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# A Plan of Pig Improvement Applicable to N.Z. Conditions

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## Introduction:

I shall endeavour, first, to define pig improvement. Can we agree that it is "the improvement of inherent capacity to produce carcasses of the highest meat value at minimum cost on the typical food supply available to the industry?"

Lest there be those among us who think that our most efficient meat-producing animal can scarcely be capable of further improvement, let me briefly survey the complexity of the problem facing the pig breeder. (I underline breeder because I say, in utter solemnity, that all who profess and call themselves breeders have not yet been led into the way of truth and the problem I am about to unfold does not cause the person I call a "fancier" many sleepless nights).

The breeder, then, must aim for a uniformly high carcass quality type with a high percentage yield as carcass and as bacon. I mention carcass quality first because the markets we are supplying are normally very selective and, for stability in the industry, it is essential that quality should be fully competitive with any other pigmeats on the market. Carcass quality improvement itself is a complex business, however, and, as we shall see, includes somewhat conflicting requirements such as length of side together with maximum thickness of belly.

His pigs must have the capacity for rapid growth and efficient conversion of the food supply into meat. His sows must breed regularly, be fecund and of a kind disposition; they must have sufficient udder design and capacity as to be able to rear bigger and better litters—up to a round dozen "forty pounders" at any stage in their life after allowing for the loss of an odd teat, here and there, during a lifetime of hectic high production. Hectic, because the sow gets no rest!

If we regard each breed as a separate entity, the task of improvement for all these factors at the same time within the one breed, is obviously a formidable one. Uniformity at a high level of efficiency for all these factors which is the goal of the pig breeder must surely be among the most difficult to achieve in the whole gamut of the domestication and improvement of livestock. At any rate it is well known that it is so upsetting to the weaker spirits that after a very short period of contemplating the problems involved they are usually found to be in solemn conclave discoursing upon the niceties of colour pattern, fringe to the ears, or that tassel which adorns the posterior portion of the pig's person!

On the other hand, the prolificacy and early maturity of the pig make it much easier to secure the benefits of progeny testing for this species than for any other of our domestic stock except, perhaps, poultry. It is nearly half a century ago since the Danes developed a practical method of progeny testing (incidentally, arising from the rival claims of breeders of the native Landrace and the imported Large White).

## PRESENT POSITION:

It is a necessary part of my subject to make an appraisal of the present situation regarding the production of pigs in New Zealand. Since the development of the dairy industry pig production has become almost entirely a sideline to dairying. Economically it has not been

possible to develop that sideline in the way it has been done in Denmark, for example, and, even leaving aside for the moment the possibility of other more economic uses of dairy by-products, it does not appear likely that the pig industry will develop on lines that will enable the work to become specialised. It will, by and large, remain a part time occupation. The average size of units is small and on farms where home breeding is practised the average number of sows in the herd is probably not more than five and, with a few exceptions, breeders of pedigree pigs run herds which are not much larger than this. Table I, which shows that the great majority of breeders register less than 10 pigs a year supports this statement.

**TABLE I.—No. of Breeders Registering Pigs, 1950.**

Grouped according to number of pigs registered in year.

Registered	Large		Large		Total
	Berkshire	White	Tamworth	Black	
100 or more	1	0	0	0	1
50—99	3	1	0	0	4
25—49	3	4	1	1	9
10—24	19	24	11	2	56
1—9	77	82	44	22	225
Totals	103	111	56	25	295

The small breeder's reluctance to pay a price for a boar which would give incentive to breeders generally to go to the trouble of progeny-testing their stock and his feeling that, because of the small number of sows kept, he can adequately cull his sow herd on general observation of type and performance, are serious stumbling blocks which would have to be overcome before any real progress could be made under the present organisation of the industry.

Any attempts made at co-operation between individual breeders have not so far been successful—possibly because they have not been accompanied by improved selection techniques, and the lack of a guiding hand but also because of the distance separating breeders and, hence, the transport problem.

It is characteristic of the small breeder that, through his inability to make the progress of which he dreams when, with high hopes, he sets up his stud, he gives up after a few years and either "goes out of pigs" or reverts to the production of commercial pigs which, he finds, are less trouble and practically as profitable. Recently a further blow to possibilities of improvement has been dealt by the closing down of many of the larger buttermilk piggeries due to the change in methods of utilising this by-product.

