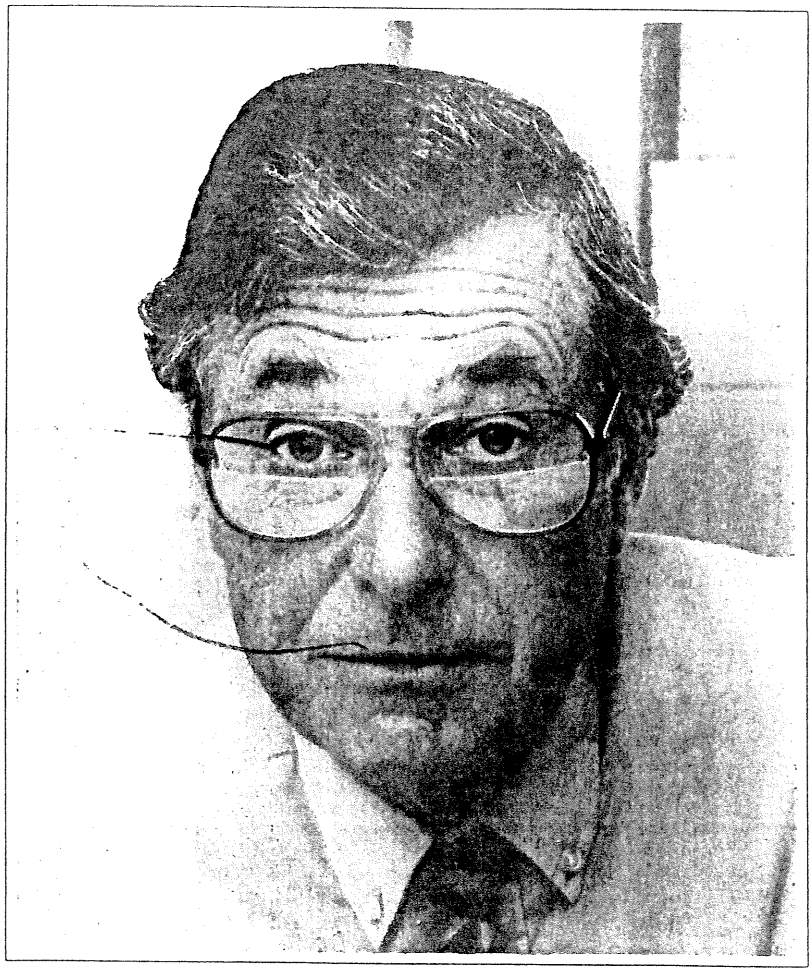
THE ALBERT MESSERVY MEMORIAL CONFERENCE



"TO IMPORT THE SEMEN OF SUPERIOR PROGENY TESTED SIRES OR NOT TO IMPORT SEMEN"

by Dr. James Allan, Ph.D.

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production proof of the bull donors is, at this stage, of lesser importance than the choosing of bulls whose ancestors were exported from the Island as far back in time and generations as possible. While some of the owners of high production herds agree that exportation has depleted the genetic resourses of the Island stock, they see the effect rather as a limitation on further improvement within the confines of the Island. They feel that imported semen should be from the very best production-proven sires.

2. Some breeders say the identification of Island bulls with better than average breeding ability for production has been inefficient and that preferential use has not been made of the better bulls. They say there has been a general tendency for young bulls to be more popular than plus-proven sires and that these factors have reduced the rate of genetic improvement in producing ability of the Island stock. They feel the genetic potential for production has fallen behind that of other countries and that the application of more efficient progeny testing in other countries has widened the gap. They feel the only remedy is to import semen from the best available proven sires.

Others feel the Jersey cattle of other countries are not necessarily better than the Island stock and that importation of semen will not necessarily be of advantage to the Island. They point out that in 1985/86 the average production of Jersey cattle in the United Kingdom was 3954 kg. milk at 5.33 percent, giving 211 kg. butterfat while that for the Island was 3914 kg. milk at 5.29 percent and 207 kg. butterfat. They feel the difference is small in spite of the larger population of Jerseys in the United Kingdom. (22000 vs 4000) and in spite of the importance of semen into the U.K. from various countries over the past years. They feel the Island average could be significantly increased by improved feeding and management in a number of herds. They point out that the yield levels of the top producing Island herds compare favourably with the top producing herds of the United Kingdom. They feel that a policy of line breeding based on a personal knowledge of the Island animals has yielded good results in the past and can continue to do so.

