Genetic Selection for Ease of Calving

J. W. Stables, *M.R.C.V.S.,*
M.M.B. Freezing Unit,
Little Horwood, Milton Keynes
Bucks, England

Introduction

Reason for the Title

The title of this paper was given to me some time ago by Professor Arthur - the Chairman of the Scientific Programme Committee, and I accepted the subject quite happily. However, a little more reflection nearer the time of writing the paper, has produced some doubts as to my ability really to take such a positive approach. Most of the recorded work tends to outline the difficulties of calving, and so by using this knowledge we hope to avoid these problems.

Definition of Dystocia

First of all, I think we should try to outline our meaning of dystocia. For argument's sake, if we think of someone inserting a hand into the vagina to check the position of a calf at birth, do we consider this as a difficult calving? I suppose that if we consider that the act of examination was necessary, then obviously the operator had some doubts as to the dam's ability to calve without assistance, so difficulty at calving could be pencilled on to the dam's health record. It would be my personal view that any examination of this type must be considered as indicating a calving problem, and that varying degrees of necessary assistance can then be recorded. I hope however that we can return to this subject a little later in my talk, and more obviously, in discussion afterwards.

Contributing Factors

Under this heading there could be many sub-headings. I have listed a few with the title of the paper in mind, but at the same time remembering the one overriding factor of herd management. My sub-headings would be:

a) The Effect of Sire of Calf.
b) The Effect of Breed of Dam.
c) The Effect of Sire of Dam.

These three items I think will give us more than enough to discuss in this session, and obviously many other important points might come to mind and be discussed informally at a later date.

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Effect of Sire of Calf

This subject is well documented both in this country and in many other countries throughout the world. The use of artificial insemination on an international basis has given both those giving the AI service and those using the AI service, the opportunity of studying the effect of varous bulls on dystocia levels in herds where their semen has been used. Because of differences in terminology and/or definition, comparisons between surveys by different authors are not always advisable.

In the UK there has been a considerable amount of work done by the MLC in beef herds where the importance of calving difficulties cannot be over-emphasized. It is easier however for me to quote the figures obtained in surveys carried out by the Milk Marketing Board, following the use of many breeds of bull in dairy herds in England and Wales.

MMB Surveys

The first important point to note on surveys is the method of obtaining the information. The MMB have relied almost entirely on the use of birth cards sent to members who have used semen of the bull, or bulls in the survey, on their cows. We are grateful to our membership, in that we have had an extremely good response from this postal method of survey. The response is in excess of 40%.

On the card we note the cow's name and the sire of calf, and ask the farmer to give us the following information:

1. Date of calving.
2. Whether this was the cow's first calving.
3. Whether there was one or more calves born.
4. If it was a single calf, was it male or female.
5. Whether it was dead or alive.
6. The calving experience, i.e., normal, some assistance, or serious difficulties.

Under this heading we have suggested that if two or more people are necessary for giving traction on ropes at the birth, it should be considered as a serious difficulty.

7. To continue with the form, we ask whether veterinary assistance was needed.
8. The weight of calf within 48 hours of birth, and to indicate whether this is estimated or actual.
9. Then one or two minor things such as colour of calf and the cow's condition etc. after calving.

Analysis

The analysis of the information carried out by our

Breeding Research team at Thames Ditton excludes from the analysis:

a) twins or multiple births
b) abortions or premature births
c) induced births
d) barren or cows sold
e) cows other than of the Friesian breed.

In the case of most bulls we obtain information on a hundred or more calvings, indeed in some cases the figure quoted give a good guide as to the potential of the sire for dystocia.

I would like to show you if I may, some details abstracted from the various calving surveys that the MMB have carried out throughout several years of cattle breeding.

Table 1.

This indicates the effect of breed of sire on calving difficulties. The dams are all Friesian cows, with the exception of the calvings to the Aberdeen Angus sires, when the information is based on Friesian maiden heifers. On this slide you can see the range of difficult calvings and also the mortality levels for the various breeds of sire.

Table 2.

The second table shows the effect of some of these breeds of bull when used on Friesian maiden heifers. A word of warning however that this information can obviously be a little misleading as the numbers of heifers involved with some of the breeds is quite small.

The figures quoted in these tables can be affected by:

1. Table 3. Calf birth weight.
2. Tables 4 & 5. Gestation length, including a table which links gestation and actual birth weights together with sex of calf.
3. Table 6. Sex of calf.
4. Table 7. Effect of season of birth.
5. Table 8. A regional effect on birth weight.

