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Editorial

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In 1960 he spent a period of study with Professor I. A. M. Lucas and Dr. G. A. Lodge at the Rowett Research Institute in Aberdeen. In 1967 he was awarded a Senior Visiting Fellowship by the Royal Irish Academy and studied pig production in the U.S. He spent a year from August 1970 to August 1971 at the University of Alberta where he was engaged as a post-doctoral fellow on research into the energy nutrition of young pigs with Dr. J. P. Bowland.

Dr. O'Grady has had published some 25 scientific papers and 50 popular articles. He has lectured at farming and scientific meetings both in Ireland and abroad. In 1970 he presented a series of 5 programmes on pig production for Telefis Eireann. His research responsibility is concerned with the nutrition, management and carcass quality of pigs. His personal research is now concerned with sows and young pigs.

Introduction

At the outset I would like to express my thanks to the Trustees for inviting me to give this fourth Edward Richards-Orpen Memorial lecture.

I have now been engaged in pig research for over thirteen years. In that period there have been many changes. The annual output of pigs has increased by over 90 per cent, the greater part of this increased production being exported so that the industry now ranks among the top earners of foreign currency. The genetic merit of the national pig herd has improved markedly. We now have leaner, faster growing and more efficient pigs that at any time in the past. The controversy in the past is no longer with us and fatteners are now happy to examine housing from an economic point of view, while keeping in mind the type of system they plan to operate. The concern with animal protein, of so much concern a decade ago, is lost and replaced by an appreciation of amino acid balance and relative costs.

The idea of co-operative fattening centres — then in embryo state — is now firmly established and supplemented with weaner groups as well as pig selling and feed purchasing groups.

Many held the view at that time that indoor sow keeping could not be practiced without serious loss in performance. Today one hardly considers systems other than total confinement ones and herd outputs in excess of 20 pigs per sow per annum are regularly achieved with such systems.

As in other branches of agriculture the past decade has been one of very rapid change and progress for the pig industry. The challenge of the future remains a demanding one. Although production efficiency has increased so has competition and there is still a very great spread in the level of efficiency achieved. Better organisation is certainly one of the most urgent needs. A successful pig industry requires high levels of efficiency at production, feed compounding, meat processing and marketing levels. There is need for much closer integration of all these activities in the future.

TRACE MINERALS

The earlier experiments undertaken at Moorepark reflected the problems encountered at that time and indicated a low level of management. Where sows were kept indoors during lactation, anaemia became a problem on some farms. Oral dosing with iron salts or putting earth into the pen each day solved the problem but were laborious. Injectable iron preparations had just come on the market and we found in several experiments that these were as good as oral dosing. Work in Britain (1) demonstrated that higher strength injections (200 mg Fe) gave improved results and in a large scale experiment we tested one of the higher strength products against oral dosing (2). The results clearly showed the superiority of the injectable product.

Table 1:

Comparison of performance of suckling pigs given iron orally or by injection

	Oral	Injection of 200 mg Fe
No. of pigs	417	417
Survival to 8 weeks %	84.9	91.4
Wt. gain 3-56 days	28.6	30.1

We have had no reason to modify our recommendations since then.

Copper sulphate (0.1 per cent in the diet) had been shown to improve growth rate and feed conversion effieciency as early as 1955 (3). Because it was cheaper than anti-biotics, gave the same degree of growth promotion and did not present problems of bacterial resistence, copper supplementation of pig diets gained widespread acceptance. Occasional reports of toxicosis, when fed at the recommended level, reduced confidence in its acceptance. An outbreak of copper poisoning occurred at Moorepark in 1965. Previously copper supplementation had been used successfully for a number of years. Experimental work (4) undertaken then showed that the zinc and protein levels in the diet were involved although the former had the greater effect. Some selected results are given in Tables 2 and 3. It was clear that the addition of 130 ppm Zinc completely eliminated the deaths associated with copper supplementation and reduced liver storage of copper by 33 per cent. This clearly demonstrated interaction between zinc and copper probably also explained the intermittent occurrence of copper toxicity. Wheat offals are known to contain high levels of zinc and so their inclusion probably supplied adequate zinc in many diets. Since this period I have not seen any further reports of copper toxicosis in pigs and as a feed additive its safety is not now questioned.

