PIG-PRODUCTION METHODS IN DENMARK, SWEDEN, HOLLAND AND IRELAND

By Brendan J Senior

Animal Nutrition Department, University College, Dublin

(*Read before the Society on 31st May,* 1949)

In the Scandinavian countries for many years past, and in Holland more recently, elaborately organised systems of pig-testing have been developed The object is to provide the farmer with the type of pig best suited to meet the exacting demands of the British bacon trade It is considered that it may be of interest at the present time of increasing pig population in Ireland to review production methods in all four countries, and to attempt to assess their value The figures and information given in this paper have been obtained from official reports and other publications, and from the directors and staffs of various pig-institutes visited by the author in Denmark, Sweden, and Holland last Autumn.

Table I gives relevant information regarding pig population and bacon exports

Table I

Number of Pigs in, and Exports of Bacon from Certain Countries in the Years 1928 *and* 1938

Country	Number of Pigs (000)	Exports of Bacon	
		Cwt (000)	Value £ (000)
Denmark			
1928	3,363	5,358	25,435
1938	2,885	3,426	16,169
Sweden*			
1928	1,369	452	2,149
1938	1,371	266	1,167
Holland			
1928†	2,018	860	3,548
1938	1,538	520	2,472
Ireland			
1928	1,183	574	2,832
1938	959	537	2,257

*Bacon and pig meat

†Number of pigs in 1928 not available Figures shown are for year 1930 Exports of Bacon in year 1928 were 1,098,000 cwt , value £4,333,000

Practically the entire export of bacon from all four countries was to Great Britain

Feeding Practices The large supplies of separated milk available in Denmark are the basis of pig-production A few hours after the whole milk has reached the creamery in the early morning, the

farmer has received back pasteurised separated milk. As a source of protein and other essential food nutrients it is unequalled. Its great value for pig feeding seems to derive from its effect in enabling the more backward pigs of a litter to thrive and progress to an extent they never could on meal mixtures alone. In Holland also, where there is extensive dairy farming, and large numbers of smaller farms, separated milk is widely used in pig-rearing although not quite to the same extent as in Denmark In Ireland, pig-production is practised most extensively in the creamery districts, although not exclusively so In the West and North West when potatoes are plentiful large numbers of pigs are profitably fattened.

In addition to milk and potatoes, the foods in common use for pig-feeding in all four countries are chiefly cereals and their by-products In Scandinavia and Holland, however, home-grown barley and rye have always formed a large proportion of the diet, whereas in Ireland imported maize is generally considered a necessary raw material for the pig industry

Objects in Pig-Production.

The common object of all commercial pig-keepers, feeding for pork or bacon, is to widen to the utmost the margin between costs of production and revenue Usually, the attempt is made simultaneously to reduce costs and to increase revenue, by rearing the greatest number of thrifty pigs per sow per annum, by feeding these in the most economical manner, and by securing that the ultimate carcase will command highest market price. The factors necessary for the achievements of these ends are mainly three, viz, appropriate inherited characteristics in the breeding stock, proper feeding methods, and suitable management Although in any successful pig enterprise it will be found that considerable thought and attention have been given to all three factors, nevertheless, it is the first-mentioned which proves most elusive, and which seems to require for its realisation elaborate pig-testing systems for the identification of suitable breeding stock

Whenever pigs are fed for the production of bacon to be sold in a competitive market, efficiency demands that the breeding stock be selected for their excellence in the following characters.—

1 Prolificacy.
2 Maternal qualities
3 Growth rate
4 Economy of gain (ratio of food consumed to gain in weight).
5 Carcase quality

1. *Prolificacy* This is the easiest of all five characters to establish, provided the standard is not set unreasonably high. Where selection has been practised for some generations in a herd of pigs, a target of 12 bonhams born and 10 weaned in each of two litters per annum is fairly easily attainable Where breeding sows are selected for points of economic importance rather than for excellence in show points a high prolificacy is usually found Mere inspection suffices as a test of prolificacy That the numbers weaned and the weights at weaning are often disappointing is usually due to inferior mothering ability, or faulty feeding or management

It may be well to mention that the ideal in the matter of prolificacy is not the birth of the greatest possible number Since about

24 ova are released at ovulation in the sow, this number could theoretically be fertilised, and develop into live bonhams. At the present stage of mammary development in sows, however, even the most superior could not satisfactorily rear more than about 14 young.

2 *Maternal Qualities.* By good maternal qualities is meant those inherited characteristics of a sow which enable her to rear annually a high number of offspring to good weaning weights A good standard is 10 uniform bonhams averaging 32 lb. each at 8 weeks of age in each of two litters per annum. By far the most important of these maternal qualities is the milking capacity of the dam An occasional sow must be culled on account of viciousness, awkwardness or other manifestations of poorly developed maternal instinct, but such animals are few and their identification calls for no special measures

Milking capacity in individual sows is difficult to measure, and even more difficult to establish as an inherited trait in a herd Nevertheless, owing to the paramount importance of breeding from good-milking sows, the necessary measures, however troublesome and elaborate, must be taken if economical pig-production is to be encouraged The importance to young pigs of a copious maternal milk supply is an outcome of the relatively very high growth-rate of pigs, and of the short life of porkers and baconers A check in the rate of growth or of weight increase at any stage in a pig's life nearly always results in economic loss The profitable bacon pig, allowing for certain modifications to be mentioned later, is the rapidly-growing pig In the great majority of cases the rapidly-growing pig can be identified at 8 weeks, and in many cases at 3 or 4 weeks of age. The milk supply of the dam is not the only determinant of bonham weights at 4 weeks. Growth impulse inherited from sire and dam is an important factor So also is environment and management While a bad litter weight at 4 weeks need not necessarily, therefore, imply poor milk flow in the dam, it may safely be claimed that a good litter weight, say 8 to 10 bonhams averaging 15 lb each, indicates a good maternal milk supply In numerous experiments where the average daily milk yield of commercial sows has been measured it has been shown that it can vary from 3½ lb to 9 lb There is scope for improvement by selection, therefore, as in the case of the dairy cow A typical milk-flow graph for the sow shows a maximum at 3 weeks, with a plateau from 3 to 4 weeks, and thereafter a gradual decline The yield during the first four weeks is usually an index of total yield This is the all-important stage in the life of the suckling pig, as after the age of 4 weeks bonhams are getting supplementary food and are no longer dependent solely on their mother's milk. Outside of research and experimental stations, therefore, the only practical method of identifying good milking cows is to weigh the litter at 3 or 4 weeks of age and to adopt standards of performance

3 *Growth Rate.* In any herd of pigs or in the pig population of a country there is a great variation in the time taken to reach a certain mature weight, even under standardised conditions of feeding and management In general the fast growing pig is the profitable pig to feed, provided that he is of the right type with respect to conformation, carcase-quality, and age at maturity.

Where the daily food allowance to fattening pigs is determined by their appetite, and for a great part of the feeding period they may be so fed, the pig with a good inherited growth stimulus will reach the desired market weight in a fewer number of days than the slower growing animal The maintenance requirement of a pig—that is, the amount of food required to just maintain a pig's weight—varies with age and environment from approximately one-quarter to one-third of the daily food intake Only the remainder of the food is available for growth and fattening, and consequently, other things being equal, every day saved in the fattening period represents an economy of food Every pig-breeder has experience of unthrifty pigs or as they are often called, " bad-doers ", which in spite even of special attention are weeks behind others in reaching market weight It is a common observation also that certain boars or sows will produce litters with marked tendencies to extremes in rates of growth Since feeding, management, and environment have a very profound effect on the rate of growth in pigs, it is a very difficult matter to isolate the effect due to breeding One of the chief objects of the Pig-Testing Stations of Denmark, Sweden, and Holland is to collect information on this point.

4 *Economy of Gain.* The figure expressing the weight of food required for each unit weight of increase in liveweight is referred to as the economy of gain Like the growth rate of a pig it is affected by inherited factors, feeding, management, and environment In comparing economy of gain figures for different groups of pigs, or in different countries some important points have to be considered In Scandinavia it is usual to give the number of fodder units per kilo increase in weight A fodder unit is 1 kilo of barley or the weight of other food which will have the same fattening properties as 1 kilo of barley, for example, 1 kilo of maize, 1 2 kilos of oats, 6 kilos of separated milk In Ireland and in other countries the economy of gain is usually expressed as the number of pounds of food per lb increase in liveweight As pigs are fed largely on maize, barley, and oats, the differences in the figures for economy of gain expressed either way, although of significance, will not be very great Economy of gain figures are more favourable for young pigs than for older, due chiefly to the higher proportions of water in the carcase of a young growing pig, that is, it takes less food to produce a pound increase in weight in a young pig than in an older A further precaution to be observed in interpreting or comparing economy of gain figures concerns the effect of environment and housing conditions Pigs confined to yards will require somewhat less food for maintenance than those taking exercise in fields, and more food will be required for maintenance in winter time in a cold house, than in one suitably warmed.