As a consequence of the fluctuating nature of the feed supply and the strict limits of economic use of supplements, it is necessary to be in a position to produce one litter as baconers and one as porkers from practically every sow. This does not encourage efforts to specialise in the production of a really high quality baconer carcass along the lines of Denmark and Canada, for instance, as the highly specialised baconer type pig would be impossible to finish properly as a light porker. The complications which this introduces into the technique of carcass testing will be obvious.

In a meat-producing animal, such as the pig, it is possible to make progress up to a certain point in carcass improvement by the process of selection of breeding stock on the type of progeny they leave as judged on exterior appearances supplemented by the butcher's or the bacon curers' constructive criticism. This, of course, is the gradual process by which all our improvement to date has been achieved and those who can look back over the pigs raised in New Zealand over

even the last twenty years will be ready to admit that some improvement has been made. I mention this because breeders generally are inclined to follow traditional methods and this conservatism tends to increase the difficulty of establishing any system of improvement based on finer measures and general technique.

When pedigree pigs are separately considered, however, the picture is not one of uniform improvement. The Tamworth breed has, in my opinion, deteriorated over the last 15 to 20 years. The Large Black has not made any improvement and, while the Large White breed has become more popular there is no evidence that the breed, as a whole, has shown any substantial improvement. A small minority of strains in the hands of exceptionally careful and competent breeders may be excepted from this general statement. Over the last five years there is no evidence of improvement in the breed. The Berkshire breed showed improvement, as judged by suitability of carcass to meet modern market demand, over a number of years following importation of Canadian blood. It is common knowledge, however, that Berkshire breeders are, to-day, at a loss to secure further improvement by the rather loose and superficial selection methods practised up to the present.

And—last but not least—under the conditions of world shortage, and reduced N.Z. production, of pigmeats over recent years the trade has considered it inexpedient to maintain strict standards of grading. Virtually all qualities sold at the same price per pound and thus the mainspring of quality improvement has been lacking. While recently premiums have been introduced to encourage finishing at more suitable weights grading is still on a lenient and quite ineffectual basis, as is indicated by the fact that 95% of carcasses are graded "prime," and only 5% suffer any quality penalty.

This appraisal of the situation reveals a somewhat sombre picture, I feel. At any rate it should emphasise that any plan for improvement must be conceived with due regard for all the difficulties involved—and the difficulties of implementation have not been yet touched upon!

The one promising aspect of the situation is that pig breeders are closely in touch with the dairy industry and have, in the Dairy Board's Herd Improvement Plan—particularly the Merit Sire Register—an example which must give them cause to think. Such thoughts must be translated into action and such action must be part of a well-ordinated plan.

## **OUTLINE OF PLAN OF IMPROVEMENT:**

### **A SPECIFIC PURPOSE FOR EACH BREED.**

The difficulty of making progress in any livestock improvement increases greatly in proportion to the number of factors for which selection is being practised (1). What are the possibilities of a system of breeding within each breed for a restricted number of characters and relying on a uniform method of cross-breeding for the production of efficient, and uniform, commercial pigs? The practice of cross-breeding is not new to farmers and whatever plan was decided on this would be preferred to a single breed system by the majority of farmers.

What I have in mind is selection for litter production in the breed or breeds which would be used as "sow breeds" and in these maintaining only the current culling level for carcass quality. On the other hand the breed or breeds which are to be used as sire breeds in the breeding system should be selected through a litter testing technique. This may lead to a certain amount of deterioration of sow qualities in this breed as the Danes have found (2), but provided culling for sow qualities is not entirely overlooked in the breed it need not be serious.

At least it is conceivable that, if the breeds are improved for fulfilling a specific purpose in a standardised breeding plan for commercial production the fullest use of genotypic selection as well as the phenomenon of heterosis could be obtained.

The system which has developed within our fat lamb industry, albeit with no progeny test, gives some indication that something of the same type of system might with advantage be applied to pig production. The distribution of the various breeds of pigs being registered in recent years (see Table II.) indicates that some system of cross-breeding for commercial production would secure the best use of the genetic qualities of the breeding stock available and in fact is the only practicable system for some years to come.

