre of forage. It should be clearly understood, however, that these values are determined by the saving in the cost of producing the gains solely, and do not include a valuation of the important benefits derived from the faster gains and earlier market finish, as well as other advantages. It may be profitable to grow forage crops even though the rent of the land and the cost of growing the crop are greater than the returns gotten when expressed by the above method of valuation.

It should also be pointed out in this connection that the effect of limiting the grain feed to pigs on forage at the point where only fair gains are made, or so as to secure the same gains on forage as are made in the dry lot, is to increase the value of the crops when estimated by this method. For example, if two lots of pigs, one in the dry lot and one on forage, are fed the amounts of grain which will insure the same average rate of gain in both lots, the showing of the forage crop would be much better than if both lots had been full fed for maximum gains. The average results shown in Table XXXIII are less favorable to the forage crops, therefore, than would be the case with this common method of feeding.

With the method of full feeding, the benefits of the forage crop are largely derived from the faster gains, while with limited feeding on forage the benefits from the crop are chiefly due to the saving effected in the grain required to produce a unit of gain.

Feeding skim-milk on forage.

An exception is to be made to the usual results of dry lot *versus* pasture feeding when skim-milk or buttermilk is used as the nitrogenous supplement. These supplements are so watery and so completely balance the deficiencies of grain, that there appears to be no benefit in faster or cheaper gains by allowing the pigs access to a succulent forage crop. The addition of a bulky forage to a ration of grain and milk would appear, in fact, to be detrimental. This is shown by the results of experiments made by Linfield at the Utah Experiment Station.[1] The average of two tests made in different years is shown in the following table:

TABLE XXXV. — SKIM-MILK ON PASTURE VERSUS SKIM-MILK IN THE DRY LOT

	RATIONS	AVERAGE DAILY GAIN PER PIG	GRAIN AND MILK TO PRODUCE 100 LB. GAIN	
			Grain	Milk
		lb.		
Dry lot . .	Grain + skim-milk or buttermilk	1.25	253	900
Mixed pasture and alfalfa .	Grain + skim-milk or buttermilk	1.18	284	832

[1] Bull. 70.

Corn alone versus corn and forage.

In all of the experiments summarized in Table XXXIII, the pigs in the dry lots were fed balanced rations. If corn alone had been given in both the forage and dry lots, the value of the forage in each case would have been greatly increased. To illustrate the high valuation of the forage crop when calculated on the basis of the cost of producing gains with corn alone in the dry lot, the few available experimental results are summarized and presented in the following table.[1] The value of these forage crops as sources of protein and mineral matter, or as means of balancing a ration of corn alone, is, also, strikingly shown by these results.

TABLE XXXVI. — SUMMARY: CORN ALONE VERSUS CORN AND FORAGE (AV. 3 EXPS.)

	Total Number Pigs	Average Number Pigs Grazed per Acre	Average Length of Test	Average Daily Gain	Average Amount Corn Required to Produce 100 Lb. Gain	Average Amount Corn Saved by 1 Acre Forage	Average Amount Pork Accredited 1 Acre Forage
			days	*lb.*	*lb.*		
Dry lot	14	—	68	.59	699.0	—	—
Forage	17	18	68	1.25	359.1	3738.18	534.79

Although the experimental work presented in this table is too meager to make generalizations possible, and although the poor returns from corn alone are extreme, the results are nevertheless suggestive. As would be expected, the value of the forage crops in these experiments was much greater than in those in which balanced

[1] Kans. Exp. Sta. Bull. 192; Ohio Exp. Sta. Bull. 243; Ala. Exp. Sta. Bull. 154.

rations were fed in the dry lot. The amount of pork accredited each acre of forage here was almost exactly double that shown in Table XXXIII. The difference in the saving of grain effected was even greater. When corn alone was fed, an acre of forage saved 3738 pounds of grain, while when corn and a nitrogenous supplement were given, an acre of forage saved 1102 pounds of feed. The pigs in these experiments, like those in the previous tests, were of spring farrow and full fed during the periods of the tests.

That the usual forage crops supply considerable quantities of food materials which are lacking in corn is also shown by the summarized results in Table XXXVI. The pigs obtaining forage in these experiments gained more than twice as fast as did those receiving corn alone in the dry lot, and the amount of corn fed for each 100 pounds' gain was practically one-half. Although most forage crops do not supply sufficient protein to balance straight corn for pigs, they do furnish sufficient materially to reduce the proportion of purchased supplements necessary for productive rations.

Summary of benefits from growing forage crops.

Considering the teachings of practical experience as well as the results of experimental studies, the following advantages for forage crops may be enumerated:

1. Pigs on forage make more rapid gains than do those confined to the dry lot, other conditions being the same. It has also been observed that forage-fed pigs are capable of sustaining a rapid rate of gain for a longer period of time. With balanced rations and full feeding, the average rate of gain, as shown by the experimental results in Table XXXIII, was increased 37 per cent. With corn alone and

full feeding, the forage increased the rate of gain, as shown in Table XXXVI, more than 111 per cent. The tonic effects of the succulence, the laxative properties of the green feed, and the variety of proteins and mineral elements supplied seem to be responsible for a state of health and thrift which insures greater capacity for the digestion and assimilation of food. It is probable, also, that the greater freedom and more exercise, and the more healthful conditions generally, contribute materially to this increased vigor.

When feeding for the quickest development and the earliest market, a ration that will stimulate rapid gains is of the greatest importance. An extra gain of $\frac{1}{4}$ pound daily would ordinarily mean a saving of more than two months' time in the production of a 225-pound shote. (See page 218.) In the development of young boars and gilts, the breeder with forage crops may secure rapid gains without the dangers of forcing which would be necessary in dry-lot feeding.

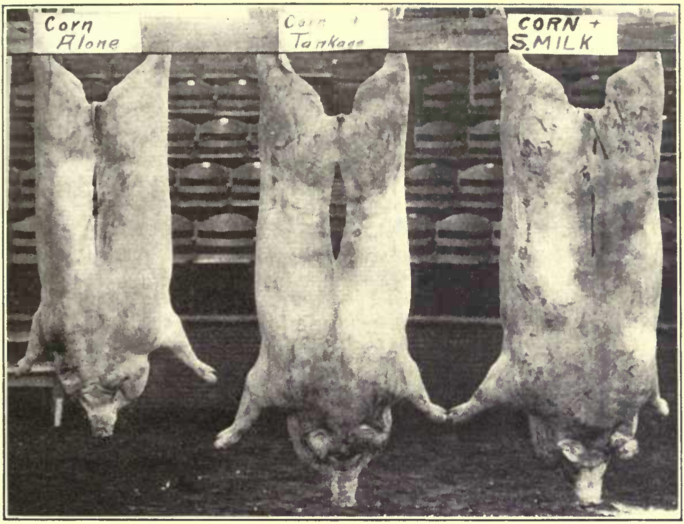
2. Pigs which have been fed on forage crops during the summer do better when placed in the dry lot than those which have not had the advantage of green feeds. The beneficial effects of the forage crops, in other words, are not confined to the forage-feeding period alone, but are noticeably maintained during the succeeding weeks of dry-lot feeding. This is another reason why the figures given in Table XXXIV do not represent the full value of these crops. This desirable residual effect is the result, no doubt, of the more vigorous state of health brought about by the forage conditions and to the larger capacity resulting from the consumption of the bulky succulent feeds.

3. When corn, or other grain, is very high or un-

obtainable, a succession of forage crops during the summer makes it possible, with the minimum of grain, to maintain thrift and fair gains until the next crop is harvested. Without these crops, the farmer is frequently forced to the necessity of sacrificing his pig crop by marketing them at very immature weights, or of carrying them through under conditions injurious to health and fatal to profits. The value of an acre of good forage in such a situation as this, which is not uncommon, is very much greater than that shown by the usual method of calculation.

4. Forage crops reduce the amount of grain required to produce 100 pounds of gain. As indicated by the average of the experimental results shown in Table XXXIII, one may expect, even when the pigs on forage are full fed and those in the dry lot are given balanced rations, a saving of 15 per cent, approximately, in the amount of grain required to produce a given amount of pork. When corn alone was full fed in both forage and dry lots, the saving effected, as shown in Table XXXVI, was more than 48 per cent. With good forage crops, this saving alone is usually sufficient to pay all the costs of providing the crops. Under given conditions, the higher the price of grain the more important does this saving become. With higher prices for pork and the increased use of corn and other grains for human consumption, any method of pork production which will save grain becomes increasingly important.

5. Another very inportant advantage resulting from the growing of forage crops, especially in the corn-belt, is due to the fact that a smaller quantity of commercial protein feeds need be purchased in order to insure balanced rations for the growing pigs. This is because these crops,



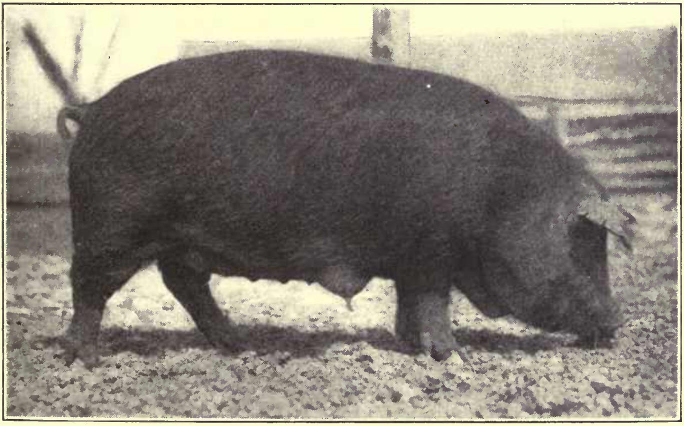


PLATE IV. — *Above*, A visible demonstration of the deficiencies of corn alone for growing and fattening pigs; *below*, A big smooth gilt with only two pairs of good teats, an expensive luxury.

especially the legumes and Dwarf Essex rape, contain liberal amounts of protein and mineral matter. The new growth of the ordinary cereal crops like oats, rye, and barley are very much richer in these growing constituents, also, than the same crops at maturity. Provision for such crops, consequently, means a smaller cash outlay for such feeds as tankage, meat-meal, shorts, middlings, or oil-meal, and the more exclusive and larger use of corn or other home-grown grains. The hog-man is, therefore, made more independent of outside sources of feed supply.

6. Access to forage crops insures that the droppings will be left where the land is certain to receive the full benefits from the fertility contained. Contrasted with the results of dry-lot feeding, where the droppings are allowed to accumulate and waste away in the barnyard, and to become a source of filth, infection, and disease, this system effects a large and an increasingly important saving. More than 85 per cent [1] of the fertility of the feed eaten by a fattening pig is recovered in the manure. Henry and Morrison [2] have calculated that the fertility value of the manure produced by a 1000 pounds of pigs in one year has a value exceeding $38, when the nitrogen is valued at 18 cents, phosphoric acid at 4.5 cents, and potash at 5 cents a pound. According to these figures, the actual fertility value of the droppings produced by an average pig during the summer would be about $2. Feeding pigs on forage is a sure and certain method of increasing rapidly the fertility of the land on which they graze.

7. Finally, forage crops mean improved sanitary conditions for the pigs. If for no other reason, all so-called

[1] Warington: "Chemistry of the Farm," page 214.
[2] "Feeds and Feeding," page 279.

permanent hog-lots should be plowed up frequently and sown to crops. Not only will these lots be made to yield food, but the complete aëration of the soil and the action of the direct rays of the sun will insure the death of parasites and disease germs more effectively and at less cost than can be accomplished by any other known method. Pigs on forage crops in contact with clean earth are more thrifty and vigorous than those confined to dry lots. The fundamental reason why pigs fed on forage display such capacity for rapid gains is because of this thrift. A condition of thrift in the growing market pig is also essential for the production of the best quality of pork, especially firm bacon. Without thrift, the pigs intended for the breeding herd are lacking the first essential for successful performance. The use of forage crops insures the conditions which encourage the development of vigor and constitution and eliminates many of the conditions responsible for unthriftiness and disease.

CHAPTER VIII

CHOOSING A FORAGE CROP: EXPERIMENTAL FEEDING TRIALS

THERE is no best single forage crop, or succession of forage crops, for all farms and all seasons. Differences in climate, rainfall, and soil make it obvious that a crop well adapted to the South or West might prove an utter failure in the North or East. Normal variations in temperature and rainfall from year to year result, also, in wide differences in the quality and value of any particular crop grown on the same soil in different years. The value of a crop in any year is conditioned on the favorableness of the season for that particular crop. Furthermore, differences in the type or plan of management followed on farms may require the use of forage crops on some farms which would not be the most profitable when other systems of management are followed. For these reasons, the selection of forage crops is first a question of location and type of farming.

Essentials of an ideal forage.

In order that a forage crop may be the most valuable for a given farm, it should possess as many desirable individual characteristics as possible. Evvard[1] of the Iowa Experiment Station has well summarized these characteristics by naming the following as the essentials

[1] Bull. 136.

of an ideal forage for hogs: "(1) adaptability to local soil and climate; (2) palatability; (3) heavy yield of digestible matter which is comparatively high in protein and suitable growing ash; (4) narrow nutritive ratio; *i.e.* the relation of digestible protein to digestible carbohydrate equivalent should not be wider than 1:5, and better still if as narrow as 1:2; (5) succulence; (6) afford pasture for a long grazing season; (7) ability to endure tramping and grazing; (8) permanency; (9) reasonable cost and ease of seeding; (10) capability of furnishing quick pasturage any time during the growing season; (11) leguminous characteristics."

MEDIUM RED CLOVER

Common red clover is one of the most valuable and widely used forage crops for hogs. In the corn-belt especially this crop is a fixture in the rotations practiced on the best farms. Being a legume it not only improves the fertility of the soil by its nitrogen-gathering property, but its abundant supply of protein and lime makes it particularly valuable as a forage crop for young pigs. Its richness in muscle and bone-building foods insures better results with straight corn feeding than can be obtained, as a rule, from the non-legumes. As an ally to corn in pork production in the corn-belt, clover is without a peer. When carefully handled, red clover will supply grazing in a favorable season from June to November.

One of the disadvantages of red clover as a forage crop is that it tends to become coarse and woody rather early in the summer, especially in the second year and in a dry season. It does not stand drought as successfully as alfalfa or rape. For this reason, the supply of succulence is not uniformly distributed throughout the summer. Clover frequently winter-kills and is quite sensitive to over-stocking. On some soils it is difficult to secure a "catch," and being a biennial it requires seeding every two years. The wide adaptability of red clover, however, the important position which it occupies in successful farming generally, and its feeding qualities, make it one of the most popular of forage crops.

More specific information relative to the value of this crop in comparison with other forages is to be found by a study of the results of feeding trials conducted at the experiment stations. The most important recent studies are summarized and reported in the following pages.

Clover versus alfalfa.

These two premier forages have been compared in five recent experimental feeding tests conducted at three different corn-belt stations. In each trial the pigs used were of spring farrow and the experiments began early in the summer, covering an average period of 135 days. Practically full corn rations were fed in all except one trial in which three-fourths of a full ration was given. In all but one of the experiments, a small proportion of tankage was fed to supplement the corn. The results are summarized and shown in Table XXXVII.

Although the pigs on clover made a shade faster gains, those on alfalfa gained the most from a unit of grain fed. Also, the alfalfa lots yielded the heavier cuttings of hay. When alfalfa is available, feeders usually prefer it to clover not only because of the results here shown, but also because it furnishes a more uniform and constant supply of forage throughout the summer.

TABLE XXXVII. — SUMMARY: CLOVER VERSUS ALFALFA

(Av. 5 Exps.) [1]

Forage	Average Number Pigs per Acre	Average Length of Tests	Average Daily Gain per Pig	Concentrates Eaten for Each 100 Lb. Gain [2]
		days	*lb.*	*lb.*
Clover .	16	135	1.175	350
Alfalfa .	16	135	1.154	343

Clover versus rape.

The relative merits of these two crops have been tested in six separate feeding experiments, the summarized results of which appear in Table XXXVIII. In each trial the pigs on clover were fed the same grain rations as were those on rape. Pigs of spring farrow were employed and, except in the Wisconsin trials, were confined to measured areas of forage. The different experiments covered periods ranging from 60 to 141 days.

TABLE XXXVIII. — SUMMARY: CLOVER VERSUS RAPE

(Av. 6 Exps.) [3]

Forage	Average Number Pigs per Acre	Average Length of Tests	Average Daily Gain per Pig	Concentrates Eaten for Each 100 Lb. Gain
		days	*lb.*	*lb.*
Clover . . .	$18\frac{2}{3}$	100	1.122	361
Rape . . .	19	100	1.071	345

[1] Iowa Exp. Sta. Bull. 136; Ind. Exp. Sta., unpublished data; Ill. Exp. Sta., unpublished data.

[2] Average amount of hay cut from each acre — alfalfa, 3238 lb.; clover, 1215 lb.

[3] Iowa Exp. Sta. Bull. 136; Ill. Exp. Sta., unpublished data; Wis. Exp. Sta., 16th and 17th An. Rpts.; Ind. Exp. Sta., unpublished data.

In four of the experiments out of the six here summarized, the pigs on clover made the faster gains, while in the other two the rape-fed pigs gained faster. In each of the experiments, on the other hand, the pigs on rape required less concentrated feed to produce a unit of gain than did those on clover. Although rape is not a legume and does not improve the soil in nitrogen-content, it is richer than clover in protein. In some of these experiments a small cutting of hay was taken from the clover lots. The carrying capacity of these crops appears to be about the same, both being very large when grown on rich soil and good stands are obtained.

At the Missouri Experiment Station,[1] Mumford and Weaver, in tests made of clover in 1908 and 1910, pastured an average of eleven pigs to the acre for 133 days. The pigs were fed straight corn in quantities to secure a uniform rate of gain of $\frac{3}{4}$ pound daily. With this method of feeding, 100 pounds of gain were secured from an average of only 295 pounds of corn.

OTHER CLOVERS

Because of its good yielding powers and fine quality of stems, alsike clover is probably the equal of medium red clover as a forage crop. The fact that it does well on acid soils too wet for ordinary clover is causing it to be more generally grown in the corn-belt. Mammoth clover is not as highly regarded, as a rule, as medium red, chiefly because of the rank coarse quality as a forage. It is a heavy yielder, however, and does well on thin sandy soil. White clover is a persistent-growing perennial which greatly adds to the value of permanent pastures

[1] Bull. 110.

of both the North and the South. In every section of the country, some variety of clover is grown successfully for forage purposes. Crimson clover is an annual possessing wide adaptations, particularly suited to the South Atlantic states. It provides valuable forage for hogs during the winter. Varieties of Bur clovers are successfully grown and used as forage crops for pigs in the South and West. They are considered valuable supplements in Bermuda pasture. Lespedeza, or Japan clover, is one of the most valuable legumes of the South. It is an annual, but reseeds itself every year. It does especially well on poor sandy soils and should be of large value as a forage for pigs, either as a part of permanent pastures or as a specially grown crop.

Investigations by Evvard and Kennedy of the Iowa Station[1] would indicate that sweet clover, especially the first year's growth, has considerable value as a forage for pigs. When fed a ration of ear corn, with 10 per cent meat-meal during the last 57 days of the period, twenty-two 38-pound pigs were pastured on an acre of sweet clover from June 22 to November 10. The good results obtained are shown by the fact that the pigs made an average daily gain of 1.02 pounds at a cost of 3.38 pounds of grain feed. The results secured from the same plot by pasturing the second year's growth the succeeding year, however, were very much less favorable. This year the pigs made an average gain of only .53 pound daily, while other pigs in the same experiment on rape and alfalfa gained, with the same grain rations, more than one pound daily. The poor results from the second crop were attributed to the extremely coarse woody nature of the growth. (See Table XL, page 161.)

[1] Bull. 136.

ALFALFA

Alfalfa is one of the most important swine forages. When of good stand, it combines the merits of unusual palatability and richness in protein and mineral matter with heavy yielding powers, permanency, the ability to furnish a uniform supply of forage through a long growing season, and exceptional ability to withstand the effects of droughts. It is a deep-rooted perennial and does best when the water-level is not too close to the surface.

Alfalfa, however, is not without its faults as a forage crop on every farm. Because it is such a valuable perennial, it does not fit in with the usual crop-rotating systems as does clover. Furthermore, alfalfa is not an easy crop to grow successfully in many sections. Much time and considerable expense are often the necessary preliminaries to a good stand. If stocked too heavily, there is great danger that the young shoots will be eaten and the crowns permanently injured. The safest and perhaps the most profitable procedure to follow is never to pasture so heavily that at least one good cutting is not taken for hay. Also, close cropping in the fall makes it very susceptible to winter-killing. The value of alfalfa as a permanent hay and forage crop is so great, however, that the rules for its successful growth are being studied more carefully and its culture widely extended.

Alfalfa versus rape.

Four experiment stations have studied more or less extensively the relative merits of alfalfa and rape as forages for pigs. In all, ten feeding experiments have been made, the summarized results of which are given in Table XXXIX. These trials covered periods of 80 days for the shortest and 190 days for the longest period. Three-fourths to full grain rations were fed, consisting of either corn alone or corn supplemented with a small proportion of tankage.

TABLE XXXIX. — SUMMARY: ALFALFA VERSUS RAPE

(Av. 10 Exps.) [1]

Forage	Average Number Pigs per Acre	Average Length of Tests	Average Daily Gain per Pig	Concentrates Eaten for Each 100 Lb. Gain
		days	*lb.*	*lb.*
Alfalfa .	22	128	1.156	348
Rape . .	19	123	1.102	343

It would appear from these average results that alfalfa is a somewhat better forage crop than rape. Although the pigs on rape required less grain for a unit of gain, those on alfalfa made slightly faster gains. A small but important difference in favor of the alfalfa is also shown by the larger number of pigs carried on a given area of forage. In five of the experiments, the alfalfa lots yielded an average of 3680 pounds of cured hay to the acre.

At the Missouri Experiment Station,[2] an average of 10.3 pigs, weighing 60 to 90 pounds at the beginning of the experiment, were pastured 163 days on an acre of alfalfa. The amount of corn required to produce 100 pounds of gain was 307, the pigs being fed the quantity of corn which would maintain a uniform rate of gain of $\frac{3}{4}$ pound daily. Assuming, as did the authors of this

[1] Kans. Exp. Sta. Bulls. 124 and 192; Iowa Exp. Sta., Evvard, Am. Society Animal Pro., 1913; Ill. Exp. Sta., unpublished data; Ind. Exp. Sta., unpublished data.

[2] Bull. 110.

bulletin, that 5.6 pounds of corn would have been required for each pound of gain made in the dry lot, the acre of alfalfa would have a credit of 592 pounds of pork. Assuming that the same pigs would have made a pound of gain from $4\frac{1}{2}$ pounds of corn, the credit due to an acre of alfalfa would be 416 pounds of pork.

Alfalfa versus sweet clover.

Forage experiments conducted at the Iowa Station [1] afford an opportunity of comparing alfalfa with second-year sweet clover and a mixture of oats, Canadian field peas, and rape. The pigs on the alfalfa and sweet clover plots averaged at the beginning of the trial $18\frac{1}{2}$ pounds and were started on forage May 19. The pigs on the mixture were turned in June 13 and averaged 26 pounds. All lots were fed ear-corn and a very small proportion of meat-meal. Full grain rations were fed only during the last 100 days of the experiment. The results of this trial are shown in Table XL.

TABLE XL.—ALFALFA VERSUS SWEET CLOVER (Second Year) VERSUS MIXTURE CANADIAN FIELD PEAS, OATS, AND RAPE

FORAGE	NUMBER PIGS PER ACRE	LENGTH OF TEST	AVERAGE DAILY GAIN PER PIG	CONCENTRATES EATEN FOR EACH 100 LB. GAIN
		days	*lb.*	*lb.*
Alfalfa	17	180	1.04	345 [2]
Sweet clover (second year)	20	150	.53	376 [3]
Canadian field peas, oats, and rape	24	160	1.15	351

[1] Evvard and Kennedy, Bull. 136.

[2] 3838 pounds of alfalfa cut from each acre.

[3] 2384 pounds of sweet clover cut from each acre.

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The pigs on the mixture of peas, oats, and rape made faster gains than did those on alfalfa and a larger number was grazed on a given area. The pigs on alfalfa, however, made their gains with the expenditure of less grain. If the alfalfa plot also is credited with the nearly two tons of hay cut to the acre, as well as the smaller cost of growing the crop, it proves to be the more profitable.[1] The results reported here for second-year sweet clover would indicate that this crop cannot be used profitably as a forage for pigs when the more standard crops are available. Although the first season's growth after seeding proved at the same station to be a good forage, it is such a vigorous grower that the stalks become woody and unpalatable very early in the second season. Good results have been reported for second-year sweet clover, however, when fall pigs are used and they are turned in early enough in the spring to keep down the rank woody growth.

DWARF-ESSEX RAPE

Rape is a quick-growing succulent annual, unsurpassed by crops of this class as a forage for pigs. The plant is unusually tender and succulent and is eaten with relish and no waste. Although not a legume, it ranks with alfalfa and the clovers as a cheap source of protein and a balancer of corn. Rape is a very heavy yielder and possesses unusual carrying capacity. It may be heavily stocked and intensively grazed for a short period or it may be handled so that it will furnish grazing until freezing. Planted in the fall, rape has proved a valuable

[1] For rent, cost of seeding, labor, alfalfa cost $10.75 an acre; sweet clover, $9.20; and the mixture of peas, oats, and rape, $13.37.

winter forage in the South. Although rape does best in a cool moist season, it stands next to alfalfa in its ability to withstand drought. It may be planted so as to supply forage any time during the season, although the earlier plantings yield heaviest. With timely rains, rape continues to renew itself throughout the summer if not pastured too closely. Alternating the pigs on different lots insures, for this reason, the best results.

Rape mixes well when sown with Canadian field peas, oats, or clover. It is often seeded with oats, and will come on and furnish valuable succulence after the grain is harvested. If sown between the corn rows at the time of last cultivation, it will insure better results when hogging-down the corn. Rape may be sown broadcast or drilled in rows 24 to 30 inches apart. The latter method of seeding is usually to be preferred as it may be cultivated, it will yield heavier, and the pigs will destroy less by tramping. Pigs recently weaned should be turned on when the plants are 14 to 16 inches high; with fall pigs, the growth should be, preferably, 16 to 18 inches high.

Every year a few feeders report that their pigs refuse to eat rape, but at none of the stations of the country where experimental studies have been made of this forage have any results been obtained which would tend to support such a conclusion. Its tendency to cause sores and blisters on thin-skinned pigs is not considered serious. The trouble may be largely avoided by keeping the pigs out while rain or dew is on the plants. Pigs badly blistered have been successfully treated by washing or spraying with a disinfectant, then greasing with lard or vaseline.

Early versus late rape and other forages.

An experiment conducted during the summer of 1909 at the Iowa Station[1] tested the relative merits of the following forage crops: early-sown rape; late-sown rape; a mixture of oats, clover, and rape; a mixture of Canadian field peas, oats, and rape; and blue-grass and timothy pasture. The rape in both lots was broadcasted, the early planting being seeded May 4th and the late July 5th. The mixtures in the other two lots were drilled May 4th. A full ration of ear-corn was fed all lots, supplemented during the last thirty days by the addition of 10 per cent of meat-meal. The results are shown in Table XLI.

TABLE XLI. — EARLY VERSUS LATE-SOWN RAPE VERSUS FORAGE MIXTURES

Forage	No. Pigs per Acre	Length of Period	Average Daily Gain per Pig	Concentrates Eaten for Each 100 Pounds Gain	Pork Credited 1 Acre of Forage[1]
Early-sown rape .	17	147	.81	326	371
Late-sown rape . .	19	104	1.36	371	195
Oats, clover, and rape[2]	17	147	.91	318	458
Canadian field peas, oats, and rape . .	17	147	.85	339	419
Blue-grass and timothy pasture . .	14	165	.72	393	28

[1] Bull. 136.

[2] Mixture of 48 pounds of oats, 8 pounds of red clover, and 2 pounds of rape sown to an acre.

[3] Figured on the basis that 4 pounds of grain would have been required to produce 1 pound of gain under dry lot conditions.

With those lots fed for approximately the same length of time, the mixture of oats, clover, and rape gave the best results. In this lot the gains were fastest, the amount of grain fed for each 100 pounds of gain made was least, and the amount of pork credited to one acre of forage greatest. Although the amount of grain required to produce 100 pounds of gain was greater in the early rape lot than in the lot on oats, peas, and rape, the gains were faster. As measured by the amount of pork or concentrates credited to each acre of forage, the latter crop was more profitable. The blue-grass and timothy pasture gave returns very much less favorable than the other forages, due, no doubt, to the fact that this crop did not supply as much protein to balance the straight corn fed during most of the experiment. The value of a late planting of rape is well shown by these results. The more rapid daily gains in this lot as compared with the early rape lot are probably to be explained by the larger size of the pigs and also by the fact that straight corn was fed for a shorter proportion of the time.

In the forage experiments at the Iowa Station in 1911, rape alone proved slightly inferior to a mixture of oats, Canadian field peas, and rape. (See Table XLIV, page 169.)

Winter rape.

That rape is deserving of consideration as a winter forage crop by the southern hog raiser was shown by experiments conducted at the Alabama Experiment Station by Gray, Summers, and Shook.[1] Ten pounds of rape seed were sown in drills 18 inches apart September 19. The soil was very poor and sandy. Pigs of average quality, weighing 45 pounds, were turned in November 9,

[1] Bull. 168.

when the trial began. The experiment closed April 5, covering a period of 147 days. The results are shown in Table XLII.

TABLE XLII. — WINTER RAPE VERSUS DRY LOT

	Concentrates Fed	Number Pigs and Area Grazed	Average Daily Gain per Pig	Concentrates Fed for Each 100 Lb. Gain	Grain and Pasture Cost per 100 Lb. Gain.[1]
		pigs; a	*lb.*	*lb.*	
Dry lot	2 corn-meal + 1 shorts, full feed.	5;	.84	520	$6.88
Rape	2 corn-meal + 1 shorts, ½ full feed.	5; ⅔	.71	258	4.90
Rape	2 corn-meal + 1 shorts, ¼ full feed.	5; ⅔	.54	165	4.13

In view of the fact that the pigs on rape received only one-half grain rations or less, the gains made in the forage lots were fairly good. The saving effected by rape in the amount of concentrates required for a unit of gain was such that its value in southern pork production would seem assured.

COMBINATIONS: CANADIAN FIELD PEAS, OATS, CLOVER, RAPE

As a rule, a mixture of two or more plants possessing similar requirements in temperature and soil give a heavier yield as a forage than any one of the crops grown

[1] Corn 70 cents a bushel; shorts at $36.00 a ton; rape at $8.00 an acre.

separately. Also, a more uniform supply of succulence may be provided by selecting for the combination crops which make most of their growth in successive periods of the summer. For these reasons, various mixtures of the above crops are commonly planted and successfully used for forage purposes.

In the latitude of the northern corn-belt and farther north, the Canadian field pea is a standard forage crop for pigs. It is a rapid-growing legume, occupying the same class as the alfalfa and the clovers in its ability to furnish protein. Five or six weeks after planting it is ready to use. It is a decided cool-weather crop and does best when planted as early in the spring as the ground can be worked, and should not be confused with the cowpea, which is extensively grown in the South. It is particularly sensitive to heat and wilts early in a dry hot summer. It should always be grown with oats, or some such crop, which will support the vines; otherwise considerable loss will result from tramping and mildew. In the North the pigs are sometimes not turned in until the pods are well filled, although the more common practice is to use it chiefly as a green crop by pasturing it after the growth is about 10 inches high.

Forage mixtures for fall pigs.

In the summer of 1910, the Iowa Station [1] fed four lots of fall pigs on different forage combinations. The forages tested were made up of a mixture of oats and rape in combination with red clover, hairy vetch, or Canadian field peas in the first three lots, while in the fourth, a mixture of oats and clover was alternately grazed with rape.

[1] Bull. 136.

The crops were seeded April 4 by drilling in the following proportions and quantities to the acre: Lot I, 48 pounds of oats, 8 pounds red clover, and 2 pounds rape; lot II, 48 pounds of oats, 30 pounds vetch, and 2 pounds rape; lot III, 48 pounds oats, 90 pounds peas, and 6 pounds rape. The mixture of oats and clover for lot IV was drilled in rows 8 inches apart. The rape was drilled in rows 24 inches apart and given three cultivations. The experiment began May 26 and closed November 11. Each lot was fed a grain ration of ear-corn with about 7 per cent of tankage added. Full rations were fed during only the last 85 days of the trial. The results are shown in Table XLIII.

Table XLIII. — A Comparison of Clover, Hairy Vetch, and Canadian Field Peas in Combination with Oats and Rape for Fall Pigs.

Forage	Number Pigs per Acre	Length of Test	Average Daily Gain per Pig	Concentrates Eaten for Each 100 Lb. Gain
		days	*lb.*	*lb.*
I. Oats, clover, and rape	11	168	1.22	445
II. Oats, vetch, and rape	11	168	1.21	447
III. Oats, peas, and rape	11	168	1.31	414
IV. Oats and clover alternated with rape	13	168	1.17	460

All the pigs were extremely heavy at the close of the experiment. For this reason the amount of feed required to produce 100 pounds of gain was considerably greater than that previously shown necessary for spring pigs. Also, the pork credited to each acre of forage was less than that usually obtained with younger pigs and similar crops. Of these three forage mixtures, oats, vetch, and rape proved the least profitable. The authors stated that the vetch was of little value in the mixture. It came on and made good growth in July and August, but the pigs ate little of it. As the result of their observations, they strongly advise against the use of hairy vetch as a hog pasture in Iowa. The returns in lot IV, in which oats and clover were alternated with rape, were disappointing. After the rape had been well eaten down early in the season, the pigs were changed to oats and clover. From late July until the end of the season, the pigs were on the rape again, as the oats and clover furnished practically no feed during this time.

Oats versus other forages.

In Table XLIV are shown the results of an experiment at the Iowa Station [1] in 1911. In this test a comparison was made of a mixture of oats, Canadian field peas, and rape with oats alone, and with rape alone. The pigs in all three lots were turned in June 13. At this date the oats in the oats-alone lot were just beginning to head.

TABLE XLIV. — A COMPARISON OF OATS WITH OTHER FORAGES FOR SPRING PIGS

FORAGE	NUMBER OF PIGS PER ACRE	LENGTH OF TEST	AVERAGE DAILY GAIN PER PIG	CONCENTRATES REQUIRED FOR EACH 100 LB. GAIN
		days	*lb.*	*lb.*
Oats	30	90	.63	365
Rape	43	160	1.07	385
Oats, Canadian field peas, and rape	31	160	1.16	370

[1] Bull. 136.

The experiment was continued for each forage lot as long as feed remained, the oats in the oats-alone lot being exhausted 70 days earlier than the forages in the other two. The pigs averaged 26 pounds when the experiment began and were given full rations of ear-corn with about 5 per cent of meat-meal.

Because of the exceptional number of pigs carried on an acre of the rape, this forage proved to be the most profitable. This lot was pastured at the rate of 30 pigs an acre until September 11, when the number was increased to 60. Seven extra pigs were added to the lot on oats, peas, and rape for 30 days in the last part of the experiment. The oats alone proved to be a poor forage with this method of pasturing, although the volunteer growth supplied considerable green feed during the late summer.

RYE

One of the most valuable qualities of green rye as a forage crop is that it furnishes a supply of green succulent material during the seasons when the ordinary forage crops and pastures are of little or no value. The merit of the crop is its availability during the fall, winter, and spring, rather than in its large yielding or grazing capacity. The benefits to be derived from a patch of rye are perhaps expressed more largely in the increased health and thrift in the breeding herd and an increased milk-flow from the sows with pigs, than in the saving effected in the cost of producing gains when growing or fattening pigs for market. If planted early in the fall, rye will supply green feed, in an open winter, until late the next spring, if carefully grazed. If pastured lightly in the spring and the pigs not allowed to remain on it late, it will yield its normal harvest in grain. The pigs are often allowed to remain on the land and the mature crop pastured as ripe rye; or it may be pastured heavily in the spring and the land early prepared and sown to other forage crops. When broadcasted between the corn rows in the late summer, rye supplies valuable succulence for the shotes when "hogging-down" the corn, or for grazing the breeding stock in the late fall and early spring. Because of its very watery nature, green rye causes rather extreme looseness of the bowels, which, with young pigs, frequently develops into scours. Keeping the pigs out of the rye when it is wet and limiting the time they are allowed to graze will help in preventing the trouble.

Rye as a winter forage.

The possibilities in the use of rye as a winter forage crop in those sections in which the winters are mild and open are well demonstrated by experimental studies made at the Kentucky Station.[1] The results of a trial conducted during the winter of 1910–11 are shown in the table on the following page. This experiment began November 11 and closed April 8, covering a period of 147 days.

The results in this test, as shown by the rate of gain and the grain required to produce a given gain, would indicate that rye may be of considerable value as a winter forage. Although young rye is fairly rich in protein, it would seem that some form of protein supplement, like tankage, should be fed for the most rapid or the most economical gains. The rye was covered with snow for a short part of the time in the winter.

[1] Bull. 175.

TABLE XLV. — WINTER RYE VERSUS DRY LOT FEEDING

Forage	Grain Rations Fed	Number Pigs in Each Lot	Average Initial Weight of Pigs	Average Daily Gain per Pig	Concentrates Required for Each 100 Lb. Gain
			lb.	*lb.*	*lb.*
Rye	10 corn-meal + 1 tankage. Full feed	7	48	1.13	376
Rye	Corn-meal alone Full feed	7	49	.85	480
Dry lot	10 corn-meal + 1 tankage. Full feed	8	47	1.03	399

"Hogging down" ripe rye.

The following interesting comparison was made in an experiment conducted at the Iowa Station in 1911.[1] One plot of rye was "hogged down" by turning in the pigs when it was ripe and the stalks beginning to crinkle down, which was July 7. In the second lot a comparable area of green rye was grazed from September 22 to November 21. The pigs in the ripe rye averaged 69 pounds when turned in, while those on the green rye averaged 36 pounds. The results are condensed in Table XLVI.

The rye in lot I was very heavy and estimated to yield 41 bushels to the acre. Although the rye grain when properly supplemented is a good feed, the results of this test would indicate that the practice of "hogging down" the ripened crop is unprofitable. The authors of the experiment stated it would have been much more

[1] Bull 136.

profitable to have harvested and sold the rye on the market than to have "hogged" it down. No corn was fed in this lot, but enough meat-meal was given to insure a balanced ration with the rye. The results of trials conducted the next summer at the same station, when corn was also fed to the pigs, again showed the practice to be an unprofitable one.

TABLE XLVI. — "HOGGING DOWN" RIPE RYE VERSUS GREEN RYE

FORAGE	CONCENTRATES FED	NUMBER OF PIGS PER ACRE	LENGTH OF TEST	AVERAGE DAILY GAIN PER PIG	CON-CENTRATES EATEN FOR EACH 100 LB. GAIN
			days	*lb.*	*lb.*
Ripe rye	.45 lb. meat-meal daily each pig	22	36	.269	169 (meat m.)
Green rye	Ear corn + $\frac{1}{10}$ meat-meal $\frac{4}{5}$ full feed	35	60	.810	324

Somewhat better results were secured from "hogging down" ripe rye by the Missouri Station [1] as indicated in the table below, which shows the results of five successive years of experiment. The pigs were of average grade and weighed 60 to 90 pounds when the trials began. In addition to the rye, they received a hand-fed ration composed of 6 parts corn to 1 of linseed-oil meal in quantities sufficient to maintain an approximate daily gain of $\frac{3}{4}$ pound for each pig.

[1] Bull. 110.

TABLE XLVII. — RESULTS FROM "HOGGING DOWN" RIPE RYE

YEAR	NUMBER DAYS PASTURED	NUMBER PIGS PER ACRE	TOTAL GAIN PER ACRE	TOTAL CONCENTRATES (Corn + Linseed M.) FED PER ACRE	CONCENTRATES FED FOR EACH 100 LB. GAIN
			lb.	*lb.*	*lb.*
1908 .	42	16	360	544	151
1909 .	42	16	318	544	171
1910 .	57	8	344	456	133
1911 .	71	12	539	1988	368
1912 .	36	8	179	288	160
Average	49.6	12	348	764	196

BLUE-GRASS: TIMOTHY

Although blue-grass has its largest use as a pasture for cattle or horses on the average farm, it may be employed profitably for the pigs during the seasons when the usual forage crops are not available. In the corn-belt especially, it has proved of large value as an adjunct to corn on those farms on which the production of forage crops and the feeding of balanced rations have been given little or no consideration. It is particularly valuable in the spring and fall as a reserve, or addition, to the regular forage crops. It may be grown on land not suitable for the production of other forage crops, it is permanent, cheap, and will supply green feed for a long grazing period. The yield and quality of blue-grass, like that of any other forage crop, varies widely with the kind of soil on which it is grown, the favorableness of the season, and the management given it. Timothy has some value as a forage crop, but its supply of protein is below that furnished by either blue-grass or rye.

Blue-grass and timothy versus clover and alfalfa.

In Table XLVIII are given the results of an experiment conducted at the Iowa Station[1] in 1909 in which a pasture of blue-grass and timothy was compared with alfalfa in one case and clover in another. The pigs were of spring farrow and weighed between 33 and 34 pounds on June 4th when the test began. In addition to the forage, the pigs of each lot were given a full feed of ear-corn, supplemented during the last 39 days of the trial by the addition of 10 per cent of meat-meal. The experiment covered a period of 165 days, practically the entire time from weaning to marketing.

TABLE XLVIII. — BLUE-GRASS AND TIMOTHY VERSUS CLOVER AND ALFALFA

FORAGE	AVERAGE NUMBER PIGS PER ACRE	AVERAGE DAILY GAIN PER PIG	CONCENTRATES TO PRODUCE 100 LB. GAIN	CONCENTRATES SAVED BY ONE ACRE FORAGE[2]	PORK ACCREDITED ONE ACRE FORAGE[2]
	lb.	*lb.*	*lb.*	*lb.*	*lb.*
Blue-grass and timothy . .	13.9	.72	393.32	111.12	27.78
Alfalfa . . .	13.9	.99	367.23	746.40	186.60
Clover . . .	13.9	1.07	251.56	1195.12	298.78
Clover . . .	13.9	1.07	354.55	1120.52	280.13

Considering that straight corn was fed in all lots except for the last 39 days, the gains made were exceptionally good. The amount of pork credited to each acre of forage would undoubtedly have been greater if a small

[1] Bull. 136.

[2] Figured on the basis that 4 pounds of concentrates would have been required for each pound of gain in dry lot feeding.

quantity of meat-meal had been fed earlier in the test. The relative merits of the crops is well shown by the rates of gain and the concentrates required to produce 100 pounds of gain. The superiority of the legumes, clover and alfalfa, over the blue-grass and timothy is very marked. Clover gave slightly better results in this experiment than did alfalfa, although the authors of the bulletin, as the result of other studies, rank it below alfalfa in value. The uniformity of the results from the two lots on clover testifies to the care exercised in making the different lots comparable.

In Table XLIX are shown the results secured from feeding spring pigs on blue-grass pasture at the Missouri Station.[1] In these tests enough of a grain ration consisting of 6 parts corn and 1 part linseed-oil meal was fed to secure a gain of approximately $\frac{3}{4}$ pound daily.

TABLE XLIX. — RESULTS FROM PASTURING BLUE-GRASS

Year	Number Days Pastured	Average Number Pigs per Acre	Total Gain per Acre	Total Concentrates Fed per Acre	Concentrates Fed for Each 100 lb. Gain
			lb.	*lb.*	*lb.*
1908 . . .	144	14	1400	7164	510
1909 . . .	144	12	1282	5612	430
1910 . . .	200	12	2112	8792	420
1911 . . .	196	11.34	1985	9323	470
1912	145	12	1445	6070	440
Average . .	165	12	1645	7392	450

These pigs weighed approximately 200 pounds on the average at the close of the grazing seasons. A cost of

[1] Bull. 110.

450 pounds of grain for each 100 pounds of gain may, therefore, be considered as fairly satisfactory.

Although timothy is not a valuable forage crop for pigs, it is sometimes profitable to make use of it for this purpose. It is very succulent and palatable, but low in its content of protein. It supplies considerably less protein in proportion to its carbohydrates than does either rye or blue-grass. As shown by experiments conducted at the Iowa Station [1] in 1906, the feeding of pigs on timothy gave fairly satisfactory results when compared with dry lot feeding. In Table L are given the averages for four lots on timothy and for comparable lots fed in the dry yard. The pigs in both the dry and forage lots were fed balanced rations.

TABLE L. — TIMOTHY VERSUS DRY LOT FEEDING

(Av. 4 Exps.)

	Number Pigs Grazed to 1 Acre	Average Initial Weight per Pig	Average Daily Gain per Pig	Concentrates Eaten for Each 100 Lb. Gain	Pork Credited 1 Acre Forage
		lb.	*lb.*	*lb.*	*lb.*
Dry lot . . .	—	59	.938	461	—
Timothy . .	11	57	1.240	406	197

SORGHUM — CANE

Sorghum is used more or less extensively as a forage for swine in the southern part of the corn-belt and farther south and in the semi-arid regions of the Southwest. Its chief merit is its ability to furnish a heavy tonnage of succulent feed in a dry hot season. It should be pas-

[1] Bull. 91.

tured ordinarily while the plant is young and tender, or when one to two feet tall, although it is sometimes allowed nearly to mature before turning in. Results of feeding trials conducted at the Alabama Experiment Station,[1] however, showed that the latter method did not give profitable returns for the crop. The following tabulated results were secured at the Missouri Experiment Station [2] when pastured early. The plants were one to two feet high when the experiments began. The pigs were fed balanced rations and were turned in when weighing from 60 to 90 pounds each.

TABLE LI. — RESULTS FROM PASTURING SORGHUM

Year	Number Days Pastured	Number Hogs per Acre	Total Gain per Acre	Total Concentrates Fed per Acre	Concentrates Fed for Each 100 Lb. Gain
			lb.	*lb.*	*lb.*
1910	105	14	1412.	6584	460
1912	68	16	869.3	3112	350
Average . . .	86.5	15	1140.6	4848	405

The chief fault of this crop as a forage is its coarseness and its carbonaceous nature. It is more suitable for cattle or sheep than it is for pigs.

SOYBEANS

Although primarily a southern crop, soybeans are grown very successfully as far north as the corn-belt. When conditions are favorable to good yields, it is of value as a forage crop for pigs. When grown on inocu-

[1] Bull. 143. [2] Bull. 110.

lated land it is a good soil builder, and its richness in protein insures excellent results when foraged by pigs fed corn. Being particularly a hot weather crop, it is usually available in the late summer and fall. In the South it will furnish considerable valuable forage and much nitrogen for the soil when grown as a second crop following grain. It may be pastured as a green forage by turning in before the pods begin to form, or as a seed crop by keeping the pigs off until the leaves begin to turn and the seed to mature. The stiff woody nature of the growth of most varieties would suggest that it could be used more profitably for its seed than for its leaves. If the seeds are allowed to mature, one acre of good beans will furnish enough protein for grazing shotes to balance four acres of 50-bushel corn. The bean itself contains practically as much protein as linseed-oil meal. Its value as a supplement to corn has encouraged the practice of planting it with the corn which is to be "hogged down." In seasons of sufficient rainfall, the growth of beans is thought to have little effect on the yield of corn.

Soybeans as a forage crop, however, has certain limitations. It does not provide grazing through a long period. When foraged chiefly as a seed crop, its use is limited to the fall and early winter; when used as a green forage, it is not available until quite late in the summer. Also, soybeans tend to produce soft pork. When pigs grazing the mature beans are fed little or no additional grain, as is commonly the practice in the South, the carcasses will lack the firmness to escape dockage by the packer. When followed by a month or more of corn feeding, however, the effects are not noticeable with pigs of the lard type.

Limited versus full feeding on soybeans.

At the Alabama Experiment Station [1] the feeding value of soybeans as a forage crop was studied in experiments covering three seasons. The results of these trials, averaged, are shown in Table LII. The pigs were in growthy condition weighing 40 to 45 pounds at the beginning of the grazing periods, and possessed some improved blood of the common lard breeds. In each year the pigs were turned in about three or four weeks before the beans themselves were ready to use, or about one week after full bloom. The object was to begin grazing early enough so that the leaves would not be lost, yet late enough to permit most of the pods to fill. To handle the crop successfully in this way, the authors cautioned against heavy stocking at first.

TABLE LII. — SOYBEAN FORAGE FOR PIGS (Average of 3 years)

	Grain Fed	Rate of Grazing	Average Number Days Grazed	Average Daily Gain per Pig	Corn Fed for Each 100 Lb. Gain	Grain + Pasture Cost of 100 Lb. Gain [2]
				lb.	*lb.*	
Dry lot	Corn-meal			.375	609	$7.61
Soybeans	Corn-meal ¼ full feed	10 pigs 1 acre	43	1.102	68	2.59
Soybeans	Corn-meal ½ full feed	10 pigs 1 acre	48	1.006	138	3.36
Soybeans	Corn-meal ¾ full feed	10 pigs 1 acre	62	1.329	175	3.17

This is a demonstration in the possibilities of economical pork-production in the South. The value of this crop

[1] Bull. 154.

[2] Corn at 70 cents a bushel; pasture at $8.00 an acre.

not only as a soil builder, but as a furnisher of protein to balance corn, is strikingly shown when the results of dry lot feeding are compared with those from the forage lots. There may be more economical methods of balancing corn in the South, but that this is one of them seems clear. In the corn-belt, pigs foraging the mature soybeans ordinarily should receive a full ration of corn, for otherwise the pigs will obtain an excess of protein in their diet. The advisability of limiting the grain fed when pigs are on forage in general is discussed in Chapter IX.

Soybeans versus rape.

The value of soybeans when used as a green forage crop for 45-pound pigs, when compared with rape, is suggested by the results of an experiment conducted at the Ohio Station.[1] The pigs were turned in on the forage crops July 15 when the plants were about ten inches high and remained 77 days, or until November 10. The results from these lots are shown in the following table:

TABLE LIII. — SOYBEAN FORAGE VERSUS RAPE

Forage	Number Pigs and Area Grazed	Average Grain Fed Daily per Pig	Average Daily Gain per Pig	Concentrates Fed for Each 100 Lb. Gain	Pork Accredited to One Acre Forage
	lb.	*lb.*	*lb.*	*lb.*	*lb.*
Soybeans . .	6 pigs, $\frac{1}{4}$ acre	2.43	.85	285	472.4
Rape . . .	6 pigs, $\frac{1}{4}$ acre	1.79	.80	224	666.8

[1] Bull. 242.

The superiority of rape when the two crops are handled under these conditions seems evident from the above results.

At the Missouri Station,[1] records were kept of the returns in pork obtained from the Medium Yellow variety of soybeans during four seasons. The pigs were turned in after the pods were well formed and fed straight corn in quantities equal to three-fourths of a full feed. The results are shown in Table LIV.

TABLE LIV. — RESULTS FROM SOYBEAN FORAGE

Year	Number Days Pastured	Average Number Pigs per Acre	Total Gain per Acre	Total Corn Fed per Acre	Corn Fed for Each 100 Lb. Gain
			lb.	*lb.*	*lb.*
1909	33	10	311	1560	503
1910	42	12	298	588	197
1911	35	9.7	287.3	672	230
1912	16	26.	152	416	273
Average . . .	31	14.4	262	809	301

These results are not favorable to the soybeans when grown and handled under these conditions. The unsatisfactory returns obtained from an acre were explained by the authors as being due largely to the difficulty of securing a good stand. They recommend for best results that the land be inoculated before the beans are sown.

COWPEAS

Much of what has been written concerning soybeans as a forage crop will apply to the cowpea, particularly

[1] Bull. 110.

as regards its value as a soil-builder, its richness in protein as a feed, and its general adaptability to southern conditions. Cowpeas are considered more strictly a hay or forage crop, while soybeans are usually looked on more as a seed crop. Any locality which can grow cowpeas successfully has a valuable forage crop for pigs during the late summer and fall. Because of its nitrogenous nature, pigs fed corn on cowpea forage require no additional feed.

Cowpeas versus dry lot.

At the Alabama Station[1] three lots of pigs were pastured on cowpeas and one was fed in the dry lot. In each forage lot two plantings of peas were provided, one early and the second a month later. The peas were practically mature when the pigs were turned in. The pigs were of normal quality and weighed an average of 53 pounds when the test began, August 12. The experiment covered a period of 60 days and ceased November 5. The results are shown in the table on the following page.

The pigs on forage in this experiment made faster gains than did those in the dry lot and there was a saving of 367 pounds of grain in the production of 100 pounds of gain as a result of the forage eaten. But the area of forage grazed was so large in each lot that the charge of $8.00 an acre was sufficient to make the cost of gains, in dollars and cents, greater than in the dry lot. Although the cost of gain is but one of the factors which must be considered in determining the actual profit or loss, it is doubtful whether a yield sufficient only to graze but little more than two pigs to the acre for 60 days would be profitable. The popularity of cowpeas

[1] Bull. 168.

as a forage crop in many states would suggest that better yields are usually secured than were obtained for this experiment.

TABLE LV. — COWPEAS VERSUS DRY LOT

FORAGE	GRAIN FED	NUMBER PIGS AND AREA GRAZED	AVERAGE DAILY GAIN PER PIG	GRAIN FED FOR EACH 100 LB. GAIN	TOTAL PASTURE AND GRAIN COST OF 100 LB. GAIN[1]
		pigs	*lb.*	*lb.*	
Dry lot	9 corn + 1 tankage Full feed	5 pigs	.54	540	$7.16
Cowpeas	9 corn + 1 tankage ½ full feed	5 pigs 2¼ acres	.97	159	8.35
Cowpeas	4 corn + 1 shorts ½ full feed	5 pigs 2¼ acres	.94	188	8.96
Cowpeas	Corn alone ½ full feed	5 pigs 2¼ acres	.90	173	8.80

In Table LVI are shown the results at the Missouri Station[2] from grazing pigs on the Whippoorwill variety of cowpeas during five different seasons. These pigs were fed rations of straight corn at the rate of about three-fourths of a full feed. From 1 to 1½ bushels of seed were drilled to the acre. Part of the peas were drilled solid and part in rows 34 inches apart.

The dates on which the pigs were turned in during the different years were as follows, in order, September 23, August 28, September 13, September 23, and September 21. In 1911 the season was very late and the peas were pastured too early for best results. The crop of

[1] Corn at 70 cents a bushel; shorts at $36.00 a ton; tankage at $40.00 a ton; and pasture at $8.00 an acre.

[2] Bull. 110.

1912 was badly injured by an early frost. The small returns in these two years are, therefore, the result of inferior yields. In only two of the five years were the pork returns satisfactory.

Table LVI. — Results from Pasturing Cowpeas

Year	Number Days Pastured	Average Number Pigs per Acre	Total Gain per Acre	Total Corn Fed per Acre	Corn Fed for Each 100 Lb. Gain
			lb.	*lb.*	*lb.*
1908	33	14	756	2200	330
1909	32	12	502	1270	253
1910	42	12	176	784	445
1911	25	13.5	171.2	504	283
1912	22	12	54.6	264	482
Average . . .	32.8	12.7	331.9	1004.5	358

PEANUTS; VELVET BEAN; CHUFAS

The peanut gives excellent results when the underground seeds or nuts are foraged by pigs. It is a legume adapted to the South, rich in nitrogenous matter, and of unusual value in improving the soil for subsequent crops. The nuts themselves are very rich in oil as well as protein. When the pigs are allowed to eat the nuts without additional feed, the pork produced is soft and of inferior quality. When fed corn, rice by-products, or other carbonaceous feeds, however, the effect is not particularly noticeable. Also, if pigs which have been fed exclusively on peanuts are subsequently given a month or more of corn feeding, sufficient firmness of the carcass would seem to be assured. When grown for the purpose of improving the soil and to furnish a reliable yield of protein feed for the pigs to harvest themselves, peanuts appear to be one of the most valuable crops for producing pork economically in the South.

Peanut forage versus dry lot.

In Table LVII are presented the average results of three years' experimental work done at the Alabama Experiment Station.[1] The peanuts were grown on poor sandy soil. Two of the three crops were below 40 per cent of an average yield. The pigs were turned in on September 21, September 26, and October 11, respectively, and were grazed an average of 53 days. A mixture of coal, lime, and salt was fed the pigs in both the peanut and dry lots.

TABLE LVII. — PEANUT PASTURE VERSUS DRY LOT (Average of 3 years)

	Grain Rations Fed	Total Pigs Each Lot	Av. Initial Wt. per Pig	Av. Daily Gain per Pig	Av. Corn Fed for Each 100 Lb. Gain	Corn Saved by 1 Acre Peanuts
			lb.	*lb.*	*lb.*	
Dry lot	Corn Full feed	15	73	.69	611	
Peanut pasture	Corn $\frac{1}{2}$ full feed	32	81	1.01	148	1028

This is a very good showing for peanuts, especially when one remembers that succeeding crops, especially cotton, are greatly benefited.

The velvet bean is another legume especially adapted to the Gulf States. The following results of a feeding trial

[1] Bull. 143.

conducted at the Alabama Station[1] suggest that a profitable method of utilizing this crop is to allow the pigs to do the harvesting. In this experiment the beans were planted in with corn, and the pigs turned in after the corn had been shucked. Because of continual drought throughout the season, the yield of cowpeas was very disappointing. The pigs averaged 62 pounds when the test began October 4, which lasted 72 days, or until December 15.

TABLE LVIII. — VELVET BEAN VERSUS COWPEA FORAGE

Forage	Grain Rations Fed	Number Pigs and Area Grazed		Average Daily Gain per Pig	Concentrates Fed for Each 100 Lb. Gain	Pasture[2] and Grain Cost of 100 Lb. Gain
		pigs:	*acres*	*lb.*	*lb.*	
Dry lot	9 corn +1 tankage Full feed	5		.84	400	$5.30
Cowpeas	9 corn +1 tankage ½ full feed	5	1.1	.76	208	9.56
Velvet bean	9 corn +1 tankage ½ full feed	5	1.9	1.23	170	5.29

Because of the protein nature of both the cowpea and velvet bean forages, it is doubtful whether a protein supplement is necessary, especially when only a half ration of corn is fed. The velvet bean, nevertheless, made an excellent showing in this experiment, especially when the area grazed is credited with the corn as well as the pork produced. When the mature velvet bean

[1] Bull. 168.

[2] Corn at 70 cents a bushel; tankage at $40.00 a ton; forage at $8.00 an acre.

seed is fed, recent investigations indicate that it is not eaten with sufficient relish to insure profitable gains.

In the following table is presented a summary of average results obtained with different forage crops tested at the Alabama Experiment Station. The experiments were conducted in 1905–06, 1906–07, and 1907–08.

TABLE LIX. — SUMMARY OF AVERAGE RESULTS WITH DIFFERENT FORAGE CROPS AT THE ALABAMA EXPERIMENT STATION

RATIONS FED	TOTAL NUMBER PIGS	AVERAGE DAILY GAIN PER PIG	FEED TO PRODUCE EACH 100 LB. GAIN	
			Concentrates	Pasture Area
		lb.	*lb.*	*acre*
Corn alone . .	15	.69	611	
Corn [1] Peanut pasture	32	1.01	183	.44
Corn $\frac{2}{3}$,[1] Cottonseed meal $\frac{1}{3}$, Peanut pasture	4	1.00	158	.08
Corn Sorghum pasture . . .	6	.37	437	.57
Corn $\frac{2}{3}$, cottonseed meal $\frac{1}{3}$,[2] Sorghum pasture . . .	11	.46	388	.26
Corn Chufa pasture	3	.72	305	.41
Corn Soybean pasture	6	1.02	158	.28
Corn $\frac{2}{3}$, cottonseed meal $\frac{1}{3}$ Sorghum soiled	5	.75	271	.13

[1] These lots are not comparable.