5 *Carcase-quality* The object in every organised pig industry is to produce a side of bacon which will fetch the highest market price and provide the maximum amounts of valuable cuts Consequently, breeding and feeding is directed towards securing good hams, light shoulders, long sides, thin backs, fat belly-cuts, etc. Excellence in these characteristics is not always represented, however, by extreme measurements For example, a certain minimum

amount of back fat is desirable The breeding problem is further complicated by the consideration that in striving for these objectives other characteristics of the pig must not be sacrificed. If light shoulder is attained at the cost of greatly decreased chest girth a pig of weak constitution will result Similar objections apply to the over-long pig and it is significant that in some countries it is considered that for a bacon pig of 200 lb liveweight the optimum length is about 95 cm —measured between the pubic and atlas bones—and no effort is now being made to increase length beyond this measurement.

All systems of pig-testing and recording are directed towards securing information on the five characteristics mentioned—the object being to identify boars and sows which excel in these qualities A consideration, however, which makes for great difficulty, is that breeding stock endowed with these characteristics do not necessarily transmit them to their offspring Hence the modern insistence on evaluating breeding stock by progeny tests rather than by an examination of pedigree or ancestors' performance Judging dams and sires by the behaviour of their offspring is more feasible in pigs, due to their high rate of reproduction, than in some other farm animals A boar or sow need be no more than 18 to 20 months old before the results of a complete test, including carcase quality, are available on the first litter of the sow and on the first dozen or so litters of the boar Even such a limited progeny test may be of great use Methods of litter-testing and recording and of evaluating and scoring pigs for desirable characteristics are similar in principle in most countries The Danish methods being the longest established and most elaborate, will be described in more detail and points of difference in the systems of other countries noted later

Pig-Testing Methods

DENMARK

In 1895 when Germany prohibited the import of live pigs from Denmark, the Danes turned their attention to the British market, to which they had been already sending small quantities of bacon They soon observed that the British shop-keeper wanted, above all, uniformity in bacon sides, with a lean back, thick streak, good ham, and light shoulder, and a great length of side yielding well in expensive cuts Every endeavour was made to select and breed from prolific stock of good mothering ability likely to produce such bacon. It was soon found that the native Landrace breed, while of vigorous constitution, prolific, and of high milking capacity, produced bacon which was much too fat, and did not give a sufficient length of side

Since British breeders had evolved a type of Large White (or Yorkshire) suited for the Wiltshire bacon trade, with lean back and light shoulder, and of considerable length, many of these boars and sows were imported into Denmark While much pure Large-White breeding was carried on, many of the boars were crossed with native Landrace sows It was found that these first-cross progeny made good bacon As knowledge of the principles of animal genetics became more widespread, breeders succeeded in combining the good carcase quality of the Large White with the excellent milking and maternal characteristics of the native Landrace, and finally what was in effect a new breed was evolved—often

referred to as the Improved Landrace As a result of constant testing and selection this breed was further improved and is now used almost exclusively in Denmark for bacon production

There are three organised groups concerned with Pig-Testing in Denmark—breeding centres registered by the State, pig-testing stations under State supervision, and bacon factories In conjunction with these will be considered the system of Herd Book registration

Danish Breeding Centres. To be regarded as a breeder in this scheme a farmer must have at least one boar and three sows of recognised breed, i e , Landrace or Large White He must submit to regular inspection of premises and stock by members of the local control committee This committee is composed of representatives of farmers' organisations and of bacon factories Prescribed hygienic and sanitary measures must be adopted Pigs must be T B tested and reactors excluded from the breeding herd All animals are marked and records are kept of matings, births, deaths, and sales. An average of four pigs (litter mates) from every two farrowings per annum must be sent to the pig-testing stations The figures from this progeny test for growth rate, economy of gain, and carcase quality are entered on the record cards of dam and sire For the guidance of the inspectors of these breeding centres a system of scoring has been drawn up, as follows —

	Maximum Points
Management	48
Conformation results . .	40
Fecundity	24
Economy of food utilisation . .	16
Carcase-quality . .	32
	160

In 1946-47 the highest score obtained was 127 and the least 76 To retain registration as a breeding centre at each annual inspection a score of at least 80 points must be obtained. In judging for management points, attention is given to such items as accuracy of records, order and cleanliness and general care taken of farm In assessing the marks for fecundity, half of the marks obtainable are allotted for numbers born alive and half for numbers surviving at 6 weeks of age The maximum number of marks for numbers at birth may be gained by a litter of fourteen The judges are empowered to ignore results of litters considered by them to be grossly abnormal The following is the scale of points for litters of varying size

At birth		At weaning	
No in litter	Points	No in litter	Points
14 or over	12	12	12
13	11	11	11
12	10	10	10
11	9	9	9
10	8	8	8
9	7	7	7
8	6	6	6

The scoring for economy of gain figures as determined on the four pigs sent to the testing-station is as follows.—

Fodder Units* per Kilo liveweight increase	Points
Less than 3 11	16
From 3 11 to 3.20	14
„ 3.21 to 3 30	12
„ 3 31 to 3 40	10
„ 3 41 to 3.50	8
„ 3 51 to 3 60	6
„ 3 61 to 3 70	4
„ 3 71 to 3 80	2
Over 3 80	0

*A fodder unit is the weight of food equivalent in feeding value to one kilo of barley

For comparison, it may be mentioned that 3 8 Fodder Units would be approximately equivalent to 4 Kilos of a suitable meal mixture for pig-feeding comprising maize, oats, wheat offal, etc In other words, to gain any marks for economy of gain, less than 4 0 lb. of such a mixture must give 1 lb liveweight increase during the fattening period

Rules are also given for the guidance of the committee officials charged with the inspection of pigs submitted by the breeding centre owner for registration as stock animals Conformation must be satisfactory It is judged by the appearance of the animal, and by examination of the carcase quality score obtained by tests on other offspring of the dam and grand-dam Records of ancestry must be available for three generations Sows must have a minimum of 12 normal teats, and in the case of a gilt the prolificacy records of a dam and grand-dam must be available These must show that a satisfactory standard was reached in at least two litters from the dam or in all normal litters of the grand-dams A satisfactory standard, for this purpose, is defined as an average of 10 born and 8 weaned Finally, economy of gain figures for the progeny of the immediate ancestors of sows for registration must not have been below the average for all pigs tested at the same time at the testing station The local committees have certain discretionary powers in the application of these rules

In addition to these State-recognised breeding centres there are local breeding centres organised on similar lines by co-operative societies and farmers' organisations Regulations covering inspection of these are somewhat less onerous, as are also the standards of performance imposed.

Table II gives the number of State-recognised breeding centres in the years stated and the total number of boars and sows registered at these centres

TABLE II

Year	LANDRACE BREED		LARGE WHITE BREED	
	No of Centres	No of Registered Stock Pigs	No of Centres	No of Registered Stock Pigs
1924	69	419	33	322
1937	238	1,959	15	136
1947	253	1,896	4	31

The average number of pigs born and weaned at the breeding centres during the year 1946-47 were as follows:—

	Landrace Breed	Large White Breed
No of litters	2,735	47
Average born per litter	11 5	11 7
Average weaned per litter	9 0	9 1

In comparing the number of litters with the number of stock pigs in Table II it is to be remembered that the latter include a large number of young sows not yet farrowed.

