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same in all sheep? Does the N-type's horns revolve in the same direction as the Merino's?

DR. DRY: So far not much data has been secured on which to make a fair comparison for fleece weight. Probably in the same conditions the weight would be much the same for N-type and for other sheep of Romney type. At present there is considerable variation in horn curl. Often N-type rams have horns in Merino style, spiralling gracefully outward, but sometimes they give trouble by growing against the head.

MR. RANSTEAD: Dr. Dry have a hint that there might be a commercial application of this work, both in regard to lamb skins, and also the very hairy wool. What applications could be made commercially?

DR. DRY: It is possible that lamb skins may be used as furs. They have attracted attention as N.Z.'s locally produced furs, and are deemed to be as handsome as imported furs. What the profit and loss of the thing will be, I do not know, because the fur coats have not been made yet. That must be done first, and then it depends on the customer and on the costs. The other possibility is local carpets. They are very difficult to procure at the present time. It would be nice if the local carpeting industry could be assisted by the multiplication of N-type sheep. Any luxury article, of course, is precarious, and it might cost too much to breed a lamb especially for fur, but if it came about that there was a real demand for a solidly useful article like carpets, and at the same time you could sell the lambs that inadvertently died for 10/- each as furs, it would be rather a nice situation. On the other hand, carpets might be secondary, and furs primary.

MR. DUNCAN: Regarding the commercial aspect; there is a marked similarity between some of these skins and karakul, and it is well known that karakul is most valuable in its immature form; it is worth more a day before birth, and rapidly loses its value as the lamb gets older; have you noticed there is a loss of attraction in those skins as they get older? also, there is a firm not ten miles from here which would like to get more of that hairy wool for making carpets - they cannot get enough of it?

DR. DRY: The coat runs off very quickly after birth. I submitted one or two skins to a proper judge - a fortnight old and a month old - and they considered them quite hopeless. They have to be taken about the time of birth. They would probably be no better as furs if they were taken before birth.

MR. DUNCAN: It would be impracticable, because you would have to slaughter the ewe. It is done in the case of karakul.

THE ACCURACY OF VARIOUS METHODS OF ESTIMATING A
DAIRY COW'S PRODUCTION OF MILK AND BUTTERFAT.

by

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One of the fundamental problems in animal breeding is that of devising means for measuring and recording the qualities of our breeding stock. In herd testing, we have the most important single method for measuring quality in dairy stock. However, in order to use herd testing results to full advantage in breeding work, it is essential that the exactness of the milk, fat percentage and butterfat figures obtained by various methods be clearly understood. This paper summarizes Dairy Research Institute (D.R.I.) data from which an indication has been obtained of the degree of accuracy which may be expected from various methods of herd testing.

During the years 1936-1942 it was necessary for experimental purposes to have an exact record of the true milk and butterfat

yields of cows in the D.R.I. herd. Milk yields were recorded daily throughout. Except for a period in 1942 when milk was sampled 6 x weekly, daily sampling also was carried out. The fat content was determined daily, or 3 x weekly, 2 x weekly, or weekly on proportional composite samples.

Throughout the whole period under review, the Institute's herd was tested by the Wellington-Hawke's Bay Herd Improvement Association in the normal manner, and independently of the Institute's work. It was possible, therefore, to contrast the actual production for 148 lactations as determined by the D.R.I. work with the figures supplied by the Herd Improvement Association (H.I.A.). The difference between the two production records in each case was expressed as a percentage of the actual yield. The results are summarised in Table I.

TABLE I			
H.I.A. results contrasted with actual yields in 148 lactations.			
	Milk	Fat %	Fat Yield
Av. % error disregarding sign	2.59	3.49	4.09
" " " taking sign into account	-0.61±3.25*	+1.25±4.35	+0.59±5.50
% of cases within ± 5% of actual	86%	76%	69%
Range of % errors	+7.31 to -9.42	+16.92 to -16.84	+17.03 to -21.37

* Means ± Standard deviation.

These figures give an indication of the degree of accuracy which has been achieved by the Herd Improvement Association officers working under reasonable conditions, but without extra facilities. It is emphasised that the comparisons given apply only under conditions where no attempt is being made to deceive the tester or otherwise falsify the results.

A substantial portion of the error of H.I.A. testing appears to be associated with Fat %. Two possible sources of error are those associated with:-

- (1) Testing at monthly intervals only;
- (2) The actual determination of fat % in the milk sample.

Data on the last point were obtained in the present work on those occasions when the H.I.A. and D.R.I. fat % determinations were made on the same day. The results of 379 comparisons showed that while in a few cases the H.I.A. tests differed markedly from the D.R.I. figures, the great majority fell within the limits of ± 0.2. Thus the main source of error appears to be that associated with the interval of testing.

Two further systems of testing are used by N.Z. farmers - the Certificate of Record (C.O.R.) and the Official Herd Test (O.H.T.). Under the C.O.R. system milk yields are recorded daily and fat % determined monthly, and with O.H.T. procedure milk and fat % are determined monthly.