3. An increase in level of production as a result of the importation of semen is seen by some as a critical economic need. Counter argument is that easily available loans have led to over capitalization and that such producers are looking for an easy way of improving the profitability of production. Further counter argument is that the economic squeeze being experienced by some producers is due to inefficient mangement of financial affairs and that the situation would not be improved by importation.

4. A Breeding Policy Working Party was appointed by the Council for the Royal Jersey A and H Society in 1979. This followed a referendum which had indicated that the members of the Society did not want to import semen into the Island. The Working Party showed that a total of 5,625 heifers were registered during the five years from 1974 to 1978. They were sired by 296 different bulls. More than half of these bulls sired less than 15 daughters each, while only three sired 100 daughters or more. Breeders were, therefore, made aware that most bulls do not stay in their herds long enough to become fully proven before being replaced by younger bulls. The Working Party concluded that, if there is to be a genetic improvement in milk production or in its components, more bulls must be progeny tested more efficiently and greater use should be made of sires who have been identified by their progeny tests to be production improvers. It was suggested that a more efficient system of identification of superior animals could be facilitated by the formation of co-operative breeders' groups, a Breed Society information service, a Breed Society semen bank, the introduction, at that time, of an improved contemporary comparison and a cow production index.

WHAT HAS BEEN THE THINKING OF OTHERS?

Mr. Ken Deeble of A.D.A.S. presented a paper, "Breeding Policies and Artificial Insemination in Jersey" to the 9th. Conference of the World Jersey Cattle Bureau in 1979. He considered the coefficients of inbreeding of a stratified sample of 200 heifers registered over a two year period. These heifers were born between April 1975 and October 1977. He was concerned about "current" inbreeding and, therefore, based his measurements on a complete pedigree for each heifer to the great-grandparental generation. He found that 63 percent of the heifers showed no inbreeding whatever during the four generations. A further 21.5 percent averaged just over one percent of inbreeding and most of the remaining 15.5. percent were six to twelve percent inbred. The overall weighted average coefficient of inbreeding was only 1.8 percent and he concluded that this amount of "current" inbreeding gave no cause for concern.

He was aware that only about 25 percent of the Island's already limited number of cows were available for mating by artificial insemination to young bulls on test. He was aware of the relatively large number of natural service bulls in use - the 200 sampled heifers were sired by 93 bulls. He was aware also that it is difficult to have contemporary daughters by different bulls for comparison within a small herd. He, therefore, drew attention to the fact that the large number of small Island herds contri-

buted significantly to the difficulty of finding bulls with an acceptable level of reliability of proof. These considerations led Ken Deeble to the conclusion that there were only two options open to the Livestock Advisory Panel of the States Committee of Agriculture.

The first option was to find a continuing supply of bulls from within the Island. He rejected this because of the inefficiency, at the time, of the progeny testing of bulls in the Island. The second option, which was the one he favoured, was to import the semen of the best and most reliably proven bulls from those countries which could meet the health requirements defined by the Island of Jersey. He felt that semen importation would provide a considerable degree of flexibility to the A.I. operation, more choice to farmers and a broadening of the genetic base in the Island. He felt, too, that it need not be more expensive.

He concluded his report by making a number of suggestions for improving the efficiency of identifying bulls and cows of superior breeding ability. These suggestions included methods for overcoming the lack of contemporaneity in small herds. One method involved the use of a few reliably proven bulls to act as "marker" bulls and so provide comparisons "across herds". As an alternative to this, he suggested the adoption of a system of "within Island" comparisons for milk yield and its components. Several of his other suggestions have been included in the current processing of Jersey Island production records in the calculation, by the Milk Marketing Board, of Improved Contemporary Comparisons.

Dr Broadbent and Mr Bourchier, both of A.D.A.S., were asked in 1985 to assess the current procedure of Jersey cattle breeding in the Island and to make recommendations regarding future policy. I will use the present tense because the report was submitted only two years ago.