Danish Pig-Testing Stations.—The purpose of these stations is to feed, under carefully controlled conditions, the groups of four pigs received from the State recognised breeding centres, to measure their food consumption and increase in weight, and in conjunction with the bacon factories to judge the quality of the carcase. The breeder selects the four pigs to be sent He is expected to choose if possible two of each sex as nearly representative of the litter as possible with regard to weight and development They must be between the ages of 6 and 9 weeks, may not weigh on the average more than 44 lb and no single pig may weigh less than 28½ lb They must have been weaned some days before dispatch, and accustomed to the eating of solid food

At the station they are fed a standard ration The formula is the same for all 5 stations but each station procures the constituent items of food locally, and grinds and mixes them Pre-war, the ration was 50% barley, 25% wheat, 25% maize, together with separated milk in amounts varying from one-third gallon to two-thirds of a gallon daily, cod-liver oil and minerals In 1945/46 barley alone was used instead of the cereal mixture, the amount fed rising to 6 lb daily for a 200-lb pig The pigs are placed on test when they reach a weight of 44 lb The amount of food given depends on the group weight which is determined fortnightly The scale of feeding is a liberal one, although for the purpose of improving carcase-quality the daily amounts are restricted somewhat as slaughter weight (approximately 200 lb) is approached

The number of pigs tested at the 5 Testing Stations in the years stated were as follows —

Year	Landrace Breed	Large White Breed
1926/27	2,160	420
1936/37	3 160	300
1942/43	2,236	60
1945/46	2,548	20

At the bacon factory further measurements and observations are made on each carcase as indicated below Many of these judgments are necessarily of a subjective nature and great care is taken to ensure that uniform standards are maintained

The figures which follow, taken from the Annual Report, are the average results obtained on the 2,548 pigs of the Landrace breed tested in 1945/46 They are given in some detail as an illustration of the nature and extent of the testing performed at these stations and at the bacon factories

Total number of hogs tested ..	1,241
,, ,, ,, sow pigs ,, ..	1,307
Died or rejected (%)	3 4
Age at beginning of test (days)	74
Weight ,, ,, ,, (lb)	44
Age at the end of test (days)	185
Weight ,, ,, ,, ,, (lb)	200
Average daily increase (lb)	1 41
Economy of Gain (Fodder units per Kilo increase)	3 29
Loss on slaughter (%)	26 9
Loss on trimming (%)	12 6
Bacon yield (%)	60 5
Thickness of back fat (cm)	3 36
,, ,, belly fat (cm)	3 28
Length of side* (cm)	93 8
Suitability for bacon (maximum points=15)	12 6
Grade I pigs (%)	90
,, II pigs (%)	9
,, III pigs (%)	1

* Pubic to Atlas bone

In addition to the points given for general suitability for bacon, points are awarded for seven other carcase quality judgments as follows —firmness of flesh, shoulder, evenness of back fat, quality of streak, shape and texture of hams, fineness of head, bone, and skin; quality of lean meat

All measurements and marks awarded are published in quarterly and annual reports, and also sent to breeders, and entered in the Herd Books It is left to interested parties to form their own individual judgments as to the suitability of tested boars and sows for their special breeding requirements Thus, for example it is claimed that a breeder producing pigs with a tendency to over fatness in the back

will seek a boar whose tested progeny consistently give thin back fat

The Danish Herd Book System There are really two Herd Books or Registers in Denmark, viz the register of selected boars and sows kept at each State-recognised breeding-centre and the National Herd Book The particulars, already mentioned, which must be entered in the local Herd Book are printed at regular intervals for the convenience of purchasers The National Herd Book is in essence an Advanced Register A special Herd Book Committee investigates the eligibility of animals for entry

The chief requirements which must be satisfied before an entry is accepted in the National Herd Book are as follows .—

(1) Information must be available for three generations as to descent It is not necessary that the parents should have been in the Herd Book

(2) The animal must either have secured registration at a State-recognised breeding centre, or, being over 1 year old, have been a prize winner at a Show [Testing-station results on parents are taken into consideration in awarding prizes at Shows]

(3) The T B test must have been passed

(4) A Boar must have sired at least 3 litters He must have had either prize-winning progeny, or tested progeny awarded marks above the testing-station average

(5) For acceptance of a sow there must be tested or prize-winning issue over 10 months of age Records of every litter farrowed must be submitted The average number of bonhams in her litters must be at least 10 born or 8 5 weaned

Herd Book entries are comprehensive and give for each animal, names of owner and breeder, description of external characteristics of the animal, lists of prizes won, results of tests on progeny, and sometimes a photograph In later issues a short list of outstanding progeny is added to the original entry

Due to the requirements regarding progeny tests, comparatively few living boars and sows are registered in the National Herd Book The number is only a small fraction of the total number of stock animals passed for breeding purposes at the State-recognised breeding centres In the current Herd Book of 1947 (34th) 67 boars and 203 sows were entered These figures represent 16 2% and 13 5% respectively of the numbers of boars and sows registered at the breeding centres during the 12 months ending 1st September, 1948

SWEDEN

Organised pig-recording and testing are of more recent origin in Sweden than in Denmark The pig population is less dense, distances are much greater, and until recent years there was no considerable export trade in bacon

In 1923, State-sponsored schemes for the improvement of pig-breeding methods were first introduced A testing station on the Danish

model was opened at Astorp for the measurement of growth rate and economy of gain The establishment of Breeding Centres and co-operative boar societies was encouraged, by State supervision and financial aid By the year 1930, there were 30 licensed breeding centres for the Large White breed and 13 for the native Lantras breed About an equal number of privately-controlled centres also exist Co-operative boar societies now number 1,000, with 20,000 members owning 1,200 boars and 40,000 sows Under certain conditions the State makes a grant of up to one-sixth the value of a boar and aids also in the provision of prize money at Shows To obtain recognition there must be a minimum of 8 members owning between them 20 sows in such a society

A distinctive feature of Swedish pig-recording is the system of weighing suckling pigs at the age of 3 weeks This method of evaluating the milking capacity of the dam was introduced in 1923 Each year about 12,000 pigs among 250 herds are so weighed All marking and weighing of pigs is performed by State supervisors An allowance of weight is made if the weighing is not done precisely on the 21st day A breeder participating in this scheme must have all his pigs recorded Inspection of the published figures shows that even amongst sows having a normal number of piglings at birth the variation in the average weight per pig at 3 weeks of age ranges from 9 lb to 17 lb Since, as explained earlier, this is largely a measure of the milking capacity of the sow, and moreover the only practical way of measuring this important characteristic, it will be appreciated what adequate scope for selection among sows is provided by this information on litter weights at 3 weeks of age Moreover, Swedish investigators who have correlated these figures with subsequent progress claim that pigs of good weights at 3 weeks, also make the best use later of food consumed, and produce a higher quality carcase The average results obtained in 1927 for these 3-week weighings were as follows —

Number of litters recorded	1,472
Average number of bonhams born per litter	10 0
Average number alive at 3 weeks	8 1
Average weight of bonhams at 3 weeks (lb)	11 0

The organisation of Swedish testing-stations is very similar to that of the Danish There are now four stations—two under State control and two privately operated Between them almost 2,000 pigs can be tested annually for growth rate and economy of gain In Sweden the four pigs to be sent to the station are chosen by the official inspectors of breeding centres, and not by the litter owner The aim in selection is to obtain two pigs of each sex as near as possible to the average litter weight The sex ratio is sacrificed if more uniform pigs can be obtained by so doing Pigs must have reached a weight of 31 lb before dispatch The foods, at present in use, are maize, barley, soya bean, coconut, dried yeast, with separated milk and the usual mineral and vitamin supplements

Since 1943, due to bacon shortages pigs were slaughtered at live weights of approximately 211 lb instead of 190 lb as previously This inevitably resulted in greater measurements for length and thickness of back and belly fat In any comparison of such measurements therefore with other years or with pigs in other countries, allowance must be made for this alteration in weight and age. It has also the effect of increasing somewhat the daily increase in weight since heavier pigs can put on a greater daily increment than lighter pigs.

The economy of gain figure will also be slightly higher, that is adversely affected, by comparison with a pig killed at a lighter weight.

A summary of the 1946 results for certain characteristics of each of the two breeds at the four testing stations follows Slaughter weight was approximately 216 lb

	Lantras Breed	Large White Breed
No of groups tested	159	132
,, pigs ,,	587	488
Age at 44 lb weight (days)	68	75
Daily gain in Weight (lb)	1 47	1 43
Loss in weight at slaughter (%)	24 7	23 6
Thickness of back fat	3 71	3 73
,, belly fat	3 67	3 62
Grade I pigs (%)	89 9	85 2
,, II ,, (%)	2 9	10 5
,, III ,, (%)	6 0	3 5
,, IV ,, (%)	1 2	8

In addition to the measurements given, marks are allotted as in Denmark for quality of hams, and of flesh, etc In Sweden an attempt has been made to express the results of all measurements and scoring in a single figure The difficulties to be overcome in designing a method for working out this index are immense, and many modifications of the first method suggested have been made In general, the various measurements or marks are divided into two classes The quantitative class includes the score for economy of gain, loss on slaughter, etc , and in the qualitative class are the points awarded for carcase quality A formula has been evolved whereby the final " net utilization value " takes into account the degree of excellence or otherwise of each pig in respect of all characteristics The method now in use aims at reflecting as closely as possible the commercial value of the pig Attempts have been made to overcome an earlier difficulty whereby a pig so inferior in certain points as to be of little value, could nevertheless score a reasonable " net utilization value " through gaining excellent marks for other characteristics In 1946 these final index figures (maximum 100) as a station average ranged from 83 0 to 92·2 for the Lantras breed, and from 82 5 to 88 2 for the Yorkshire breed