Table 2

Effect of copper and zinc supplementation of diets on mortality and growth rate of pigs. (4)

	No. of pigs	Deaths of copper toxicosis	Daily gain g
Low protein series			
Control	76	0	506
Copper added	92	18	402
Copper and zinc added	92	0	496
High protein series			
Control	92	0	515
Copper added	92	6	494
Copper and zinc added	92	0	534

Table 3

Effect of copper and zinc supplementation of diets on copper content of pigs livers (ppm of tissue DM), (4)

	Control	Copper	Copper and Zinc	Overall Mean
Low protein	292	1,168	830	763
High protein	101	873	535	503
Overall mean	196	1,020	682	

More recently concern about the use of antibiotics in feeds has increased and legislation in many countries prohibits the use of some or all antibiotics as feed additives. This has had the effect of increasing the importance of copper sulphate as a growth stimulant. There is presently great commercial interest in the development of non antibiotic additives and a number are available. It is not clear if they offer advantages over copper sulphate.

Trace mineral concentrations vary with ingredients and probably with the region where grains and other feeds are grown. We have adopted the practice of adding a supplement to all feeds which meets requirements even where feedstuffs have unusually low concentrations. At present it costs 5.5p per ton to add iron, iodine, zinc, copper, manganese and selenium at nutritionally required levels. As the toxic level of these minerals ranges from 40 to 200 times the nutritional requirement there is no danger attached to adding a blanket allowance. In this situation research into trace minerals is low on our list of priorities.

Dairy byproducts. The past decade has seen very great changes in the supply of dairy byproducts available for animal feed. Skim milk was important in the 50's and 60's but is now so valuable for processing as to exclude it from pigfeeding except in those areas where rationalisation of dairy processing is retarded. Production of whey on the other hand has increased from 9.3 million gallons in 1960 to about 100 million gallons in 1972. Predictions of future production are liable to great errors. With milk production up 7.5% in 1972 and with cheese production in 1972 nearly 50% higher than in 1971 it is possible to visualise that production of whey will reach 200 or even 300 million gallons per annum before the end of this decade.

The availability of whey offers the Irish pig industry a clearcut advantage over its competitors. In 1972 the total amount of whey available represented 4.5% of total pig feed or 7.5% of feed used in the fattening period. Data available from Moorepark (6. 7. 8 Tables 4 and 5) clearly show that liquid whey can represent up to 22% of total feed in fattening while maintaining maximum performance. If whey is concentrated or dried the limit on inclusion can be raised to nearly 40%.

Table 4

Response of growing-finishing pigs to different levels of fresh whey in the diet (6).

Experiment 1. High scale of feed				
Whey D.M. inclusion %	0	13	18	22
Daily gain g	717	772	760	760
F.C.E.	3.37	3.32	3.18	3.07
Experiment 2. Low scale				
Daily gain g	613	627	648	627
F.C.E.	3.43	3.45	3.19	3.26

Table 5

Response of growing-finishing pigs to different levels of whey solids in the diet (7, 8)

	Whey dry matter inclusion %			
	0	20	40	60
Experiment 1. Dried whey				
Daily gain	750	761	726	641
F.C.E.	3.06	3.04	2.87	3.17
Experiment 2. Concentrated whey				
Daily gain	754	744	662	607
F.C.E.	2.83	3.08	3.18	2.94

If whey is available delivered at 1p per gallon and compound feed costs £45 per ton there is a saving of 1.5p for every 3 gallons of whey used on £500,000 per annum on a usage of 100 million gallons. It is worth emphasising that this sum would offset a £2 per ton carriage charge on the total feed required to produce an extra million pigs (5) and is unquestionably a valuable asset that must be utilised fully. In my opinion the research has been done on whey feeding. It is up to producers separately or in groups to solve the necessary organisational problems associated with fully utilising this natural advantage.

Grains and offals. Despite good housing and management and rations that were obviously adequate in crude protein, slow growth and poor F.C.E. have been a serious problem on many farms. To attempt a solution to this problem Tom Hanrahan and I initiated a project into the interchangeability of feed ingredients. Imported wheat offals appeared of questionable value and this assessment was confirmed in digestible studies. (9) Some results are given in Table 6.