In the D.R.I. work, the actual productions in 50 lactations were determined from daily milk recording and daily fat analysis. In these cases it was possible not only to contrast the true record with the H.I.A. figure, but both of these with records calculated as if obtained under O.H.T. or C.O.R. procedure. I have to thank Mr. Phillipot of the Dairy Division for his assistance in this work. Mr. Phillipot very kindly checked the procedure, check tested, and, where necessary, corrected the records according to the usual C.O.R. practice. The differences and percentage differences were calculated as outlined above. Table II summarises the results.

TABLE II				
H.I.A., O.H.T., and C.O.R. results contrasted with each other and with actual yields - 50 lactations				
		Milk	Fat %	Fat Yield
Av. % error Disregarding sign	H.I.A.	2.53	4.57	4.64
	O.H.T.	2.39	4.04	4.62
	C.O.R.	-	-	3.94
Av. % Error taking sign into account	H.I.A.	-1.69+2.79	+2.38+5.49	+0.72+6.51
	O.H.T.	+1.15+2.73	-1.15+5.29	+0.02+6.35
	C.O.R.	-	-	-1.26+5.10
% cases within ± 5% of actual	H.I.A.	84%	68%	64%
	O.H.T.	94%	68%	64%
	C.O.R.	-	-	68%
Range % error	H.I.A.	+6.65 to -6.86	+17.17 to -16.84	+17.03 to -21.37
	O.H.T.	+5.86 to -7.48	+9.59 to -14.96	+11.48 to -19.96
	C.O.R.	-	-	+ 9.65 to -14.97

In general, the results show that under fair conditions of testing, there is less difference than might be expected between the three systems in the degree of accuracy obtained. The explanation may be that a large part of the error is associated with fat % which in all systems is determined at monthly intervals only. In H.I.A. and O.H.T. there is an error associated with the recording of milk yield once a month only, but, as this error apparently is independent of that associated with fat %, it sometimes tends to make the result for fat yield more accurate, and sometimes less accurate. The net result, as shown in Figure 5, appears to be that the range of the error is a little greater for H.I.A. and O.H.T., but that the concentration of cases within ± 5% of the true result is not widely different.

It is clear from the preceding tables that milk and butterfat records derived from monthly testing while sufficiently accurate for practical purposes, are subject to too much inaccuracy to be used in exact experimental work. Testing at more frequent intervals is required for milk secretion studies, such as, for example, the effect of various methods of feeding on milk production and composition, where small numbers of cows are involved. To obtain data on the accuracy of more frequent testing, the figures available for the 50 lactations were used to calculate the results which would have been obtained from twice weekly, once weekly, fortnightly and monthly testing on set days. In all cases the test days were centered. The average percentage differences (taking sign into account) and the standard deviations are shown in Table III.

TABLE III			
Accuracy of testing at varying intervals			
Frequency of Test	Average % error		
	Milk	Fat %	Fat Yield
Twice weekly	-0.79+1.11	-0.53+1.64	-1.29+2.42
Weekly	+0.52+1.10	-0.38+2.41	+0.14+2.65
Fortnightly	+1.52+1.71	-0.33+3.52	+1.18+3.90
Monthly	+1.35+3.72	-0.65+4.12	+0.56+6.45

These figures provide a valuable guide as to the frequency of testing required for varying degrees of accuracy.

Monthly testing for milk and fat yield is now, and is likely to remain the most important single method of providing data essential for constructive breeding in dairy cattle. From the data presented it is conservatively estimated that under good conditions for testing, the chances are 2 out of 3, that for milk the lactation record will be within + 4% of the true yield, for fat % ± 6% and for butterfat yield ± 7% of the true yield.

DISCUSSION ON DR. CAMPBELL'S PAPER:

THE PRESIDENT: It is clear that we cannot get anywhere near the true production of a cow by testing samples once a month. I have always been careful, in quoting herd testing figures, to say that the results shown on the herd testing sheets are the approximate yield of the cow for the period during which those test figures were made up, and I have gone further and said that if the dairy-farmer wants the actual yield, then he has to be prepared to pay very much more than 4/- or 5/- a cow for a day by day schedule throughout the whole of the milking season, and that, of course, is unnecessary.