[2] Cottonseed meal is dangerous when fed for a longer period than a month.

RECOMMENDATIONS FOR FORAGE CROP PLANTINGS

For every farm there is probably a succession or rotation of forage crops which is more suitable and valuable than any other. It should be the purpose of every hog-raiser to determine this. With the idea of supplementing the records of experimental studies, there are given in the following tables the forage crops which have been recommended in the different states as being best adapted to their respective conditions, together with other useful information regarding rate of seeding, time and rate of pasturing.

TABLE LX. — FORAGE CROPS FOR INDIANA [1]

Crops	Approximate Date of Sowing	Rate of Sowing per Acre	Approximate Time of Pasturing	Number of 100-Lb. Pigs per Acre
SERIES I				
Oats . . .	Mar. 20–Apr. 10	2–3 bu.	May 1–June 1	8–12
Rape . . .	Apr. 1–15	2–6 lb.	May 25–July 1	12–20
Rape . . .	Apr. 15–May 1	2–6 lb.	June 25–July 25	12–15
Clover, red or mammoth . .	Mar. 25–Apr. 15		July 15–Sept. 1	8–10
Cowpeas or soybeans.	May 20–June 10	½ to 1½ bu.	Aug. 25–Oct. 15	12–18
Rye . . .	Aug. or Sept.	1 to 1½ bu.	Oct. 1 to freezing	10–15
SERIES II				
Rye . . .	Aug. or Sept.	1 to 1½ bu.	Apr. 1–May 15	8–10
Rape . . .	Apr. 1–10	2–6 lb.	May 15–June 15	12–20
Rape . . .	Apr. 20–30	2–6 lb.	June 15–July 15	12–20
Rape . . .	Apr. 1–10	2–6 lb.	July 10–Aug. 1	12–20
Clover . .	Mar. 25–Apr. 10		July 15–Sept. 1	8–10
Cowpeas .	May 20–30	½ to 1½ bu.	Aug. 20–Oct. 10	12–18
Rye . . .	August	1 to 1½ bu.	Oct. 1 to freezing	
SERIES III				
Rape and oats . .	Apr. 1–10 Apr. 20–May 1	2–4 lb. rape 1½ bu. oats	May 15–June 15	12–20
Rape . . .	Alternate between	2–6 lb.	June 10–July 15	12–20
Rape . . .	previous sowings	2–6 lb.	July 15–Nov. 15	12–15

[1] Fisher and King: Circ. 35, Ind. Exp. Sta.

TABLE LXI. — FORAGE CROPS FOR MISSOURI [1]

Crops	Approximate Date of Sowing	Month Available for Pasture	Number of Hogs per Acre
Blue-grass		April	6– 8
Rye	August and September	"	8–12
Wheat	September and October	"	6–10
Blue-grass and white clover		May	6–10
Clover	Previous spring	"	8–12
Oats and rape. . .	April 1–10	"	15–20
Alfalfa	Not less than 1 year old	"	15–20
Timothy	Previous year	"	8–12
Clover	Previous year	June	8–12
Alfalfa	Not less than 1 year old	"	15–20
Rape and oats . .	April 15–30	"	20–25
Blue-grass and white clover		"	8–10
Clover and timothy .	Old, or spring sown	July	8–12
Alfalfa	1 year old	"	15–20
Rape	May 15–June 1	"	12–15
Sorghum	April 15–May 1	"	20–25
Alfalfa	1 year old or over	August	12–15
Clover	Spring sown	"	8–12
Rape	April 1–10, grazed down once	"	12–15
Sorghum	June 1–10	"	20–25
Alfalfa	Previous year	Septembe	15–20
Rape	July, or April 15–30, grazed down once	"	20–25
Blue-grass and white clover		"	6–8
Cowpeas	June 15	"	12–20
Sorghum	July 1	"	20–25
Blue-grass and white clover		October	5–7
Timothy and clover.	Spring	"	8–10
Alfalfa	1 year old	"	12–15
Cowpeas	July in corn	"	12–15
Rye	August and September	"	8–10
Wheat	September	"	6–8
Blue-grass		November	6–8
Rye and crimson clover	August and September	"	8–10
Rape	July and August, or second growth	"	12–15
Clover	Spring	"	10
Alfalfa		"	10–12
Rye	August and September	December, January, February and March	
Wheat	September and October	"	
Blue-grass		"	

[1] King: Vol. 7, No. 5; Mo. State Bd. Agr.

As the result of the experimental studies at the Missouri Experiment Station, Mumford and Weaver recommended the following rotation as being ideal for Missouri conditions.

TABLE LXII. — FORAGE ROTATION FOR MISSOURI [1]

YEAR	FIELD NO. 1	FIELD NO. 2	FIELD NO. 3	FIELD NO. 4	FIELD NO. 5
First . .	Blue-grass	Rape, oats, and clover	Clover	Sorghum	Corn and cowpeas
Second .	"	Clover	Sorghum	Corn and cowpeas	Rape, oats, and clover
Third .	"	Sorghum	Corn and cowpeas	Rape, oats, and clover	Clover
Fourth .	"	Corn and cowpeas	Rape, oats and clover	Clover	Sorghum

TABLE LXIII. — FOUR-YEAR FORAGE ROTATIONS FOR NORTH DAKOTA [2]

YEAR	LOT I	LOT II	LOT III	LOT IV
1st				
First	Peas	Peas	Grain	Clover
Second	Peas	Grain	Clover	Peas
Third	Grain	Clover	Peas	Peas
Fourth	Clover	Peas	Peas	Grain
2d				
First	Brome	Rape	Peas	Corn
Second	Brome	Peas	Corn	Rape
Third	Brome	Corn	Rape	Peas
Fourth	Corn	Rape	Peas	Brome

[1] Mumford and Weaver: Bull. 110, Mo. Exp. Sta.
[2] Richards: N. Dak. Exp. Sta. Bull. 83.

Table LXIV. — Pasture Crops for Sub-Humid Districts [1]

Crops	Approximate Date of Sowing	Approximate Time of Pasturing	Number Hogs per Acre
Winter wheat . .	Early in September	Oct. 15–Nov. 15, Mar. 15–June 1	5–8
Clover	April, previous year	April 10–Dec. 1	8–15
Alfalfa	A previous year	April 15–Nov. 15	8–15
Kale or rape . .	April and May	June 15– Dec. 1	8–15
Rape and clover .	May 1	July 10–Nov. 15	6–14
Winter wheat . .	Early in May	June 1–Nov. 15	6–15
Wheat in corn .	July 15–20	Sept. 15–Nov. 15	6–12
Stubble field . .		Aug. 25–April 1	

Table LXV. — Forage Crops for North Carolina [2]

Crops	Approximate Date of Sowing	Date of Sowing per Acre	Approximate Time of Pasturing
Rye	Aug. 1–Dec. 1	$1\frac{1}{2}$ bu.	Oct. 1–Apr. 20
Rye and crimson clover	Aug. 1–Oct. 1	1 bu. 15 lb.	Nov. 15–Apr. 25
Oats	Sept. 10–Nov. 15	$1\frac{1}{2}$–2 bu.	Nov. 1–July 15
Wheat	Sept. 15–Dec. 1	$1\frac{1}{2}$ bu.	Nov. 30–July 15
Oats and vetch . .	Aug. 10–Oct. 1	$1\frac{1}{2}$ bu. $\frac{1}{2}$ bu.	Nov. 15–Apr. 20
New Era cowpeas .	May 15–July 15	1 bu.	July 10–Oct. 15
Soybeans	May 15–July 15	1 bu.	July 15–Oct. 15
Carolina field peas and oats	Feb. 15–Mar. 1	1 bu. 1 bu.	Apr. 15–June 15
Alfalfa	Sept. 1–Oct. 15	30 lb.	May 20–Sept. 20
Bermuda grass . .	Mar. 15–May 15	Root-stocks	June 1–Aug. 15
Spanish peanuts . .	May 15–July 15	2 bu. in hills	Sept. 1–Dec. 15
Sweet potatoes . .	May 1–July 1	10,000 plants per acre	Sept. 15–Dec. 1
Mangels	Apr. 20–May 15	4–5 lb.	Oct. 15–Jan. 1
Chufas	Apr. 1–May 10	2 bu.	Sept. 15–Jan. 1
Artichokes	Nov. 1–Feb. 20	3–5 bu.	Nov. 1–Mar. 1
Burr clover . . .	Sept. 1–Oct. 1	20 lb. cleaned 40 lb. burr	Dec. 1–Mar. 1
Red clover	Sept. 10–Oct. 15	15 lb.	Apr. 1–June 15
Japan clover . . .	Apr. 1–May 15	25 lb.	June 1–Sept. 15
White clover . . .	Sept. 1–Oct. 1	5–8 lb.	Dec. 15–June 1
Rape	Aug. 15–May 1	6 lb.	8–10 weeks from seeding

[1] Hunter: Farmers' Bull. 599, U. S. Dept. Agr.
[2] Curtis: Bull. 207, N. C. Exp. Sta.

TABLE LXVI. — SUCCESSION OF FORAGE CROPS FOR ALABAMA [1]

CROPS	APPROXIMATE DATE OF SOWING	RATE OF SOWING PER ACRE	NUMBER DAYS AFTER PLANTING UNTIL READY TO GRAZE
FALL PLANTINGS:			
Alfalfa . .	Sept. 1–Oct. 15	15–25 lb.	90–120
Burr clover	Sept. 1–Oct. 1	15–20 lb. cleaned 36 lb. in burr	90–120
Oats . . .	Sept. 1–Nov. 1	1½ to 3 bu.	90–120
Rape . . .	Sept. 20–Oct. 15	4–6 lb. drilled 5–10 lb. broadcast	60–75
Rye . . .	Sept. 1–Nov. 1	1½ –2 bu.	90–120
Vetch . .	Sept. 1–Oct. 15	1 bu.	90–120
SPRING PLANTINGS:			
Alfalfa . .	Feb. 25–April 1	15–25 lb.	75–90
Chufas . .	Mar. 15–June 1	3–4 pks.	120–150
		½ bu. drilled	
Cowpeas .	May 1–July 10	1½ bu. broadcast	75–90
Japan clover	Mar. 1–Mar. 15	24 lb.	60–75
Oats . . .	Feb. 1–Mar. 20	1½–3 bu.	75–90
Peanuts . .	May 1–June 30	1–2 bu. unhulled	90–120
		4–6 lb. drilled	
Rape . . .	Mar. 1–31	9–10 lb. broadcast	60–75
Sorghum .	Apr. 1–June 30	1½–2 bu.	60–90
		½ bu. drilled	
Soybeans .	Apr. 1–June 30	1½ bu. broadcast	90–120

[1] Gray, Duggar, and Ridgway: Bull. 143, Ala. Exp. Sta.

CHAPTER IX

METHODS OF FEEDING ON FORAGE

THE question whether pigs fed corn or other home-grown grains when on green forage should receive in addition a nitrogenous supplement like tankage, shorts, or linseed-oil meal, is one which demands the attention of nearly all hog-raisers. Three important factors affect this problem and should be considered before a decision is reached. These are: first, the composition of the forage, particularly as regards its supply of protein; second, the age of the pigs; and third, whether a full or a limited grain ration is fed. In addition, the price of these supplements must be considered in every case.

THE COMPOSITION OF FORAGE CROPS

The ability of a forage successfully to balance a straight grain ration depends on its richness in protein and the quantity of forage eaten by the pigs. That some forage crops contain more protein than others, and that the same forage varies widely at different states of its growth, are shown by the analysis presented in Table LXVII.

It is generally understood that the legumes — alfalfa, clovers, soybeans, and cowpeas — are considerably richer as a class in protein, in proportion to the amount of carbohydrates, than are the non-legumes like rape, green rye, blue-grass. An examination of this table, however, will fail to show any great difference, especially when the analyses are made at the stages of growth when eaten by the pigs. Rape is shown here to contain a larger proportion of protein to carbohydrates than does medium red clover, and as much as alfalfa. Blue-grass, green rye, oats, and green wheat when grazed while young and before jointing would appear to be in the same class as rape. With advancing maturity, however, these crops, excepting rape, rapidly lose their protein nature and become as fattening in their proportions as corn.

The younger the pig, other things being equal, the more protein does his system require. A forage supplying sufficient protein to balance corn for fall pigs weighing more than 100 pounds might require the addition of some supplement for spring pigs weighing less than 100 pounds. For the same reason, pigs farrowed in the spring require less protein in the late summer than early in the summer.

When pigs are given a full ration of corn on forage, they eat less forage both absolutely and relatively than when the grain ration is limited to a three-fourths or a half ration. The more intensive the grain feeding, therefore, the greater the necessity of adding some meat-meal, middlings, and the like, to the grain fed. When young pigs are fed only a half grain ration on alfalfa, it is very doubtful whether a supplement is warranted; but when given a full feed of grain on alfalfa, a protein supplement might be profitable.

EXPERIMENTAL FEEDING TRIALS

A consideration of practical feeding tests, however, is necessary properly to supplement our limited knowledge of the composition of the different forage crops and the other factors involved. The advisability of giving

TABLE LXVII. — COMPOSITION OF FORAGE CROPS

Forage	Stage of Growth	Water	Protein	Carbohydrates		Fat (Ether Extract)	Ash	Ratio of Protein[1] to Carbohydrate Equivalent	Station and Bulletin
				Nitrogen-free Extract	Crude Fiber				
Blue-grass . . .	Green-heads well browned	52.49	5.25	20.42	15.19	1.35	5.27	1 : 7.42	Iowa 136
"	Before heading	76.20	5.30	9.30	5.20	1.30	2.70	1 : 3.34	"Feeds and Feeding"
"	7 in. high	82.52	4.66	5.88	3.90	1.32	1.72	1 : 2.80	Kentucky 175
Blue-grass and timothy	Blue-grass well headed Timothy not shooting	64.30	2.78	17.53	12.37	.67	2.30	1 : 11.35	Iowa 136
Green rye	6 in. high	81.86	4.51	7.52	2.93	1.00	2.18	1 : 2.87	" "
" "	5 in. high	81.90	6.50	6.54	1.99	.90	2.17	1 : 1.52	Kentucky 175
" "	27 in. high	82.82	2.72	8.02	4.20	.65	1.59	1 : 5.08	" "
Green wheat	5 in. high	75.80	6.54	10.07	3.90	.69	3.00	1 : 2.39	" "
" "	24 in. high	78.24	2.31	11.09	5.96	.65	1.75	1 : 8.08	" "
Green oats	8 in. high	86.96	4.90	4.00	1.71	.83	1.60	1 : 1.58	" "
Rape (Dwarf Essex)	14 in. high	90.77	2.13	4.05	1.46	.31	1.28	1 : 2.94	Iowa 136
" " "	20 in. high	89.08	2.81	3.73	1.88	.40	2.10	1 : 2.35	" "
Rape (edible portion only)	24–28 in. high	80.98	5.37	9.88	1.16	.65	1.97	1 : 2.35	" "
Oats, Canadian field peas, and rape	Rape 14 in. high	85.04	2.63	5.42	4.84	.63	1.44	1 : 4.49	" "
Oats, Canadian field peas, and rape	Oats ½ in. head Rape 20 in. high	85.48	3.16	4.64	3.43	.45	2.84	1 : 2.90	" "

Oats, red clover, and rape	Rape 11–14 in. high Very little clover	84.59	2.08	6.66	4.69	.39	1.59	1 : 5.97	Iowa 136
Oats, red clover, and rape	Rape 20 in. high Oats ½ in. head Very little clover	85.83	2.58	5.20	3.71	.48	2.19	1 : 3.91	" "
Medium red clover	One-half in bloom	78.98	4.00	8.34	6.24	.53	1.91	1 : 3.97	" "
" " "	Full bloom	74.06	4.13	11.47	7.05	.66	2.63	1 : 4.88	" "
" " "	11 in. high	81.25	4.31	9.20	2.64	.59	2.01	1 : 3.08	Kentucky 175
Alfalfa	9 in. high	73.11	4.09	9.20	10.82	.46	2.32	1 : 5.17	Iowa 136
"	8 in. high	84.35	4.71	5.59	2.87	.55	1.93	1 : 2.08	Kentucky 175
Alfalfa (edible part only)	10 in. high	75.75	7.44	11.28	2.34	.52	2.67	1 : 2.00	Iowa 136
Sweet clover, yellow	8–10 in. high	72.50	5.30	11.13	6.89	.95	3.23	1 : 3.84	" "
Sweet clover (edible part only)	"	78.38	6.56	8.64	1.88	1.20	3.34	1 : 2.06	" "
White clover	6 in. high	82.69	4.46	5.24	2.27	.57	4.77	1 : 2.00	Kentucky 175
Soybeans, green	12 in. high	80.69	3.12	9.21	4.33	.52	2.13	1 : 4.75	" "
Cowpeas, green	"	85.50	2.97	6.55	2.47	.53	1.98	1 : 3.48	" "
Shelled corn	. . . . .	10.5	10.1	70.9	2.00	5.00	1.50	1 : 8.45	"Feeds and Feeding"

[1] Carbohydrate equivalent determined by adding to the carbohydrates the product of the pounds of fat multiplied by 2¼.

a nitrogenous concentrate when pigs are fed on forage will be suggested by the results of experiment station studies tabulated in the following pages.

Supplements for pigs on rape.

In Table LXVIII are the results obtained at the Missouri Experiment Station when pure-bred Poland-China gilts on good rape forage were fed different rations. The pigs were spring-farrowed and averaged 40 pounds in each lot at the beginning of the test, which lasted 112 days.

TABLE LXVIII. — CORN VERSUS CORN AND A SUPPLEMENT FOR PIGS ON RAPE [1]

Rations	Forage	Average Daily Feed per Pig	Average Daily Gain per Pig	Concentrates Fed for Each 100 Lb. Gain
		lb.	*lb.*	*lb.*
4 corn+ 4 shorts+ 1 bran+ 1 tankage	Rape	3.50	1.01	348
9 corn+ 1 tankage	"	3.50	1.05	332
1 corn+ 1 shorts	"	3.50	.96	364
1 corn+ 4 skim-milk	"	1.88 corn 6.04 skim-milk	.98	193 corn 772 skim-milk
Corn alone	"	3.10	.80	390

These gilts averaged approximately 153 pounds when the experiment closed. In all cases the feeding of a supplement with the corn gave faster gains than when

[1] L. A. Weaver: Poland-China Journal, July, 1917.

the corn was fed alone. There was also a saving in the feed required for each 100 pounds of gain. The ration of 9 parts of corn and 1 of tankage proved the best. With normal prices, this ration would give more profitable results than corn alone.

Evvard of the Iowa Experiment Station[1] fed different proportions of meat-meal or tankage with corn to spring pigs on alfalfa and rape with the following interesting results, as shown in Table LXIX.

TABLE LXIX. — BEST PROPORTION OF TANKAGE TO FEED WITH CORN TO PIGS ON RAPE AND ALFALFA

RATIONS	FORAGE	AVERAGE NUMBER PIGS PER ACRE	LENGTH OF PERIOD	AVERAGE DAILY GAIN PER PIG	CONCENTRATES FED FOR EACH 100 LB. GAIN
			days	*lb.*	*lb.*
Corn alone	Rape	25	160	.81	338 corn
$12\frac{1}{2}$ corn + 1 tankage	"	25.9	160	.93	316 corn 25 tankage
$8\frac{1}{5}$ corn + 1 tankage	"	27.3	160	.96	311 corn 38 tankage
7 corn + 1 tankage	"	28.3	160	.96	309 corn 44 tankage
Corn alone	Alfalfa	44.4	190	.64	398 corn
$13\frac{5}{8}$ corn 1 tankage	"	43.5	190	.94	329 corn 24 tankage

Regarding the advisability of feeding tankage or meat-meal to pigs on rape, Evvard says: "Rape requires very little if any supplement. Our experience indicates, and the above figures are in line with this, that about 5 per

[1] Proc. Am. Soc. Animal Nutrition: 1913.

cent as much meat-meal as corn is sufficient in the growing and fattening of spring pigs while on rape."

The feeding of the 7 to 8 per cent of tankage with the corn was profitable here with the pigs on alfalfa.

At the Ohio Station, one lot of pigs was fed corn alone on rape, and a second corn and tankage on rape. These pigs were spring farrowed and weighed about 44 pounds each when the test began. The experiment lasted 77 days. The following table shows the results:

TABLE LXX. — CORN VERSUS CORN AND TANKAGE FOR PIGS ON RAPE[1]

RATIONS	FORAGE	AVERAGE FEED DAILY PER PIG	AVERAGE DAILY GAIN PER PIG	CONCENTRATES FED FOR EACH 100 LB. GAIN
		lb.	*lb.*	*lb.*
Corn alone .	Rape	1.79	.77	231.8
9 Corn and 1 tankage .	"	1.79	.80	201.24 corn 22.36 tankage

The pigs in this experiment were fed a very limited amount of grain and the rates of gain in the two lots were practically the same. Twenty-two pounds of tankage effected a saving only of 30 pounds of corn. Straight corn was, therefore, practically as efficient as corn and tankage. At the usual prices, corn alone was the more profitable ration. In interpreting the results of this trial, one should remember that no more than half rations were fed.

Amount of supplements on alfalfa.

In the following table are summarized the results of one experiment conducted at the Kansas Experiment

[1] Carmichael and Eastwood: Ohio Exp. Sta. Bull. 242.

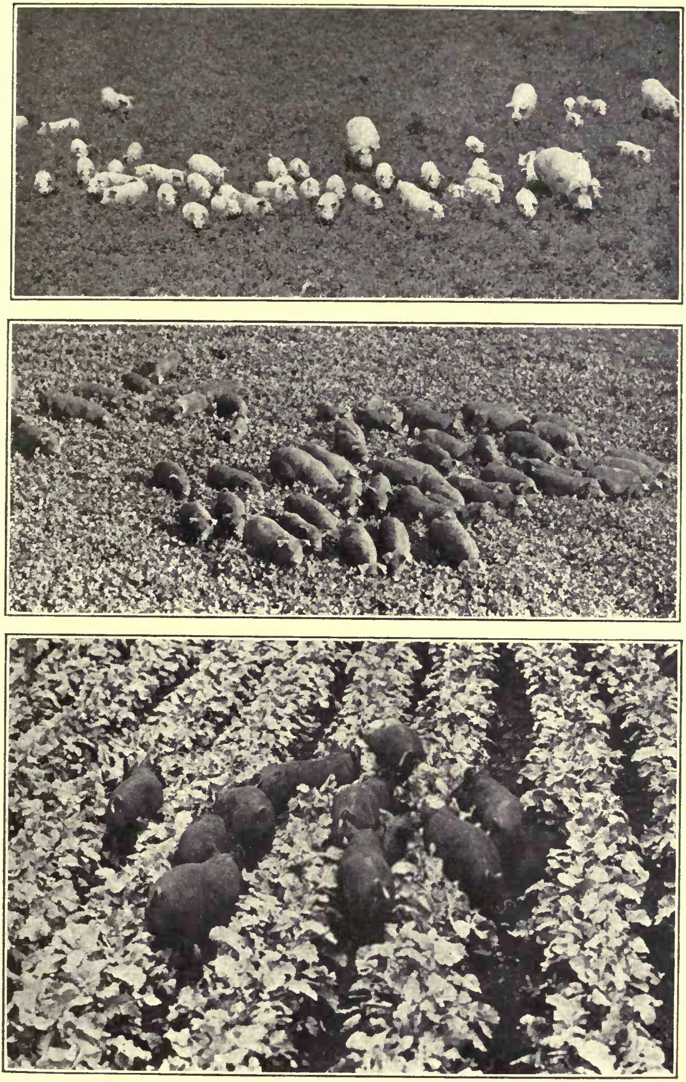


PLATE V. — *Above*, Sows and pigs on alfalfa; *middle*, Pigs in clover; *below*, Pigs in rape.

Station and two at the Nebraska Station. The pigs in the Kansas experiment averaged 32 pounds when the test began and in the Nebraska experiments 39 and 68 pounds respectively. Full grain rations were fed in the former; while practically one-half rations were fed in the first Nebraska experiment.

TABLE LXXI. — CORN ALONE VERSUS CORN AND A SUPPLEMENT FOR PIGS ON ALFALFA [1]

RATIONS	FORAGE	NUMBER PIGS	AVERAGE FEED DAILY PER PIG	AVERAGE DAILY GAIN PER PIG	CONCENTRATES REQUIRED FOR EACH 100 LB. GAIN
			lb.	*lb.*	*lb.*
Corn alone	Alfalfa	10	2.48	.649	384
Corn 62%, Shorts 30%, Tankage 8%	"	10	4.29	1.222	351
Corn alone	Alfalfa	30	2 lb. per cwt.	.63	173
3 corn 1 shorts	"	30	"	.53	196
95% corn, 5% tankage	Alfalfa	8	—	1.03	345
90% corn, 10% tankage	"	8	—	1.03	349

The results from these experiments appear contradictory. Just why the pigs fed corn alone in the first experiment did not eat more and gain faster is not clear. When weanling pigs are fed half rations on good alfalfa pasture, the results of the first Nebraska experiment would indicate that the addition of a protein supplement

[1] Kans. Exp. Sta. Bull. 192, Wright. Neb. Exp. Sta. Bull. 99 and 94, Snyder and Burnett.

is altogether unnecessary. The composition of green forage makes this seem reasonable. In the second Nebraska experiment, 5 per cent of tankage with corn proved as efficient as 10 per cent.

Supplements for pigs on winter rye.

Two experiments at the Kentucky Experiment Station were calculated to answer the question as to whether it was necessary to feed a nitrogenous supplement with corn to young pigs on winter rye. The pigs in both trials averaged about 48 pounds at the beginning. The experiments began in November and closed in May and April, respectively.

TABLE LXXII. — CORN ALONE VERSUS CORN AND SOYBEANS OR TANKAGE FOR PIGS ON WINTER RYE [1]

FORAGE	RATIONS	NUMBER OF PIGS	AVERAGE FEED DAILY PER PIG	AVERAGE DAILY GAIN PER PIG	CONCENTRATES REQUIRED TO PRODUCE 100 LB. GAIN
			lb.	*lb.*	*lb.*
Corn-meal	Winter rye	5	3.21	.78	411
6 corn-meal + 1 soybean meal	" "	4	3.58	.98	365
Corn-meal	Winter rye	7	4.09	.85	480
10 corn-meal + 1 tankage	" "	7	4.25	1.13	376

In these experiments it was profitable to feed the soybeans and tankage. Although young rye is very rich in its content of protein, the quantity of forage eaten on the dry matter basis, especially during the

[1] Good: Ky. Exp. Sta. Bull. 175.

winter, would seem to be insufficient to supply the requirements of the pigs when given a full feed of corn.

Supplements for pigs on timothy and blue-grass.

An experiment conducted at the Iowa Experiment Station compared a ration of corn alone with one made up of 2 parts corn and 1 shorts, and another of 5 parts corn to 1 meat-meal, for 59-pound pigs on timothy pasture. A fourth lot of pigs on red clover was fed corn alone. The experiment covered a period of 112 days, beginning July 24 and closing November 13. The results are shown in the following table:

TABLE LXXIII. — CORN ALONE VERSUS CORN AND A SUPPLEMENT FOR PIGS ON TIMOTHY[1]

RATIONS	FORAGE	NUMBER OF PIGS	AVERAGE FEED DAILY PER PIG	AVERAGE DAILY GAIN PER PIG	CONCENTRATES REQUIRED TO PRODUCE 100 LB. GAIN
			lb.	*lb.*	*lb.*
2 corn + 1 shorts	Timothy	10	4.50	1.12	400.90
5 corn + 1 meat-meal	"	10	5.48	1.37	409.60
Corn alone	"	10	4.17	.92	451.40
Corn alone	Clover	10	4.97	1.19	416.10

The pigs given meat-meal with their corn were approximately 50 pounds heavier at the close of the experiment than were those fed corn alone on timothy. Not only did these pigs gain faster, but less feed was required to produce a given gain. One pound of meat-meal replaced

[1] Kennedy and Robbins: Iowa Exp. Sta. Bull. 91.

1.6 pounds of corn. With normal prices for feed, this would not mean a saving in the actual cost of producing 100 pounds of gain, but the heavier weight and the quicker market finish of those fed meat-meal would insure a profit. A smaller proportion of meat-meal would probably have been more profitable. The pigs fed shorts with their corn made somewhat faster gains than those given corn alone, but with the usual prices the cost of gains was no cheaper.

It is apparent from these results that when rapid gains and a quick market finish are especially desired, the feeding of a nitrogenous supplement might be profitable. The excellent showing of the pigs on clover compared with the other lots is about what would be expected from a knowledge of its composition.

The best proportion of tankage to feed with corn to 48-pound pigs when on a pasture of blue-grass and timothy was tested in an experiment at the Ohio Experiment Station[1] lasting 140 days. The results are shown in Table LXXIV.

TABLE LXXIV. — THE BEST PROPORTION OF TANKAGE TO FEED WITH CORN ON BLUE-GRASS AND TIMOTHY[1]

Rations	Forage	Number of Pigs	Average Feed Daily per Pig	Average Daily Gain per Pig	Concentrates Required to Produce 100 Lb. Gain
			lb.	lb.	lb.
9 corn and 1 tankage	Blue-grass and timothy	8	4.71	1.25	375.3
19 corn and 1 tankage	"	8	4.62	1.19	389.4

[1] Carmichael and Ridgway: Ohio Exp. Sta. Bull. 242.

The green feed available for these pigs was not abundant at any time. The difference in the rate of gain, and the amount of total concentrated feed required to produce 100 pounds of gain in the two lots was very small, though favoring slightly those fed the larger proportion of tankage. With corn figured at 56 cents a bushel and tankage 48 dollars a ton, the pigs fed the smaller proportion of tankage made the cheaper gains. One hundred pounds of gain on the 10 per cent of tankage ration cost $4.28, while on the 5 per cent tankage ration the cost was only $4.17, a difference of 11 cents.

Corn alone on clover.

At the Iowa Experiment Station one lot of pigs on medium red clover was fed a ration of straight corn, while a second similar lot on clover was given corn with 10 per cent meat-meal added. The experiment began June 20 and closed November 10, covering a period of 141 days. The pigs were given full rations during the last 85 days only. The results of this test are shown in Table LXXV.

TABLE LXXV. — CORN ALONE VERSUS CORN AND TANKAGE FOR PIGS ON CLOVER[1]

Rations	Forage	Number of Pigs	Average Initial Weight per Pig	Average Daily Gain per Pig	Concentrates Fed for Each 100 Lb. Gain
			lb.	*lb.*	*lb.*
Corn alone	Medium red clover	18	39	.84	370.63
9 Corn 1 Tankage	"	15	39	1.13	334.10

[1] Evvard, Kildee, and Kennedy: Iowa Exp. Sta. Bull. 136.

With 56-cent corn and $40 a ton tankage, the cost of producing 100 pounds of gain would be practically the same on the two rations. The more rapid gains of those fed tankage, however, would indicate that the tankage feeding would be profitable when an early finish is desirable.

Oats, Canadian field peas, and rape.

Another experiment at the same station sought to determine the best proportion of meat-meal to feed pigs while grazing a forage mixture of oats, Canadian field peas, and rape. These pigs were full fed during the last 100 days only, although receiving liberal rations during the first 60 days. The experiment began June 13 and lasted 160 days. The results are shown in Table LXXVI.

TABLE LXXVI. — BEST PROPORTION OF MEAT-MEAL TO FEED WITH CORN TO PIGS ON A MIXTURE OF OATS, CANADIAN FIELD PEAS, AND RAPE [1]

RATIONS	FORAGE	NUMBER OF PIGS	AVERAGE INITIAL WEIGHT PER PIG	AVERAGE DAILY GAIN PER PIG	CONCENTRATES FED FOR EACH 100 LB. GAIN
			lb.	*lb.*	*lb.*
19 corn and 1 meat-meal .	Oats, Canadian field peas, and rape	21	26	1.15	351.44
9 corn and 1 meat-meal .	"	21	25	1.16	367.41

In this experiment, the smaller proportion of meat-meal produced the cheaper and more economical gains, and practically as rapid.

[1] Evvard, Kildee, and Kennedy: Iowa Exp. Sta. Bull. 136.

General summary.

In the absence of more definite information regarding the best proportion of nitrogenous supplements to feed with corn or other similar grains under different conditions, the following general summary of suggestions is made in Table LXXVII. These suggestions are largely based on the foregoing experimental studies and take account of the age of pigs, the composition and quality of the forage crops, and whether full or limited grain rations are fed. To simplify the statement, the proportion of protein supplement recommended is stated in terms of tankage or meat-meal containing 55 to 60 per cent of protein. By reference to Table CXXII, page 279, the amount of shorts, middlings, linseed-oil meal, and the like, which would supply approximately the same proportion of protein in the ration, can be determined.

TABLE LXXVII. — SHOWING PROPORTION OF NITROGENOUS SUPPLEMENTS TO FEED WITH CORN TO PIGS ON FORAGE

FORAGE	FOR PIGS WEIGHING LESS THAN 100 POUNDS		FOR PIGS WEIGHING MORE THAN 100 POUNDS	
	When fed full grain rations for rapid gains	When fed limited grain rations for moderate gains	When fed full grain rations for rapid gains	When fed limited grain rations for moderate gains
When on alfalfa, clover, Canadian field peas, rape, or a mixture of any of these with oats	5–10% Best grade tankage or meat-meal	0–5% Best grade tankage or meat-meal	0–5% Best grade tankage or meat-meal	None
When on blue-grass, timothy, green rye, oats, sorghum, or similar forages	8–12% Best grade tankage or meat-meal	6–8% Best grade tankage or meat-meal	6–8% Best grade tankage or meat-meal	0–5% Best grade tankage or meat-meal
When on fairly mature soybeans, cowpeas, or peanuts	None	None	None	None

It will be noted that there is a considerable range in the proportion of supplement recommended for a given group of forages and for pigs of a given weight and system of feeding. This is because of the normal variations which occur in the abundance and quality of forage supplied by a given crop in different years, as well as the normal differences in composition which exist between the forages of the same group. It frequently happens that the crop is so much below average that the desired rate of gain can only be secured by a larger proportion of supplement even than the maximum figure recommended in the table. On the other hand, when the forage is abundant and palatable, the smaller proportions will be sufficient because of the larger quantity of the protein-rich forage eaten.

Another reason why exact quantities cannot be stated is because of the variations which may occur from year to year in the relation of the price of corn and the price of supplements in general. When grain is cheap and supplements relatively high, a smaller proportion of supplement to grain will be more profitable than when grain is high and the commercial supplements cheap. When barley, rye, wheat, or oats, or any mixture of these is fed, a slightly smaller proportion of the protein supplement is required than when corn is used.

FEEDING A GRAIN RATION TO PIGS ON FORAGE

The digestive apparatus of the pig is so limited in capacity that he is unable to make even moderate gains on green forage alone. Pigs weighing less than 100 pounds fail to maintain their weight on ordinary pastures, especially if they have previously been fed some grain.

Thrifty growthy shotes weighing 100 pounds or more will ordinarily do just a little better than maintain their weight when on the best of forages. Thin mature sows will hold their own on good pasture and will make a gain of as much as a half pound daily on alfalfa, clover, or rape. Much depends, however, on their condition, previous feeding, and the quality of the forage. Although well-grown thrifty pigs may maintain their weight on good forages alone for a period of several months, they lose condition, take on a rough appearance, and become extremely "pot-bellied" in appearance. They apparently grow in bone and stature, but lose in weight and fat.

The problem of the feeder, however, is not one of maintenance but of production. He is concerned, not with the cost of maintaining his pigs at a constant weight, but with the cost of producing the gains which will insure market finish or breeding development. An important principle to remember at this point is that it is only that part of the ration fed above maintenance which is available for growth or fat production. In the production of pork, therefore, the returns from the entire ration are determined by the quantity fed in excess of the maintenance requirements. Some grain is necessary if continuous gains are made. Just how much grain should be fed while the pigs are on forage in order to insure the greatest economy of production, all factors considered, is the question to which we will now give our attention.

Pigs intended for market

In the production of market pigs, the problem of deciding whether full or limited grain feeding, with good forages, is the most suitable and profitable for a given farm should first be considered in its larger aspect; namely, with reference to the primary purpose for which the hogs are produced and the general system of feeding which best suits the plan of management followed for the farm as a whole. This phase of the question has already been discussed in the earlier pages of Chapter VII.

The other considerations which affect the problem more directly are the rate and cost of gains during the forage season; the rate and cost of gains during the dry lot feeding period; the proportion of old and new corn used in full as against limited feeding while on forage; and the time of marketing as affected by limited *versus* full feeding while on forage.

Rate and cost of gains during forage season.

Most of the experimental work done to help solve the question of whether a full or a limited ration on forage was the most efficient and profitable has been confined to a study of the forage period only, rather than for the entire period from weaning to the time market weights had been attained. Since 1904, fifteen separate experiments [1] of this kind have been conducted in which twenty-five comparisons of limited *versus* full grain feeding have been made. A careful study of the results furnished by these practical tests, considered individually and collectively, supports the following conclusions:

(1) The more liberal the grain feeding, the faster were the gains. Maximum gains were made only when full

[1] Neb. Exp. Sta. Bull. 99; Kans. Exp. Sta. Bull. 192; Ala. Exp. Sta. Bull. 147; Iowa Exp. Sta. Circ. Letter; Ohio Exp. Sta. unpublished data; Ill. Exp. Sta., Circ. Letter; Ind. Exp. Sta., unpublished data.

rations were fed. In all the experiments there was no exception to this result.

(2) The feeding of but one-fourth a full grain ration secured a gain of as much as ½ pound daily only when the pigs were on the best of forage. It would seem that the gains made on limited rations, especially when fed one-half full feed or less, are more largely dependent on

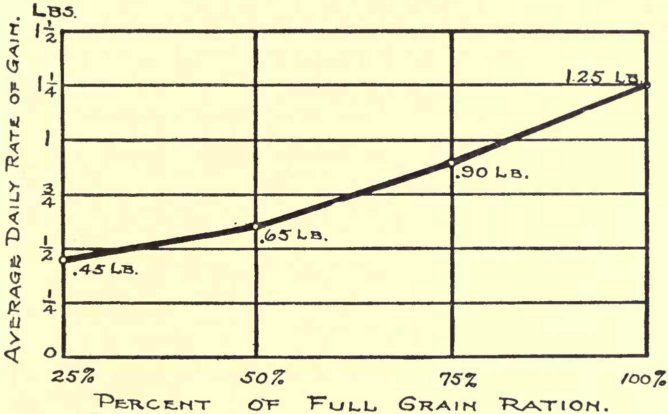


Fig. 9. — Relation of intensity of feeding spring pigs on forage to the rate of gain.

the quality and abundance of the forage than are the gains made by pigs fed the heavier grain allowances.

A summary study of the gains made in these experiments seemed to justify the expectation that good spring pigs on first-class forage crops will, when fed limited rations, make gains closely approximating those indicated in Fig. 9.

(3) With respect to the amount of grain consumed for each 100 pounds of gain made by the pigs on the different rations, a survey of the experimental results referred to

above indicated that, as a rule, the heavier the grain allowance the larger was the grain consumption for a unit of gain. The exceptions to this rule were when the pigs were fed such a limited ration that their daily gains were less than $\frac{1}{3}$ pound, and in other cases, when the quality or abundance of the forage was not up to standard. This conclusion is expressed graphically in Fig. 10, which is based on the summarized results of these studies.

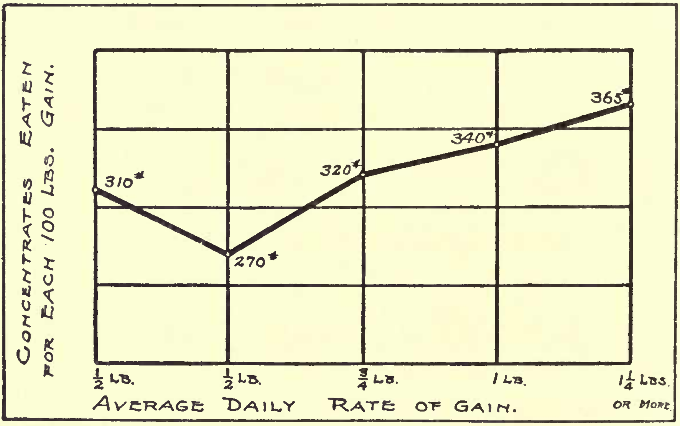


FIG. 10 — Relation of the rate of gain made by pigs on forage to the amount of concentrates required for each one hundred pounds gain.

Rate and cost of gains during the entire feeding period.

It is not possible to say from the figures just considered which is more profitable, a limited or a full grain ration. This is true because pigs fed during the summer on limited rations do not reach marketable weights by the end of the forage season, in consequence of which there is necessitated a longer subsequent period of dry lot feeding for those fed the restricted rations. Since the number of pounds of grain required to produce a unit of gain is greater for pigs fed in the dry lot and at heavier weights than for pigs on forage and of lighter weights, it is necessary to feed the different lots to the same market weight before a reliable comparison can be made.

A study of the results of three series of experiments recently made at the Iowa, Illinois, and Indiana stations,[1] together with the results of experiments covering the forage period only, indicate that we may expect results under the average of good farm conditions closely approximating those shown in Table LXXVIII.

TABLE LXXVIII. — RATE OF GAIN AND FEED REQUIRED FOR EACH 100 POUNDS GAIN DURING FORAGE AND DRY LOT PERIODS

Method of Feeding on Forage	Average Daily Gain per Pig on Forage	Average Weight per Pig at End of Forage Period	Concentrates for Each 100 Lb. Gain on Forage	Average Daily Gain per Pig, Dry Lot Period	Number Days Dry Lot Feeding	Concentrates for Each 100 Lb. Gain Entire Period
	lb.	*lb.*	*lb.*	*lb.*	*days*	*lb.*
¼ full feed, or 1% weight daily . .	.45	95	285	1.25	104	505
½ full feed, or 2% weight daily . .	.65	120	295	1.25	84	435
¾ full feed, or 3% weight daily . .	.90	150	335	1.25	60	400
Full feed . .	1.25	193	365	1.25	26	400

[1] Evvard and Dunn, Iowa Exp. Sta., Circ. Letter; W. J. Carmichael, Ill. Exp. Sta., Circ. Letter; Skinner and Smith, Ind. Exp. Sta., unpublished data.

In Table LXXIX the actual amount of concentrates which would be fed in the forage and dry lot periods is calculated from the above figures. The results are stated in terms of shelled corn and tankage, and assume that the latter makes up 8 per cent of the ration, on the average.

TABLE LXXIX. — EFFECT OF LIMITED VERSUS FULL FEEDING ON FORAGE ON THE TOTAL AMOUNT AND PROPORTION OF OLD AND NEW CORN REQUIRED FROM 40 TO 225 POUNDS WEIGHT

METHOD OF FEEDING ON FORAGE	OLD CORN EATEN ON FORAGE		NEW CORN EATEN IN DRY LOT		TOTAL BUSHELS SHELLED CORN	TOTAL POUNDS NUMBER 1 TANKAGE
	Number bushels	Per Cent entire amount	Number bushels	Per Cent entire amount		
¼ full feed, or 1% weight daily . .	2.57	17	12.78	83	15.35	75
½ full feed, or 2% weight daily . .	3.88	29	9.34	71	13.22	64
¾ full feed, or 3% weight daily . .	6.05	50	6.11	50	12.16	59
Full feed . .	9.17	75	2.99	25	12.16	59

The above table serves to illustrate the important principle that as the intensity of grain feeding increases from a limited to a full ration on forage, the proportion of old to new corn fed increases. In other words, full rations during the summer on forage necessitate a large use of old corn and permit of only a minimum use of the cheaper new corn; while the feeding of limited rations during the summer results in a minimum use of old corn and a maximum use of new corn. Pigs farrowed March 1st will ordinarily reach market weights six weeks before pigs farrowed April 1st. With the best grade of pigs and abundant forage, even April pigs will frequently make the gains which will enable their marketing direct from the forage field.

In total feed consumed, the results show a saving of more than a bushel of corn for each pig by feeding full

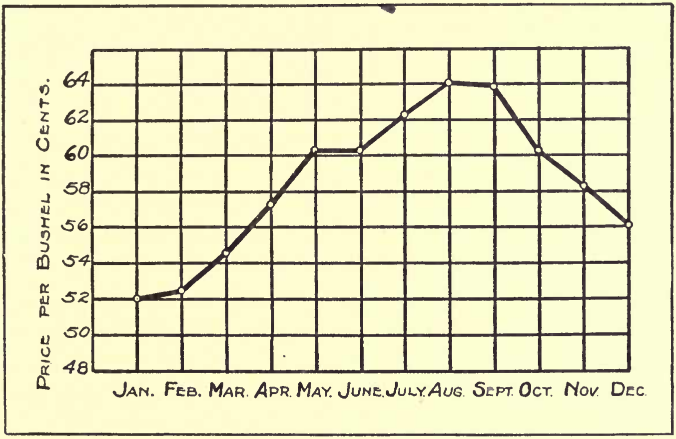


FIG. 11. — Monthly price fluctuations of No. 2 corn on Chicago market, 1903–1914.

or three-fourths full rations while on forage than when a half ration or less was given. The total feed consumed in the different systems of feeding does not, however, give a reliable basis for the determination of the feed cost of production, since new corn is cheaper than old. For this reason, the actual cost for the limited-fed pigs is less than these figures by themselves would suggest.

The variation in the price of corn during the different months of the year is shown in Fig. 11. This curve is based on the actual price of standard No. 2 corn on the Chicago market for the ten-year period from 1903 to 1914, inclusive. According to this curve, the average forage-feeding period of June 15 to October 15 comes when the price of corn is high. The average price for these months was 61.6 cents a bushel, while for the immediate succeeding four months it was 55.6 cents, a difference of 6.1 cents a bushel. Actually there is a greater spread than this on the farm, because the feeding of new corn commences very much earlier than the marketing of new corn, or before its presence on the market can be felt. The farm price of new corn for November and December is probably lower, therefore, than is indicated by the above curve. The actual feed cost of production stated in dollars and cents would be less, therefore, for the pigs fed three-fourths ration while on forage than for those given the full rations.

Time of marketing as affected by system of feeding.

There still remains an additional point which must be noted. Pigs which are full fed on forage reach marketable weight earlier than do limited-fed pigs, and the early market is usually the better one. For the twelve years from 1905 to 1916, the average price of hogs on the Chicago market in September and October was approximately 57 cents a hundred higher than in December and January. From year to year, the pigs fed the more liberal rations on forage have the advantage of selling at a time when the supply is relatively low and the price high (see Chapter XVI). This advantage, however, will hold only so long as the great bulk of the spring pig crop is marketed in

December and January as at present. According to the figures in the above table, a difference in selling price of only 7.6 cents a hundredweight in favor of the full-fed pigs as compared with those receiving three-fourths rations would be sufficient to make up for the difference between them in the cost of production.

In Fig. 12 are shown the weight curves of pigs from birth to the weight of 225 pounds when fed full and limited rations on forage. The attempt is here made to show graphically the effect of different systems of feeding during the summer on the gains in weight and the time of marketing. All the pigs are assumed to gain 1.25 pounds daily during the dry lot periods.

Summary and conclusions.

The feeding of limited grain rations to pigs on forage during the summer results in the following advantages: 1. Pigs fed a limited ration make a minimum use of expensive old corn and a maximum use of the cheaper new corn in producing the necessary gains. This is its most important advantage. 2. The amount of grain required to produce a unit of gain while the pigs are on forage is usually less with limited than with full rations. 3. The feeding of limited rations during the summer fits in well with the practice of hogging-down corn in the fall and is adapted to the production of pigs suitable for following cattle during the winter.

The important advantages of full feeding on forage may be enumerated as follows: 1. Pigs fed full grain rations on forage make faster gains during the summer than do pigs receiving limited rations. In consequence they are ready for an earlier market, the risks from disease and other sources of loss are reduced, the money

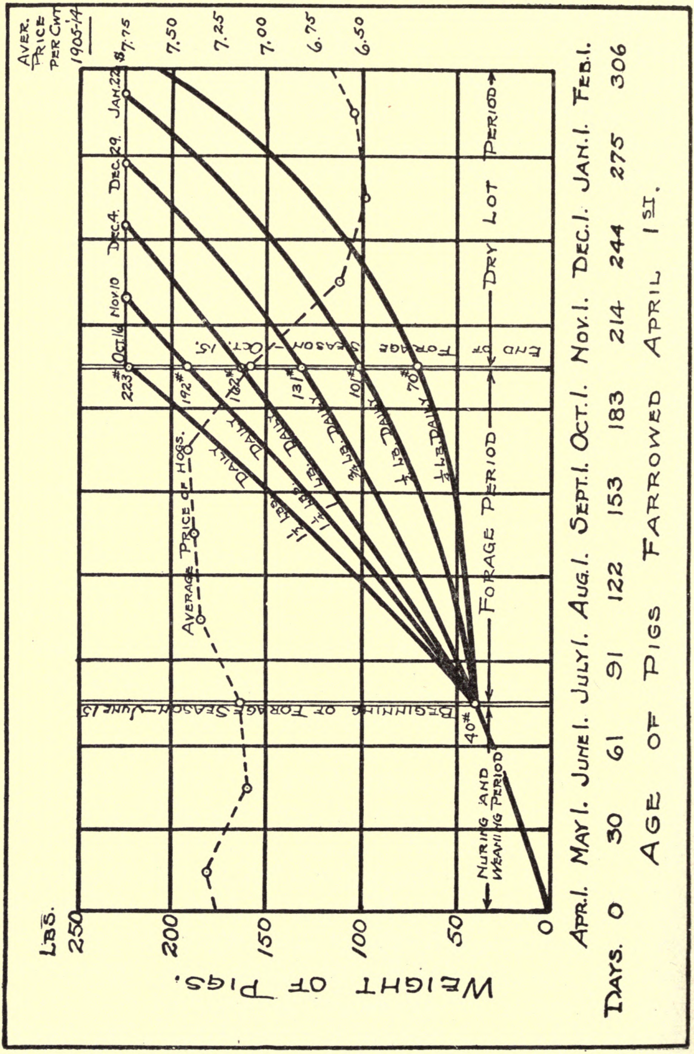


FIG. 12. — The effect of limited and full grain rations on forage to the rate of gain and time of marketing.

invested in the pigs is made available sooner, and expense for labor and winter equipment is spared. 2. The length of the dry lot feeding period is reduced to a minimum when full grain rations are fed during the summer. Pigs farrowed in February and March may be marketed direct from the forage field. 3. Less total concentrates are required in the production of a 225-pound market pig when full or three-fourths full rations are fed on forage than with more limited rations. Between three-fourths rations on forage and full rations there seems to be no consistent difference. When the forage supply throughout the summer is excellent, slightly less total concentrates will probably be required with three-fourths than with full ration. 4. Although old corn is more expensive than new, under normal conditions in the corn-belt the actual money cost of growing and fattening a 225-pound market pig is less with full or three-fourths rations than when more limited grain rations are fed. 5. An important advantage for the method of full feeding during the summer arises from the better price usually received for the earlier marketed pigs.

Considering the grain cost of production, the time required by the pigs to attain market weight, and the selling price as affected by early or late marketing, the advantages seem to lie with the system of feeding which supplies either full or three-fourths grain rations while the pigs are on forage. The only justification for the practice of feeding less than three-fourths rations during the summer to pigs intended for direct marketing would seem to be, therefore, the scarcity or abnormally high price of corn and suitable corn substitutes.

This conclusion, it should be understood, applies only to farm conditions in which the pigs are produced mainly for the purpose of marketing corn. Pigs intended for following cattle during the winter ordinarily should not be fed full rations in the summer. Also, the business of producing feeder or stocker pigs has already developed to some magnitude in localities which do not produce much corn, but where suitable growing feeds are available. Obviously the best practice for such conditions is to feed only the amount of grain which will promote fair gains and maintain thrift. Such conditions usually impose the limited-feeding system.

Pigs intended for the breeding herd

In the feeding of market pigs, the objects are economy and rapidity of production. In the feeding of pigs intended for the breeding herd, the primary object is the production of a strong well-balanced breeding development, with size. Although economy of production is essential with breeding as with market pigs, it is secondary in importance.

Possible dangers from full feeding.

The question of whether constitution and breeding development are better promoted by full feeding on forage, or by the use of limited grain rations, is one which practical experience must be largely depended on to answer. The central question is concerned with the dangers which may attend full and unlimited grain feeding, in excessive fatness, "blind" teats, broken-down pasterns, and the failure to develop in a manner to insure reliable breeding traits with approaching maturity.

Conditions which affect the problem.

Breeding gilts and young boars may be injured permanently by the practice of feeding full grain rations during the summer. This is the verdict of the breeder who has been a careful and observant feeder. There are, of course, exceptions to this rule. When the forage is especially abundant and of good quality, and when the pigs are of the type which tend more to growth and late maturity than to fat production and early maturity, the little danger which may attend full feeding may be overbalanced by the advantages resulting from larger size, quicker and better sales of the pigs in the fall, or a larger and more attractive appearance at maturity. When the grain ration fed, also, is one which tends more to the production of growth than the formation of fat, and when considerable quantities of bulky feeds like ground oats, chopped alfalfa hay, or wheat bran are fed, the probability of danger is still further reduced.

The system adopted by the breeder, then, is a question of judgment based on a careful consideration of the quality and abundance of the forage available, the type of his pigs, the character of the ration which he determines is best and most economical to feed, and the advantages which may come from good size and development at an early age. In addition, constant observation during the summer must be depended on promptly to correct any mistake in judgment which may have been made in the system of feeding previously adopted.

Summary and conclusion.

A safe procedure which will permit good growth and maximum breeding development is suggested by the following recommendations based on successful practice:

1. When full grain rations are fed, or when the self-feeder is employed, it is essential that the grains be

lightened up by the addition of some bulky feed like ground oats, fine quality of cut alfalfa or clover hay, or wheat bran. The proportion of these feeds should be determined and frequently regulated according to the degree of fatness of the pigs and the amount of exercise which they are taking. To avoid the evils of excessive fatness and inactivity, constant observation is required on the part of the feeder.

2. Under most conditions, best results can probably be secured by hand-feeding. By limiting the amount of grain to no more than three-fourths as much as will be eaten at any time, or a little less, the quantity of forage eaten and the amount of rustling done can be more accurately and as conveniently regulated by hand-feeding as when the self-feeder is depended on. With two-thirds to three-fourths full rations and good forage crops, the pigs will grow fast without running the danger of becoming too fat.

3. Breeding pigs which are to be shown should, of course, be pushed from the start; but most of the pushing should be done in July and August rather than in May and June. The financial value of show winnings is such that the pedigree breeder feels justified in intensive feeding even though the future breeding value of the gilt or boar is jeopardized.

4. Young boars and future breeding gilts are not injured by a reasonable amount of fat. Thrifty growthy pigs are never thin. Fine-boned pigs which are too early disposed to fat formation are not the kind the breeder should raise. Much of the injury assigned to excessive feeding can be assigned more properly to a wrong ideal of type in breeding.

GENERAL MANAGEMENT OF THE PIGS IN THE SUMMER

Sanitation.

The best results from any system of feeding are possible only when the pigs are under conditions which tend to promote health and thrift. This means that sanitary yards, clean drinking water, comfortable quarters, and a reasonable amount of exercise must be provided. The forage-crop system of feeding furnishes the conditions which make these essentials easy of attainment on the average farm.

The pigs must be kept free from worms and lice if health is maintained and every pound of feed eaten is to count in the production of profitable gains. The health of the pig crop must also be guarded by reducing as much as possible the dangers of cholera infection. The prompt administration of the serum treatment (Dorset-Niles) is the only known way of reducing the loss when cholera comes. If the pigs have already been rendered permanently immune by the double method of treatment, worry of possible cholera losses may cease (see Chapter XX).

Ringing.

Although it is the nature of a hog to root, his disposition toward an excessive amount can be curbed by the feeding of balanced rations, by providing a constant supply of green forage, and by having a mixture of salt, ashes, and charcoal constantly available. Under ideal conditions it is doubtful whether the pigs intended for early market should be rung at all. In any case, it should not be resorted to unless necessary to save valuable sod. Although pigs that have been properly rung suffer little inconvenience, it is also true that when carelessly performed it may be the cause of much annoyance or even suffering. Sore noses, the result of setting the rings too deep, or the use of rings which are too small, are often the cause for the failure of pigs to do well in the feed yard.

The morning feed of the pigs should be reduced materially the day they are to be rung, as the driving and excitement will tend to "upset" their digestive functions if full of feed. A home-made trap which catches and holds the pigs by the neck is a very practical and efficient method of securing them. This should be placed in the doorway of a pen and the pigs directed to it with hurdles, if a permanent chute is not a part of the equipment.

One ring placed in the center of the upper rim will be sufficient ordinarily for shotes, although three, one in the center and one on either side, are frequently necessary for old sows. The old-fashioned ring which joins in the flesh of the nose is objected to by some on the ground that it more frequently causes excessive soreness, than the so-called fish-hook ring. A criticism sometimes made of the latter, however, is that the connection of the ring offers too much opportunity for the accumulation of mud balls. The size of the ring should be such that when it is set at the correct depth the flesh will not be pinched or drawn. The ring should enter a little way back of the cartilaginous rim of the snout.

Shade and water.

The importance of shade and plenty of cool water during the summer is such as to warrant more attention than it usually receives. In the absence of natural shade, artificial shades should be provided, constructed in a way which permits the free passage of the air through them. Raised board floors will be cleaner and more free from dust than will dirt floors. Individual houses which are made with the sides hinged at the top so that they may be swung open make good summer shelters. The feeder who keeps his pigs well supplied with cool water in hot weather will secure gains when as good a feeder, careless about this point, will fail.

FEED COST OF RAISING THE PIG TO MARKET WEIGHT OR BREEDING AGE

In the following tables the feed cost of growing and finishing the market pig and of developing the gilt to breeding age is calculated. The figures are based on experimental feeding results previously considered and assume in the case of the pigs fed on forage during the summer that they were grazed at the average rate of fifteen to the acre.