Table 6

Effects of imported pollard on digestibility of pig diets

	Level of pollard in diet %		
	0	27	40
Gross energy Mcal/kg	3.81	3.82	3.83
Digestibility %	77.2	72.0	68.3
Digestible energy Mcal/kg	2.94	2.73	2.52

Although gross energy of pollard containing diets was slightly higher than that of barley based ones, per cent digestibility decreased by about 0.2 units for each 1 per cent inclusion of pollard. From this it was calculated that the D.E. concentration of imported pollard was 2.2 Mcal/kg compared to a value of 3.0 Mcal in the case of barley — a decrease of almost 27 per cent. Growth trials confirmed the digestibility data. The inclusion of 20 and 40 per cent pollard reduced growth rate by 6 and 12 per cent respectively while F.C.E. was poorer by corresponding amounts.

An extension of this work by Tom Hanrahan (19) has shown that maize and milo are some 10 per cent higher than barley in D.E. although in growth trials their superiority was less — some 3 to 5 per cent. This probably reflects poorer amino acid balance but unquestionably they represent better value. Work just completed shows the D.E. value of native wheat to be variable. On the basis of work in other countries one would have expected wheat to be considerably superior to barley.

Any expansion of pig production will necessitate increased imports of feed ingredients and only through a knowledge of the nutritive value of the different alternatives can a rational import policy be based. In a world where efficiency is the basis of success Irish farmers cannot afford the luxury of lower quality feeds. Table 7 shows the imports of wheat offals since 1965 and the maximum extent to which they could have been included in the average pig ration. It is evident that foreign pollard is on the wane, whether through an appreciation of our findings or not I cannot be sure. It is however a development in the right direction.

Table 7

Import trends in wheat offals (tons)

Year	Pig Feed USED[1]	Offals imported[2]	Maximum inclusion %
1965	530,000	111,830	21.0
1966	490,000	81,615	16.6
1967	430,000	80,873	18.8
1968	495,000	84,506	17.1
1969	575,000	89,502	15.6
1970	580,0C0	71,411	12.3
1971	630,000	31,058[3]	4.9

[1] calculated from pig production.
[2] source C.S.O.
[3] extrapolated from January-October figures.

I do not condemn the use of low energy ingredients per se. If price is right they may represent good value. The feeder however must be made aware that the resultant diet is lower in energy and will result in poorer performance. Only then can he determine the economics of using such feeds. Under E.E.C. conditions however the relative cost of energy will be higher and low energy feeds incur higher transport costs per unit of energy. For example, 2 tons of maize have the same nutritive value as 3 tons of foreign pollard and the relative transport costs of nutrients may be even more divergent when volume is taken into account.

Where a wider range of ingredients is available more complex diets can be expected — in many instances formulated by linear programming. The feeding value of such diets depends on the nutritional specification used and on the accuracy of the information available on ingredient composition. It is easy to visualise the error resulting from assuming that foreign pollard contains 2.7 Mcal DE/kg when in fact its energy content is only 2.2 Mcal/kg. There are many other instances where errors can result from inadequate knowledge of ingredient composition or of variations within a particular ingredient.

The increasing emphasis on environmental protection and the need to avoid pollution is another factor in favour of the use of high energy diets. Our data showed that the inclusion of 40 per cent pollard in diets increased the output on wet faeces by about 60 per cent and that of faecal dry matter by about 35 per cent.

Many more restrictions about the use of various feeds are known to man than to the pig. We are now feeding 80% wheat diets to pigs without any of the predicted digestive upsets. Similarly we are using levels of molasses a good deal higher than recommended and not yet encountering the expected scours.

I envisage a continuing need for more information on the nutritive value of many unconventional ingredients and so consider the programme of research on this topic now underway at Moorepark of great importance. It is a pleasure to acknowledge the support given to this work by the U.S. Feed Grains Council from 1967 to 1972 and the fact that this support has now been taken over by a group of Co-operatives.

CARCASS QUALITY

Success in exporting pigmeat can hardly be achieved without having genetically lean pigs and in my introduction I have mentioned the improvements that have taken place in the Irish national herd in recent years. Within any particular strain of pig however carcass leanness and efficiency of production can be influenced in a number of ways. These effects are important both to the producer in that they influence profitability and to the processor in that they effect the quality of the final product.

