THE WINTER-FEEDING OF STOCK IN CANTERBURY.

FACTORS IN DAIRY COW PRODUCTION.

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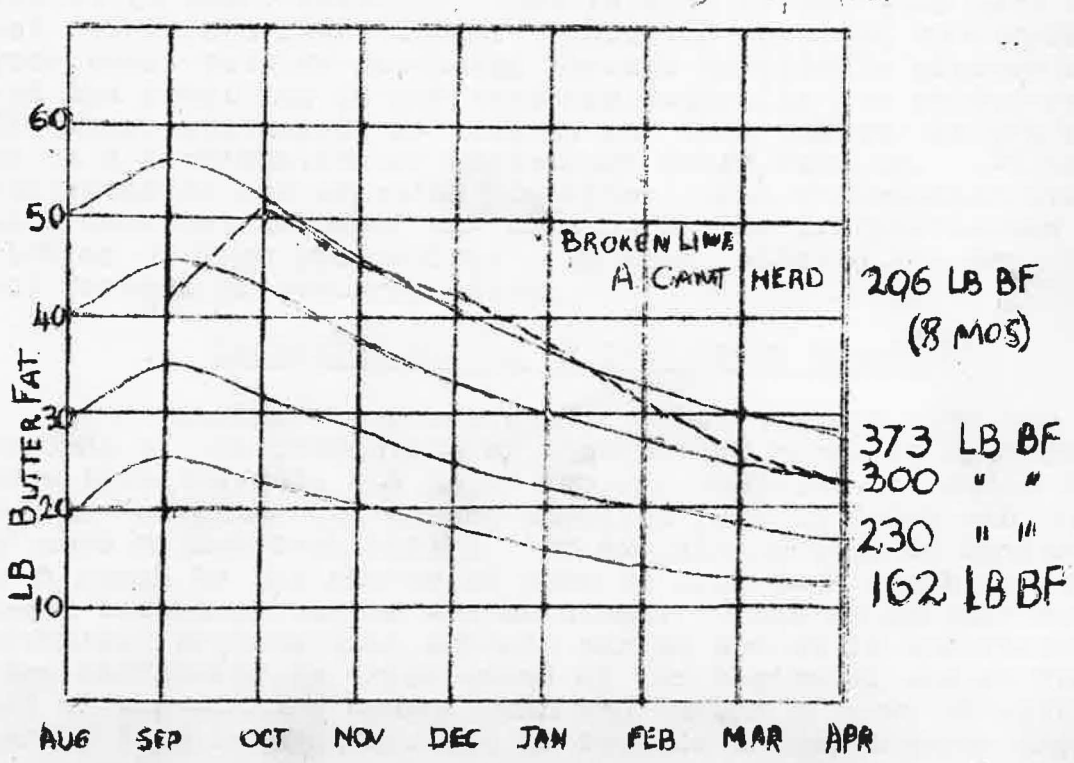
The winter feeding of stock is often discussed as though it were of itself the most self-contained aspect of stock production. Many farmers feed their stock poorly in winter and get profitable returns, while others, who feed better in winter, get poorer returns. A consideration of these and allied facts, makes it evident that winter feed must be considered, not only by itself, but also in relation to the kind and quality of feeding, and the returns therefrom, during the whole year. The annual returns of butter-fat have often been quoted on a per cow, per acre, or production cost per pound basis. Those calculations express the effects of high and low production, but they are little informative as to causes. A more informative line of approach which displays both cause and effect is through the lactation curve.

LACTATION CURVES.

From an examination of the records of Milk Recording societies in 1875, Gavin, in England, made a beginning with lactation curves and these have since been further investigated in America and in England. A Lactation curve is a statement in the form of a graph in monthly or weekly periods of the yearly production of a cow, in pounds of butterfat per month, or pounds or gallons of milk. In the following, pounds of butterfat per month will be used. It has been established that normal well fed cows attain their maximum production in the 6th to 8th weeks after calving and fall off in subsequent months at the rate of from 9 to 11 per cent. Thus for a production period of 9 months, the following would represent the normal yearly butterfat production of cows at different levels.