TABLE LXXX. — COST OF FEEDING WEANLING PIG TO MARKET WEIGHT (35 TO 225 POUNDS)

I. With forage crops during the summer.

Total Pounds of Concentrates, or Number of Feed Units Required	Total Cost of Concentrates	Total Forage Crop Charge	Total Feed Cost
760	at 1 ¢ per lb. . . $ 7.60	at $10 per acre $ .67	$ 8.27
	at 1¼¢ per lb. . . 9.50	at $10 per acre .67	10.17
	at 1½¢ per lb. . . 11.40	at $12 per acre .80	12.20
	at 1¾¢ per lb. . . 13.30	at $12 per acre .80	14.10
	at 2 ¢ per lb. . . 15.20	at $14 per acre .92	16.12
	at 2½¢ per lb. . . 19.00	at $15 per acre 1.00	20.00

TABLE LXXX. — *Continued*

II. Under dry lot conditions.

Total Pounds of Concentrates, or Number of Feed Units Required	Total Feed Cost	
893	at 1 ¢ per lb.	$ 8.93
	at 1¼¢ per lb.	11.16
	at 1½¢ per lb.	13.39
	at 1¾¢ per lb.	15.63
	at 2 ¢ per lb.	17.86
	at 2½¢ per lb.	22.32

TABLE LXXXI. — FEED COST OF RAISING THE BREEDING GILT (35 POUNDS TO 200 POUNDS)

I. With forage crops during the summer.

Total Pounds of Concentrates, or Number of Feed Units Required	Total Cost of Concentrates	Total Forage Crop Charge	Total Feed Cost
577	at 1 ¢ per lb. . . $ 5.77	at $10 per acre $ .67	$ 6.44
	at 1¼¢ per lb. . . 7.21	at $10 per acre .67	7.88
	at 1½¢ per lb. . . 8.65	at $12 per acre .80	9.45
	at 1¾¢ per lb. . . 10.10	at $12 per acre .80	10.90
	at 2 ¢ per lb. . . 11.54	at $14 per acre .92	12.46
	at 2½¢ per lb. . . 14.42	at $15 per acre 1.00	15.42

TABLE XXXI. — *Continued*

II. Under dry lot conditions.

Total Pounds of Concentrates, or Number of Feed Units Required	Total Feed Cost	
680	at 1 ¢ per lb.	$ 6.80
	at $1\frac{1}{4}$¢ per lb.	8.50
	at $1\frac{1}{2}$¢ per lb.	10.20
	at $1\frac{3}{4}$¢ per lb.	11.90
	at 2¢ per lb.	13.60
	at $2\frac{1}{2}$¢ per lb.	17.00

CHAPTER X

HOGGING-DOWN CORN

At one time "hogging-down" corn was looked on by most farmers as a shiftless wasteful method of feeding; but the many advantages of this method of harvesting a part of the corn crop, as well as the good results in gains made by the hogs, has caused the practice markedly to increase during the last ten or fifteen years. The increasing scarcity of labor and the favorable reports from experimental tests have largely been responsible for a change in attitude among those farmers who formerly looked on the practice with disfavor.

"HOGGING-DOWN" VERSUS YARD FEEDING

The experimental studies at the Minnesota and Iowa Experiment Stations[1] have demonstrated that pigs do as well, and a little better, when harvesting their own corn as when the corn is husked in the usual way and fed to them at the barn. In Table LXXXII are the results of four direct comparisons of the "hogging-down" and the common yard, or dry lot, methods of feeding.

In the two Minnesota experiments, shorts were fed in each lot at the rate of 1 part shorts to about 4 parts of corn. In each of these tests, also, the pigs eating the standing corn had rape in addition, the result of

[1] Gaumnitz, Wilson, Bassett, Minn. Exp. Sta. Bull. 104. Evvard, Kennedy, Kildee, Iowa Exp. Sta. Bull. 143.

broadcasting in the corn at the rate of 3 pounds of seed to the acre just before the last cultivation. The fact that the yard-fed pigs did not have access to a forage crop would naturally tend to insure more rapid and economical gains for the field-fed pigs. In the first Iowa experiment, no supplement was fed in either lot; in the second, sufficient meat-meal was supplied in each lot to make up approximately 10 per cent of the gain eaten.

TABLE LXXXII.—HOGGING-DOWN CORN VERSUS YARD FEEDING (Minn. and Iowa Experiment Stations)

METHOD OF FEEDING	AVERAGE SUPPLEMENT FED DAILY	NUMBER PIGS AND AREA GRAZED	NUMBER DAYS	AVERAGE DAILY GAIN PER PIG	CONCENTRATES [1] REQUIRED FOR EACH 100 POUNDS GAIN
Minn. 1905					
Yard fed . .	1 lb. shorts per cwt.	13 pigs	49	.98	831 corn [2] 169 shorts
Hogging-down	1 lb. shorts per cwt.	26 pigs 3 acres	49	1.30	696 corn [2] 139 shorts
Minn. 1906					
Yard fed . .	1 lb. shorts per cwt.	8 pigs	51	1.09	573 corn 146 shorts
Hogging-down	1 lb. shorts per cwt.	32 pigs 3 acres	51	1.44	532 corn 103 shorts
Iowa, 1911					
Yard fed . .	None	10 pigs	60	.62	608.5 corn
Hogging-down	None	10 pigs $\frac{9}{10}$ acre	76	.42	721.5 corn
Yard fed . .	.51 lb. meat-meal per pig	10 pigs	60	1.17	356 corn 41 meat-meal
Hogging-down	.51 lb. meat-meal per pig	10 pigs $\frac{9}{10}$ acre	58	1.23	365.1 corn 43.7 meat-meal
Averages					
Yard fed . .		Total 41 pigs	55	.965	389.21 concentrates
Hogging-down		Total 78 pigs $7\frac{8}{10}$ acres	58	1.097	371.47 concentrates

[1] Corn was figured on the shelled basis.
[2] Green weight of corn, not shrunk.

No forage was supplied in either of these comparisons. The pigs in the first Minnesota experiment averaged 147 pounds, and in the second 125 pounds, when they went into the experiments. In both the Iowa tests, the pigs weighed at the beginning approximately 69 pounds. The Minnesota pigs were turned in November 29 and 9 respectively in the two experiments, and the Iowa pigs, September 19.

The averaged results of these four comparisons show the reliability and economy of the hogging-down system of feeding corn when well managed. With but one exception, namely, the first Iowa experiment, the pigs harvesting their own corn gained faster than did those fed in the usual way. In this comparison no supplement of any kind was fed. The authors of the experiment attributed the exceptionally poor gains made in this lot to the fact that the poor appetites of the pigs made it necessary to continue them in the field until December 4th to get them to clean up, at which time the weather had become bad and the field muddy.

TABLE LXXXIII. — EXPERIENCE OF 177 FARMERS WITH "HOGGING-DOWN" CORN AS COMPARED WITH DRY LOT AND PASTURE FEEDING [1]

IN HOGGING-DOWN CORN GAINS ARE	NUMBER REPORTING	PER CENT REPORTING ON EACH COMPARISON
More rapid	141	79.67 [2]
More economical	105	59.32
But little different	10	5.65
Less rapid	3	1.69
Less economical	1	.56

[1] Evvard, Kennedy, Kildee, Iowa Exp. Sta. Bull. 143.
[2] Some reported on more than one comparison.

As shown by the data in the preceding table, the experience of the practical feeder coincides with the results of experiment station studies. These figures were obtained by the Iowa Station in response to inquiries addressed to farmers who had experience with the hogging-down method of feeding.

Granting that the pigs gain as rapidly and as economically when hogging-down corn, as when fed from the scoop shovel or trough, the saving in labor alone would be sufficient to guarantee popularity for this method. The average cost of husking and marketing a bushel of corn as estimated by 148 farmers interviewed by the Iowa Experiment Station was 8.81 cents. The cost of husking alone is now 8 to 10 cents a bushel.

Other important advantages to which practical feeders testify are the following: Cribbing space is saved; the hogs develop strong constitutions and are in good condition for following cattle or for a short finishing feed in the dry lot; the droppings are left where they will do the most good, which insures cleaner yards at the barn and better prospects for the succeeding crop; and, when hogging-down is practiced, a poor stand of corn may be supplemented most advantageously by sowing rape or other forage crop at the time of last cultivation, thus insuring a larger return in pork or feed from a given area.

SUPPLEMENTAL FORAGE CROPS

In order that satisfactory results may be obtained from hogging-down corn, it is necessary that a nitrogenous supplement be provided either in the form of a commercial concentrate or a forage crop. The crop may be grown in with the corn or in the field adjacent to it. The forages most highly recommended are alfalfa, clover, rape, green rye, pumpkins, soybeans, and cowpeas. Excepting alfalfa and clover, these crops are often planted in the field with the corn. When the stand of corn is good and the rainfall favorable, a good yield of forage may be expected. In case the stand of corn is below average and weather conditions are favorable during the growing months, the yield of forage should be abundant.

TABLE LXXXIV. — SUPPLEMENTAL FORAGES FOR HOGGING-DOWN CORN (Iowa Exp. Sta. Bull. 143)

	Year	Average Initial Weight Pigs	Average Daily Gain per Pig	Estimate Yield of Corn per Acre	Pork Produced by One Acre	Cost of Growing Crops [1]	Comparative Cost [2] of Producing 100 Lbs. Gain
		lb.	*lb.*	*bu.*	*lb.*		
Soybeans forage	1909	82	1.573		619	$14.48	$2.34
Cowpeas forage	1909	82	1.216		504	14.48	2.87
Rape and pumpkins . . .	1910	92	.931		651.7	12.15	1.86
Soybeans forage	1910	92	.828		483.8	14.48	2.99
Canada field peas forage .	1910	50	.706		333.8	14.75	4.42
Hairy vetch forage . . .	1910	93	.418		292.8	17.15	5.85
None	1911	69	.420	46.02	357.2	11.15	3.14
Meat-meal 10%	1911	69	1.230	50.53	795.0	19.32 [3]	2.43
Soybeans forage	1911	68	.840	38.64	504.4	14.48	2.87
Green rye and 10% meat-meal . . .	1911	69	1.44	42.69	789.6	21.20 [3]	2.69

[1] Includes cost of both corn and forage.

[2] These figures determined by charging the corn at the actual cost of production, $11.15 an acre, rather than at the market price of the grain in the field.

[3] This includes the cost of the meat-meal purchased.

The Iowa Experiment Station[1] has done some useful work along the line of determining the most valuable forages to grow in Iowa cornfields which are to be hogged-down. These trials were conducted during the fall of 1909, 1910, and 1911. In 1909 the pigs were turned into the corn on September 14; in 1910 on September 9, excepting the lot with Canadian field peas for forage which was started July 29; and in 1911 on September 19. The plan was to turn the pigs in as soon as the corn was well dented. The pigs on the Canadian field peas in the 1910 experiment were started at the unusual date of July 29 because the peas were ripe at that time. The various lots were in the corn-fields from 42 to 76 days. The results obtained from the different crops are shown in the preceding table.

These results are interesting as well as instructive. In the 1909 experiment, soybeans proved themselves a more profitable crop than cowpeas as shown by the rate of gain, total pork produced by an acre of corn and forage, and the cost of the gains. Of the forages tested in the fall of 1910, rape and pumpkins demonstrated their superior qualities. This crop was mostly rape since an average of only forty pumpkins were produced to the acre. The pigs in this lot made faster and cheaper gains and produced considerably more pork from an acre than did those on any of the other forages tested. The authors say concerning the merits of this crop: "Taking everything into consideration on this corn-rape-pumpkin area, — the high yield of corn, the good stand of rape with a few pumpkins, the special adaptability of rape as a supplement to corn, the palatability of both rape and pumpkins combined with the vermifugal or

[1] Evvard, Kennedy, and Kildee, Bull. 143.

worm-expelling properties of the pumpkin seed, and the succulence of the two crops, — the reasons for the superiority of this combination are clear." Soybeans gave good results again in 1919, but the returns from the Canadian fields pea and the hairy vetch were not a credit to these crops. The fact that Canadian field peas are a cool weather crop, requiring a very short growing season, makes it ill-adapted for planting in corn. The yield of vetch was luxurious, but the unpalatable nature of the plant for hogs resulted in insufficient consumption for good gains, and the heavy yield materially reduced the supply of moisture and plant-food available for the corn. The authors of the experiment considered hairy vetch an utter failure for "hogging-down" purposes.

In 1911 four fields of corn were again "hogged-down," two of which only contained forages. Soybeans were grown in one and rye in the other. The results were very much in favor of the green rye when supplemented by the addition of a small quantity of meat-meal. The large amount of pork produced by an acre of the corn and rye forage was in part the result of the smaller yield of corn in the lot containing the soybeans. The pigs receiving no supplement, either in the form of a forage or a concentrate, made extremely unsatisfactory gains. The lot which received approximately 10 per cent as much meat-meal daily as it ate of corn gained nearly three times as rapidly, and from the same area of corn produced more than double the quantity of pork. It is apparently just as necessary properly to supplement standing corn as it is corn fed in the ordinary way. The effect of growing the forage in with the corn on the yield of corn is also suggested by these results.

The method and rate of planting, and the actual cost of growing the forage crops tested in these experiments, are shown in the following table:

TABLE LXXXV. — ACRE COST OF GROWING FORAGE SUPPLEMENTS [1]

SUPPLEMENTARY CROPS	YEAR USED	WHEN PLANTED	RATE OF SEEDING, LB.	CROP CHARGES		
				Seed	Seeding	Total
Dwarf Essex rape	1910	Last cultivation	3	$.24	$.16	$.40
Rape and pumpkins	1910	Rape, last cultivation, pumpkins after corn was up	3 1	R. .24 P. .35	.41	1.00
Winter rye	1911	Drilled in after last cultivation	136.5	2.73	.60	3.33
Soybeans	1909 1910 1911	Drilled, corn-planting time	45.5	2.73	.60	3.33
Cowpeas	1909 1910	Drilled, corn-planting time	45.5	2.73	.60	3.33
Canadian field peas	1910	Drilled, corn-planting time	60.	3.00	.60	3.60
Hairy vetch	1910	Drilled, corn-planting time	45.	5.40	.60	6.00

The best forage crop to grow for supplementing corn which is to be hogged-off must be decided by each feeder for himself after considering his general scheme of management and the forages of proved value best adapted to his soil and climate. For sowing in corn, the above experiments give rape and rye high valuations for conditions similar to those of central Iowa. Farther south soybeans

[1] Iowa Exp. Sta. Bull. 143.

and cowpeas will undoubtedly give better results than in these trials.

Whether or not it is better to grow the forage in with the corn or adjacent to it, is a point undetermined. Much depends on the particular conditions. A well-balanced rotation for the farm will ordinarily provide sufficient clover or other legume to make seeding in with the corn unnecessary.

FIELD MANAGEMENT

Pigs which have been receiving all the grain they will eat should be accustomed gradually to new corn and full feeding before they are turned into the standing corn. This is especially true if much of the corn is down and the pigs are well grown. Ordinarily, the corn should be well dented before hogging-down begins.

Well-grown shotes farrowed in the spring are best adapted to this method of feeding, and they will gain faster and clean up the corn more thoroughly if they are not fat when turned in. Gilts intended for the breeding herd should be watched closely and removed before there is evidence of over-fatness. Brood sows which are not nursing fall pigs may be used to advantage for cleaning up after the shotes, or for breaking down the corn for pigs which are too light to do this for themselves. They should not, however, be allowed to become so heavy that their breeding qualities are impaired.

The acreage of corn to set aside for hogging-off will be determined chiefly by the number and size of the pigs and the yield of the corn. No larger area should be planned than can be thoroughly eaten before the bad weather of early winter sets in. This will mean a grazing period of fifty to sixty days on the average. Some farmers believe in limiting the area grazed at one time so that each field is cleaned up in fifteen to twenty days. Although this means more labor and expense for fencing, experience favors the method, especially when the season is wet and the soil sticky. In a dry fall, there is thought to be little gained by confining the pigs to limited areas for short periods. Twenty-six-inch woven wire set on light posts which may be driven two rods apart will usually be the most economical and satisfactory method of temporarily fencing the areas used.

The following table [1] gives the approximate number of days required to hog-off an acre of corn by a given number of 125-pound pigs.

TABLE LXXXVI. — SHOWING THE APPROXIMATE NUMBER OF DAYS REQUIRED TO HOG-OFF AN ACRE OF CORN BY A GIVEN NUMBER OF PIGS WEIGHING 125 POUNDS

NUMBER OF PIGS	AVERAGE WEIGHTS OF PIG	WITH CORN SHRUNK TO JAN. 1 AND YIELDING								
		30 Bu. per Acre	35 Bu. per Acre	40 Bu. per Acre	45 Bu. per Acre	50 Bu. per Acre	55 Bu. per Acre	60 Bu. per Acre	65 Bu. per Acre	70 Bu. per Acre
	lb.	*days*	*days*	*days*	*days*	*days*	*days*	*days*	*days*	*days*
Will keep 10 pigs . .	125	22.5	26.2	30	33.7	37.5	41.2	45.0	48.7	52.5
Will keep 20 pigs . .	125	11.2	13.1	15	16.8	18.7	20.6	22.5	24.3	26.2
Will keep 30 pigs . .	125	7.5	8.7	10	11.2	12.5	13.7	15.0	16.2	17.5
Will keep 40 pigs . .	125	5.6	6.5	7.5	8.4	9.3	10.3	11.2	13.2	14.1
Will keep 50 pigs . .	125	4.5	5.2	6.0	6.7	7.5	8.2	9.0	9.7	10.5
Will keep 60 pigs . .	125	3.7	4.4	5.0	5.6	6.2	6.8	7.5	8.1	8.7
Will keep 70 pigs . .	125	3.2	3.7	4.3	4.8	5.3	5.8	6.4	6.9	7.5
Will keep 80 pigs . .	125	2.8	3.3	3.7	4.2	4.6	5.1	5.6	6.1	6.5

[1] Gaumnitz, Wilson, and Bassett, Bull. 104, Minn. Exp. Sta.

The carrying capacity of an acre of corn as given by the Iowa Experiment Station[1] is somewhat greater than that estimated above, as shown in the following table:

TABLE LXXXVII. — CARRYING CAPACITY OF AN ACRE OF STANDING CORN

Average weight of pigs at the beginning, 125–150 lb.

BUSHELS TO THE ACRE	30 DAYS	60 DAYS	90 DAYS	120 DAYS
40	14–15	6–7	4–5	3
50	18–19	8–9	5–6	4
60	21–22	10–11	6–7	4–5
70	26–27	12–13	7–8	5–6

In order that the pigs make satisfactory gains, they must be supplied with water that is pure and easily accessible. Portable sanitary watering devices are especially convenient when the field is not within easy distance of the barn. Also, the pigs must have a comfortable place to sleep in order to do well. With no protection, a chilly rain in the late fall will undo a week's feeding. Movable cots or temporarily constructed sheds may be provided at little expense of time or labor. Although a labor saver, the hogging-down method of feeding requires that constant attention be given to the essentials of good care and management if best results are to be obtained.

[1] Evvard, Kennedy, and Kildee, Iowa Exp. Sta. Bull. 143.

CHAPTER XI

FATTENING PIGS IN THE DRY LOT (THE USE OF NITROGENOUS OR PROTEIN SUPPLEMENTS)

Before the pig crop is ready for market, a more or less extensive period of dry lot feeding is usually necessary. Early spring pigs which have been liberally fed during the summer on good forage crops, or those which have "hogged-down" corn until December, usually have the weight and condition which make a long feed unnecessary. Pigs which have been farrowed late, on the other hand, and have received little grain during the summer, require a rather extended period of dry lot feeding before attaining the weight and finish desired by the market. The average spring pig does not reach market until December or January, which means a feeding period of sixty to ninety days.

One of the easiest classes of live-stock on the farm to feed successfully is the well-known pig which is being fattened for market. The problem of accomplishing this most economically is rendered complex only by the great variety of feeds available and the variations which occur from year to year in the price of these feeds.

The most profitable ration to feed in any year should be determined ordinarily by the supply and price of home-grown grains and the availability and cost of the different nitrogenous or protein supplements on the market. Usually, although not always, corn or some other home-grown grain should be used as the basis of the fattening ration. Although these dry-lot fed pigs have the age which makes their requirements for protein and mineral matter less than during the summer, their demands for growing constituents are nevertheless greater than can be supplied by corn or any other grain alone. A ration that is both cheap and balanced is necessary to insure economical gains and a quick market finish.

In dry lot feeding, the supply of protein with which to balance the home-grown grains must be obtained largely in the form of commercial by-products, known generally as nitrogenous or protein supplements. Owing to the increasing use of grain for human consumption and the higher prices for pork products, these feeds have assumed a position of much greater importance than formerly when prices were lower. The necessity of feeding a supplement with the grains has been determined by numerous experimental studies at the state experiment stations, as well as by the accumulated experiences of practical feeders.

DAIRY BY-PRODUCTS

The by-products of the dairy are more highly prized by hog-men than perhaps any other form of protein supplement. The value of skim-milk and buttermilk is such as to make pork production a valuable adjunct to profitable dairying when either of these products are available for swine feeding. Although 100 pounds of skim-milk or buttermilk contain less than 10 pounds of dry matter, this latter is so rich in easily digested proteins and mineral constituents of the kinds needed as to make them unusually efficient as means of balancing the grains.

Plate VI. — Hogging-down corn and soybeans.

In the table below are summarized the results of seven feeding experiments in which rations of corn and skim-milk or buttermilk were compared with rations of corn alone. In two of the experiments, those at South Dakota and Ohio, the pigs in both lots had access to a blue-grass pasture, which resulted in a better showing for the lots fed corn alone than would have been the case if they had been confined to dry lots. In the other five, all lots were fed in dry yards. These results represent work from seven different stations and involved the use of a total of 106 pigs averaging a little over 100 pounds when the experiments began.

TABLE LXXXVIII. — SUMMARY: CORN ALONE VERSUS CORN AND SKIM-MILK OR BUTTERMILK[1] (AV. 7 EXPS.)

AVERAGE DAILY RATION	TOTAL NUMBER OF PIGS	AVERAGE INITIAL WEIGHT PER PIG	AVERAGE FINAL WEIGHT PER PIG	AVERAGE DAILY GAIN PER PIG	FEED TO PRODUCE 100 LB. GAIN
		lb.	*lb.*	*lb.*	*lb.*
5.09 corn	53	106.42	184.61	1.04	492.88 corn
5.09 corn 12.58 buttermilk and skim-milk	53	108.38	229.46	1.66	302.07 corn 799.40 buttermilk and skim-milk

The sum total of this evidence as expressed in the summary table gives to skim-milk and buttermilk unusually high valuations. The fifty-three pigs which received either skim-milk or buttermilk with their corn gained 59.61 per cent faster than did those receiving corn alone. This was sufficient to effect a saving of 36 days

[1] Ind. Exp. Sta. Bull. 137; S. Dak. Exp. Sta. Bull. 136; Dem. Exp. St. Joseph Stock Yds. Co.; Ohio Exp. Sta. Bull. 209; Neb. Exp. Sta. Bull. 107; N. H. Exp. Sta. Bull. 113; Tex. Exp. Sta. Bull. 131.

in the time required to produce 100 pounds of gain. The average weight at the close of the experiments was 229 pounds for those fed skim-milk or buttermilk, and 184 pounds for those fed corn alone. To have made the latter as heavy when sold as those fed the milk rations, it would have been necessary to have continued them on feed 43 days after the experiments closed.

Not only were the gains faster for those fed milk, but they were also cheaper. The feeding of 799.4 pounds of buttermilk or skim-milk resulted in a saving of 190.81 pounds of corn; or in other words, 4.18 pounds of milk had the equivalent value of 1 pound of corn. On the basis, then, of the average result of these seven experiments, the value of skim-milk or buttermilk in reducing the cost of gains when corn alone is fed would be as shown in the following table:

Table LXXXIX. — Money Value of Skim-Milk or Buttermilk When Fed with Corn to Fattening Pigs

When a bushel of corn is worth	56¢	70¢	84¢	98¢	$1.12	$1.26	$1.40	$1.54	$1.68
100 pounds of skim-milk or buttermilk are worth . . .	23.9¢	29.9¢	35.9¢	41.9¢	47.8¢	53.8¢	59.8¢	71.8¢	77.7¢

According to these valuations, therefore, the price of a bushel of corn divided by 2.34 will give the value of 100 pounds of skim-milk or buttermilk when fed under these conditions.

These values, it should be understood, are based entirely on the saving of corn required to produce a given gain. They do not include the important additional advantage of more rapid gains and the earlier market finish which also resulted from their use. On the other hand, these figures do not mean that the feeder can necessarily afford to pay these prices for skim-milk or buttermilk, since it might be possible for him to balance his corn more cheaply by the purchase of a protein supplement in some other form. He can afford to pay these prices only when there is no cheaper source of protein available.

In the average ration above, 2.47 pounds of skim-milk or buttermilk were fed with each pound of corn. If a larger proportion had been used, the value of the milk would have been less than is shown by these figures. On the other hand, if less than 2.47 pounds of milk had been fed with each pound of corn, a larger credit and a higher valuation would have resulted.

This principle is illustrated by the results of feeding trials conducted by Henry [1] at the Wisconsin Experiment Station. In these experiments a total of 88 pigs, averaging a little more than 100 pounds at the beginning, were used, with the results shown in the following table:

TABLE XC. — SKIM-MILK AND CORN-MEAL REQUIRED FOR 100 POUNDS OF GAIN BY PIGS

PROPORTION OF SKIM-MILK TO CORN-MEAL	FEED TO PRODUCE 100 LB. GAIN	MILK TO REPLACE [2] 100 LB. CORN
	lb.	*lb.*
1# corn with 1 to 3 lb. milk . . .	321 corn 585 milk	327
1# corn with 3 to 5 lb. milk . . .	265 corn 1048 milk	446
1# corn with 5 to 7 lb. milk . . .	250 corn 1434 milk	574
1# corn with 7 to 9 lb. milk . . .	207 corn 1616 milk	552

[1] Wis. Rpt. 1895; Henry and Morrison's "Feeds and Feeding."

[2] Figured on the basis that 500 lb. of corn alone would have been required to produce 100 lb. of gain.

The smaller the proportion of milk fed with the corn, the greater was its value a pound.

From 2 to 3 pounds of milk to 1 pound of corn are required to make the ration balanced and most productive of rapid gains for growing and fattening pigs. However, when the supply of milk is abundant and cheap, a larger proportion than 3 to 1 will often be profitable, especially when grain is scarce and high in price. When the supply of milk is limited, however, smaller proportions will be necessary and will give, as a rule, the most economical results, especially when grain is abundant and relatively cheap.

Buttermilk versus skim-milk.

As indicated by the following table showing the average composition of buttermilk and skim-milk, one would expect them to be equally efficient as supplements to the ordinary grains in pig feeding.

TABLE XCI. — COMPOSITION OF BUTTERMILK AND SKIM-MILK [1]

	TOTAL DRY MATTER IN 100 LB.	DIGESTIBLE NUTRIMENTS IN 100 LB.			NUTRITIVE RATIO [2]
		Proteins	Carbohydrates	Fats	
	lb.	*lb.*	*lb.*	*lb.*	
Buttermilk . .	9.4	3.4	4.9	0.1	1 : 1.5
Skim-milk . .	9.9	3.6	5.1	0.2	1 : 1.5

Buttermilk is, as a rule, more variable in composition and feeding value than is skim-milk, due to the fact that

[1] Appendix, Henry and Morrison's "Feeds and Feeding."

[2] Determined by dividing the digestible carbohydrates plus $2\frac{1}{2}$ times the digestible fats, by the digestible proteins.

considerable wash water is often incorporated with it. The average of all tests, however, indicates that they are of quite equal feeding value. This is illustrated by two trials conducted by Wilson at the South Dakota Experiment Station, the average results of which are shown in Table XCII.

TABLE XCII. — BUTTERMILK VERSUS SKIM-MILK FOR FATTENING PIGS[1]

RATIONS FED	NUMBER PIGS	AVERAGE INITIAL WEIGHT PER PIG	AVERAGE FINAL WEIGHT PER PIG	AVERAGE DAILY GAIN PER PIG	FEED TO PRODUCE 100 POUNDS GAIN
		lb.	*lb.*	*lb.*	*lb.*
Corn + buttermilk	12	92.5	195.5	1.66	315 corn 864 buttermilk
Corn + skim-milk	12	92.0	193.5	1.65	312 corn 859 skim-milk

Skim-milk and buttermilk versus other supplements.

The feeding value of skim-milk was compared with that of other standard protein supplements in two experiments conducted at the Indiana Experiment Station by Skinner and Cochel. The proportion of supplement fed in each lot was such as to make all rations equally balanced, or to give them a nutritive ratio of 1 : 7.4. There were five pigs in each lot in the first experiment, and six in the second. The results are shown in Table XCIII.

In both experiments skim-milk proved to be the most efficient and profitable supplement with which to balance corn. In each case the gains were faster and the cost of producing 100 pounds of gain cheaper than with any of

[1] S. Dak. Exp. Sta. Bull. 136.

the other feeds. The gains in the second experiment were not as satisfactory as in the first because of the excessive heat in July and also because the pigs in this experiment had been fed more liberal grain rations previous to the test.

TABLE XCIII. — SKIM-MILK VERSUS OTHER PROTEIN SUPPLEMENTS FOR FATTENING PIGS [1]

I. — Apr. 10–June 9, 1909 — 60 days

RATIONS	AVERAGE INITIAL WEIGHT PER PIG	AVERAGE FINAL WEIGHT PER PIG	AVERAGE DAILY GAIN PER PIG	FEED TO PRODUCE 100 LB. GAIN	COST OF PRODUCING 100 LB. GAIN [2]
	lb.	*lb.*	*lb.*	*lb.*	
8 corn-meal + 1 linseed-oil meal	112.4	217.4	1.75	333.4 corn 41.6 linseed-oil meal	$3.63
7 corn-meal + 1 soybean meal	113.8	223.2	1.82	321.13 corn 45.87 soybean meal	$3.57
15 corn-meal + 1 tankage	116.6	226.8	1.83	359.07 corn 23.93 tankage	$3.71
1 corn-meal + 1 middlings	115.4	234.0	1.97	180.50 corn 180.50 middlings	$3.88
1 corn-meal + 1½ skim-milk	113.6	235.2	2.02	297 corn 445 skim-milk	$3.56

II. — June 19–Aug. 18, 1908 — 60 days

RATIONS	AVERAGE INITIAL WEIGHT PER PIG	AVERAGE FINAL WEIGHT PER PIG	AVERAGE DAILY GAIN PER PIG	FEED TO PRODUCE 100 LB. GAIN	COST OF PRODUCING 100 LB. GAIN
8 corn-meal + 1 soybean meal	105.6	160	.90	400 corn 50 soybean meal	$6.16
8 corn-meal + 1 linseed-oil meal	106.0	165	.98	414 corn 51 linseed-oil meal	$6.36
1 corn-meal + 1½ skim-milk	105.5	211.6	1.76	267 corn 400 skim-milk	$4.60

[1] Ind. Exp. Sta. Bull. 137.

[2] Prices charged for feeds were as follows: I. — corn-meal, $18 a ton; linseed-oil meal and soybean meal, $30 a ton; tankage, $40 a ton; middlings, $25 a ton; skim-milk, 20 cents a hundredweight. II. — corn-meal, 80 cents a bushel; linseed-oil meal and soybean meal, $30 a ton; skim-milk, 25 cents a hundredweight.

At the Ohio Experiment Station,[1] two series of experiments were conducted for the purpose of comparing skim-milk and tankage as supplements to corn, and of determining the best proportion of skim-milk to feed with corn. Both trials were under dry lot conditions. In the lots where the corn and skim-milk were fed, *ad libitum*, the corn was given twice daily and the skim-milk three times. With each feed they were given all they would take in two hours. The results of the two trials are averaged and appear in Table XCIV.

Table XCIV. — Different Proportions of Skim-Milk with Corn for Fattening Pigs (Av. 2 Exps.)

Rations, Proportions by Weight	Total Number Pigs	Average Length of Experiments	Average Initial Weight per Pig	Average Daily Gain per Pig	Average Feed Eaten for Each 100 Lb. Gain
		days	*lb.*	*lb.*	*lb.*
9 corn 1 tankage	10	87	50	.864	369 corn 41 tankage
1 corn 1 skim-milk	10	87	52	1.058	326 corn 326 skim-milk
1 corn 3 skim-milk	10	87	51	1.176	261 corn 789 skim-milk
1 corn 5 skim-milk	10	87	50	1.299	226 corn 1128 skim-milk
Corn and skim-milk (both *ad lib.*)	10	87	51	1.573	185 corn 1445 skim-milk

In each experiment the lots fed the skim-milk made considerably faster gains than those fed the tankage.

[1] Robison, Bull. 316.

The larger the proportion of skim-milk given, also, the more rapid were the gains, but the value of the skim-milk in reducing the amount of corn required to produce 100 pounds of gain was greatest when the smaller proportions were fed (see Table XC, page 243). With an abundant and cheap supply of skim-milk available, it would be profitable to feed the larger proportions.

Skim-milk or buttermilk versus tankage.

Summarizing the results from all the experiments in which skim-milk or buttermilk were compared with tankage for fattening pigs, the average results are stated in Table XCV.

TABLE XCV. — SUMMARY: SKIM-MILK OR BUTTERMILK VERSUS TANKAGE AS A SUPPLEMENT TO CORN FOR FATTENING PIGS (Av. 8 Exps.)

AVERAGE RATION, PROPORTIONS BY WEIGHT	AVERAGE DAILY GAIN PER PIG	FEED EATEN FOR EACH 100 POUNDS GAIN
	lb.	*lb.*
10.6 corn 1 tankage	1.202	378.38 corn 35.74 tankage
1 corn 2.6 skim-milk or buttermilk	1.518	287.20 corn 753.25 skim-milk or buttermilk

According to these averages, 753.25 pounds of skim-milk or buttermilk replaced or were equivalent to 91.18 pounds of corn and 35.74 pounds of tankage. As based on the amount of feed required to produce 100 pounds of gain, then, skim-milk and tankage would have the relative values shown in Table XCVI.

TABLE XCVI. — VALUE OF SKIM-MILK OR BUTTERMILK AS AFFECTED BY THE PRICE OF CORN AND TANKAGE

When corn and tankage cost	Corn 56¢ per bushel Tankage $40 per ton	Corn 70¢ per bushel Tankage $50 per ton	Corn 84¢ per bushel Tankage $60 per ton	Corn 98¢ per bushel Tankage $70 per ton	Corn $1.40 per bushel Tankage $100 per ton
Skim-milk or buttermilk is worth . .	21.6¢ per cwt.	27.0¢ per cwt.	32.4¢ per cwt.	37.8¢ per cwt.	54.0¢ per cwt.

These figures mean that, with the above ratio of prices between corn and tankage, the value of skim-milk or buttermilk was 10.8 per cent of that of tankage. Or, stated in another way, 100 pounds of skim-milk or buttermilk was worth 54 per cent of the value of a ton of tankage divided by 100.

The above valuations of skim-milk and buttermilk are wholly determined by the saving effected in the feed required to produce a unit of gain. They do not include a valuation of the 26 per cent faster gains made on the rations containing the dairy products. For this reason, therefore, skim-milk and buttermilk have somewhat higher values than shown by these figures.

All the experiments with fattening pigs in the dry lot tend to show the feeding value of skim-milk and buttermilk to be out of all proportion to the amount of dry matter which they furnish. The great merit of these two products must be assumed to lie, therefore, in the kind or quality of the proteins and mineral compounds rather than in their amounts. Their palatability and digestibility contribute also to their efficiency.

Whey.

As shown in Table XCVII, whey is even more watery in composition than skim-milk or buttermilk. Furthermore, the dry matter which it does carry contains considerably less protein. A pound of skim-milk furnishes on the average more than four times as much protein as an equal amount of whey. Due to the differences in methods employed in the manufacture of cheese, whey is quite variable in composition and value.

TABLE XCVII. — COMPOSITION OF WHEY COMPARED WITH SKIM-MILK [1]

	Total Dry Matter in 100 Lb.	Digestible Nutrients in 100 Lb.			Nutritive Ratio
		Proteins	Carbohydrates	Fats	
Skim-milk	9.9	3.6	5.1	0.2	1 : 1.5
Whey . .	6.6	0.8	4.7	0.3	1 : 6.8

Day of the Ontario Agricultural College conducted two experiments in which sweet and sour whey, with meal, was compared with meal alone. The averaged results of these two trials are shown in Table XCVIII. Two pounds of whey were fed with 1 pound of meal, which was made up of shorts, barley, and wheat or peas.

TABLE XCVIII. — WHEY AND MEAL VERSUS MEAL ALONE [2]

Rations	Average Daily Gain per Pig	Feed to Produce 100 Lb. Gain
	lb.	*lb.*
Meal alone	1.43	493.5 meal
Meal + sweet whey	1.76	381 meal 860 whey
Meal + sour whey	1.78	382.5 meal 818.5 whey

[1] Appendix, Henry and Morrison's "Feeds and Feeding."
[2] Ont. Agr. Coll. Rpt., 1896.

The pigs fed whey gained faster and required less meal for a given gain than did those given the meal mixture alone. The results also show that sour whey was as valuable as sweet.

The quantity of whey required to replace 1 pound of concentrates in the production of gains with fattening pigs has been determined by Day[1] at the Ontario Agricultural College and Henry[2] at the Wisconsin Experiment Station. The figure obtained at the Ontario Station is the average result of three trials in which $2\frac{1}{2}$ to 6 pounds of whey were fed with each pound of a meal mixture containing 50 per cent of shorts. The result at the Wisconsin station is the average of ten trials in which 2 to 10 pounds of whey were fed with each pound of combination of equal parts corn-meal and shorts. At the Ontario Station, 9.88 pounds of whey were required to replace 1 pound of meal. At the Wisconsin Station, 7.58 pounds of whey were required to replace 1 pound of meal.

The whey used in the Wisconsin trials was reported to contain more than the average percentage of butter-fat, which accounts for its higher value. As reported by Henry and Morrison,[3] pig-feeding experiments conducted at the Copenhagen, Denmark, Experiment Station give 12 pounds of whey the value of 1 pound of mixed grain. Since 4.18 pounds of skim-milk or buttermilk was shown to be equivalent to 1 pound of corn, it would seem that whey has less than one-half the feeding value of skim-milk or buttermilk.

Two experiments by Day with fattening pigs, covering periods of 104 and 90 days, showed that ordinary whey

[1] Ont. Agr. Coll. Rpt., 1909. [2] Wis. Exp. Sta. Rpt., 1891.
[3] "Feeds and Feeding."

is on the average 33 per cent more valuable than separated whey. The same experimenter also proved that pasteurized whey was equal to ordinary whey in feeding value.

Due to the fact that whey is not so rich in protein as skim-milk or buttermilk, it is not so effective in balancing corn. The best results from feeding whey are obtained, therefore, when it is combined with a meal or grain mixture containing more protein than corn alone.

Precautions in feeding dairy products.

Although sour skim-milk is as valuable as sweet, except for very young pigs, it is important when feeding it in this condition that its degree of sourness or acidity be as uniform as possible from day to day. Feeding milk which is nearly sweet one day and clabber the next is a common cause of scours, which mean a halt in the gains and a waste of feed. Also, very much better results may be expected when the milk is supplied daily at regular intervals and in uniform amounts. In feeding dairy products, it is essential for best results that special measures be taken to keep the pails, cans, and other receptacles thoroughly clean. Sour, filthy utensils, especially when combined with careless irregular methods of feeding, may counteract entirely the beneficial effects of the feeds themselves.

Dairy by-products should in all cases be subjected to a high temperature for a sufficient length of time to kill all disease germs before being fed. In case it is not required by law, it should be insisted on by the individual feeders when the creamery or cheese factory is patronized. This process, known as pasteurization,[1] is especially necessary to guard against tuberculosis in

[1] 150° F. for twenty minutes, or 185° F. for less time.

the pigs fed milk coming from infected herds. Although the disease, when present, rarely develops to the stage where detection is possible in the live animal, inspection after slaughter may result in the condemnation of the carcass in whole or in part.

At the Iowa Experiment Station,[1] 80 pigs were divided into two equal lots and fed for a period of 196 days rations of grain and skim-milk. Lot I was fed skim-milk containing virulent bacilli of tuberculosis artificially added and lot II an equal quantity which had been pasteurized at a temperature of 200° F. At the end of the test, both lots of pigs appeared equally healthy, although those receiving the clean milk gained a little faster than those getting the tubercular milk. The results of the post mortem inspection, however, were as follows: Of the 40 head fed tubercular skim-milk, all were affected with tuberculosis; of the 40 head receiving the pasteurized skim-milk, only two were infected. In the first lot 30 per cent of the carcasses only were fit for human consumption, 45 per cent were fit only for lard, and 45 per cent were entirely unfit for food or the making of food products.

This practical test demonstrated conclusively that pigs fed skim-milk containing the germs of tuberculosis may in a relatively short time develop the disease sufficiently to necessitate condemnation of the carcass for food.

Out of a total of 7,343,746 hogs slaughtered under Government inspection at the Chicago market in 1916, 24,526, or .33 per cent, were condemned for tuberculosis as inedible.[2] It is the general claim of packers that nearly 1 per cent of all hogs killed are condemned in whole

[1] Kennedy, Robbins, Bouska, Bull. 92.

[2] H. R. Smith, Live-stock Commissioner, Chicago Live-stock Exchange.

or in part because of this disease, and, further, that the greatest loss is among hogs coming from the more highly developed dairy districts. With the present method of sale, this loss is borne by the packer, who has no direct way of protecting himself.

The seriousness of tuberculosis is so threatening to the live-stock interests as a whole, as well as to human health, that the hog-raiser is under special obligation to do his part in helping to control or permanently eradicate the disease. He can coöperate in this campaign by refusing to feed unpasteurized milk coming from untested herds.

PACKING-HOUSE BY-PRODUCTS

Next to skim-milk and buttermilk, the by-products of the slaughter- and packing-house have come to be regarded by swine-men as of special value and efficiency. These include tankage or meat-meal, blood-meal or dried blood, and various combinations of meat scrap and bone. In the table on the following page is shown the average composition of the more common feeds of this class.

These products as a class are characterized by the absence of carbohydrates and by extreme richness in protein and mineral matter. Compared with corn, they are the very opposite in composition.

Digester tankage, usually sold under the name of feeding tankage, tankage, or meat-meal, is the most extensively employed of any of these products. It largely represents the residue of the grease tanks plus varying amounts of blood, meat, bone, and the residue from evaporated tank water. This material is thoroughly cooked in large tanks under high steam pressure, after which the water and grease are drawn off and the remaining contents subjected to hydraulic pressure, then dried and finely ground. As manufactured by well-equipped plants, feeding or digester tankage is a high-grade product very uniform in feeding qualities, and not to be confused with fertilizer tankage. Feeding tankage manufactured at small slaughtering establishments and serum plants is often less uniform in comparison, owing largely to the varying degree of thoroughness with which the fat or oil has been removed.

TABLE XCIX. — COMPOSITION OF MEAT AND BONE PRODUCTS [1]

FEED	TOTAL DRY MATTER IN 100 LB.	TOTAL DIGESTIBLE NUTRIENTS IN 100 LB.			ASH	NUTRITIVE RATIO
		Protein	Carbohydrates	Fats		
Tankage over 60% protein	92.6	58.7		12.6	10.5	1 : 0.5
Tankage 55–60% protein	92.5	54.0		12.7	13.6	1 : 0.5
Tankage 45–55% protein	92.5	48.1		13.7	19.7	1 : 0.6
Tankage below 45% protein	93.5	37.6		16.7	22.6	1 : 1.0
Dried blood	90.3	69.1		0.9	3.3	1 : 0.03
Meat- and bone-meal	94.0	37.0		11.0	36.8	1 : 0.7
Meat- and bone-meal	93.4	30.9		9.8	45.8	1 : 0.7
Pork cracklings	95.0	52.4		32.6	2.3	1 : 1.4
Corn	89.5	7.5	67.8	4.6	1.5	1 : 10.4

Due to the fact that tankage is cooked under 40 pounds steam pressure for several hours, it is to be considered a strictly sterile product free from disease germs when it comes from the factory. Being dried to an 8 per cent

[1] Appendix, Henry and Morrison's "Feeds and Feeding."

moisture basis reduces, also, the chances of contamination later. The uncooked by-products from slaughterhouses are to be regarded, on the other hand, as highly dangerous.

Corn alone versus corn and tankage.

Probably no protein feed on the market has been as extensively studied as has tankage. In Table C are summarized the results of fifteen individual feeding experiments conducted at six different experiment stations. Each experiment reported was a test of a combination of corn and tankage against corn alone when fed in the dry lot to pigs averaging approximately 138 pounds when the experiments began. In practically all the tests, so-called number one tankage, containing from 55 to 60 per cent of protein, was used.

TABLE C.—SUMMARY: CORN ALONE VERSUS CORN AND TANKAGE OR MEAT-MEAL[1] (Av. 15 Exps.)

AVERAGE DAILY RATION PER PIG	TOTAL NUMBER PIGS	AVERAGE INITIAL WEIGHT PER PIG	AVERAGE FINAL WEIGHT PER PIG	AVERAGE DAILY GAIN PER PIG	FEED EATEN FOR EACH 100 LB. GAIN
		lb.	*lb.*	*lb.*	*lb.*
5.94 corn . .	109	136.7	215.8	1.115	545.9 corn
6.54 corn . . .705 tank. or meat-meal	160	138.7	262.1	1.740	380.2 corn 40.2 tank. or meat-meal

The deficiency of a ration of corn alone was emphatically shown by the result of every one of these practical feeding tests. The results in both rate and cost of gain show up in strong contrast when compared with the balanced combination of corn and tankage.

[1] Ind. Exp. Sta. Bull. 137; Iowa Exp. Sta. Bull. 91; Neb. Exp. Sta. Bull. 147; Mo. Exp. Sta. Bull. 65; Kans. Exp. Sta. Bull. 192; Ohio Exp. Sta. Bull. 209.

The averaged results as given in the summary table show that the pigs fed corn and tankage gained more than 56 per cent faster than did those fed corn alone, and were 46 pounds heavier at the close of the average feeding period. The fact that the pigs fed corn and tankage ate 1.3 pounds of feed daily in excess of that consumed when corn alone was fed, testifies to the palatability of this feed.

Not only were the gains faster, but they were also made on less feed. The feeding of 40.21 pounds of tankage had the effect of saving an average of 165.74 pounds of corn. In other words, as fed in these experiments, 1 pound of tankage in the balanced ration had the value of 4.12 pounds of corn in the ration of corn alone. This does not include the credit due the tankage for the faster gains and earlier market finish, but is based alone on the saving of corn effected in the production of a given gain. The money value of tankage in reducing the cost of gains, then, when fed under the average conditions represented in these experiments, would be as given in the following table:

Table CI. — Money Value of Tankage or Meat-Meal When Fed with Corn to Fattening Pigs

When a bushel of corn is worth .	56¢	70¢	84¢	98¢	$1.26	$1.40
A ton of tankage is worth . .	$82.40	$103	$123.60	$144.20	$185.40	$206

If no other supplements were available, the feeder could afford to pay these extreme prices for the best grade of tankage rather than feed corn alone. With the competition of other forms of protein supplements on the market, however, it is not necessary nor wise to pay these prices. The price one can afford to pay must be determined by the relative value of tankage and other suitable supplements. The most direct and satisfactory way of making this comparison is by the aid of the carefully conducted practical feeding experiment.

Tankage versus linseed-oil meal.

Direct comparison of tankage and linseed-oil meal (old process) for finishing pigs in the dry lot has been made in eight recent experiments. In each test the pigs were fed to market weights, which required an average of 74 days' feeding. The summarized results of these studies are shown in Table CII.

TABLE CII. — SUMMARY: TANKAGE VERSUS LINSEED-OIL MEAL (Av. 8 Exps.) [1]

Average Ration, Proportions by Weight	Average Initial Weight per Pig	Average Daily Gain per Pig	Average Feed Consumed for Each 100 Lb. Gain
	lb.	*lb.*	*lb.*
7.6 corn . . .			362.52 corn
1 linseed-oil meal	119	1.505	47.65 linseed-oil meal
15.4 corn . . .			378.82 corn
1 tankage . . .	119	1.581	24.53 tankage

The summarized results show up in favor of the tankage rations, both in rate of gain and total feed required to produce a given gain. Furthermore, but little more than half as much tankage was fed as oil-meal, which permitted the use of a larger proportion of corn in the tankage rations.

[1] Ind. Exp. Sta. Bull. 137 and 126; Ohio Exp. Sta. Bull. 213; Neb. Exp. Sta. Bull. 147.

As calculated from the averaged quantity of corn and supplement required to produce a unit of gain in these eight experiments, tankage and linseed-oil meal would have the following relative money values:

TABLE CIII. — VALUE OF TANKAGE AS AFFECTED BY THE PRICE OF CORN AND LINSEED-OIL MEAL

When corn and linseed-oil meal are worth	Corn 56¢ per bushel Linseed-oil meal $30 per ton	Corn 70¢ per bushel Linseed-oil meal $40 per ton	Corn 84¢ per bushel Linseed-oil meal $45 per ton	Corn 98¢ per bushel Linseed-oil meal $50 per ton	Corn $1.40 per bushel Linseed-oil meal $75 per ton
Tankage is worth .	$44.98 per ton	$61.08 per ton	$67.47 per ton	$73.86 per ton	$112.46 per ton

Tankage versus wheat shorts or middlings.

The problem of choosing between wheat shorts or middlings and tankage, in obtaining the supply of protein with which to balance corn for fattening pigs in the dry lot, is one demanding annual consideration. To give information regarding the relative efficiency of these two supplements, the results of six practical feeding tests are summarized in Table CIV. These experiments covered an average period of 74 days, and the pigs were generally fed to finished market weights.

These results show that a balanced ration of corn and tankage was more palatable than one of corn and shorts or middlings. This was true in every experiment but one. The pigs fed tankage made average daily gains of $\frac{1}{4}$ pound in excess of those given shorts or middlings. The reliability of these results, however, is affected, no doubt, by the extreme variation of the proportions in which the shorts or middlings were fed in the different experiments. Usually it is necessary to feed 1 part of shorts or middlings to 1 of corn in order to have as much protein in the ration as is supplied by a combination of 10 parts of corn and 1 of tankage. From the standpoint of the farmer, that supplement which is richest in protein and which consequently permits of the use of a larger proportion of corn in the ration, is always to be preferred.

TABLE CIV. — SUMMARY: TANKAGE VERSUS WHEAT SHORTS OR MIDDLINGS (AV. 6 EXPS.) [1]

AVERAGE RATION, PROPORTIONS BY WEIGHT	AVERAGE INITIAL WEIGHT PER PIG	AVERAGE DAILY GAIN PER PIG	AVERAGE FEED CONSUMED FOR EACH 100 LB. GAIN
	lb.	*lb.*	*lb.*
63.2 % corn . . . . 36.8 % shorts or middlings . .	115	1.396	272.12 corn 158.36 shorts or middlings
90.5 % corn . . . . 9.5 % tankage . .	115	1.570	352.37 corn 36.79 tank

The relative values of tankage and shorts or middlings as determined by the average quantity of these feeds required to produce 100 pounds of gain, are calculated and shown in Table CV.

TABLE CV. — VALUE OF TANKAGE AS AFFECTED BY THE PRICE OF CORN AND WHEAT SHORTS OR MIDDLINGS

When corn and shorts or middlings are worth	Corn 56 per bushel Shorts $25 per ton	Corn 70¢ per bushel Shorts $30 per ton	Corn 84¢ per bushel Shorts $40 per ton	Corn 98¢ per bushel Shorts $45 per ton	Corn $1.40 per bushel Shorts $60 per ton
Tankage is worth .	$63.98 per ton	$74.60 per ton	$106.74 per ton	$117.34 per ton	$149.20 per ton

[1] Ind. Exp. Sta. Bull. 137; Ohio Exp. Sta. Bull. 213 and 209; Kans. Exp. Sta. Bull. 192; Neb. Exp. Sta. Bull. 147.

Corn and tankage versus corn, shorts, and tankage.

Although tankage is proved to be a more efficient supplement to corn than shorts or middlings, and more economical with the usual prices, a combination of tankage and shorts is superior to tankage alone. Three experiments conducted by Weaver at the Missouri Experiment Station and three by Wright at the Kansas Station give rather conclusive evidence in support of this. In all these tests the two rations were fed to fattening pigs in the dry lot, and the experiments closed when approximate market weights had been attained. The summarized results of these six experiments, which covered an average period of 63 days, are shown in Table CVI.

TABLE CVI. — SUMMARY: CORN AND TANKAGE VERSUS CORN, SHORTS, AND TANKAGE[1] (AV. 6 EXPS.)

RATIONS PROPORTIONS BY WEIGHT	AVERAGE DAILY GAIN PER PIG	FEED CONSUMED FOR 100 LB. GAIN
	lb.	*lb.*
91.15% corn . . . . . 8.85% tankage	1.560	411.65 corn 40.01 tankage
67.03% corn . . . . . . 25.39% shorts . . . . 7.58% tankage	1.793	293.01 corn 111.02 shorts 33.14 tankage

The pigs fed an average of 25 per cent of shorts with corn and tankage gained daily .23 of a pound faster than those not receiving shorts. In each of the six tests the consumption of feed was greater and the gains faster with the former ration. In the corn and tankage ration, a total of 451.66 pounds of feed was required to produce 100 pounds of gain, and in the corn, shorts, and

[1] Mo. Exp. Sta. Bull. 144; Kans. Exp. Sta. Bull. 192.

tankage ration, a total of 437.17 pounds. As determined by the feed required to produce 100 pounds of gain, 111 pounds of shorts were equal to 118.6 pounds of corn and 6.87 pounds of tankage.

The rations containing shorts could, no doubt, have been made cheaper without sacrificing palatability or balance, by increasing somewhat the proportion of corn and reducing that of shorts.

Tankage versus soybean meal.

Eight experiments conducted at four experiment stations give information regarding the relative values of tankage and soybean meal when fed to balance corn for fattening pigs. In each of the tests here summarized, the corn was fed as meal and the soybeans ground. The experiments covered an average period of 70 days. A compilation of the results obtained is shown in the summary, Table CVII.

TABLE CVII. — SUMMARY: TANKAGE VERSUS SOYBEAN MEAL (Av. 8 Exps.)[1]

Average Ration, Proportion by Weight	Average Initial Weight per Pig	Average Daily Gain per Pig	Feed Consumed for Each 100 Lb. Gain
	lb.	*lb.*	*lb.*
79.8% corn . . . . 20.2% soybean meal .	121	1.435	346.74 corn 69.92 soybean meal
87.8% corn . . . . 12.2% tankage . . .	122	1.590	348.08 corn 42.50 tankage

The pigs fed an average of 12 per cent tankage in their ration gained faster than those receiving a ration con-

[1] Ind. Exp. Sta. Bull. 137; Ohio Exp. Sta. Bulls. 209 and 213; Kans. Exp. Sta. Bull. 192; Ky. Exp. Sta. Bull. 175.

taining 20 per cent of soybean meal. This was true in every experiment but one, in which the gains were practically the same. Since tankage contains nearly double the quantity of protein, 1 pound of tankage is about as effective as 2 pounds of soybean meal in balancing a corn ration. As a rule in these experiments, tankage proved to be the more palatable.

In feed required to produce 100 pounds of gain, 42.5 pounds of tankage and 1.34 of corn were equivalent to 69.92 pounds of soybean meal. This would give for tankage and soybean meal the relative values shown in Table CVIII.

TABLE CVIII. — VALUE OF TANKAGE AS AFFECTED BY PRICE OF CORN AND SOYBEANS

When corn and soybean meal are worth	Corn 56¢ per bushel Soybean meal $30 per ton	Corn 70¢ per bushel Soybean meal $40 per ton	Corn 84¢ per bushel Soybean meal $45 per ton	Corn 98¢ per bushel Soybean meal $50 per ton	Corn $1.40 per bushel Soybean meal $75 per ton
Tankage is worth .	$48.72 per ton	$65.02 per ton	$73.08 per ton	$81.16 per ton	$121.81 per ton

Summary.

The sum total of all the experimental evidence considered in the preceding pages supports the conclusion that high-grade tankage or meat-meal stands next to skim-milk as a supplement to corn for fattening pigs in the dry lot. For feeding pigs on forage there is every reason to believe that its relative efficiency is as great. Like skim-milk tankage is an animal food, and chemists have determined that the proteins contained in animal foods comprise a more suitable combination of muscle-building constituents than is contained, as a rule, in the proteins from vegetable sources. Another reason why tankage is highly efficient for balancing corn is because of its extreme richness in ash or bone-building material. Furthermore, a large part of this ash is calcium or lime, which is present in very meager amounts in corn. Tankage is a mild laxative when fed in small amounts and tends to promote a healthful condition generally.

LINSEED-OIL MEAL

Linseed-oil meal is the ground residue after the oil has been extracted from flaxseed. There are two methods of removing this oil, known as the old and the new process. Woll [1] describes the methods of manufacture as follows: "By the former method the cleaned and ground seeds are placed in large linen bags and subjected to heavy pressure until the residue forms cakes about one inch thick and about 13 by 32 inches. The cakes are broken into small pieces or ground to a fine meal, usually the latter, which is generally sold as old-process linseed-oil meal, or simply oil meal. In the new process of manufacture the flaxseed is ground and heated to about 160° F., and is then placed in large percolators which hold about 1000 bushels or more. The seed is treated repeatedly with naphtha until practically all the oil is dissolved. Live steam is then introduced into the percolators and the naphtha gradually driven out of the mass. The meal is transferred to steam-heated driers, and, when dried, elevated to the meal bins and sacked."

There is little difference in the value of these feeds suggested by the figures given in the composition table. The chief difference is that the old-process meal contains

[1] "Productive Feeding of Farm Animals."

about 4 per cent more fat than the new process. Old-process meal, however, is much the more popular and generally used feed. In practically all the experiments here reported, the old-process meal was employed.

TABLE CIX. — COMPOSITION OF OLD AND NEW PROCESS LINSEED-OIL MEAL[1]

	TOTAL DRY MATTER IN 100 LB.	TOTAL DIGESTIBLE NUTRIENTS IN 100 LB.			ASH	NUTRITIVE RATIO
		Protein	Carbo-hydrates	Fats		
	lb.	*lb.*	*lb.*	*lb.*	*lb.*	
Old-process linseed-oil meal	90.9	30.2	32.6	6.7	5.4	1 : 1.6
New-process linseed-oil meal	90.4	31.7	37.9	2.8	5.6	1 : 1.4

Corn alone versus corn and linseed-oil meal.

In Table CX are shown the summarized results of four experiments in which rations of corn alone were fed against corn with linseed-oil meal added. The tests were conducted under dry-lot conditions and covered an average period of 90 days.

TABLE CX. — SUMMARY: CORN ALONE VERSUS CORN AND LINSEED-OIL MEAL (AV. 4 EXPS.)

AVERAGE RATION, PROPORTIONS BY WEIGHT	TOTAL NUMBER PIGS	AVERAGE INITIAL WEIGHT PER PIG	AVERAGE DAILY GAIN PER PIG	FEED EATEN FOR EACH 100 LB. GAIN
		lb.	*lb.*	*lb.*
Corn alone . .	30	115	.916	532.82 corn
6.6 corn, 1 linseed-oil meal	30	117	1.453	357.12 corn 54.42 linseed-oil meal

[1] Appendix, Henry and Morrison's "Feeds and Feeding."

Balancing the corn with linseed-oil meal had the effect of enhancing the palatability of the ration, increasing the consumption of feed, and in stimulating more rapid gains. The pigs fed linseed-oil meal with their corn were on the average 50 pounds heavier at the end of the average feeding period of 90 days.

A unit of gain was also made on less feed. The feeding of 54.42 pounds of linseed-oil meal had the effect of saving 175.70 pounds of corn. With corn worth 56 cents a bushel, this would mean a valuation of $64.56 for a ton of linseed-oil meal when fed under the conditions of these experiments. An exaggerated value, however, is given to linseed-oil meal by this method of determination. A more reliable test is obtained by comparing it with other protein supplements of the same class.

Linseed-oil meal versus tankage.

On page 258 is given a summarized statement of the results of eight practical feeding experiments in which rations of corn and linseed-oil meal were compared with those of corn and tankage. As determined by the amount of feed required to produce 100 pounds of gain in these experiments, the money value of linseed-oil meal would be as shown in Table CXI.