Sex has the largest effect on carcass leanness. Under standard housing, feeding and management, boars are considerably leaner than gilts which in turn are leaner than castrates. As boar taint prevents the use of entire males, this superiority cannot be exploited at present. The rapid concentration of fattening into large units does allow separate housing of sexes which can then either be fed differently or slaughtered at different weights to manipulate carcass leanness. Where pigs are being diverted into markets other than Wiltshire bacon this latter may be attractive. The potential for such manipulation is clear from data published in 1966 (10). Both fat measurements and dissectable fat increased at higher slaughter weights, while meat percentage decreased (Table 8). In the same experiment sex effects on carcass quality were demonstrated and are shown in Table 9.

Table 8

Effect of slaughter weight on carcass traits (10)

	Slaughter weight kg			
	84	90	96	103
Loin fat mm	22.3	24.7	25.6	27.5
Shoulder fat mm	40.7	44.5	44.4	47.2
'C' fat mm	18.0	19.1	20.0	22.6
Subcutaneous fat %	25.7	26.0	26.7	28.5
Meat %	63.2	63.2	62.5	61.1

Table 9

Sex differences in carcass fatness (10)

	Gilts	Castrates
Loin fat mm	23.2	26.9
Shoulder fat mm	42.7	45.7
'C' fat mm	18.4	21.5
Subcutaneous fat %	24.6	28.9
Meat %	64.3	60.7

It can be calculated from the data given in Tables 8 and 9 that the sex differences are comparable to those brought about by a difference of 15 kg in slaughter weight. For Wiltshire cure standard weights of sides are of great importance. Should pigs be cut up and sold as pork cuts or other processed products however it may be possible to use different slaughter weights to even out leanness.

Higher levels of feed result in faster growth but also in fatter carcasses so that the relative advantages of each effect are important in determining profitability. The carcass studies referred to above indicated that fast growth could be combined with lean carcasses by reducing slaughter weight. Higher feeding giving an 11 per cent increase in growth rate can be practiced without deterioration in leanness if pigs are slaughtered 7 kg lighter. This combination gives a 20 per cent increase in throughput of pigs.

Slaughter weight has been a bone of contention in pig production for many years. There will always be some conflict between the requirements of factories and markets and the production costs of farmers. Undoubtedly killing costs are lower where weights are higher. Some factories may have outlets for fat and so the increased fat content of heavier carcasses may not influence profitability unduly. Processors will undoubtedly do their own economics but it is important for everyone to have information on basic production costs. In the Netherlands this conflict between production and processing costs is solved by paying a higher price per kg carcass for pigs of heavier weights. The earlier experiments referred to (10) were further examined by Kearney (11) and feed conversion efficiency calculated at various weights. Overall performance in the experiment was not good as at that stage we had not developed what has since become known as the 'Moorepark Ration'. It was however comparable to the level of performance achieved presently on many farms i.e. daily gain 558 g (1.23 lb) and F.C.E. 3.7. the relationship between weight of pig and F.C.E. is shown in Table 10.

Table 10

Effect of weight on pig on F.C.E. (11)

Weight of pig		F. C. E. at given weight
kg	lb	
24.0	53	2.4
34.5	76	2.9
45.4	100	3.3
56.7	125	3.8
67.5	149	4.3
79.0	174	4.8
91.0	200	5.3
102.7	226	5.8

This experiment showed that there was increase in overall daily gain when pigs were kept to weights in excess of 175 lb.

More recently Hanrahan and Carroll (12) have undertaken some extremely comprehensive work on a wider range of slaughter weights. The same pattern emerges showing that keeping pigs to higher weights does not improve rate of gain while F.C.E. constantly deteriorates. This aspect is shown in Figure 1. In this experiment overall rate of gain was in excess of 800 g/day (1.75 lb) and F.C.E. up to 85kg (187 lb) 3.14. Feed conversion for the increments above this have been calculated and are shown in Table 11. The data clearly demonstrate the increased feed necessary to put on liveweight as the pig gets heavier even where overall performance is extremely high. Where overall performance is poor weight gains above 180 lb is clearly unprofitable at normal feed and pig prices.