While these curves are this shape for herds, they may show much variation for individual cows. Some cows milk at the same rate for the whole 12 months, and others give 250lbs. fat in 4 to 5 months, and then dry off. These are exceptions, but apparently are of infrequent occurrence since an examination of the performances of many herds makes it evident that the existence of such individual cows in no way invalidates the statement that lactation curves of normal, well fed herds conform to the shapes outlined above.

Graphs are difficult to reproduce and for convenience throughout this paper, this material will be presented in tabular form. The information in in the preceding graphs is set out in

TABLE I.

POUNDS OF BUTTER-FAT PER MONTH OF NORMAL COWS OF DIFFERENT CAPACITY - IN 9 MONTHS.					One Herd in Canterbury. 1930.
Aug.	20	30	40	50	-
Sept.	25	35	45	56	40
Oct.	22.5	31.5	41.5	51.2	50
Nov.	20.2	28.4	37.1	46.1	56
Dec.	18.2	25.6	33.4	41.5	43
Jan.	16.4	23.1	30.1	37.4	38
Feb.	14.8	20.8	27.1	33.7	31
March	13.4	18.8	24.4	30.4	26
April	12.1	17.0	22.0	27.4	22
	162	230	300	373	296

These normals are set out here for the purpose of demonstrating the fact that B.F. production at any level is not by nature a haphazard process. Some cows, even if well fed, are low producers, such as in column (1) 162lbs. Most cows are low producers because of a departure from the above normals, in two ways; first through failure to reach maximum production until the 3rd or 4th, or even 5th month of the milking season, and second through not milking for 9 months. Of the cows examined in Canterbury, approximately 20 per cent are good cows, sufficiently well cared for to be producing almost to their maximum. The returns of one such herd are set out in the last column. About 60 per cent are equally good cows, but low producing through unsuitable circumstances, and the remaining 20 per cent are naturally low producers. The above statement, as well as any that follow, is not meant to be a condemnation of Canterbury dairy farming. It is a statement of the existing position. The information available does not allow of any comment on the profitableness of low or of high production. It does indicate the more important factors of cow production.

LACTATION CURVES OF CANTERBURY HERDS.

During the years 1927, 1928, 1929 and 1930 the records of the production of a number of herds in Canterbury were investigated. A Dairy Company supplied the sales of butter-fat, and herd owners supplied calving dates and number of cows milked each month. By dividing pounds of butter-fat each month by the number of cows in milk each month for every herd, lactation curves are obtained. This is an easy non-technical process that any one can do and it is informative. Some difficulty is experienced at the beginning and at the end of the milking season when the number of cows in milk varies from day to day, but if records of calving and drying

off dates are kept, it is not difficult to find the average number of c ws in milk for these months from the total cow days of milking, divided by 30. If allowance is made for whole milk or butterfat used on the farm, the record will be so much the more accurate thereby.

The pounds of butter-fat produced by herds in Canterbury per cow in milk each month, are set out in Table II for years 1927 to 1930.

TABLE II.

CANTERBURY HERDS 4 YEARS

AVERAGE B.F. PRODUCTION PER COW PER MONTH.

	1927	1928	1929	1930	15 herds recorded in 1927	and in 1930.
Aug.	10.1	12.3	16.9	17.0	11.9	22.0
Sep.	20.9	25.3	25.4	26.6	22.6	29.0
Oct.	29.1	28.4	32.8	33.2	30.4	36.1
Nov.	31.9	31.1	33.0	34.8	33.4	35.0
Dec.	30.6	32.7	34.0	34.2	32.2	35.0
Jan.	27.8	30.4	31.8	31.9	29.9	33.0
Feb.	22.6	23.5	26.1	28.2	24.0	29.1
March	19.9	22.6	23.7	25.7	22.0	26.6
April	13.6	17.6	20.4	19.4	14.9	20.0
Total	206.5	223.9	243.7	251.0	221.3	266.8
No. of herds	76	67	41	31	15	15

It will be seen that in every year the cows reach their maximum in November or December, and that from December onwards their production rate is comparable to that of 300lb. cows. (Table I).

In 1928 -29 -30, the production per cow in the last 5 months is 139, 136 and 127lbs, respectively. That of a 300lb. cow is 137lb. during the same period.