TABLE CXI. — VALUE OF LINSEED-OIL MEAL AS AFFECTED BY THE PRICE OF CORN AND TANKAGE

When corn and tankage are worth . .	Corn 56¢ per bushel Tankage $40 per ton	Corn 70¢ per bushel Tankage $50 per ton	Corn 84¢ per bushel Tankage $60 per ton	Corn 98¢ per bushel Tankage $70 per ton	Corn $1.40 per bushel Tankage $100 per ton
Linseed-oil meal is worth	$27.43 per ton	$34.29 per ton	$41.14 per ton	$48.00 per ton	$68.58 per ton

To balance a corn ration, 1 pound of tankage will go nearly as far as 2 pounds of linseed-oil meal. In the above experiments the following average proportions by weight were fed: 7.6 parts corn to 1 of linseed-oil meal and 15.4 parts of corn to 1 of tankage.

Linseed-oil meal versus wheat shorts or middlings.

The feeding qualities of linseed-oil meal as compared with shorts or middlings have been studied in six different experiments. Only those in which the shorts rations were fed in the proportion of one or more parts of shorts or middlings to two of corn are included, since a smaller amount does not furnish a well-balanced ration. The results of these experiments, which were all with fattening pigs in the dry lot, are summarized in Table CXII.

TABLE CXII. — SUMMARY: LINSEED-OIL MEAL VERSUS WHEAT SHORTS OR MIDDLINGS (Av. 6 Exps.) [1]

AVERAGE RATION, PROPORTIONS BY WEIGHT	AVERAGE INITIAL WEIGHT PER PIG	AVERAGE DAILY GAIN PER PIG	AVERAGE FEED EATEN PER 100 LB. GAIN
	lb.	*lb.*	*lb.*
1.13 corn 1 middlings . . .	110	1.286	238.45 corn 201.59 middlings
5.33 corn 1 linseed-oil meal .	109	1.564	325.16 corn 60.98 linseed-oil meal

With but one exception, the pigs in these experiments given the average ration of 5.33 parts of corn to 1 of linseed-oil meal ate more feed and gained faster than those fed the average ration of 1.13 parts of corn to 1 of

[1] Ind. Exp. Sta. Bull. 137; Mo. Exp. Sta. Bulls. 65 and 67; Ohio Exp. Sta. Bull. 213.

middlings. The pigs eating the former ration made a daily gain of more than $\frac{1}{4}$ pound in excess of that gained by the pigs fed the middlings.

Another important advantage of linseed-oil meal over shorts or middlings was that a larger proportion of the ration was corn. In order to supply as much protein as was contained in the ration of 5 parts corn and 1 part of linseed-oil meal, it would be necessary to feed 1 pound of shorts or middlings with each pound of corn.

A smaller amount of total feed was consumed in the production of a given gain, also, with the linseed-oil meal ration than with the ration containing middlings. Based on the feed required to produce 100 pounds of gain, as given in the summary table, linseed-oil meal would have the valuations shown in Table CXIII.

Table CXIII. — Value of Linseed-Oil Meal as Affected by the Price of Corn and Wheat Shorts or Middlings

When corn and middlings are worth .	Corn 56¢ per bushel Middlings $25 per ton	Corn 70¢ per bushel Middlings $30 per ton	Corn 84¢ per bushel Middlings $40 per ton	Corn 98¢ per bushel Middlings $45 per ton	Corn $1.40 per bushel Middlings $60 per ton
Linseed-oil meal is worth	$55.18 per ton	$64.85 per ton	$91.04 per ton	$100.71 per ton	$129.70 per ton

If the addition of shorts or middlings to a ration of corn and tankage has the effect of improving its value and efficiency, there is reason to believe that a combination of corn, shorts or middlings, and linseed-oil meal would be an improvement over corn and linseed-oil meal alone, although there is no evidence except general experience to support it. A ration of 8 parts of corn, 2 parts shorts or middlings, and 1 part linseed-oil meal, by weight, would probably stimulate more rapid and as cheap gains as one of 6 parts corn and 1 of linseed-oil meal.

Linseed-oil meal versus soybean meal (ground soybeans). The Indiana and Ohio experiment stations have conducted four experiments in which rations of corn and linseed-oil meal were compared with rations of corn and soybean meal. Although soybeans have not been used extensively as a supplement to corn for fattening pigs in the dry lot, the results of these practical feeding tests would indicate their value when available for feeding purposes. Soybean is a legume and offers a most valuable source of home-grown protein in many sections of the United States. A tabulation of the results of these experiments is summarized in Table CXIV.

TABLE CXIV. — SUMMARY: LINSEED-OIL MEAL VERSUS SOYBEAN MEAL (AV. 4 EXPS.) [1]

AVERAGE RATION, PROPORTIONS BY WEIGHT	AVERAGE INITIAL WEIGHT PER PIG	AVERAGE DAILY GAIN PER PIG	FEED CONSUMED FOR EACH 100 LB. GAIN
	lb.	*lb.*	*lb.*
5.8 corn 1 soybeans	105	1.435	320.81 corn 55.04 soybeans
6.1 corn 1 linseed-oil meal. .	105	1.410	339.93 corn 54.96 linseed-oil meal

These results indicate that a ton of ground soybeans has practically the same value as a ton of linseed-oil meal.

Summary. The results of all the experimental studies in which linseed-oil meal has been fed in comparison with the

[1] Ind. Exp. Sta. Bulls. 126 and 137; Ohio Exp. Sta. Bull. 213.

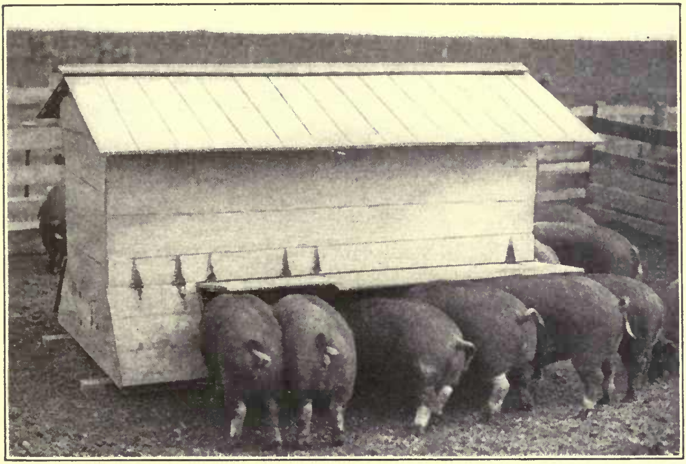
other standard protein supplements would indicate that it occupies a position next to tankage in feeding value. In most cases the rations of corn and linseed-oil meal did not prove so palatable nor so productive of rapid gains as did those of corn and skim-milk or corn and tankage. Generally, the feed cost of producing a unit of gain, also, was greater with the linseed-oil meal rations. Linseed-oil meal and soybean meal were shown to have practically equal value. Compared with rations of corn and wheat shorts or middlings, the linseed-oil meal and corn rations ordinarily proved more efficient in stimulating rapid and cheaper gains.

In addition to supplying needed proteins, linseed-oil meal is a natural laxative. In the absence of wheat bran or succulent feeds, it possesses large value when fed in small quantities to brood sows, boars, and gilts. Because of its regulative properties, its value for breeding stock generally is probably much greater than when measured solely by fattening experiments.

BY-PRODUCTS FROM THE MANUFACTURE OF WHEAT FLOUR

In the manufacture of flour from wheat, enormous quantities of by-products become annually available for feeding purposes. Excepting bran and screenings, these feeds are more generally fed to swine than to other classes of stock.

Wheat bran represents the outer and woody coat of the wheat berry plus small and varying quantities of adhering flour particles. The bran manufactured in the modern flour mill is more flaky, lighter in weight, and more free of starch or flour particles than that coming from mills where the separation of the white flour is less complete. Standard wheat middlings or shorts represent the



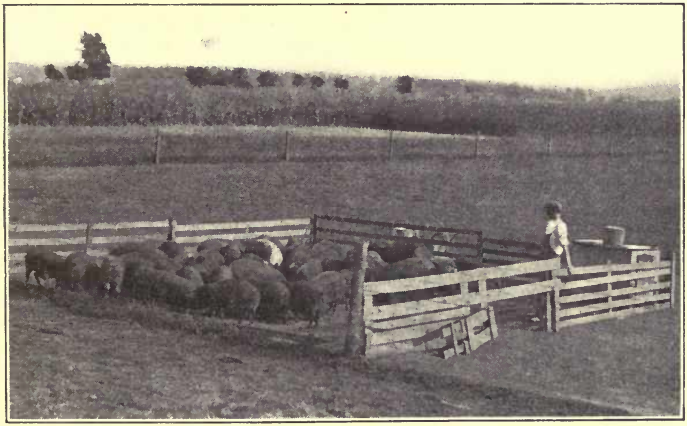


PLATE VII. — *Above*, Pigs on the self-feeder; *below*, A practical convenience in hand-feeding.

finer parts of the bran layers together with considerable amounts of adhering starch or flour grains. Brown middlings is a term sometimes employed also to designate this feed. Red-dog or dark feeding flour comprises the germ of the wheat, considerable flour, and small quantities of fine bran. It is low grade flour. So-called white or flour middlings represent a product intermediate in grade between standard middlings or shorts and red dog flour; that is, it contains less bran and more flour than the former, and less flour and more bran than the latter. It is equivalent to a mixture of the two. Shipstuffs, sometimes designated wheat mixed feed, is a collective name for the entire and ungraded mill run, all the by-products being run together. Wheat screenings are the weed seeds, shrunken and broken kernels obtained in the process of cleaning and grading wheat preparatory to milling.

In Table CXV is shown the average composition of each of these by-products, together with that of corn for the purpose of comparison.

TABLE CXV. — COMPOSITION OF WHEAT FLOUR BY-PRODUCTS [1]

FEED	TOTAL DRY MATTER IN 100 LB.	TOTAL DIGESTIBLE NUTRIENTS IN 100 LB.			ASH	NUTRITIVE RATIO
		Protein	Cabohydrates	Fats		
Bran	89.9	12.5	41.6	3.0	6.3	1:3.9
Standard middlings (shorts)	89.6	13.4	46.2	4.3	4.4	1:4.2
White or flour middlings	89.3	15.7	52.8	4.3	3.7	1:4.0
Red-dog flour	88.9	14.8	56.5	3.5	2.5	1:4.4
Screenings	89.8	9.6	47.3	3.6	3.9	1:5.8
Corn	89.5	7.5	67.8	4.6	1.5	1:10.4

[1] Appendix, Henry and Morrison's "Feeds and Feeding."

As a class, these by-products contain much smaller proportions of protein to carbohydrates and fats than does skim-milk or buttermilk, tankage, or linseed-oil meal. They occupy an intermediate position between the carbonaceous grains on the one hand and the more concentrated and richer protein or nitrogenous feeds on the other. The quantity of these which it is necessary to feed, consequently, in order successfully to balance corn is considerably greater than when the richer protein feeds are used. Bran and middlings or shorts are high in their content of ash or mineral matter. The particular kinds of mineral elements supplied, however, are not the ones most needed to make up for the mineral deficiencies of corn. They are not so valuable as bone-making feeds, therefore, as their composition might suggest.

Standard wheat middlings or shorts are the most extensively employed of any of these by-products for fattening pigs. It is a feed which the successful swine grower is rarely without. Wheat bran is better suited to breeding stock than to growing or fattening pigs. Its bulk and laxative properties make it especially valuable when used as a part of the winter rations for the brood sows and boars. For young pigs and fattening shotes, it is too bulky to be economical or productive of rapid gains. Screenings also contain more fiber than pigs can accommodate successfully.

The practical value of wheat shorts or middlings as a furnisher of protein with which to balance corn for fattening pigs is shown by the results of six experiments summarized in Table CXVI. In each test one lot of pigs was fed corn alone, and a second similar lot shorts or middlings in the average proportion of 1 pound of the supplement to 1.39 pounds of corn. The feeding periods lasted an average of 81 days.

TABLE CXVI. — SUMMARY: CORN ALONE VERSUS CORN AND WHEAT SHORTS OR MIDDLINGS (AV. 6 EXPS.) [1]

AVERAGE RATION PROPORTIONS BY WEIGHT	TOTAL NUMBER PIGS	AVERAGE INITIAL WEIGHT PER PIG	AVERAGE DAILY GAIN PER PIG	FEED EATEN FOR EACH 100 LB. GAIN
		lb.	*lb.*	*lb.*
Corn	28	108	.797	554.68 corn
1.39 corn . . . 1 shorts or middlings . . .	28	105	1.156	258.18 corn 184.76 shorts or middlings

In every instance in which the shorts or middlings were fed, the gains were faster and the total feed requirement for producing 100 pounds of gain less. Here again are demonstrated the deficiencies of a ration of corn alone for well-grown fattening pigs. For producing 100 pounds of gain, 184.76 pounds of shorts or middlings effected a saving of 296.50 pounds of corn. That is, this quantity of shorts or middlings fed in the balanced ration replaced or was the equivalent of 296.50 pounds of corn fed in the corn-alone ration. The value of the shorts or middlings in reducing the cost of gains compared with that of corn alone, then, would be as shown in Table CXVII.

TABLE CXVII. — MONEY VALUE OF WHEAT SHORTS OR MIDDLINGS WHEN FED WITH CORN TO FATTENING PIGS

When corn cost . .	56¢ per bushel	70¢ per bushel	84¢ per bushel	98¢ per bushel	$1.40 per bushel
Wheat shorts or middlings are worth .	$32.08 per ton	$40.11 per ton	$47.98 per ton	$56.17 per ton	$80.24 per ton

[1] Neb. Exp. Sta. Bull. 107; Ohio Exp. Sta. Bulls. 209 and 213; Mo. Exp. Sta. Bull. 65; Ind. Exp. Sta. Bull. 108.

These figures indicate that one could afford to pay these prices rather than feed corn alone. Owing to the fact, however, that other protein supplements are available on the market, the real money value of shorts or middlings is dependent on the prices of the feeds with which they must compete.

Shorts or middlings versus skim-milk or buttermilk.

At four experiment stations, feeding trials have been conducted in which rations of corn and shorts or middlings were compared with those of corn and skim-milk or buttermilk for fattening pigs in the dry lot. In each trial the corn was fed as a meal and in the form of a slop. The summarized results from these experiments are shown in Table CXVIII.

TABLE CXVIII. — SUMMARY: WHEAT SHORTS OR MIDDLINGS VERSUS SKIM-MILK OR BUTTERMILK (AV. 4 EXPS.) [1]

AVERAGE RATION, PROPORTIONS, BY WEIGHT	TOTAL NUMBER PIGS	AVERAGE INITIAL WEIGHT PER PIG	AVERAGE DAILY GAIN PER PIG	FEED EATEN FOR EACH 100 LB. GAIN
		lb.	*lb.*	*lb.*
1 corn				249.56 corn
2.15 skim-milk or buttermilk .	20	99.0	1.867	536.91 milk
1.12 corn				234.28 corn
1 middlings . . .	20	101.2	1.260	208.38 middlings

In each case the milk ration proved the more palatable and productive of rapid gains. The pigs receiving skim-milk or buttermilk gained daily .6 of a pound faster and

[1] Ohio Exp. Sta. Bull. 209; Mo. Exp. Sta. Bull. 79; Pa. Exp. Sta. Bull. 9; Ind. Exp. Sta. Bull. 137.

weighed nearly 50 pounds heavier at the close of the experiments.

The amount of feed required to produce 100 pounds of gain shows 208.38 pounds of shorts or middlings to have the value of 15.28 pounds of corn and 536.91 of skim-milk or buttermilk. This would result in giving to shorts or middlings the values shown in Table CXIX.

TABLE CXIX. — VALUE OF WHEAT SHORTS OR MIDDLINGS AS AFFECTED BY THE PRICE OF CORN AND SKIM-MILK OR BUTTERMILK

When corn and skim-milk or buttermilk are worth	Corn 56¢ per bushel Milk 20¢ per cwt.	Corn 70¢ per bushel Milk 25¢ per cwt.	Corn 84¢ per bushel Milk 30¢ per cwt.	Corn 84¢ per bushel Milk 35¢ per cwt.	Corn 98¢ per bushel Milk 40¢ per cwt.	Corn $1.40 per bushel Milk 50¢ per cwt.
Shorts or middlings are worth	$11.77 per ton	$14.71 per ton	$17.66 per ton	$20.23 per ton	$23.17 per ton	$30.38 per ton

Summary.

When measured solely by the results of these experiments, shorts or middlings did not prove as efficient for balancing corn as did skim-milk, tankage, or linseed-oil meal. There was more variation in the showing by this ration in the different experiments, also, than was true of the other rations. This was probably because the quality of shorts or middlings varies considerably from time to time, especially that produced by mills in different sections. The tendency, also, to use the term shorts or middlings to designate any of these products ranging in quality from bran or shipstuff on the one side to flour middlings or red-dog flour on the other, may have been responsible for the excellent showing of this ration in some of these experiments and its very ordinary showing in others. The most serious criticism against the use of standard shorts or the finer grades of middlings as exclusive supplements, however, arises from the large amount or proportion necessary to feed in order properly to balance a straight corn ration. The largest value of these feeds as a class is probably derived from their use in conjunction with other supplements richer in protein, and as a basis for slops in feeding show and breeding stock.

GENERAL SUMMARY

Believing that a summarized statement showing the value of standard protein-rich supplements for balancing a ration of straight corn for fattening pigs in the dry lot would be of interest, the data given in the preceding tables of this chapter are brought together in Table CXX. These averages are based on the results of thirty-five experiments comparing rations of corn alone and corn with a protein supplement added. A total of 594 pigs, averaging 118 pounds at the beginning of the tests, was involved.

TABLE CXX.—CORN ALONE VERSUS CORN AND A PROTEIN SUPPLEMENT

Rations	Average Daily Gain per Pig	Feed Eaten for Each 100 Lb. Gain[1]	Pork Produced with each 56 Lb. Feed
	lb.	*lb.*	*lb.*
Corn alone	.964	544.06 corn	10.29
Corn and protein supplement	1.462	436.23 corn and supplement	12.84

[1] Skim-milk and buttermilk reduced to basis of other supplements by dividing by 5.

The preceding table teaches a valuable lesson. For practical use, however, it is more interesting than valuable. More specific information is required to settle the question of the most effective and economical supplement to buy to balance corn for fattening pigs. To help answer this question, the summarized results of all the previously considered experiments in which two standard protein supplements were compared are averaged and brought together in Table CXXI.

Table CXXI. — The Relative Value of Standard Protein Supplement for Fattening Pigs in the Dry Lot

Rations, Proportions by Weight	Average Daily Gain per Pig	Feed Eaten for Each 100 Lb. Gain	Number of Experiments
	lb.	*lb.*	
1.13 corn 1 wheat shorts or middlings	1.286	238.45 corn 201.59 shorts	6
5.33 corn 1 linseed-oil meal	1.564	325.16 corn 60.98 linseed-oil meal	
6.1 corn 1 linseed-oil meal	1.410	339.93 corn 54.96 linseed-oil meal	4
5.8 corn 1 ground soybeans	1.430	320.81 corn 55.04 soybeans	
7.6 corn 1 linseed-oil meal	1.505	362.52 corn 47.65 linseed-oil meal	8
15.4 corn 1 tankage or meat-meal	1.581	378.82 corn 24.53 tankage	
10.6 corn 1 tankage	1.202	387.77 corn 30.48 tankage	
1 corn 2.6 skim-milk or buttermilk	1.518	325.00 corn 584.50 milk	8

In Table CXXI, only the two rations included within the same two double lines are comparable. In the first section linseed-oil meal is compared with shorts or middlings, the former supplement, based on the averages of six experiments, giving the better results. In the second section, linseed-oil meal and soybean meal are compared, the results indicating almost equality of value. In the same way tankage is proved slightly superior to linseed-oil meal as a supplement to corn as shown in the third section, and skim-milk or buttermilk superior to tankage in the fifth or last part of the table. The reasons why the results of the corn and tankage ration as shown in the last part of the table are not as favorable from the same ration when it was compared with corn and linseed-oil meal, are probably due to one or more of the following factors: the age or thrift or breeding of the pigs, the length of the experiments, or the favorableness of the weather or other general conditions.

Owing to the variation in the amount of protein contained by the different nitrogenous supplements, some must be fed in larger amounts than others. In some of the rations included in this summary, the amount of supplements fed was excessive, while in the others less was fed than necessary to insure an adequate supply of protein. The relation between the price of corn and that of the supplement, and the relation of feed to pork prices, is probably the reason for the variations noted.

In Table CXXII is stated the proportions in which it is necessary to feed the different supplements in order to supply approximately the same proportion of protein in a corn ration. Under average conditions, the experimental feeding trials already studied would indicate that a nutritive ration of 1 : 6.35–6.50 (that is, 1 part of digestible protein to 6.35 to 6.50 parts of digestible carbohydrate equivalents in the ration) is approximately correct for fattening pigs in the dry lot.

TABLE CXXII. — THE PROPORTION OF THE DIFFERENT PROTEIN SUPPLEMENTS REQUIRED TO BALANCE CORN FOR GROWING AND FATTENING PIGS [1]

PROTEIN SUPPLEMENT	PER CENT OF SUPPLEMENT	PER CENT OF CORN	NUTRITIVE RATIO
Tankage or meat-meal (55–60% protein) . .	9	91	1 : 6.42
Linseed-oil meal (o.p.) .	17	83	1 : 6.31
Soybeans	18	82	1 : 6.47
Standard wheat shorts or middlings	50	50	1 : 6.51
Skim-milk	65	35	1 : 6.32
Buttermilk	65	35	1 : 6.43

[1] Calculations are based on the feed compositions as given in Henry and Morrison's "Feeds and Feeding."

CHAPTER XII

OTHER CEREAL GRAINS FOR GROWING AND FATTENING PIGS

Where corn can be grown as in the corn-belt proper, it probably will continue to be the main reliance in pork production. In those sections in which corn is not grown extensively, however, other cereal grains must be depended on largely as the basis for the growing and fattening rations. Even within the corn-belt, it is sometimes profitable to substitute in whole or part some one of these cereals for corn.

The composition of those cereal grains employed more or less extensively is shown in Table CXXIII.

Table CXXIII. — Composition Cereal Grains [1]

Grain	Total Dry Matter in 100 lb.	Total Digestible Nutrients in 100 Lb.			Ash	Nutritive Ratio
		Protein	Carbohydrates	Fats		
Corn	89.5	7.5	67.8	4.6	1.5	1 : 10.4
Barley	90.7	9.0	66.8	1.6	2.7	1 : 7.8
Wheat	89.8	9.2	67.5	1.5	1.9	1 : 7.7
Rye	90.6	9.9	68.4	1.2	2.0	1 : 7.2
Oats	90.8	9.7	52.1	3.8	3.5	1 : 6.3
Emmer (Spelt)	91.3	9.5	63.2	1.7	3.7	1 : 7.1
Kafir	88.2	9.0	65.8	2.3	1.7	1 : 7.9
Milo	89.3	8.7	66.2	2.2	2.8	1 : 8.2
Sorghum	87.3	7.5	66.2	2.6	1.9	1 : 9.6
Feterita	89.2	9.3	66.6	2.5	1.5	1 : 7.8
Kaoliang	90.1	8.5	67.0	3.3	1.9	1 : 8.8

[1] Appendix, Henry and Morrison's "Feeds and Feeding."

All these cereals are rich in carbohydrates, mostly starch, and poor in protein and ash. With the exception of oats and emmer, they are highly concentrated and better suited to fattening than to growing animals. Although similar in composition as expressed by the usual chemical analysis, each possesses peculiarities in taste, physical properties, and chemical make-up which affect its usefulness as a swine-feed.

BARLEY

Perhaps barley is more widely used for swine-feeding than any other grain. In Canada, Great Britain, and the continental European countries, it is largely depended on in the production of the finest quality of bacon. In the West and Northwest, barley is generally used and highly thought of, fed alone with supplements or in combination with other grains.

Barley versus corn.

In Table CXXIV have been brought together results of American pig-feeding experiments in which rations containing barley were compared with those including corn. In all cases both cereals were fed ground, and commonly in the form of a thick slop.

In every instance the pigs fed the corn ration made faster gains than with the barley. Considering only the three experiments in which a direct comparison of barley and corn is possible, the gains made on the corn rations were on the average 18 per cent faster than those on the barley. For producing the same gain, 100 pounds of corn proved equivalent to 120 pounds of barley.

TABLE CXXIV. — BARLEY VERSUS CORN FOR GROWING AND FATTENING PIGS

Grain	Supplement	Number Pigs Each Lot	Length of Test	Average Initial Weight per Pig	Average Daily Gain per Pig	Feed Eaten for Each 100 Lb. Gain (not including hay)	Station and Author
			days	*lb.*	*lb.*	*lb.*	*lb.*
Corn	Wheat shorts	6	83	138	1.50	347 corn 92 shorts	N. Dak. Bull. 84 Shepperd and Richards
Barley	"	6	83	136	1.23	458 barley 116 shorts	
Corn	Alfalfa meal	4	56	147	1.02	389 corn 97 alfalfa meal	Wyoming Bull. 107 Faville
Barley	"	4	56	140	.98	400 barley 100 alfalfa meal	
Corn	Alfalfa hay	30	148	86	1.01	442 corn	Nebraska Bull. 124 Snyder and Burnett
½ Corn ½ Barley	"	30	148	86	.96	494 corn and barley	
Corn	Alfalfa hay	20	94	82	1.02	470 corn	Nebraska Bull. 99
Emmer	"	20	94	81	.77	618 emmer	Snyder and Burnett
Barley	"	20	94	80	.81	590 barley	
Corn	Alfalfa hay	12	42	160	1.53	470 corn	Nebraska Bull. 99
½ Corn ½ Emmer	"	12	42	146	1.35	482 corn and emmer	Snyder and Burnett
½ Corn ½ Barley	"	12	42	155	1.45	463 corn and barley	

Being richer in protein and mineral matter, a ration of barley alone may be regarded as less objectionable for young and growing pigs than one of corn alone. For fattening shotes of the lard type, and in rations which are properly supplemented, on the other hand, corn will usually give better results than barley.

The results of the two Nebraska experiments indicate that emmer is somewhat less valuable than barley, probably due to its containing a high percentage of fiber.

To give the best results in rapid and economical gains, however, barley must be supplemented properly when fed to growing or fattening pigs. This principle is illustrated by the results of an experiment conducted by Faville[1] at the Wyoming Experiment Station as shown in Table CXXV.

TABLE CXXV. — BARLEY VERSUS BARLEY PLUS MEAT-MEAL FOR FINISHING FATTENING PIGS

Ration, Proportions by Weight	Number Pigs Each Lot	Length of Test	Average Initial Weight per Pig	Average Daily Gain per Pig	Feed Eaten for Each 100 Lb. Gain
		days	*lb.*	*lb.*	*lb.*
Barley meal .	5	70	88	1 46	413 barley
9 barley meal 1 meat-meal	5	70	87	1.74	333 barley 37 meat-meal

Barley rations for bacon-production.

The work of Day at the Ontario Agricultural College and Grisdale of the Central Experimental Farms at Ottawa has demonstrated conclusively the superiority of barley over all other cereal grains for the production of bacon of the highest quality. Although corn produces lard of good firmness, color, and texture, the results of Canadian experiments generally show its inferiority for the production of firm bacon. In Table CXXVI are the results of experiments comparing barley and corn for feeding pigs intended for bacon-production.

[1] Bull. 114.

TABLE CXXVI. — BARLEY RATIONS FOR BACON-PRODUCTION

Rations, Proportions by Weight	Number Pigs Each Lot	Length of Test	Average Initial Weight per Pig	Average Daily Gain per Pig	Feed Eaten for Each 100 Pounds Gain	Station and Author
		days	*lb.*	*lb.*	*lb.*	
Corn-meal	4	112	74	.87	416 corn	Cen. Exp. Farms, Bull. 33, Grisdale
Barley meal	4	112	73	1.00	435 barley	
1 corn-meal, 1 w middlings	12	140	—	.817	432 corn and middlings	Annual Report 1900, Ont. Agr. College, Day
1 barley meal, 1 w. middlings	12	140	—	.841	430 barley and middlings	
4 barley meal, 1 w. middlings	5	120	54	.789	458 barley and middlings	
2 barley meal, 2 corn-meal, 1 w. middlings	5	120	54	.762	478 barley, corn, and middlings	
2 barley meal, 2 oat meal, 1 w. middlings	5	120	54	.645	526 barley, oats and middlings	
2 barley meal, 2 roots (cooked), 1 w. middlings	5	120	54	.850	397 meal, 361 roots	
2 barley meal, 2 roots (uncooked), 1 w. middlings	5	120	54	.807	423 meal, 374 roots	

Contrary to the results of experiments conducted in the states and reported in Table CXXIV, the rations containing barley in the Canadian experiments produced faster gains with less feed than did those containing corn. The contradiction in the two sets of results is probably to be explained by a difference in the quality of corn and barley fed. Examination of the carcasses showed the corn-fed pigs to be decidedly inferior to the barley-fed animals.

Regarding the suitability of barley for bacon-production Day [1] says: "Barley is a noted hog food in Europe; but some feeders in this country do not look upon it with favor. We have secured excellent results from barley, however, both in the amount of gain and the quality of bacon. For young pigs it should be mixed with wheat middlings, a very little barley being used at first, and the quantity gradually increased. For older pigs peas or wheat may be added. Some succulent food, such as roots or green feed, should always be fed with it; and skim-milk makes a great improvement. It is not generally regarded with favor as a food for breeding sows."

WHEAT

The demand for wheat flour in this country and abroad leaves little sound wheat available for feeding purposes. Occasionally, however, through the scarcity of old corn and a large wheat crop, this cereal is available at a price more commensurate with its feeding value. At such times the corn-belt feeder especially desires to know the relative merits of wheat and corn, and the method of feeding wheat most likely to give the best results.

Wheat versus corn.

Plumb and Anderson [2] at the Indiana station and Snyder and Burnett [3] at the Nebraska station have conducted feeding trials in which the dry unground wheat was compared with shelled corn. In the Indiana experi-

[1] Ont. Agr. Coll. Bull. 129. [2] Bull. 67. [3] *Ibid.* 167.

ment skim-milk was fed as a supplement, and in the Nebraska experiment access to alfalfa hay was given. The results of these are averaged and reported in Table CXXVII.

TABLE CXXVII. — WHOLE WHEAT (dry) VERSUS SHELLED CORN (dry) (Av. 2 Exps.)

GRAIN	TOTAL NUMBER PIGS	AVERAGE LENGTH OF EXPERIMENTS	AVERAGE INITIAL WEIGHT PER PIG	AVERAGE DAILY GAIN PER PIG	CONCENTRATES EATEN FOR EACH 100 LB. GAIN
		Days	*lb.*	*lb.*	*lb.*
Shelled corn .	13	101	77.4	1.135	390 corn
Whole wheat	13	101	76.6	1.020	432 wheat

In both these experiments, better results were obtained with shelled corn than with whole wheat. The fact that wheat is hard to masticate, that it tends to become gummy and form a pasty mass when chewed, is probably responsible for its poor showing in these tests.

TABLE CXXVIII. — GROUND WHEAT VERSUS GROUND CORN (Av. 6 Exps.)

RATIONS	TOTAL NUMBER PIGS	AVERAGE LENGTH OF EXPERIMENTS	AVERAGE INITIAL WEIGHT PER PIG	AVERAGE DAILY GAIN PER PIG	CONCENTRATES EATEN FOR EACH 100 LB. GAIN
		days	*lb.*	*lb.*	*lb.*
Ground corn .	46	110	100	1.136	522.6
Ground wheat	46	110	102	1.291	474.4

To determine the relative merits of ground wheat and ground corn, fed as a thick slop, the averaged results of six experiments conducted at the Missouri,[1] Ohio,[2]

[1] Weaver, Bull. 136. [2] Eastwood, Bull. 268.

and Nebraska,[1] experiment stations are summarized in Table CXXVIII. In three of the experiments the grains were fed alone, while in the other three protein supplements were given in the same proportion in both rations.

In every experiment contributing results in the above table, the gains were faster on the wheat than on the corn rations; and, with the exception of one experiment, a unit of gain was made on less feed. The averaged results showed the pigs on the wheat rations to have gained 13.6 per cent faster; and for producing a given gain, 100 pounds of wheat proved equivalent to 110 pounds of corn. For growing pigs, however, shelled corn is as efficient as ground corn (see page 339). Since it is necessary to grind wheat, the advantage of wheat over corn when available at the same price is largely offset by the expense of grinding.

Wheat versus one-half wheat and one-half corn.

Four experiments by Weaver[2] at the Missouri Experiment Station gave uniformly better results from ground wheat alone than from a mixture of equal parts of ground wheat and ground corn, both when the grains were fed alone and when supplemented with tankage. The average daily gain on the wheat-alone ration was 1.385 pounds and on a mixture of the two grains 1.31 pounds, and the total feed required to produce 100 pounds of gain 476 and 503 pounds, respectively. The thirty-six pigs averaged about 97 pounds at the beginning of the experiments, which covered an average period of 120 days.

On the other hand, Henry,[3] at the Wisconsin Station

[1] Smith, Bull. 75.
[2] Bull. 136.
[3] Wis. An. Rpt., 1894.

in three experiments with eighteen pigs averaging 159 pounds, obtained slightly but uniformly better results from the mixture of equal parts ground wheat and ground corn than from ground wheat alone, both rations in each experiment being unsupplemented. High-grade wheat was used at both stations and the rations fed in the form of a thick slop. The averaged data of all seven experiments at both stations give results which favor very slightly the wheat-alone ration.

Dry whole wheat versus soaked whole wheat.

The results of three experiments, involving thirty-eight pigs, give information regarding the advantage of soaking whole wheat. Two were conducted at the Nebraska[1] Experiment Station and one at the Indiana station.[2] In one of the Nebraska trials, the pigs were given in addition to the wheat access to alfalfa hay, of which they ate very little. The essential results are averaged and shown in Table CXXIX.

TABLE CXXIX. — DRY WHOLE WHEAT VERSUS SOAKED WHOLE WHEAT (Av. 3. Exps.)

Ration	Total Number Pigs	Average Length of Experiments	Average Initial Weight per Pig	Average Daily Gain per Pig	Concentrates Eaten for Each 100 Lb. Gain
		days	*lb.*	*lb.*	*lb.*
Dry whole wheat .	19	98	88	.89	500
Soaked whole wheat	19	98	88	.94	478

[1] Snyder and Burnett, Neb. Exp. Sta. Bull. 147; Smith, Neb. Exp. Sta. Bull. 75.
[2] Plumb and Anderson, Ind. Bull. 67.

In each experiment the results in rate and economy of gain were in favor of the soaked wheat. With neither ration, however, were the results satisfactory.

Soaked whole wheat versus soaked ground wheat.

Accumulated studies by the experiment stations of the country have proved rather conclusively that wheat must be ground for the best results. In Table CXXX the results of five experiments are summarized when soaked whole wheat was fed one lot of pigs and soaked ground whole wheat another lot. The wheat was soaked twenty-four to forty-eight hours. Tankage was fed as a supplement in one experiment and alfalfa hay in a second. In the other cases no protein feeds were used. In one of the trials the wheat fed had been frosted.

TABLE CXXX. — SOAKED WHOLE WHEAT VERSUS SOAKED GROUND WHEAT (AV. 5 EXPS.) [1]

RATIONS	TOTAL NUMBER PIGS	AVERAGE LENGTH OF EXPERIMENTS	AVERAGE INITIAL WEIGHT PER PIG	AVERAGE DAILY GAIN PER PIG	CONCENTRATES EATEN FOR EACH 100 LB. GAIN
		days	*lb.*	*lb.*	*lb.*
Soaked whole wheat . .	42	81	135	1.118	538
Soaked ground wheat . .	43	81	136	1.354	442

For producing a given gain, 100 pounds of soaked ground wheat is shown here to have the value of 121 pounds of soaked whole wheat. In addition, the pigs

[1] Grisdale, Central Exp. Farms, Canada, Bull. 33; Bliss and Lee, Neb. Exp. Sta. Bull. 144; Snyder and Burnett, Neb. Exp. Sta. Bull. 147; Good and Smith, Ky. Exp. Sta. Bull. 75.

fed the ground wheat gained 21 per cent faster than those fed the whole wheat.

Wheat alone versus wheat and a protein supplement.

Like corn, wheat must be supplemented with a feed rich in nitrogenous material if the most rapid and economical gains are made. This is demonstrated by the results of six experiments, summarized in Table CXXXI. In all of the trials but one, the wheat was ground and fed as a slop; in five of the trials 5 to 8 per cent of tankage was fed in the supplemented ration, and in the other 50 per cent of wheat shorts.

TABLE CXXXI. — WHEAT ALONE VERSUS WHEAT AND A PROTEIN SUPPLEMENT[1] (Av. 6 Exps.)

Rations	Total Number Pigs	Average Length of Experiments	Average Initial Weight per Pig	Average Daily Gain per Pig	Total Concentrates Eaten for Each 100 Lb. Gain
		days	*lb.*	*lb.*	*lb.*
Wheat alone	53	89	106	1.158	475
Wheat and supplement	52	89	106	1.356	437

Frosted versus sound wheat.

In practically all the experiments thus far considered with wheat, the grain fed was sound and marketable. Wheat which has been injured while in the dough stage by hot winds or frost or damaged by excessive rains during harvest, is considered to have a lower feeding value than wheat which has been properly filled or been uninjured.

[1] Weaver, Mo. Exp. Sta. Bull. 136; Good and Smith, Ky. Exp. Sta. Bull. 190; Bliss and Lee, Neb. Exp. Sta. Bull. 144; Clark, Mont. Exp. Sta. Bull. 89.

Likewise "salvage" wheat, which has been more or less damaged by elevator fire, is no doubt less valuable than sound wheat in direct proportion to the degree of injury done.

An experiment conducted at the Montana Experiment Station by Clark [1] suggests the feeding qualities of frosted as contrasted with good wheat. The wheat for both lots of pigs was ground and fed without supplements, in the form of a slop. The results are shown in Table CXXXII.

TABLE CXXXII. — FROSTED WHEAT VERSUS SOUND WHEAT

RATIONS	LENGTH OF EXPERIMENT	AVERAGE INITIAL WEIGHT PER PIG	AVERAGE FINAL WEIGHT PER PIG	AVERAGE DAILY GAIN PER PIG	FEED EATEN FOR EACH 100 LB. GAIN
	days	*lb.*	*lb.*	*lb.*	*lb.*
Frosted wheat . .	49	149	194	.92	560
Sound wheat. . .	49	150	199	1.01	532

In this experiment, 100 pounds of sound wheat were equal to 105 pounds of frosted wheat. The pigs receiving the sound grain also gained 9.7 per cent faster.

RYE

The composition of rye would suggest that its feeding value for growing and fattening pigs would be equal if not superior to that of corn. The results of a few experimental feeding tests, however, prove rather conclusively that its value is a little less than corn. The results of an experiment by H. R. Smith [2] at the Nebraska

[1] Bull. 89.

[2] *Ibid.*, 75.

Experiment Station are shown in Table CXXXIII. In each lot the grain was fed ground without a supplement and in the form of a slop.

TABLE CXXXIII. — GROUND RYE VERSUS GROUND CORN

Grain	Number Pigs	Length of Experiment	Average Initial Weight per Pig	Average Daily Gain per Pig	Feed Eaten for Each 100 Lb. Gain
		days	*lb.*	*lb.*	*lb.*
Ground corn . . .	6	91	110	.71	609
Ground rye . . .	6	91	107	.67	624

Although the pigs were occasionally given lime and charcoal, the gains were hardly satisfactory in either lot. The corn-fed pigs gained faster, however, than the rye-fed, 100 pounds of the former being equal to 102 pounds of rye in the production of a unit of gain. The rye was eaten with less relish and in slightly smaller amounts than was the corn. Owing to the difficulty of masticating rye successfully, it must be ground for best results.

At the experimental substation at North Platte, Nebraska, Snyder and Burnett[1] conducted three pig-feeding experiments in which rye was compared with wheat. In two of the trials the grains were fed soaked and without grinding, and in one the grains were both soaked and ground. The pigs in two of the tests had access to alfalfa hay in a rack, while in the other experiment the grains were fed alone. The results of these three experiments are shown in Table CXXXIV, the first part of which gives the average of the two trials.

[1] Bull. 147.

TABLE CXXXIV. — RYE VERSUS WHEAT

RATIONS	NUMBER OF PIGS	LENGTH OF EXPERIMENTS	AVERAGE INITIAL WEIGHT PER PIG	AVERAGE DAILY GAIN PER PIG	AVERAGE TOTAL FEED EATEN FOR EACH 100 LB. GAIN
		days	*lb.*	*lb.*	*lb.*
Whole wheat — soaked . . .	19	98	107.5	1.05	504 wheat 10 alfalfa hay
Whole rye — soaked . . .	19	98	109.9	.88	546 rye 12 alfalfa hay
Ground wheat — soaked . . .	10	98	123	1.39	425 wheat 10 alfalfa hay
Ground rye — soaked . . .	10	98	123	.83	572 rye 23 alfalfa hay

In all cases the wheat gave better results than the rye, especially when both were ground. Averaging the results from all three trials, 100 pounds of wheat proved equal to 116 pounds of rye in the production of a given gain. The rate of gain, also, was approximately 35 per cent faster on the wheat than on the rye rations.

According to Henry and Morrison,[1] extensive experiments in Denmark have shown rye meal to be slightly less valuable than corn-meal, and about equal to barley meal in the production of pork. The bacon from rye-fed pigs was good, though not so satisfactory as when it was fed in combination with other grains. Rye bran and rye middlings, on the other hand, produced bacon of a very inferior quality.

OATS

Although oats are an excellent feed for brood sows and other hogs not receiving full fattening rations, they

[1] "Feeds and Feeding," 1915.

are too bulky to give satisfactory results when fed to growing pigs and fattening shotes. A hundred pounds of oats contain 15.3 pounds less of digestible nutrients than the same amount of corn. Corn contains 2 per cent of woody fiber, while oats contain 10.9 per cent. This is the principal reason why oats are less digestible than corn and too bulky for pigs fed for rapid gains.

Oats versus corn.

Two experiments by Eastwood [1] at the Ohio Experiment Station furnish a very reliable test for contrasting the results from feeding corn and oats to growing pigs. The averaged figures are stated in Table CXXXV.

TABLE CXXXV. — OATS VERSUS CORN

(Av. 2 Exps.)

Rations, Proportions by Weight	Total Number Pigs	Average Length of Experiments	Average Initial Weight per Pig	Average Daily Gain per Pig	Feed Eaten for Each 100 Lb. Gain
		days	*lb.*	*lb.*	*lb.*
9 ground corn . 1 tankage . . .	10	105	103	1.63	381.78 corn 42.42 tank.
9 ground oats . 1 tankage . . .	10	105	99	1.04	480.10 oats 53.34 tank.

In these experiments the corn-fed pigs gained .59 pound daily faster than the oat-fed animals. The amount of feed required to produce 100 pounds of gain showed 100 pounds of corn equal to 125 pounds of oats. In addition, a smaller quantity of tankage was eaten for a unit of gain by those fed corn.

Experiments by Henry [2] at the Wisconsin Experiment

[1] Bull. 268. [2] Wis. An. Rpt., 1889.

Station and Eastwood [1] at the Ohio Station indicate that as the proportion of oats in the ration is increased the efficiency of the ration is reduced. The detailed results of these experiments are shown in Table CXXXVI.

TABLE CXXXVI. — THE EFFECT OF FEEDING DIFFERENT PROPORTIONS OF OATS WITH CORN

Rations, Proportions by Weight	Number Pigs	Length of Experiments	Average Initial Weight per Pig	Average Daily Gain per Pig	Feed Eaten for Each 100 Lb. Gain
		days	*lb.*	*lb.*	*lb.*
1 whole oats 2 corn-meal	3	60	115	.82	164 oats 328 corn
2 whole oats 1 corn-meal	3	60	115	.68	376 oats 188 corn
1 ground oats 2 corn-meal	3	60	115	1.27	134 oats 268 corn
2 ground oats 1 corn-meal	3	60	115	1.03	286 oats 143 corn
3 ground oats 6 ground corn 1 tankage	5	84	152	1.57	137.4 oats 274.8 corn 45.8 tankage
6 ground oats 3 ground corn 1 tankage	5	84	148	1.49	283.9 oats 141.9 corn 47.3 tankage

In every instance, as the proportion of oats was increased, the feed consumption and the rate of gain decreased. In the first Wisconsin experiment, when the oats were unground, 100 pounds of corn-meal proved equal to 151 pounds of whole oats. When the oats were ground, 100 pounds of corn were equivalent to 121 pounds of oats. The results of the Ohio experiment showed 100 pounds of corn equal to 110 pounds of oats in producing a given

[1] Bull. 268.

gain. In addition, a larger amount of tankage was eaten for a given gain in the ration containing the larger proportion of oats. The two Wisconsin experiments suggest what general practice has confirmed, viz., that oats must be ground for best results.

Like other grains, oats vary considerably in feeding value. As a rule, that produced in Canada and the northern states is heavier and consequently higher in feeding value than that grown farther south.

KAFIR, MILO, CANE

Feeding experiments generally have shown that kafir, milo, and cane, or sweet sorghum, are not as efficient as corn. Because of the adaptability of these crops to semi-arid conditions, however, their usefulness in pork production is large.

Kafir versus corn.

Wheeler [1] at the Kansas Station conducted two short experiments in which kafir meal and corn-meal were compared for fattening pigs in the dry lot. In each test the grains were supplemented with ground soybeans. The figures in Table CXXXVII show the averaged results.

These results indicate that kafir ranks close to corn as a fattening feed. The difference here shown, however, would probably have been more favorable to the corn ration if the amount of feed in one of the experiments had not been limited. Kafir as a rule is less palatable than corn, and with unrestricted rations, considerably more corn than kafir is consumed.

[1] Bull. 192.

TABLE CXXXVII. — KAFIR MEAL VERSUS CORN-MEAL

(Av. 2 Exps.)

Rations, Proportions by Weight	Total Number Pigs	Average Length of Experiment	Average Initial Weight per Pig	Average Daily Gain per Pig	Feed Eaten for Each 100 Lb. Gain
		days	*lb.*	*lb.*	*lb.*
4 kafir meal 1 soybean meal . .	24	28	159	1.23	506
4 corn-meal 1 soybean meal . .	24	28	155	1.26	494

Cane, milo, kafir, kaoliang, and feterita versus corn.

The results of two rather extensive experiments conducted at the Hays Branch Experiment Station, Kansas,[1] where grains adapted to the western part of the state were compared with corn, are detailed in Table CXXXVIII.

TABLE CXXXVIII. — A COMPARISON OF DIFFERENT GRAINS FOR FATTENING PIGS

Grains	Number Pigs	Length of Experiment	Average Initial Weight per Pig	Average Daily Gain per Pig	Total Feed Eaten Each 100 Lb. Gain
		days	*lb.*	*lb.*	*lb.*
Sorghum (cane) .	10	60	125	1.70	440
Milo	10	60	124	1.70	390
Kafir	10	60	125	1.80	390
Corn	10	60	125	2.00	370
Kaoliang . . .	10	74	140	1.31	572
Milo	10	74	140	1.43	523
Kafir	10	74	140	1.40	534
Feterita . . .	10	74	140	1.36	549
Corn	10	74	140	1.46	514

[1] First table — Wright, Bull. 192. Second table — Cochel, Kansas Industrialist, May, 1915, and Henry and Morrison's "Feeds and Feeding."

In both experiments the grain fed in each lot was supplemented by 30 per cent shorts and 5 to 8 per cent tankage. In all cases, also, the grains were reduced to a meal.

In both experiments the corn ration produced the most rapid gains, with the least total feed consumed for a unit of gain. But the excellent showing of the other grains should furnish much encouragement to the hog-raiser who cannot grow corn successfully, but does produce these other crops in quantity.

On the average, the results showed milo and kafir to be practically equal in feeding value, both grains being considerably superior to either kaoliang or feterita. In the first experiment sorghum produced as rapid gains as milo, but with the latter more feed was required for a unit of gain.

In an experiment at the Nebraska Experiment Station, Snyder and Burnett[1] compared rations of corn and cane, with a combination of both, fed in each case with 10 per cent chopped alfalfa hay.

TABLE CXXXIX. — SORGHUM VERSUS SORGHUM AND CORN

Grains	Number of Pigs	Length of Experiments	Average Initial Weight per Pig	Average Daily Gain per Pig	Grain Eaten for Each 100 Lb. Gain
		days	*lb.*	*lb.*	*lb.*
Corn	10	63	141	1.69	386
½ corn ½ cane (sorghum)	10	63	140	1.43	442
Cane (sorghum) .	10	63	140	1.15	548

The combination of cane and corn gave very much better results than cane alone.

[1] Bull. 124.

Kaoliang meal and corn-meal were compared by Wilson [1] at the South Dakota Experiment Station in two trials, results of which are averaged in Table CXL. In one of the experiments the grains were fed alone, while in the other the pigs were given access to alfalfa hay in a rack.

TABLE CXL. — KAOLIANG MEAL VERSUS CORN-MEAL

(Av. 2 trials)

Grains	Total Number Pigs	Average Length of Experiments	Average Initial Weight per Pig	Average Daily Gain per Pig	Grain Eaten for Each 100 Lb. Gain
		days	*lb.*	*lb.*	*lb.*
Kaoliang meal . .	8	55	207	.925	621
Corn-meal . . .	8	55	196	1.255	492

Very fair gains were made on the kaoliang ration, but the amount of feed required to produce 100 pounds of gain was excessive.

[1] Bull. 157.

CHAPTER XIII

CORN SUBSTITUTES AND OTHER BY-PRODUCTS FOR GROWING AND FATTENING PIGS

A TIME may come, even in the corn-belt, when corn will be regarded as too valuable to make its general use for live-stock feeding either patriotic or profitable. It may be many years under normal conditions before this situation is realized, but the more or less restricted area of the corn-belt, the rapid increase in the use of corn for human food and other commercial purposes, and the rate at which the population of the country is increasing in density, are conditions which point to an increasing scarcity of all cereal grains for feeding purposes in the future.

CORN BY-PRODUCTS

The three most commonly used corn by-products for pig-feeding are hominy feed, corn feed meal, and corn germ meal. In addition, gluten feed and gluten meal have been employed to a limited extent.

Hominy feed.

This by-product is officially designated either hominy feed, hominy meal, or hominy chop. It is tentatively defined as follows by the Association of Feed Control Officials of the United States: "A kiln-dried mixture of the mill run bran coating, the mill run germ, with or without a partial extraction of the oil, and a part of the starchy portion of the white corn kernel obtained in the manufacture of hominy, hominy grits and corn germ meal by the degerminating process." Yellow hominy feed is identical to the above except that it is manufactured from yellow corn.

Hominy feed has a composition very similar to corn and is to be regarded, therefore, as a substitute and not a supplement for corn. Being low in protein and rich in carbohydrates, it must be balanced, like corn, by the addition of a feed rich in protein if satisfactory results are obtained from it.

From 1909 to 1911, Skinner and King of the Indiana Experiment Station[1] conducted seven trials in each of which corn-meal and hominy meal were compared for fattening pigs in the dry lot. In three of the experiments, 33 per cent of shorts was fed to balance the rations and in four 5 per cent of tankage. In all cases the rations were hand-fed in the form of a thick slop. The summarized results are shown in Table CXLI.

Table CXLI. — Hominy Meal versus Corn-Meal

(Av. 7 trials)

Rations	Total Number Pigs	Average Length of Experiments	Average Initial Weight per Pig	Average Daily Gain per Pig	Total Feed Eaten for Each 100 Lb. Gain
		days	*lb.*	*lb.*	*lb.*
Corn-meal and supplement	51	87	112	.96	514
Hominy meal and supplement. . .	50	87	110	1.15	429

[1] Bull. 158.

In each of the seven experiments, the pigs fed the hominy meal gained faster, and with a smaller expenditure of feed for a unit of gain, than did those fed the cornmeal. On the average, the gains from the former ration were nearly 20 per cent faster, and 100 pounds of the hominy ration equaled 119 pounds of the corn ration.

More recent feeding experiments, however, show a higher feeding value for corn than for hominy. Five trials at the Iowa Experiment Station and two at the Indiana Station since 1916 gave uniformly better results from corn than from hominy, the averaged conclusions of which are shown in Table CXLII. In four of the Iowa experiments the pigs had access to blue-grass pasture, and in one they were on rape. In the Indiana trials the pigs were fed in dry lots. Shelled corn was fed in five of the trials and ground corn in two. In all cases the feeds were properly supplemented in self-feeders.

TABLE CXLII. — HOMINY MEAL VERSUS CORN FOR GROWING AND FATTENING PIGS[1]

(Av. 7 trials)

RATIONS	TOTAL NUMBER PIGS	AVERAGE LENGTH OF EXPERIMENT	AVERAGE INITIAL WEIGHT PER PIG	AVERAGE DAILY GAIN PER PIG	CONCENTRATES EATEN FOR EACH 100 LB. GAIN
		days	*lb.*	*lb.*	*lb.*
Corn and supplement .	50	91	71	1.396	398.9
Hominy and supplement	50	91	71	1.289	421.3

In every one of the experiments here summarized, a smaller total amount of feed was required to produce

[1] Evvard and Dunn, Iowa Exp. Sta. Circ. letter; Skinner and Starr, Ind. Exp. Sta., Circ. letter.

100 pounds of gain with the corn than with the hominy ration. In every instance but one, also, the rate of gain was faster on the corn ration. On the average, 100 pounds of the corn was equivalent to 105 pounds of the hominy ration. A slightly smaller proportion of supplement was eaten, however, by the pigs receiving the hominy. The rate of gain was, on the average, practically 8 per cent faster on the corn ration.

A modification of the methods of manufacturing hominy feed is probably responsible for the failure of this product to give as good results in these recent experiments as it did in those reported in Table CXLI. The analyses of the hominy used in the Indiana trials showed that the feed contained more fat and less fiber than that in the 1917 and 1918 experiments. The germ which formerly went into the hominy entire is now usually pressed for its oil and the remaining product either put back with the other by-products or sold alone as corn germ meal.

Corn feed meal.

The Association of Feed Control Officials of the United States defines this product as follows: "Corn Feed Meal is the by-product obtained in the manufacture of cracked corn, with or without aspiration products added to the siftings, and is the by-product obtained in the manufacture of table meal from the whole grain by the non-degerminating process." This is a relatively new feed and the processes in its manufacture are probably not uniform.

Analyses of this feed indicate that it is similar to corn in composition, but a little richer in protein and fiber with a little less of nitrogen-free-extract. Like hominy, it must be fed with a protein supplement for good results.

In two series of experiments at the Indiana Experiment Station in 1917–18, Skinner and Starr [1] made four comparisons of different corn feed meals with corn for fattening well-grown shotes in the dry lot. In each trial the corn was ground. The rations in all cases were supplemented with tankage, the feeds being supplied in separate compartments of a self-feeder. The summarized results are shown in Table CXLIII.

Table CXLIII. — Corn Feed Meal versus Corn-Meal for Fattening Pigs

(Av. 4 trials)

Rations	Total Number Pigs	Average Length of Experiments	Average Initial Weight per Pig	Average Daily Gain per Pig	Total Feed Eaten for Each 100 Lb. Gain
		days	*lb.*	*lb.*	*lb.*
Corn and tankage .	20	63	130	1.81	467
Corn feed meal and tankage	40	63	130	1.89	439

The three brands of corn feed meal in the first experiment gave very uniform results. In every case the pigs fed this corn substitute gained a little faster than they did on corn, while the average amount of feed required to produce 100 pounds of gain was also less. These results indicate that corn feed meal is practically equal to corn when fed under the conditions of this experiment.

Corn germ meal.

This by-product was formerly referred to as germ oil meal, which is obtained in the manufacture of starch,

[1] Circ. letters.

glucose, and other corn products. It represents the germ layer of the corn kernel from which part of the oil has been extracted. Two methods are employed in the separation of the germ from the kernel. In the manufacture of starch, the germ is usually removed by the use of a weak water solution of sulfurous acid, while in the making of hominy it is removed by mechanical processes.

Chemical analysis of the feeds in the first Indiana feeding trial showed that the corn germ meals were considerably richer in protein than corn, and further, that the starch corn germ meal contained 6 per cent more protein than the hominy corn germ meal. Judging from the chemical analyses given in the following table, both feeds contain sufficient protein to dispense with the use of any supplement.

TABLE CXLIV. — COMPOSITION OF CORN GERM MEALS AND CORN (From Ind. State Chemist)

Feeds	Water	Protein	Carbohydrates		Fats	Ash
			Crude fiber	Nitrogen-free-extract		
	%	%	%	%	%	%
Starch Corn germ meal .	9.3	24.6	8.6	45.3	10.1	2.1
Hominy Corn germ meal .	4.6	18.5	7.1	56.2	6.3	7.3
Corn-meal . . .	11.5	9.4	2.0	71.5	4.1	1.5

Preliminary investigations by Skinner and Starr [1] at the Indiana Experiment Station suggest the possibilities in the use of corn germ meal as a substitute for corn. Two

[1] Circ. letter.

experiments were conducted with the results shown in Table CXLV. The pigs used were well-grown shotes which were confined to dry lots during the trials. In all cases each feed was given in a separate compartment of the self-feeder unless stated otherwise in the table. The corn germ meal from the starch factories is referred to in these experiments as starch corn germ meal, while that from the hominy mills is called hominy corn germ meal.

TABLE CXLV. — CORN GERM MEAL AS A SUBSTITUTE FOR CORN

Ind. Exp. Sta. Aug. 10–Oct. 9, 1917 — 60 days.

RATIONS, SELF-FED, FREE CHOICE	NUMBER PIGS	AVERAGE DAILY GAIN PER PIG	FEED EATEN FOR EACH 100 LB. GAIN
		lb.	*lb.*
Starch corn germ meal .	10	.28	884.6 starch corn germ meal
Starch corn germ meal Corn-meal	10	1.65	55.6 starch corn germ meal 390.1 corn-meal
Starch corn germ meal Tankage	10	.675	327.4 starch corn germ meal 251.5 tankage
Hominy corn germ meal	10	1.50	419 hominy corn germ meal
Corn-meal Tankage	10	1.80	711 corn-meal 41 tankage

Ind. Exp. Sta. Nov. 6, 1917–Jan. 10, 1918 — 65 days

Starch corn germ meal .	7	.03	8973 starch corn germ meal
Mixture 1 part starch corn germ meal and 1 part corn-meal . .	7	.75	280 starch corn germ meal 280 corn-meal
Mixture 1 part starch corn germ meal and 3 parts corn-meal . .	7	1.35	199 starch corn germ meal 595 corn-meal
Hominy corn germ meal	7	1.23	530 hominy corn germ meal
Corn-meal Tankage	7	1.83	488 corn-meal 27.4 tankage

In both experiments the pigs receiving the starch corn germ meal alone did little more than maintain themselves. On the other hand, the gains by the pigs receiving the hominy corn germ meal were on the average 1.36 pounds daily. Feeding both starch corn germ meal and corn in separate compartments of the self-feeder resulted in the pigs eating very little of the former. When it was fed with tankage, free-choice, the pigs ate nearly as much tankage as they did starch corn germ meal.

The unsatisfactory results obtained in these trials from feeding corn germ meal as maunfactured by the starch factories were obviously due to its unpalatability. The use of acid in loosening the germ layer in its manufacture was believed to be the reason why it was not eaten with relish. Hominy corn germ meal proved to be nearly as palatable as corn.

Corn gluten meal and corn gluten feed.

The part of the corn kernel which remains after the removal of most of the starch, germ, and bran in the manufacture of corn-starch and glucose is officially named corn gluten meal. It contains most of the corn gluten. It may or may not contain the so-called corn solubles which represent the part of the protein and mineral phosphates which go into solution in the processes of separation. Corn gluten feed is the same as corn gluten meal with the bran added. Gluten feed is consequently more bulky and less digestible than gluten meal.