Table 11

Relationship between liveweight and F.C.E.

Liveweight range		F.C.E.
kg	lb	
30— 85	66—187	3.14
85— 95	187—209	4.2
95—105	209—231	4.5
105—115	231—253	4.8

HOUSING OF BACON PIGS

Perhaps no area of pig production was so confused at the beginning of the last decade. Several types of fattening house had their supporters and detractors all of whom believed that efficient pig production was impossible without the aid of their chosen house. The fact that facilities were being built at Moorepark offered a unique opportunity to examine different types of house. The results are now well known (20). In two experiments involving a total of 1,328 pigs, performance on a range of feed levels and slaughter weights was compared in Danish, Jordan and Solari houses. Overall, pigs in the Danish house grew 5.2 per cent faster and converted feed some 5 per cent more efficiently than those in the other houses. Carcass differences were small but tended to favour the Jordan and Solari houses. Despite the better performance in the Danish house an economic evaluation of the data showed profitability per pig to be greater in the Jordan house due to its lower capital cost and consequent lower housing charges. A most important concept was apparent from this finding — namely that performance as such is not the sole criterion by which a house must be judged. If housing charges are lower a slightly lower level of pig performance can still leave most profit. In a situation where capital is limiting this factor of lower housing cost becomes even more important as it allows not alone a lower housing charge per pig but also a greater size of enterprise for the same investment. For example a choice of a £10 per pig house vs. a £25 per pig house allows a 20 per cent increase in enterprise size for the same investment using present day weaner and feed prices. Following this earlier work, findings from Britain and from Moorepark (21) demonstrated that the differences recorded between our houses could be entirely accounted for by the fact that feeding was from troughs in the Danish and off the floor in the other types. Developments since then allow trough feeding in Jordan houses so that they or other efficient low cost houses are more profitable on a per pig basis as well as demanding a lower investment, per pig space.

Occasionally one still hears of statements from other countries that the Jordan house does not work. Irish pig keepers planning for expansion might well be pleased. It has been clear for at least a decade that the Jordan house requires a climate having neither extremes of heat or cold. Most countries do not have such a climate. It is however one of our great advantages in pig production as well as in grass growth.

Developments in dairying and whey production emphasise one further advantage of the Jordan house. It is designed to withstand humid conditions. Where large quantities of whey are fed it is impossible to avoid humid conditions so that the Jordan house and whey feeding are complementary and represent the two great natural advantages of Irish pig production.

The Jordan house has often been described as an unventilated house and this is completely inaccurate. It is a draught free house but well ventilated. An example of the effects of inadequate ventilation has recently been observed at Moorepark where a prototype new design of house — the Gemini was tested. Some results are given in Table 11A

Table 11A

Performance of pigs in original and modified Gemini house compared with that in Danish house (22)

	Original		Improved	
	Gemini	Danish	Gemini	Danish
Daily gain g	587	710	650	645
F.C.E.	3.83	3.08	3.23	3.06

FEEDING AND MANAGEMENT OF SOWS AND LITTERS

Developments in intensive sow keeping were slow in coming compared to those in managing growing-finishing pigs. There were a number of reasons for this. Outdoor exercises were considered essential for normal reproductive performance. This belief reflected a lack of information on the nutritional needs of the sow as well as a belief that exercise was an essential component of the normal processes of pregnancy and lactation.

The development of total confinement housing — firstly group housing with individual feeding and later stalls — gave the necessary stimulus to initiate studies on the protein and energy requirements of sows.

Pregnancy: Initial studies at Moorepark were concerned with the effects of level and pattern of feeding in gestation (13). In conjunction with other studies abroad this work demonstrated that low feed intakes in gestation depressed birthweights and that this effect remained to weaning and indeed to slaughter where a 1 lb difference in birthweight resulted in a 9 day difference in age at slaughter. The extent of some effects are shown in Table 12. It is pertinent to note that in this as in most other experiments low feed intake in pregnancy did not influence number of piglets born. The effects on birthweight and subsequent performance can be caused either by a low level of feed as shown or by a higher level of a lower energy feed. Further studies (14) demonstrated that 2.0 kg per day of a barley based diet (3.0 Mcal DE/kg) gave normal birthweights (Table 13).