Canterbury cows are about 50 to 60lbs. below their maximum 9 months producing capacity and this loss occurs in the first four months of the milking season.

Some contend that the Decmeber or November maximum is a false one due to late calvers that are in good condition, and therefore high producers. Against this, the fact that production falls off after December in a normal way is presumptive evidence that there is nothing abnormal about the peak production. If it is admitted that high production is due to good condition of the cow, the critics and the author are in agreement on the point.

It will be seen from the totals column that there is an improvement of 44.5lb B.F. per cow from 1927 to 1930. This may be due to the accidental examination in 1930 of better herds, i.e. farms, or farmers, or better cows than those examined in 1927.

As evidence that this is not the case, all the herds (15) that were recorded in 1927 and again in 1930 were grouped each year and the results are set out in the last two columns of the above table. These show an improvement of 45.3lbs. of B.F. and eliminate the factor of different farms, etc. Again the improvements may be due to better cows. These 15 herds contained, 168 cows in 1927 and 180 cows in 1930 and it is reasonable to suppose that some of the 1927 cows were milking in 1930. None of these 15 owners herd-test.

Any replacements in these herds would be made with the same judgement or selection in 1930 as was used prior to that date, and new cows would therefore be of the same quality as cows already in the herds. The remaining and most probable cause of improvement is through better feeding, presumably occasioned by a consideration of information obtained from their own lactation curves as supplied to them while the investigation was in progress.

LENGTH OF TIME IN MILK.

The second attribute of low production is a short milking season. Some dairymen delay the calving of their cows until there is an adequate feed supply but all their cows calve in one month; others spread the calving over 3 or 4 months.

The practice may mean profitable dairying but it is inimical to high production. Information about the length of time in milk of Canterbury cows is set out in Table III. This Table has been prepared by finding the total cows in milk each month, calling the best month 100 per cent and expressing all other months as a percentage of this.

TABLE III.

PERCENTAGE OF COWS IN MILK EACH MONTH

	Canterbury herds in				1928 12 herds producing 136lb. B.F.	1928 12 herds producing 266lbs. B.F.
	1927	1928	1929	1930		
Aug.	25	19	20	12	5.5	29
Sep.	47	44	47	52	34.0	67
Oct.	77	77	80	86	69	92
Nov.	93	94	97	92	90	96
Dec.	100	100	100	98	96	100
Jan.	100	100	99	100	100	100
Feb.	98	100	99	99	99	100
Mar.	96	96	95	97	97	98
Apr.	92	96	93	95	86	98
TOTAL	728	726	730	731	676	780

In every year there is a gradual increase in the percentage of cows in milk each month, until the 5th or 6th month, when all cows have calved. There appears to be no lengthening of the season from 1927 to 1930. From the totals it is seen that in a nine months season there is an effective milking season equivalent to all cows for a period of $7\frac{1}{3}$ months, i.e. about 80 per cent of full time efficiency. In actual production it means a loss of only about 10 per cent owing to the fact that in the early part of the season those cows that are milking, produce at a low level. The last two columns of Table III were obtained from the returns of the 12 lowest producing herds and the 12 highest producing herds in 1928; It will be seen that the high producers milk, on the average, one month longer than the average of all cows considered.

Just as test and quantity of milk combine to give the product "butterfat per cow" so length of lactation and rate of production per month combine to give the same thing. The latter two factors are the only related varients in total yield that react to man's treatment of the animal.

Herd testing has supplied information about individual cows in the herd and also about length of lactation,

and production levels from month to month. Probably its greatest value arises from the latter two pieces of information. Many herd owners have used this information obtained from herd testing and have realised the necessity of attending to the details of length of milking season, feeding, etc. Lactation curves could be compiled by a body such as the present Herd Testing Service from information already partly collected as monthly butterfat returns by Dairy Factories. Such a service could give valuable information, to many herd owners at a low cost per head, and therefore be most useful.

Length of lactation and rate of production though variants in herd production are not prime causes in it, since both are the effects of feed supply and are controlled only by this. Consideration of the feed supply is therefore of some importance.

FEED SUPPLY.

