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THE RELATIONSHIP OF ARTIFICIAL INSEMINATION TO
FUTURE DAIRY CATTLE BREEDING

by

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The past breeding season completed the sixth year's work on artificial insemination in dairy cows carried out from Ruakura. This experience has taught us quite definitely that many of the rosy dreams we enjoyed about the possibilities of artificial insemination in New Zealand will not materialise as easily as we hoped six years ago. In fact, some of our earlier plans may never be brought into practical application if we are to maintain economic stability in the work.

Three seasons' extension work among farmers has also shown us many pitfalls which will have to be avoided in the future field work, while information obtained from a visit overseas has given us a good insight into the problems facing similar breeding units in America, England and the U.S.S.R.

In looking ahead and trying to plan in our minds what part this work may take in the dairy industry of the future, and particularly that of New Zealand, we must take into account the lessons learned in technique and organisation, realise our limitations and adapt our plan to suit the peculiar needs of the New Zealand industry.

The present is perhaps a suitable time to review the potentialities of artificial insemination, and its general application to stock breeding, because we feel that one stage, the preliminary one of technical development, has been passed, and the second phase, that of extension, is just beginning. In view of the highly coloured and somewhat ill-informed views held about the possibilities of artificial insemination on many sides the present seems a suitable time to clarify the position with regard to dairying in New Zealand.

At the outset let us be clear what artificial insemination is, what it can achieve and especially what it is going to cost. Let us remind ourselves that artificial insemination is only one factor, and fundamentally an unessential one, in a group of events necessary in the production of healthy, fertile, highly productive stock. Artificial insemination adds nothing to that productivity, it adds nothing to the fertility of bulls or cows. At its simplest it is going to be a very costly business. It must be emphasised very emphatically that artificial insemination is only an aid to a breeding programme, and not the programme itself. The one outstanding advantage that artificial insemination can give a breeding plan is the greatly increased coverage of females by one outstanding male, this results in some saving of time in achieving the end result. It is this feature that makes it such a valuable tool in applying a definite breeding programme. Even in this respect our earlier hopes have not yet been realised, but we are confident that the present ten-fold advantage it holds over natural mating can be very substantially increased, though probably to a limit which falls short of the expectations of many people.

With these rather sobering thoughts in mind, let us turn aside to see what others are achieving in the same field of work, reviewing their objectives and the conditions under which their work is being done. We can then summarise what we have achieved ourselves, so that we will be able to look ahead with a clearer appreciation of our limitations and plan a rational method of fulfilling our dairy breeding programme with the help of artificial insemination.

When considering the work in other countries with a view to comparing their progress, objectives and conditions of work with our own, there are several factors which must be kept in mind in which conditions and views in New Zealand differ from those of other countries, but before dealing with these in some

detail, let us remember that in measuring achievements in this field, we may be somewhat led astray if we consider only the actual numbers of animals inseminated, and fail to take into account the standards they have set themselves in their objectives and whether these are being attained. The issue is confused by the fact that in some countries where artificial breeding has been making rapid progress in numbers, there are very few production records, so that if improved production is the objective measurements of progress are impossible.

Dealing with the points mentioned above, the position in each of the main dairying countries can be very broadly summarised as follows:-

1. Relation of Average Cow Production to Production in Pedigree Herds:-

- a. Denmark: Margin probably not great, but intensive milk recording at least identifies individual animals' production.
- b. America: Margin probably not great and where extensive herd recording is carried out the outstanding individuals can be located. In some States herd testing is at a very low ebb, and no measure of the difference can be made.
- c. England: Margin unknown due to general poor response to milk recording. Position is complicated by the fact that dual purpose cattle are popular creating a dual value to consider in the bulls.
- d. U.S.S.R. Very wide margin between the production of the local unimproved cattle, which form a very substantial proportion of the total animals, and the pedigree bulls of improved breeds.
- e. New Zealand: Very narrow margin, if any.