Table 12

Effects of sow feed intake in gestation on litter performance (means of 3 parities)

	Sow feed level (kg/day)	
	2.7	1.35
No. born	10.3	10.1
Litter wt. at birth kg	12.9	11.2
Litter wt. at weaning kg	118.5	92.5
Creep feed/litter kg	86.7	74.0

Table 13

Effect of sow feed level in gestation on piglet birthweights (14)

	Feed level in gestation kg/day	
	2.7	2.0
Mean piglet wt. kg.		
Parity 1	1.49	1.43
Parity 2	1.56	1.55
Parity 3	1.47	1.48

This level of feed in pregnancy has been used as a standard in the Moorepark herd for many years and is totally satisfactory under reasonable environmental conditions and for sows free of heavy parasite infestation. It may be that we have not adequately stressed these qualifications. Certainly we have found cases of extremely thin sows on farms where this allowance appears to have been adhered to. Comparisons of sow and weaner diets (15) have shown that FCE and presumably DE of some commercial formulations can be up to 18.5 per cent poorer than our standard known to contain 3.0 Mcal DE/kg. If such a formulation is fed sows would require 2.37 kg ($5\frac{1}{4}$ lb) to supply the same energy as 2 kg of our recommended standard. This again illustrates the necessity for knowledge of the energy concentrations of diets if management decisions are to be soundly based.

Nutritional recommendations have indicated increased requirements for protein and energy with the advancement of pregnancy in sows. While these are based on metabolic data they do involve a complicated feeding system. Consequently we considered it important to compare such a system with one allowing a constant feed level throughout pregnancy. Some results are given in Table 14 and clearly show no advantage whatsoever from the more complicated system. More recently Elsley et al (16) examined constant and variable systems where the overall level of feed was lower.

Table 14

Effect of feed distribution pattern on performance of pregnant sows (Means of 3 parities)

	Treatment	
	Constant 2.7 kg	Variable 3.6-1.8-3.6 kg
Total feed in gestation kg	310	310
No. born	10.3	10.0
No. weaned	7.9	7.6
Litter wt. at birth	12.9	12.9
Litter wt. at weaning	118.5	117.0

Again no improvement on the constant system was obtained. It is now an accepted maxim of sow management that litter size should be standardised soon after birth by fostering on or off piglets. Thus standard feeding systems can be safely recommended in pregnancy and lactation. This is an important advance in management and allows labour output to be increased. In turn this allows bigger sow herds on many mixed farms and improves the structure of the industry.

Rather surprisingly all recent research indicates that the sow requires less protein than previously estimated. This is easily explained from findings in Britain and France that protein utilisation is more efficient in pregnancy. While no experiments have been completed on this topic in Ireland, findings from abroad have been implemented in Moorepark and a 13 per cent crude protein diet has been used as a standard for some 4 years with excellent results. The vast majority of compounders now market such a sow feed.

Lactation: Two experiments have been undertaken to examine the response of lactating sows to quantity and quality of protein. In the first of these (14) reproductive performance was equally good at 11.7 and 15.8 per cent crude protein in the diet and where fishmeal or groundnut meal were used as the source of supplementary protein (Table 15).

Table 15

Effect of level and source of dietary protein in diets of lactating sows on litter performance

		Protein level %		Source of Protein	
	Parity	15.8	11.7	Fishmeal	Groundnut
Litter wt. at birth kg	1	—	—	—	—
	2	15.1	14.9	15.0	15.1
	3	16.2	15.8	14.9	17.1
No. weaned	1	7.9	7.8	7.6	8.1
	2	8.2	8.0	8.2	8.0
	3	8.4	8.8	8.2	9.1
Litter wt. at weaning kg.	1	77.5	77.3	78.0	76.8
	2	86.4	84.1	84.2	86.2
	3	80.0	86.3	86.8	79.4

An experiment has just been completed (17) where the low protein control has only 9.3 per cent crude protein and this is supplemented with synthetic amino acids and different levels of soyabean meal in an attempt to obtain information on the limiting amino acids in lactation. During each of three lactations there were no differences in litter performance or in milk composition between treatments so that sows getting diets composed only of barley, vitamins and minerals performed similarly to those given diets having 11.8 and 14.3 per cent crude protein. There were no indications of a response to supplementation of barley or barley-soya diets with lysine and methionine. Sows given lower protein diets lost more weight after weaning their first and second litters. This latter effect is important and further studies are underway to examine its causes.