For the purposes of translating Tables of Butter-fat production into Tables of yearly feed supply it is necessary to use the fundamental facts, that the maintenance of a 1,000lb. cow is 6lb. of Strach Equivalent per day, - less for correspondingly lower weights, - and that every pound of butter-fat requires 6lbs. of S.E. for its production. Using these figures, the feed requirements for one month for a 1000lb. cow producing 40lb. butter-fat is 180lb. of S.E. for maintenance, and 240lb. S.E. for production; a total of 420lb. of S.E.

Cows that produce at their maximum capacity, do so only when their weight remains constant within narrow limits throughout the year. Those producing below their maximum, frequently do so because their live weight changes considerably (by perhaps as much as 30 per cent). Thus cows of 1000lb. weight may come [illegible] 700lb. [illegible] end of the milking season and during the winter, and build up this 300lb. as soon as grass is available in spring and early summer.

The first use to which food is put by these cows is to build up body reserves, and they cannot milk to capacity and store body weight at the same time. For purposes of illustration it is assumed that the high producer maintains a constant weight and that the low producer varies in weight from month to month as indicated.

Few will dispute that a cow does vary in weight. No one is aked to believe that it does so according to the standards here set down as an example. Feed supply, i.e. the season, determines weight change in amount and time.

Table IV sets out feed supply of high and low producers in detail allowing for weight changes of the low producers and for variable maintenance appropriate to their weight. For the storage of one pound of live weight, 2lb. of S.E. are required; the same weight lost gives out 1.66lb. of S.E. for production or for maintenance.

TABLE IV.

High producers 300lb. B.F. from Table I.				Low Producers. 206lb. B.F. from Table II. 1927 group.					
Starch equivalent for Maint.	Prod.	Total	% of years total	Starch equivalent for Maint. (Liv.Wt.)		Prod.	Change in L.W.	Total	% of years total
Aug. 180	240	420	10.3	142	(700)	61	-	207	6.2
Sep. 180	270	450	11.1	142	(700)	125	-	267	7.9
Oct. 180	249	429	10.5	156	(800)	175	+200	531	15.8
Nov. 180	222	402	9.9	169	(900)	191	+200	560	16.6
Dec. 180	200	380	9.3	180	(1000)	183	+200	563	16.7
Jan. 180	181	361	8.6	169	(900)	166	-166	169	5.0
Feb. 180	162	342	8.4	156	(800)	133	-166	123	3.6
Mar. 180	146	326	8.0	163	(850)	119	+100	382	11.4
Apr. 180	132	312	7.6	163	(850)	81	-	244	7.3
May. 180	20*	200	4.9	156	(800)	20*	-83	95	2.8
Jun. 180	40*	220	5.4	149	(750)	40*	-83	106	3.2
Jul. 180	40*	220	5.4	142	(700)	40*	-83	99	2.9
Tot. 2160	1902	4062		1887		1334		3346	

*For production of calf.

The intake of the high producers will be limited by their capacity to produce milk while that of the low producers will be limited by their stomach capacity. This table is set out in full for the purpose of letting those interested see how the figures in the percentage columns are arrived at. There are differences that appear small but in the following table it will be seen how important these differences are. Table V has been prepared by using the percentage columns of Table IV and setting down in columns 3, 4 and 5, the average, maximum and minimum grass growths each month, as a percentage of total growth obtained over a four year period at Lincoln College.