Herd Book The first volume of the Swedish Pig Herd Book was issued in 1914 Regulations required inspection of every animal before the entry could be accepted, but up to 1928 only the exterior characteristics which could be visually assessed were considered In recent years standards of excellence have been adopted Boars can now be registered only if their dams have been graded as above average at a testing-station and in addition produced litters of certain minimum weights—calculated either as an average of the first two litters or of three consecutive litters The latter standard is one of 3 litters within 16 months averaging 77 lbs per litter at 3 weeks of age Both parents must be registered in the Herd Book The boar for entry must be not less than 9 months of age and external characteristics must be satisfactory

Sows submitted for entry to Herd Book must also be inspected Adult sows must have qualified in the manner outlined for a boar's

dam. Gilts must not be less than 12 months of age and must have been bred from a dam of similar standard Sows and gilts are required to have 12 well-placed active teats Up to the year 1931, a total of 6,500 boars and 5,000 sows of the Large White breed had been registered and 700 boars and 1,500 sows of the Lantras breed In the year 1936, the total number of Large White pigs entered in the Herd Book was 939, and of the Lantras breed 538.

Licensing of boars was introduced in 1930, and since then it is forbidden to use an unlicensed boar outside the herd of the owner

HOLLAND

Table 1 shows that Holland supports a large pig population, and has become an important exporter of bacon to Great Britain In normal times there is a considerable export trade in pork to adjoining countries The pig industry is based chiefly on the small farms, as an adjunct to dairying The relatively small size of the country, and the excellent transport system enable inspection and farm recording work to be performed with less trouble and expense than in many other countries

Pig-breeding along modern lines is of more recent growth in Holland than in the Scandinavian countries The organisers therefore had the advantage of being able to study results of methods already in operation over long periods It is a tribute to Scandinavian methods that they have been followed in so many respects in Holland

Control of pig-breeding in Holland is through registration of breeders in the Herd Book Each of the eleven provinces has a separate Herd Book for each of the two main breeds The Landvarken or Dutch Landrace used for bacon-production, and the Large White used for pork The Central Bureau for pig-breeding in Utrecht coordinates all selection and testing work and keeps a central register of breeders and their animals Despite the large numbers of centres involved, the indexing system enables rapid access to be made to any particulars required A remarkable feature is the ease with which the progeny as well as the ancestors of outstanding boars and sows may be traced Only boars which are registered in the Herd Book may be used for breeding purposes Large numbers are consequently admitted to the Herd Book each year but nevertheless certain standards of performance are required A farmer wishing to produce pigs for breeding purposes must notify all services to the registrar of the Herd Book, and likewise within 48 hours, all farrowings An inspector visits the farm before weaning date, compares dates of mating and of farrowing and examines the bonhams If he is satisfied as to their breeding and considers them vigorous, well developed, and thrifty they are tattooed in the left ear and their numbers recorded for identification purposes, should the owner later decide to submit them for admission to the Herd Book

Boars and sows, submitted for entry to the Herd Book, must be inspected at an age of not less than 8 months The qualities required are suitability for bacon in the case of the Landrace and for pork in the case of the Large White in so far as these qualities can be estimated by visual inspection Sows must have 12 teats If accepted for the Herd Book, pigs are tattoed in right ear In 1946 there were 42,000 registered breeders of pigs Since registration in the Herd Book is the method adopted of licensing boars, the numbers so registered are very

large, and a very exacting standard cannot be enforced Grading-up of the pig population, however, is constantly proceeding through a system designed to identify the best boars and sows of all those registered in the Herd Book. These are called " Elite " boars and " Star " sows and selection is based not only on appearance, fecundity, etc , but on the results of progeny tests at the State testing stations. A boar is classed as " Elite " if 75 per cent. of his tested litters (numbering at least 4) qualify at the testing stations. A " Star " sow is the dam of a qualifying litter at a testing station. In scoring for " Elite " boars and " Star " sows the emphasis is on carcase quality points, but a very bad figure for growth rate or economy of gain would cause rejection The great majority of boars in use by farmers in 1947 were descended from " Star " sows.

The first testing stations were established in 1930 To-day there are nine, capable of testing 2,000 pigs annually Management and direction is more or less on Scandinavian lines Four pigs are sent for testing. They are selected by a Herd Book inspector, who attempts to choose 2 hogs and 2 sows as nearly representative of litter size as possible Their aggregate weight must not exceed 176 lb

The foods in use at the stations are —maize meal, barley meal, wheat by-products, soya bean meal, and for older pigs coconut meal. Minerals and vitamins are also added, and in addition each animal gets 2 litres of separated milk daily The fat pigs are slaughtered at a weight of 200 lb for bacon and 275 lb for pork Carcase measuring and judging of bacon and pork quality are performed in nearby factories In Holland extraordinary care is taken to remove grounds for criticism arising out of the subjective nature of assays for such characteristics as softness or hardness of flesh, general type, colour of flesh, etc One side of the carcase is judged in the local bacon factory by Herd Book officials who had been observing the same pigs during their trials at the Testing Station This helps the officials to gain an experienced eye in appraising the suitability for bacon or pork of live pigs. The other half of each carcase, from each local factory, is sent to a central bacon factory and cold stored Once weekly a senior and experienced Herd Book officer again judges all carcases in the presence of local factory officials In this way a remarkable degree of uniform scoring by the judges is secured

A summary follows of the 1947 average results for the Landrace breed (bacon) and for the Large White (pork)

	Landrace	Large White
No of hogs tested	776	170
,, sow pigs tested	814	178
Age at beginning of test (days)	72	72
Weight ,, ,, (lb)	49	51
Age at end of test (days)	175	222
Weight at end of test (lb)	183	277
Average daily increase (lb)	1 47	1 50
Economy of gain (fodder units per Kilo increase)	3 29	3 68
Loss on slaughter (%)	24 2	22 6
Length of side (cm)*	81 5	85 0
Grade I pigs (%)	96 6	—
,, II ,, (%)	3 4	—
,, III ,, (%)	0 0	—

*Pubic bone to anterior edge of first rib.

Included also in the Annual Reports are the scores for quality and texture of carcase and hams

IRELAND

In Ireland, control and direction of pig-breeding is based on the Livestock Breeding Act, 1925 Improvement of carcase quality is encouraged by grading at the bacon factories and payment on quality Regulations made in accordance with the provisions of the 1925 Act require that all boars to be used for breeding must be submitted for inspection before they reach the age of 6 months Unless licensed as a result of this inspection they may not be used for breeding even in the owner's own herd. Assessment of the suitability of these boars is based on visual appraisement of external characteristics such as length of side, shape of hams, shoulder, etc. It is generally considered that variance from conventionally accepted breed standards for the Large White will tend to disqualify a boar submitted for inspection There are 17 such breed points mentioned in the Irish Large White Herd Book They refer mostly to number of teats, shape of head, set of ears and tail, proportion and shape of shoulders, back, belly, sides, etc., and colour and texture of skin and hair The Department of Agriculture constantly exhort breeders to select for length and depth of sides and fine shoulders By propaganda and subsidy they have for many years encouraged the use of pedigree boars (that is, boars entered in the Herd Book) which have been inspected and licensed by officials of the Department The declared policy is the establishment of one uniform type of pig, "long, lean, thrifty, and quick-maturing, which produces not only first grade bacon but is also suitable for production of lean pork of excellent quality "[1] In 1937-38, 938 boars were inspected, out of which number 21 were rejected

Up to about a decade ago a second breed of pigs, known as the Large White Ulster, existed in the northern portions of Ireland It has been described as "a white, thin-skinned pig with lop ears resembling closely the Landrace of Denmark and Sweden[2]" While suitable for the roll and ham trade of those parts, and for killing on the farm as was the practice, this breed was unsuitable for the Wiltshire trade. Sides were too short, and there was considerable excess of fat The thin skin damaged too easily where pigs had to be transported alive to bacon factories The Large Ulster breed on the other hand was noted for the docility and good milking capacity and generally excellent mothering ability of the sows

The Irish Herd Book is administered by the Royal Dublin Society. It was kept as a register from 1900 to 1923 In 1924 the first volume of the Herd Book was published There are no qualifications governing entry of animals beyond that of descent from registered parents Rule 1 of the Herd Book says "Any animal is eligible for entry which is the produce of a Sire and Dam, both of which are duly entered in the Herd Book of Irish Large White Pigs, and of all other animals of the Large White Breed of Pigs whose pedigrees satisfy the requirements of the Herd Book Committee" Regulations are in force for the earmarking of pigs by breeders for purposes of identification