2. The Emphasis Placed on the Standards Required from Bulls Used in Artificial Insemination.

- a. Denmark: Principle of proven sires widely appreciated. In spite of this only 10% of bulls in use in artificial breeding units have daughters in milk.
- b. America: In the bulk of the work less than 25% of bulls in use are proven sires. The proportion of the total work done would probably be less due to generally reduced fertility in the older bulls. Otherwise bulls are selected by the usual pedigree breeders' methods, (In one large breeding unit 80% of all services used were from proven sires.)
- c. England: Usually there is no barrier to artificial breeding units procuring the highest priced bulls in the breed, and obviously better bulls than the average small farmer could afford, but in view of the lack of complete milk records, and in view of the fact that the value of the bull as a beef animal is often taken into consideration, it is difficult to state the position precisely.

- d. U.S.S.R.: The process of grading up proceeds in steps as the poorer bulls are eliminated. State organisations undertake the improvement of a breed, young bulls being supplied from a controlled area to artificial breeding units in other suitable areas in the USSR. In one area where in 1933, 163 bulls were used to mate 8,000 cows naturally, now 48 are used to breed 10,000 artificially. That is the top 25% of the bulls are used in this area. In these nursery areas all the cattle are tested for production. This area deals with a dairying breed, in general dual purpose cattle are more important.
- e. New Zealand: The standard set for bulls for this work is placed so high that very few bulls qualify annually, and of the total number qualifying only about 4 or 5 become available for artificial insemination each year.

3. Spread of work throughout the year.

In all countries except New Zealand, the breeding of dairy cows goes on throughout the year, though admittedly with peaks at certain seasons. This spread of work has several advantages, chief among which are:-

1. Fairly even distribution of work ensures that technicians are employed continuously at a reasonable level of work.
2. Fewer cows to be handled per man per day - 5 or 6 instead of 50 or 60.
3. A longer time is available for a bull to show his fertility with resulting confidence in his use.
4. Technicians in mid-season form.
5. The estimation of running expenses and costs is easier as technicians are employed all the year.
6. Regular work for bulls, etc., etc.

In spite of the fact that most overseas units operate for twelve months each year the volume of work done per technician in New Zealand in six weeks does not fall far short of the overseas annual total, and the number of cows served per bull compares favourably on a time comparison. The extreme seasonal breeding of dairy cows in New Zealand constitutes such a problem in organisation that a few details may help to illustrate our difficulties to those unfamiliar with the position. It must be admitted at first that there are some advantages arising out of this system of mating, one of them being the presentation of an enormous population of cows ready for service in a very short time, so that as our technique improves a very wide coverage should be possible per bull. The fact that the work only goes on for three months or so would also tend to reduce expenses, if technicians could be absorbed in other work during the off-season. Further, more cows are available on each farm during the mating season than would be the case if mating were spread throughout the year. This would economise the technicians' time in travelling and packing and unpacking instruments.

The actual problem set by the very seasonal mating period may be better appreciated if it is stated that of any projected population of cows selected for breeding, from 80-90% of them will be presented for service within the first three weeks that the unit is functioning.

This means that the volume of work that can be handled by one man is limited to what he can get through during the first three or four weeks of the breeding season. If the conception

rates are in the order of 60% holding on the first round he will be relatively under employed for the remainder of the breeding season. In a unit of 1,000 cows a technician would have to inseminate up to 50 or even 60 cows daily. In the 1944 season 2,600 cows were inseminated, and of these 2,400 were done in the first three weeks.

4. Main objectives and Relative Importance of subsidiary Objectives:

- a. Denmark: The spreading of outstanding bulls' services is no doubt the most important objective, but in view of the small size of the herds the advantage of doing away with a bull on the farm is a very real one. Where bull clubs have been organised before artificial insemination was started the change to artificial breeding is very easy.
- b. America: The numerous small herds make the service attractive from the point of view of not keeping a bull. One or two units are operating for disease control.
- c. England: Position similar to that in America.
- d. U.S.S.R.: Stock improvement is the aim of the work, but as dual purpose cattle are frequently used, milk production is not the sole consideration. Stock improvement is directed by the state and the complicating views and interests of a body of individual breeders are not factors to be taken into account.
- e. New Zealand: The size of the usual commercial herd is large enough to warrant a farmer keeping at least one bull. The fact that it has not been our intention to settle all cows in a herd artificially, but to provide replacements only, makes it necessary for a farmer to keep his bull to mate late cows. The sole object of the work in New Zealand is the improvement of the national herd.