It is clear however that the sow is much more efficient in utilising dietary protein than had been expected some years ago. It is also interesting that weight change and regularity of breeding are the most sensitive areas rather than yield or composition of milk.

Energy requirement for a 6 week lactation were examined in a joint experiment undertaken at the Rowett Institute, Aberdeen and at Moorepark (18). Low energy levels in lactation (4.2-4.5 kg/day) progressively reduced milk yield from 1st to 3rd lactation and this was reflected in differences in litter weights in the 3rd lactation. When slaughtered at this stage it was seen that body fat reserves of sows had been seriously depleted where dietary energy was restricted. Some of the more important results are given in Tables 16 and 17.

Table 16

Effect of feed level (energy intake) in lactation on milk yield at 21 days

		Energy level kg/day			
	Parity	4.5	5.3	6.0	6.8
Dairy milk yield kg	1	5.9	5.4	5.7	6.1
	2	5.4	6.0	6.9	6.6
	3	5.5	6.8	7.3	8.0

Table 17

Effect of energy intake in lactation of carcass components of sows at end of the 3rd lactation

	Daily feed intake kg.			
	4.5	5.3	6.0	6.8
Carcass wt. kg	95	103	112	133
Skim and fat %	16.5	17.5	22.7	26.9
Meat %	68.1	68.2	63.0	60.2

This experiment illustrated very clearly that sows can draw on body reserves to maintain milk yield. There is obviously a limit to the length of time they can continue under such a system and in the experiment referred to this seemed to be about 3 lactations. Where it is normal and economical to keep sows in the herd for several cycles, only results of long term experiments can give accurate information on treatment effects. Unfortunately this means fewer experiments. It also means that U.S. results, where it is general to discard the sow after one litter, are of lesser value.

On the positive side, results in the joint experiment demonstrated complete consistency between centres so that we can avail of British findings with considerable confidence in the future. Overall conclusions from the study show that where moderate feeding is practiced in gestation (2.0 kg/day) and with 5 or 6 week lactations, sows should be fed highly in lactation, i.e. up to 7.0 kg/day for best overall effieciency. The advantages of this system will be most pronounced in the 3rd and subsequent lactations.

There remains the period between weaning and remating, the length of which is a very important determinant of sow output. Very little is known about optimum nutrition in this period. Work at the University of Nottingham suggested a gain from flushing during oestrus but further work was unable to confirm the earlier findings. Rather than look at the oestrus period we decided to examine feeding during the entire period and an experiment has been completed where three levels of feed were given from 24 hours post weaning to the 2nd service. Following this all sows received the standard allowance of 2.0 kg/day in gestation. Some results are given in Table 18.

Table 18

Effect of level of feed post weaning on sow performance

	Level of feed kg/day		
	2.0	3.5	5.0
Days weaning to mating	6.1	5.1	5.5
Litter size at birth	12.0	11.6	10.9

These differences were not significant but do show some slight advantage for the medium level of feed. As environmental conditions on many farms may not be as good as those at Moorepark this level of feed seems a reasonable compromise. In summary then a level of 12.5 to 13.5 per cent crude protein seems suitable for sows at all stages of production. Where diets contain 3.0 Mcal DE/kg recommended daily levels of feed are 2.0 kg in gestation, 6.0 to 7.0 kg in lactation and 3.5 kg between weaning and re-mating. This system of course applies to 5 or 6 week weaning. Different systems may be necessary with earlier weaning.

The past decade has seen a great increase in intensive sow keeping. It is not unreasonable to ask if there are any indications that sows are reacting to this and that regularity of breeding, litter size and longevity are now poorer than when sows generally had access to pasture, a good deal more exercise and both higher levels of feed and protein. Data from Moorepark might give some clues here as we have gone through the developments mentioned in the past decade. Every indication we have shows that the overall position is improving. For example in our first sow experiment 81.8% of control sows produced third litters; in the most recent experiment the comparable figure is 86.3%. Number weaned per litter has increased by 0.84 in the same period and weaning to mating interval and conception ratios are now close to the biological limit. Of 337 sows mated at Moorepark in the first 10 months of 1972, 314 or 93.2 per cent conceived and of the 23 repeats all but 2 were pregnant after the repeat mating. The monthly pattern is given in Table 19. A high proportion of gilts (30%) were included in the figures for August to October.