In 1948 there were 1,057 entries of boars and sows in the R D S Herd Book When the pig population was high the annual number of entries was about double this number In 1934, for example, 1,357 boars and 908 sows were entered

Following the report of the Pig Industry Tribunal of 1933 and the

setting-up of the Bacon Marketing Board, classification and grading of bacon was introduced in Irish bacon factories, and payments made to producers according to the carcase quality Class depended on dead weight, and grade on measurements of thickness of back fat In February, 1938, the following were the requirements for the various grades (inches converted to cms) —

Grade	Min Back	Max Back	Max Shoulder	Max Loin
Bonus Grade	1 91	3 02	4 45	3 02
Grade A	1 91	3 02	5 08	3 02
,, B	1 91	3 02	5 72	3 02

There are no published statistics of the numbers of pigs falling into the various classes and grades, but it has been stated that in 1937 nearly all pigs delivered to curers were graded and that 46 per cent were in Class I, Grade A [3] In 1939 the proportion of bonus grade pigs was reported to be as high as 10 per cent of the killings at certain factories [4]

Since there are no testing stations in Ireland it is not possible to give figures for growth rate or economy of gain fully representative of the Irish Large White breed of pigs Occasionally, however, the published results of feeding experiments give indications of these trends

Table III gives figures obtained in feeding trials conducted during recent years in the Animal Nutrition Department of University College, Dublin, [5, 6, 7] They are selected from those experimental groups where good food mixtures were fed and where the pigs were housed and managed in a manner corresponding to good farm practice In comparing results from different experiments it is to be noted that within the weight range quoted, the daily weight increment of a pig will increase somewhat with age, and that the economy of gain will be less favourable for older pigs

TABLE III

Growth Rate and Economy of Gain Figures for certain Irish Large White Pigs

Feeding Trial	No of Pigs in Group	Initial Weight (lb)	Final Weight (lb)	Daily Increase	Economy of Gain*
(*a*)	12	35	193	1 30	2 77
(*b*)	14	45	200	1 27	2·92
(*c*)	12	35	220	1 26	3 09
(*d*)	30	40	202	1 38	4 50
(*e*)	6	33	213	1 50	2 88

* Pounds of food per lb live-weight increase If expressed as fodder units per kilo live-weight increase, the figures would be less by approximately 5%

The figures reflect a considerable variation in performance by these groups of fattening pigs. The results may be more instructive if presented in the way in which they would affect the practical pig-keeper. If it is assumed that under present conditions the fattening period commences at a weight of 2 stones and ends at a live weight of 16 stones, the pigs of group (*d*) would each consume during the fattening period about 7¾ cwt. of meal mixture and those of group (*a*) about 5 cwt. Moreover the difference in rate of daily increase in live-weight between group (*e*) and group (*c*) would represent a saving of about 3 weeks in the fatening period It is to be emphasised that due to the small numbers of pigs involved, it would be unwise to consider these results applicable to the Irish pig population in general. It would obviously be an advantage, however, to be able to identify and breed from thrifty pigs, such as some of those whose performance records are given above

Discussion of Methods.

From the description given of the pig recording and testing systems of Denmark, Sweden and Holland, it will be evident that the single aim in view is the propagation of utility strains of pigs capable of converting food into bacon (or pork) of the highest quality with the greatest economy. Suitability for this purpose is the criterion of value at all exhibitions and competitions Herd Books do not merely register ancestry, but in varying degrees, insist on compliance with certain utility standards before entry of pigs can be accepted Two questions of practical interest arise from a study of these testing systems. Firstly, to what extent have the stated objects been achieved? Secondly, are all of the methods adopted essential to the achievement of the object?

Results Obtained with the Scandinavian System of Pig-Testing.

For a proper evaluation of the Scandinavian system it would be necessary to have available the results of tests on the general pig population of a country, and not merely results on selected pigs sent to stations These latter are bred from sires and dams already selected for apparent excellence in desirable characteristics, such as growth rate, economy of gain, carcase quality Moreover, the number of tested pigs is only a small fraction of the total population. Neither is it possible to compare the performance and quality of pigs in countries having elaborate testing systems with those in countries without such systems, because it is only in the former that comprehensive records are kept. Without these records comparisons are unreliable. Observation alone, however, in Scandinavia and in Holland shows that great success has been achieved in exporting bacon of remarkable uniformity to the British market at competitive prices and of a grade eminently suited to the requirements of the British consumer.

A further evaluation of the methods in use may be made by examining the progress made over a period of years. Thus a comparison of carcase measurements shows in many cases considerable improvement as seen in Table IV.

TABLE IV.

Changes in Carcase Measurements over Certain Periods

Country	Year	Length of Side*	Thickness of Back Fat
		cm	cm
Denmark	1923	89	4 20
,,	1935	92	3·50
,,	1945	94	3·36
Holland	1930	75 6	—
,,	1941	80 4	—
,,	1947	81 5	—

* Danish and Dutch measurements are taken between different points of the carcase and the figures are not comparable A 95 cm Danish measurement corresponds approximately to 80 cm Dutch

In 1936. Jay L. Lush[8] made a comprehensive analysis of the results achieved by the Danish system of pig-testing. He found that thickness of fat and body length were hereditary to a greater degree than the other characteristics measured. This, no doubt, explains why the optimum length and back fat thickness have been reached in practically all of the pigs tested at these stations in Denmark, Sweden and Holland. Many breeders in those countries now believe that striving after further length may impair vigour and constitution

Good Rearing Results. The number and weight of bonhams reared per sow annually is an important test of economical and efficient production. Comparisons over extended periods are not possible, but the figures given earlier represent very high average performances. Moreover, mere inspection of pig herds in Denmark, Sweden and Holland shows a very remarkable udder development in sows, and a striking uniformity of size within litters Selected Irish Large White sows can be found to give excellent bonham weights at 3 weeks, but it is to be emphasised that the average figure of 11 lb. each for an average of 8 bonhams per litter quoted for Swedish Large White Sows is an average for nearly 1,500 sows of commercial stock. There seems no escape from the conclusion that to identify and breed from the best utility strains of sows within a breed, it is essential to ascertain the numbers and the weight-for-age relationship of the offspring at some stage not later than weaning and preferably at the age of 3 or 4 weeks This involves also the acceptance of standards of performance which must be passed before sows are admitted to Herd Books or registration

Growth Rate and Economy of Gain Changes in growth rate and economy of gain over a period of years are given in Table V.

TABLE V

Changes in Growth Rate and Economy of Gain over Certain Periods

Country	Year	Growth Rate (Daily increase in lb.)	Economy of Gain (Fodder units per kilo increase)
Denmark	1923	1 26	3 65
,,	1935	1 40	3 35
,,	1945	1 41	3 29
Holland	1934	1 30	3 40
,,	1941	1 43	3 24
,,	1947	1 47	3 29

It will be seen that although the figures represent good standards of performance, they have not greatly improved over a period of years. This is all the more remarkable when it is remembered that during the past twenty years considerable advances have been made in the science of pig nutrition. The stated additions of minerals and of vitamins A and D to the testing station diets should, by themselves, have caused an improvement in growth rate and economy of food utilisation even without inherited excellence in these characteristics.

It is true, however, that average figures such as those of Table V unaccompanied by indications of the range and the deviations from the mean, may conceal a considerable measure of improved performance. The pigs, for example, may be tending to much greater uniformity even though the average performance is unchanged. A further consideration is that the search for pigs yielding thin back bacon will probably have the effect of slowing down the average rate of growth. In the report already referred to, Lush, discussing the improvements in growth rate and economy of gain between the years 1923 and 1935 says: "much of the general improvement is due to genetic changes in the swine population brought about by selecting breeding stock from descendants of these animals which had made the best showing in rate and economy of gain." Nevertheless, he shows that growth rate and economy of gain are less highly hereditary than thickness of fat and body length.

It may be concluded, therefore, that in Denmark, Sweden and Holland the scope for further improvement in growth rate or economy of gain in the particular herds under test is very limited. It may be that the feeding methods adopted, limited as they necessarily are by considerations of cost and convenience, are not sufficiently sensitive to identify the outstanding sires and dams, although undoubtedly enabling the inferior to be excluded. The use of only four pigs from a litter reduces the significance of the results, and so also does the fact that although the pigs of a group of four are weighed individually, they are fed collectively. In this connection it is of interest to note that improved testing stations in course of erection in Denmark make provision for the individual feeding of the test pigs.