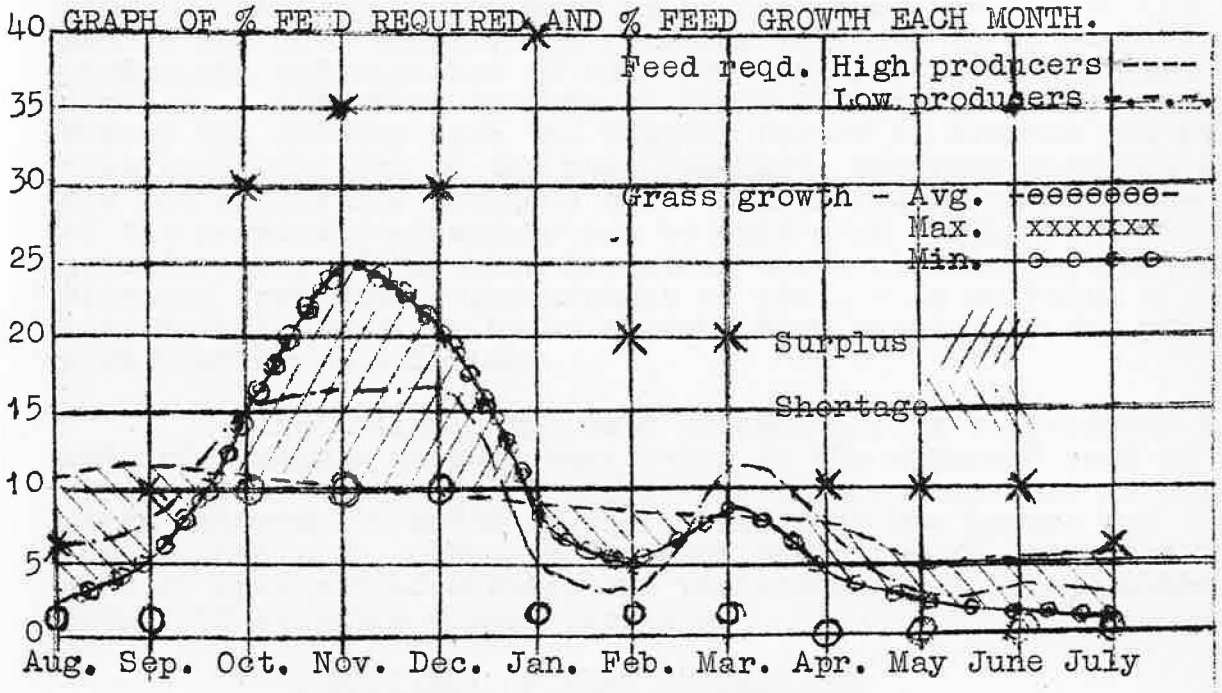
TABLE V.

PERCENTAGES OF FEED REQUIRED AND GRASS GROWTH FOR TWELVE MONTHS.

Feed required each month by cows producing -			% grass growth each month 4 year period. 1927 - 30.		
	300lb. B.F.	206lb. B.F. 1927 group	Avg.	Max.	Min.
Aug.	10.3	6.2	2	6	1
Sep.	11.1	7.9	5	10	1
Oct.	10.5	15.8	15	30	10
Nov.	9.9	16.6	25	35	10
Dec.	9.3	16.7	20	30	10
Jan.	8.6	5.0	7	40	2
Feb.	8.4	3.6	5	20	2
Mar.	8.0	11.4	8	20	2
Apr.	7.6	7.3	4	10	0
May.	4.9	2.8	3	10	0
Jun.	5.4	3.2	2	10	0
Jul.	5.4	2.9	2	6	1

It will be seen from Table V, Column i, that the monthly feed requirements of the high producers, maintained at constant weight, shows little variation from month to month. It reaches a maximum in September and gradually falls off to a minimum in May. It is quite unrelated to grass growth and therefore has been arranged by the owner of the cows.

That of the low producer varies considerably from month to month, reaches one maximum in November ard December, another in March and drops to low levels in February and in May to June. It actually follows the graph of grass production. In fact the variations in grass growth or other feed supply determine the variations in live weight change. The differences are well displayed in graphical form.



The low producing cow, column 1i in table V, loses weight during January and February while milking, gains a little in March when the grass is better and then loses weight in June and July. In October, November and December she returns to her normal weight. In doing this she uses much more feed than the constant weight high producer in spring, and very much less feed in autumn. Some dairy farmers maintain that this practice has many advantages since it tends to keep grass growth under control in spring, and certainly gets over the difficulty of poor grass in early autumn. By comparing columns 2 and 3 of Table V it appears, however, that on an average such a cow cannot eat all the grass that grows in November and December, and therefore that some waste must occur even in average seasons (a little hay is made).

Maximum and minimum grass growth are included in columns 4 and 5 to show the enormous variations that may take place in grass growth, and to emphasise the point that even though animals can be sufficiently accomodating to use the average grass growth, there are such wide departures from the average of monthly growth in different years, that there must be wasts of grass, or starvation of cows unless reserves of feed are put by.