From some of these items you can see the obvious interplay between what can be considered a genetic factor and a managemental factor.

Effect of Dam

Many workers still quote that the size of calf, which seems obviously to be linked with the calf's sire, is the most important factor in producing calving problems. I am not entirely convinced by this logic, even though its backing by statistical evidence is very strong. In this section therefore, I would like you to consider what I think are some important factors.

We as veterinary surgeons work mainly with clinical eyes and not necessarily with mathematical minds. I am certain that most veterinary surgeons would, on questioning, agree that the Friesian breed seems to have more calving problems than do other dairy breeds. We know all the mathematical arguments that can be put forward to tell us that of course this is likely to be so, because in most parts of the country we are likely to be seeing more Friesian cows than any other breed. But I would like to make the following points:

The variation in ability to calve between breeds such as Jersey, Ayrshire and Friesian. We are often told that the Jersey calf is so small, and that the Ayrshire calf is not very much bigger than the Jersey, whereas the Friesian has to cope with a much larger calf.

Table 9. If we look at the birth weights of calves and

Table 1. Factors Affecting Dystocia Levels.

Serious Calving Difficulty — Effect Of Breed Of Sire

Friesian Dams (Cows)*

Sire	Dystocia %	Range %	Mortality %
British Friesian	2.7	0.6 - 6.0	2.4
Hereford	1.2	0.0 - 6.4	2.3
Charolais	3.4	0.9 - 5.7	4.7
Chianina	6.1	4.2 - 7.1	6.5
Blonde D'Aquitaine	2.0	0.6 - 2.8	3.6
South Devon	2.7	0.5 - 5.1	5.6
Simmental	1.0	0.6 - 2.6	3.8
Limousin	2.4	1.2 - 5.2	3.3
Aberdeen Angus*	1.9	0.4 - 3.7	5.3

*Friesian Maiden Heifers

Table 2.

Serious Calving Difficulty — Effect of Breed of Sire

Friesian Dams (Maiden Heifers)

Sire	Dystocia %
Aberdeen Angus	1.4
Hereford	2.7
Charolais	5.7
Limousin	8.2
Simmental	8.8
British Friesian	5.7

Table 3.

Calf Birth Weight

Friesian Dams (Cows)

Effect of Breed of Calf

Breed Of Sire	Calf Birth Weight (lbs)	
	1975 Survey	1977 Survey
British Friesian	88.98	
Hereford	90.02	89.71
Limousin	91.80	
Charolais	101.70	104.70
South Devon		98.50
Blonde D'Aquitaine		98.11
Chianina		109.50

Table 4.

Factors Affecting Dystocia Levels

Calf Birth Weight

Friesian Dams (Cows)*

Effect of Breed of Calf

Breed Of Sire	Calf B/W Table	Gestation (Days)
Aberdeen Angus		278.8*
British Friesian	(1.)	281.0
Hereford	(2.)	282.1
Charolais	(7.)	284.2
Simmental	(6.)	284.3
South Devon	(4.)	284.9
Chianina	(8.)	286.1
Blonde D'Aquitane	(5.)	287.3
Limousin	(3.)	287.4

*Maiden Heifers

compare this with the body weight of dams, I'm not altogether certain that the variation is size is as great as we might be led to believe.

Table 10. If we than study the effect of parity, the next slide shows the results of surveys in many countries of the world as far as maiden heifers and cows are concerned. It would seem that the Friesian maiden heifer has particular problems at calving.

Table 11. Let me also show you some figures from the ABRO, Cold Norton Farm. These were taken from some reciprocal cross-breeding studies. They are in fact actual cow weights, actual birth weights of their calves, and as the herd was under the same management, we must presume that the same standards applied in judging the dystocia levels. We can see quite clearly from these figures that the Friesian bull on Friesian cows created far greater problems than did the Friesian bull used on either Ayrshire or Jersey cows.

Table 5.