Gluten feed contains from 17 to 25 per cent of protein, and gluten meal from 27 to 36 per cent. Although sufficiently rich in protein to suggest large usefulness for balancing a corn ration, they have never proved popular in practice, and are generally regarded as being more palatable and appropriate for cattle than for hogs. Very much more gluten feed is sold than gluten meal.

In 1917 Evvard and Dunn [1] at the Iowa Experiment Station conducted feeding trials in which 45- to 50-pound pigs on rape were fed rations in which gluten feed was used both as a supplement to and a substitute for corn. The results from five of the rations in which all of the feeds were supplied separately in self-feeders are shown in Table CXLVI.

Table CXLVI. — Gluten Feed as a Substitute and a Supplement to Corn for Fattening Pigs on Rape

Rations, Self-fed, Free Choice	Number of Pigs	Length of Experiment	Average Daily Gain per Pig	Feed Consumed for Each 100 Lb. Gain
		days	*lb.*	*lb.*
Corn	7	90	.84	341 corn
Gluten feed . .	7	90	.70	372 gluten feed
Corn . . . . . Tankage . . .	7	90	1.25	309 corn 40 tankage
Gluten feed Tankage . . .	7	90	.86	330 gluten feed 67 tankage
Corn Gluten feed . .	7	90	.78	331 corn 22 gluten feed

The rations in which gluten feed was given alone, and also with tankage, did not give as good results as did corresponding rations in which corn was fed. In fact, corn alone gave better results than the ration of gluten feed and tankage or of gluten feed and corn. The authors concluded that for growing and fattening pigs fed full rations on forage, the gluten feed contained too

[1] Circ. letter.

much fiber to be satisfactory. Chemical studies have indicated, also, that the kind of proteins and ash or mineral ingredients contained in corn by-products generally are not of a nature most effectively to balance the deficiencies of corn itself.

PEANUTS

Peanuts are a valuable hog forage crop in the South. (See Chapter XVIII.) The seed when fed alone, however, produces very soft pork which is sharply discriminated against by the packer. The use of peanuts for the production of oil has largely developed in recent years, and has resulted in two by-products which promise considerable value for pork-production, especially in the South. These are peanut oil meal and unhulled peanut oil feed. Peanut oil meal is merely the hulled and ground peanut minus most of the oil. Unhulled peanut oil feed is the unhulled and ground peanut minus the oil. The latter sometimes goes by the name ground whole pressed peanuts.

Peanut oil meal as a supplement to milo.

At the Texas Experiment Station, Burk[1] studied the value of these peanut by-products when fed as supplements to milo chop to fattening pigs in the dry lot. The peanut meal contained 42 per cent protein, about the same as cottonseed meal, and 8.3 per cent fiber. The ground whole pressed peanuts contained 36 per cent protein and 22 per cent fiber. The rations were hand-fed and the quantity of the mixed ration given was governed by the appetite of the pigs. The results are shown in Table CXLVII.

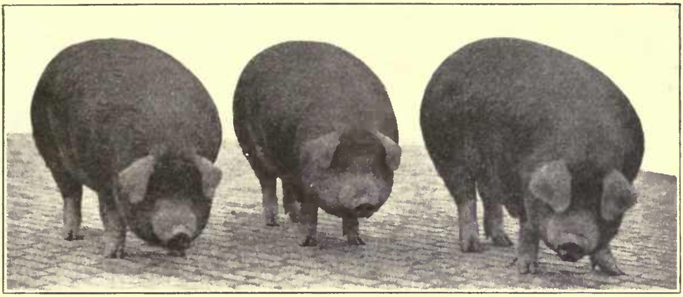
[1] Bull. 201.

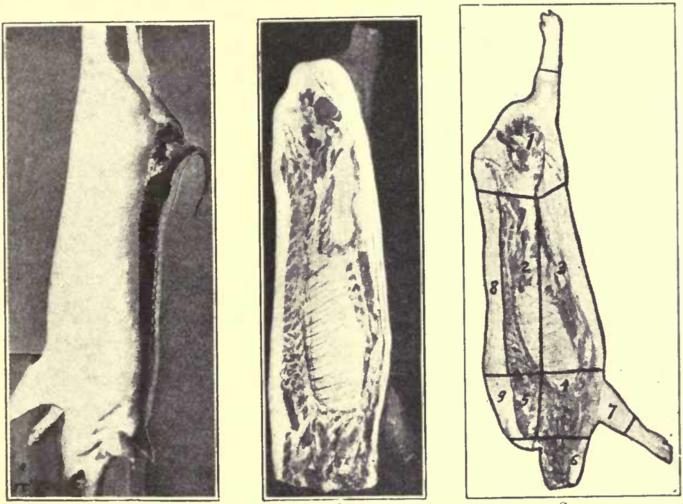
TABLE CXLVII. — PEANUT OIL MEAL AND UNHULLED PEANUT OIL FEED AS SUPPLEMENTS TO MILO

Rations, Proportions by Weight	Number of Pigs	Length of Experiment	Average Initial Weight per Pig	Average Daily Gain per Pig	Total Feed Eaten for Each 100 Lb. Gain
		days	*lb.*	*lb.*	*lb.*
Milo chops[1] . .	10	77	124.6	.727	648
6 milo chops 1 cottonseed meal	10	77	125.8	1.260	417
10 milo chops 1 meat meal . .	10	77	124.8	1.180	455
7 milo chops, 1 peanut meal .	10	77	125.6	1.210	434
2½ milo chops 1 ground whole pressed peanuts	10	77	125.8	1.228	428
1 milo chops 1 peanut meal .	10	77	129.6	1.424	368

The pork produced by the peanut rations was pronounced satisfactory by the packers. As indicated by the rate and economy of gains, the peanut feeds made an excellent showing. That milo is too carbonaceous to give good results when fed alone is strikingly shown by comparing the gains on this ration with those made in the lots in which protein supplements were fed. The fact that the milo rations when balanced with peanut meal or ground whole pressed peanuts produced faster gains with less feed than the ration balanced with meat-meal (tankage), is a strong testimony of the feeding value of these by-products. No injurious or poisonous effects whatever were noted among the pigs fed this proportion of cottonseed meal. (See p. 317.)

[1] Milo chops = coarsely ground milo seeds.





1 2 3

PLATE VIII. — *Above*, Champion pen Duroc-Jersey barrows, International 1918; *below*, 1. Carcass of a model bacon hog. (Bull. 10, Dept. of Agr., Dominion of Canada.) 2. Number 1 Wiltshire side (Bull. 10, Dept. of Agr., Dominion of Canada); 3. Pork cuts, lard hog (Bull. 147, Ill. Exp. Sta.); 1. Long-cut ham; 2. Loin; 3. Belly; 4. Picnicbutt; 5. Boston butt; 6. Jowl; 7. Hock; 8. Fat back; 9. Clear plate; 2, 8. Back; 2, 3, 8. Side; 4, 7. Picnic shoulder; 5, 9. Shoulder butt; 8, 9. Long fat back; 4, 5, 7, 9. Rough shoulder.

Peanut meal versus linseed-oil meal versus tankage.

Evvard [1] of the Iowa Station fed peanut meal in comparison with other supplements to growing pigs on bluegrass. The feeds in each lot were supplied separately in self-feeders. Each lot of pigs was fed to the average weight of 165 pounds before the experiment for that lot closed. The rations and the gains are shown in Table CXLVIII.

TABLE CXLVIII.—PEANUT MEAL VERSUS LINSEED-OIL MEAL, TANKAGE, AND OAT-MEAL AS SUPPLEMENTS TO CORN

Rations, Self-fed Free-choice	Average Initial Weight per Pig	Days to Reach Weight of 165 Lb.	Average Daily Gain per Pig	Feed Eaten for Each 100 Lb. Gain
			lb.	
Shelled corn [2] Tankage	47	89	1.41	323 corn 40 tankage
Shelled corn Linseed-oil meal	47	104	1.14	362 corn 21 linseed-oil m.
Shelled corn Peanut meal	47	89	1.33	281 corn 88 peanut meal
Shelled corn Oat-meal [3]	47	100	1.19	288 corn 76 oat-meal

The peanut meal gave results in this experiment second only to tankage. The author of the experiment calculated the peanut meal to have a money value of $64.20 a ton when corn is valued at $1.12 a bushel and tankage at $100 a ton, when fed under the conditions of this experiment. The peanut meal was more palatable than the

[1] Circ. letter.

[2] Average for two lots fed different brands of tankage.

[3] A by-product in the manufacture of oat-meal, probably the same as oat middlings or oat shorts.

linseed-oil meal or oat-meal. The oat-meal by-product gave very good results, but was not eaten with relish, especially in the first part of the experiment.

RICE PRODUCTS

In the manufacture of table rice, three by-products are produced — rice bran, rice polish, and rice hulls. The last feed contains an average of about 35 per cent fiber and is too bulky and hard to digest to be suitable in any quantity for pig-feeding. Rice bran, also, contains from 12 to 16 per cent fiber and is consequently more bulky than wheat bran. Both rice bran and rice polish are rather extensively used in the South. Being carbonaceous like corn, they require about the same proportion of protein feeds in order to insure the best results.

Rice bran and rice polish versus corn.

Dvorachek and Fowler [1] of the Arkansas Experiment Station conducted four feeding experiments in each of which rice bran and rice polish were compared with corn chops (ground corn) for fattening pigs in the dry lot. On one of the trials the feeds were each given without supplement. In the other three from 9 to 10 per cent of the rations was tankage. The results of these four experiments are averaged in Table CXLIX.

The author of the experiments stated that none of the pigs fed the rice products showed evidences of imperfect nutrition. He also stated that rice bran, due to its tendency to become rancid in hot weather, could not be fed economically during the summer. It was also criticized for being too bulky to insure a good finish on fattening

[1] Bull. 128.

pigs. Despite these faults, however, rice bran gave very good results in these experiments. Although the rice polish was not so palatable as the corn, especially in the latter stages of fattening, and although it caused severe scouring when not soaked from twelve to twenty-four hours before feeding, the pigs made faster and more economical gains than did those fed corn chops.

TABLE CXLIX. — RICE BRAN AND RICE POLISH *versus* CORN CHOP (AV. 4 EXPS.)

FEEDS	TOTAL NUMBER PIGS	AVERAGE LENGTH OF EXPERIMENTS	AVERAGE INITIAL WEIGHT PER PIG	AVERAGE DAILY GAIN PER PIG	TOTAL FEED EATEN FOR EACH 100 LB. GAIN
		days	*lb.*	*lb.*	*lb.*
Corn chops and supplement . . .	21	76	106	1.290	426
Rice bran and supplement . . .	21	76	106	1.255	445
Rice polish and supplement . . .	21	76	106	1.840	360

Extensive studies by Duggar [1] at the Alabama Experiment Station in which rations containing corn-meal as the basis were compared with those containing rice polish showed uniformly faster and usually cheaper gains from the rice polish than from the corn-meal. The averaged results showed 373 pounds of rice polish equivalent to 474 pounds of corn-meal.

Rice bran versus peanuts and corn.

Additional evidence on the feeding value of rice bran is furnished by an experiment by Burns.[2] This test was

[1] Bull. 122. [2] *Ibid.*, 131.

divided into two periods with an intervening interval of 14 days. The corn chops and the rice bran were soaked twenty-four hours before feeding. Part of the time the peanuts were fed on the vines and the remainder they were removed from the vines before feeding. The rations fed and the results for each period are shown separately in Table CL.

TABLE CL. — RICE BRAN VERSUS PEANUTS VERSUS CORN FOR FATTENING PIGS

RATIONS, PROPORTION BY WEIGHT	NUMBER OF PIGS	LENGTH OF PERIOD	AVERAGE INITIAL WEIGHT PER PIG	AVERAGE DAILY GAIN PER PIG	TOTAL FEED EATEN FOR EACH 100 LB. GAIN
		days	*lb.*	*lb*	*lb.*
I. Corn chops [1]	6	91	41.6	.21	966
II. Rice bran	6	91	41.6	.73	384
III. Whole peanuts	6	91	43.3	.67	296
I. 4 Corn chops, 4 Rice bran, 1 Tankage	6	39	63.6	1.06	236
II. 4 Corn chops, 4 Rice bran	6	39	118.3	1.24	270
III. 1.9 Corn chops, 1 Peanuts	6	39	105.0	1.58	188

In the first period the rate of gain was not satisfactory in any of the lots, particularly when corn chops were fed. The pigs on corn during this period ate the least feed and made the smallest gains of any. The feed required to produce 100 pounds of gain was also abnormally high on this ration. The marked improvement in the rate of gain shown here by all lots in the second period is evidence of the improved palatability and value of a

[1] Corn chops = coarsely ground corn.

ration containing a variety of feeds and properly balanced. This applies especially to the rations fed to lots I and II. The total feed required to produce 100 pounds of gain during the second period was abnormally small. Ordinarily the feeder cannot expect such economical gains.

The experts who examined the carcasses of the different lots pronounced the meat produced on the corn ration very good, firm and solid. The carcasses from lot II, fed rice bran chiefly, were said to be very poor, soft, and thin. The meat produced by lot III, those fed largely on peanuts, was described as follows: "very poor, very soft and what we term oily; the meat was very soft and flabby."

The most obvious conclusions to be drawn from these results are: first, that an exclusive corn or rice bran ration is not economical; second, that rice bran is at least equal to corn in feeding value; and third, that so large a proportion of peanuts in the ration will seriously affect the quality and selling value of the meat.

COWPEAS AND SOYBEANS

The seeds of cowpea and soybean are rich in protein and are valuable, therefore, for balancing carbonaceous feeds like corn. Soybean seed usually contains more than 30 per cent protein, and cowpeas about 24 per cent.

Cowpeas versus corn.

In Table CLI are the results of pig-feeding experiments conducted at the Alabama Experiment Station in which the value of cowpeas as a whole and a partial substitute for corn was determined. The rations fed and the results are presented separately for each experiment. In all cases the corn and cowpeas were fed ground.

TABLE CLI. — GROUND COWPEAS VERSUS CORN-MEAL FOR FATTENING PIGS

Rations, Proportions by Weight	Number of Pigs	Length of Experiments	Average Daily Gain per Pig	Total Feed Eaten for Each 100 Lb. Gain	Station and Author
		days	*lb.*	*lb.*	
Corn	4		.74	478	Ala. Bull. 143, Gray, Duggar, and Ridgway
½ corn, ½ cowpeas	4		.93	395	
Corn	3	119	.46	487	Ala. Bull. 83 Duggar
Cowpeas	3	119	.59	481	
½ corn, ½ cowpeas	3	119	.62	433	
Corn	3	70	.32	806	Ala. Bull. 93 Duggar
½ corn, ½ cowpeas	3	70	.51	528	
¾ sweet potatoes, ¼ cowpeas	3	56	.39	1334	Ala. Bull. 93 Duggar
½ corn, ½ cowpeas	3	56	.77	400	

In every instance the combination of corn and cowpeas gave better results than corn alone. The rate of gain on the corn rations averaged .506 pound daily, and on the ration of one-half cowpeas .686 pound daily, an increase of more than 35 per cent. Cowpeas alone did not give satisfactory results. While corn is excessively carbonaceous for growing and fattening pigs, cowpeas are unnecessarily rich in protein when fed alone. From the nature of their composition, a combination of both would be expected to give better results than either alone. Where cowpeas are not grown extensively, a ration of 4 to 5 parts of corn to 1 of cowpeas would probably give more economical results than when a larger proportion of peas is fed.

Corn alone versus corn and soybeans.

In Table CXIV, page 269, soybeans are shown to have practically the same value as linseed-oil meal in corn rations for fattening pigs. For further information, experiments comparing corn alone and corn and soybean meal are summarized in Table CLII.

TABLE CLII. — CORN ALONE VERSUS CORN AND SOYBEAN MEAL[1] (AV. 3 EXPS.)

RATIONS, PROPORTIONS BY WEIGHT	TOTAL NUMBER OF PIGS	AVERAGE LENGTH OF EXPERIMENT	AVERAGE INITIAL WEIGHT PER PIG	AVERAGE DAILY GAIN PER PIG	FEED EATEN FOR EACH 100 LB. GAIN
		days	*lb.*	*lb.*	*lb.*
Corn-meal . .	26	56	124	.95	594. corn
3 57 corn-meal 1 soybean meal	26	56	125	1 30	345.4 corn 96.5 soybeans

Fed against corn alone, the corn and soybean ration increased the rate of gain by more than $\frac{1}{3}$ pound daily for each pig and reduced by 152 pounds the total amount of feed required to produce 100 pounds of gain. As fed in these experiments, 100 pounds of soybean meal with corn has the value of 257 pounds of corn when fed alone.

COTTONSEED MEAL

Cottonseed meal should be regarded by all swine-men as a highly dangerous feed. If given in limited amounts

[1] Skinner, Ind. Exp. Sta. Bull. 108; Wheeler, Kans. Exp. Sta. Bull. 192; Good, Ky. Exp. Sta. Bull. 175.

as a supplement to corn or other carbonaceous feeds, and for a limited period, usually not to exceed thirty or forty days, excellent results may be secured from its use. Dinwiddie[1] expresses the conviction, with much experimental evidence to support it, that cottonseed meal can be fed indefinitely provided the amount does not exceed $\frac{1}{3}$ pound daily for a pig weighing 50 to 75 pounds, or $\frac{4}{10}$ pound daily for one weighing 75 to 100 pounds, or $\frac{1}{2}$ pound daily for an animal weighing 100 to 150 pounds. Numerous experiments[2] have shown satisfactory and profitable results from the limited use of cottonseed meal for a short fattening period. On the other hand, other investigators after successive and continuous efforts to discover a practical and safe method of feeding it have announced with emphasis their conviction that cottonseed or cottonseed meal could not be fed in any form, for even a limited period, without running a serious risk of loss.

The following condensed statement by Henry and Morrison[3] may be accepted at this time as a reliable summing-up of the numerous and extensive studies which have been made of this feed by the experiment stations of the country:

"As now prepared, cottonseed meal is poisonous to swine. All the various proposed ways for safely feeding this meal have failed under careful and continued tests. Pigs thrive at first on the meal, but usually in from 4 to 6 weeks some die — not all, as a rule, but so many that all possible profits from the use of this feed are lost. A few feeders continue to use the meal, experience enabling

[1] Ark. Exp. Sta. Bull. 85.
[2] Rommel, U. S. Dept. Agr. Bur. An. Ind., Bull. 47.
[3] "Feeds and Feeding," 1915.

them to avoid most of the losses. If cottonseed meal is not fed continuously for over 40 days and does not form over one-fourth of the ration, and if pigs are freely supplied with green forage or grazed on pasture, the risk from this feed is slight. It is considered safe to have pigs follow steers which are being fed cottonseed meal, for the meal does not seem to be poisonous after passing through the cattle. Care should always be taken that the steers do not throw so much meal out of the feed boxes that the pigs may be poisoned by eating such waste meal."

DRIED DISTILLERS' AND BREWERS' GRAINS

Although a considerable number of pigs are commercially fattened every year on distillery slops as they come direct from the factory, the dried products are generally to be regarded as not well adapted to swine. Dried distillers' and brewers' grains are high in their content of fiber, which is the principal reason why they are not suitable when fed in any quantity to growing and fattening pigs. In addition, they are not very palatable. However, they are nitrogenous, carrying as much as 23 to 27 per cent protein, and when fed in small proportions with corn, better results are usually obtained than from corn alone.[1]

MOLASSES

To determine the possibility of partially substituting cane, or black-strap molasses for corn, Burns [2] conducted at the Texas Station a dry lot feeding experiment with three groups of pigs. This test was prompted by the increasing price of corn and the similarity in chemical

[1] Ky. Exp. Sta., Bull. 190. [2] Bull. 131.

composition of corn and molasses. The rations fed each lot and the results are reported in Table CLIII.

TABLE CLIII. — BLACK-STRAP MOLASSES AS A SUBSTITUTE FOR CORN

Rations, Proportions by Weight	Number of Pigs	Length of Experiments	Average Initial Weight per Pig	Average Daily Gain per Pig	Feed Eaten for Each 100 Lb. Gain
		days	*lb.*	*lb.*	*lb.*
1 corn chops 1 molasses	8	91	127	.90	487 corn 466 molasses
3 corn chops 1 molasses	8	91	121	1.45	449 corn 145 molasses
Corn chops	8	91	114	1.66	522 corn

The results showed the ration of corn alone superior to either ration containing the molasses. The ration in which the smaller proportion of molasses was fed produced faster and cheaper gains than the one containing the larger proportion. Since molasses is a carbonaceous feed like corn, all the rations lacked balance, or protein. Burns expressed his belief that molasses feeding would be attended with better results when a protein supplement like skim-milk or tankage is fed along with a combination of corn and molasses.

The results of an experiment by Clark[1] at the Utah Experiment Station would indicate that beet molasses may be fed with profit to fattening well-grown shotes. In this experiment rations containing sugar-beets, wet beet pulp, and molasses were fed with wheat shorts. The daily rations and the results are shown in Table CLIV.

[1] Bull. 101.

Table CLIV. — Sugar-Beet Molasses for Fattening Well-Grown Shotes

Average Daily Ration	Length of Experiment	Average Initial Weight per Pig	Average Daily Gain per Pig	Food Eaten for Each 100 Lb. Gain
	days	*lb.*	*lb.*	*lb.*
7.6# shorts . . .	48	130	1.7	444 shorts
3.2# shorts . . . 8.3# sugar-beets .	48	130	1.2	268 shorts 697 sugar-beets
3.3# shorts . . . 12.3# wet beet pulp	48	130	1.2	275 shorts 1030 wet beet pulp
3# shorts . . . 9.4# wet beet pulp 4.4# beet molasses	48	130	1.6	186 shorts 600 wet beet pulp 281 molasses

The pigs given the beet molasses ration gained 22 per cent faster than those fed the same ration without the molasses, and almost as fast as those fed shorts alone. For producing a unit of gain, approximately 127 pounds of beet molasses had the value of 100 pounds of shorts. In the ration containing the sugar-beets, 396 pounds of beets proved equivalent to 100 pounds of shorts, while 609 pounds of the wet beet pulp was equal to 100 pounds of shorts.

Beet molasses as fed by Clinton [1] at the Cornell Station was not very palatable and had a tendency to cause scours.

ROOTS: TUBERS

As a class, roots and tubers contain from 70 to more than 90 per cent of water. Because of this they are too bulky for fattening pigs except when fed in relatively

[1] Bull. 199.

small amounts and as adjuncts to a meal or grain ration. As a class, also, they are carbonaceous in nature. Most of those generally used for pig-feeding contain smaller proportions of protein than corn. The succulent quality of roots insures a laxative effect for the rations in which they are fed. This is the chief reason for their beneficial results when fed to breeding stock during seasons when pasture is not available.

TABLE CLV. — VALUE OF ROOTS FOR FATTENING PIGS [1]
(Av. 8 Exps.)

Average Daily Ration	Total Number Pigs	Average Length of Experiments	Average Initial Weight per Pig	Average Daily Gain per Pig	Feed Eaten for Each 100 Lb. Gain
		days	*lb.*	*lb.*	
5.4# concentrates	38	88	90	1.2	499 concentrates
3.6# concentrates 5.6# roots . . .	38	88	87	1.0	358 concentrates 631 roots

Experimental studies to determine the value of the different roots for fattening pigs are more or less fragmentary in extent, many of them being inconclusive so far as showing any considerable merit for these feeds. As a general proposition, it may be said that the addition of roots to a meal or grain ration does not hasten the rate of gain, but does result in a saving in the amount of meal or grain required to produce a unit of gain. This is shown by a compilation of experimental data by Henry and Morrison [2] shown in Table CLV. These figures

[1] Clark, Utah Exp. Sta. Bull. 101; Lazenby, Ohio Rpt., 1884; Plumb and Van Norman, Ind. Exp. Sta. Bulls. 79 and 82; Robertson, Ottawa Exp. Farms, Rpt. 1891; Sanborn, Utah Rpt., 1891; Shaw, Mont. Exp. Sta. Bull. 27.

[2] "Feeds and Feeding," 1915.

represent the average results of eight experiments in which rations of concentrates alone were compared with the same rations with roots added.

On the average, the 631 pounds of roots fed for each 100 pounds of gain saved 141 pounds of concentrates. This would give 447 pounds of roots the value of 100 pounds of concentrates. The roots fed did not contain an average of more than 15 per cent of dry matter, while the concentrates had about 90 per cent. In these experiments, then, 100 pounds of dry matter in roots had the value, approximately, of 134 pounds of dry matter in the form of concentrates.

Sweet potatoes.

In the South, sweet potatoes furnish a heavy yield of fairly palatable feed suitable for finishing pigs for market. The general practice is to allow the pigs to forage them during the fall and early winter. In order to secure satisfactory results, the pigs should receive in addition a fair allowance of grain. Since sweet potatoes contain extremely meager quantities of protein, best results are secured when the tubers are properly supplemented by the addition of a nitrogenous supplement.

Earle and Orr [1] of the Alabama Station conducted a short experiment in which the sweet potatoes were harvested by hand and fed to pigs confined to the dry lot. One group of pigs was fed corn and the other sweet potatoes with the results shown in Table CLVI.

The sweet potatoes, hand-fed, did not give satisfactory results in this test, but the number of pigs in each lot was such that the results cannot be considered conclusive. The authors of the experiment concluded that

[1] Bull. 93.

sweet potatoes could not be profitably grown, stored, and fed to pigs by hand.

TABLE CLVI. — SWEET POTATOES, HAND-FED, VERSUS CORN

RATIONS, PROPORTIONS BY WEIGHT	NUMBER OF PIGS	LENGTH OF EXPERIMENT	AVERAGE DAILY GAIN PER PIG	FEED EATEN FOR EACH 100 LB. GAIN	DRY MATTER EATEN FOR EACH 100 LB. GAIN
		days	*lb.*	*lb.*	*lb.*
¾ sweet potatoes . ¼ ground cowpeas	3	56	.391	1334	600
½ corn-meal . . ½ ground cowpeas	3	56	.775	400	360

That sweet potatoes will give fairly good results when the pigs are allowed to do the harvesting is indicated by an experiment by Newman and Pickett [1] at the South Carolina Experiment Station. In this trial, pigs averaging 162 pounds at the beginning made an average daily gain of .86 pound on sweet potatoes alone, the experiment covering thirty-three days. In the same trial, a similar group of three pigs fed corn alone gained 1.39 pounds daily. The amount of feed required to produce 100 pounds of gain was 3245 pounds of sweet potatoes and 602 of corn respectively. The authors estimated the yield of sweet potatoes and concluded that one acre could be credited with 369 pounds of pork. At the Alabama Experiment Station, Duggar [2] fed two shotes grazing sweet potatoes a grain ration of 2 parts corn and 1 part ground cowpeas. In the thirty-three days of the trial, the pigs made 100 pounds of gain from 313 pounds of the grain mixture, which indicated only fair returns from the sweet potatoes eaten in addition.

[1] Bull. 122. [2] *Ibid.*, 122.

Potatoes.

When potatoes are extremely cheap, they may be fed profitably to fattening pigs if cooked and properly supplemented. Potatoes are one of the feeds which require cooking. Raw potatoes are not eaten with relish and fail to maintain pigs when given alone.[1] The necessity of feeding some nitrogenous supplement is shown by the fact that potatoes contain a smaller proportion of protein than corn.

The value of cooked potatoes for finishing well-grown shotes in the dry lot is indicated by the results of two experiments conducted at the Wisconsin Experiment Station by Henry.[2] In each trial corn-meal alone was fed to one group of pigs, and a mixture of 1 part corn-meal and 3 parts cooked potatoes to a second similar group. A minimum of water was used in cooking the potatoes so that none of the liquid was lost. The weight of the cooked potatoes with liquid just equaled that of the raw potatoes. The averaged results of these two experiments are shown in Table CLVII.

TABLE CLVII. — COOKED POTATOES FOR FATTENING PIGS

(Av. 2 Exps.)

Rations, Proportions by Weight	Total Number of Pigs	Average Length of Experiments	Average Initial Weight per Pig	Average Daily Gain per Pig	Feed Eaten for Each 100 Lb. Gain
		days	*lb.*	*lb.*	*lb.*
Corn-meal . . .	5	42	229	1.668	439 corn
1 corn-meal . . 3 cooked potatoes	5	42	232	1.499	262 corn 788 potatoes

[1] Grisdale, Ottawa Exp. Farms, Bull. 57.
[2] Wis. Exp. Sta., An. Rpt., 1890.

The pigs were well grown and made unusually rapid gains considering that neither ration contained a protein supplement. In these experiments, 788 pounds of cooked potatoes had the effect of saving an average of 177 pounds of corn-meal, although reducing slightly the rate of gain. This would indicate that 445 pounds of cooked potatoes were equivalent in value to 100 pounds of corn-meal. The summarized results of all experiments made at Copenhagen (Denmark) Station by Fjord, and reported by Henry and Morrison,[1] gave 400 pounds of cooked potatoes the value of 100 pounds of mixed grain. Grisdale[2] reports a fair quality of bacon produced from a ration of 100 pounds of cooked potatoes with 20 pounds of meal.

Other roots.

Sugar-beets and mangels are considered the best roots for swine-feeding in Canada and the western states. Grisdale[2] concludes that carrots are not as palatable nor as good keepers as mangels or suger-beets. Sugar-beets are more palatable than mangels, although the latter are especially recommended for brood sows. A good quality of bacon is produced on rations containing roots. Clark[3] at the Montana Experiment Station found that pigs refused to eat turnips and rutabagas when fed raw. French[4] of the Oregon station found that 162-pound pigs failed to gain when grazed on artichokes and given no other feed. When the pigs were given a ration of ground wheat and oats, however, they made an average daily gain of .81 pound with an expenditure of 310 pounds of grain for each 100 pounds of gain made.

[1] "Feeds and Feeding," 1915.
[2] Ottawa Exp. Farms, Bull. 51.
[3] Bull. 27. [4] *Ibid.*, 54.

CONDIMENTAL STOCK FOODS

Condimental stock foods or feeds, sometimes called proprietary stock foods, are usually mixtures made up of one or more common feed stuffs like wheat bran, wheat middlings, linseed-oil meal, dried blood, cottonseed meal, with a base, filler, or diluent of grain screenings, ground oat hulls, corncob meal, peat or peanut hulls, to which have been added certain condiments, herbs, and drugs, such as common salt, Epsom salts, Glauber's salts, gentian, charcoal, ginger, fenugreek, anise, saltpeter, copperas, as "tonics," "regulators," "appetizers," "conditioners," and so on.[1]

Experimental feeding trials.

In view of the fact that the manufacturers of these products make large claims concerning their value when fed in rather minute quantities with the regular rations, and due to the fact, also, that their cost is high and their use quite common, a detailed study was made of all American and Canadian pig-feeding experiments in which various brands of stock-foods had been fed. In all, eight experiments have been made which involved the use of a total of 261 pigs averaging approximately 110 pounds when the trials began. The experiments were conducted under dry-lot conditions, excepting those made at the South Dakota Station. In two of these trials the pigs had access to limited areas of rape, and in one, both groups of pigs were on blue-grass. The length of the average feeding period was 77 days. The stock foods were purchased on the open market and fed in each case according to the manufacturer's directions. In Table

[1] Jones and Proulx, Ind. Exp. Sta. Bulls. 177 and 216.

CLVIII comparable results have been brought together so that the evidence furnished by these experiments would be more clear for practical interpretation.

TABLE CLVIII. — SUMMARY: VALUE OF CONDIMENTAL STOCK FOODS FOR FATTENING PIGS

RATIONS	AVERAGE DAILY GAIN PER PIG	TOTAL FEED EATEN FOR EACH 100 LB. GAIN	COST OF EACH 100 LB. GAIN	NUMBER OF EXPERIMENTS
	lb.	*lb.*		
Grain alone	1.152	547	$5.07	Average 6 experiments
Grain alone + Stock food	1.233	522	5.34	
Balanced ration	1.315	404	3.49	Average 2 experiments
Balanced ration + Stock food	1.243	409	4.47	
Balanced ration	1.989	412	4.70	Average 2 experiments
Grain alone + Stock food	1.496	550	5.74	

The averaged results from the six experiments in which corn alone was compared to corn with a stock-food added, showed that the latter increased the rate of gain 7.03 per cent and reduced the total amount of feed (including the stock-food) required for a given gain by 4.57 per cent. The actual money cost of producing 100 pounds of gain, however, was 27 cents less for those fed the ration of corn alone.

In two of the experiments, a balanced ration was compared with the same ration with a stock-food added. In this case the balanced ration without the stock-food produced 5.79 per cent faster gains, required 1.22 per cent less feed for a unit of gain, and produced 100 pounds of increase at a saving of 98 cents.

When a well-balanced ration was compared with one of corn alone with stock-food added, the balanced ration produced 32.95 per cent faster gains, required 25.09 per cent less feed to produce the same gain, and made a money charge of $1.04 less for producing 100 pounds of gain than the ration of corn and stock-food.

It would appear, then, from these results that the addition of a stock-food to an unbalanced ration like corn alone for fattening pigs is hardly justified, even under assumed conditions in which no protein feeds are available. Although increasing perceptibly the rate of gain, the actual money cost of a unit of gain was increased 27 cents for every 100 pounds. The answer given by these results to the question whether it pays to feed a stock-food if the pigs are already receiving a balanced ration is clearly in the negative. The mere addition of a stock-food to such a ration seems to have the effect of reducing the rate of gain and increasing the cost. And finally, when a ration of corn and stock-food, which is altogether too common, is compared with a balanced ration of corn and a standard protein feed, the results are in wide contrast. They pointedly suggest that the money spent for stock-foods would be better used if invested in some good nitrogenous feed of proven worth. So far as the evidence of actual experimental feeding tests is concerned, therefore, there seems to be no ground on which the use of condimental stock-foods for fattening pigs can be justified in practice.

Medicinal properties.

Of the 101 drugs discovered in stock-foods and studied by Beal and Rose,[1] 68.7 per cent were found to have dis-

[1] Purdue Univ. thesis, 1914.

tinct medicinal properties. The other 31.3 per cent did not possess these properties worthy of mention. Of the former class, 41 had a tonic action, stimulating digestion and body vigor; 20 had diuretic properties, *i.e.*, stimulated the action of the kidneys; 18 were laxatives, promoting bowel action; 10 were vermifuges or worm expellants; and 8 were astringents.

Street[1] of the New Jersey Station made a comprehensive microscopical and chemical analysis of fifty different brands of condimental feeds and condition powders sold in New Jersey in 1904. From this study, and a review of the results of feeding experiments, he came to the following conclusions:

1. "A loss of appetite, or a run-down condition, induced by over-work or insufficient feed, may often be remedied by the use of a stimulating or tonic food, the ingredients for making which the feeder should always keep at hand. In the majority of cases simply a change of food will bring about the desired effect, but when this is ineffective a liberal use of common salt in the ration will generally prove beneficial.

2. "The claims of the manufacturers of condimental feeds, when not preposterous, are exaggerated and misleading. No one feed, however skillfully compounded, can serve as a remedy for all ailments of all classes of live-stock.

3. "Instead of being prepared according to scientific formulas, as claimed, many of the condimental feeds are heterogeneous mixtures, with little regard to the requirements of the animal, and in certain cases the drugs used have a counteracting effect on each other.

4. "Even where effective drugs have been used, the amount of the mixture to be given to the animal, accord-

[1] Bull. 184.

ing to the instructions of the maunfacturers, is generally so small that no possible benefit can be expected from its use.

5. "Assuming that the condimental feeds are scientifically prepared mixtures of useful and effective ingredients, and their use as directed would confer upon the animal the benefits claimed, their excessive cost would prohibit their use by the careful and economical feeder. Such ingredients, which they contain and which might be of benefit, any feeder can obtain and mix for at from one-tenth to one-twentieth the cost of the prepared foods. He would have the added advantage of knowing just what drugs he was administering to his animals and could give them such quantities of the needed medicines as veterinary experience has shown to be necessary."

Effect on digestion.

Stock foods do not improve the digestibility of the rations in which they are used, according to the results obtained in actual digestion trials by Michael and Kennedy at the Iowa Station.[1] In this experiment four groups of pigs were fed. Corn alone was given to one lot, and corn and a stock-food to each of the other three lots. The effect of the stock-foods on the digestibility of the organic matter is shown in the following table:

TABLE CLIX. — THE EFFECT OF STOCK-FOODS ON THE DIGESTIBILITY OF CORN

RATION FED	PER CENT OF ORGANIC MATTER DIGESTED
Corn alone	89.84
Corn + Standard stock-food	89.74
Corn + Iowa stock-food	89.60
Corn + International stock-food . . .	89.25

[1] Bull. 113.

Conclusions.

Growing and fattening pigs do not do well when restricted to a diet of straight corn, especially when confined to insanitary dry lots. Young pigs particularly lose condition, fail in appetite, and take on a more or less haggard and serious appearance. Neither do pigs do well when full of worms. Such pigs as these need the tonic of a balanced ration. Their digestive systems should be regulated by giving them access to forage crops in season, or by feeding a small amount of some feed possessing laxative properties, like linseed-oil meal or wheat bran. A reliable conditioner is obtained by a sensible combination of good feed and water and clean quarters. Worms can be dislodged more effectively by the use of standard veterinary formulas, given in proper sized doses, than by the use of a general corrector. The best appetizer is a healthy body, properly nourished on complete and well-balanced rations and free from internal or external parasites. Appetite is something which comes from within, and does not require artificial stimulation in a healthy animal, especially in a pig.

CHAPTER XIV

PREPARATION OF FEEDS AND METHODS OF FEEDING

THE idea underlying the practice of grinding, shelling, soaking, or cooking feed for pigs is that the special preparation will result in improving its palatability, hence increasing consumption and hastening gains, or that it will insure more complete digestion, thus resulting in less waste of feed and greater economy of gains. But these special methods of preparation necessitate more or less expense for labor, machinery, and equipment. Before any method of preparation is justified, therefore, it must be shown that the increased rate and economy of gains which may result are sufficient to pay this extra feed cost.

CORN

Grinding corn.

Numerous and extensive feeding experiments in which ground corn has been fed against ear and shelled corn have been made at the Wisconsin, Iowa, and Indiana Experiment stations. The advisability of grinding will be determined by a study of these results, the Wisconsin trials being considered first.

In Table CLX appear the average results of ten years of experimental work at the Wisconsin Station [1] as com-

[1] An. Rpt., Wis. Exp. Sta., 1906.

piled by Henry and Morrison.[1] A total of eighteen separate experiments, involving the use of 280 pigs, was involved in this study. The pigs averaged 175 pounds at the beginning of the trials, which covered feeding periods ranging from 63 to 98 days. The experiments were made during the winter and in each case old corn only was used. One lot of pigs was fed ground corn and another similar lot shelled corn. In all the experiments the corn was supplemented with wheat middlings in the ratio of 2 parts corn to 1 part wheat middlings. The shelled corn was fed alone and dry, and the middlings were mixed and fed wet with a small quantity of water.

TABLE CLX. — GROUND CORN VERSUS SHELLED CORN FOR FATTENING PIGS

(Av. 18 Exps.)

RATIONS	AVERAGE INITIAL WEIGHT PER PIG	TOTAL GAIN ALL PIGS	AVERAGE TOTAL FEED EATEN FOR EACH 100 LB. GAIN
	lb.	*lb.*	*lb.*
Shelled corn and wheat middlings	175	13,828	501
Ground corn and wheat middlings	175	15,891	471

As a rule, these experiments were with large well-grown pigs fed to rather heavy weight. The averaged results show the rate of gain to have been increased practically 15 per cent by grinding, and the amount of feed required to produce 100 pounds of gain reduced practically 6 per cent. These results were quite consistently shown in the individual experiments.

[1] "Feeds and Feeding," p. 574.

Soaking and grinding corn.

Kennedy and Robbins [1] of the Iowa Experiment Station conducted a total of seven experiments in each of which four groups of pigs were fed on the following rations, dry ear-corn, soaked shelled corn, dry corn-meal (fed dry), and soaked corn-meal. The experiments were run during the summer and fall. Corn grown the preceding year was used, except in four of the trials when new corn was fed in the last part of the trials for an average period of 48 days. In four of the experiments the pigs had access to blue-grass and timothy lots, while in the other three they were confined to dry lots. In all cases except one, a small quantity of meat-meal was fed as a supplement. The results are averaged in Table CLXI.

TABLE CLXI. — GRINDING VERSUS OTHER METHODS OF PREPARING CORN FOR FATTENING PIGS

(Av. 7 Exps.)

Rations	Total Number of Pigs	Average Length of Experiments	Average Initial Weight per Pig	Average Daily Gain per Pig	Average Total Feed Eaten for Each 100 Lb. Gain
		days	*lb.*	*lb.*	*lb.*
Dry ear corn . . .	68	138	103	1.271	445 [3]
Soaked shelled corn [2]	68	138	103	1.353	441
Dry corn-meal . .	68	138	103	1.286	473
Soaked corn-meal [2] .	68	138	103	1.383	469

In these experiments, the unground corn gave better results than the shelled corn fed in the Wisconsin trials. Although the gains were not so rapid, less feed was required

[1] Bull. 106. [2] Soaked 12 or 24 hours.

[3] Calculated on the shelled-corn basis.

to produce a unit of gain with ear-corn than with corn-meal either dry or soaked. A study of the individual experiments shows this to have been the case particularly when lighter pigs were fed. In four of the experiments in which 48-pound pigs were used, the gains were both more rapid and economical on ear-corn than on either ration containing corn-meal. Considering both rate and economy of gains, soaked shelled corn was the most profitable ration fed.

Based on observations made during the progress of the experiments and the final results, the authors made the following deductions: Young pigs masticate whole corn more thoroughly than do older hogs. Young pigs do not relish dry corn-meal as do older hogs. Soaking corn is more advantageous for 200-pound hogs when on pasture than when in the dry lot. Shelled corn soaked twelve hours is better than that soaked twenty-four hours. Hogs under 200 pounds in weight made the most economical gains when their corn was fed in the form of dry ear-corn, although shelled corn soaked in water twelve hours made slightly faster gains. Hogs over 200 pounds in weight made more economical gains on shelled corn soaked in water twelve hours than on dry ear-corn or corn-meal in either form, and the gains on soaked shelled corn were nearly as rapid as on any of the other forms in which corn was fed. The amount of corn saved by shelling and soaking for hogs of this weight varied from 4.1 per cent to 7.4 per cent, being highest for hogs on pasture.

Ear-corn versus shelled corn versus ground corn.

At the Indiana Experiment Station, King[1] conducted a series of eight feeding experiments during 1911 and

[1] Proc. Am. Society Animal Production, 1914.

1912 to determine the effect of shelling or grinding corn as influenced by the age or weight of the pigs fed. One group of pigs was fed dry ear-corn, another dry shelled corn, and a third corn-meal wet by pouring on water at feeding time. Each ration was balanced by feeding tankage once daily in the form of a thin slop. In two of the experiments a small quantity of shorts was given with the tankage. The trials were conducted under dry lot conditions, the individual experiments being continued until all the pigs had attained approximate market weights. The average initial weight of the three lots of pigs fed in the different tests was as follows, — 52#, 56#, 86#, 102#, 156#, 159#, 211#, and 218#, this variation being for the special purpose of affording a means of studying the effects of weight on the economy of the two methods of preparation. The average results of all eight experiments, shown in Table CLXII, will first be considered.

Table CLXII. — Ground Corn versus Shelled Corn versus Ear-Corn for Fattening Pigs

(Av. 8 Exps.)

Rations	Total Number of Pigs	Average Length of Experiments	Average Initial Weight per Pig	Average Daily Gain per Pig	Average Total Feed Eaten for Each 100 Lb. Gain
		days	*lb.*	*lb.*	*lb.*
Dry ear-corn . . .	67	113	130	1.237	431 [1]
Dry shelled corn . .	66	113	130	1.241	442
Wet corn-meal . .	67	113	130	1.364	416

The averaged results show that less feed was required for a unit of gain with ear-corn than with shelled corn,

[1] Calculated on shelled basis.

the rate of gain being practically the same. Grinding the corn and feeding it wet had the effect of increasing the rate of gain 10 per cent over ear or shelled corn and of reducing by 4.7 per cent the amount of feed required for a unit of gain.

General average results from grinding.

Summarizing the results from all the Iowa and Indiana experiments in which dry ear-corn was compared with corn-meal fed wet or after soaking, the results appear in Table CLXIII.

TABLE CLXIII. — SUMMARY: EAR-CORN VERSUS GROUND CORN FOR FATTENING PIGS

(Av. 15 Exps.)

Rations	Total Number of Pigs	Average Length of Experiments	Average Initial Weight per Pig	Average Daily Gain per Pig	Average Total Feed Eaten for Each 100 Lb. Gain
		days	*lb.*	*lb.*	*lb.*
Dry ear-corn .	135	125	117	1.253	437
Wet or soaked ground corn .	135	125	117	1.372	441

These results show that the rate of gain was increased 9.5 per cent by grinding and feeding the corn either wet or soaked. The amount of the ration required to produce a unit of gain, however, was 9.1 per cent less for ear than for ground corn.

If the average results of the eighteen trials at the Wisconsin Station, Table CLX, are included with these averages, it is found that grinding effected a saving of 3.09 per cent when compared with shelled corn or corn fed on the ear. These results, then, based on the averages of thirty-three experiments in which pigs of all ages and degrees of fatness were used, do not show a sufficient saving in feed by grinding to pay for the cost of the preparation.

Value of grinding as affected by age and finish of pigs.

The effect of grinding corn for pigs can be interpreted more accurately, however, if the results for the lighter pigs are placed in one group and those from the heavier animals in another. King arranged the results of the eight Indiana trials in this way as shown in Table CLXIV.

TABLE CLXIV. — EFFECT OF WEIGHT AND CONDITION ON THE ECONOMY OF GRINDING CORN FOR FATTENING PIGS

	Average Initial Weight per Pig	Condition of Corn Feed	Average Daily Gain per Pig	Total Feed Eaten for Each 100 Lb. Gain
	lb.		*lb.*	*lb.*
First period 3 months	78	Ear-corn	.826	393
		Shelled corn	.806	398
		Ground corn	.826	393
Second period 3 months	180	Ear-corn	1.263	444
		Shelled corn	1.266	452
		Ground corn	1.390	425

The percentage of feed saved by grinding during the two feeding periods is shown in Table CLXV.

TABLE CLXV. — SHOWING PERCENTAGE OF FEED SAVED BY GRINDING

	First Period	Second Period
Percentage saved over ear-corn .	0	4.3
Percentage saved over shelled corn	1.3	6.0

It would appear from these results that growing and fattening pigs, up to a weight of about 150 pounds, do as well on unground as on ground corn. Pigs during the last three months of their market preparation, however, seem to gain faster and more economically on ground corn than on either ear or shelled corn. A study of the detailed results by successive months of these experiments shows that the heavier and fatter the pigs become, the greater is the advantage of grinding. This rule is also suggested and largely confirmed by the results of the Iowa experiments.

General conclusions.

The following general conclusions appear to be justified by all the experimental results considered:

1. There is no advantage in feeding dry shelled corn over ear-corn, so far as rate and economy of gains are concerned.

2. Pigs receiving shelled corn soaked twelve hours make faster gains with slightly less feed than do pigs fed ear-corn. This is particularly true for older pigs during the latter months of fattening and when they are on grass or forage crops.

3. Ear-corn or dry shelled corn will, as a rule, give as rapid and more economical gains with pigs weighing less than 150 pounds as will ground corn fed wet or soaked. Pigs weighing from 150 pounds up to market weights, however, will usually gain faster with from 4 to 6 per cent less feed for a unit of gain, when on ground corn fed wet or soaked than when on ear or dry shelled corn.

4. When corn is ground, it should be wet or soaked before feeding. Dry corn-meal does not seem to be relished, especially by young pigs.

5. Corn and cob-meal (ground ear-corn) is too bulky and hard to digest to make it at all suitable for growing or fattening pigs.

6. In general, pigs experience a temporary check in gains when for any reason a change is made from soaked or ground corn to ear-corn.

The actual estimated cost of shelling and grinding a bushel of corn at the Iowa Station[1] in 1907 and 1908 was as follows: for shelling, 1 cent; for shelling and grinding, 3 cents; for grinding fine corn and cob-meal, 6 cents. The charge made by mills for shelling and grinding corn at the present time (1918) is around 10 cents a bushel.

SMALL GRAINS

Grinding and soaking.

When wheat, oats, rye, barley, kafir, milo, and other small grains are fed to pigs unground, a larger proportion passes through undigested than when whole corn is fed. For this reason and also because the whole small grains are not eaten with relish, experiments generally show a very much larger saving from grinding small grains than from grinding corn. In fact when grinding is at all possible, small grains should not, as a rule, be fed in any other condition. The ground grains may be expected to give better results, also, when given wet or soaked than when fed dry. When grinding is not possible, small hard grains should be soaked for at least twelve hours.

These general conclusions are based on the results of feeding tests conducted at the various experiment stations of this country and Canada. After a thorough compila-

[1] Bull. 106.

tion of the experimental data available on this question in 1904, Rommel[1] concluded that approximately 12.26 per cent of the small grains is saved by grinding.

Cooking.

As the result of numerous practical feeding tests, it has been definitely established that the old-time practice of cooking feed for pigs is a detriment rather than a benefit. A compilation of the results of seventeen experiments by Henry and Morrison[2] in which corn, barley, peas, and various combinations of these were fed cooked and uncooked, showed in every instance but one an actual loss from cooking. The averaged results showed 100 pounds of uncooked grain equal to 114 pounds of cooked grain.

Cooking feed for swine may be justified and even beneficial under certain special conditions, however. In fitting hogs for show, a few breeders believe that the highest condition of bloom is facilitated by cooking the feed, although, no doubt, the tendency is to exaggerate the benefits. Sick animals or those out of condition may be helped, also, by an occasional ration of cooked feeds.

Proportion of water in slop.

Although ground grains give a little better results when fed wet than dry, the proportion of water in the slop does not appear to be important except when excessive quantities are supplied. This is indicated by the results of a trial made by Plumb and Van Norman[3] at the Indiana Station as shown in Table CLXVI.

[1] Bur. An. Ind., U. S. Dept. Agr., Bull. 47.
[2] "Feeds and Feeding," p. 576, 1915. [3] Bull. 86.

TABLE CLXVI. — THE EFFECT OF THE PROPORTION OF WATER IN THE SLOP

	NUMBER OF PIGS	LENGTH OF EXPERIMENT	AVERAGE INITIAL WEIGHT PER PIG	AVERAGE DAILY GAIN PER PIG	FEED EATEN FOR EACH 100 LB. GAIN
		days	*lb.*	*lb.*	*lb.*
Corn-meal and shorts (dry)	4	147	60	1.08	359
1 corn-meal and shorts 1 water . . .	4	147	59	1.10	380
1 corn-meal and shorts 2 water . . .	4	147	60	1.10	374
1 corn-meal and shorts 3 water . . .	4	147	60	1.05	375

In this experiment, slightly more economical results were obtained from the ration when fed dry than when given as a slop. The rate and economy of gains were not materially affected by increasing the proportion of water to dry feed from one to three.

METHODS OF FEEDING

Successful feeding of any class of live-stock involves not only the selection of a suitable combination of feeds, but also the application of the ration with judgment and a constant regard to the little things which may become large in importance if ignored.

Hand feeding.

The amount of the ration supplied at each feed merits special care when full rations are given. It is better to under-feed than to over-feed. In order to maintain a keen appetite, to avoid sour troughs, and to insure the most rapid gains and the fewest setbacks, a little less should be fed at each time than would actually be eaten. A good hog-raiser takes more time in feeding his pigs than is necessary merely to throw them their rations; he watches them eat and notes how they "clean up." When the weather is extremely hot, they will want less feed than when it is cool. Feeding three times a day is practicable when maximum gains are desired.

When feeding limited rations, it is particularly important that ample trough room be provided so that every pig receives his share. This is especially true when the pigs are of unequal size. So far as practicable, the pig crop should be graded so that only those of about equal strength are together. Like most stock, pigs must be fed regularly if the best results are obtained. Careless methods and irregular habits on the part of the feeder are perhaps more often responsible for the failure of the pigs than almost any other factor.

The pigs must be healthy and thrifty to respond properly to good rations. It is, therefore, of considerable importance when feeding a group of pigs to make certain that their supply of water is abundant, easily accessible, and pure, that they are free from worms and lice, and that their sleeping quarters are clean and comfortable.

The self-feeder.

This device makes it possible for the pigs to feed themselves. The feeds are supplied in bulk or quantity sufficient to last several days or a week, the pigs being given their individual liberty to eat as often as they wish and as much at any time as their appetites dictate or their capacities permit. Compared with the ordinary method of hand-feeding, the self-feeder makes two important changes: instead of receiving their feed in measured amounts and at regular intervals, the pigs have their individual freedom regarding both the time of eating and the amount consumed.

In addition to these two features, the self-feeder introduces a third. The several feeds supplied in the self-feeder are usually placed in separate compartments, in consequence of which the pig is permitted free choice of the kind and amount of each feed. Corn or some other grain is placed in one compartment or feeder and a nitrogenous or protein supplement in another. Frequently, also, charcoal, wood-ashes, lime, and salt are supplied in other compartments, mixed together or fed separately. In other words, this feature of the self-feeder gives each pig the opportunity of balancing his own ration. When the feeds are supplied separately in this way, the method of feeding is usually designated as "self-fed, free-choice," or "cafeteria" style.

The common practice of hauling out on the pasture a wagon-load of ear-corn and then scooping out an allowance each day sufficient to keep feed before the pigs all the time, is in reality a type of self-feeding. Although a few hog-men can be found here and there who have practiced for many years the present method of self-feeding, its general use is comparatively recent. The present general interest had its beginning with the experimental studies by Evvard at the Iowa Experiment Station and by Weaver at the Missouri Experiment Station, which were begun in 1914. Since then a number of other stations have undertaken and completed extensive tests of the self-feeding system.

Self-feeding versus hand-feeding.

In Table CLXVII the results of twenty-four separate comparisons of self-feeding and hand-feeding are summarized. These experiments were conducted at five different experiment stations[1] and involved the use of 433 pigs averaging approximately 70 pounds in weight when the trials began. On the average, the experiments covered a period of 101 days, the shortest being 42 and the longest 193 days. In eleven of the trials the pigs were on forage, and in thirteen in dry lots. In each case, the hand-fed pigs were given full rations and the proportion of supplements fed determined by the usual methods. In each case but one, the self-fed pigs were given their feeds in separate or individual compartments of the feeder. In this case corn was fed in one compartment and a mixture of middlings and tankage in the other, thus permitting only a partial "free-choice" in selecting the feeds.

TABLE CLXVII. — SUMMARY: HAND-FEEDING VERSUS SELF-FEEDING (FREE CHOICE) (Av. of 23 Exps.)

METHOD OF FEEDING	TOTAL NUMBER OF PIGS[2]	AVERAGE LENGTH OF EXPERIMENTS	AVERAGE INITIAL WEIGHT PER PIG	AVERAGE DAILY GAIN PER PIG	AVERAGE TOTAL CONCENTRATES CONSUMED FOR EACH 100 LB. GAIN[3]
		days	*lb.*	*lb.*	*lb.*
Hand-fed . . .	217	101	71	1.260	395
Self-fed, free choice	216	101	71	1.375	390

[1] Evvard and Dunn, Iowa Exp. Sta., Circ. letter; Weaver, Mo. Exp. Sta. Bul. 144; W. J. Carmichael, Ill. Exp. Sta., Circ. letter; B. E. Carmichael and Robison, Ohio Exp. Sta., letter; Snyder, Neb. Exp. Sta. Bull. 165.

[2] Assuming five pigs in each lot of the Iowa experiments where number was not stated.

[3] Wheat instead of corn was fed in one experiment.

As a general rule, the self-fed pigs ate more and made faster gains than those which were hand-fed. In nineteen of the trials, the self-fed pigs gained the faster, while in five the hand-fed pigs made the quickest gain. According to the summary table, the average daily gain of the self-fed pigs was more than 9 per cent faster than for the hand-fed animals.

There was more difference in the rate of gain from the two methods of feeding than in the amount of feed required to produce a given gain. On the average, the self-fed pigs ate 1.26 per cent less concentrates for a unit of gain than the hand-fed ones. In these trials a smaller proportion of tankage and shorts was eaten, also, by those receiving their rations in the self-feeder, "free-choice" style.

These figures appear to supply rather convincing evidence in favor of the self-feeder when it is the intention to push the pigs for an early market. When the saving of labor is also considered, the practicability of this method of feeding would seem to be established, especially when the feeds offered are the same as those supplied in the above experiments, corn, wheat middlings or shorts, and tankage.

With these feeds at least the self-fed pigs ate no more of the expensive nitrogenous or protein supplements than was necessary to balance the corn. Also, the gains would indicate that their consumption of these feeds was ample in satisfying their body needs. That the appetite or instinct of the pig cannot always be depended on, however, to insure the minimum consumption of protein feeds for economy of gains, is also probably true. When the grain or other carbohydrate feed offered in a self-feeder is less palatable than the particular protein feed supplied, the tendency is for the pigs to consume a larger amount of the latter than is necessary for balance, or desirable from the standpoint of economy (see Table CXLV, page 306). This is particularly important when the grains are relatively cheap and protein supplements high. With corn as the principal carbohydrate feed, however, there will be little disposition on the part of the pig to eat more tankage or mill feeds than necessary to supply the necessary balance.

Summary and conclusions.

The important advantages of the self-feeding method of growing and fattening pigs for market may be enumerated as follows:

1. Self-fed pigs usually eat more and gain faster than do hand-fed pigs. This is perhaps its most valuable feature.

2. Pigs on self-feeders make as much gain from a given amount of feed as do hand-fed animals.

3. The self-feeding method is a labor-saver, especially for pigs which are out on pasture or forage crops.

4. When the carbohydrate and protein feeds are supplied in separate compartments, *i.e.*, "free-choice" style, as is customary, the pigs may be depended on to eat sufficient protein to satisfy their physiological needs. When corn or other equally palatable carbonaceous feed is given, the pigs will eat no more of the expensive protein feeds than is necessary for balance or economy of gains.

Few disadvantages attend the self-feeding method when used with judgment and care and when maximum gains are desired. However, a few points must be observed if the best or even satisfactory results are secured.

1. The self-feeding method is not adapted to the feed-

ing of any class of swine when rapid gains are not desired. The question of the adaptability of the self-feeder is largely one of the advisability of full feeding.

2. For satisfactory results in self-feeding, it is necessary that both carbonaceous and protein feeds be supplied, and that these feeds be palatable. If the carbohydrate feed is not well liked and the protein is expensive, it will be best to mix the two in the proper proportion, thus eliminating the "free-choice" feature.

3. The self-feeder does not relieve one of all the work or responsibility in feeding. The "feeder" should be visited daily. The spaces which regulate the flow of feed should be carefully adjusted so that no feed is wasted, all the compartments of the feeder must be kept open and feeding all the time, and the caked mud should be removed frequently from the troughs. The feeder should not be set in a mud hole, but rather on a concrete or board floor; and it should be located in the shade in summer and a warm protected place in winter. To make the self-feeding system for fattening pigs complete and most efficient, a feeder containing salt, charcoal, and wood-ashes or lime should be provided, especially when the pigs are confined to the dry lot.