**TABLE II.—No. of Pigs Registered in various breeds in recent years.**

Breed.	1948		1950	
	Sows	Boars	Sows	Boars
Berkshire ....	790	381	542	251
Large White ....	474	282	468	278
Tamworth ....	292	154	266	157
Large Black ....	181	73	82	45
Duroc Jersey ....	4	1	—	—
Total ....	1741	891	1358	731

Whether the eventual aim of the plan would be to fatten all the first-cross pigs—in other words by using two breeds only—or whether first cross sows of two breeds, both bred primarily for sow qualities, should constitute the commercial sow herds—to be mated with a boar of a breed selected primarily for carcass characters—is, I feel, a matter for further research under New Zealand conditions. Some work has been done in America, however, which seems to indicate that a system based on a first cross sow mated to a boar of a third breed gives the most efficient results from the aspects of litter production and food utilisation. No carcass quality results appear to have been recorded in connection with this experiment—at least none were published in the reports of the experiments which I have been able to study (3).

McMeekan (N.Z.J.A. May, 1936) working with N.Z. pigs in the Manawatu in 1933 to 1935 and covering 433 litters failed to find any advantage in litter production from cross-breeding, but remarked on substantial strain and individual differences.

Further work in pig recording in this country confirms the differences which exist between strains in regard to sow qualities. What this means in effect is that there are good strains in each of the breeds which are, on the whole, higher producers. The task is to select the highest producers irrespective of breed and in the first place at any rate it will probably be desirable in order to achieve uniformity to lay commercial breeding plans on a crossing system.

Whatever the results of this research it would also indicate which breeds and/or strains should be the ones, selected for development as prepotent in regard to sow qualities and which for carcass qualities. Obviously the techniques employed would vary radically according to the purpose for which selection was taking place.

#### **THE PLACE OF EXISTING BREEDS:**

It would be fruitless to speculate on the results at this stage but not altogether pointless, I feel, to mention one or two preliminary considerations in the light of available facts. The Large White breed seems assured of a place in any scheme of improvement for the markets which interest us. It is, of course, the pre-eminent bacon pig of the

British Commonwealth and our records show that certain strains at least, very largely due to high prolificacy, produce litters which in the hands of pigmen capable of fully exploiting them, out-match the performance of any of our other breeds in this respect. If a one-breed system were decided on the Large White could be put forward a strong claim to be that breed. If desirable, strains could be developed separately for sow qualities (primarily) and for carcass qualities (primarily) these strains being crossed to produce the commercial pigs.

The white colour would suit the trade. The same applies when the White boar is used over Berkshire or Tamworth sows or crosses of these two breeds, but the use of Large Black blood will introduce the possibility of pigmentation which is a defect so far as porkers are concerned, and seedy cut, which is a defect in any carcass.

#### **BACONER AND PORKER SIRES:**

In view of the practical necessity of producing baconers from one litter and porkers from the next, and for all these to be white-skinned pigs, we should examine ways and means of achieving the apparently impossible task of producing uniformly high quality in both. The dams of the pigs to be fattened should obviously be of intermediate or "dual purpose" type so far as carcass conformation and rate of maturity are concerned. Given a minimum of co-operation in breeding, it is possible to postulate a system in which one farmer kept a baconer type boar (which would be used by both for the summer matings, Dec.-March) and his neighbour a porker type (used by both for winter matings, June-Sept.). I feel that these two types could be segregated from within the present New Zealand Large White Breed within a few generations of breeding on a proper technique towards the specialised ends in view. It may, however, be necessary to evolve a new white breed, importing a few sires of the modern Middle White breed until a sufficiently early maturing type is fixed in the breed, whose special function in the industry would be to provide porker sires.

Militating against the adoption of an all White breeding policy in the foreseeable future are the smallness of numbers of white pigs as yet being bred in the country, the prejudice against the white pig on the part of many farmers, and the lack of suitable piggery facilities on many farms to enable the improved Large White to exhibit its true qualities.

The Berkshire is still the most popular breed in New Zealand as a result of its qualities of hardiness and the ability of the sows to maintain themselves largely on grass. The ability of the breed to produce the early maturing lean-fleshed porkers normally in greatest demand on the London market is still unquestioned in spite of developments towards bacon type over the past 20 years. For these reasons alone the Berkshire must have a place in any scheme of improvement undertaken in the near future.

Whether the Tamworth and/or Large Black breeds or any other breeds which may be imported or developed in the future were included in any scheme beyond the initial stages would depend on their performance in the early testing period and whether a three-breed system proved to have any advantages which could not be obtained by selection for a specified purpose within the breeds already mentioned. These two breeds are declining in all the major pig-producing countries in which they have been used. However, it must not be overlooked that the Large Black has valuable sow qualities which might conceivably outweigh the defects of skin pigmentation in crosses with the Large White and of seedy cut. The foraging qualities of both of these breeds will be of less practical importance under improved husbandry conditions.