To some extent, the low producer of varying live weight obviates the necessity of cutting hay or ensilage, but she also precludes the possibility of doing so, and consequently such cows that are in poor condition in winter give themselves the legacy of being low producing in the following spring and of being starved in autumn. It therefore becomes difficult and perhaps inadvisable to lay the blame of

low production at the door of winter feeding. It might be more reasonably charged against the general farm policy and the absence of feed in January and February, May and June or other months when grass, the staple food, is in short supply. Wordsworth's lines "Getting and spending, we lay waste our powers" might have been meant for the dairy cow.

It is an age-old practice, most convenient to mankind and indespensible to the very existence of the animal, for the animal to use its body as a store house for its own feed supply. The more highly exploited and artificial the existence of the animal, the more it is necessary for man to organise its food supply, and if dairy cows are to be high producing, organisation of the feed supply is a most urgent problem. Attention to this by those interested in the industry has already been the biggest factor in success and it must be productive of the most immediate progress where it is now not adequately attended to. Evaluation of the aptness of the present feed supply can be made most easily from a consideration of the herd lactation curve or from information obtained from actual measurement of cows, - as an index of live weight status, - by an organisation similar to the present Herd Testing Association.

When animals are used excessively as storehouses it not infrequently happens that owing to the apparent need of a winter feed supply, undue expense is incurred on this in a tardy attempt to build up the animal that has become too low in condition, with a consequent reduction in the grass area or spring feed supply, and therefore a reduction in the output of saleable animal products.

EFFICIENCY OF FEED CONVERSION.

One further aspect of feed utilisation that may negative the value of otherwise excellent feeding is the amounts of feed that are used for maintenance and for production purposes. Those who keep cows do so for profit and usually attempt to keep such a number that their profits are as great as possible. In his bulletin, No. 138, N.Z. Department of Agriculture, on Dairy Farm Management, Fawcett produced figures to show that the greater the number of cows per acre, the greater the production per acre, that cows per acre is a cause of returns per acre, and that high producing cows, while valuable, tendto be over exploited as a factor in high per acre production. His contentions require consideration in the light of fundamental principles.

Reverting to Table IV, it will be seen that the high producers consume 4062lb. of S.E., and convert 1802 of these into butterfat (100 for calf production). This means that they are converting 44.5 per cent of all the feed that they eat into butterfat. The butterfat production on any farm is determined by two most rudimentary factors, both under the control of the owner. The first is the amount of feed that grows and ths second the percentage of this that is turned into butterfat.

The owner has some control over the first by the kind of pasture or crop he uses, and the top-dressing and treatment he gives them; over the second by the quality of the cow he uses, the number he keeps and the way he organises their feed supply. Cockayne first indicated the importance of this aspect of cow production in the N.Z. Journal of

Agricluture, Vol. XXIII, and most dairy farmers were quick to realise the importance of reducing the number of cows in order to get higher total production of butterfat. Fawcett appears to have drawn a wrong inference when he suggests that high production per acre is due to high cow numbers per acre. If we take Table I of his bulletin and translate his cow numbers and pounds of butterfat per acre into feed produced per acre, we get the following:-

TABLE VI.

Av. B.F. per ac. Bul.138 Table 1.	Feed used per ac. for prod. lb. S.E. B.F.X.6	Cows carried per ac. Bul.138 Table 1.	Feed used per ac. for cow maint. lb. S.E. cows X 2200	Total feed produced per ac. lb. S.E.	per cent turned into B.F.
161.9	971	.535	1177	2148	45.2
139.0	814	.490	1078	1892	43.0
119.5	717	.440	968	1685	42.5
99.6	597	.382	840	1437	41.1
81.9	491	.338	743	1234	39.8
63.8	386	.293	644	1030	37.5
38.0	228	.198	435	663	34.4