Are Scandinavian Pig-Testing Methods Essential?

It is a common observation among feeders that the rate of progress made by a pig remains remarkably consistent throughout his life. Under ordinary conditions of feeding and environment, if he starts

well as a suckling bonham, he usually continues to do well and vice-versa Sufficient experimental data is not available to test this common belief, as weighings for growth rate determinations usually are made only between the ages of 9 or 10 weeks and 6 months It is significant, however, that in Sweden where each year thousands of pigs are weighed at 3 weeks, many of which subsequently go to testing stations, the belief is held that the pigs of highest weight at 3 weeks are later found to be the fastest growers It has been claimed earlier in this paper that to identify the most productive sows it is necessary to weigh the litters at 3 or 4 weeks of age Should it be found that the weight at this age is also indicative of the growth rate to be expected later, it would be an overwhelming argument in favour of the introduction of this practice on the widest possible scale, for the reason that since this weighing could be done on the farm, a far higher proportion of the sows and boars of a country could be thus tested than could ever be done through testing stations

Direct determinations of economy of gain figures for the offspring of sows and boars can be made only by methods such as those practised in the testing stations If, however, the rapidly growing pig is also the pig which makes best use of its food, it may be possible to avoid the expense of undertaking economy of gain tests for purposes of identifying the thrifty and profitable pig Fortunately, in this case, data are available for investigation In the reports of the testing station are published the figures for the average daily gain and the average economy of gain for each group of 4 pigs

Table VI gives the results of a computation of the correlation coefficients for these two sets of measurements for various Danish and Dutch stations The figures for growth rate and for economy of gain are means of determinations on groups of 4 pigs, each group being the progeny of one sow

TABLE VI

Correlation Coefficients between Growth Rate and Economy of Gain

Testing Station	Breed	No of Test Groups	Growth Rate		Economy of Gain		Correlation Coefficient	Standard Error of Correlation Coefficient
			Daily Increase lb	Range	Fodder Units per Kilo increase	Range		
DENMARK 1945/46								
Skaeruplund	Landrace	182	1 43	1 23–1 57	3 23	2 96–3 58	— 63	045
Overlojstrup	,,	162	1 46	1 28–1 64	3 20	2 83–3 72	— 89	016
Elsemnde	,,	119	1 36	1 12–1 55	3 46	3 16–3 85	— 62	056
Bregentved	,,	94	1 37	1 26–1 53	3 28	2 91–3 66	— 69	054
Hong	,,	80	1 39	1 13–1 60	3 33	2 94–3 91	— 86	030
HOLLAND 1938								
Aver Heino	Dutch Landrace	101	1 32	1 03–1 63	3 25	2 77–3 70	— 71	050
Gelderland	,,	149	1 36	1 06–1 58	3 27	2 95–3 76	— 63	050
Hoorn	Large White	55	1 45	1 19–1 72	3 70	3 34–4 71	— 63	080
Utrecht	,,	48	1 30	1 06–1 47	3 89	3 47–4 60	— 72	068

The figures show a high inverse correlation between growth rate and economy of gain for both breeds in both Danish and Dutch tests. The high degree of correlation is not surprising. Under the conditions of feeding necessarily adopted at such stations the fastest growing pigs will tend to make the best use of the food supplied. In group feeding trials pigs may be rationed according to age or weight or appetite. The general procedure at testing stations where, ultimately, quality of carcase is also to be judged is to feed on a fairly liberal scale in accordance with weight, subject to maximum daily amounts dictated by considerations of effect of over-feeding on carcase quality. Consequently since time of slaughter is determined by weight, and slow-growing pigs are kept on test until they reach this weight, they consume more food for maintenance than their faster-growing comrades. This tends to mask any superiority they might have in physiological efficiency as converters of meals into bacon. Moreover, it seems impossible to devise a level of feeding which simultaneously can test for maximum possible growth rate, economy of gain and carcase quality. The feeding procedure adopted, is, of course, the only practical way of identifying the commercially desirable pigs.

The computation of Table VI is presented in another way in Table VII. The tested groups have been divided in respect of figures for growth rate and for economy of gain into the best third, the middle third and the worst third. In the final column of Table VII is shown for each station the number of pigs belonging to the worst third in respect of economy of gain, which are found among the best third in respect of growth rate.