They define the marketing objectives of Jersey Island cattle breeders as, (1) Dairy products for the Island market and, (2) Breeding stock for export. They are satisfied that the first objective is being achieved. They feel that, although udder conformation, legs, feet and general type are extremely good, the latter objective is not being satisfactorily achieved because, "production leaves much to be desired". They ascribe this shortfall to the fact that a relatively large number of bulls is used so that their average genetic merit is likely to be as near to breed average as to insure that there is very little, if any, genetic progress in production terms. They point out that this situation has existed for many years and is the result of a large number of small herds and a high proportion of natural service coupled with, in the past, a rather less than adequate system of genetic

evaluation of animals in the Island. They feel that production traits will have to be improved if Island cattle are to compete successfully for the world export trade.

The are pleased to note that the protein content of the milk of Island cows is now being recorded, that ICC's based on sophisticated correction factors are now being calculated by the MMB for Island bulls and that the facility of a Cow Genetic Index (CGI) for the identification of cows of superior breeding ability is now available. They feel, however, that a conventional progeny testing programme within the confines of the Island is still not feasible. They reject the practicality of progeny testing Island bulls in other countries as well as the possibility of overall improvement by line breeding. The feel the importation of semen is the best option available to Island breeders and that, if this course of action is taken, the semen of five or six bulls should be imported. This semen could be used to complement the existing A.I. stud so that the progeny of Island and other bulls could be compared in the same herds and years.

YOU HAVE ASKED ME WHAT I THINK

I would like to say at the outset that I agree with Mr. Francis Le Ruez in his assertion that no "system" can replace the care, judgement, eye and experience that goes into breeding. At the same time, I think that all four of these attributes can be enhanced by the marshalling of information - information, for example, about what a bull has bred concerning type, temperament and components of conformation as well as the yield of milk, butterfat and protein. What I think is important, is that the information be available at an early enough age of the animal for the breeder to make timely decisions.

I do not think it is wise, in a community where interests cover a diversity of marketing fields, for a group concerned with, say, the fresh milk market to demand that bulls be ranked only according to the milk yield of their daughters and to demand that only those bulls with an ICC rating greater than, say +100 kg. be eligible for further use. The rank order of merit of the available bulls could be significantly reshuffled by sorting them according to weight of butterfat, weight of protein or combined weight of butterfat and protein. And their rank order of merit could again be significantly reshuffled by evaluating them according to overall type or any combination of components of conformation. I do not think any one criterion of classification would be more correct than any other. This is because I think each breeder should have the freedom to attempt to satisfy the needs

of his chosen segment of the market. To me it is of paramount importance for a breeder to base his chosen strategy on information which is both reliable and available in time to use it constructively. I think that too little information is available on too may animals too late in their lifetimes.

Let me explain, by example, what I mean. I have given the numbers and names of 13 bulls in Table 1. They were all aged between 5 years and 5 years 11 months in March this year. Most were alive at that time. Most had their first daughters registered in 1983 and registrations of additional daughters continued during the following three years. Had all their heifers been registered in 1983, a lot would have been known, in 1987, about the breeding values of these bulls. You would have had reliable information about milk, butterfat and protein yield, temperament, type and all the components of conformation. You would have been able to use this information in making selection decisions in your breeding programmes. Each breeder could have used that part of the information that he considers important in the achievement of his breeding objectives. What do you, in fact, have? You have only one or two completed records of the daughters of four of the bulls. This does not say much about either type or production and the problem is that additional information will accumulate slowly over the next two or three years. The pattern of bull usage, being spread sparsely over several years, prevents you from having reliable information when you need it.

It may be argued that this assertion is not really valid, that information on these bulls will accumulate more rapidly and that you will be able to use it in making informed selection decisions next year. To test this fairly critically, let us skip the six year old bulls and look at the nine most popular bulls who were either seven or eight years old in March this year and who were alive in the Island at that time. I have listed them in Table 2 according to their ICC ratings for milk yield but have also given the butterfat and protein yields to show that the order of merit would be reshuffled by choosing either one of these or their sum as the criterion of merit. I have given the total number of registered daughters sired by each bull during the past five years, from 1982 to 1986, and, most important, his ICC weighting factor which is a measure of the reliability of the ralative yield ratings. Apart from Stuart Oxford Triumph, Lynn's Dairylike Dreamer, Melpomene's Welcome Boy and Golden Natalie's Noble, the weighting factors are very low. This confirms my assertion concerning the slow rate at which information is accumulated on the breeding values of bulls. The low weighting factors also

show that the production information in Table 2 is unreliable. By the time information with an acceptable degree of reliability has been accumulated, it will be of very little use in a breeding programme. I must emphasise that this is a product of the pattern of bull usage in so far that, when the decision has been made to use a young bull, he is not used heavily enough in that year.