Table 19

Conception to mating in the Moorepark herd in 1972

Month	Number mated	No. of repeats	Conception ratio %
January	39	2	94.9
February	32	3	90.6
March	31	2	93.5
April	27	4	85.2
May	29	1	96.6
June	34	2	94.1
July	33	3	90.9
August	42	1	97.6
September	38	2	94.7
October	32	3	90.6

Weaning to mating intervals in control sows are only 7 days on average and this represents over 2.3 litters per sow per annum and 20.7 pigs per sow per annum with 9 pigs weaned per litter — a highly profitable situation.

Future Research: A theoretical examination of the output figures just described shows two potential areas of improvement — more litters per annum which means earlier weaning and more pigs weaned per litter. In both cases a different type of research involving whole herd systems is required. There is a considerable volume of research documenting the optimum environmental requirements of the young pig. I believe we now need work on fitting these needs into a sow and litter situation or indeed a house of sows and litters. This means co-operative work involving the disciplines of physiology, husbandry and engineering. I am convinced that as much as 2 extra pigs could be reared per litter if such a project were successful in devising the correct house and fitting it into a pig keeping system.

In relation to earlier weaning it is clear from work abroad that the physiology of the sow presents greater problems than the rearing of the early weaned pigs. Again this must be examined in the context of a whole herd system.

Perhaps no area of pig keeping generated more controversy in the past than housing. Today our ability to produce pigs profitably in cheaper houses than any of our competitors require is a major advantage which will benefit the Irish pig industry in the future. Compared to most European countries it represents a saving of up to £1.00 per pig in production costs and together with the availability of whey constitutes our greatest advantage. No doubt we can make further improvements which will be labour saving and ease management. We must never forget however that housing here has to exploit our moderate climate.

An area which is in the news and undoubtedly needs research is effluent disposal. It is crazy to accept that the disposal of animal wastes presents a pollution problem in Ireland when it can be handled in the Netherlands where the density of pig production is at least 15 times that here and is combined with a high density of humans. Regrettably many of the planning authorities are imposing inflexible regulations which could prevent the pig industry from achieving its potential contribution to the economy. Research is urgently needed into the efficient use of animal wastes with emphasis on fertiliser value rather than pollution potential. Only on the basis of information from such a project can sensible planning legislation be drawn up.

Finally a word of warning in relation to breeding. It has recently been postulated that intensive selection for leanness without due regard for other criteria has resulted in disease prone pigs of low fecundity in Denmark and the U.S. Proving or disproving such an assertion may not be possible. It does seem important to me however to record that work in Canada shows that selection for growth rate and vigour can be combined with that for leanness without any slowing in the rate of improvement in either characteristic.

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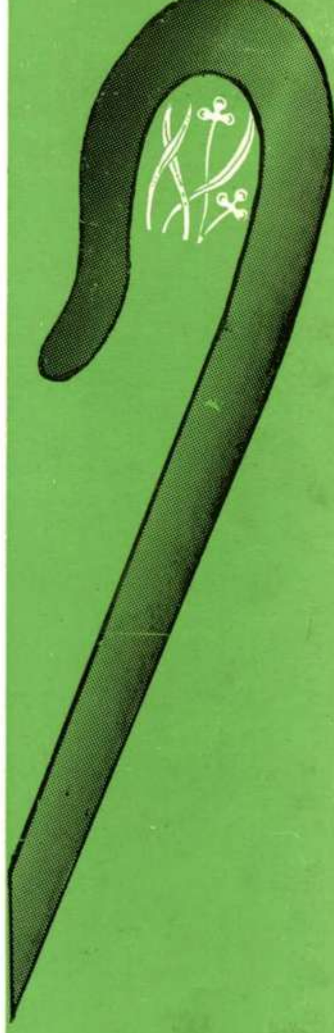

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