Gestation Lengths And Actual Birth Weights

Overall Figures (Normal + Some Assistance + Serious Difficulties)

	Gestation Length			Actual Birth Weight		
	No. Obs.	Mean (days)	S.D.	No. Obs.	Mean (days)	S.D.
Chianina (3.2.77)						
Male	635	287.2	5.6	207	113.0	15.4
Female	583	286.3	5.6	150	104.5	13.5
Overall	1,218	286.8	5.6	357	109.5	15.2
Blonde D'Aquitaine (17.2.77)						
Male	449	288.4	5.4	170	103.6	15.5
Female	391	286.8	5.3	135	91.2	13.1
Overall	840	287.7	5.4	305	98.1	15.7
South Devon (8.3.77)						
Male	705	285.6	4.9	191	101.9	17.0
Female	629	285.0	5.7	170	94.6	13.4
Overall	1,334	285.3	5.3	361	98.5	15.8
Simmental (21.3.77)						
Male	1,305	285.5	5.3	260	102.6	15.7
Female	1,085	283.9	5.0	211	92.1	14.1
Overall	2,390	284.8	5.2	471	97.9	15.9
Hereford (12.4.77)						
Male	1,756	282.6	4.8	147	94.2	13.7
Female	1,558	281.7	4.8	136	84.8	12.8
Overall	2,390	284.8	5.2	471	97.9	15.9
Charolais (12.5.77)						
Male	689	286.3	5.2	107	109.3	16.1
Female	572	284.7	4.9	69	97.5	16.6
Overall	1,261	285.6	5.2	176	104.7	17.3

But although this is a very interesting aspect of the work, just look at the comparison between the birth weights of calves and the body weight of cows. Let me remind you that these are actual figures, and here it is quite obvious that these Jerseys were able to cope with the increased birth weight of calf far better than could the Friesians.

The question raised is: Why does the Friesian have this problem? In studies I have made, I think there are two vital components that we need to know more about. We are, after all, discussing the relationship between the size and shape of the pelvic canal of the dam, and the size and shape of the calf which must pass through that canal.

I suggest to you that some breeds have the ability to prepare and relax at calving far better than others. I have no evidence to back this thinking, but I would wonder if some of the clinicians in the audience might like to comment. It is my personal opinion that the Jersey and Ayrshire breeds do seem to relax far more than does the Friesian, particularly the Friesian heifer, at calving. This could be due to hormonal levels, or it might just be a simple fact of anatomy that the Friesian has a greater muscle depth in the pelvic area and is not able to relax so easily. With more sensitive assay techniques becoming available, it might be possible to study hormonal levels at parturition in more detail.

From my point of view however, the great interest has been the study of the boney structures of the pelvic canal. After all, these are the main limiting factors as far as birth is concerned. Fat and other tissues in the pelvic canal cannot be pushed one side because of the boney structures. When I began this work some years ago, I was quite surprised to find that very little comparative information was obtainable. Some of the anatomy books quote various pelvic measurements, the exact siting of these are not very clear, nor is the breed of cow specified.

Table 6.

Serious Calving Difficulty Effect Of Sex Of Calf

Friesian Dams (Cows And Heifers)

Breed Of Sire	% Difficult Calvings			
	Heifers		Cows	
	M	F	M	F
Hereford	4.66	0.00	1.31	0.45
Blonde D'Aquitaine	16.00	0.00	2.67	0.00
South Devon	4.17	6.98	3.26	1.43
Simmental	5.00	0.00	2.15	0.55
Chianina	13.33	2.63	9.61	2.23
Charolais	X	X	7.90	2.20
Limousin	11.80	5.00	3.00	1.71

I therefore took internal measurements of the pelvic canals of many cows after slaughter. In order to be able to fit in with the normal working of the slaughterhouse, I found this easier to do once the carcases were hanging on the hook. It was comparatively easy, although time consuming, to measure carcases on one runner, and then turn to the adjacent runner to measure the other sides. By amalgamating the sets of figures it was possible to obtain measurements indicating the length, height and width at varous points within the pelvic canals.

I think here, it is of interest just to remember that the only complete bony encirclement is at the anterior inlet to the pelvic canal. The posterior area is not a complete bone circle, although of course the various ligaments, including the posterior border of the sacro-sciatic ligament, can be very strong.

It would seem from the figures I have obtained, let me say this, that I appreciate that the numbers of Jersey and Ayrshire cows measured are very limited, that the Friesian and Ayrshire cow has a pelvic capacity, if I might use that word, which is very similar. The Jersey cow's pelvis is not all that much smaller than those of the other two breeds, but if there is a limitation in that breed it is the width of the pelvic inlet. Therefore it is quite obvious that the pelvic capacity of the two lighter weight breeds is very much greater compared with body size of those breds, than is pelvic capacity compared with body size in the Friesian. Hence one can suggest that these breeds can cope more easily with the increase birth weight and size of calf which occurs in cross-breeding.