It will be seen that the farms compared vary in production per acre from 2148lb. of S.E. down to 663lb. of S.E. per acre, and the percentage of this that is turned into butterfat varies from 45.2 per cent on the high production farms down to 34.4 per cent on the low production farms. If the efficiency of conversion of the lowest producing farms was as good as that of the highest producing, the lowest producing farms would be carrying .164 cows to the acre and producing 501b. of butterfat per acre, an improvement of about 30 per cent in per acre production by reducing cow numbers per acre by about 16 per cent. The fact that high correlations are obtained between butterfat per acre and cows carried per acre means little since both these items are merely the consequences of the amount of grass that grows and of the efficiency with which it is converted into butterfat. The percentage of grass turned into butterfat on average dairy farms would appear to be about 40 to 42 and the maximum about 50 to 52 for farms quoted in bulletin No. 138. Some slight improvement is still possible in this direction even in the North Island. If the number of cows in milk is multiplied by 2200, and the total sales of butterfat multiplied by 6, the sum of these two amounts is the total feed used by the cows. The percentage efficiency is then found by dividing the product "butterfat X 6" by the total feed used. When a man knows this efficiency he knows how much attention to give to his feed supply

Dairy production has been approached from every angle by different interests, and has received stimuli from research into quality of produce, quality of stock, disease control, grass quality, stock feeding, herd testing, etc., as well as from commercial interests such as top-dressing, home separation, feed conservation, machinery and equipment. Always, however, the greatest advantage is obtained by the herd owner who is most capable of helping himself and people do this most readily, not whne they are told to do so because of some obscure scientific fact that they can never observe themselves, but when they are supplied with information that

is easily understood, or which they may collect by their own observation. Herd testing has been a success principally because it has supplied the latter kind of information. The method of approach outlined above is of value for the same reason.

Everyone likes to have a measure of the success he is achieving, especially when that measure enables him to put a value on all the factors concerned in that success. This principle appears to have been appreciated in Western Australia where a "better dairying" competition has been in progress for four years.

The scale of points adopted is as follows:-

Journal of Agriculture W. A. June, 1935. Page 118.

	Max points
(1) Conservation of fodder and summer fodder crops (300 points)	
(a) Condition - quality and condition	60
(b) Silage - quality, type, wastage, etc.	60
(c) Summer fodder - cultivation disease, yield	50
(d) Amount conserved per cow	130
(2) Pasture (240 points)	
(a) Condition - freedom from weeds, mixture, etc.	150
(b) Management - fertilisation, etc.	90
(3) Dairy herd (120 points)	
(a) Breeding and dairy types	60
(b) Condition and freedom from disease	30
(c) Herd sire (1) Pure bred20(2) Ex-tested dam 10	30
(4) Returns per acre (30 points)	
(a) Butterfat per acre	100
(b) Side lines - pigs, poultry, etc.	20
(5) Pigs (30 points)	
(a) Breed and type	10
(b) Number of breeding sows in proportion to milch cows	10
(c) Housing, feeding and management	10
(6) Farm management (140 points)	
(a) Lay-out and convenience	50
(b) Sanitation (1) General30(2) Milk sheds, dairy utensils, care of cream, etc.40	70
(c) Book-keeping and records	20
(7) Utilisation of skim milk (50 points) Based on number of pigs reared and calf months per cow	50
Total	1000

A consideration of the points allotted to the different factors in better dairying gives food for thought.

From recent developments in New Zealand it is apparent that an attempt to improve the dairy industry is going to be made by improving the quality of our produce. This should improve the sale value of it, but higher priced butterfat must mean better opportunities for the manufacturers of butter substitutes, and may ultimately be of doubtful benefit to the

producer of butterfat. Improvement in the dairy industry could be made in New Zealand by increased output, even at present low prices, and although it may be an embarrassment, increased putput is still inevitable in New Zealand unless statutory limitations are imposed on individual dairy farmers. Denmark may have benefited by reducing her output, already efficient and of high quality, but in the author's opinion, New Zealand is not in a position to follow her example until the dairy industry is producing to its maximum - wasting, no grass, wasting no cows.

This paper has been prepared for the purpose of exploring some major problems of the dairy industry, and of demonstrating a method of approach in agricultural research in general.

A great deal of information about produce, sheep, cattle and pigs is recorded by farmers and if collected and analysed would provide a sound starting point for the technical research worker. A suitable organisation employing recording officers would be productive of more good than any other system. The psychology behind the idea of an instructor for non-primitive communities is unsound whereas recorders whose business is to observe, collect information, tabulate and distribute it without obligation on either side, is essentially sound and has proved itself to be acceptable in the case of Herd Testing and Pig Breeding.