I find it interesting, in spite of criticism to the effect that too much attention is given to type and conformation, that a summary of such information on the daughters of each bull is not freely available. I am sure that marshalled information of this nature would be of use to breeders in making their selection decisions.

I would like now to look at some of the older bulls - nine years and older - who had heifers registered during the past five years, from 1982 to 1986. I have listed the 15 most popular bulls in this age category in Table 3 with their ICC ratings and the number of daughters registered during the five year period. Every one of them had daughters registered in 1986. In fact, on average, one fifth (128) of their (636) daughters were registered in 1986. Only two of these bulls, Colombo and Cresta's Gay Prince, are still alive in the Island and their weighting factors are only nine and five respectively. I think this confirms my earlier comment about too little information too late. I think it is even further confirmed by the observation that the total of 313 daughters registered over the past five years from the bulls with positive ICC ratings for milk yield is not significantly different from the total of 323 daughters from those with negative ratings.

To what extent have these bulls been used to breed sons, grandsons and great grandsons? I have marshalled this information, together with some of the inter-relationships between the bulls themselves, in Table 4. It is encouraging to see that considerably more sons and grandsons have been bred from the bulls in the upper part of the Table, with positive ICC ratings for milk yield, than from those lower down. On the other hand, it is a little disconcerting to see that Munifordia's Gamboge has been allowed to have such a great influence. His sons, grandsons, and great grandsons have bred 780 registered daughters over the past five years.

I would like to return for a moment, on a very much more encouraging note, to Table 3. The weighting factors, as measures of the reliability of estimation of the breeding values of the bulls, are generally higher than those of the younger bulls in Table 2. The observed variation in the production ratings, i.e. Milk from -195 kg. to +287 kg., Butterfat from

-13.2 kg. to +15.2 kg. and Protein from -3.2 kg. to +8.3 kg. represents genetic variation and it would seem there is plenty of it. I think this should allay the fears of those breeders who feel there is too little genetic variation within the Island on which to select.

I would like to look, briefly, at the 68 bulls who were three or four years of age in March 1987 and who had a total of 909 daughters registered during the three years, from 1984 to 1986. Here again, the pattern of light use, spread over several years, can be clearly seen. I think this is the most important problem area in reducing the avilability of timely and reliable information about the breeding abilities of bulls in the Island - breeding abilities for conformation as well as for production. The 16 most popular bulls in this relatively young group were responsible for 466 of the 909 daughters registered. (See Table 5.) The other 443 were sired by 52 bulls, each with a few daughters, and no-one seems to be particularly interested in any of them. This is a pity because more than half of them could have been given a reasonable chance of proving themselves.

So much for comment and criticism. What can be done about it and what sort of answer can I give to the original question concerning the importation of semen? Allow me to express three wishes. Firstly, I hope I am correct in assuming that you agree with the definition that selection is choice based on information. If this is so, we can consider when and how the required information on type, conformation and production can be collected and marshalled. Secondly, I hope you realize, with fewer than 4000 cows, that you cannot afford the luxury of restricting the testing of bulls to a small group of co-operating herds. As you will see, however, the acceptance of this does not constitute a radical change from what most of you are doing at present. Thirdly, I hope you will accept that the testing of 150 bulls over a four year period is unnecessarily excessive and that a carefully considered reduction to, say, 60 could satisfy the requirements of all breeders.

As I see it, the Island requires an infrastructure for the testing of young bulls with a view to obtaining timely and reliable information on their breeding abilities for both type and production. As I see it, too, this infrastructure will be as important for the establishment, within the Island, of a meaningful improvement programme as it will be for the intelligent use of imported semen, should you decide to avail yourselves of this option. The infrastructure must make provision for the further use of those proven bulls which the individual breeder considers to be of value in attempting to meet the requirements of his chosen sector of the market, and so to recover the

costs of the testing programme.

With the design of an infrastructure in mind, I studied the age structures of 51 herds, each with at least 20 lactations in the same year. These gave estimates of the average survival rates in successive lactations and, therefore, of the age structure of the "Island herd" The results are given in Table 6. Please accept that the following figures serve only as a guide and are, therefore, modifiable. I based the calculations on a total of 3500 lactations to allow for the exclusion from testing of the top, say, 100 cows for contract matings, in each year, to breed bulls for testing. These could be, say, 50 cows identified by a Cow Genetic Index (CGI) to be those with the best estimated breeding values for production and, say, 50 cows identified by the senior judges of the Island to be of the most desirable type.