## INDUSTRY ORGANISATION TO CONTROL BREEDING PLAN:

Before going on to the measurement of qualities in our breeding pigs let us consider industry organisation covering the breeding and most effective use of the improved pigs. Education in the principles of breeding and selection on the basis of a carefully designed progeny test must be a fundamental plank in the policy adopted. The small-scale breeder must realise the limitations under which he is working from the point of view of effective selection. Progeny testing **within** such herds will be of very limited value as the potential for selection on the sire's side is absent, only one boar normally being used. By full co-operation of all breeders under a comprehensive plan, the central theme of which was progeny testing of all purebred pigs and publication of the results of these tests, the small breeder would be able to maintain his place and to give a real service to the industry. He would still be at a disadvantage as against the larger breeder economically and in the fullest operation of sire selection (unless a satisfactory technique of artificial insemination in pigs is developed and can be economically applied), but would get real assistance in his breeding work from the published results of tests carried out under known conditions. On the basis of such results he could proceed to select his future herd sires with the assurance that they would effect some measure of improvement in his stock. It must not be forgotten that most of the approved breeding centres in Denmark are not large establishments and their success in due very largely to the overall plan and publication of litter test results.

In theory this testing work could be controlled by the pig breeders' own organisation, the N.Z.P.B.A., and obviously this organisation would need to be firmly convinced of the necessity for a progeny testing scheme and agree to the details of the plan decided upon. Such details should eventually include an approval system, approval to be withdrawn from any breeder whose stock failed to reach a certain standard under test or who, for other reasons, failed to satisfy the approving authority. The pre-supposition of such authority, however, as well as the cost of the scheme and the fact that the commercial producer, the processing side of the industry and the consumer all stand to benefit from the work dictate the necessity for a wider representation on the authority. State assistance and some degree of State supervision would appear to be indicated as is given in Denmark.

If the National Pig Industry Council, or its successor, were given Statutory authority to control the scheme the working committee concerned should comprise representatives of the N.Z.P.B.A., commercial producers, bacon curers, and exporters under the Chairman of the Council.

If and when Testing Stations were established they could fall naturally under the authority of the central body acting with local advisory councils and with appropriate technical supervision.

In order to establish anything like a uniform cross-breeding system it would be necessary to use the information obtained from a survey of the suitability of the various breeds and strains for various purposes and to base the recommended cross-breeding technique on this.

The strains which proved themselves most suitable for selection for **sow qualities** would, under the scheme which I am suggesting, be developed as regards purity for these qualities by judicious inbreeding. By similar methods, but of course, a different technique, strains with a high degree of purity for all the desired carcass qualities would be developed with the idea of using the superior males of this strain as the "sire strain" in the final cross for carcass production. So far this is all in the province of the pedigree breeder.

Whether the pure strains developed for sow qualities would be crossed to provide the sow herds for the commercial producer or not would have to depend on their performance as pure line sows compared with that of crosses between the pure lines. There is some evidence from the American work that the commercial producer should work on the crossbred sow herd, and possibly the cross should be between two breeds rather than between different strains of the one breed (2).

If this proved desirable it would be necessary for some breeder or organisation in every pig producing locality to be specialising in the breeding of replacement sows for farmers from the selected pure strains. The pig club type of organisation could, I feel, carry out this function and increase its value as a centre of live interest in pigs in its area.

I have postulated three stages in breeding pigs:

1. Pure breeding of different lines for the **different** and somewhat divergent but specific qualities.
2. An intermediate stage of crossing two purified **sow** lines to provide the sow herds of the commercial farmer.
3. Outcrossing on these crossbred sows with boars from the strains selected for carcass quality combined with growth rate or, finally, economy of gain.

The progeny testing system to be employed in the various lines can now be considered.

#### **TECHNIQUES OF PROGENY TESTING:**

Where progeny testing schemes with pigs have been furthest developed, as in the Scandinavian countries and Canada, they have been based on measurement of bacon carcass qualities and economy of gain of a representative sample of the litter. Selection of both sows and boars is carried out on the basis of the overall assessment of these results.

Gradual but steady improvement in the qualities for which selection has been practised, has been achieved, but the Danes, who have been at it longest, are, as I have already mentioned, concerned about a deterioration which has taken place in sow qualities.

I cannot conceive of any system of testing which, amended to include a porker test, would be a more suitable one on which, ultimately, to base our selection of breeding stock in the "carcass" or "boar breed" for the commercial breeding system I have postulated but, obviously, an entirely different system would need to be used to test the "sow breeds" or strains.