Many workers overseas quote the value of area of pelvic inlet in cows when considering dystocia potential. It is possible that that area is most important in maiden heifers, although its importance in cows cannot be overlooked as I will explain later.

There is however another interesting factor, and that is that within the Friesian carcases measured there seemed to be a reasonably high percentage of pelvises which had a much lower pelvic height. The whole effect was that as the sacral length increased so the distance between the sacrum and ischio pubic area decreased. This had the effect of giving a long low pelvic canal.

I think this factor must be considered very carefully and we should then cast our minds back to the size, and most important, shape of the calf. I believe that the Friesian calf has a comparatively greater depth from sternum to the spinal column, particularly in the area of the first rib. This being true, then the calf trying to negotiate the long low canal must have greater difficulty in reaching the outside world.

Effect of Sire of Dam

It is interesting that if one discusses the conformation of Friesians with many of the breeders of those cattle, one finds that they are looking for cows with length from the tuber-coxae to the tuber-ischii. By doing this they would hope to get greater length in the animals' quarters, and this carried through under the cow, would apparently give greater length, and therefore potential size, to the udder. At the same time, and I'm sure for aesthetic reasons only, they like to have the tail head get back as far as possible, giving a

Table 7. Factors Affecting Dystocia Levels

Calf Birth Weight*
Friesian Dams (Cows)
Effect Of Season
Herford Sires
*Weights At 10 Days
Warrn Farm Date

Month	Weight (lbs.)
January	103.1
February	102.0
March	103.1
April	104.2
May	105.9
June	110.5
July	117.0
August	112.9
September	112.2
October	112.1
November	104.8
December	102.0

Table 8. Factors Affecting Dystocia Levels

Calf Birth Weight
Friesian Dams (Cows)
Effect Of Region
Deviations From Breed Average (lbs.)

Region	Charolais	Hereford	Friesian	(Sires)
North	-5.21	-1.22	+1.29	
Wales	+0.86	-4.87	-4.42	
Midlands	-0.59	+0.29	+0.94	
S. East	-1.27	+0.07	-2.37	
S. West	+6.21	+5.73	+4.56	
Average Weight Of Calf	101.67	90.02	88.98	

Table 9.

The ratio of birth weight of calf to dam of the same breed (Friesian, Ayrshire, and Jersey).

Breed	Calf Weight (Lbs)	Dam Weight (Lbs)	Ratio
Friesian	90	1150	1:12.6
Ayrshire	75	950	1:12.6
Jersey	55	750	1:13.6

squarish appearance to the cow when seen from the side. In doing this they have unknowingly bred for the increased length of sacrum and have therefore bred into their cattle the possiblity of the long low sacral canal. Between 7 & 8% of Friesian cattle measured show this type of canal.

Having said this, I think there is great potential in some of the work we have in hand in the MMB at present, studying the progeny of our young bulls and trying to see whether these bulls tend to throw cattle with any specific problems in the pelvic structure. In an organization such as the MMB, which is after all, the largest cattle breeding organization in the world, I feel we have responsibility and ability to make sure we do not let our members breed the type of cattle which might in due course have calving problems.

Just think of the enormous value there would be to farmers if we could find some simple external measurements on the maiden heifers just prior to service, which would tell whether or not the heifer was capable of calving a normal sized Friesian calf. We are already seeing the tendency for farmers to use Hereford as alternative bulls to Aberdeen Angus on their maiden heifers, and this in itself can give a useful financial boost to the income from dairy cattle. I suggest that from a breed improvement point of view, if we could only obtain more pure bred calves from maiden heifers it would increase the potential for dairy farmers to select future breeding stock.

In the USA many of the AI Services are beginning to classify their sires according to dystocia levels. But even among workers there, there seems to be a strong opinion that the sire of the dam must be looked at more closely in future to see what effect, if any, he has on subsequent calving performance of his progeny.

I would like now to comment on one aspect of genetic influence on dystocia, which as far as I know has not been mentioned before. This concerns the egg transfer work which has been used over the last 18 months or two years. There has been one planned project in which Jersey recipient cows were implanted with pure-bred Friesian fertilized eggs. It is quite interesting to note that out of 13 calvings (eleven by one bull, and one by each of two other bulls) seven of the calvings were described as difficult or worse. Of the calves born, only four had birth weights between 65 and 75 lbs. The others weighed from 89 lbs up to 105 lbs. Quite obviously, the large calves generally, although not always, are considered the culprits in the amount of difficulty encountered.