Were 15 young bulls of your choice to be mated in each year of the testing period to 3500 cows, it would represent the insemination of 233 cows per test bull and this would lead, under normal circumstances, to 760/15 = 50 first lactations per test bull. By "normal" I am referring to the fact that only 50 percent of heifer calves born are registered. It would be necessary to ensure that the daughters of bulls on test be equitably distributed over herds, with special attention being given to contemporaneity of daughters of different bulls in the same herd, particularly in small herds. Perhaps the formation of Breeders' Groups whose members have similar objectives could help in controlling this. The 15 young bulls should be withdrawn from service after 12 to 14 months to collect and store their semen. They would be replaced by a second set of young bulls, again of your choice, for use during the next 12 to 14 months. This procedure would be followed four times in a given cycle.

The daughters of each successive set of bulls would complete their first lactations in groups over the following four years, thus providing timely and reliable information on the breeding abilities of their sires with respect to both type and production. Each set of proven bulls could then be used for further matings to all cows during the year following the completion of their own daughters' lactations. There would be four successive "further use" years. The decision as to which bulls would be used in this way would rest entirely with the individual breeder.

I am sure some bulls would not be used further and for this reason I have noted a nominal minimum selection of 5/15 in each of the four "further use" years. I do not think that fewer that 5/15 proven bulls per set should be

used for breeding additional daughters or, especially, replacement sons. But, even with this minimum of 4 x 5 = 20 selected bulls per cycle, the increase in the coefficient of inbreeding per 12 year period need not be greater than one percent. I want to stress that the 60 bulls per testing cycle would be of your choice and that, when proven, the decision as to which of them will be used further will also be yours. I see no need for corporate regulations in this matter. If a breeder is prepared to contribute to the testing of bulls, he should be free to use them according to his own assessment of the test results. There would be a further advantage in this system of concentrated matings over relatively short periods in so far that, during the four years of "further use" of the proven sires, twice as many daughters could be raised than is usual. These could be used to replace the poorer cows in the milking herd or offered for sale to overseas buyers as animals with a reliable performance backing. The age structure and composition of the "Island herd" would also be fairly well defined. This could be of considerable use to overseas buyers and to yourselves.

I had originally thought to start this paper with an assessment of inbreeding and the role it may play in coming to a decision concerning the advisability of importing semen. It seems now that its most logical place is at the end. Were the Island stock to be inbred, on average, say, 20 percent, I would consider it advisable to import. It was necessary, therefore, to have a measure of inbreeding. I drew a stratified sample of 200 heifer calves registered in 1986 and completed each pedigree in full to the grandparental generation. I then traced a random line from each grandparent according to the method of Wright and McPhee (1925) for a further, on average, nine generations to a base population represented by animals alive in the Island between 1925 and 1935. I divided the inbreeding into current, intermediate and long term periods and found the coefficient to be no more than two percent in each period.

Lord Jersey has found that all bulls trace back to Flying Fox and has expressed concern about the accumulated total coefficient of inbreeding over the past 225 years. I am disinclined to share in this concern because there are many known cases of the so called "founder principle" in both naturally and artificially established populations which have shown no ill effects. I found the current generation interval to be very close to five years and, since Island breeding practice is unlikely to have varied very greatly in

this respect, the 225 year history of the Island breed is equivalent to some 45 generations. I think the culling of off-type animals and the existence of genetic repair mechanisms have both had an advantageous effect over a long period of slow inbreeding.

The total of six percent is very low. This, together with the small expected increase in the coefficient of inbreeding in the proposed testing system and the presence of sufficient genetic variation in yield of milk, butterfat and protein in the Island stock, makes it unnecessary to import semen. I must admit that I am personally relieved to find that it is not necessary. I think the Island breed can be improved in a variety of ways by diligent testing and the judicious use of tested bulls and cows. By doing this, I think you will be able to compete successfully in the various facets of the local and international markets.

TABLE 1 The number of heifers registered per year over the four years, 1983 to 1986, and sired by bulls who were aged between 5 years and 5 years 11 months in March 1987. The ICC weighting factor, W, is given for bulls who were evaluated on 12 December 1986.