5. Cost of Artificial Insemination in relation to the value of the Cow:

- a. Denmark: About 25/- per cow.
- b. America: 5 dollars about 1/50th of the value of a cow.
- c. England: One pound to 25 shillings. About 1/40th of price.
- d. U.S.S.R.: If money payment is made it will vary from 1/20 to 1/60 of the value of a cow. The vast majority of the work is done without fee as part of the collective farm service.
- e. New Zealand: Not actually considered at present but would be high in proportion, say 1/12th.

Summarising the position in respect to the factors just considered we may say that in New Zealand:

- a. The National herd shows no margin between the production of the commercial herd and the pedigree herd.
- b. The standards set for bulls for artificial insemination are placed so high that very few qualify.

- c. An extremely short breeding season presents a problem in organisation.
- d. Subsidiary objectives do not exist.
- e. Relatively costs are high in proportion to the value of cows.
- f. Very specialised breed of cow.

Turning now to what has been done so far in New Zealand, we may consider the work as developing in three stages. The first was one of technical development spent in becoming familiar with the details of the various phases of the work. The second covered the first attempt to pass into extension work, while the third was a change from a simple to a more difficult technique which was found to give better results in the field. This change-over in technique was an important step which has far reaching effects on the volume of work possible in the very short dairy mating period in New Zealand. At first we visualised the wide-spread distribution of material from breeding units located at central points in the most concentrated dairying districts. In order to reduce costs and to ensure very wide coverage, we thought that a system could be developed whereby farmers handled their own cows while existing services such as cream collecting lorries, rural mail deliveries, could be used to distribute the material. An experiment was set up two years ago to try the system out on a fairly large scale. This was done, after a small field experiment the previous year had given some hopeful results. The large experiment failed in that the conception rates were far too low, though as far as the organisation was concerned, the plan worked very satisfactorily. This failure was a keen disappointment to many of us and it naturally raised many questions about our technique, the fertility of the bulls, the dose rate and so on. Some of these points will be dealt with in a moment, but here it is important to note that the experience gained in the field in this breeding season completely altered our outlook on the extension side of the work. Leaving aside for the moment the technical difficulties, let us look briefly at the problem from the point of view of field organisation, bearing in mind that the sole object of the work is the improvement of the national herd. This consists of about 1,700,000 dairy cows. Our field experiment of 1944 showed us that out of 2,600 cows inseminated 2,400 were inseminated in the first three weeks that the scheme was in operation. In round figures 90% of the estimated coverage had to be made in three weeks. While it is true that the national herd would have a slightly staggered mating season there is not much more than a month between Auckland and Wellington and little help can be expected from this direction. It is not reasonable to suppose that all the cows in the country would be mated artificially but, even supposing a group such as those cows included in the Herd Improvement Associations were attempted this would involve about 300,000 cows scattered throughout the length and breadth of New Zealand. It will be realised that it is rather a different matter to provide a daily insemination service as compared to a monthly test. At a conservative estimate we would expect from such a population at least 220,000 ready for service during the first three weeks. If 220,000 were actually ready for insemination in three weeks a much larger volume of semen would have to be prepared than would exactly cover that number, as it is impossible to predict what will be needed from day to day, and a certain margin allowed for safety. In round figures 70,000 cows would have to be done each week for the early part of the season to cover about 17% of the national herd. Even with the most generous estimates of services per bull, say one each day, and with extended dilutions say 1:25 the present pool of bulls is capable of covering 6% of such a group. (Actually neither of the two conditions mentioned above have been attained by us yet, so at present these estimates are very generous.) Thus with the techniques and bulls available to us at the moment we could cover about 6% of the 17% of the national herd with amounts to one per cent, which our generous estimates. The field experiment carried out two years ago brought

home to us very emphatically the hopeless task we were facing with the bulls at hand.