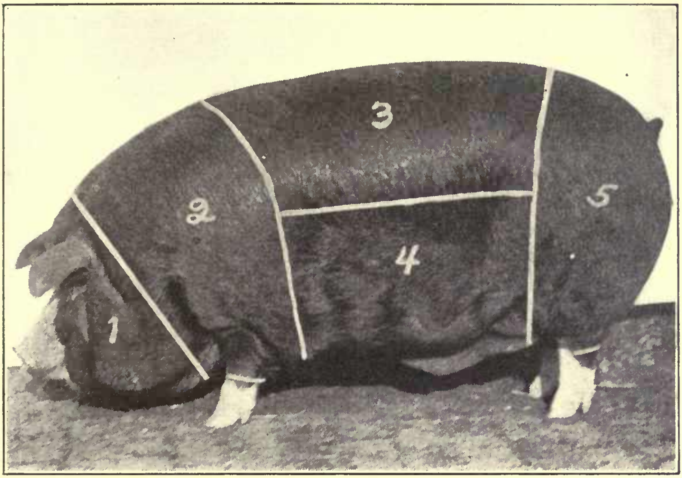
CHAPTER XV

THE COST OF PRODUCING PORK

In this chapter are brought together the several determinations which have been made in the previous chapters on the feed costs of maintaining the breeding herd and growing and finishing the market pig. To these have been added the cost for labor, interest, depreciation and insurance on equipment, and other charges. With these data, the attempt has been made to determine the actual cost of production under corn-belt conditions.

TABLE CLXVIII. — SHOWING THE COST OF PRODUCING THE FINISHED 225-POUND PIG EXPRESSED IN TERMS OF CORN

SYSTEM OF MANAGEMENT	TOTAL COST	FEED COST	LABOR COST	OTHER COST	RATIO BETWEEN COST OF 100 LB. LIVE PORK AND THE PRICE OF A BUSHEL OF CORN
A. When produced by gilts only, 5 pigs raised to the litter	25.91 bu.	18.24 bu.	2.03 bu.	5.64 bu.	11.51 : 1
B. When produced by mature sows kept until four years old, one litter annually, 7 pigs raised to the litter	25.29 bu.	18.05 bu.	1.62 bu.	5.62 bu.	11.24 : 1



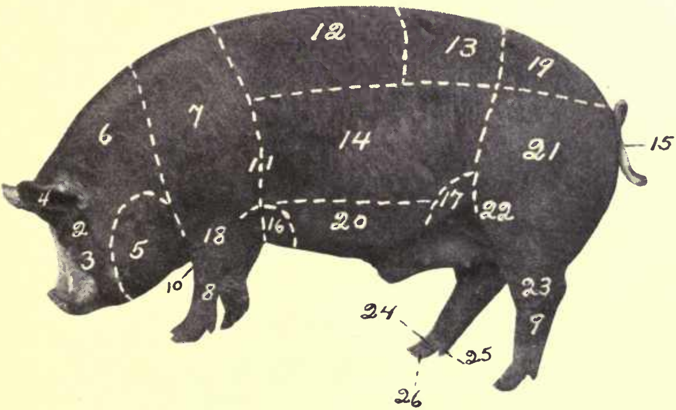


PLATE IX. — *Above,* Location of wholesale cuts of lard hog. 1. Head; 2. Shoulder; 3. Loin; 4. Belly; 5. Ham; *below,* Points of the hog; 1. Snout; 2. Eyes; 3. Face; 4. Ears; 5. Jowl; 6. Neck; 8. Foreleg; 9. Hindleg; 10. Breast; 11. Chest line; 12. Back; 13. Loin; 14. Side; 15. Tail; 16. Fore flank; 17. Hind flank; 18. Fore arm; 19. Rump; 20. Belly; 21. Ham; 22. Stifle; 23. Hock; 24. Pastern; 25. Dewclaw; 26. Foot.

Table CLXVIII. — *Continued*

System of Management	Total Cost	Feed Cost	Labor Cost	Other Cost	Ratio Between Cost of 100 Lb. Live Pork and the Price of a Bushel of Corn
C. When produced by mature sows kept until four years old, three litters every two years after maturity, 7 pigs raised to the litter	24.58 bu.	17.73 bu.	1.47 bu.	5.38 bu.	10.93 : 1
D. When produced by mature sows kept until four years old, two litters annually after maturity, 7 pigs raised to the litter	24.16 bu.	17.56 bu.	1.37 bu.	5.23 bu.	10.74 : 1

The final result of these studies is summarized in Table CLXVIII, in which the cost of production is expressed in terms of corn.

The methods employed in arriving at these results, and the data on which the determinations are based, appear in the following pages:

I. Feed cost of growing and finishing the market pig (35–225 lb.):

1. With good forage crops, —
   (*a*) 760 feed units or pounds of concentrates @ $1\frac{1}{2}$¢ per lb. $11.40
   (*b*) One-fifteenth acre good forage @ $12.00 per acre 80
   Total feed costs 12.20

2. Under dry lot conditions, — 893 feed units or lb. of concentrates @ 1½¢ per lb.	$13.39
II. Other costs of growing and finishing the market pig:	
(*a*) Vaccination	.75
(*b*) Interest on average value of pig for 8 mo. ($12 @ 5%)	.40
(*c*) Interest, depreciation and insurance on general equipment	2.00
(*d*) Risk of loss (2%)	.24
Total other costs	3.39
Total feed and other costs of growing and finishing the market pig	15.59

To the above must be added the cost of the pig at weaning time. This will be influenced principally by the system of breeding followed and the number of pigs raised to the litter.

A

When Produced by Gilt. After Weaning Her Litter Gilt is Fattened and Sold for Pork

I. Feed cost of raising the sow pig to breeding age (35 to 200 lb.):	
(*a*) 577 feed units or pounds of concentrates @ 1½¢ per lb	$8.65
(*b*) One-fifteenth acre good forage @ $12.00 per acre	.80
Total feed costs	9.45
II. Cost of feeding gilt from breeding to farrowing time (567 feed units or pounds of concentrates @ 1½¢ per lb.)	8.50
III. Cost of feeding sow (gilt) and nursing litter (713 feed units or pounds of concentrates @ 1½¢ per lb.)	10.70
IV. Other costs of raising gilt and maintaining her to 17 mo. of age:	
(*a*) Charge for sow pig (estimated)	5.00
(*b*) Interest on average value of gilt (17 mo. @ 5%)	1.41
(*c*) Risk of loss (3%)	.60
(*d*) Charge for vaccination	.75
(*e*) Interest, depreciation, and insurance on general equipment	6.00

(*f*) Service fee	$ 2.00
(*g*) Labor	10.00
Total other costs	25.76
Total feed plus other costs of litter, at weaning time	54.41
V. Value of gilt for pork (300 lb. @ $9.08 per cwt. minus cost of 50 lb. gain @ $7.50 per cwt.)	23.49
Total cost of weaned litter produced by gilt	30.92
The total cost of each pig would, therefore, be as follows:	
1. With 4 pigs raised to the litter	7.73
2. " 5 " " " " "	6.18
3. " 6 " " " " "	5.15
4. " 7 " " " " "	4.42

B

When Produced by Mature Sows Kept until Four Years Old and Yielding One Litter Annually. After Weaning Her Fourth Litter She is Fattened and Sold for Pork

I. Feed cost of raising the sow pig to breeding age (35–200 lb.)	$9.45
II. Cost of feeding gilt from breeding to farrowing time	8.50
III. Cost of feeding sow (gilt) and nursing litter	10.70
IV. Cost of feeding open yearling sow six months during summer (300 feed units or pounds of concentrates @ 1½¢ per lb. plus pasture charge, $1.50)	6.00
V. Cost of feeding pregnant sow during three winters (1605 feed units or pounds of concentrates @ 1½¢ per lb.)	24.07
VI. Cost of feeding sow and three nursing litters (2377 feed units or pounds of concentrates @ 1½¢ per lb.)	35.66
VII. Cost of maintaining open sow during two summers of six mo. (98 feed units or pounds of concentrates @ 1½¢ per lb. plus $6.00 forage charge)	7.47
VIII. Other costs of raising and maintaining brood sow four years:	
(*a*) Charge for sow pig (estimated)	5.00
(*b*) Four years interest on average value of sow ($40.00 @ 5%)	8.00
(*c*) Risk of loss (1½% annually)	2.40
(*d*) Charge for vaccination	.75

	(*e*) Interest, depreciation, and insurance on general equipment for four years	$24.00
	(*f*) Four service fees	8.00
	(*g*) Labor for four years	40.00
	Total feed plus other costs of four litters at weaning time	190.00
IX.	Value of sow for pork (425 lb. @ $8.78 per cwt. minus cost of 75 lb. gain @ $7.87 per cwt.)	31.40
	Total cost each weaned litter produced by mature sow raising one litter annually	39.65
	The total cost of each weaned pig would, therefore, be as follows:	
	1. With 5 pigs raised to the litter	7.93
	2. " 6 " " " " "	6.61
	3. " 7 " " " " "	5.66
	4. " 8 " " " " "	4.96

C

When Produced by Mature Sows Kept until Four Years Old and Yielding Three Litters Every Two Years after Maturity (Total of 5 Litters). After Weaning Her Fifth Litter She is Fattened and Sold for Pork

I.	Feed cost of raising the sow pig to breeding age (35–200 lb.)	$9.45
II.	Cost of feeding gilt from breeding to farrowing time	8.50
III.	Cost of feeding the sow (gilt) and nursing litter	10.70
IV.	Cost of feeding open yearling sow six months during summer	6.00
V.	Cost of feeding pregnant sow during three winters	24.07
VI.	Cost of feeding pregnant sow during one summer (76 feed units or pounds of concentrates at $1\frac{1}{2}$¢ per lb. plus $3.00 pasture charge)	4.14
VII.	Cost of feeding sow and four nursing litters (3170 feed units or pounds of concentrates @ $1\frac{1}{2}$¢ per lb.)	47.55
VIII.	Cost of maintaining open sow during one summer of six mo. (49 feed units or pounds of concentrates @ $1\frac{1}{2}$¢ per lb. plus $3.00 forage charge)	3.73
IX.	Other costs of raising and maintaining brood sow four years:	
	(*a*) Charge for sow pig (estimated)	5.00
	(*b*) Four years interest on average value of sow ($40 @ 5%)	8.00

(*c*) Risk of loss ($1\frac{3}{4}\%$ annually)	$ 2.80
(*d*) Charge for vaccination	.75
(*e*) Interest, depreciation, and insurance on general equipment for four years	24.00
(*f*) Five service fees	10.00
(*g*) Labor for four years	45.00
Total feed plus other costs of five litters at weaning time	209.69
X. Value of sow for pork	31.40
Total cost each weaned litter produced by mature sow raising three litters every two years after maturity	35.66
The total cost of each weaned pig would, therefore, be as follows:	
1. With 5 pigs raised to the litter	7.13
2. " 6 " " " " "	5.94
3. " 7 " " " " "	5.07
4. " 8 " " " " "	4.46

D

WHEN PRODUCED BY MATURE SOWS KEPT UNTIL FOUR YEARS OLD AND YIELDING TWO LITTERS EVERY YEAR AFTER MATURITY (TOTAL OF 6 LITTERS). AFTER WEANING HER SIXTH LITTER SHE IS FATTENED AND SOLD FOR PORK

I. Feed cost of raising the sow pig to breeding age (35–200 lb.)	$9.45
II. Cost of feeding gilt from breeding to farrowing time	8.50
III. Cost of feeding sow (gilt) and nursing litter . .	10.70
IV. Cost of feeding open yearling sow six months during the summer	6.00
V. Cost of feeding pregnant sow during three winters	24.07
VI. Cost of feeding pregnant sow during two summers (152 feed units or pounds of concentrates @ $1\frac{1}{2}$¢ per lb. plus $6.00 pasture charge)	8.28
VII. Cost of feeding sow and five nursing litters (3962 feed units or pounds of concentrates @ $1\frac{1}{2}$¢ per lb.)	59.43
VIII. Other costs of raising and maintaining brood sow four years:	
(*a*) Charge for sow pig (estimated)	5.00
(*b*) Four years interest on average value of sow ($40.00 @ 5%)	8.00
(*c*) Risk of loss (2% annually)	3.20

(*d*) Charge for vaccination	$ 0.75
(*e*) Interest, depreciation, and insurance on general equipment for four years	24.00
(*f*) Six service fees	12.00
(*g*) Labor for four years	50.00
Total feed plus other costs of six litters at weaning time	229.38
IX. Value of sow for pork	31.40
Total cost each weaned litter produced by mature sow raising two litters every year after maturity	33.00
The total cost of each weaned pig would, therefore, be as follows:	
1. With 5 pigs raised to the litter	6.60
2. " 6 " " " " "	5.50
3. " 7 " " " " "	4.71
4. " 8 " " " " "	4.12

A summarized statement of the cost of the pigs at weaning time when produced according to these four systems of management is shown in Table CLXIX.

Table CLXIX. — Showing Entire Cost of the Individual Pig at Weaning Time

System of Management	Number of Pigs Raised to the Litter				
	4	5	6	7	8
A. When produced by gilts only	$7.73	$6.18	$5.15	$4.42	
B. When produced by mature sows kept until 4 yr. old, one litter annually . . .		7.93	6.61	5.66	$4.96
C. When produced by mature sows kept until 4 yr. old, three litters every two years after maturity		7.13	5.94	5.07	4.46
D. When produced by mature sows kept until 4 yr. old, two litters every year after maturity		6.60	5.50	4.71	4.12

Combining now the cost of growing and finishing the pig with the cost at weaning time, the entire cost of the finished 225-pound market pig is shown in Table CLXX.

TABLE CLXX. — SHOWING THE ENTIRE COST OF THE FINISHED 225-POUND MARKET PIG

SYSTEM OF MANAGEMENT	NUMBER OF PIGS RAISED TO THE LITTER				
	4	5	6	7	8
A. When produced by gilts only	$23.32 or 10.36 per cwt.	$21.77 or 9.67 per cwt.	$20.74 or 9.21 per cwt.	$20.01 or 8.89 per cwt.	
B. When produced by mature sows kept until four years old, one litter annually		23.52 or 10.45 per cwt.	22.20 or 9.86 per cwt.	21.25 or 9.44 per cwt.	$20.55 or 9.13 per cwt.
C. When produced by mature sows kept until four years old, three litters every two years after maturity		22.72 or 10.09 per cwt.	21.53 or 9.57 per cwt.	20.66 or 9.18 per cwt.	20.05 or 8.91 per cwt.
D. When produced by mature sows kept until four years old, two litters annually after maturity		22.19 or 9.86 per cwt.	21.09 or 9.37 per cwt.	20.30 or 9.02 per cwt.	19.71 or 8.76 per cwt.

Not all of the expense of producing pork is represented by the cost of the feed eaten. If the items of expense are grouped under the headings feed, labor, and other costs, the distribution will be as it appears in Table CLXXI.

Table CLXXI. — Showing Distribution of Costs in Producing the Finished 225-Pound Market Pig

System of Management	Feed Cost	Labor Cost	Other Costs
A. When produced by gilts only, 5 pigs raised to the litter . . .	70.39%	7.85%	21.76%
B. When produced by mature sows kept until four years old, one litter annually, 7 pigs raised to the litter	71.35%	6.43%	22.22%
C. When produced by mature sows kept until four years old, three litters every two years after maturity, 7 pigs raised to the litter	72.12%	6.00%	21.88%
D. When produced by mature sows kept until four years old, two litters annually after maturity, 7 pigs raised to the litter .	72.66%	5.69%	21.65%

In figuring the feed cost of producing the finished market pig, feed was charged at the rate of $1\frac{1}{2}$ cents for each feed unit, or the equivalent of one pound of concentrated feed such as corn. Charge for forage was at the comparable rate of $12 an acre. At this rate a bushel of corn would cost 84 cents. If it is assumed that the rates used in figuring the labor and other costs were about on a par with 84-cent corn, it would be possible to express the entire cost of the finished market pig in terms of corn. This has been done with the interesting result shown in Table CLXVIII. In this table is also shown the ratio between the actual cost of 100 pounds of finished pork on foot and the value of a bushel of corn as determined by the results of this study. A ratio of 11.51 to 1, for example, means that the actual cost of producing 100 pounds of live hog was found to be equal to eleven and fifty-one hundredths times the cost of a bushel of corn, when the system of management used was as given in A.

General observations.

In interpreting the results of this study, it is important to note the systems of management employed, the methods of feeding practiced, and the prices charged for feed, labor, and other expenses. It is particularly important to recollect that the concentrated feeds were charged at the rate of $1\frac{1}{2}$ cents a pound, the roughages used having been reduced to their concentrate equivalents according to the valuations in the Scandinavian Feed Unit system.

The conditions as a whole under which the experiments were conducted and on which these calculations were largely based were, no doubt, superior to the average farm conditions. Sows and pigs selected for experimental feeding must be thrifty and as uniform as possible in feeding qualities. This results in the exclusion of those individuals which tend to pull down the average performance, or make the results from comparable groups less reliable. First-class forage crops were generally used also, and the number of pigs carried by each acre was large. On the other hand, the rations fed the brood sows were liberal and the charges for equipment and upkeep were undoubtedly higher than on the average hog farm. Furthermore, the good breeder may maintain a class of brood sows which will continue to be reliable breeders for a longer period than four years. On the whole, the conditions were probably comparable with the average of the best.

The figures in the above tables afford an opportunity of comparing the cost of the finished market pig under four general systems of production. In making this comparison with the idea of determining the most profitable system to follow, however, several important considerations should be made. The first is that the gilt does not produce nor raise, on the average, as large litters as the mature sow. The number of pigs farrowed normally increases up to and including the fourth litter (see Fig. 8, page 99). A second important fact is the impossibility of having as early pigs when gilts are exclusively depended on as when more mature sows are used. This means a later and usually a lower market for pigs farrowed by gilts. More important in the long run, probably, is the difficulty of improving, or even of maintaining, a high average of breeding performance when gilts only are employed. The exclusive use of gilts for the production of the pig crop sacrifices the opportunity of improving the herd by selection based on breeding performance. Too often, also, sole dependence on gilts results in a deterioration of the herd in size and feeding capacity.

The figures emphasize strongly the importance of raising two litters every year from mature sows. Two litters every year after maturity resulted in an average reduction of 45 cents a hundred in the cost of production as compared with the system of raising only one litter annually.

Finally, the importance of the size of the litter as a factor in economy of production is strikingly emphasized by the results. With the smallest number of pigs to the litter, the average cost of production was practically $1.25 a hundredweight greater than when the largest number was produced, and the range of variation was only three pigs to the litter. On the whole, it would seem that large litters and reliable breeding qualities on the part of the female herd represent a point which merits special attention in producing pork economically.

CHAPTER XVI

MARKETING AND MARKETS

SUCCESS with hogs involves not only economical production, but also successful marketing. The responsibilities of the producer do not end until the finished market pigs pass over the scales into the possession of the buyer. Since the producer has to pay the bill, the cost of marketing the live animal must be included with that of production before a determination of actual profits is possible.

For the most successful marketing, one should have knowledge of the methods and cost of shipping, familiarity with the system of classifying and grading hogs at the large markets, an understanding of general market conditions, and the factors which affect the supply and price of hogs at the dominant market centers. A rather brief consideration will be given in this chapter to the more important features of each one of these points.

MARKETING

Three general methods or avenues are open to the farmer for disposing of his hogs; namely, through the large public stock yards and packing centers; through the local butcher or small packer; and in the form of farm or home-cured meats.[1] The larger part of the hogs pro-

[1] L. D. Hall, F. M. Simpson, and S. W. Doty: Rpt. 113, U. S. Dept. Agr. Meat Situation in the United States, Part V, "Costs and Methods of Marketing Livestock and Meats." All the figures given on marketing, unless otherwise indicated, are taken from this report.

duced in the corn-belt find their way directly or indirectly to the large slaughtering or packing centers. In the cotton states, in New England, and the western range states, on the other hand, the hogs are generally disposed of locally to retail butchers, or slaughtered at home and the meat cured or sold in the carcass fresh. For the entire country, the Bureau of Census [1] gives the following estimates for all hogs slaughtered in 1909: 63.6 per cent were killed in large slaughtering and meat packing establishments, 7.5 per cent in retail slaughter houses, and 28.9 per cent on the farms where grown.

Shipping.

Of the hogs shipped from the corn-belt, 23 per cent is handled by the owners, while most of the remaining number is shipped by local dealers or shippers. In some districts, particularly in Minnesota, community livestock shipping associations are performing a useful function in enabling the man with a few hogs to be independent of the local dealer or shipper and in giving him the advantages of a larger market at a minimum cost. Comparatively few hogs are purchased in the country by packer representatives or buyers.

When practicable, it is advisable for the producer to ship his own hogs. He will be more certain to receive what his animals are worth on the market than he will by selling to a shipper. The average margin received by the local shipper or buyer for handling hogs in the principal pork-producing states in the corn-belt was 62 cents a hundredweight. Another important advantage in the farmer shipping his own hogs is the opportunity afforded for studying market requirements and the methods employed

[1] Bull. of the 13th Census, 1910.

by the packer in handling and disposing of the products. Most of the knowledge which can be gained at the large market centers is indispensable to the feeder in more correctly interpreting market conditions, for the most intelligent reading of market reports, and in knowing the weight and type of hog for which the highest prices are commonly paid in the different seasons of the year.

In shipping hogs to market, every effort should be made to prevent abnormal shrink or loss in transit, and to arrive at the yards at a time and with the hogs in such condition that their most favorable presentation to the buyer will be assured. Unfortunately all the conditions which have much to do in guaranteeing these results are not under the control of the shipper; the railroads and the weather play very important parts. The shipper can do much, however, to help avoid delays and prevent heavy shrink.

The freight agent should be interviewed early and the cars ordered in time to insure their delivery when wanted. No very radical change should be made in the rations fed the hogs two or three days before loading. Hogs which have been on grass or forage, however, will shrink less if confined to the dry lot a week before shipping. Those which have been fed largely on slops should have their rations gradually changed to dry feed, mostly corn. Hogs ship much better when empty than when full of feed, especially in hot weather. They should not have their regular ration just before hauling to the shipping point. They should have a rest if possible before being loaded on to the cars. The advisability of feeding at the local shipping point before loading or while in transit should be determined by the distance to market. It is very doubtful whether much feed should be given the day of loading, however, if the hogs are due to arrive at the market within twenty-four hours after leaving their home yards.

The cars should be thoroughly cleaned before loading. Half rotted straw or manure should not be used for bedding, but clean straw in winter and preferably sand, if available, in summer. Sawdust, hay, cinders, gravel, and coal are also quite generally employed. Overloading in hot weather is fatal. They will ride better if the car is just comfortably full when the hogs are lying down. The average number of hogs to a car arriving at the Chicago yards in 1915 was seventy-six, and at Kansas City eighty-two. About 18 per cent of the stock cars owned by the railroads in 1908 were double-deck cars.[1]

In driving and loading, the hogs should not be hurried or excited. Crippled hogs sell at a discount of $1.00 a hundred. Marks and lumps on hogs, the result of kicks, beatings, or injury in loading or in transit, spoil the appearance and value of the carcass and affect the selling price proportionally. Because of the fright and worry caused by rough handling and jostlings while on the cars, the shipper should be prompt to protest against any unnecessary switching and general rough treatment when stops are made and additional cars are taken on.

In hot weather the hogs should be hosed as often as possible before loading and in transit. Facilities for this should be demanded at division points. If the haul is longer than thirty-six hours, the amended Federal twenty-eight-hour law requires that stock be unloaded for rest, feed and water, which frequently works a hardship on the shipper. An ingenious method of saving the hogs in

[1] Frank Andrews: "Cost and Method of Transporting Meat Animals," U. S. Dept. Agr., Year Book, 1908.

extremely hot weather is that of suspending from the car roof sacks containing large cakes of ice, the movements of the car being sufficient to distribute the cold drip. At some future time the railroads may equip their hog-cars with artificial sprinkling devices. Such an improvement would result in a tremendous saving during the hot months of the summer. In winter it is a good plan to protect the hogs from the cold winds by nailing a few strips of heavy building paper on the inside of the car, especially on the windward side.

Selling.

The responsibility of the commission firm to which the shipment has been consigned begins when the hogs arrive at the market. The employees of the stock yards company and the commission firm's helpers, or yardmen, will see that the hogs are unloaded and yarded. After a short rest, the hogs should be watered and fed. A good fill is essential not only to reduce the natural shipping shrink, but also because the hogs will be more contented and rest better before the buyers begin to arrive. Unusual efforts to gain weight by an abnormal fill may reduce the shrink, but it will also have the effect of lowering the price bid. On the Chicago market, the seller has the privilege of saying when the hogs shall be weighed. As a consequence of this understanding between the buyer and seller, the hogs are put over the scales when in the judgment of the shipper and salesman they have eaten and drunk their fill and when further delay would mean a loss of weight. A good hosing when the weather is not too cold will help greatly in giving the hogs a better appearance. The owner should be with his hogs early and until they are sold and weighed, but the judgment of his commission man should be largely depended on in all matters pertaining to their care and sale.

Costs of marketing.

The various items entering into the expense of shipping and selling a load of hogs at one of the large market centers may be grouped as follows: (1) cost of hauling to local shipping point; (2) cost of loading on to car, including bedding and feed; (3) freight; (4) shrink; (5) commission, yardage, feed, and the like. These costs of course vary widely, depending chiefly on the distance to market. The charges assigned below to each of these items are largely based on investigations made in 1909 and later by the Office of Markets and Rural Organization of the United States Department of Agriculture.[1]

1. Cost of hauling in wagon (average distance of 5 miles)	$1.44 per wagon load
2. Cost of loading on cars, including cost of bedding and feed	2.00 per car
3. Freight (maximum rates, single-deck cars, Central Association, Interstate Commerce ruling, Jan. 1915; minimum weight for single-deck cars, 17,000 pounds)	
(*a*) distance 100 miles	13.22¢ to 13.80¢ per cwt.
(*b*) " 200 "	16.96¢ to 18.11¢ " "
(*c*) " 300 "	19.84¢ to 20.99¢ " "
(*d*) " 400 "	22.71¢ to 25.30¢ " "
(*e*) " 500 "	25.59¢ to 28.17¢ " "
4. Shrink (estimated average) . . .	3 per cent
5. Commission,	
(*a*) for single-deck car	$ 8.00 per car
(*b*) for double-deck car	12.00 " "
6. Yardage	8¢ per head
7. Feed — corn	$1.25 per bushel

[1] L. D. Hall, F. M. Simpson, and S. W. Doty, Bull. 113.

Assuming an average haul of 250 miles and seventy-six hogs to the car, the total cost of marketing would be $1.60 a head, or approximately 70 cents a hundredweight for a 225-pound hog.

Shipping hogs by motor truck.

The use of the motor truck for hauling hogs is an interesting recent development in marketing methods. A large proportion of the receipts at the smaller markets now come in by auto, covering distances often more than 100 miles. During the first six months of 1918, the number of hogs arriving at the larger Omaha market numbered 92,780, equivalent to eight carloads for each market day. This was an increase of 180 per cent in the number marketed by this method over the corresponding period of 1917.[1]

MARKET CLASSES

The daily run of hogs at any large market center, especially in midsummer, is made up of individuals of all ages and weights, in all degrees of condition or finish, feeders and fat hogs, stags, old sows, boars, and pigs, as well as prime well-finished fat barrows. In handling such a mixture, some system of classification and grading is obviously necessary in order to facilitate trade and the accurate reporting of market prices. It is highly desirable that the producer be acquainted with this classification and the standard trade terms used in connection with it. A correct interpretation of market reports is, in fact, impossible without it.

The following outline of market classes is given by

[1] Bur. Markets, U. S. Dept. Agr., News Letter, July 3, 1918.

Dietrich[1] as representative of the classifications made on the Chicago market and followed more or less closely at other centers. Primarily the classification is on the basis of the use to which the hogs are put by the packer, and secondarily, on a basis of weight:

Classes	Sub-Classes
1. Prime heavy hogs, 350–500 lb.	None
2. Butcher hogs, 180–350 lb.	Heavy butchers, 280–350 lb.
	Medium butchers, 220–280 lb.
	Light butchers, 180–220 lb.
3. Packing hogs, 200–500 lb.	Heavy packing, 300–500 lb.
	Medium packing, 250–300 lb.
	Mixed packing, 200–280 lb.
4. Light hogs, 125–220 lb.	Bacon: English, 160–220 lb.
	Bacon: United States, 155–195 lb.
	Light mixed, 150–220 lb.
	Light light, 125–150 lb.
5. Pigs, 60–125 lb.	
6. Roughs	
7. Stags	
8. Boars	
9. Miscellaneous	Roasting pigs, 15–30 lb.
	Feeders
	Governments
	Pen holders
	Dead hogs

The hogs included in each one of these subclasses are graded according to their killing qualities as indicated by their form, condition, and quality. The terms used for grading are prime, for the best, choice, good, common, and inferior. The Prime Heavy class contains only one grade, prime. Butcher hogs and Bacon hogs are largely of the better grades, while Packing hogs, Light Mixed, and Light Lights range from inferior to good only in grades.

[1] Ill. Exp. Sta. Bull. 97.

Prime heavy hogs.

As the name indicates, the hogs included in this class must be thick fat and heavier than is common. In addition they must be smooth and well finished. The class is largely made up of barrows, but a few "clear" sows (not seedy or shelly) may be included. They are sometimes designated as "Heavy Loin hogs," "Fat Backs," or merely "Prime Heavies." Owing to the increased cost of production and the growing tendency for the market to prefer the medium and lighter weights, comparatively few hogs are now fed to these weights. Most of the hogs in this class weigh from 350 to 400 pounds.

Prime Heavy hogs dress on an average of 82 to 84 per cent chilled carcass to live weight, head on and leaf lard in.[1] Chilled carcasses weigh about $2\frac{1}{2}$ per cent less than green or warm carcasses. Hogs of this class are chiefly used for making heavy loins, fat backs, dry salt bellies, skinned hams, picnic hams, Boston butts and plates. With certain market demands, however, they are cut into the same products as heavy packing hogs.

Butcher hogs.

Hogs of this class weigh from 180 to 350 pounds, being redivided into the subclasses, heavy, medium, and light, according to their weight. In each of these subclasses they are designated prime, good, or common according to their killing qualities as indicated by their quality, condition, and form. This class as a rule is largely made up of barrows from six to twelve months of age, although

[1] The figures on dressing percentage of the different classes of hogs given in this section were supplied by Wilson & Co., Chicago.

"clear" young sows which have never produced pigs may be included. Medium to light weight butcher hogs are the most popular and highest selling hogs on the market. From 25 to 30 per cent of all hogs coming to the market are of this class.

As the name suggests, butcher hogs are largely depended on to supply the demand for fresh pork. They are usually divided into the following cuts, — fresh loins, fat backs, Boston butts, New York shoulders, short cut hams, clear bellies, and extra clears. According to the records of Wilson and Company, butcher hogs kill out as follows:

TABLE CLXXII. — AVERAGE DRESSED YIELDS OF BUTCHER HOGS

	LIVE WEIGHT	CHILLED DRESSED WEIGHT, HEAD ON LEAF LARD IN	CHILLED DRESSED WEIGHT, HEAD OFF LEAF LARD OUT
Heavy butchers .	280–350 lb.	80–82%	72–74%
Medium butchers	220–280 lb.	78–80%	70–72%
Light butchers . .	180–220 lb.	77–97%	69–71%

Packing hogs.

Packing hogs may weigh all the way from 200 up to 500 pounds. As a class it is made up principally of sows which have done service as breeders. Extremely rough barrows, too coarse in quality to go as butcher hogs, and good stags, are also included in this class. The grades range from inferior to good. About 40 per cent of all the hogs coming to the Chicago market belong to this group. Packing hogs generally are deficient in quality and too heavy to be suitable for use as fresh or smoked meats. As the name indicates, they are ordinarily packed as barreled pork or dry salt meats, the hams being made into "short cuts" and the shoulders into picnic hams and Boston butts. They are usually dressed with the heads off and the leaf lard out. The following represents the average dressed yields:

Table CLXXIII. — Average Dressed Yields of Packing Hogs

	Live Weight	Chilled Dressed Weight, Head on Leaf Lard In	Chilled Dressed Weight, Head off Leaf Lard Out
Heavy packing hogs	300–500 lb.	81–83%	73–75%
Medium packing hogs	250–300 lb.	79–80%	71–72%
Light packing hogs	200–280 lb.	77–78%	69–70%

Sows which are "piggy" are sold subject to a dockage. In some markets it is the custom to apply a dockage of 20 to 40 pounds regardless of any signs of pregnancy. At the Chicago market, however, sows are not subject to dock unless they are noticeably advanced in pregnancy.

Light hogs.

This class is made up of young light weight barrows and "clear" sows, ranging in weight from 125 pounds, the minimum for Light Lights, to 220 pounds for the heavier Light Mixed or Bacon hogs, and in age from five to eight months. Variations in type and condition are chiefly responsible for the three subclasses, Bacon hogs, Light Mixed, and Lights. In 1904 it was estimated that 15 per cent of all the hogs coming to the Chicago market were of this class. What are commonly termed "shippers" and "singers" are of this group.

The Bacon subclass includes all smooth barrows and "clear" sows of proper weight which approximate the bacon type. Since few hogs of strictly bacon type are produced in the corn-belt, the class is chiefly made up of medium to thin hogs of lard type breeding. The better hogs in this subclass go as English bacon, while those lacking somewhat in type and the proper condition classify as United States bacon. Bacon hogs are dressed either for English bacon or premium bacon and short or long cut hams and shoulders.

The subclass, Light Mixed, contains a miscellaneous mixture similar, except as to weight, to the mixed packing subclass. Light Lights are similar to the Light Mixed except as to weight. These two subclasses are usually dressed with head on and leaf lard in and are principally shipped East and sold as fresh meat by the retail trade.

Following is the average dressed yields of light hogs as reported by Wilson & Company:

TABLE CLXXIV. — AVERAGE DRESSED YIELDS OF LIGHT HOGS

	LIVE WEIGHT	CHILLED DRESSED WEIGHT, HEAD ON LEAF LARD IN	CHILLED DRESSED WEIGHT, HEAD OFF LEAF LARD OUT
Bacon hogs . . .	160–220 lb.	76–77%	68–69%
Light mixed hogs .	150–220 lb.	75–76%	67–68%
Extra light . . .	125–150 lb.	74–75%	66–67%
Shipper hogs . .	100–200 lb.	72–76%	64–68%

Pigs.

This class includes pigs which weigh 60 to 125 pounds. With more weight and finish they would be butcher hogs. Pigs are too young to furnish meat which will cure well, and are generally sold by the packer to retail dealers who dispose of the carcasses in the form of chops, boiling pieces, and other fresh cuts, the trimmings being used for sausage. It is estimated that around 10 per cent of all the hogs coming to the Chicago market are of this class. With the general use of hog cholera serum, many of the thin pigs which now come to market find their way immediately to the feeding plant of the professional feeder. Pigs dress out about as follows:

TABLE CLXXV. — AVERAGE DRESSED YIELD OF PIGS

	Live Weight	Chilled Dressed Weight, Head on Leaf Lard In
Shipper pigs	20–100 lb.	62–72 %

Roughs.

A few hogs coming to market are so inferior in form, condition, and quality that they cannot be included even with the poorer grades of packing hogs and are given the descriptive name, Roughs. The meat is very coarse in quality and is used by the cheaper trade for both packing and fresh meat purposes.

Stags.

Stags are castrated boars and sell with a dockage of 80 pounds. Due to the dock and their heavy weight and high condition, the quoted prices for stags are sometimes as high as for packing and even butcher hogs. A dockage of 80 pounds on a 480-pound stag is equivalent to a reduction of $1\frac{2}{3}$ cents a pound when stags are quoted at \$10 a hundredweight. If not too staggy in appearance, they may sell in the packing class. Their carcasses are usually disposed of in the same manner as those of packing hogs.

Boars.

Boars are sold without dockage, due to which, together with the coarse quality and strong flavor of some of the meat, they sell from $4 to $5 a hundred less than the better classes. The pork is largely used for the manufacture of sausage. Due to their low selling price, it is more profitable for the farmer to castrate the boars, then fatten and sell as stags, than it is to sell them entire.

Miscellaneous classes.

Roasting pigs usually weigh from 15 to 30 pounds and are dressed with head and feet on. During the holiday season they may sell at fancy prices, being handled very much in the same way as poultry. At other seasons they sell at a sacrifice to the grower.

Although the larger number of pigs now handled as *Feeders* do not pass through the stockyard centers, nevertheless the number found here in the summer and fall has greatly increased during the last few years. It is a class which is beginning to assume considerable importance.

Governments are hogs which have failed to pass the first government inspection, which occurs before the hogs are weighed. They show evidence of sickness or unsoundness which require them to be slaughtered under special inspection. If the carcass is found to be unsafe for human food, it is condemned and tanked, the products being used in the manufacture of grease and fertilizers.

Dead hogs which arrive at the yards amount to about .40 per cent of the receipts. These hogs are tanked under the supervision of a government inspector and the products disposed of to the manufacturers of soap, grease, and fertilizers.

SUPPLY AND PRICE FLUCTUATIONS AND THEIR USUAL CAUSES

Like any other commodity bought and sold on the open market, the price of hogs in general is the reaction of the demand for pork on the supply of hogs. According to this law of supply and demand, when the supply of hogs increases and the demand for pork remains constant the price goes down; and when the supply decreases and the demand is constant the price rises. In the same way, when the supply of hogs is constant, an increase in the demand for pork tends to increase the price, while a falling off in the demand tends to lower the price. These are the natural and inevitable results when the market is open and competition among buyers is free.

In the following pages, a brief analysis is made of the principal factors which affected the supply and price of hogs on the Chicago market, during the ten-year period from 1905 to 1914 inclusive. The Chicago market is selected for this study because it is the largest and because the prices paid there, with freight rates, determine the prices paid at other market centers. Its dominant position is shown by the fact that practically 28 per cent of all the hogs received at the fourteen principal markets of the country in 1915 was credited to the Chicago yards. The receipts at the different markets were as follows: [1]

[1] Chicago Daily Farmers' and Drovers' Journal, Year Book of Figures, 1917.

Market	Receipts	Market	Receipts
Chicago	7,652,071	Sioux City . . .	1,768,818
Omaha	2,642,973	St. Joseph . . .	1,697,842
St. Louis . . .	2,591,768	Milwaukee . . .	583,071
Kansas City . .	2,530,730	Oklahoma City . .	484,842
Indianapolis . .	2,435,319	Wichita	479,469
St. Paul	2,155,201	Fort Worth . . .	463,879
East Buffalo . .	1,769,920	Denver	343,653

Monthly variations in the supply.

In Fig. 13 curves are plotted which show graphically the actual supply of hogs by months for each of the ten years and the average monthly supply for the entire ten-year period. These curves have two rather significant features. The curves for the different years are remarkably uniform in their direction, and in practically every year the period of heavy runs falls in December and January and the light runs in April and September. From September on to January, the supply rises rapidly and regularly.

It will now be considered why the supply of hogs varies from month to month throughout the year. The uniformity in the direction of the curves for the different individual years suggests the probability that these seasonal variations are the result of factors which are quite constant from year to year.

The heavy run of hogs which is common in December, January, and February is due to the fact that this is the normal time for the marketing of pigs farrowed the preceding spring. About 75 per cent of the hogs coming to the Chicago market are spring or summer farrowed. In 1916 the Bureau of Crop Estimates reported that 60 per cent of the pigs born each year are farrowed in March, April, and May. The general practice is to feed old corn

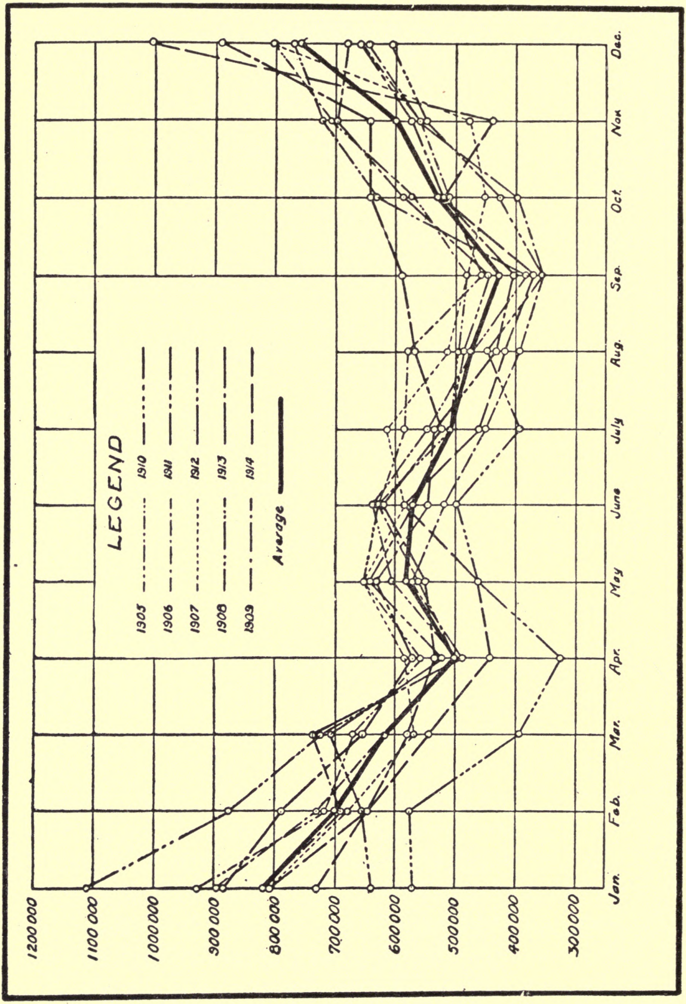


FIG. 13.—Curves showing the monthly supply of hogs on the Chicago market for each of the ten years from 1905 to 1914.

rather sparingly during the summer and to depend largely on the cheaper new corn for most of the gains. As shown in Fig. 11, page 215, the price of corn is highest in August and September and lowest in December, January, and February. In addition to the effect of cheap corn, the use of pigs for hogging-down corn and for following cattle during the winter tend to retard the marketing of the previous spring crop.

The supply from January to April rapidly and quite regularly diminishes under normal conditions. This is the natural result of the heavy liquidations taking place in the preceding months. The low run during April is the logical consequence of the effort to reduce stock before the assessor arrives, the readjustments required on rented farms at moving time, and the desire to sell all marketable stock before the rush of spring work commences.

Fall pigs are normally ready for market in May and June and hence the rise in the supply during these months. This is the time also when the culls from the breeding herd begin to arrive following a brief period of fattening. The risk of loss from shipping in hot weather and the increasing scarcity and price of corn are also important factors resulting in a larger supply during the early summer and a consequent diminishing supply from June to September.

A study of the individual supply curves shows few variations from the average. Such differences which are to be noted are usually the result of special conditions or influences which tend to effect a change of plan from the regular time of marketing. The following are some of the more common of these influences: a partial failure of the corn crop over a considerable area of the corn-belt; the present and prospective price of corn and hogs; cholera epidemics; difficulty of obtaining cars for shipments; unusual weather conditions; strikes and labor troubles at the large industrial centers.

From the standpoint of the packers, a more uniform supply of hogs from month to month throughout the year would make possible greater efficiency and economy in handling the pork products. Their labor would be more regularly employed, the capacity of their plants would be greatly increased, and more reliable service by the railroads in distributing their products would be assured. Since the perfection of refrigeration, in 1880, the packers are in position to handle as many hogs in summer as in winter.

In the interests of the farmer, a more uniform supply of hogs on the market throughout the year would give the packers and other buying agents less power over the market. When the large runs accumulate in December and January, the opportunity to break the market is a chance which the buyers do not neglect. The result is that the bulk of the packers' supplies are purchased when the runs are heaviest and the prices lowest. Since supplies during the summer are relatively light, the buyer pays high prices for hogs only when his purchases are fewest. These are advantages which the packers would not enjoy if the monthly runs were more uniform.

The conditions on the farms where the hogs are produced and raised for market do not promise, however, any radical change in time of marketing. There are a few tendencies however, which operate in that direction. A larger number of February and March pigs are being produced now than formerly; the use of the self-feeder in growing and fattening market pigs is becoming more general; there is an increasing appreciation of the value of forage crops; and the number of fall pigs produced is increasing. The effect of these influences will tend to equalize somewhat the summer and winter receipts.

Variations in the daily supply.

A prominent feature at the large central markets is the tendency for the week's shipments to accumulate and fall on Mondays and Wednesdays. In 1915 the hogs arriving at the Chicago yards were distributed throughout the week as follows:[1] on Mondays, 24 per cent; on Tuesdays, 14; on Wednesdays, 23; on Thursdays, 19; on Fridays, 13; and on Saturdays, 4. In the case of cattle, there was even a greater tendency for congestion on Mondays and Wednesdays.

It is generally conceded by both buyers and commission men that the market would be less erratic if shipments were more uniformly distributed throughout the first five working days of the week, and that there would be a large saving from increased efficiency in handling the stock at the yards and packing plants. From the shipper's viewpoint, there is no question but that a more regular supply would be advantageous. Sharp breaks in the market, the evil result of glutted yards, would be less frequent and a more stable market result.

The custom of loading for the Monday and Wednesday markets seems to have been due to the failure of the railroads to provide through service for large shipments on other days. The packer suffered from the same restrictions in getting the products to his numerous distributing centers and to seaboard ports. To correct the evils grow-

[1] Bur. Crop Estimates, U. S. Dept. Agr., Monthly Crop Rpt., Vol. 2, 1916.

ing out of this custom, the Bureau of Markets of the United States Department of Agriculture, on the authority granted by Congress, inaugurated for the war period the zone system of loading for stock consigned to the Chicago market. This regulation went into effect December 10, 1917. The effect of this control on the distribution of receipts of hogs and cattle throughout the week is indicated by the figures in Table CLXXVI.

TABLE CLXXVI. — AVERAGE PERCENTAGE DISTRIBUTION OF WEEKLY RECEIPTS, MARCH 11 TO JUNE 15, 1918

	YEAR	MON.	TUES.	WED.	THURS.	FRI.	SAT.
Cattle	1917	35.2	10.4	37.0	11.6	4.3	1.5
	1918	29.4	24.3	11.9	21.9	9.1	3.4
Hogs	1917	31.3	10.6	21.6	16.0	13.1	7.4
	1918	29.1	16.1	12.6	18.7	16.1	7.4

That the better distribution of receipts did not in the earlier stages of this regulation bring about a more stable market was no doubt due to the very abnormal conditions created by the war, and more particularly to the irregularity with which the buying orders for the Government and Allies were put into the hands of the packers.

Variations in the yearly supply.

Reference to Fig. 17 will show the variations in the receipts of hogs on the Chicago market which are common from year to year. It is to be noted that years of heavy supply tend both to be preceded and followed by years of light supply. It would appear that periods of heavy and light production are separated by intervals of two to three years; and that years of high production tend to succeed one another every four to five years.

The chief cause of these yearly fluctuations is, no doubt, the relation between the price of corn and that of hogs. In other words, the chief stimulant to increased production is to be found in the profits derived by the producer the preceding year. Increased production tends to follow the year when the price of hogs is high compared with the price of corn. In 1908 the price of corn was high and the price of hogs low. The effect on production is shown by a reduction of a million and a half head in the receipts in 1909, followed by another million in 1910. In 1910 hogs were high and corn relatively cheap. The result was a greatly increased production in 1911. According to the report of the commission appointed by the Food Administration to investigate the cost of producing hogs,[1] the average ratio between the price of hogs a hundredweight and the price of corn a bushel was 11.67 for the ten-year period from 1907 to 1916 inclusive.[2] During this period, in other words, 100 pounds of live hogs sold for 11.67 times as much as a bushel of No. 2 corn on the Chicago market. The recommendations of this committee were based on the ascertained principle that when a ratio less than 11.67 exists between the price of hogs and that of the corn which was fed into them, production is discouraged and the supply reduced; and when a wider ratio than 11.67 exists, production is stimulated and the supply of hogs increases.

[1] John M. Evvard, Lawrence P. Funk, N. H. Gentry, W. A. Williams, J. H. Skinner, Tait Butler, E. W. Burdie.

[2] This method of determining cost of production was suggested by the previous studies of "Wallaces' Farmer" of Des Moines, Iowa.

Weight as a factor in supply.

The variations in the average weight of hogs by months throughout the year for the twelve-year period from 1905 to 1916 inclusive are seen in Fig. 14. From January to August the weight quite regularly increases, and from August to November there is a rapid decline in weight. During November and December the weights are light because the receipts are largely made up of spring pigs,

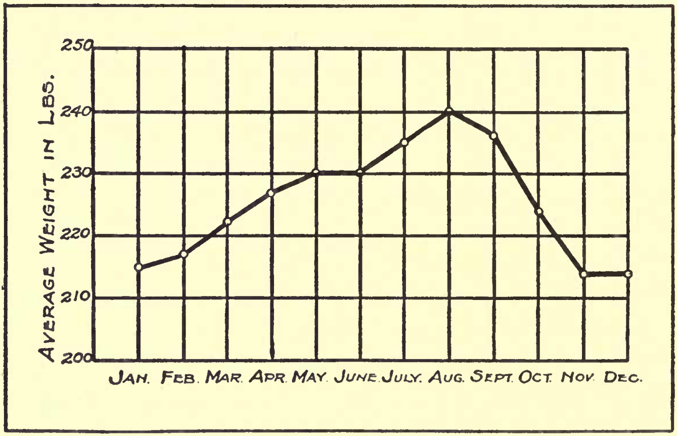


Fig. 14. — Average monthly variations in the weight of hogs on the Chicago market from 1905 to 1916.

many of which are not finished. From January on the weight increases as the age of the pigs marketed increases. June weights, on the average, are no heavier than May weights, probably because of a large proportion of fall pigs. The extra heavy weights during the late summer and early fall are largely due to the marketing of old sows and stags and well-finished fall pigs. The rapid decline in weight during the fall is largely to be explained by the light weight of the first marketed spring pigs, many of which have been rushed to market because of cholera scares. As it happens, the average weight of the hogs marketed is heaviest in those months when the receipts are lightest. The variations in weight, therefore, tend to equalize the supply of hogs during the different months of the year.

As shown in Fig. 15, the average weight of market hogs varies widely from year to year. The principal factor

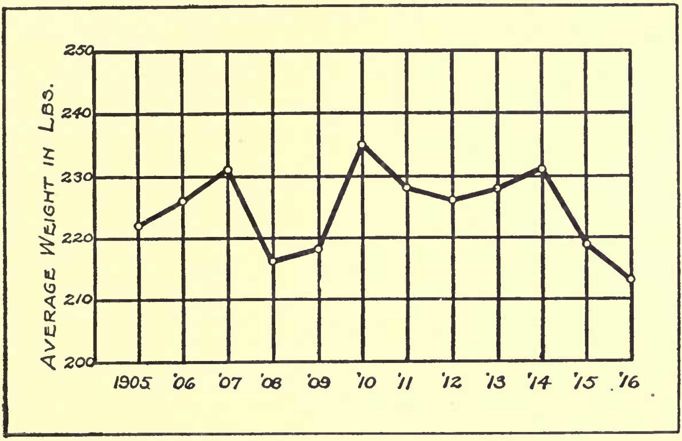


FIG. 15. — Average annual weight of hogs on the Chicago market from 1905 to 1916.

responsible for this is the relation which exists between the price of corn and that of hogs. When hogs are high and corn relatively cheap, every pig in the corn-belt will be held and fed to full market weight; and on the other hand, when hogs are cheap and corn high and rising, the natural result is that the pigs are sent to market in an unfinished condition and the corn sold for cash. The record annual weight of hogs marketed in 1910 is a striking illustration of this principle. High absolute prices for corn seem to cause the marketing of unfinished pigs, even though the price of hogs for the time being is correspondingly high. From year to year, weights average lowest in those years when the receipts are highest. The factor of weight, consequently, tends to equalize the supply from year to year, as it does from month to month.

Seasonal variations in price.

The average prices paid for light and heavy hogs by months on the Chicago market during the ten-year period from 1905 to 1914 inclusive, are shown graphically in Fig. 16. The average supply curve is also given for purposes of comparison. According to these curves for light and heavy hogs, hogs sell highest in September and April and lowest in December and January. Winter prices are relatively low and summer prices high. The more important of the causes responsible for these typical price variations throughout the year will now be considered.

That an intimate relationship exists between the price of hogs in any month and the supply, is clearly apparent on a comparison of the price and supply curves in Fig. 16. The price of hogs is highest, on the average, in those months when the average supply is lowest; and when the supply is heaviest, the price is lowest. Exceptions to this rule are occasionally to be found, of course, in individual months, notably, for example, during the closing months of 1909 and the early months of 1911. The exceptions, however, are temporary and more apparent than real. In the long run, a deficiency in the supply of live hogs is bound to increase prices, while a surplus of live hogs is certain to reduce them.

In the summer and early fall, heavy weight hogs predominate on the market, particularly during July, August and September; and in the winter light weights predominate. In addition, the packer's demand is for heavy hogs in winter and for light hogs in summer. The effect of both supply and demand, therefore, is to cause light hogs

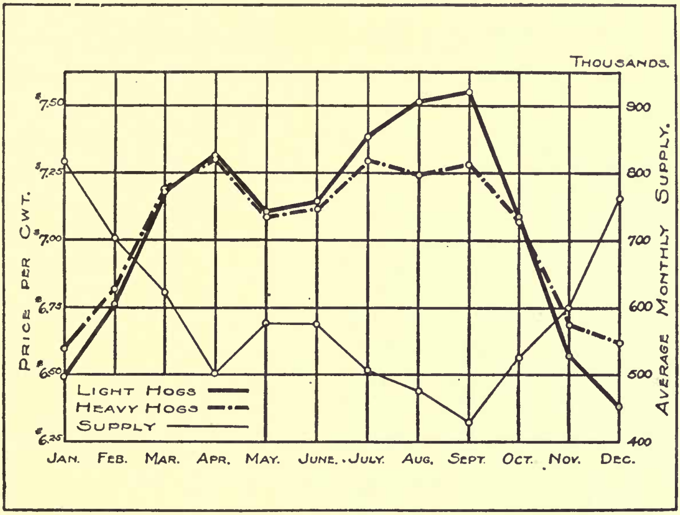


FIG. 16. — Curves showing the average monthly price of light and heavy hogs on the Chicago market from 1905 to 1914.

to sell at a premium during the summer, and heavy hogs at a premium in the winter.

The supply of hogs on the market for any month, however, is not the only factor influencing the price: the demand for pork is also to be reckoned with. As a general proposition, it may be said that consumption of pork is heavier in winter than in summer. When the general economic conditions are constant throughout the year, and the price of pork normal, variations in demand and consumption in the different months are largely the result of temperature. The prosperity of the southern farmer, or the condition of the cotton crop, is an important factor influencing the demand for pork during the summer. The effect of general economic conditions, and the price of pork, is to influence the demand, but quite independent of any given season.

Prices of dressed hogs, and wholesale and retail cuts, seem to follow quite closely the price of hogs. As a rule, a rise or fall in the price of live hogs is followed in one or two months by a rise or fall in the price of fresh pork cuts. Prices of cured products, smoked hams and bacon, and the products on which futures are bought and sold on the board of trade, short ribs, mess pork, and lard, follow the general trend of live hog prices, but are less sensitive to the seasonal fluctuations than are the fresh cuts.[1]

Yearly variations in price.

In Fig. 17 the average annual price of hogs on the Chicago market is shown by a plotted curve for the years from 1905 to 1916 inclusive. The supply curve for the same period of time is also shown. At the bottom of the figure the average price of No. 2 cash corn on the Chicago market is indicated for each year.

Like the supply, the price of hogs is subject to wide fluctuations from year to year. Under normal conditions, years of high prices tend to be preceded and followed by years of low prices.

That variation in supply is the chief and fundamental factor which determines the average price of hogs from

[1] L. D. Hall, F. M. Simpson, and S. W. Doty: "Methods and Cost of Marketing Livestock and Meats," U. S. Dept. Agr., Rpt. 113.

year to year seems to be conclusively shown by these curves. From 1905 to 1911, the direction of the supply and price curves is in exact opposition. In 1916 a marked increase in both receipts and price is noted, due to the greatly increased demand occasioned by war.

The general demand for pork products exerts an important influence on the price of hogs from year to year.

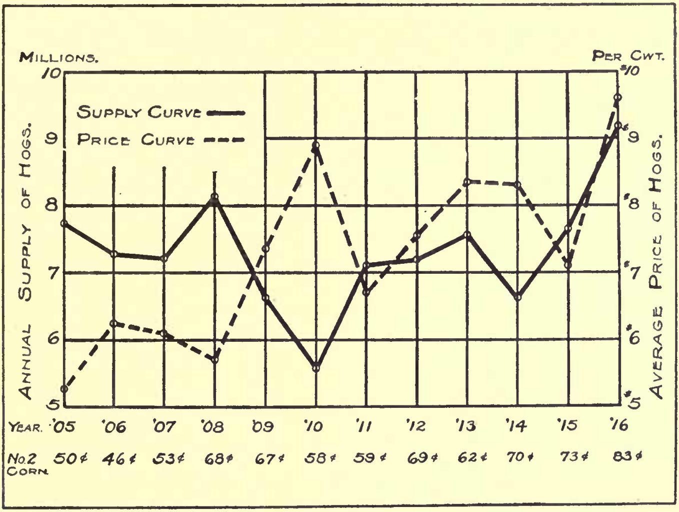
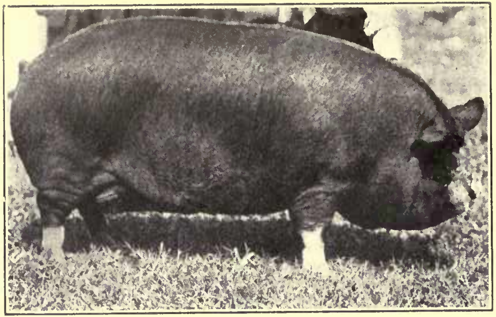
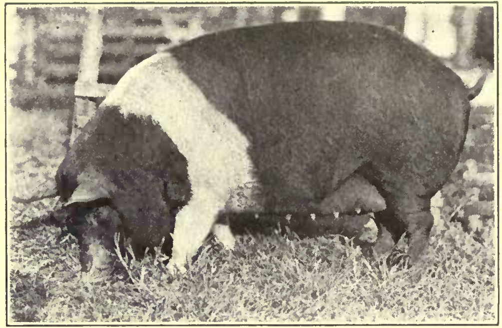


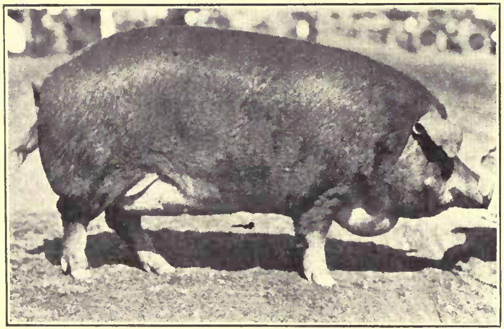
FIG. 17. — Curves showing the average annual price and supply of hogs on the Chicago market from 1905 to 1916.

The effect of the rapid increase in the population of the country has been to reduce the per capita number of swine. For many years there has been a steady and persistent decline in the number of swine per capita of the population. In 1840 it was 1.54 hogs per capita, and in 1910, .75. The effect of this growing shortage is in the direction of higher prices.

The most important factor in the demand for any year is probably to be found in the general economic conditions which prevail throughout the country. More pork is eaten when business is good, when labor is regularly employed and well paid, than when times are hard and labor employment is uncertain and wages low. Another fact which exerts an important influence on demands is that more pork is eaten when the price is relatively low than when it is high. The maximum price of pork is ordinarily limited just below the point where the average consumer cannot afford to eat it.