Litter recording, with special attention being given to three weeks litter weights, should, in this case, provide the measure. Boars would be proven on the performance of their daughters as in the improvement of dairy cattle but due to the greater fecundity of the pig more progress should be possible. In the early stages, at any rate, litter recording on the individual farms would, I feel, provide a satisfactory basis for selection. Special attention would have to be given to the effect of season of farrowing and other non-genetic influences.

I have not gone very deeply into the actual techniques which would be involved as that would be decided only when the spadework on the overall pattern of the plan to be adopted had been done. What is wanted as a start, and is almost entirely lacking, is a body of information about the performance of our existing pure breeds of pigs as they are today, on the farms. Standards and schemes of recording

are already available to the breeder and the value of these records of performance even under individual farm conditions is far beyond the cost of obtaining them to the individual breeder himself. By combining in an improvement plan breeders could ensure that they get full value for the extra effort and cost involved. By providing for ordered development the cost need never be excessive.

#### **STEPS IN THE IMPLEMENTATION OF THE PLAN:**

At the outset an intensive campaign to ensure that all pig breeders have an understanding of progeny testing and the necessity for them to co-operate in a National improvement plan if any progress is to be made. Concurrently with this:—

1. A body of litter recording and carcass evaluation on the registered purebred animals is required. I suggest that progress can be made by using the results obtained on individual breeders' farms.

2. A large-scale dual-mating experiment to establish the advantages and disadvantages of various crossing systems. Then—

3. Further refinement of testing techniques to enable maximum improvement of each breed and strain for the special purpose for which bred—or if one breed system proved to be more desirable—to enable the most efficient all-over assessment of performance to be made. In this case, litter recording should be maintained as the basis onto which is added litter testing as carried out in Denmark.

Two further important features of the plan should be:—

4. Publication of the test results in such a way that all breeders can use the results in their breeding work.

5. The N.Z.P.B.A. should establish a card index system so that the registered progeny of every registered animal can be traced with ease to provide easier assessment of true breeding ability.

Extension of the benefits of improved pure breeding stock to the industry could best be achieved through co-operative groups or clubs working with the purebred stock but, in the early stages at any rate, cross-breeding on a uniform plan. Crossbred sows would be distributed to members. Co-operative boar ownership is not so practical under New Zealand conditions, but the degree of co-operation already referred to, may be practicable or, on the other hand, artificial insemination may become a practical proposition.

Such groups, properly handled, could form the best schools for the propagation of the principles behind the improvement plan and assist in obtaining uniformity in output.

#### **References:**

- (1) Lush, J. L., Animal Breeding Plans, Iowa State College Press, 1944.
- (2) 34th Report on Comparative Tests with Pigs from State Recognised Breeding Centres, 1944-5.
- (3) University of Minnesota. Agricultural Extension Division Bulletins. 180, 320.

## Discussion

Mr. SMITH: There are several points I should like to question. The whole conception appears to complicate things unnecessarily. Pedigree registrations are not a reliable guide to the proportions in commercial breeds. The sow is probably the best treated animal on the farm. She is never pregnant and lactating at the same time nor is she expected to grow a fleece of wool. I think it is too complicated to select sows for one purpose and boars for another. Co-operative clubs of farmers are not a suitable vehicle for propagation of improved breeding stock. Should we provide pigs to suit the present environment or change the environment to suit a pig that we can breed? Do you consider cross-breeding and then inbreeding a possible means of improvement in New Zealand? I would like Dr. Rae's opinion on this.

Dr. RAE: In America the research workers are still doubtful of the value of hybrid hogs but commercial interests have gone ahead and sold stock throughout the Mid-west, and made exaggerated claims for the value of the method. The amount of heterosis is not great—about 5%. When more diverse strains are used there is more hybrid vigour. They prefer crosses from two inbred lines in different breeds. The rate of inbreeding is not very important, the result is the same whether the end point is reached quickly or slowly. It is better to produce a large number of inbred lines and then cull heavily rather than to select as inbreeding proceeds. The testing of lines is beset with difficulties even in the case of maize. I think it would be worth while trying here.

Mr. LONGWILL: The main theme of the paper was suggested by the American work of non-inbred, as well as inbred, strains of pigs. It would be unfair to base one's opinion of what could be done through co-operative clubs of producers on the experience of the pig clubs which operated just before the war, as these had no basis of tested stock on which to work.