From the technical point of view we had several questions to answer: were the poor results due to the low fertility of the bulls, or to faulty technique? If our technique was at fault was it some detail which needed improving to bring the conception rate to a satisfactory level or were our methods basically incapable of producing the required results under the conditions imposed upon them? Up to this time we had been using the cervical technique exclusively, but when it became apparent that the results were not going to be satisfactory we made some intra-uterine inseminations for comparison, and the much better results showed quite clearly that the bulls at any rate were not the cause of the trouble.

The comparisons between the cervical and the uterine methods were important because it was felt that if we were forced to use the intra-uterine technique in order to obtain a satisfactory conception rate, it would limit the field work to what could be done by technicians, which would reduce the coverage to an insignificant level. It may be said that the cervical technique at a fifty per cent conception rate on the first round would suit New Zealand conditions better than the intra-uterine at a sixty five per cent level because of the much greater scope possible by the former method. The advantage to the uterine method would become more marked if it maintained its conception rate at higher dilutions than the cervical method. This is particularly important in New Zealand where the shortage of suitable bulls is so acute. The past season's work has shown that there is about a fifteen per cent advantage to the uterine method using dilutions up to one to four or one to six. We have not yet been able to show where the minimum figure of sperm concentration lies for satisfactory conception rates for each method, but the indications at present are that a good deal higher concentration is necessary with the cervical method. In short if we had an ample supply of the right type of bull the cervical method could be employed, but where the utmost use must be made of each bull by using high dilutions then the uterine method is forced upon us.

Summarising the position in New Zealand today we can say:-

1. The extremely seasonal nature of the breeding season produces an almost insurmountable barrier to the nation wide coverage of commercial cows.
2. Really outstanding bulls are impossible to obtain in large numbers.
3. In order to obtain the utmost from the bulls that are available we are forced to use a technique which is more restricted in use due to the greater skill required to do it, with an unavoidable increase in the cost of the service.

Before proceeding to suggest methods whereby we might make the best of the rather unfavourable situation outlined above, we must remember that we have gained in the past years very valuable experience in the management of bulls and the running of bull centres. And while satisfactory settling of cows by our bulls is the final object of our techniques, many subsidiary problems in the providing of regular service to farmers have been overcome. The handling and training of bulls, which had been running free with a herd of cows all their lives, and are then presented at a ripe age to the bull centre, unrun, and unhandled is no mean feat of which those concerned can be justly proud.

Our objective up to the present has been the improvement of the national herd through the extended use of outstanding bulls by artificial insemination on commercial herds. The improvement in the production of the daughters of our bulls over that of their dams would raise the national average production if our coverage were extensive enough.

I have tried to show that such a scheme is at present mechanically impossible if we are to maintain our standards in bulls and give an economic service. The outstanding shortage at the moment is the type of bull we are prepared to use, and until they are forthcoming in larger numbers very little can be done. It seems that artificial insemination could be most profitably used at present in pedigree herds to increase the number of really outstanding bulls that we have by breeding sons of proven sires which could be used naturally in commercial herds, i.e., using A.I. to breed bull calves rather than heifers. The assertion that the son of a proven sire is a better bet than the average run of bulls at present offered to commercial herds would have to be accepted, and of course the fullest co-operation from pedigree breeders would be necessary before such a scheme could have any useful effect. The advantages of this plan are:-

1. The much greater effect that would be felt in the industry with the sons of proven sires used naturally in commercial herds. Even with the present artificial insemination coverage a hundred bull calves should be available from each proven sire annually.
2. It is estimated that with an improvement in the numbers of bulls surveyed each year it would not be unreasonable to visualise a complete coverage of pedigree herds.
3. All progeny from the proven sires would be utilised. Under any scheme directed at the commercial herds only, half of the matings are ineffectual in contributing any advantage because the bull calves are sold at birth.
4. In pedigree herds the time factor is not quite such an important one as it is in commercial herds, so that the work could be scattered over a rather longer mating period, and out of season mating would not be beyond consideration.
5. The higher value of the pedigree cow and the value of the progeny should stand a higher insemination cost than could be borne by the commercial herd.

Although the difficulties are quite apparent in this approach, its implementation is from our point of view within the limits of our present techniques, while the earlier plan of dealing with commercial herds is, we feel, impossible at present.