In this same herd the sire was changed in the next year and calves are due just about now. So far only three calves have been born, these have all been females, one calving was difficult, and the birth weight in these three calves ranged from 79 lbs to 85 lbs.

Just to try and get some indication of the sires calving performance in other local herds, 105 calvings from Friesian cows inseminated with semen from the two bulls were checked in seven herds. Only one case of assistance was noted.

I realize that judgement cannot be made on such small numbers, but I think perhaps it would be just as well to keep them in mind if egg transfer work is to be continued, and especially if such work is likely to involve native breeds in overseas countries. Quite obviously it shows that the Jersey might run into problems with calvings if the resulting calves are of pure-bred Friesian type. I think once again this might well be worthy of more intensive study to see whether the shape of calf is of importance in this type of partutition case.

Table 10. Factors Affecting Dystocia Levels

Parity Of Dam

Breed Of Cow	% Difficulty Calvings	
	Heifers	Cows
German Friesian (1965)	19.2	6.1
German Friesian (1966)	26.6	8.0
Dutch Friesian (1963)	13.5	1.8
Dutch Friesian (1963)	18.0	5.0
Dutch Friesian (1965)	19.2	6.8
Israeli Friesian (1972)	6.4	1.5
M.R.I. (1963)	13.5	1.8
Swedish Friesian (1976)	15.7	4.8
British Friesian M.M.B. Data	9.2	2.7

Table 11.

Calving Difficulties Dystocia Levels

Friesian, Ayrshire, Jersey Dams (Cows)

Friesian Sire

Comparison Of Calf Birth Weight/Cow Weight/and Calving Difficulties %

Breed of Sire	Breed Of Dam	Calf Weight (Lbs)	Cow Weight (Lbs)	Ratio	Dystocia %
Friesian	Friesian	88	1070	1:12.1	40.0
Friesian	Ayrshire	81	937	1:11.5	25.7
Friesian	Jersey	68	759	1:11.1	15.9

Table 12. Factors Affecting Dystocia Levels

Calf Birth Weight

Ratio Of Calf Birth Weight To Dam's Body Weight (Lbs.)

Breed	Calf Weight	Dam Weight	Ratio
Friesian	90	1150	1:12.6
Ayrshire	75	950	1:12.6
Jersey	55	750	1:13.6

It is in this work that pelvic area of recipient dams could also be important.

Table 12.

Finally, might I just quote the happenings in one Continental breed. This breed, when I first began my work, had been the subject of some intensive veterinary studies including clinical and slaughterhouse checks. At that time there was an incidence of 20% caesarean births in the breed. Some five years later the incidence of caesarean births had risen to 40%, and in some herds the caesarean births were at 80%. I would suggest to you that these figures are really quite extraordinary but should always be kept in mind. This breed was one in which the double muscling effect was quite popular with breeders.

The veterinary workers who made the study have suggested that the pelvic shape in the breed could be described as resembling a trapezoid. In normal cattle viewed from above the trapezoid shape was wider across the tuber-ischii than across the trochanters. This is similar to the shape we see in British breeds of cattle. In some of the cattle seen in the breed the shape of pelvis was almost rectangular, whereas in the exteme cases there was the reverse trapezoid shape of pelvis, in which the width across the tuber-ischii was less than the width across the great trochanters. When this reverse trapezoid-shape pelvis was seen then the pelvic inlet was extremely narrow and caused great difficulty in the process of parturition.

I hope that I have indicated some possible lines for further discussion, and maybe given some stimulus to interest in the problems of calving, especially in modern herds which are becoming less and less labour intensive, and more and more dependent on the ability of organizations such as the Milk Marketing Board to warn if problems are likely to arise. The importance of breeders using their skills to produce cattle able to calve easily is something that cattle breeding organisations should encourage not only on economic grounds - vital as they are, but also on grounds of animal welfare for dam and calf.

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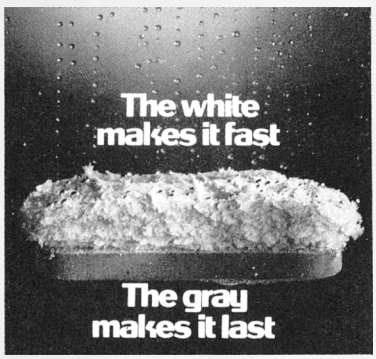

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