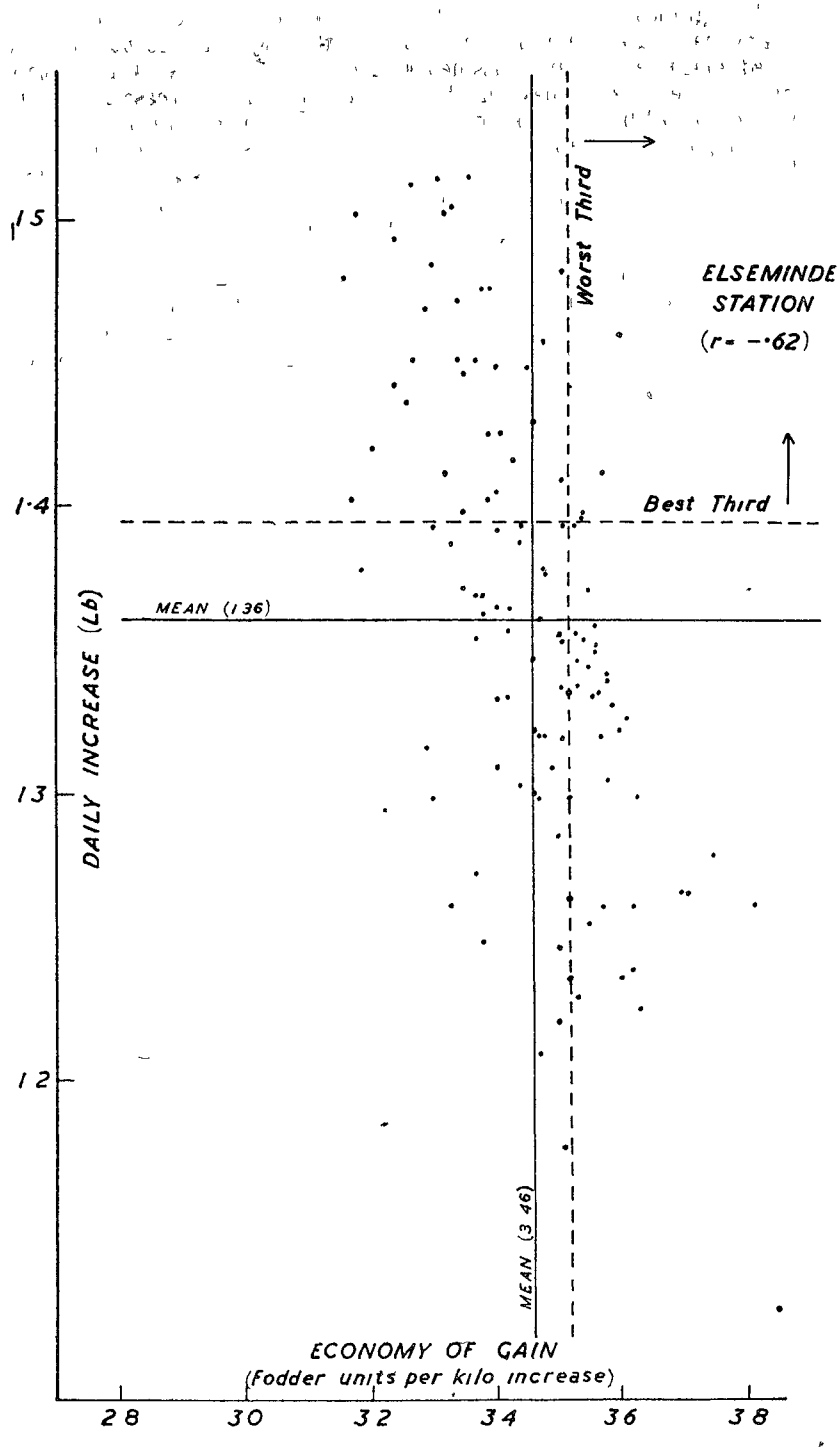
TABLE VII

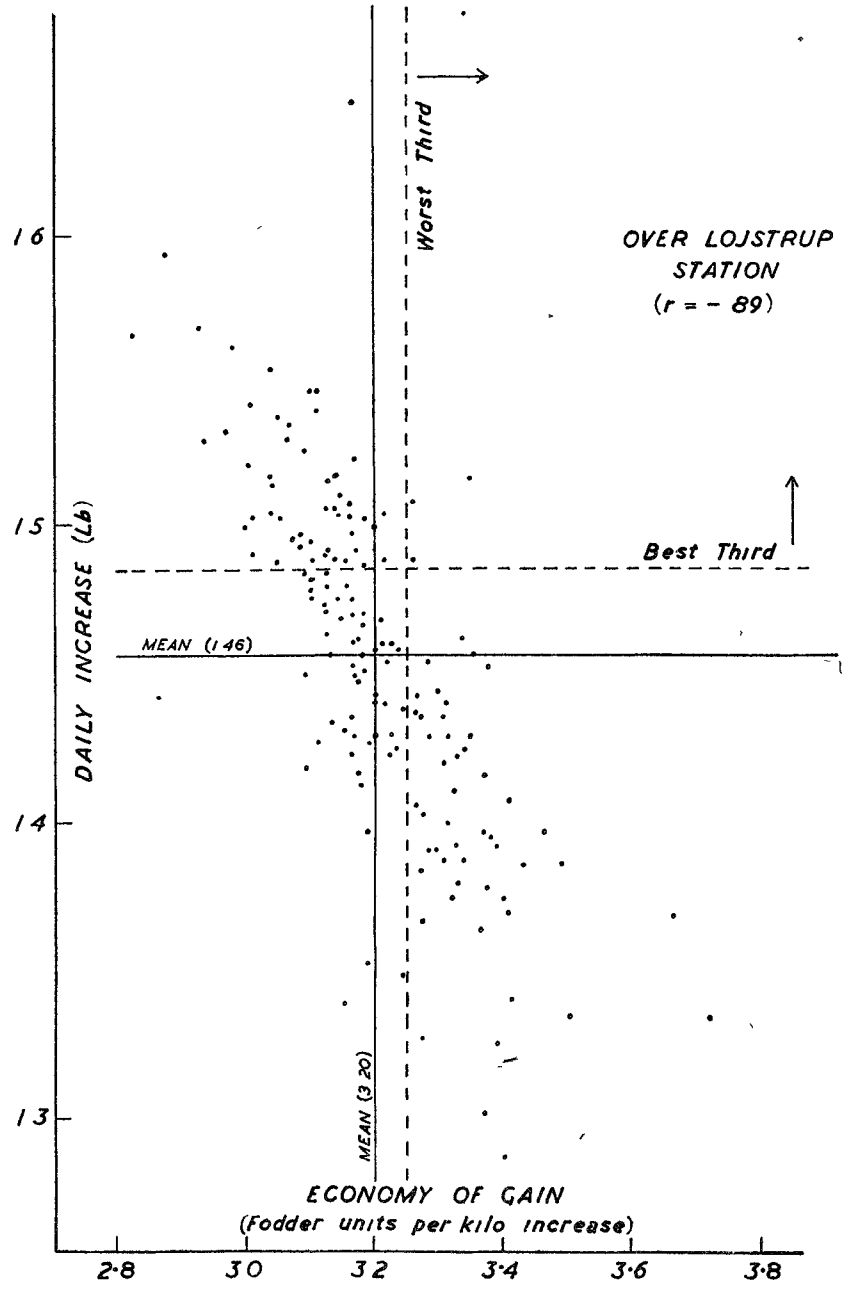
Relationship between Growth Rate and Economy of Gain

Testing Station	Breed	No. of Test Groups	Column A. Growth rate. Figure above which are found the Best Third of the Test Groups (Daily Increase in lb.)	Column B. Economy of gain. Figure above which are found the Worst Third of the Test Groups (Fodder Units per Kilo Increase)	Number of Test Groups common to Columns A and B
DENMARK					
Skaerupland	Landrace	182	1·45	3·28	7
Overlojstrup	,,	162	1·48	3·24	3
Elsemnde	,,	119	1·39	3·51	4
Bregentved	,,	94	1·39	3·33	2
Hong	,,	80	1·43	3·38	3
HOLLAND					
Rijperkerk	Danish Landrace	35	1·27	3·28	3
Aver Heino	Dutch Landrace	101	1·36	3·27	3
Gelderland	,,	149	1·43	3·34	6
Hoorn	Large White	55	1·50	3·75	1
Utrecht	,,	48	1·34	3·99	1
		1,025			33

The significance of this result arises from the consideration that if in any particular year the best third of the pigs with respect to any tested characteristic are classified as good, and the worst third as bad, then by selecting the best third in respect of daily increase in weight we exclude all but 10% of the pigs classified as bad in respect of economy of gain If in any scheme for selection of sows based on testing the growth rate of their litters, it is considered satisfactory to select not more than one-third, and to exclude more than 90% of the worst third in respect of economy of gain, it would appear therefore that the direct determination of economy of gain could be avoided

The information given in Tables VI and VII is presented also for two of the Danish stations, in the form of scatter diagrams These show visually that though the correlations in Table VI between growth rate and economy of gain are fairly high, individual groups can depart substantially from the ideal linear trend (when the correlation coefficient would be equal to -1) For a given growth rate there is a fairly marked variability in economy of gain


1·5
1·4
1·3
1·2
DAILY INCREASE (LB)
Worst Third
ELSEMINDE
STATION
(r = -·62)
Best Third
MEAN (1·36)
MEAN (3·46)
ECONOMY OF GAIN
(Fodder units per kilo increase)
2·8
3·0
3·2
3·4
3·6
3·8


Worst Third
OVER LOJSTRUP
STATION
(r = - 89)
Best Third
MEAN (1 46)
DAILY INCREASE (Lb)
16
15
14
13
MEAN (3 20)
ECONOMY OF GAIN
(Fodder units per kilo increase)
2·8
3 0
3 2
3·4
3·6
3·8

Measuring Rate of Growth.

It now becomes of interest to examine whether there is any satisfactory way of measuring growth rate other than the Scandinavian and Dutch methods of feeding groups of 4 litter mates in large testing-stations Certainly no other workable method could be devised which would give the same accuracy of technique or uniformity of environment and conditions of management In any country, however, only a few of such well-organised but expensive testing stations could be established, and consequently, the number of tested sows and boars would be very few Any method which would enable a greatly increased number of dams and sires to be progeny-tested and would enable also the entire litter to be weighed instead of only four selected pigs, would be worth investigation

In the testing station procedure for determination of the daily live-weight gain, the significant weighings are the first and the last The additional fortnightly weighings are useful as a check on the progress of the animal, and for determining to a certain extent the amount of the daily ration, but they are obviously not used in calculating the average daily increase in weight A weighing of each pig in a litter at weaning on the farm, and again when finished for bacon either on farm or at factory, would equally well give the average daily increase in weight Practical difficulties of accurate weighings, allowances for food recently consumed, etc, would be considerable, but possibly not insurmountable If adopted on a scale embracing a significant fraction of the breeding stock in a country, the advantages thus gained might outweigh the loss of accuracy in individual weighings

One great difficulty however arises in any scheme designed to substitute weighings on the farm instead of at a testing-station, as a method of comparing the growth rates of litters of different sows It is the certainty that levels of feeding and conditions of management would vary enormously on the farms of different breeders No system of inspection could ensure uniformity Since the whole object of any such scheme would be the identification of those sows possessing, among other characteristics, the inherited ability to produce litters of rapidly-growing pigs, a workable solution may be found if it is accepted that however well fed or managed a litter of fattening pigs may be, they cannot as a rule make excellent gains in weight, and at the same time, produce a good bacon carcase unless they have an inherited capacity to rapid growth

Undoubtedly, it is possible through very special feeding to accellerate the growth and fattening rate of a pig beyond what that animal would sustain on a normal diet But if the standard of performance is fixed sufficiently high, those pigs which reach it will be genetically fast-growing pigs, irrespective of what their diet may be As a deterrent to unrestricted use of forcing feeds, carcase quality tests on the pigs after slaughter could be imposed, since over-fed pigs produce bacon which is too fat Moreover, if a minimum litter size were insisted on, it would at once render ineligible for awards the dams of small-sized litters Very often the fast-growing pigs are from litters numbering either by accident or design only 4 or 5 bonhams

The view that it is feasible to identify suitable breeding pigs by test-feeding their progeny on the farm rather than under controlled

conditions in stations, gains support by the analogy with the present Irish system of breeding and judging pedigree beef bulls These animals are fed from birth most expensively Their rations include large quantities of whole milk, cooked meals etc Nevertheless, the system although subject to criticism, does help in general to identify the fast-growing animal with the required inherited capacity to lay on fat

It is felt that in a country such as Ireland, without testing-stations, and where nevertheless, some method is urgently needed of distinguishing those boars and sows likely to produce fast-growing and thrifty offspring, it would be worth while investigating the possibility of a simple system such as that suggested of recording and testing on farms

Securing Good Carcase Quality.