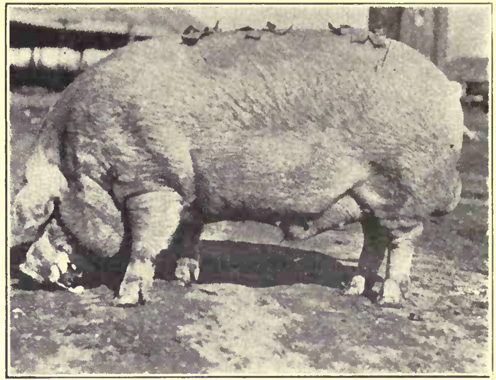


PLATE X. — Representatives of the different breeds. *Upper left*, Berkshire sow, Successor Beuler (Hood Farms); *upper right*, A champion Hampshire sow (Willie Essig); *lower left*, A champion Duroc-Jersey sow; *lower right*, Chester White boar, Prince Big Bone (E. M. Boyer).

CHAPTER XVII

JUDGING

A GOOD judge of hogs possesses the most valuable asset necessary for success as a breeder. The breeder or feeder who is not a reliable judge cannot succeed in the hog business regardless of the advantages he may enjoy in equipment, financial backing, or other favorable conditions. Good judges, however, are not born as such, and the individual must have training and experience before he is competent.

An important part of the training necessary consists in gaining an appreciation of the essential duties or functions which the different classes of hogs have to perform. The best finished fat barrow, for example, is the one which not only has been a good feeder, but which will dress out the most profitably as a killer. A knowledge of the butcher's requirements is necessary as a foundation for the formation of correct ideas of the fat or bacon hog type. For the same reason, the ideal of brood sow type should be based on an experienced understanding of the work she has to do. Any conception of type which is not consistent with reliable breeding performance is fatal to the future of the herd or breed. An appreciation of this fundamental principle is important, for it will promote stability of judgment and reasonable independence towards temporary fads and the demands for extremes in type.

TYPES OF HOGS

With respect to type, all hogs are roughly divided into two classes, known respectively as the lard type and the bacon type. The efforts of the breeder to furnish the finest bacon have resulted in the evolution of the bacon hog; while the efforts of the breeder to produce a profitable feeding hog possessing the maximum of lard-producing tendencies have resulted in the modern lard hog. Differences between these two primary types are due, therefore, to the essential variation in the market demands which were responsible for their creation.

The lard type of hog has been developed to his highest degree of perfection in the corn-belt, because corn is essentially a fat or lard-producing food. But it is not correct to say that the modern lard type is the sole result of corn feeding; the development of this type has been brought about by the selection for breeding purposes of those individuals which responded favorably to corn-belt conditions. It is a matter of good fortune that the market should prefer the type of hog which the farmers of the corn-belt are best qualified by natural advantages to produce.

The bacon type of hog, on the other hand, has found its highest development in an environment which supplies a variety of feeds less fattening in their qualities than corn. In Canada, where the bacon type is generally produced, peas, barley, and oats are the grains on which chief reliance is placed. With these advantages and the continued selection for the type which produces high-grade British bacon, the Canadian farmer has developed and maintained a hog conforming to the standard of the bacon type.

JUDGING THE FINISHED FAT BARROW OF THE LARD TYPE

Market requirements.

On the daily market, highest prices are paid for the kind of hog which the daily records of the buyers have shown to be the best killers. From the butcher or packer's point of view, a good killer is one which furnishes a carcass yielding a high percentage of dressed to live weight, of suitable weight and condition, correct in shape, and possessing fine quality of fat and lean.

High dressing percentage is of special importance because of the influence it exerts on the price which the buyer can afford to pay for the live hog. The average market hog dresses about 74 per cent of chilled carcass to live weight, while the average grade of the medium-weight butcher hogs will dress about 78 per cent. The first prize carcasses at the last four International Livestock Expositions (1913, '16, '17, and '18) represented an average of 85 per cent of carcass to live weight, the highest being 92 and the lowest 80.85 per cent.

The importance of dressing percentage as a factor in determining selling price is brought out by the figures presented in Table CLXXVII. These calculations were made on the basis of a 10-cent market and a live weight of 225 pounds. The carcasses from the low dressing hogs were assumed to have the same value a pound as the heavier dressing carcasses.

TABLE CLXXVII. — THE RELATION OF DRESSING PERCENTAGE TO SELLING VALUE ON FOOT

Dressing percentage . .	70	75	80	85
Relative value per pound on foot	10¢	10.71¢	11.43¢	12.14¢

These figures mean that if hogs weighing an average of 225 pounds and dressing 70 per cent are worth 10 cents a pound, hogs of the same weight dressing 75 per cent are worth 10.71 cents a pound, and so on. That is to say, for every increase of 1 per cent in dressing yield, the selling value on foot is enhanced between 14 and 15 cents a hundredweight.

In actual practice, such wide variations in dressing percentage as given in this table are not common with hogs of the same weight. Variations in dressed weights are due chiefly to differences in weight, condition, and fill. The supply and demand for lard on the one hand, and for fresh pork cuts on the other, are largely responsible for the failure of the selling price of live hogs always to harmonize with the dressing percentage.

The weight, condition, shape, and quality of the carcass also bear an intimate relationship to the price which the buyer can afford to pay for the hog on foot. With respect to weight, the carcasses in greatest demand are furnished by butcher hogs weighing from 200 to 260 pounds alive.[1] The most profitable cutting carcasses are broad, thick, and of medium length, symmetrical in shape, even in their lines, and uniform in width and thickness. There should be no tendency towards stagginess, shown by coarse and extra heavy shoulders, the loin should not be weak nor the hams light. The carcass as a whole should present a plump smooth surface, the skin being thin and free from creases, blotches, or bruises. The fat covering should be thick and of uniform depth. After chilling the fat should be firm and ivory white, rather than yellow, stringy, or oily. The lean meat should be bright and fine-

[1] E. R. Gentry, general hog buyer, Armour & Co.

grained, rather than dark and coarse.[1] These desirable features mean that the carcass will yield the high-priced market cuts with a minimum of trimming; that the shrinkage in curing the hams and bacon will be small; and that the flavor, quality, and general attractiveness of the cuts, both cured and fresh, will be of the best — all of which mean a caracass whose products command the highest prices in the open market.

A compilation by E. R. Gentry [2] of the killing records of medium-weight butcher hogs dressed by Armour and Company gives the following average percentages of the different cuts and products:

Cuts	Per Cent of Live Weight
Hams	12.50
Shoulders	10.50
Belly bacon	11.50
Fat backs	9.95
Loins	9.75
Prime steam lard	12.50
Tenderloins, spareribs, tails, snouts, etc.	6.50
Total dressed carcass	73.20
Leaf fat	2.80
Casings, heart, liver, cheek meat, etc.	12.00
Total edible products	88.00
Moisture and fecal matter	12.00
Total	100.00

The score-card.

The score-card represents the efforts of the live-stock judge to describe in detail the perfect animal. In addition, the effort is made to assign each detail a value which correctly indicates its importance when considered in relation to the whole. The arrangement of the score-card is

[1] L. D. Hall, Ill. Exp. Sta. Bull. 147.
[2] Progressive Hog Raising, Armour & Co.

such that a systematic and detailed examination of the animal is facilitated. Blank spaces are usually provided in which the scorer may record his ratings for the different "points" or details.

The score-card method of selecting animals or of judging groups or classes is not a practical one, owing chiefly to the time required. Its general use is impracticable also because few are sufficiently expert in its use to do consistently accurate work with it. But the fundamental reason why the score-card result must always be subject to review is because a given "point" may be so faulty that its importance in relation to the individual as a whole is enhanced far beyond the number of credit points assigned it by the score-card. As an expression of a standard of perfection and as a means of preliminary study, however, the score-card has proved itself of great value in teaching the rudiments of live-stock judging to the beginner.

Score-Card for Market Hogs of the Lard Type

Scale of Points	Standard	Student's Score
General Appearance — 30 per cent		
1. Weight — score according to age . .	4	
2. Form — deep, broad, medium length, smooth, compact, symmetrical; standing squarely on mediumly short legs	10	
3. Condition — fat, well finished; deep, even, firm yet mellow covering; free from rolls or flabbiness	10	
4. Quality — hair smooth and fine; bone of medium size, clean, and strong; smooth, refined general appearance; free from creases and wrinkles . . .	6	

Scale of Points	Standard	Student's Score
Head and Neck — 8 per cent		
5. Snout — medium length, not coarse .	1	
6. Eyes — able to see; prominent, clear, not obscured by fat	1	
7. Face — short and clean; cheeks full .	1	
8. Ears — fine, medium size, attached neatly	1	
9. Jowl — full, firm, neat, free from wrinkles	2	
10. Neck — short, full, smooth to shoulder .	2	
Forequarters — 12 per cent		
11. Shoulders — broad, deep, smooth, compact on top	8	
12. Breast — full, smooth, neat	2	
13. Legs — straight, short, strong; bone clean, hard; pasterns short, strong upright; feet medium size	2	
Body — 33 per cent		
14. Chest — deep, wide, full; large girth .	4	
15. Sides — medium length, deep, straight, smooth; free from creases and wrinkles	8	
16. Back — broad, uniform in width, strongly arched; thickly and evenly covered	9	
17. Loin — wide, thick, strong; same width as back	9	
18. Belly and Underline — straight, smooth, firm, flanks low and full	6	
Hindquarters — 17 per cent		
19. Rump — long, wide, evenly fleshed; not steep	3	
20. Hams — long, thick, wide, deep, plump, firm; not baggy	9	
21. Legs — straight, short, strong; bone clean, hard; pasterns short, strong, upright; feet medium size	2	
Total	100	

It will be noted that this score-card is divided into two parts. In the first part, under general appearance, the essential points or features are taken up in a general way, while in the remaining sections the details are each given separate consideration.

Weight (4 per cent). — In scoring weight, it is customary to consider both the butcher's and feeder's requirements. From the butcher's or packer's standpoint, the most desirable market weights range from 200 to 275 pounds. From the standpoint of the feeder, the pig which has made the most rapid gains and is heaviest for his age is the most profitable, other things being equal. The following weights for fat barrows may be regarded as about ideal from the producer's point of view under conditions of intensive feeding: at six months, 200 pounds; at nine months, 300 pounds; and at twelve months, 400 pounds. Heavy hogs dress higher than light ones, largely because they are usually fatter and more mature in conformation. The following yields were furnished by Swift and Company, Chicago, as representative of hogs of good average quality as they come to their plant:

Live Weight	Per Cent of Chilled Carcass to Live Weight
30–60 pounds	60–64 per cent
125–150 "	74½ " "
150–200 "	76 " "
200–225 "	78 " "
225–250 "	79 " "
250–300 "	79½ " "
300–400 "	80 " "
400–500 "	81 " "

These yields included the head and leaf fat. Chilled carcasses weigh 2½ per cent less than warm or fresh carcasses, on the average. Show barrows will dress from 3 to 5 per cent higher than these figures.

Form (10 per cent). — The ideal fat barrow should first impress one by his symmetry and compactness of form. He should be deep from end to end, with a nicely arched top line and a straight trim underline. He should have great width of top, with an abrupt square spring of rib, rather than one which falls gradually from the middle line of the back. He should be uniform in width from the shoulders clear back to the base of the hams. His side lines should be straight and the width of back and loin carried down as uniformly as possible to the belly line. His jowl should be full, but not heavy or pendent, and the head just medium in size. The legs should be straight and strong and set squarely under each corner of the body. Such conformation means a high proportion of dressed to live weight, a maximum development in the more valuable parts, and a minimum amount of trimming in the preparation of the various cuts for market.

Condition (10 per cent). — The conformation of the ideal fat hog just described is in large part the result of high condition. From the strictly lard or fat hog standpoint, the fatter a barrow is the better, provided the fat is smoothly laid on and of desirable firmness. The covering over the back, loin, and rump should be particularly deep and uniform in its thickness. There should be no tendency for the fat to accumulate about the jowl, underline, and lower hams at the expense of covering on top. A general tendency to flabbiness and softness along the lower lines, unevenness of covering along the back, and a general inability to move about with ease are evidence of an overdone condition. Lack of finish or condition is shown by a general lack of thickness and plumpness in form, and lack of depth and mellowness in the covering over the back and loin. High condition in the finished fat or lard hog is desired chiefly because of the market demand for lard, and also because of its relation to high dressing percentage.

Quality (6 per cent). — Quality is fineness of texture as opposed to coarseness. The fat hog should show quality and refinement in every line and feature. His hair should be fine, straight, and lie close to the body. The bone should be medium in size, hard, and clean-cut in appearance. The head should be light, the features refined, and the ears light. The skin should be soft and healthy and there should be an entire absence of any tendency to creases. Deep creases about the shoulders and along the sides should be regarded as serious, as should general coarseness of features. Quality is important in the fat hog because fine quality on foot indicates fine texture of the meat on the block. It is important also as it indicates a minimum development of the cheaper parts of the carcass and a high dressing percentage. Weight, form, condition, and quality are the general points on which decisions are based in judging finished fat hogs. The remaining parts of the score-card permit of a consideration of these same points as applied to the separate details.

Head and neck (8 per cent). — The head and neck constitute a rather unimportant part of the fat hog. To the butcher the head is cheap meat at best and the more refined, therefore, the better. A broad head, short neck, and snout are usually associated with a broad back and loin and deep, heavy hams. Quality and refinement in these features are desirable because they indicate fine grain in the carcasses and light offal waste.

Forequarters (12 per cent). — The shoulders are the most important part of the forequarters. This is indicated on the score-card by the large credit of eight points given it.

It is particularly important that the shoulders be smooth and compact on top and free from any tendency to roughness or creases along the sides. The shoulders should be deep also and the breast full and the legs wide apart.

Body (33 per cent). — All parts of the body are important to the butcher because together they represent the largest part of the dressed carcass. A broad, thick, strongly arched back, deep smooth sides, and a trim, straight, muscular underline are the most important features to be desired. Perhaps the most common and serious faults are a heavy paunch and "wasty" underline, "fish" back, weak loin, and creases just back of the shoulders on the sides.

Hindquarters (17 per cent). — The hams represent the principal parts of the hindquarters. The rump is a part of the ham cut. The width of the rump and the thickness of the hams should be the same as the width of the back and loin. The hams should not be soft and baggy, but long, full, deep, and muscular. They should also be broad or wide, and well covered in the region of the stifles. The legs should be straight, strong, and set well apart.

JUDGING THE FINISHED BARROW OF THE BACON TYPE

Market requirements.

The English market sets the standard for high-grade bacon and is extremely critical and discriminating. The manufacturers of British bacon are, therefore, closely restricted in regard to the kind of hog which they can profitably use and the methods employed in curing it. Most of the bacon exported by Canada is in the form of the Wiltshire side (Plate VIII), which is especially designed to meet the English demands. The requirements in a number one Wiltshire side may be enumerated as follows: First, the side when it comes out of the salt must be firm and hard; second, the side must contain a maximum of lean meat of fine grain and color, mixed with and covered by just the right amount of fat; third, the carcass or side must possess the desirable shape; fourth, it must be within the limits of weight; and fifth, it should be heavy in proportion to the live weight.

Of these points it is most important that the bacon be firm. Softness is claimed to be the most common and serious fault. Day, while at the Ontario Agricultural College, made numerous experiments to determine the causes of soft bacon.[1] At the conclusion of his study, the following were given as the most frequent: unthriftiness of the pigs due to insanitary conditions, or a faulty or unbalanced ration; not finished in condition; and an exclusive corn ration for an extended time during the growing period. A moderate amount of exercise, a balanced ration of mixed grains with dairy by-products, and general thriftiness and health all tended to produce firm bacon. Barley, either alone or with oats or middlings, produced bacon of the very best quality.

"A streak of fat and a streak of lean" expresses well one of the essentials of good bacon. The lean must also be fine in texture and bright in color. The fat in addition to being firm and white must be even and uniform in depth, from $1\frac{1}{4}$ to 2 inches along the back and loin. The carcass should be long, especially between the top of the shoulder and the ham, and uniform in width and thickness from end to end. The most valuable retail

[1] Bull. 10, The Production of Bacon for the British Market; Dominion of Canada, Dept. Agr., Branch of the Live-stock Commission.

cuts from a Wiltshire side are from the side proper, in the region of the loin, back, and the fore or bottom part of the bacon proper, hence the demand for long, deep sides and light hams and shoulders. The cheapest cuts are from the lower shoulder and lower ham. Rough heavy shoulders, baggy hams, rough skin, and too much fat are, next to softness, the most common causes for disqualification.

The most desirable weights are produced by pigs weighing from 180 to 195 pounds alive. High dressing percentage is important with bacon as with fat hogs, but variations are quite secondary as a factor in the price paid for the live animal. Because of the differences in size, type, and condition, good bacon hogs usually dress from 3 to 5 per cent less than good barrows of the fat type.

Score-card for bacon hogs.

To satisfy these market requirements, the bacon hog must conform closely to the ideal as expressed by the description given in the following score-card, which is by G. E. Day:[1]

Score-Card for Market Hogs of the Bacon Type

Scale of Points	Standard	Student's Score
General Appearance — 35 per cent		
1. Size — well developed for age . . .	5	
2. Form — long; smooth, all parts proportionately developed so as to give the impression of a well-balanced, strongly built animal. Top line, strong; underline, straight; belly, trim and neat	10	

[1] "Productive Swine Husbandry."

Scale of Points	Standard	Student's Score
3. Quality — hair fine; skin smooth, showing no tendency to wrinkle; bone, clean and strong; but not coarse; flesh, firm and smooth, with no flabbiness at jowl, fore-flank, belly or ham	10	
4. Condition — well covered with firm flesh, especially along the back and loin, but not heavily loaded with fat	6	
5. Style — active and sprightly, walking without a swaying movement, and standing well up on toes	4	
Head and Neck — 8 per cent		
6. Snout — medium length and moderately fine	1	
7. Face — broad between eyes; poll broad and full	1	
8. Eyes — good size, full, and bright . .	1	
9. Jowl — fair width and muscular, but very neat, showing no flabbiness . .	2	
10. Ears — moderately thin, and fringed with fine hair	1	
11. Neck — medium length and muscular, but possessing no tendency to arch on top	2	
Forequarters — 13 per cent		
12. Shoulders — smooth, somewhat rounded from side to side over top, and very compact; no wider than back, and not running back on side so as to shorten distance between shoulders and ham	6	
13. Breast — good width and full . . .	3	
14. Fore legs — set well apart, medium length and straight; pasterns upright; bone, clean and strong; feet, medium size and strongly formed .	4	

Scale of Points	Standard	Student's Score
Body — 30 per cent		
15. Back — medium width, rising slightly above the straight line, and forming a very slight arch from neck to root of tail	6	
16. Loin — wide as rest of back, strong and full, but not unduly arched . .	5	
17. Ribs — good length and moderately arched	4	
18. Side — fairly deep; long, smooth, and straight between shoulder and ham; a straight edge laid over shoulder point and ham should touch the side throughout	8	
19. Heart girth — full, but not flabby at fore flanks, filled out even with side of shoulder; there should be no tucked-up appearance back of fore legs nor droop back of shoulder top .	5	
20. Flank — full and low	2	
Hindquarters — 14 per cent		
21. Rump — same width as back; long and slightly rounded from a point above hips to tail; and somewhat rounded from side to side over top	4	
22. Ham — full without flabbiness; thigh, tapering towards hock without wrinkles or folds, and carrying flesh well down towards hock	6	
23. Hind legs — medium length; hocks set well apart, but not bowed outward; bone, clean and strong; pasterns, upright; feet, medium size and strongly formed	4	
Total	100	

JUDGING BREEDING HOGS OF THE LARD TYPE

In judging breeding hogs, the essential duties which they have to perform should be kept uppermost in mind. To judge the brood sow by fat barrow standards is to neglect to consider many of the features most closely associated with breeding performance. This is true of breeding animals in show condition as well as for those in ordinary flesh.

The breeder's requirements.

The duties of the brood sow are much more complex than those of the finished barrow ready for market. First, and most important, the brood sow should be a prolific and regular breeder; second, she should be able to produce the kind of pigs which meet the demands of the feeder with regard to their ability to make rapid gains and the disposition to be finished or mature at market age; and third, she should produce a type of pig which will give the maximum returns as a killer when he goes to the butcher or packer. These statements apply also to the boar. Every breeder is striving to produce the type of hog which he believes will be most successful in meeting these demands.

A standard of excellence.

Breeders are not agreed on what constitutes the ideal type of hog. Even those who profess allegiance to the same breed differ in what they believe to be the best and most profitable type to produce. The essential differences between the various breeds of lard hogs are due chiefly to the varying emphasis placed by the breeders on the fundamental requirements, breeding qualities, feeding qualities, and killing qualities. Although there are breed differences, and although individual strains and herds show dissimilar types, it is also true that in most points there is great unanimity of view. There is no better evidence of this than is furnished by the striking similarity of the respective breed champions at any large show.

The description given in the following score-card attempts to express accurately the essential features of an ideal brood sow, irrespective of color, set of ear, dish of face, or other breed type features. The plan of the score-card follows closely the method of description employed by the National Association of Expert Swine Judges and the ideal expressed is based on the type as it is exhibited by the best specimens of our different lard breeds.

Score-Card for Brood Sows of the Lard Type

Scale of Points	Standard	Student's Score
1. Size — score according to condition and age	10	
2. Head — wide between the eyes; face moderately dished, medium in length, refined and feminine	4	
3. Eyes — full, prominent, clear	2	
4. Ears — medium size; strong knuckle; fine quality	2	
5. Neck — full, slightly arched, short; free from creases; blending smoothly with shoulders	2	
6. Jowl — full, firm, smooth, neat . . .	2	
7. Shoulders — compact, smooth; broad, deep, full; blending smoothly with neck, back, and sides	6	
8. Chest — deep, full, large girth; wide at base	8	

Scale of Points	Standard	Student's Score
9. Back and Loin — strong, evenly arched; wide spring of rib, uniform in width; smooth, mellow covering	14	
10. Sides — deep, long, full, straight with shoulders and ham; smooth, even, free from creases or wrinkles . . .	8	
11. Belly and Flanks — belly broad, full, neat; teats sound, prominent, numerous, symmetrically placed; flanks low and full	8	
12. Rump and Ham — rump wide, same width as loin, long, full, rounding, sloping gradually from loin to tail; hams long and deep, wide, thick, plump, muscular, firm, smooth; stifles well covered; junction of hams low and full	8	
13. Feet and Legs — legs medium length, straight and set squarely under each corner of the body; bone of ample size, clean cut and hard, showing quality, substance, and strength; pasterns straight, nearly upright, strong; toes short, sound, squarely placed, equal size	10	
14. Tail — medium size and length, nicely curled, tapering; indicative of sufficient size and quality	1	
15. Coat — fine, straight, thick, smooth, glossy, lying close to body, evenly distributed	3	
16. Skin — healthy, soft, clear, smooth, free from excessive scurf or scales . . .	2	
17. Action and Style — action free and easy, legs carried straight forward; attractive carriage	3	
18. Disposition — easy to handle, gentle, active, lively	3	
19. Symmetry and Balance of Points . .	4	
Total	100	

By making the following substitutions or changes the above score-card may be used for the boar:

Scale of Points	Standard	Student's Score
2. Head — wide between the eyes; face moderately dished, medium in length; strong and masculine	4	
5. Neck — full, slightly arched, short, strong; free from creases; blending smoothly with shoulders	2	
8. Chest — Give 10 instead of 8 points .	10	
11. Belly and Flanks — belly broad, full, trim; rudimentaries prominent; flanks low and full	6	

IMPORTANT GENERAL POINTS IN JUDGING

In actual judging, the details of the score-card may be appropriately grouped under the following general heads: (1) Size, (2) form, (3) feet and legs, (4) condition, (5) quality, and (6) sex characteristics and disposition. The importance and significance of these fundamental points will now be more fully considered.

Size.

The size should be judged according to the age and condition of the individual. Mature sows in good breeding condition should weigh 500 to 550 pounds, and mature boars 600 to 650 pounds; sows eighteen months old in good breeding condition, 425 to 450 pounds, and boars 500 to 550 pounds; gilts and boars twelve months of age and in thrifty growing condition, 375 to 400 pounds. Mature sows and boars in show condition should weigh about 150 to 200 pounds more than when in breeding condition; yearling sows and boars about 100 pounds more and gilts and young boars twelve months old about 50 pounds more. Larger sizes are not objectionable if accompanied by quality, symmetry and smoothness of form, and activity.

There is good reason for this large size. Breeding animals should be large because the ability of the pig to make rapid gains is very largely determined by the size of its parents. Within reasonable limits, the larger the parents the faster the gaining capacity of the pigs. The demand for larger size in most of our lard breeds of swine originated with the farmers who insisted on having pigs to feed which had something besides refinement and early maturity to recommend them. This is the justification of the 500-pound sow in the face of the market demand for a 250-pound pig.

That some breeders are going to the extreme in the matter of size is undoubtedly true. The danger comes from seeking extreme size without at the same time insisting on its necessary complement of smoothness and sufficient early maturity. The fact that large size and quality seem opposed to each other when either is developed to an extreme degree makes the attainment of the ideal size with quality extremely difficult. That it is not impossible, however, is demonstrated by the best individual specimens at our state and national shows.

Form.

The form should also be judged according to the age and condition of the individual. The body should be deep and of good length (the sow should be a little longer in the middle than the boar); the back should be strong and well arched, the line of arch being regular from neck to tail; the flank should be low and full, and the length of the legs medium. The shoulders should be smooth and compact; the back and loin broad, showing great spring of rib; there should be no doubt about where the back and loin stop and the sides begin. There should be great uniformity of width from the front of the shoulders clear back to the base of the hams, along the middle and bottom lines as well as along the top. The heart girth should be full and the sides straight and even; the hams should be long, deep, wide, and thick. The head should be broad and the snout of medium length. The eyes should be large, prominent, and clear; the neck short, full, and joining smoothly with the shoulders on top and along the sides. All these parts should be joined together in a manner to give great symmetry and smoothness of form.

The sow or boar in breeding condition should not appear so lowset nor so thick as the same individual in show condition. Defects in conformation are more apparent when the animal is medium in flesh than when fat. For this reason it is important that the judge in the show-ring correctly estimate the effect of fat on the appearance and form.

The ideal type or form of the brood sow is the one which best qualifies her for the work she has to do. The form here described is one which permits of regular breeding habits and at the same time insures constitution and feeding capacity in her pigs, and their ability to top the market when sold to the butcher.

Form or type seems to be more or less influenced by size. Extreme size frequently means extreme length of leg and lack of thickness or spring of rib. It is also too often associated with a slack heart girth, flat rump, and a general lack of symmetry. On the other hand, the small kinds tend towards the extremely short, thick, "dumpy" type, inclining their pigs more to fat and early maturity than to bone development and growth. To a large extent this is probably due, not so much to the fact that symmetry of form and large size are necessarily opposed to one another, but because of the tendency of the breeder to neglect the form in his constant effort to obtain size. A wide spring of rib and a balanced symmetrical conformation are possible in individuals of great size. If individuals possessing this desirable combination can be produced, it means that whole herds of this type are possible.

Feet and legs.

In the mature sow and boar, the legs should be of medium length, neither too short nor too long. Pigs should appear a trifle upstanding. The bone should not be fine, but medium to large in size, and clean cut, hard, and strong in appearance. The legs should be straight viewed from the side, front, or rear, attached squarely under each corner of the body, and particularly strong at the hocks, knees, and pasterns. The pasterns should be short also, and the feet strong and symmetrically shaped.

Breeders who select for fine bone in their hogs usually lose size, constitution, and general ruggedness. And, on the other hand, those who value heavy bone as a merit in itself are in danger of sacrificing quality, smoothness, and early maturity. Since the ideal hog must have size with quality, and ruggedness with smoothness and early maturity, the wise course for the breeder to pursue would seem to be one which lay between these two extremes.

Condition.

Show standards place a premium on high condition regardless of the fact that injury to the breeding functions frequently results. To meet this standard without doing permanent injury to the individuals should be the purpose and endeavor of the exhibitor. The fat covering should not only be thick, but also uniform in depth all over the top from the shoulders back to the tail and down along the sides. There should be no tendency to bareness in the region of the rump and loin, or to rolls along the fore ribs or back. The covering should be firm and elastic to the touch on top, and there should be no excessive softness or flabbiness in the jowl, along the lower lines and hams. High condition is to the credit of the individual, provided the fat covering is smooth and firm and the weight is carried with ease and style. The judge, however, is justified in sharply discriminating against excessive fatness as shown by lack of smoothness, or extreme softness or flabbiness of covering, and general inability to move about with ease and freedom. When in breeding flesh, the sow or boar should give evidence of easy keeping qualities as shown by the general appearance of health, good condition on moderate feed, and elasticity of covering along the back and loin.

Quality.

The indications of quality are the same in breeding hogs as in the fat barrow. The sow or boar in thin or fat condition should have a smooth fine coat of hair. Swirls are especially undesirable. There should be an entire absence of any tendency towards deep creases, wrinkles, coarse or unhealthy skin. Excessive development of shields on the mature boar is objectionable.

There should be no evidence of coarseness or grossness of the features about the head; the face should be clean (free from coarse hair and wrinkled skin), the ears thin, and the jowls neat. The bone should be clean and hard looking. A little more general refinement is expected in the sow than in the boar.

Quality is desired in breeding stock because of the relation it bears to early maturity and killing qualities of the finished market pig. Early maturity means the ability to fatten and be ready for market at a comparatively early age. The degree of early maturity wanted in hog stock is that which is just sufficient to guarantee a fairly finished condition when the pigs are from six to eight months of age. The ideal is not only to have pigs which possess large capacity for growth, but which at the same time possess sufficient ability to fatten to satisfy market requirements when sold.

Quality must not be insisted on, however, to the point where size and growthiness are sacrificed. The tendency to do this has ruined many herds. It seems to be much easier to secure and maintain a high degree of quality than it is size. Although it is difficult to develop and maintain ample size in itself, to do this and at the same time retain sufficient quality is more difficult still, but possible. At any rate this is the ideal which all breeders are striving to produce.

Sex characteristics and disposition.

Strong masculinity should be as pronounced in the boar as femininity is in the sow. Masculinity is shown not only by normally developed sex organs, but also by the tendency to be less refined about the head than is characteristic of the sow, stronger in the neck, heavier in front, a little closer in coupling, and more compact in form. A prominent development of rudimentaries in the boar is believed by many to indicate deep milking tendencies in his gilts. Femininity of the sow should be displayed by a strong development of the mammary system. The teats should be prominent, symmetrically placed, uniformly developed, and as many as twelve or fourteen. Refinement about the head and good length and depth of sides are characteristics also of the most feminine sows. Strong development of the characters associated with sex are believed to indicate fertile reliable breeding traits in the sow and boar.

It is a matter of considerable importance that the boar and sow have good dispositions. They should be mild and quiet rather than nervous, irritable, mean, or cross. But they should be active and vigorous rather than sluggish, awkward, or unduly lazy. A good disposition is closely associated with the best feeding qualities as well as being an important factor in the number of pigs which a sow succeeds in raising.

Breed type characteristics.

The features or peculiarities which serve to distinguish one breed of hogs from another of the same type collectively represent its breed type characteristics. Variations in the characters of color, set of ear, or dish of face are the ones on which breed differences are primarily based. In addition to these, slight variations in general conformation, size, refinement, and early maturity are met with in varying degree. These features were not considered in the score-card described previously.

In judging pure-bred hogs of the breeding classes, however, a faithful adherence to breed type standards, as well as to the ideals common to all breeds, is the duty of every judge. The standard adopted by the judge should be the one sought by the best present-day breeders rather than that described in unrevised score-cards or standards which have long been out of date. But a thorough knowledge of breed type standards cannot be acquired alone by reading descriptions, however clear and accurate they may be. Although these are helpful, they must be supplemented by the knowledge gained through intimate contact with the affairs of the breed and the constant observation of the type preferred by most breeders as reflected in their selections made in the herd, sale, and show ring. Due to the fact that few, if any, breeds have a fixed and constant type, and because also at no time are all breeders exactly agreed on the emphasis which should be placed on certain points, there is always ample opportunity for the individual preference of the judge to be expressed in the type which he selects. The power which the judge has in molding and uniting the varying ideals of the breeders is the heaviest and most important responsibility conferred on him by the office. To select the type which will make good as practical pork producers without sacrificing in any important degree the breed type characteristics, which represent the trade mark of a breed, should be the steady purpose of the judge and breeder. (See Chapter XIX.)

JUDGING GILTS AND YOUNG BOARS

In judging young boars and gilts, it is important that they be considered as prospective breeders rather than according to the standards of type required of mature individuals or finished fat barrows. The type of gilt should be preferred which gives promise by her size and form to develop into a large, smooth, roomy sow at maturity. To obtain this type the mistake should not be made of selecting the short, thick, fine-boned kind. The short, chubby gilt which possesses the form and finish of a mature sow rarely develops into the type the breeder desires. To obtain the kind which will grow out well, preference should be given to those which appear a trifle leggy and which are large for their age. It is of great importance also that they be strong in the back, of good length, possess prominent well-placed teats, and be squarely placed on straight legs of ample bone. With these all the depth, spring of rib, and quality possible should be secured.

JUDGING FEEDERS

The most important point in the selection of feeder pigs is to have them healthy, vigorous, and free from any contagious disease. Pigs which have passed through stock-yards, although vaccinated against cholera, are a greater risk than pigs which have never been shipped. Pigs which cough much, have rough coats or mattery eyes, or are gaunt and listless in appearance should also be looked on with suspicion (see Chapter XX). A knowledge of the conditions of sanitation and methods of feeding employed on the farm where the pigs were produced is necessary in order to judge accurately their probable health and feeding qualities.

A second important point is to get the pigs as uniform as possible in age, weight, condition, previous feeding, color, and type. Similarity of color usually means similarity of breeding and hence uniformity in the resulting features of type and early maturity. A load of pigs uniform in age, condition, and method of previous feeding will feed more uniformly, reach market weight and finish more nearly at the same time, and will sell more satisfactorily when placed on the market.

The ability of a pig to make rapid gains is largely influenced by his form or type. Also, his appearance when finished for market may be predicted by that when thin. He should possess the same essentials of good conformation demanded of the pig intended for the breeding herd, with emphasis on those features which denote vigor and feeding capacity. He should be broad at the poll, wide between the eyes, with a face of medium length. A narrow head and long sharp nose are not associated with either good feeding or good killing qualities. He should be strong backed, wide in his spring of rib, and show plenty of capacity of middle. A full heart girth and low flanks are indications of constitution and gaining ability which should not be overlooked. It is of special importance also that he be good in his legs and feet; that is, they should be medium in length, squarely set, straight and strong.

Condition, or degree of fatness, is an important point in judging feeders. The most satisfactory feeders, as a rule, are those which are well grown for their weight, or in other words, are in a thrifty growing condition rather than fat. Pigs which have been grain-fed in dry lots do not gain as well as those which have been largely grown on forage. Forage-fed pigs are usually thinner, have more "stretch," are glossier of coat and more healthy than pen-fed pigs.

In weight feeder pigs usually range from 65 to 150 pounds, and in age from three to eight months. There seems to be no best weight or age, although the heavier and older the pigs, the shorter will be the time required to get them to market condition. Although the lighter pigs require a longer feed and do not make such rapid gains, they make more gain from a given unit of feed consumed. For following cattle the heavier pigs are more suitable.

As much quality should be secured as possible provided general vigor and constitution are not sacrificed. Quality in feeder pigs will insure a finished condition when market weights are reached and will do much to help sell them when ready to ship.

CHAPTER XVIII

BREEDS OF HOGS

THERE are now in America eight clearly defined breeds of hogs which may be regarded as fairly well established in numbers, or which give promise of soon becoming so. These are the Poland-China, Duroc-Jersey, Hampshire, Berkshire, Chester-White, and Spotted Poland-Chinas of the lard type, and the Large Yorkshire and Tamworth of the bacon type. The Hampshire should perhaps be classed as intermediate between the lard and the bacon types, although the type as generally shown seems to exhibit more of the former characteristics than of the latter. As bred in Canada, the Berkshire has a decided leaning toward the bacon type. In addition to these more common breeds, the following are less widely distributed: Cheshire, Victoria, Essex, Suffolk, Small Yorkshire, and Mule-Foot.

As generally understood, a breed may be defined as a group of animals the individuals of which possess certain well-defined characteristics in common and which transmit these characteristics to their offspring with a reasonable degree of certainty. The great variety of stock contributing the foundation blood of the different breeds furnished the possibilities in hereditary combinations which made possible the later development of the improved types by selection. The best evidence now indicates that the part which more liberal feeding and improved environment played in breed formation and improvement was to provide the conditions whereby the inherent possibilities of the individuals could be tested. More intensive feeding, in other words, was not the direct cause of the evolution of the modern early-maturing breeds; it was the selection by the breeder of those individuals which were capable of prospering under these conditions.

Although most of the breeds of hogs are not so old as the larger number of breeds of cattle and horses, as age is usually reckoned, they are older than most other improved animals when measured by number of generations rather than by number of years. This is because little more than a year separates two successive generations of hogs, while there are from three to four in cattle and usually five in horses. This, with the large number of young produced by each generation, explains why the development of the various breeds of hogs has been so rapid and the degree of improvement effected so extraordinary; for there is probably no species or breed of farm animal which has been more successfully bred to meet given economic needs than has the American hog.

In the following pages very brief consideration is given to the origin, history, and present dominant characteristics of the more common breeds. The purpose is not to attempt an answer to the question as to what is the best breed of hogs, but rather to note the important characteristics for which each is distinguished.

THE POLAND-CHINA (PLATE IX)

The birthplace of the Poland-China breed is in southwestern Ohio in the counties of Butler, Warren, and

Hamilton. The breed originated from a composite stock of great variety. The Warren County pig, which was the widely known hog of this district from 1816 to 1835, was the product of crossing the medium-sized Big China on the larger, coarser Russian and Byfield stock. All these hogs were mostly white. From 1835 to 1839, Berkshire blood was introduced in considerable quantities. The color and much of the early maturity and quality which later distinguished the breed undoubtedly came from this source. In 1839 a few white hogs were imported from Ireland, called the Irish Grazier. It is claimed that no outside blood has been introduced since 1845.

The development of the breed from that time until recently has been in the direction of great refinement, remarkable early maturity, and quality. A more brilliant demonstration of the fine art of the breeder is probably not to be found in the whole history of live-stock improvement than that furnished by the perfection of form and show-ring quality attained by this breed according to the standards then set. Since about 1914 the breeder's ideal has radically changed in response to the feeder's demand for more ruggedness and size and the breeder's demand for more reliable breeding habits. Where extreme quality was formerly sought, extreme size is now demanded. The change of type which has been brought about in the short space of five years is a remarkable demonstration of the possibilities of the breed and of the resourcefulness of the breeders in meeting the new demand. At the present time, the breed is rapidly advancing towards greater uniformity of type and the ideal which demands great size, but which also requires sufficient symmetry of form and early maturity to meet the practical demands of the feeder and market.

THE DUROC-JERSEY (PLATE X)

Much uncertainty exists regarding the exact elements making up the foundations of the Duroc-Jersey breed, but it is believed to have originated from a fusion of the so-called Jersey Red breed of New Jersey and New York, and the Durocs of New York. The former were large and inclined to be coarse, while the latter were rather fine of bone and carcass. These two strains of red hogs probably descended from importations of Red Guinea hogs from Africa, made as early as 1804, the Spanish red hogs from Spain, and the Red Portuguese breed from Portugal. It is believed that sandy-colored Berkshires, which were more or less common at that time, also contributed some influence on the foundation stock.

Uniformity of color and type and the other characteristics for which this breed has become noted have been developed chiefly since 1885. From 1900 to the present time the breed has attained an unusually strong position of merited popularity, especially throughout the corn-belt and the South. The two characteristics which have had most to do in winning this position are: first, the prolificacy of the sows; and second, the good feeding qualities of the pigs. Like the Poland-China, the Duroc-Jersey is now being bred for greater scale. With all breeders working towards the common goal of size with quality, prolificacy, and vigorous feeding qualities, the breed will undoubtedly be able to maintain the high position which it has gained.

THE HAMPSHIRE (PLATE X)

Little authentic information exists relative to the origin of this breed. It is recorded, however, that from 1820 to

1825 importations were made from England to Massachusetts of hogs which there gained popularity and were known as the Thin Rind. In 1835 Thin Rind hogs, probably from eastern sources, were introduced into Kentucky, where the breed probably had its early development. The official beginning of the breed was in Boone County, Kentucky, in 1893, under the name Thin Rind. In 1904 the name was changed by the association to Hampshire.

The history of the development of this breed has largely been written in the last fifteen years. During that period the breed has experienced an unprecedented growth in numbers and popularity. This has been due not only to the merit of the breed itself, but to the energetic methods of the association in promoting the breed's interests.

The Hampshire is a medium-sized breed, full of quality; the sows are good mothers and the pigs excellent rustlers and great killers. As judged at the different shows, a diversity of types exists. Although most of those produced in the corn-belt are more of the lard than of the bacon type, some breeders select for the latter and many for the type which is a happy blend of both. A severe handicap with which the breed has to contend is the self-imposed restriction that only those which wear the white belt are eligible to favor.

THE BERKSHIRE (PLATE X)

The Berkshire is the oldest of our breeds of lard hogs and the only one of English origin. In 1789 it was written by Culley [1] that Berkshires were more numerous than any

[1] Plumb's "Types and Breeds of Farm Animals."

other pigs in England. They were described at that time as being reddish-brown with black spots, with large drooping ears, short legs, fine bone, and inclined to fatten at an early age. Another writer at about the same time said they were large-boned, with turned-up snouts, and some of the specimens very large. On this stock Chinese, Siamese, and Neapolitan blood was used with the effect of reducing size, increasing refinement and the early disposition to fatten. In 1830 they were said to be of a sandy or whitish-brown color spotted regularly with dark brown or black, erect of ears, the head, snout, body and legs short, and producers of superior bacon. Most of this development took place in Berkshire and neighboring counties in central southern England.

The first importation to America occurred in 1823. From then on to 1841 several fairly large shipments were made. By 1845 there were well-established herds in New Jersey, New York, and Pennsylvania.

The dominant characteristic of the Berkshire is its excellent killing qualities. The carcass is unusually firm and contains a very high proportion of lean meat of the finest texture. This is the principal reason why it is popular in Canada where it is bred along bacon type standards, and for the preference which many American packers have expressed for the breed. They are very prepotent, unexcelled in rustling qualities, and quickly adapt themselves to new conditions. As bred in recent years, they are medium as to size. The rather tardy recognition by the association of the need for more size to meet the new demand, has lost for the breed some of its former popularity in the corn-belt. However, with the emphasis which is now being placed in selection on size and feeding capacity, and the general disposition among the breeders to give less attention to the "finer points" of breed-type, the breed's admirers feel confident that the high position which it has attained will be successfully maintained.

THE CHESTER-WHITE (PLATE X)

The Chester-White breed as it now exists has been developed from a foundation stock made up of three principal strains. The first was the white hogs bred in Chester and Delaware counties, Pennsylvania. These descended from some white pigs imported from England in 1820, and later from the same source some white hogs with black and sandy patches of hair, said to have been Chinese stock. The second strain was developed in Ohio and was known as Todd's Improved Chester-Whites. These were produced by selection and crossing from stock originally imported to Connecticut from England and called the Norfolk Thin Rind pigs, the Byfield breed in Massachusetts, the Large Grass breed in Ohio, and a Normandy boar of French ancestry. The third strain was also developed in Ohio and went under the name, Ohio Improved Chester-Whites, the "O. I. C.'s." These were developed from white pigs purchased in the eastern states in 1865.

The Chester-White is, therefore, one of the oldest breeds of hogs which has had an American origin. Due to the large size and mellow feeding qualities for which the white hogs were early noted, it played a leading rôle with the farmer in his invasion of the rich corn lands of the Middle West. The breed has always been a popular farmer's hog. The sows are noted for their ability to produce good-sized litters, the pigs are good gainers and mature early, while the finished fat barrows have made an enviable record in the show-ring and on the block. Like most lard breeds, the Chester-White has suffered from over-refinements. Since about 1917, however, the breeders have been conservatively breeding for more scale.

THE SPOTTED POLAND-CHINA (PLATE XI)

This breed had its official beginning with the organization of the National Spotted Poland-China Record Association at Indianapolis, January 1st, 1914. The real beginning of the breed, however, dates much farther back. As is well known, a larger part of the stock making up the foundations of the Poland-China breed was white in color and many of the herds which were maintained from 1845 to 1880 were largely spotted. These old spotted Polands had a reputation for size, ruggedness, bone, and prolificacy. The modern Spotted Poland-China descended from those herds located chiefly in central Indiana, which preserved the old spotted type for their standard. In 1914 B. E. Arbuckle and Son, Brownsburg, Indiana, imported a pair of spotted hogs from England which are recognized as foundation animals. It is believed that the blood of these hogs is found in about 5 per cent of the animals of to-day.

According to Secretary Fred L. Obenchain, Bainbridge, Indiana, to be eligible to record, an animal must descend from individuals already recorded in the National Spotted Poland-China Record Association, the American Spotted Poland-China Record Association, the National Spotted Poland Association, or the American, National, or Standard Poland-China Associations. In addition to meeting the breeding or pedigree requirements for registry, they must conform to the official standard for the individuals, in color (not less than 20 or more than 80 per cent black), size, form, and quality.

The aim of the present day breeders is to maintain and improve on the virtues of the old Spotted Poland-China. During the last few years, the breed has grown rapidly in numbers and popularity and the herds have become more uniform in type. With the utility type the standard and coöperation and unity of purpose among the breeders the rule, the future for the breed appears bright.

THE LARGE YORKSHIRE (PLATE XI)

This English bacon breed had its origin in Yorkshire and neighboring counties of England nearly a century ago. The early foundation stock consisted of large white hogs with black or bluish spots on the skin, with heavy bone, very large drooping ears, long legs, and narrow backs and loins. This stock is said to have been improved by the use of some Berkshire blood as early as 1842, and later, of white Leicester hogs. These latter were large, but fine of head and bone, and with erect ears. To improve their fattening qualities, boars of the Small Yorkshire breed were also used.

Yorkshires were imported into the United States at a comparatively early date, but have never become widely distributed since they are better adapted to bacon than to lard production. In Canada where the bacon type of hog predominates, the Yorkshire has become the standard breed. Most of the herds in this country are found in Minnesota and other small-grain growing sections.

In addition to its bacon type, the predominating characteristics of this breed are its large size and the unusual prolificacy of the sows. The pigs are fine rustlers and compare favorably with any breed in their ability to make rapid gains. Judged by lard-type standards, the pigs do not fatten early, but when the Yorkshire is crossed with any of the lard breeds the pigs admirably suit the requirements of the corn-belt feeder and packer. To profit by the pig-producing ability of the breed, boars of the lard breeds should be crossed on Yorkshire sows. A careful study of present show-ring standards disclosed the interesting fact that most of the lard breeds seem to be tending somewhat in the direction of Yorkshire type, which is not to be considered as altogether to their discredit.

THE TAMWORTH (PLATE XI)

Although the Tamworth is regarded as one of the oldest English varieties, little is known regarding its early history and development. The stock from which the breed originated is described as having been of a dark-red color, very lean and active, slow to mature, with very long legs and snouts, and shallow bodies. This type of hog was common in central England at an early date, especially in Staffordshire where the breed is supposed to have had its early development. The breed seems to have been slow in winning general popularity in England, and it was not until about 1880 that its present characteristics became fixed by selection. The Royal Agricultural Society did not give the breed a separate show classification until 1885.

The first pigs of this breed to be imported into America were brought into Ohio in 1882, but they were not destined to win any general popularity in this country. At about the same time Canadian importations were made and here the breed found more congenial environment and has since enjoyed a reasonable degree of popularity.

The Tamworth as now bred is of the extreme bacon type, long, smooth, and deep-sided. The sows are remarkably prolific, the pigs are excellent rustlers and good gainers and are of the type which produce meat suitable for the manufacture of fine bacon.

CHAPTER XIX

BREEDING

THE fundamental purpose of the breeder is to improve his stock. There are two ways of doing this: first, through better methods of care and feeding; and second, through the use of breeding animals which possess improved "blood" or breeding. In this chapter the breeding side only will be considered; first, briefly the facts of reproduction and heredity as now understood, and second, the application and bearing which these facts have on the methods and practices of the breeder.

THE LAW OF HEREDITY

The process of reproduction.

Every pig has his origin in the union of two germ-cells, one produced by the sire and one by the dam. When these two germ-cells, male and female, unite, a new individual is born. This process is called fertilization, the successful completion of which marks the real birth of the individual.

The female germ-cell is called the egg or ovum (plural, ova), and the male germ-cell the sperm or spermatozoön (plural, spermatozoa). About every three weeks during the breeding seasons the sow, if vigorous and in breeding condition, produces and ripens a number of eggs, usually from five to twelve. These are produced or secreted by special organs, called ovaries, situated in the region of the loin just in front of and below the kidneys. When the eggs are ripened, they drop into the upper end of the Fallopian tubes and, through gravity, finally reach the womb or uterus. The outward manifestations of these functional activities are called "heat." The male germ-cells or sperms are secreted by the testes, the essential part of the testicles, corresponding in function to the ovaries of the sow. For every egg produced by the sow, the boar produces many thousands of sperms. The number of sperms contained in a cubic millimeter of semen from a normal boar runs from 6000 to 600,000,[1] depending on his natural vigor and the distribution of the services. The average number produced in an isolated service is about 450,000 to a cubic millimeter. At this rate a teaspoonful of semen would contain 3,600,000 sperms.

The female germ-cells or eggs are relatively large compared with the male germ-cells or sperms. Although too small to be visible with the naked eye, the eggs are several thousand times larger than the sperms. The sperms are extremely minute, measuring $\frac{1}{19}$ of a millimeter in length, which would require that 482 be laid end to end to measure one inch. The large size of the egg compared with the sperm does not mean that the sow contributes a larger hereditary influence to the pigs than does the boar, but only that the food supply (egg-yolk) necessary to sustain the life of the fertilized egg until conception is complete, is carried in the egg.

The shape of the egg is spherical like a ball, while the sperm is elongated, consisting of a head, middle, and tail piece, very much resembling a tadpole in appearance. While the egg is passive, the live sperm is active and capable of locomotion. This is accomplished by the rapid

[1] L. L. Lewis, Okla. Exp. Sta. Bull. 96.

vibrations of its tail-like appendage. Fertilization, or the successful union of the egg and sperm, is thus conditioned on the vigor and activity of the sperm. There being in a normal breeding service many thousand sperms for each egg produced by the sow, the sperms which are most active and get to the eggs first are the ones which fertilize them. Only one sperm ever unites with an egg under normal conditions.

As soon as the eggs are fertilized, they attach themselves to the lining membrane of the uterus and begin to absorb nourishment through its walls. Each individual egg grows in size and divides into two; each in turn absorbs nourishment, grows in size, and divides into two, so that where at first there was only the single fertilized egg-cell, there are now four cells. This change, called cell division, represents the beginning of embryonic development. The process of cell division continues throughout the gestation period and, under normal conditions, in about 113 days so-called birth takes place.

"*Like begets like.*"

Within each cell resides the hereditary material which is being passed on from parent to offspring. The extraordinary fact is that although these germ-cells are so minute as to be invisible, yet they contain every particle of hereditary matter, every influence, which the parent contributes to the unborn pig. The pig inherits nothing which he does not receive in these two cells, one supplied by the sire and one by the dam.

When the male and female germ-cells unite to form the fertilized egg, there is consequently a union of the hereditary qualities contributed by the boar and sow. Since each germ-cell carries a full set of characters, it follows that the fertilized egg, and consequently the new-born pig, is double or dual in nature. In some of his characters the pig may resemble the sire and in others the dam; in some features he may bear an unmistakable resemblance to an ancestor farther back in his pedigree. Speaking in general terms, it may be said that the hereditary make-up of the pig, his color, set of ear, feeding qualities, vigor, and in fact every character, is the result of the combined hereditary influence of his entire ancestry.

This resemblance between the individual pig and his ancestors is the result of the operation of the law of heredity that "like tends to beget like." By this law every living thing reproduces after its own kind and is responsible for the faith which the breeder has in the saying "blood will tell."

Variations.

Although prepotent breeding animals transmit their likenesses to their offspring with remarkable faithfulness, it is also true that many and wide variations occur among individuals of even identical breeding or ancestry. This is well illustrated by the variations common among the individual pigs of the same litter, raised together and fed from the same trough. (See Plate XII.) Although heredity impresses or insures a strong family resemblance, it does not operate in a manner to exclude differences or variations.

Variations among individuals of the same or identical ancestry are of two kinds; first, hereditary variations; and second, variations due to differences in the conditions under which the individuals were developed.

Hereditary variations among pigs of the same litter are due to differences in the hereditary contents of the germ-cells from which the individuals developed. They are sometimes called, therefore, germinal variations. The several eggs produced by the sow when she comes in heat are not alike, especially if she is of mixed breeding. As a rule, the more uniform the type of the animals in the sow's pedigree, the more uniform will be her eggs with respect to this character; the more dissimilar the types in the pedigree, the greater will be the germinal variations among the eggs produced. In the same way, the sperms produced by the boar vary with respect to any and all characters to the same degree that the individuals in his ancestry vary in these same characters. When ten sperms unite with ten eggs in the process of fertilization following breeding, the chances for variations among the pigs which develop from these eggs are still further magnified. If variations are reasonable among pigs of the same ancestry, it is obvious that pigs of dissimilar parentage, for the same reasons would normally present even greater variations.

Variations of this kind are of fundamental importance to the breeder because without them improvement would be impossible. It was through the selection of the desirable hereditary variations and their correct combination in mating that all breed improvement has been brought about. Observations of the breeder have shown that some variations are desirable and some undesirable, the larger number being undesirable. There is always the tendency in pure-bred herds, therefore, for the offspring to be inferior to their parents. In other words, pigs produced by prize-winning parents are not so good, on the average, as the parents themselves; a few may be better, but most are inferior. A clear appreciation of this fact on the part of young breeders especially will insure less frequent occurrence of disappointing results.

So-called reversions[1] are hereditary variations and may be defined as the reappearance of a character in an individual which was not present or shown in its immediate ancestry, but which was present in two or more of the individuals farther back. It is the "cropping up" of a character which has been "lost" for several generations. The appearance of spotted pigs among Poland-Chinas bred according to the medium or old-type standard is a good instance of reverting back to the old type, or the occasional appearance of spots of red hair among Berkshires. The common tendency of so-called big-type parents to throw pigs of the small fine-boned type is another instance of the same tendency.

In Plate XII is shown a white sow with a litter of pigs containing one black one, a reversion.[2] The sire of these pigs was white like the dam, but both were cross-bred, the product of mating a Berkshire and Yorkshire. In this case the black color skipped but one generation. In Fig. 18 the principle of all variations of this kind is illustrated.

This diagram supposes a Yorkshire and Berkshire to be mated. All the pigs from this first cross will be white like the Yorkshire parent, as proved by actual tests. These cross-bred white pigs are then mated to a pure Yorkshire boar and again all the pigs are white. If these white pigs, which in breeding are said to be three-fourths Yorkshire and one-fourth Berkshire, are mated to a boar of the same breeding, as illustrated in the diagram, the chances are that some of the pigs will be black. In this case there is a "cropping out" of a character which was not present in

[1] Sometimes called atavism. So-called "sports" are usually reversions.

[2] W. W. Smith: American Breeders' Magazine, p. 116.

the immediate parents or grandparents, but which was present in two of the eight grandparents.

The appearance of this black pig, as in the case of all reversions, was not an exception to the law of heredity that "like begets like"; it was rather a proof or guarantee of it. Although the cross-bred pigs produced by the first Yorkshire-Berkshire mating were all white, so far as their breeding or hereditary qualities were concerned they

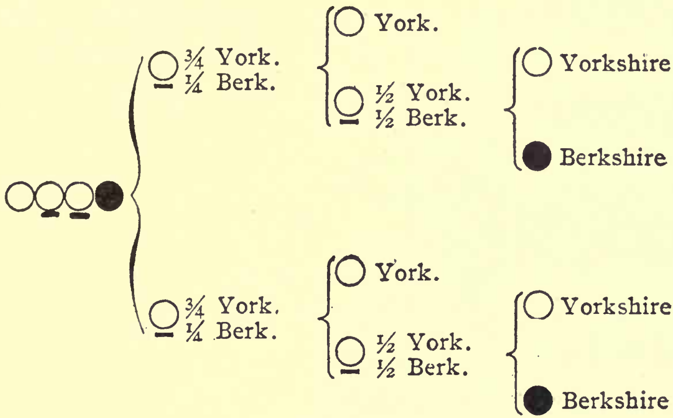


Fig. 18. — Illustrating the principle of reversions.

were as much black as white. The black did not show in the bodies of these cross-bred pigs because the white dominated over it. The black, in other words, was present in a hidden or latent condition, illustrated in the diagram by a dash below the circle. It was also present in some of the pigs in the next generation, so that in the succeeding generation when two of these white pigs, each with black latent, were bred together some of the pigs were black. What is true of color is true also of the hundreds of other characters making up the individual. A character may lie latent, or be covered up as it were, for five, ten, or any number of generations and then make its appearance. When two animals are mated each of which have the same character latent, some of the offspring will show the character developed. Reversion, in other words, is merely the expression of a character which was always present in some of the ancestors, but which was latent or not developed.

Incidentally these facts make plain the fundamental and important principle that the individual appearance of an animal only partially or imperfectly represents his breeding possibilities. In other words, the individuality of an animal is not altogether a safe criterion of his breeding ability. It also explains why two individuals with exactly the same pedigree may differ materially in breeding qualities.

The older a breed, or the more carefully it has been bred within certain lines, the fewer will be the number of latent characters present. Reversions or the appearance of the unexpected become less frequent, therefore, in old well-established herds than in those in which out-crossing or cross-breeding has been resorted to. The selection of breeding stock within rather definite and narrow limits tends ultimately to reduce reversions, while out-crossing has the opposite effect of bringing about the conditions which result in variations and so-called reversions.

The second kind of variations are those which result from differences in the conditions under which the individuals have been developed. They are sometimes called acquired characters. Variations of size and vigor which result from differences of feeding and care are most common. Two pigs may have an inheritance equally good, but if one is raised in a dry lot on corn and water, while the other has the advantage of balanced rations, succulent feeds, and plenty of exercise, there will be a marked difference between them at maturity. Likewise, pigs from well-developed parents of the best of breeding, if not properly developed, will show a wide variation from their sire and dam. These are not due to any difference in inheritance, but rather to the fact that in one case the hereditary possibilities had the chance to develop, while in the other they did not have the opportunity. In order to produce good hogs, therefore, the breeder must not only produce pigs which possess the proper inheritance, but he must also give them the conditions which will promote and make possible the full development of these hereditary possibilities. In the practical sense, the breeder who is not a good feeder cannot succeed.

Variations due to differences in feeding and management, however, are not transmitted to succeeding generations. The effect of good development on the individual does not improve or change in any way the hereditary content of his germ-cells, but is temporary and limited to the individual alone. The importance of good feeding in the development of a young boar is not that he may be able to get pigs which have more size and better feeding qualities, but chiefly to test his own hereditary possibility in this particular. Incidentally he will be a more vigorous breeder and possess an individuality which is an asset to the appearance of the herd. A boar which has the natural ability to respond to good feeding is more certain to get pigs of this kind than one which did not inherit this capacity. Good development of breeding stock is important, therefore, because it is an aid to more accurate selection.

Prepotency.