An alternative plan would be the setting up of nursery farms for the breeding of bulls to meet our needs. This might be done after the manner of the Beltsville herd in America, where proven sires are sent to artificial breeding units all over America, or it might be organised along the lines of the Soviet G.P.R. or State Organisation for Cattle Improvement. In this case the cattle in an area are taken in hand by the State Organisation and improved to an extent, when young bulls are made available to other breeding units. Such a scheme might work in a locality where a group of breeders would co-operate in a concerted breeding plan. It is quite obvious that to obtain satisfactory results unified control would have to be exercised over all breeding in such a unit.

Both these systems involve a considerable departure from the usual practices adopted in breeding pedigree animals, and if put into practice would require a considerable sacrifice in personal control and judgment. If any other plan could be suggested that would produce the quality of bulls in the numbers required through the ordinary channels of trade the outlook for the success of herd improvement would be much brighter. Without the full co-operation of the pedigree breeders the task is going to be longer, and unless there is some profit incentive in the plan it is unlikely that the co-operation will be forthcoming.

The third alternative which suggests itself is the lowering of the present standard before bulls will be accepted for this work. If we still had the commercial herd in view this would seem a fairly reasonable way out. There are three main facts which rule it out of serious consideration.

In the first place it has been shown that it is at present impossible to make an impressionable coverage in an economic manner on commercial herds in the limited time available in New Zealand, secondly, there are not nearly enough bulls even if every surveyed sire were used irrespective of his results, and, thirdly, the expense entailed would be the same as if better bulls had been used and the small advantage gained, would not pay for the expense laid out in attaining it.

It seems clear that the present failure to improve the national herd through artificial insemination is due partly to the extreme shortage of the right bulls and partly to the limitations of the present techniques of artificial insemination. No technique available anywhere in the world today can help us out with the number of bulls coming forward each year. With the need for greater coverage from each bull each year by artificial insemination is the need for a great many more bulls of the right calibre, and the solution to this part of the problem lies with every dairy farmer, because the locating of the outstanding animal can only be done through consistent herd testing, and if progress is to be made this aspect of the work will have to be supported much more widely and consistently than it is at present. In addition if the benefits of herd testing and through it sire survey work are to be fully extended by artificial insemination the farmer will have to give up some of the orthodox practices such as discarding heifer calves from heifers, disposing of bulls too early, etc.

We are not satisfied with the present techniques, let us improve these, but at the same time let us realise that there will be a final limit to the coverage from each bull. By the time we have attained this limit let us see that there are sufficient bulls available with an average daughter production of over 400 lbs. of fat annually to allow us to make a worthwhile contribution towards improved production in our dairy stock in New Zealand.

Unless some definite plan combining all aspects of the problem can be worked out for New Zealand, the techniques of artificial insemination will remain an interesting but useless barnyard trick.

If we want to provide a service for small herds, or if we want to extend the coverage of existing fashionable bulls we are in a position now to provide such a service, but the end result will be something very different from what we have been working for during the past six years. Such a system might be termed an artificial insemination scheme but not a herd improvement plan. In the course of the work which has been done among farmers, it has been obvious that something more than calves from good bulls is expected from artificial insemination. The sterility problem thrusts itself unwelcomed upon us at every turn. Although it was stated earlier in this paper that artificial insemination did not hold any hope in itself of solving sterility problems in general, the organisation of an artificial breeding unit offers a good opportunity for valuable work in this direction. The mere fact of recording accurately the service dates and sexual behaviour of cows serves as a starting point in investigations, and the use of bulls which are settling cows in other herds would at least indicate the cow as the source of the trouble under such circumstances. This aspect of the work has received very little attention in the past due to lack of man-power, it surely provides another important consideration in the plans for the future.

In conclusion it appears quite clear that the improvement of the national herd by the help of artificial insemination is

not going to be an easy or a quick process. To obtain even a small increase in average production it is going to mean better work from technicians, stud breeders and commercial dairy farmers. Let each of us see to it that we are contributing our full share in working out the solutions to the many-sided problems of dairy herd improvement in New Zealand.