Can the testing-station method be dispensed with as a means of improving carcase quality? It is unlikely that any other system could give the breeder such reliable figures for carcase measurements and quality It is just possible, however, that the undoubted improvement shown over a period of years in Table IV is in part due to the visual appraisement of conformation which is always taken into consideration by breeders in addition to the quantitative figures available in those countries In Holland particularly, since the testing-station system is of more recent growth, many tested sows have been selected in respect of carcase quality largely on external characteristics Thickness of back fat is almost impossible to assess by inspection, but one of the carcase characteristics most easily judged in this way is length of side Table VIII has been prepared, therefore, in which the correlation coefficients between length of side and thickness of back fat for Danish stations in 1945/46 have been computed

TABLE VIII

Correlation Coefficients between Length of Side and Back fat Thickness

Testing Station	No of Test Groups	Length of Side	Thickness of Back fat	Correlation Coefficient	Standard Error of Correlation Coefficient
		cm	cm		
Skaeruplund	182	93 5	3 36	— 27	07
Overlojstrup	162	93 4	3 37	— 27	07
Elseminde	119	94 5	3 43	— 31	08
Bregentved	94	93 6	3 25	— 24	10
Hong	80	94 2	3 41	— 26	10

It will be seen that there is an inverse correlation of fair significance Whether there is a physiological or anatomical relationship, or whether the magnitude of both measurements is determined largely by some other factor, such as level of feeding, is for practical pur-

poses quite irrelevant Experience in Ireland would suggest also that in practice, selection for length to a considerable extent selects also for thin back fat It has been seen that 46 per cent of pigs graded in 1937 qualified for grade A So far as is known, breeders in general gave no consideration to back fat measurements of progeny or of ancestors when selecting for boars and sows However, when licensing boars under the Livestock Breeding Act, inspectors pay great attention to length and so do all breeders when selecting sows for breeding In the absence of published figures for Irish carcase measurements and quality it is impossible to arrive at a definite conclusion, but the evidence suggests that selection for carcase points, such as length of side and shape of ham, by inspection alone can effect a great measure of improvement If, in addition to inspection, even a single measurement of back fat thickness were made at the factory, and if breeders took cognisance of factory grading when selecting breeding stock, there can be little doubt that Irish Large White pigs could approach the standard of carcase quality attained elsewhere

The final consideration is whether a test for carcase quality could be fitted into a scheme such as that suggested for testing prolificacy, mothering ability, growth rate and economy of gain by observation and measurements made on the farm It is submitted that this is also possible provided that steps are taken to ensure that where the desirable thin back fat is obtained it is the result of inherited tendency and not of special feeding and management Thus, lean back can be produced in some pigs by restricted feeding Such a level of feeding, however, would produce an objectionable soft fat and would also reduce greatly the rate of live-weight increase By careful choice of standards for back-fat quality and for average daily gain, therefore, it is claimed that pigs with an inherited disposition to lean back could be identified even though fed in a relatively uncontrolled manner on the farm

Summary and Conclusions.

1 Danish, Swedish and Dutch methods of pig breeding and testing have been described The common aim is to identify and breed from utility strains of pigs best suited to provide the type of bacon required by the British market

2 The outstanding feature of the methods employed is the insistence at every stage on utility standards of performance to be reached by breeding stock before they can be registered or accepted in Herd Books as being of superior type

3 Although these methods have been very successful, the suggestion is made that an alternative scheme of testing on farms might be tried in Ireland It is claimed it would be simpler and cheaper and would enable a significant proportion of the boar and sow population to be tested

The scheme would require the co-operation of farmers, farmers' organisations, bacon factories, and the Herd Book Society The supervisors would need to collect data as follows —Frequency of farrowing, number and individual weights of bonhams at 3 weeks and at 8 weeks of age, age and weights at slaughter, and thickness of back

fat Selection of breeding stock for length and conformation would need to be continued An advanced register in the Herd Book would be required for boars and sows of outstanding merit

4 At least one large testing station of Scandinavian model but adapted for individual feeding of the entire test litter would be needed for certain purposes chiefly experimental These would include the checking on a random sample basis of results obtained by the suggested scheme of farm recording, the ascertaining of optimum environmental conditions of ventilation, temperature and humidity for large-scale piggeries, the more accurate progeny testing of outstanding boars, the test-mating of superior breeding stock for the purpose of eliminating congenital defects

References

(1) Lucey, *Pig Breeders' Annual* 1931–32
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(4) *Pig Breeders' Annual*, 1939–40
(5) Sheehy, *Jn Dept Agr*, XXXVI, No 2
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DISCUSSION.

PROFESSOR SHEEHY, proposing the vote of thanks, said Dr Senior's paper comes at an opportune time This country is about to re-enter a highly competitive market for bacon, and the impression which we shall be able to make on that market will depend on the degree of increased economy which can be introduced into the pig industry We shall have to produce pigs at least as economically as our competitors

In order to identify the best stock for breeding the Scandinavian countries have recorded pigs, the methods employed being characterised by "the insistence at every stage on utility standards of performance to be reached by breeding stock before they can be registered or accepted in herd books as being of superior type" Consequent on these measures there has been established an extraordinary degree of uniformity among the pigs, and uniformity at a high level of production Other than the empirical selection by individual farmers, we have nothing in this country comparable with Scandinavian pig recording Our pigs show conspicuous lack of uniformity and while we have some good strains, perhaps some very good strains, we have too many bad pigs, especially pigs which cost too much food in the production of the hundredweight of bacon

From the slight amount of information at one's disposal, one estimates that from weaning to slaughter the pigs of this country consume, on an average, about 4 hundredweights of food (calculated as meal) to produce a hundredweight of live body weight We have some pigs which do this for 3 hundredweights of food The possible saving on a million 2 hundredweight pigs, by raising the economy of all pigs to

the level of the best is 2 million hundredweights of food If even half of this could be achieved for all the pigs in the country, it would add enormously to the profits from pig production

Scandinavian methods are laborious and expensive, and if Dr Senior's simplified methods of recording would get us the information required to grade up our pigs, then he has made a substantial contribution to the pig industry I have great pleasure in proposing to him a hearty vote of thanks for his paper

MR HUSSEY also welcomed Dr Senior's admirable paper There was a tendency for the Social inquiry side of the Society's activities to concentrate somewhat on subjects of urban interest and it was refreshing to have a paper which smacked so strongly of the countryside It was a most timely as well as informative paper As he read the figures in Table I, imports of bacon before the war were roughly 20 lb per head of population in Great Britain and, with rapidly increasing imports to-day and considerable expansion in Britain's home pig production, an approach to that figure could be expected in the near future It was safe to say that within a few years the sellers' market in bacon would have been replaced by a competitive one, and now was the time for Irish producers to decide what steps should be taken to ensure our holding our place He was in agreement with the method so ably suggested by Dr Senior in his paper, of improving the bacon-productivity of our pigs, if the Exchequer found itself unable to finance the more elaborate pig-testing stations used in other countries It was wrong to suggest that these stations were costly to run—it seemed to be overlooked that in the Danish stations, at least, pigs on test became the property of the station and their sale when fat went a good way to offset the cost of the stations In fact, he understood that the cost of running the five major Danish stations was only in the neighbourhood of £10,000 per annum—surely a very small premium for the remarkable return Denmark got for her pig products

He was not too happy about the correlation coefficients of Table VIII and would be hesitant to base a pig-breeding policy on them On the other hand, it was probable that with the more indiscriminate breeding which had taken place in Ireland, greater scope existed for improvement in breeding for thin back fat It was possible that the narrower range of figures from largely uniform pigs in Denmark had resulted in smaller correlation figures than might be obtained in Ireland

Finally, he found it rather difficult to reconcile the statement on lines 14-15, p 221, with that on p 223, par 2, and the general policy of progeny testing If breeding stock do not necessarily transmit their characteristics to their offspring, what was the point of progeny testing, apparently expecting a future projection in this regard to be more effective than it had been in the past?

MR R L DEMPSTER said the present ration of bacon and ham in U K is 2 ozs per head Pre-war consumption was estimated at 6 ozs per head Prospects of getting additional supplies of beef and mutton are very poor for many years, and there is a body of opinion which stresses that if supplies were available the U K consumption of bacon, hams and pork might reach 10-12 ozs per week per head

European and British supplies of pigs are increasing rapidly, but, in view of the position regarding beef and mutton, it appears certain

that there will be a very large market for our pig products in U K for a considerable time

In answer to a member he stated that there was an embargo on the export of pigs from Denmark for breeding purposes

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