		No. of heifers registered					
No.	Bull	'83	'84	'85	'86	Tot.	W
0519	Chalet Sunny Royal	-	9	12	21	42	-
0520	Louise's April Lad	5	18	21	3	47	1.7
0522	Papillon	17	10	7	2	36	3.4
0525	Avonteur Begere Dazzler	5	11	3	-	19	-
0526	Ansom Renown	5	3	7	7	22	-
0537	Victorious Beau	13	12	2	9	36	-
0539	Munifordia's Masterman	3	18	7	6	34	-
0547	Stuart Designer's Crest	3	25	29	19	76	-
0553	Lynn's Dairylike Majesty	3	15	16	11	45	0.9
0557	Firecrest Oxford Guy	-	15	13	12	40	-
0558	Blanc Pignon Rosewood Boy	8	34	40	5	87	0.9
0560	Typro's Lucky Lad	-	3	9	5	17	-
0565	Bagatelle Oxford R.G.M.	6	23	21	8	58	-

TABLE 2 The ICC ratings of the 15 most popular bulls who were either seven or eight years old in March 1987 and who had heifers registered over the past five years, from 1982 to 1986.

No.	Bull	Number of heifers	ICC rating			
			Milk kg	B'fat kg	Prot. kg	W
0361	Supreme Vedas Lord	44	+150	+2.9	+3.6	1.6
0388	Supreme Vedas Advancer	72	+113	+5.4	+2.6	8.9
0411	Guarding Oxfordia Ruler	44	+ 68	+5.4	+1.7	6.5
0394	Stuart Oxford Triumph*	75	+ 62	+5.0	+3.4	19.8
0399	Itaska's Fillpail Twinkler	45	+ 54	-0.1	+2.8	5.0
0488	Dazzle's Golden Boy	45	+ 48	+2.3	+0.9	3.1
0452	Holmdale Duke	32	+ 5	-1.4	+0.4	2.2
0449	Melpomene's Welcome Boy*	73	- 5	+5.1	+1.8	28.4
0477	Zebre's Dazzling Zenith	31	- 5	+3.6	+2.4	5.4
0372	Day Dreamer	33	- 7	-6.7	+0.3	7.3
0430	Margarethe Designer	28	- 9	-3.0	-3.3	5.5
0465	Margarethe Dream Dazzler	34	- 28	+3.0	-2.1	3.6
0420	Golden Natalie's Noble	68	- 45	+1.8	+2.4	18.6
0345	Samudra's Ruler	49	-105	-5.2	-2.6	7.7
0375	Lynn's Dairylike Dreamer	47	-158	-8.4	-9.1	18.3

Note: (1) All but two (*) of these bulls were alive in the Island in March 1987.

(2) I do not have the ICC rating for Margarethe Keep Dreamer 0508 who had 54 heifers registered.

TABLE 3 The ICC ratings of the 15 most popular bulls who were nine years old or older in March 1987 and who had heifers registered over the past five years, from 1982 to 1986.

		No. daughters		ICC rating			
		Total		Milk	B'fat	Prot.	
No.	Bull	5 yrs	1986	kg	kg	kg	W
9905	Oakwood Keeping Designer	58	10	+287	+15.2	+5.1	51
9869	Sybil's Oxford Pride Lord	30	5	+234	+ 6.4	+8.3	27
0216	Dreamer's Margarethe Royal	51	7	+179	+12.7	+6.7	13
0252	Natalie's Gamboge	30	18	+ 79	+ 4.7	-0.6	13
082	Munifordia's Gamboge	69	12	+ 64	+ 5.7	+4.1	27
0299	Colombo	50	17	+ 63	+ 1.4	+1.1	9
0142	Natalie's Surprise Ruler	25	10	+ 11	+ 8.3	+4.2	14
0249	Cresta's Gay Prince	41	9	- 10	- 1.3	+0.8	5
9640	Fairfield Advancer	29	9	- 20	- 7.0	+3.8	27
0277	Ceres Margarethe Royal	25	6	- 41	- 1.3	-2.1	7
0335	East Lynn Surprise Beau	25	5	- 97	- 2.1	-2.5	16
0330	Natalie's Double Lad	54	10	-100	- 5.7	+0.9	13
0327	Natalie's Navigator	53	2	-103	- 3.3	-3.2	85
0110	Mermaid's Warrior Count	74	1	-109	-13.2	-0.9	24
014	Fairfield Lorenzo	22	7	-195	+ 2.8	+2.9	21
		636	128				

TABLE 4 The number of sons, grandsons and great grandsons bred from the bulls of nine years and older in Table 3.