DISCUSSION ON MR. JAMES' PAPER:

THE PRESIDENT: We all know that the dairy industry is at an absolute standstill. In the not far-distant future, our competition overseas in butter and cheese will be ever so much more intense than it is at the moment, and you can be certain that farmers overseas will follow modern lines. Is this country prepared to get down to modern methods? Many a farmer has spent hundreds of pounds on bulls to improve his herd from a 350 lb. average, and he is probably averaging 330 lb. today. So even if the cost of artificial insemination were £2 or £3 a cow, I am sure there are many dairy farmers with pedigree cows who would be willing to pay that price, if they could be assured that they would get 30 to 40 calves from such a bull, half, say, being heifer calves. As I see the position today, it is not a question of what it is going to cost the industry. It is to artificial insemination that we must look to bring about an improvement in the very shortest space of time. Mr. James has emphasised that the short-cut is improving our pedigree herds. Every service, or close on every second service, would mean a pedigree bull from an outstanding sire to head the grade herds of the Dominion. The important thing is, however, what is it going to take to get the breeders to look at it from that point of view? The breeders are out to supply what the market asks for, and the market is asking, generally speaking, for nothing but a pedigree bull. Well, if we have to wait until the breeders change their minds, or their objective, and supply what is really for the good of the industry, I wonder how long that is going to take. This is a more important question than any since dairying started in this country.

DR. McMEEKAN: We all thank Mr. James for his very thoughtful paper, one which fits admirably into the picture that has been presented to us so far today. Subject to correction by Mr. James, I would like to review my summing up of the situation. It appears to me that in our dairy cattle breeding work, we tried first of all herd testing, or cow testing, as a means of improvement. It failed, because of the poor parent and progeny correlation, or, in other words, the impossibility of getting anywhere with dam selection. The next step was the development of the sire survey scheme in the hope that improvement would come through the sire. That has also failed apparently, because it represented merely a theoretical possibility. In actual numbers, they are so few as to be negligible, and our present machinery is not likely to improve that result. It was hoped, however, that artificial insemination would overcome the weakness of numbers by spreading the sire over a larger population. Mr. James has suggested that that also has very definite limitations, and, from the national herd point of view, is completely impractical at the present time. In his proposals at the end, he draws attention to what appears to be the next logical line of attack - that of attempting to exploit the proven sire through its use on the pedigree cow. That system would obviously provide sons of proven sire, which, as Mr. Stewart has pointed out, are probably a better bet, but only probably. The point I want to make is this: just as we had to try herd-testing and so on as methods of improvement, so does it seem vital that this method suggested by Mr. James should also be tried, but the emphasis should be placed on the fact that such trial will still be in the nature of an experimental approach. We do not know definitely that the sons of the proven sires will be any better than the average bull in use in the industry today. And we will not know it until we can persuade pedigree breeders to use the proven sires which at the moment they are not using by A.I. to

provide them in large numbers, to be tested by the Group Testing Association. The only other comment I have to make is in regard to Mr. James' suggestion that the standard of sire in use for A.I. might be lowered. Our present standard, I would submit, is low enough. It means the production of 385 of fat; if we reduced it to 330 lb. of fat - equal to a herd average of 280 lb. - we would still not be increasing the number of bulls very substantially, and a standard of that level would not appeal to even the commercial farmer with whom we are dealing; it certainly would not appeal to the pedigree breeder.

MR. COOPER: Recently Mr. Stewart and I visited one of the leading Jersey breeders in this country - a man with 13 bulls in the present bull list - and we suggested to him, more or less trailing our coats, what about a policy of using just proven bulls. Well, he "did his scone" completely. He was completely wedded to the idea of family matings. He had followed that idea all through, and, incidentally, the majority of his proven bulls are all traced from one family, which gives him confidence in his assertion. I do not know whether Mr. James has made any approaches to pedigree breeders, but he will be up against tremendous conventional opposition to any suggestion of using proven bulls indiscriminately. The industry should develop those methods quite independently of the stud breeders, and, if it were successful, the stud breeders would probably come into line.