MR. PHILLIPOT: There are a few comments I could make on Dr. Campbell's paper. I may say I have not had any opportunity of studying the paper before it was delivered today, and anything I can say will probably be disjointed. Moreover, anything I can say should not be construed as putting one system against another. Each system is serving its purpose effectively. Dr. Campbell is to be congratulated on such a painstaking piece of work and such a fair summing up of the position. It is a little encouraging to us to hear these results, because we did a similar job about 1906-1908, before I joined the Division, and I have been quoting those figures for many years, and still wondered whether they are reliable. We reckoned that with the old Association system, which is something similar to the present Group system, compared with what is now the C.O.R. system, there was an average difference of three per cent. between the three systems. That is perhaps a little more accurate than what Dr. Campbell has found today. I think the slide indicated that the Group was based on a 24 hour, similarly with C.O.R. and O.H.T. I think the Group is really based on 12 hour marking, as compared with a strict 24 hour, with a preliminary check, for the O.H.T. and C.O.R. system. Dr. Campbell mentioned that at the Research Institute there was no inducement to get higher results, so that that factor did not enter into it. That is a factor which I think should be emphasised fairly strongly. Unfortunately, possibly one-third or may be one-half, of our rules for C.O.R. and O.H.T. are to try and stop that attempt to get enhanced records through irregular factors. That would have to be taken into consideration when comparing the results obtained by Dr. Campbell with those actually obtained in field work. He said that the Wellington-Hawke's Bay Herd Improvement Association carried out its work in the normal manner. I assume that that means that an officer of that Association visited the farm in the usual way and took samples in the usual way, and tested them under ordinary conditions. It has always been the problem of the C.O.R. and O.H.T., and all systems of testing, to get some system which did not permit manipulation on the part of the test-herd owner, and that must be emphasized. It is pleasing to note the remarkable relationship between the three systems, how accurately they compare. It should give confidence to everybody operating the systems. It is noticed that the total range is in favour of O.H.T., and more than so in the case of C.O.R. It is remarkable that the deviation is not greater than it is. I have learned a great deal from the figures Dr. Campbell has put before us. I was at the College for the best part of a day, and was impressed with the detail. There was only one suggestion I could make; I understand that the returns at the College do not provide as much information as we asked for, for C.O.R. I suggest that if a test officer visits a farm on C.O.R., and finds a drop in weights of 2 lb. over the previous two days, he is required to get an explanation from the owner, and record it on his report. I think, from memory, reports on detailed variations, other than those for obvious conditions - feed conditions and so on - were not included.

DR. CAMPBELL: As set out on the second slide, I was referring to the 24 hour sampling as being representative of the milk secretion for the 24 hours. There are differences, of course, as Mr. Phillipot points out, in the way it is determined under the three systems, and one difference is that under O.H.T. and C.O.R. there is a check on the previous times of milking

which is not available under H.I.A. methods. Another point I might mention: Mr. Page from the Wellington-Hawke's Bay Herd Improvement Association has assured me that he made no attempt to assign us better than average testers during the period. Mr. Phillpot is right in assuming that no special assistance was given to the testing officer. Admittedly he had a clean room to work in. It was fairly well lighted, and he could get hot water, but those were the only considerations extended to him. The odd records of cows that showed a very wide variation from the true figures were examined in detail, and you might be interested to know that these cows were not affected by any peculiar circumstances other than a tendency to vary in test widely from day to day. These cases were those which, even with random sampling, happened to have a run of high or low tests, on test days, which gave a wide error over the whole lactation. As to the records associated with our milk yields, I think we could provide better data than the average farmer. The C.O.R. test data are, of course, dependent on the farmer's word for the conditions affecting ups and downs in milk production, and in reality the Dairy Division is getting that only second or third hand, and sometimes based only on the memory of the farmer if he has forgotten to write something down.

MR. PHILLPOT: I did not intend that as a criticism about your records not being complete - they were more complete than we needed; it was that the type of question we asked could not always be answered from the data you put down. May I also ask if the samples were tested in duplicate?

DR. CAMPBELL: Our own samples were.

MR. PATON: Regarding once-a-month sampling and how it tends to interfere with the system compared with the Daily Record: in view of the variability of the test, it is rather surprising that the milk was more consistent and the test more variable. How was it that the month's sample range of variation was not greater? I think part of the explanation of that is that if you get a cow temporarily down with milk for the day, there is a tendency for the test to go up sufficiently to act as a compensating factor. So, on the day, the chances are, if you did catch a cow down in milk supply, the butterfat test would be enhanced. So working the whole thing out, you get something similar to what would be the case if you caught the cow for the normal month.

DR. HAMILTON: In making comparisons between methods of testing, Dr. Campbell pointed out that the H.I.A. test was using its own test figures. If my memory serves me correctly, they tended to show a rather higher average test than the Dairy Research Institute's figures. In calculating O.H.T. and C.O.R. figures, I take it that actually the Dairy Research Institute's own test figures were used. I would ask whether the very slight differences he shows between the H.I.A. test and the O.H.T. is completely accounted for by the small discrepancies in the test figures, or whether there were other causes of variation which I did not note.

DR. CAMPBELL: Concerning fat yields there would be a difference in milk between H.I.A. and O.H.T. which would enter into the differences in the yields of fat. In the differences of fat per centage, I think the averages, the ranges, and the standard deviation, were not significantly different, and that the main difference was in the "skewness", which would be accounted for by the factor which you mention. I do not think the differences in averages were real differences.

DR. MOMEKAN: The really significant part of this paper, from the point of view of animal breeding and herd improvement in particular, appears to be the fact that these figures show a remarkably small increase in accuracy for the greater amount of work necessary in taking daily as compared with monthly milking weights. That is the major point from the breeding point