No.	Bull	No. of sons	No. of g'sons	No. of great g'sons
9905	Oakwood Keeping Designer	5	-	-
9869	Sybil's Oxford Pride Lord	2	2	-
0216	Dreamer's Margarethe Royal	6	1	-
0252	Natalie's Gamboge (Son of MG)	2	1	-
082	Munifordia's Gamboge (MG)	11	8	8
0299	Colombo (Son of MG)	-	-	-
0142	Natalie's Surprise Ruler	-	-	-
0249	Cresta's Gay Prince (Son of MG)	-	-	-
9640	Fairfield Advancer	1	1	-
0277	Ceres Margarethe Royal	1	-	-
0335	East Lynn Surprise Beau (Son of MG)	-	-	-
0330	Natalie's Double Lad (Son of Natalie's Gamboge)	-	-	-
0327	Natalie's Navigator	2	2	-
0110	Mermaid's Warrior Count	1	-	-
014	Fairfield Lorenzo (Paternal ½ brother of MG)	1	-	-

TABLE 5 The number of heifers registered per year over the three years, 1984 to 1986, and sired by the 16 most popular bulls who were either three or four years old in March 1987.

No.	Bull	No. of heifers registered '84	'85	'86	Tot.
0566	Timaru Oxford Butter King	4	11	6	21
0568	La Fontaine Milkflow Boy	3	17	-	20
0575	Easter Butter Star	1	18	8	27
0583	Natalie's Concentration	21	6	3	30
0591	Regal Blonde Monarch	15	12	12	39
0596	Dreaming Ruler Designer	1	11	9	21
0601	Fordia's Escort	4	17	35	56
0604	Wahine's Sam Designer	2	9	16	27
0605	Glen's Dreaming Royal	5	6	12	23
0606	Eastfield Sybil Lord	1	8	11	20
0610	Natalie's Butterboy	-	25	5	30
0615	Stuart Royal Design	2	21	14	37
0616	Stuart Triumph Warrior	1	20	-	21
0623	Natalie's Design Prince	4	11	8	23
0634	Lynn's M.G. Vanguard	-	10	34	44
0653	La Pompe Chesil	-	2	25	27
		64	204	198	466

TABLE 6 The average survival rates in successive lactations and the age structure of the "Island herd".

Lactation number	Average survival rate	Age structure of "Island herd"
1	1.00	760
2	.86	654
3	.70	532
4	.53	402
5	.40	304
6	.35	266
7	.28	212
8	.20	152
9	.12	90
10	.11	84
11	.06	44
	4.61	3 500

TABLE 7

Lactation number	Av. survival rate	Age structure of "Island herd"	Four year testing cycle				Four year "further use" cycle				Four year testing cycle			
			15 A bulls x all cows	15 B bulls x all cows	15 C bulls x all cows	15 D bulls x all cows	$^{5}/_{15}$A bulls x all cows	$^{5}/_{15}$B bulls x all cows	$^{5}/_{15}$C bulls x all cows	$^{5}/_{15}$D bulls x all cows	15A' bulls x all cows	15B' bulls x all cows	15C' bulls x all cows	15D' bulls x all cows
1	1.00	760				760A	760B	760C	760D	760SA	760SB	760SC	760SD	760A'
2	0.86	654					654A	654B	654C	654D	654SA	654SB	654SC	654SD
3	0.70	532						532A	532B	532C	532D	532SA	532SB	532SC
4	0.53	402							402A	402B	402C	402D	402SA	402SB
5	0.40	304								304A	304B	304C	304D	304SA
6	0.35	266	760 A = 1st. lactn. daughs. of 15 group A bulls								266A	266B	266C	266D
7	0.28	212	6^{54} A = 2nd. lactn. daughs. of 15 group A bulls									212A	212B	212C
8	0.20	152	760SA = 1st. lactn. daughs. of selected group A bulls										152 A	152B
9	0.12	90	6^{54}SA = 2nd. lactn. daughs. of selected group A bulls											90A
10	0.11	84												
11	0.06	44												
	4.61	3500												