DR. HAMILTON: We are dealing with a very complex problem here. At the present time, our herd average is about 240 lb. per cow at the pail. Dr. McMeekan has mentioned that the bulls being used at Ruakura conform with the standard the Herd Recording Council has laid down, having an average progeny production of about 385 of fat, which is roughly equivalent to a herd average of about 335 lb. That leaves a considerable margin of about 90 lb. above the herd average for the Dominion. I am inclined to think that for certain districts in the Dominion, or even perhaps for certain herds, we could appreciably lower that standard, or, alternatively, one could say that breeding is not the limiting factor to production in the case of almost 50 per cent. of the herds in the Dominion, but rather feeding. It is purely hypothetical to talk in terms of putting almost super-quality, proven sires over herds where one could say with some confidence that feeding was the limiting factor to production. I think, both from the national and individual breeders' point of view, it would be an extremely wasteful procedure. You have only to look through the analysis of average production per cow in the Dairy Council's report, to be amazed at the number of herds - some very big herds - with appallingly low productions. In a very good season - 1940-41 - I found that in the Whangarei County there were herds of 100 cows producing under 140 lb. of fat per cow at the pail. I do not think artificial insemination is of even remote interest to those herds. The first thing they have to do is to learn to feed their cows. The type of bull we have selected initially for A.I. work at Ruakura, I think, was chosen to a certain extent for propaganda purposes - we wanted the progeny produced by artificial insemination to be good. We wanted to sell to the industry the idea that A.I. was a good thing, and with that idea in mind we purposely kept a standard at a very high level, which we have been able to maintain for the scope of the work carried out. As to the physical impossibility of covering those districts or herds which would be prepared to come into artificial insemination schemes, I would quite agree with Mr. James that if somebody said tomorrow that we had to start out and cover say half the herds in the Dominion, or, as he suggested, just those in the Herd Improvement Associations, it could not be done, but it seems to me that this is a thing which, like herd testing, must develop gradually, with technicians being trained a few at a time. I think, too, that there is a reasonable possibility that other work might be found for those technicians during the other nine or ten months of the year. I know, for instance, that Dr. Filmer has been worried about the manpower situation in regard to vaccinations for con-

tagious abortion. Those technicians might be trained to do that work also. Other projects of the Council - tuberculosis action, for instance - have been discussed by the Council from time to time, but they have always been shelved because of the impracticability of getting the trained personnel. There are all sorts of possible schemes of that nature which require consideration in drawing up any plan for improvement. Mr. James has given us an exceedingly valuable and balanced picture, but he is a little unduly pessimistic about the possibilities of covering fairly large numbers of grade herds, and, as Mr. Cooper pointed out, a little optimistic about the co-operation he will be able to get from the pedigree breeder.

DR. FILMER: There is one item in this very big subject which has not yet been touched on. You cannot have proven sires if you use only proven sires; in other words, to prove sires, you have to take unproven young bulls and use them in order to get enough cows to provide enough progeny in order to prove those that will prove. So the system must provide for the utilisation of quite large numbers of young bulls in the industry - whether they are used by artificial insemination or by natural mating. If they are used by natural mating, the coverage will be larger, which, in some respects, might be desirable in giving you a chance to pick up a very small number of really high producers. It seems to me that the scheme Mr. James has suggested, of using your proven sires in the pedigree herds, enables you - if the theory is right, and one must admit it still has to be proved - by turning out sons of those proven sires from the best of our cows for proving, to start that much higher up in the proving scale. If the idea is right, then surely with each generation we lift that a little higher again. There is a chance of grading up gradually by that method. It has been suggested that the demand always creates the supply. I very much question that doctrine. If we go back through history, we will find that some of the innovations that are today considered necessities were strenuously opposed. The first motor-car on the streets was almost torn to pieces, because it was considered to be an invention of the devil. I suggest that the supply will create the demand, and I believe it is our job to show how to breed the right bulls. Our first approach at least, should be to the pedigree breeders. If we cannot do anything with them, as somebody has suggested we cannot, then obviously the industry has to find some other means of doing it, but I believe we should, in the first instance, do our utmost to enable the pedigree breeders to use the methods which we believe are most likely to produce the results, and until we do fail we should not anticipate failure.