As understood by the breeder, prepotency is the ability of an animal to impress on his offspring his own characteristics to the exclusion of those of the other parent. It is the ability of an individual to "breed on." Because the sire is more depended on than is the dam in live-stock improvement, prepotency is sought in the sire rather than in the dam. A prepotent sire is the cornerstone of all herd improvement. Prepotency is desirable in the sire used for the production of grade stock and of supreme importance in the head of a pure-bred herd.

Observations show that prepotent animals are usually the product of rather close breeding, or, in other words, the result of selecting animals within certain clearly defined limits of type and breeding. As shown by experimental studies, the result of such selection is that the germ-cells produced by the boar or sow will be more alike in their hereditary qualities and, further, that there will be fewer differences between the hereditary qualities of the sperms on the one hand and the eggs on the other. Pigs resulting from the union of such germ-cells will be prepotent when mated with individuals the result of diverse germ-cells the product of mixed breeding. Line and in-breeding have the practical effect, therefore, of intensifying the hereditary qualities and hence of securing prepotency in animals so bred. Scrub animals which are the result of scrub ancestry are prepotent in the qualities of the scrub, just as superior specimens are prepotent in their desirable characters.

Relative influence of the sire and dam.

As a general rule, it may be said that the sire and dam are equal in the influence which each exerts on the charac-

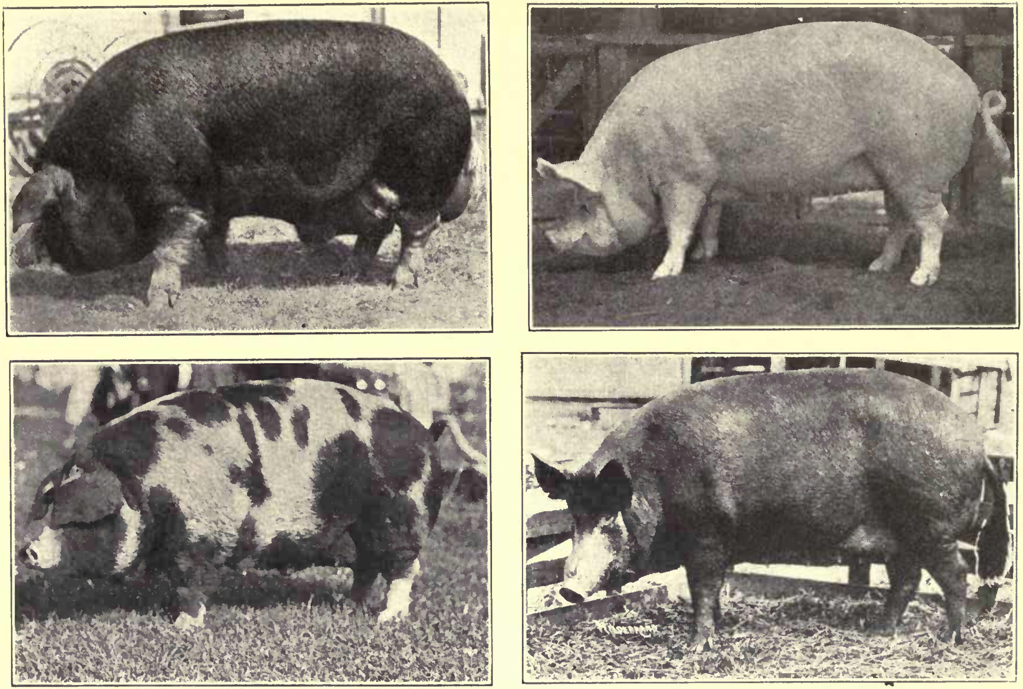


PLATE XI. — Representatives of the different breeds. *Upper left*, Poland-China boar, Giant Buster (Williams and Spurling); *upper right*, A champion Large Yorkshire sow; *lower left*, Spotted Poland-China sow, Wilhelmina (A. P. Underwood); *lower right*, Tamworth sow (Oak Ridge Farm).

teristics of the offspring. That is, so far as sex is concerned, they are equal from the standpoint of heredity. As has been seen, the sire contributes a germ-cell to the fertilized egg, and the dam furnishes a germ-cell. Furthermore, each one of these germ-cells contains a complete set of characters for the new individual. Some of the characters of the sire may dominate those of the dam, and with other characters the reverse may be the case. With many characters, the result is an apparent blend, or intermediate between the sire on the one hand and the dam on the other. The question of whether the black of the boar will dominate the white of the sow is not a matter of sex, but of the character. If one parent is better bred than the other, it will for this reason be more prepotent, independent of any influence of sex. The old theory that the outside and external characteristics are determined by the sire and the inside or functional activities by the dam has long since been exploded.

SYSTEMS OF BREEDING

Up-grading.

The quickest, cheapest, and surest method of live-stock improvement is up-grading. It is the only method adapted to those farms which do not already have pure-bred, or pedigreed herds. By up-grading is meant the mating of the common grade sows of the farm with a pure-bred boar, continuously generation after generation. In effect it means the elimination of the scrub or grade boar. Successful up-grading implies that the pure-bred boar selected be a good individual and that only the best gilts of each pig crop be retained for breeding purposes.

As illustrated in Fig. 19, the rate of improvement in up-grading is rapid and its results certain. The first cross with a pure-bred sire produces pigs which are one-half pure. When the gilts of this litter are mated with a pure-bred sire, the result is a litter three-fourths pure in breeding. The third top cross produces pigs seven-eighths pure-bred, or very high grades and the next cross fifteen-sixteenths pure. For feeding and market purposes, the high-grade pig is practically the equal of the pure-bred.

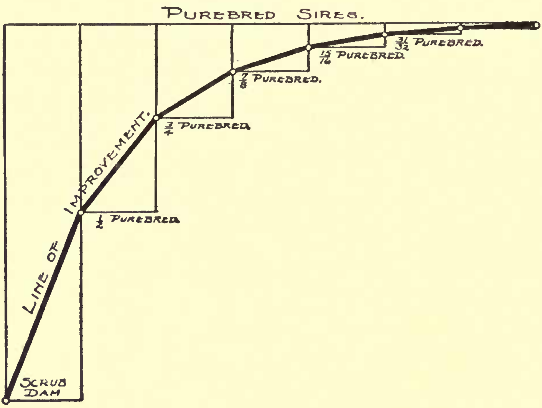


FIG. 19. — Showing rate of improvement in up-grading and degree of improvement effected in each generation.

For breeding purposes, however, the high grade, although good in individuality, is unreliable and disappointing.

As illustrated by the diagram, improvement in the up-grading process is at first rapid and then more slow with each succeeding generation. The degree of improvement effected by the first cross with the pure-bred sire is twice as great as that in the second generation; and in the third generation the degree of improvement is only one-half that in the second. Improvement in succeeding generations becomes more and more imperceptible as the high-grade females approach in merit and breeding the pure-bred sires employed. This illustration makes plain the important principle that the more nearly a herd approaches in excellence the ideal, the more difficult does further improvement become. It is easy to improve a mediocre herd, but extremely difficult to better or even maintain a highly improved one.

Up-grading is economical because the sire mates with the entire female herd and his influence consequently extends to the entire pig crop. The influence of the sow, on the other hand, is limited to a few. Due to the fact that the increased cost of the pure-bred boar over the scrub or grade boar is thus distributed among a very large number of pigs, the cost of the improvement resulting is extremely low.

Cross-breeding.

By cross-breeding is generally understood the mating of two pure-bred individuals which belong to different breeds, as the use of a Poland-China boar on Yorkshire sows, or a Berkshire boar on Duroc-Jersey sows. The mating of a pure-bred boar of one breed to grade sows of another breed is also referred to as cross-breeding. Fundamentally, cross-breeding means the mating of individuals of dissimilar type or breeding. In this sense it is correct to speak of crossing one family or strain with another family or strain of the same breed.

Experiments and observations show that cross-breeding usually has the effect of slightly increasing vigor and feeding qualities. Since these qualities are fundamental in the profitable production of market animals, the reason for the practice of this system of mating is apparent. Another possible advantage in the production of market hogs is the opportunity afforded of selecting the sows from a breed or of a type known to be unusually prolific and heavy milkers and the use on these of a boar possessing the type which will insure by the cross sufficient early maturity and market qualities in the pigs produced.

But even from the standpoint of the farmer who is producing only grade or market hogs, cross-breeding presents certain difficulties and disadvantages. It necessitates the maintenance of two distinct herds, a small one for the production of the brood sows and a larger herd made up of the cross-bred feeder pigs. A second and more important objection to cross-breeding as usually conducted is the tendency to retain for breeding purposes some of the cross-bred pigs. The temptation to do this is strong, with the usual result that in a very short time the herd presents all varieties of color and type.

The reason why cross-breeding cannot be generally recommended is not so much from any evil in the practice itself when systematically pursued, but rather because when once begun it too frequently degenerates into mixed and indiscriminate mating with its attendant evils. It should also be understood that even at its best, cross-breeding is not a method of live-stock improvement. Its sole purpose is to produce a more profitable type of market animal through the use of the improved blood of two distinct breeds or types.

Although the crossing of two distinct and carefully bred strains of the same breed has a reinvigorating effect on the pigs so produced, it finally results in a splitting up of type and the production of reversions in later generations. This result explains why the breeder of pedigreed hogs is always loath to introduce into his carefully bred herd blood from some unrelated strain. The surest way of destroying a type which has required many years of patient effort to build up is to make a radical out-cross. When outside blood is necessary in order to avoid the possible evils of in-breeding, experience shows that it should be introduced in a rather dilute form, that is, by selecting a sire from some closely related strain.

In-breeding.

In principle, in-breeding is the opposite of cross-breeding. It means the mating of individuals more or less closely related. If the individuals are as closely related

- D. B's Dutchess 76842
  - High Chief 13423
    - Ohio Chief 8727
    - Arlie M. 28520
  - Watson's Dutchess
    - John's Ohio Chief 17483
      - Ohio Chief 8727
    - Maywood S. 4th 3240

as full brother or sister, half brother and sister, first cousins, sire and daughter, or dam and son, it is called close in-breeding or incestuous breeding. Practically all in-breeding takes the form of line-breeding. Line-bred pedigrees show the repeated introduction of the blood of some one animal. The result is that it emphasizes and intensifies the influence of a single individual, or of the group of individuals just back of him in the pedigree.

A good example of line-breeding frequently seen is represented in the pedigree of D. B's Dutchess 76842, as shown in the previous diagram. In this case a son of Ohio Chief was mated with a granddaughter of Ohio Chief.

In the accompanying diagram is the pedigree of Baron Duke IV 33446, which shows a little closer line-breeding than the first pedigree. In this instance a sow was mated to her own grand-sire. The relationship is even more close than this, for Handsome Duke was a half brother to Longfellow, and Dora Lee was a full sister.

Baron Lee IV 33446	Longfellow 16835		
	Lady Lee VII 25107	Model Duke	Longfellow 16835
		Emma Lee	Handsome Duke
			Dora Lee

The question of whether in-breeding is safe and desirable must be judged by the results. Experience has shown that a sire which is in-bred has his breeding qualities intensified, that he is more prepotent in impressing himself on his offspring, that his get are more uniform, and the character of his breeding can be more surely predicted. There is no question regarding the supreme value of these things in a sire. The practical question is whether this method of mating can be followed without grave danger of reducing fertility and undermining vigor and constitution. If it cannot, uniform prepotent breeding qualities obtained by in-breeding are bought, certainly, at too great a cost.

The methods followed by the constructive breeders of the past will throw light on this problem. Bakewell, who was our first great breeder and teacher, mated "the best to the best," it is said, regardless of relationship. He succeeded in effecting such wonderful improvement in the meat and early maturing qualities of his Longhorn cattle and Leicester sheep that his method was hailed as the new discovery in breeding. Cruickshank was a great constructive breeder. From the time Champion of England was produced, his method was that of concentrating, intensifying, and fixing in his herd the blood of this great bull. Collings brothers, the Booths, and Bates did not hesitate to in-breed when the animals were strong and suited to one another. Likewise, the founders of the Aberdeen-Angus and Hereford breeds used in-breeding to a very marked degree. The fact is that practically every early breeder who achieved eminence practiced in-breeding to a greater or less degree. The beginning foundations of practically all our improved breeds of live-stock are consequently narrow rather than broad. Gentry of Berkshire fame is a recent breeder whose success no doubt is in part the result of the careful mating of individuals descending from the great Longfellow 16835.

It would be a mistake, however, not to set down the observation that practically every one of these breeders recognized and experienced the possible evils which lay hidden in the system. Practically every one who successfully used in-breeding to fix type and establish uniformity came to the point in his experience where he clearly saw the necessity of introducing fresh blood, or, in other words, of making an out-cross. This was apparent in a tendency towards sterility and a lack of vigor and constitution. Further, the observations of everyday experience furnished some pertinent facts in this connection. A gilt produces a litter of pigs by her own sire and the usual result is a large proportion of runts, with possibly one or two of them half male and half female (hermaphrodites). Some of the pigs, on the other hand, may have escaped apparent injury and are unusually thrifty and vigorous. Such extremely close breeding almost invariably has the effect of greatly reducing the vigor of pigs.

If the experiences of the early constructive breeders are put together, the general observations of present-day breeders, and the results of scientifically planned breeding experiments with small animals like rats, mice, guinea pigs, and insects, the result will support the following conclusions:

1. In-breeding has the effect of simplifying and purifying the hereditary or breeding qualities of an individual, whether good or bad. This it does by bringing into expression characters which were once latent or hidden, thus enabling the breeder to eliminate from the herd those animals which show undesirable reversions. It is

an important vehicle, therefore, in obtaining concentration of blood and fixity of type. The extensive practice of in-breeding in the early formation of our present breeds was justified by this fact.

2. When in-breeding is practiced promiscuously, it almost inevitably results in reduced vigor and impaired fertility. The closer the relationship, the quicker and more certain will these results follow. Even when used mildly and with the greatest skill and caution, the probabilities are that some weakness will ultimately result if long continued.

3. The conditions are not existent to-day which justify in-breeding as they were during the formative period of the breeds' development. Then there was dissimilarity of type and ancestry, while now there is uniformity of type and a breed or blood relationship more or less close among all the individuals of a breed. The first breeders often could not find as good stock outside their own herds as they had in them, and hence used sires of their own breeding. Now, the opportunity for selection is much broader and the necessity for using a closely related sire is practically eliminated. Furthermore, present-day stock is probably less immune from the possible evils of in-breeding than the foundation stocks, because a certain amount of in-breeding has already been practiced in every breed.

PRINCIPLES IN THE SELECTION OF BREEDING STOCK

There are three ways of judging an animal's ability as a breeder: first, by his individuality; second, by his pedigree or breeding; and third, by his actual performance record as a breeder.

Individuality.

Individuality is more generally depended on in estimating the future breeding value of a boar or sow. If the animal is too young to have mature offspring and his pedigree or breeding is unknown, it is the sole dependence in selection. By individuality is meant everything about the animal which can be seen or judged, such as size, conformation, feet and legs, breed type features, and the like. (See Chapter XVII.) Show-ring judging is based entirely on individuality.

That the merit of an animal in individuality is an indication of his probable value as a breeder is proved by the experience and observations of every breeder. This is another way of saying that like tends to produce like. It is the maxim on which all breed development has been built. Of two animals raised under the same conditions, one good in individuality and one inferior, the better one almost invariably proves the better producer. Sometimes, however, the reverse is true. The individuality of an animal is the product of his inheritance plus his opportunities for development. He may be well bred but poorly fed, in which case he would probably prove a better breeder than another which was ordinary in breeding but which had every advantage for full development. However, this is the exception and not the rule.

The ultimate injury to a breed through the pursuit by breeders of certain non-essentials and fads of color or family name, is due to the fact that under these conditions individuality is often ignored. No matter how attractive the pedigree in real merit, if the individuality is below standard he should be rejected. A good pedigree is of the highest value only when there is good individuality to back it up. The real test of breeding is its ability to produce good individuals.

Pedigree.

A pedigree is a record or statement of an animal's ancestry. In addition to the name and herd-book number of each animal, usually it includes also a statement of the date of birth with name and address of the breeder. It may extend back to the beginning of the breed's recorded history, although usually it includes only the first three or four generations immediately back of the individual.

The most practical way of writing a pedigree is according to the bracket form illustrated in the following diagram:

GIANT BUSTER 90455 Bred by W.C. Disher, New Eston, Ohio Owned by Williams & Spruling, Bryant, Ind., and Taylorville, Ill.	DISHER'S GIANT 89271 Bred by J. W. Pfander & Sons, Clarinda, Ia.	BIG BEN 61935 (S.) Bred by Chas. Herring, Columbus, Neb.	SMOOTH PRICE 55487 (S.)
			MOLLIE JONES 5th (133595)
		MAMMOTH GIANTESS EQUAL 152839 (S.) Bred by J. W. Pfander & Sons, Clarinda, Ia.	LONG KING'S EQUAL 53730 (S.)
			MAMMOTH GIANTESS 3d 120027
	BIG LIL 195342 (N.) 186174 (S.)	BIG WONDER 72131 Bred by Wm. S. Powell, Moline, Kans.	WONDER 41551 (S.)
			LADY MONARCH 158410
		LADY LUNKER 182572 Wm. Lentz, Ankeny, Ia.	BIG CROW 162503 (A.)
			BLACK NIGHT 394520 (A.)

This method of writing a pedigree has the merit of clearly showing all the blood lines and the correct relation of these lines and individuals. It is always the custom to place the name of the sire at the top of the bracket and the name of the dam at the bottom. In reading the pedigree the following method is usually followed: Giant Buster was by Disher's Giant and out of Big Lil by Big Wonder. The second dam was Lady Lunker by Big Crow. Disher's Giant was by Big Ben and out of Mammoth Giantess' Equal by Long King's Equal, and so on.

To judge accurately the value of the breeding shown in a pedigree, it is essential that one have a knowledge of the individual animals in the pedigree. The ability to read a pedigree intelligently comes, therefore, only after years of close study of breed history, involving an intimate acquaintance with the leading breeders and a thorough knowledge of the records of the show and sale rings.

From a breed or herd improvement standpoint, a pedigree is good or bad according as the individuals in it are good or bad. If the immediate parents are good individuals and the grandparents are uniformly good, there is sufficient reason for calling it a good pedigree. If to this good individuals in the third and fourth generations are added, there is a still stronger guarantee of merit. Uniformity of type among the individuals of a pedigree is also of great importance, since it stands for similarity of blood and is a guarantee of prepotency in the animal whose pedigree is being studied. To these two points, a third should be added, the records of the individuals as breeders and producers. If the individuals in a pedigree have the ability to produce favorable offspring as well as being good themselves, a guarantee of future performance is practically certain.

In judging a boar or sow's value as a prospective breeder, the pedigree stands for the individual's heredity or inheritance. If a full and complete knowledge of the pedigree is possible, and this is rare, the importance to be attached to it should be about equal to that given to the individuality of the animal. In buying or selecting animals for the herd, therefore, one should insist on the combination of good individuality with good pedigrees behind them. If the individual under consideration is of the best type and he has in addition a good pedigree, there is reason to believe that he will be a satisfactory producer.

Performance.

The value of an animal as a breeder is indicated by his individuality and pedigree; but the only real and final test is actual breeding performance. For this reason, tested sires are more reliable than those of immature age. A fuller appreciation of this fact will prevent further sacrifice of proven boars just approaching the period of their greatest usefulness. It will also operate against unreasonable discrimination by the buyer in favor of the pig and consequently result in a freer use of the knife. Brood sows which have demonstrated their ability as breeders should not be sacrificed in favor of younger sows, regardless of the more attractive appearance of the gilt. The good producer should maintain her position in the herd so long as there are no better ones, according to the same standard, to take her place. Herd selection of brood sows should be based on performance first and looks last. (See Chapter IV, page 89.)

FUNDAMENTAL IDEALS IN BREED OR HERD IMPROVEMENT

The measure of a breed's standing is its popularity with the practical man who is producing pork for market. The test of a breed's efficiency, in other words, is the performance it gives in the hands of the farmer. This means that no breed can survive the competition whose type is not the utility type or whose standards of selection are based more on some fad of color, type or pedigree than on real individual merit. The pedigree breeder's ideal should be based on the farmer's ideal. The question of the ideal farmer's hog is considered in the following paragraphs.

1. In the first place, the ideal breed or herd of hogs must have brood sows capable of regularly producing large even litters; *i.e.*, the sows must be prolific. Prolific breeding quality is probably the most valuable trait for any breed. To a very large extent it is true that a breed is popular or unpopular according as the sows are prolific or not. The question then is, how can regular prolific breeding traits be developed or maintained in a herd.

The first rule is to keep in the breeding herd only those sows which have demonstrated by actual performance their ability to produce and raise good litters. The policy of rigorous culling on the basis of breeding performance should be one of the rules of practice in every pure-bred and grade herd. To follow this rule without regard to pedigree, show-ring attainments, or money cost, requires on the part of the breeder nerve and a high sense of his responsibility.

The second rule which will guarantee improvement in the size of the litters is to be careful to select the gilts which are to be retained for breeding from the large litters only. If this practice is followed year after year, the breeding average will be maintained or improved. The sows which produce the large litters, which milk down and become thin during the nursing period, are the kind which transmit prolific breeding qualities to their pigs.

The third point to which attention should be given is always to prefer the boar which is from a large litter and prolific strain. The sire is supposed to influence equally with the dam the ability of the gilt to produce large litters. Since the size of the litter is limited by the number of eggs produced by the dam, the boar to which the sow is mated is believed to have no influence on the size of the resulting litter, provided he is vigorous (see Chapter V). Although this is true, the pig-producing ability of the sow pigs in this litter will be as much influenced by the sire as by the dam.

2. In addition to regular prolific breeding qualities, the ideal farmer's hog must have capacity for making rapid growth. The efficiency of any breed as pork-producers is largely determined by the ability of the pigs to make rapid gains in the feed yard. Also, rapid gains usually mean economical ones.

The constitution and feeding capacity of a herd can be improved by giving more attention to the matter of size and feeding quality in the stock selected for breeding purposes. Too much attention was devoted in the past to quality and refinement and not enough to vigor and growthiness. This was particularly true ten years ago. The result was a hog possessing extraordinary ability to fatten at an early age, but at a sacrifice of size and gaining capacity. Quality is desirable and necessary, but when quality is not combined with substance it does not greatly add to the utility value of the pigs. The present popularity of the so-called big types is the natural result of this demand on the part of the feeder.

The second point of importance in maintaining feeding qualities and growthiness in hogs is to select only those gilts which are large for their age and which give promise by their type or conformation of developing sufficient size at maturity. This means that the short, low-set, fine-boned kind must be shunned. The gilts which appear leggy, which are long-sided, strong-backed, and set on straight legs of ample bone usually develop well and improve with age.

3. The third important quality which the ideal breed or herd of hogs must possess is the ability to top the market when sold. The ultimate end of the hog is the pork barrel, and the price received for the finished shotes is an important factor determining the profits of the business. This factor is probably more important in the production of bacon than of lard hogs.

The market prefers and will pay the highest price for hogs which will yield a large proportion of dressed to live weight and carcasses which possess the weight and quality which will please the consumer. The type of finished fat barrow which will give these results is one which is fairly fat, which is wide and thick of back and loin, deep in the hams and sides, which is smooth and uniform in his width, neat about the head and jowl, and trim in his underline. To produce pigs which will be ideal killers, they must have sufficient quality and the aptitude to fatten when six to ten months of age. To produce this kind, the sows and boars must be selected which by their easy feeding qualities and general smoothness seem to possess the ability to transmit quality to their offspring.

In other words, they must themselves possess quality, smoothness, and easy feeding qualities.

In seeking quality and early maturity, however, care must be exercised. The effort to secure quality has in many instances been overdone, with the result that fertile breeding qualities, substance, and constitution were lost. What is desired is all the quality possible without sacrificing the more fundamental essentials which have to do with reproduction and growth. The sows should be prolific, produce pigs capable of rapid growth, and in addition, these pigs should be smooth and fat at the age when they can be most profitably marketed. If an ideal breed of hogs is ever evolved, it will be the result of the proper combination of these three essentials.

CHAPTER XX

THE PREVENTION OF HOG DISEASES

By R. A. Craig

BECAUSE of the heavy death rate, pork production was until a few years ago considered a hazardous business. Previous to 1916 the annual death rate among hogs in the corn-belt states was from 6 to 25 per cent. The financial loss for the United States in certain years has amounted to about $100,000,000.

Although the death rate resulting from cholera and other infectious swine diseases has been greatly lowered in the past few years, these diseases are still quite prevalent. The death rate in hogs continues higher than in other kinds of farm animals. Control or eradication of infectious swine diseases cannot occur until health officers and stockmen have a better appreciation and knowledge of disease-control measures.

RELATION OF SANITATION TO DISEASE

Sanitation may be defined as the application of necessary health-conserving and disease-prevention methods. It has a very close relation to herd management. The practice of feeding medicated stock-foods or vaccinating hogs for the purpose of preventing a "filth disease" cannot take the place of sanitation. The best results can be secured only through practicing sanitation in caring for animals together with the use of a reliable remedy or vaccine in case the herd is diseased, or has been exposed to a communicable disease.

The relation of sanitation to disease may be discussed under the following heads: confining hogs in crowded quarters; location, construction, and arrangement of buildings and yards; method of feeding; and source of water supply.

It is not uncommon for hogs to be closely confined and in quarters that are overcrowded. Such quarters are usually the filthiest places on the farm, as it is very difficult to keep crowded pens and houses clean. Disease-producing germs such as the *Bacillus tuberculosis* and filterable virus of hog cholera cannot originate in filth, but when introduced into filthy quarters the infection soon spreads among the animals. Close confinement and crowding greatly lower resistance toward disease, especially in young animals, and filthy feeding floors and watering places favor the entrance of disease-producing germs into the body. Some of these germs may live for months in the manure and litter that is allowed to accumulate about the pens and houses. Infestation by lung and intestinal worms and lice is greatest when hogs are closely confined.

Straw stacks, old straw sheds, and houses with dirt floors are very unsatisfactory shelters for hogs. Young animals cannot thrive or remain healthy if allowed to pile up and burrow into straw stacks, or lie on a wet bed of straw and in dusty quarters. Such "makeshift" quarters greatly increase the cost of producing pork. During the fall, winter, and spring, hogs should have a clean dry bed of straw. Portable houses and sun shades should have a wood or concrete floor. Earth floors are usually dusty, and dust is one of the greatest enemies to the health of hogs. It is very seldom that a floor of dirt is kept free of filth. Much of the bronchitis, pneumonia, rheumatism, and pig scours can be prevented by avoiding these insanitary conditions.

If the site selected for the buildings and yards does not have sufficient surface drainage, grading and tiling the yards may correct this condition. It is advisable to arrange the lots so that any one of them can be plowed, and sowed to rape, rye, or other forage crops. This is the most effective method of cleaning hog lots that have been used continuously. Manure, corn-cobs, and other litter should not be allowed to accumulate in the hog-houses and yards. The yards should be cleaned by raking or scraping the litter into piles. The litter may be burned or scattered over a field and later plowed under. Small yards may be covered with lime after they have been thoroughly cleaned.

The two most important sanitary features to consider when building a hog-house are the windows and floors. Sunlight and well-ventilated quarters are necessary to the health of animals. Unless the floor is made of a material that does not readily take up the filth, it cannot be kept clean. The windows should be so placed as to permit sunlight to reach all parts of the floor, and ventilate the building without causing drafts to strike the hogs while they are lying on their beds.

Hogs should not be given feed on the ground, especially if the yard is muddy. If hand-feeding is practiced, a concrete feeding-floor amply large to accommodate the herd should be provided. The feeding-floor should be cleaned daily, and frequently sprinkled with a disinfectant. If garbage is fed, the floor should be cleaned, washed, and disinfected daily. When hogs are given wide range, there is no objection from a sanitary point of view to feeding on the ground, providing a different place is selected from day to day. Feeding from a self-feeder is more sanitary than hand-feeding on the floor or ground.

It is not advisable to allow hogs to wallow in or drink from small streams. In the corn-belt such streams usually receive sewage from other hog lots, and are a common source of disease. Ponds and wallows are usually little better than cesspools. They receive the drainage from the surface of the lot and should be filled in with dirt in order to prevent hogs using them for wallowing or drinking places. Water from a good well given to the hogs in clean troughs or drinking fountains is the only satisfactory water supply.

Disinfection of hog-houses and yards.

The first step in disinfecting hog-houses and yards is to give the surface that is to be disinfected a thorough cleaning. All litter such as manure, straw, and corn-cobs should first be removed from the lot, and dust and dirt brushed and scraped from the walls and floors of the hog-houses. The surface of an earth floor should be removed to a depth of several inches. Portable houses or piles of rails and lumber should be moved in order to permit cleaning under them. Straw should be hauled to a field that is to be plowed later, or piled where other live-stock cannot come in contact with it. Plowing the lots and sowing a forage crop is the most economical method of cleaning them. They may be covered with quicklime, or rested for a few months in order to permit the sun and other natural disinfectants to destroy the disease-producing germs. The houses should be sprayed with a water solution of a reliable cresol or coal tar disinfectant. Unless the pump used throws the spray with sufficient force to drive the disinfectant into cracks and uneven places in the walls and floors, the disease-producing germs are not killed and the house is not rid of the infection. The same is true if any of the surface is missed. For this reason, it is best to add sufficient hydrated lime to the disinfecting solution to make a thin whitewash. This enables the person who is applying the solution to detect any part of the surface that has not been covered.

The most reliable and safest disinfectant for hog-houses and feeding floors is a 3 per cent water solution of liquor cresolis compound. Coal-tar disinfectants may be used in 3 to 5 per cent water solutions. The following gives the quantity of disinfectant to a gallon of water used in making the different per cent solutions:

Table CLXXVIII. — Disinfectants for Hog-Houses

Quantity of Disinfectant	Quantity of Water	Per Cent Solution
1.2 ounces	1 gallon	1
2.5 ounces	1 gallon	2
3.8 ounces	1 gallon	3
5.0 ounces	1 gallon	4
6.3 ounces	1 gallon	5

RELATION OF QUARANTINE LAWS TO DISEASE

Better quarantine laws and proper enforcement of them are necessary before such diseases as hog cholera and tuberculosis can be controlled and stamped out. Stockmen realize this and instead of considering intra- and interstate quarantine laws a detriment, as was the case a few years ago, they now appreciate the value of the protection that these laws have given the swine industry.

In order to prevent the spread of communicable diseases, an early diagnosis is necessary. If stock-men had a better knowledge of this class of disease, they would be able to practice control measures at a time when the most good could be accomplished. In case a disease is believed to be infectious, a veterinarian should be called for the purpose of diagnosis, and if it proves infectious he should notify the proper health officer.

Most infectious diseases can be controlled by quarantining the exposed and sick animals on the premises where the outbreak occurs. However, in the control of tuberculosis it is necessary to slaughter tubercular hogs. Stockmen should voluntarily comply with quarantine regulations recommended by the Federal and state health officers. A man who sells cholera hogs to his neighbor in order to escape personal loss is pursuing a very shortsighted policy. In selling diseased animals he violates the laws of his state, perpetuates hog cholera in his community, and makes it necessary to keep his hogs immunized against cholera.

DISEASES OF THE DIGESTIVE SYSTEM

Stomatitis or sore mouth.

The two forms of inflammation of the mouth are the simple and the ulcerative. The simple form of the disease is met with in young and mature hogs, and the ulcerative in young pigs.

Simple inflamation of the mouth is usually caused by irritation from hot or decomposed feeds and feeds containing irritating substances. Treating hogs with irritating drenches is sometimes a cause. Very serious outbreaks of stomatitis sometimes occur in hogs that are allowed to feed about straw stacks, due to the awns or beards of barley or other grains penetrating and lodging in the mucous membrane of the mouth. Sick animals may develop sore mouth because of their debilitated condition and the salivary secretions not keeping the mucous membrane clean.

Difficult mastication or inability to eat, champing the teeth and dipping the snout into water are common symptoms. After the first or dry stage of the inflammation has passed, frothy saliva may accumulate about the lips or hang in strings from the mouth. The lips and cheeks may appear swollen, and the lining membrane of the mouth coated or red. A mild localized case of stomatitis may not be noticed by the attendant.

Unless the lining membrane of the mouth is severely injured by irritating food, the disease responds quickly to dieting and treatment with antiseptic washes. Preventive treatment consists in avoiding irritating feeds and insanitary drinking places. Plenty of clean water should be provided so that the hog can clean its mouth. Usually this is all the treatment necessary. If awns become lodged in the mucous membrane, they should be removed. The mouth may be washed daily with an antiseptic solution, such as a teaspoonful of powdered alum dissolved in one quart of water, or $\frac{1}{4}$ per cent water solution of liquor cresolis compound. Mouth washes should be applied to the inside of the cheeks, lips, and other parts of the mouth with a syringe.

Ulcerative inflammation of the mouth is a disease of pigs caused by the *Bacillus necrophorus*. It is spread by pigs nursing mothers whose udders have become soiled with filth that contains the disease-producing germs. Pigs that have ulcerative sore mouth, if allowed to nurse mothers having healthy litters, leave the virus of the disease on the teats and the infection spreads to the healthy pigs. Eruption of the teeth is, no doubt, a common predisposing factor.

The first symptom, which usually escapes notice, is a localized inflammation of the lining membrane of the lips, cheeks, and gums. Early in the disease the inflamed part is slightly swollen and red; later it is white in color. This white patch soon sloughs, leaving a deep irregular ulcer. At first the pig shows some difficulty in nursing, but as soon as the ulcers form it refuses to nurse, appears dull and weak, and loses flesh rapidly. Portions of the lips, snout, and gums may slough off. Scabs may be present on the face and neck. The death rate is very high.

The treatment is largely preventive. This consists in using the necessary precautions against bringing the disease on to the premises, and keeping the quarters free from mud, dust, and filth. If the disease is detected before it has affected more than one or two litters, the unexposed litters with their mothers and the sows that have not farrowed should be moved to new quarters, and the infected pigs either killed or placed in quarantine. It is advisable to clean the sows' udders daily, by washing with a disinfectant. A different solution and cloth should be used on each sow in order to avoid distributing the disease-producing germs. The pigs should be examined daily, and treated promptly if symptoms of the disease are noted. Such disinfectants as 2 per cent water solution of liquor cresolis compound, or 2 per cent water solution of permanganate of potassium may be used. Dipping the pigs, head foremost, into the latter disinfectant may be practiced in large herds. Ulcers should be scraped or curetted and cauterized with lunar caustic. It is best to kill pigs showing extensive ulceration of the gums and lips.

Gastro-enteritis or inflammation of the stomach and intestines.

Inflammation of the stomach and intestines may occur independently, but usually both organs are involved. The causes are very similar. The disease is common in feeding hogs that have "gone off feed" for a few days, and when they again begin to eat overload their stomachs. Feeds that are spoiled or contain such acrid poisons as washing-powders are common causes in swill-fed hogs. It may occur as a complication of other diseases. Gastritis is always present in salt poisoning.

The symptoms are loss of appetite, restlessness, and sometimes colicky pains. In poisoning caused by salt, brine, or washing-powders, marked weakness and depression occur. The hog usually wanders off by itself, acts dull, grunts, lies down in a quiet place, or stands with the back arched and abdomen held tense. Vomiting is a common symptom. Constipation and diarrhœa occur. The body temperature may be above normal early in the disease; later, normal or subnormal.

The treatment is largely preventive. This consists in preventing hogs that are off feed from overloading when they again begin to eat, and practicing proper precautions when feeding slop or garbage. Poisoning from eating too much salt is common in hogs. Hogs should be salted at regular intervals or have access to it at all times. Stock-foods that consist mostly of common salt, Glauber's or Epsom salts should not be mixed with the feed. Hogs that are not accustomed to them should be fed sparingly at first and not allowed to eat all they want. Withholding all feed at first and later feeding a light ration is the most effective curative treatment. From 1 to 4 ounces of linseed-oil, depending on the size of the hog, should be administered early in the disease.

Diarrhœa or scours in pigs.

It is not uncommon for young pigs to have congestion and inflammation of the stomach and intestine. This disease is characterized by a diarrhœa.

The causes of diarrhœa may be grouped under the following heads: diseased condition of the mother; wrong methods of caring for the mother and her litter; and specific infection.

At the time of farrowing, the sow is sometimes very sick, and the act of farrowing may be prolonged. Unless the necessary precautions are observed by the attendant, the pigs may develop a severe diarrhœa because of the abnormal composition of the mother's milk. The sow should not be given feed until she is in condition to digest it. It is advisable to physic her in order to rid the intestine of the toxic substances that may be absorbed and later eliminated in the milk.

Changes in the ration, excitement, and disease alter the composition of the mother's milk, and such milk may prove irritating to the digestive organs of the pig. Dark filthy quarters, and cold damp beds lower the pig's vitality. Such conditions may act as predisposing factors or as direct causes of the disease. In years when the spring season is cold and wet, the latter causes are responsible for the heavy death rate occurring in pigs that are not well housed and cared for.

Diarrhœa caused by irritating germs is a highly infectious disease. These germs gain entrance to the body of the pig by way of the digestive tract and navel cord. Infectious diarrhœa is very fatal.

Preventive measures are the most satisfactory so far known for diarrhœa in pigs. This prevention consists in avoiding conditions that may directly or indirectly cause the disease; in allowing the sow plenty of exercise; and in feeding her the right kind of ration before farrowing, in order that she may give birth to strong healthy pigs.

Pigs from a few days to a few weeks old may be treated indirectly by dieting and giving the mother a physic. It is advisable to feed the mother a very light ration, especially if she is a heavy milker. From 2 to 4 ounces of linseed-oil should be given in a drench or with the feed. Older pigs may receive treatment direct. The dose of linseed-oil depends on the age and size of the pigs and will vary from one teaspoonful to one tablespoonful. The following mixture may be given: bicarbonate of soda 4 drams, bismuth subnitrate 2 drams, and salol 1 dram. This mixture may be given in gelatin capsules, from four to fifteen grain doses twice daily being administered.

DISEASES OF THE RESPIRATORY ORGANS

Diseases of the air passages and lungs are common in hogs. This group of diseases may be classified as specific when due to an infection such as the *Bacillus suisepticus* and filterable virus, and non-specific when due to such causes as chilling, irritation from inhaling dust, and unventilated quarters.

The most prominent symptom in sore throat and bronchitis is coughing. Paroxysms of coughing may occur when the hog gets up from its bed and moves about. Young hogs may not thrive, but the appetite usually remains good. If the hog has pneumonia or pleurisy, it is usually seen lying in its bed. The animal gives evidence of loss of appetite, displays abnormal rapid breathing, and shows elevation of body temperature during the first stage of the disease.

It is unnecessary to use drugs for the treatment of non-specific respiratory diseases. All that is necessary is special attention to the quarters and diet. A well-balanced ration should be fed to hogs in order to keep them thriving. They should not be allowed to lie in dusty places, straw stacks, manure heaps, or damp quarters. Shady places where hogs are sure to lie during the hot weather usually become very dusty. It is best to wet down the dust in such places and afterwards sprinkle them over with crude oil. Danger from unventilated damp sleeping quarters and drafts can be avoided by proper construction of hog-houses; careful attention should be given here.

Good nursing is the most important treatment for hogs having pneumonia. A clean comfortable bed and well-ventilated quarters should be provided. From ½ to 2 ounces of linseed-oil may be given and the dose repeated after an interval of two or three days.

The only satisfactory treatment for specific pneumonia or pleuro-pneumonia is prevention. This is based on sanitation, as a successful vaccine is not available. Hog cholera caused by the filterable virus with its complication pneumonia can be successfully treated with anti-hog-cholera serum.

DISEASES OF THE NERVOUS SYSTEM

Partial or complete paralysis of the posterior portion of the body.

This is a common disease of young hogs. It may be due to the following causes: injuries such as strains and blows to the region of the back; pressure on the spinal cord resulting from enlargements of the disks between the vertebræ; constipation; extreme heat from the sun's rays; and close hot quarters. Young fat animals may suffer from malnutrition of the bones because of a faulty ration and complete fractures of bones occur. A condition resembling paralysis of the hind parts results when the thigh bones are fractured. Rheumatic inflammation of the back muscles is followed by partial loss of control over the movement of the hind parts. As the shoulder muscles are usually affected as well, the hog may walk on its knees. This symptom enables the attendant to differentiate between the two diseases.

The prognosis is unfavorable. Unless the hog shows evidence of recovery in the first two or three weeks, it is not advisable to continue treatment.

The following preventive measures should be practiced. A predisposition toward rickets and fractures of the bones may be avoided by feeding a well-balanced ration and allowing young hogs exercise in a pasture or lot. Hogs should not be allowed to sleep or feed in quarters where they pile up and crowd one another.

The treatment consists in giving the hog a comfortable well-bedded pen. It should not be forced to move about. A light diet and clean drinking water should be fed. Any tendency toward becoming constipated may be overcome

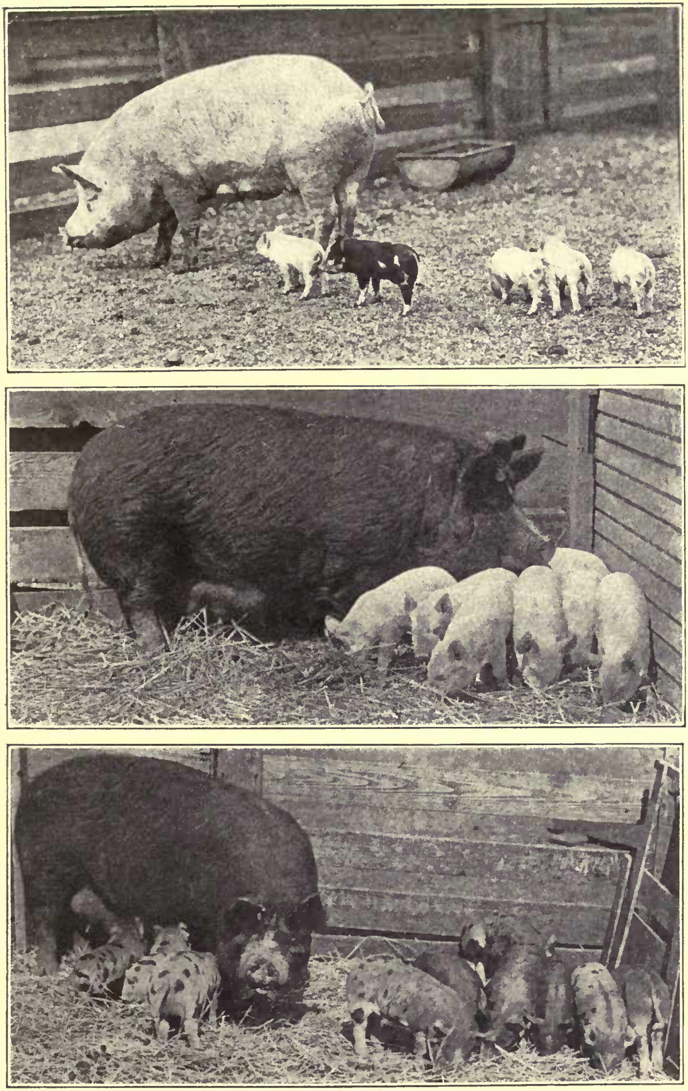


Plate XII. — *Above,* Litter of pigs containing a reversion in color, the product of mating Berkshire-Yorkshire parents; *middle,* Poland-China sow with litter of pigs by a Yorkshire boar; *below,* Berkshire sow with litter of pigs by a Duroc-Jersey boar.

by giving the hog a physic in small doses with its feed daily or at two- or three-day intervals.

Spasm of the diaphragm or thumps.

This disease is characterized by a jerky contraction of the flank muscles. It may be differentiated from palpitation, a functional disorder of the heart, by determining the relation of the heart beats to the abrupt contractions of the flank muscles. It is very common in young pigs, and rarely occurs in mature hogs.

The spasmodic contractions of the diaphragm are caused by irritation of the diaphragmatic nerves. This condition is due to gastric irritation resulting from insufficient exercise and a liberal ration.

Prevention, which consists in avoiding conditions that may cause the disease, is more important than the curative treatment. As soon as symptoms of "thumps" are shown, the ration should be cut and the animal forced to take exercise. Young pigs may be exercised in a well-bedded pen, or placed in a pen adjoining the mother's for a few hours daily. The mother should be given from 2 to 6 ounces of linseed-oil, depending on her age and weight. Young hogs may receive from ½ to 2 ounces of linseed-oil.

CASTRATION

Castration of the male hog is usually performed by the owner or attendant. It is not the common practice to call a veterinarian and the operation may be performed in a very careless indifferent manner. Unless the operator is experienced or willing to practice correct methods, it is more profitable to turn it over to an experienced careful person.

Pigs may be castrated when a few weeks or a few months of age. It is not best to operate at weaning time, as both castration and weaning together may temporarily check the hog's growth. The season of the year makes very little difference, providing the necessary care is given the hogs before and after the operation.

Preparation for castration consists in withholding feed for ten or twelve hours and confining the hogs in a clean well-bedded pen or lot. If this is practiced, they are in a better condition for the operation and cleaner to handle than when filled with feed and covered with mud and filth.

The instruments necessary are a heavy scalpel and probe-pointed bistoury. Some operators use scissors for cutting of the cord and its covering. It is advisable to sever the testicular cords of a hog more than six months old with an emasculator in order to avoid hemorrhage. Scrotal hernia in hogs is common, and it is best for the operator to provide himself with a straight surgeon's needle and heavy linen or silk thread for ligating the cord and covering. A pan or pail of a water solution of liquor cresolis compound or an equally good disinfectant with pieces of oakum or absorbent cotton for washing and cleaning the scrotum are necessary.

If a number of hogs are to be castrated, they should be confined in a small pen, as this enables the attendant to handle them without unduly exciting or exercising them. They should be placed on a table or the floor of an adjoining pen and held firmly by the attendant. It may be necessary to tie the legs of a mature hog with a quarter-inch rope in order to confine him for the operation. The skin over the scrotum is first cleaned by washing with a disinfecting solution. An incision parallel with and a little to one side of the middle line or raphe is made through the scrotal wall and covering of the testicle. The testicle and cord are then pulled well out, the cord broken off with a quick jerk and twist, scraped off with a knife, or cut off with the emasculator in order to avoid hemorrhage. The opposite testicle is then removed, and the incisions lengthened by cutting the scrotal wall to the bottom of the sack, using a probe-pointed bistoury.

If the cord is severed high up so that the cut end does not hang into the scrotal sack, and complete drainage for the wound secretions and pus provided, there is little danger of fibrous tumors forming as a complication. If such tumors form they should be removed.

Scrotal hernia is frequently met with. It may be overcome by practicing the covered operation. The hog is prepared for this by withholding feed for twenty-four hours. The animal is held or hung up by the hind legs. The hernia is reduced by manipulating the mass of intestines, so that they drop back into the abdominal cavity. The scrotal sack is cleaned the same as for castration, and an incision made through the scrotal wall, but not through the thin covering of the testicle. The testicle with the cord and covering is drawn well out, a needle carrying a strong silk or linen thread passed through the cord at as low a point as possible, the cord and covering ligated, and cut off about one-half inch above the ligature. The incision in the scrotal sack is then made large enough to insure drainage.

PARASITES OF HOGS

Parasites that infest hogs may be classified as external and internal. External parasites are the hog-louse, *Hœmatopinus suis,* which infests the surface of the skin, and a small mite that burrows under the epidermis. The former is the most common louse, and the latter is the least common of the sarcoptic mites occurring in domestic animals. The mite is of little economic importance.

The favorite points of attack of the hog-louse are the under surface of the body, neck and inside of the thighs. The irritation to the skin is severe. Young hogs that are badly infested may be so restless and lose so much blood that they become unthrifty.

It is very difficult completely to rid a drove of hogs of lice. The most satisfactory method is to practice dipping at frequent intervals. The most effective agent for destroying hog-lice is crude oil. The layer of oil on top of the water in the dipping tank should not be less than one inch thick. Crude oil may be applied to the bodies of the hogs with a sprinkling pot or swab. If this method is practiced, it is advisable to crowd the hogs into a small pen. This may be done in cold weather when it is impossible to dip them.

The most common internal parasites of hogs are the round worms. They infest the lungs, intestines, and abdominal cavity. The *Ascaris suis* which inhabits the small intestine and liver is the most common intestinal worm. It varies from 4 to 10 inches in length. Other intestinal worms are the whip worm, *Trichocephalus crenatus* and the pin worm, *Œsophagostoma dentatum.* The former is about 2 inches long and inhabits the first division of the large intestine, and the latter is about .5 inch long and inhabits the posterior portion of the large intestine. The thorn-headed worm, *Echinorhynchus gigas,* is a common intestinal parasite in some sections of the country. It is usually found with its proboscis or thorn imbedded in the wall of the small intestine. It is from 3 to 10 inches long.

The treatment of intestinal worms is both preventive and medicinal. Hogs become badly infested with these parasites by taking the eggs and embryos into the digestive tract along with the feed and water. If confined in yards and pastures that have become filthy through continuous use, serious infestation of the intestines occurs. The preventive treatment consists in not keeping hogs in the same place throughout the year. Yards and pastures should be so arranged that the hogs can be changed about, and each lot rested for a few months during the year. The feeding and drinking places should be kept clean. The thorn-headed worm has an intermediate host, the larvæ of the May beetle, and pastures may remain infested with the immature form of this parasite for a long period.

A combination of santonin and calomel is the most satisfactory medicinal remedy for intestinal worms. The dose for young hogs weighing from forty to eighty pounds is 2 grains of santonin and 2 grains of calomel given in a capsule. Hogs should be prepared for the treatment by withholding all feed for at least twelve hours. By dividing the drove into lots of ten to fifteen hogs, santonin and calomel may be given in the feed. Santonin 3 to 5 grains and calomel 5 to 8 grains is the amount given for each 100 pounds body weight. If the hogs are small and it requires two or three to weigh 100 pounds, they should receive the large dose; if they weigh about 100 pounds, they should be given the small dose. The drugs should be mixed and divided into the same number of powders as there are lots of hogs. Ground feed is placed in the trough and dampened with water and the powder sprinkled evenly over it. The hogs are then allowed to eat the feed.

The lung worm, *Strongylus paradoxus,* is a common parasite of young hogs. It is a small hair-like worm varying in length from .6 to 1.6 inches, and usually is found in the small bronchial tubes mixed with mucus.

The first symptom occurring in verminous bronchitis is coughing on leaving the bed, or after exercising. In badly infested hogs, paroxysms of coughing occur and considerable mucus may be forced out. The appetite of the pig remains good, and hogs that are well cared for do not become unthrifty.

The preventive treatment is the same as recommended for intestinal worms. Hogs that receive special care such as all the feed that they can eat and well-ventilated sleeping quarters and a clean dry bed, do not become stunted or unthrifty when infested with lung worms. There is no effective line of medicinal treatment for this disease.

The kidney worm, *Sclerostoma pinguicola,* is commonly found in the fat which surrounds the kidney. It is from 1 to 1.5 inches long and appears dark or mottled when seen against the white fatty tissue. This parasite may irritate the parts that it infests, but does not seem to produce visible symptoms of disease. Although paralysis of the hind parts is attributed to the kidney worm by many stock-men, there is no evidence that would indicate this.

Because of the location of this parasite, no medicinal application will destroy it. The preventive treatment is the same as recommended for controlling the spread of other round worms.

INFECTIOUS DISEASES

Hog cholera is the commonest infectious disease occurring in farm animals. Tuberculosis is less prevalent among hogs than cattle. In dairy sections of the country, where hogs are exposed to this disease by feeding after tubercular cattle or drinking milk from tubercular herds, a very large percentage become infected.

Some of the more common infectious diseases, such as infectious pneumonia, necroenteritis, and hemorrhagic septicemia, are not very well understood. The latter group of diseases may cause serious loss in feeding hogs if the herd is not well cared for and the yards and houses are insanitary. The rather common practice of disposing of the apparently well hogs in a herd affected with infectious pneumonia or necroenteritis by marketing them, has resulted in stock cars and public stock-yards becoming permanently infected with the germs of these diseases. This condition is responsible for the prevalence of these so-called "mixed infections" in sections of the country where hogs are shipped from public stock-yards to the country for feeding purposes.

Hog cholera. (Fig. 20.)

The specific cause of hog cholera is an ultra-microscopic organism that is present in the body excretions and tissues of cholera hogs. This virus cannot be cultivated in the laboratory or seen with the microscope, and the name ultra-microscopic virus is used in speaking of it. The presence of this virus in filtrates of cholera blood, that are free from any visible organism, can be proved by inoculating susceptible hogs. Typical hog cholera is produced, and hogs that are exposed to the sick animals promptly develop this disease. Bacteria may invade the tissues of the sick hog. These are usually termed secondary-invading bacteria, and they seem to have an important part in producing hemorrhages in the tissues and intestinal ulcers. *Bacillius suipestifer* and *B. suisepticus* are the most common bacteria found in the tissues of cholera hogs.

Hog cholera is spread by the susceptible animal coming in direct or indirect contact with the cholera hog. The

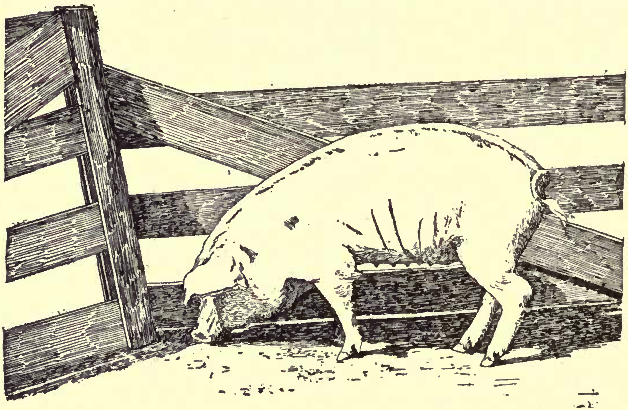


FIG. 20. — A hog having acute cholera.

methods of indirect contact are as follows: dogs and birds feeding on the carcasses of cholera hogs and carrying parts of carcasses into neighboring yards; feeding garbage containing scraps of pork; small streams receiving filth or sewage from neighboring hog-yards; transporting hogs in uncleaned stock-cars, and from public stockyards to the country; improper methods of vaccination; and carrying filth on wheels of wagons and shoes of persons from infected to non-infected yards.

The early symptoms occurring in hog cholera are elevation of body temperature, depression, weakness, and staggering. Depression and weakness are especially noticeable when the hog is forced to get up from its bed. Vomiting, diarrhœa, or rapid labored breathing may occur.

The early symptoms in hog cholera closely resemble those occurring in other infectious diseases. Other means of diagnosis must be employed. The history of the outbreak and character of the lesions found on post mortem examination are more important than the symptoms. A fatally sick hog should be killed for post mortem examination, as the lesions of disease are not changed by decomposition of the tissues as is the case if the hog has been dead for a short time.

It is very necessary to make an early diagnosis of any disease. If recognized early, curative treatment can be employed at a time when it will do the most good, and in the case of hog cholera, its spread to neighboring herds can be prevented. Stock-men are beginning to recognize the importance of handling hog cholera the same as other infectious diseases, and employing experienced veterinarians to diagnose it and recommend measures of control.

The most important measures for the control of hog cholera are the quarantining of farms where outbreaks of the disease occur; the reporting of all cholera herds to the proper health officers; the slaughter of fatally sick hogs and those having the chronic form of the disease; the vaccination of the other hogs in the herd; the cremation of the carcasses of all cholera hogs; and the cleaning and disinfecting of the yards.

Stock-cars should be disinfected immediately after unloading, and public stock-yards quarantined. Car shipments of feeding and stock hogs should be unloaded in yards set off for this purpose. These yards should be cleaned and disinfected after each shipment. All shipped-in hogs should be vaccinated by the double method, and quarantined for at least three weeks.

If the houses and yards can be cleaned and disinfected and their location does not endanger other herds, the sick animals should not be moved to new quarters. If the houses are old and poorly constructed and the yards covered with such litter as corn-cobs, manure piles, and old straw stacks, it is advisable to provide more comfortable and sanitary quarters. When the weather is warm, a low shed large enough to accommodate all of the hogs and an open field are best. This furnishes protection from the sun and a clean range. Clean, roomy, dry, and well-ventilated sleeping quarters, free from drafts, and well-drained yards are best when the weather is cool and wet.

A very light ration should be given. It is not advisable to feed kitchen slops, skim-milk, or buttermilk. Intestinal antiseptics should be used. Sulfocarbolate tablets, or copper sulfate may be given with the drinking water or slop. If copper sulfate is used as an intestinal antiseptic, 4 ounces may be dissolved in 1 gallon of drinking water, and 1 quart of this stock solution should be added to each 10 gallons of water or slop. The troughs should be disinfected and turned bottom up after watering or feeding the animals. This method of feeding should be practiced as soon as symptoms of cholera develop, and continued for at least one week after recovery.

The first step in disinfecting hog-houses and yards is thoroughly to clean the walls, floors, and yards. Dust and dirt should be brushed or scraped from the walls and floors. If the floor is earth, the surface should be removed to a depth of several inches and covered with quicklime. The yards should be cleaned; piles of old lumber and rails hauled away; portable hog-houses moved about, so as to permit cleaning under them; straw stacks, straw sheds, and manure piles hauled to a field and plowed under if possible; and muddy places drained, filled, or fenced off. If there are any places into which hogs crawl or sleep under buildings, they should be cleaned if possible, or closed up. The yard or yards should be covered with quicklime, and a disinfecting solution applied to the walls and floors of the hog-houses. The most reliable disinfectant is 3 per cent water solution of liquor cresolis compound with sufficient hydrated lime added to make a very thin whitewash. This should be applied to the cleaned surface with a spray pump. The feeding floors, troughs, and self-feeders should receive frequent disinfecting.

The double method of vaccinating hogs for permanent immunity is practiced in sections of the country where the disease is common. This method of vaccination consists in injecting a certain quantity of anti-hog-cholera serum and hog cholera blood at different points beneath the skin or subcutaneously. Serum only or the single method of vaccination or treatment may be used for producing a temporary immunity, or treating cholera hogs.

Tuberculosis.

Tuberculosis is one of the oldest animal diseases on record. It is only within the last few years that stockmen have realized the extent to which tuberculosis has spread among swine. The direct or specific cause is Koch's *Bacillus tuberculosis*. This bacillus has greater vitality than the hog cholera virus, and it is able to resist high temperatures, changes in temperature, drying, and putrefaction to a greater degree than most non-spore-producing germs.

Animals that have generalized tuberculosis may disseminate the germs of the disease in the secretions from the air passages and udder and in the feces. If the diseased tissue opens directly into any part of the air passages, the discharges may be coughed up or swallowed and eliminated in the feces. Open intestinal tuberculosis infects the feces. Milk becomes infected with the tubercle bacillus through contamination with filth, and the discharge from broken-down tubercular tissue in the udder.

The tubercular cow, steer, and sow are responsible for the prevalence of this disease among hogs. Allowing hogs to run after cattle is sure to result in infection of a large percentage of them if there are any open cases of tuberculosis in the herd.

A tubercular brood sow is sure to communicate the disease to her litter. If the surroundings are insanitary, a common condition of hog-yards and houses, the disease spreads and develops very rapidly.

Tuberculosis cannot be recognized in the early stage of the disease by the symptoms alone. Later, when the disease becomes generalized, characteristic symptoms may develop. The only reliable method of diagnosis is the tuberculin test.

There is no curative treatment for swine tuberculosis. The disease may be stamped out in the herd by practicing the following methods: The hogs should be tuberculin-tested by an experienced person, all reactors killed, the non-reactors marketed, and the quarters cleaned and disinfected. The hog-houses and yards should not be used for at least six months after they have been given a thorough cleaning and disinfecting.

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