MR. CANDY: I am one of those who feel Mr. James was a little too woeful in regard to the particular project in which he has, I think, rendered signal service to the farming community. We have made various approaches to herd improvement work. Dr. McMeekan said our sire survey work had been tried and had failed; now we have tried A.I. and it has failed. This term "failure" to my mind, is completely wrong. It is not that the sire survey system has failed, but that we have failed at this stage to educate a sufficient section of the farming community to the value of it. That is where we have failed - not in the doing of the thing itself. That has been one of the fundamental factors in our herd improvement plan, and was the reason for the inauguration of our system of consulting officers in the various areas, a system which we have to extend as time goes on for the very purpose of educating the farming community as a whole, whether it be a grade farmer to the necessity of having his herd testing records kept year by year, or whether it be to try and dissipate some of the ideas the pedigree breeders have had over a long period of years, which ideas, rightly or wrongly you workers in various fields consider need a complete overhaul. If we are able, by education, to get that respect and understanding of our problems from a greater percentage of the farming community, then all these things will add their quota to raising the standard of cattle. Dr. Hamilton made a pertinent

point when he said our average production per cow was about 240 lb. and we would not raise anything by A.I. under the equivalent of 330 lb. I think it was explained at this meeting last year by Mr. Ward the tremendous economy gained to this country on every 10 lb. fat rise in production of our cows, and there is certainly a very big margin where we can make an improvement. It appears to me that what we are trying to do is to breed a higher percentage of bulls of such calibre that the ordinary farmers lacking general knowledge in the selection of bulls, will be forced to buy something better than if you did not do the work. If you are able, by various means, to provide for him a higher percentage of bulls - whether used under A.I. or natural - which have the factors considered desirable for relatively high and continued production, then you are doing a very worthy job indeed. We owe our thanks to the Animal Research Division, Dr. McMeekan, Mr. James, and their officers, for the work they have done in this particular sphere. If they feel the road is long and hard, and is going uphill, we will hope for a very bright future not far ahead. Every road has its turning.

DR. McMAHON: I know there are certain differences between a sheep and a cow, and I know that you are dealing with a more strongly inherited feature in milk and butter-fat production than we are with fleece weight, but I would stress the difficulty of completely eliminating environmental factors in cases where you are comparing bulls tested under different environments. I think A.I. might play a very useful part. If you turned your scheme round the other way, Dr. Filmer, and used A.I. to test a number of bulls, with a few progeny each in a different environment, you would get a much more accurate progeny test. I believe you might make more progress like that, than working through a lesser progeny test and a very efficient A.I. system.

DR. McMEEKAN: It is being done in a slightly different manner. Through artificial insemination, Mr. James has put a number of sons of proven sires over cows in a large number of different herds. Our object was deliberately one of attempting to supply our own source of proven sires more rapidly by getting a large number of daughters, and more accurately by eliminating the effect of environment. I emphatically disagree with Mr. Candy's remarks. I believe that the herd test has not failed because we have failed to persuade all the farmers to test, but because of the inherent weakness in the system itself - a weakness associated with poor parent-progeny correlation. Similarly, my reason for suggesting that the sire-survey system has failed is essentially tied up with the fact that in order to provide sufficient bulls for the job, we would have to have all the cows in the Dominion under test, and approximately three-eighths of the daughters going into the herds each year being the daughters of unproven bulls in order to maintain the supply of proven sires to produce the other five-eighths of replacement daughters from such animals. In terms of simple arithmetic, the sire survey system really does not work. That is a statement I throw out for discussion, and I hope Dr. McMahon's statement on sheep, in respect of the difference between it and the cow, will have some bearing on it. At the moment, there is one "snag", in my opinion, to his argument. I do not think we yet have sufficient reliable information to suggest that feeding is the main cause of the difference in per-cow production. In support of that statement, I make two comments: this year, New Zealand has been faced in its major dairying areas with the greatest food shortage during the bulk of the season that they have ever experienced, and yet production per cow in those areas for the season are down about 17 per cent.

MR. CANDY: More than that.

DR. McMEEKAN: The figures I saw last week showed 17 per cent to the end of March.