Break versus Paddock Grazing of Dairy Cattle

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ALL members of this Society should be familiar with the pasture utilisation technique now commonly known as "break" grazing in New Zealand and as "strip" grazing or "close folding" in Europe. The method was introduced by Professor W. M. Riddet some fifteen years ago. In its initial form it referred to the rationing of limited supplies of autumn-saved pastures to early calving cows, by controlled grazing-off in narrow strips with the aid of an easily moved electric fence. One of the outstanding pioneers of the system under practical conditions—Long of Levin—has described his methods and observations in detail, while Lees of Ruakura has presented data on the food value and yields of autumn-saved herbage together with measurements of the production advantages accruing from its utilisation by break grazing.

The method has undoubtedly proved of immense value in solving the problem of providing green feed during the interval between calving of the herd in late winter-early spring and the commencement of adequate spring growth of grass. It is now so widely adopted throughout the country as to have become a standard technique amongst progressive grassland dairymen.

It is important to note that the method involves four major features:

1. Closing a portion of the farm during a period of good growth for use during a period of inadequate growth.
2. Storing of this saved feed through the winter **in situ.**
3. Rationing of the limited quantities available to milking cows at a critical stage of lactation.
4. Grazing in "breaks" to effect complete utilisation.

Farmers experimenting with the method have been impressed with its results. They have observed that it not only provides a practical method of meeting the herd feeding problem of July and August, but also that it appears to result in more complete use of available feed. There is less soiling and trampling of herbage; hungry cows quickly consume the feed on the small "break" offered, grazing it almost with the precision of a mower.

These observations focussed attention on the actual method of utilisation so that it is not surprising that without scientific stimulation, farmers should have begun to extend "break grazing" beyond the autumn-saved pasture stage into the main period of grass growth. Equally, it is not surprising that advisory officers, working from similar observations, should begin to advocate such extension as a key factor in efficient pasture utilisation. The important point to note here, however, is that this development was not based on any critical experimentation.

Since the frequent shifting of electric fences involves extra work —justifiable during periods of critical feed shortage, but not necessarily so over the whole year—and since on many other counts it is highly desirable that objective data be obtained on all major variables in methods of pasture use, Ruakura workers decided to examine the precise effects of "break grazing" as compared with the relatively standard system of "paddock grazing" on a rotational basis.

The design of suitable experiments presented many problems. It was immediately obvious that if a system of "break grazing" does indeed involve "rationing" of available pasture, then more grass should be available for conservation as silage or hay. Similarly, if the system really does save pasture from soilage and trampling, thus giving more complete utilisation, it will again result in larger areas being available either for more saved fodder or for more stock. Carrying capacity and production per acre could, therefore, be influenced to a corresponding degree. Still further, if the available grass on the farm at any one time is made to go further by break grazing, then its use over the period of maximum flush growth could exaggerate the often embarrassing problems of control characteristic of this period. Again, the continuous use of a break grazing system, which after all is but an extreme development of the principle of controlled rotational grazing, might have as great effects upon botanical composition and overall productivity of a sward as has the "rotational" relative to the "set-stocking" system of pasture management.

Accordingly, it was argued that the overall effects of the new grazing technique could really be measured effectively only by controlled experiments on a complete farm management basis. Such an undertaking is a major enterprise and in any case is subject to serious experimental difficulties. It would be justified only if a much sounder case could be made for the system than that of limited field observation and arguments deduced from results of a method designed originally for a completely different and highly specialised aspect of grassland dairying.

In consequence, we concluded that examination of some of the less complicated issues was a highly desirable preliminary to any large scale attack on the broader front. Initially, therefore, we decided to limit ourselves in the first instance to a single but basic question:

Given a field of grass at the milk producing stage of growth during the main part of the grass growing season, will this field yield more milk and butterfat if utilised in daily breaks than if grazed on a paddock basis?

Essentially this is the same as the question posed by workers in Scotland, England and Holland, who have been examing break grazing as a method of making the best use of the limited amounts of pasture available during the short grazing season typical of these countries. In this connection it is important to stress that in all the experiments in these countries of which we have published information, the workers have assumed that break grazing does indeed give better utilisation so that in every case a greater area has been allotted to paddock grazed experimental groups. Thus, differences in production per acre have been predetermined by the relative carrying capacities chosen.

Experimental Design.

In this Ruakura experiment, which was conducted in the 1951-52 season, equal areas were used to compare the two methods: Approximately 16 acres divided into eight separate fields were used. Each field was subdivided into two equal parts with a semi-permanent fence to permit paddock grazing on one half and break grazing on the other.

Ten sets of identical twin cows were distributed at random on a twin set basis between the two treatments, so that each area carried the same number of identical stock. The twin sets varied in age from 3 to 6 years. They were selected on their performance from calving, so that at the commencement of the experiment they were a particularly even lot on a "within-set" basis. The two herds had averaged 29 days in milk. They had run together from the commencement of the dry period. Since calving they had been accumstomed to "break

grazing" having been rationed on autumn-saved pasture plus silage. The experiment ran from September to January inclusive, a total of 147 days, and thus covered the major grass growing period of the dairying season. The grass year was a good one and supplementary feeding was not necessary until February, at which time the experiment was discontinued. The pastures on the experimental area were dominantly ryegrass-white clover with a small proportion of cocksfoot and yorkshire fog.

Grazing of the experimental area commenced on the 30th August. As each new paddock was opened up, the "break-fed herd" was given a strip of its half of the paddock sufficiently wide to provide for a twenty-four hour period. At the same time the "paddock grazed herd" was allowed free range on the whole of its half. Here it remained until the "break-fed herd," moving forward in daily breaks, had completed the grazing of the whole of its half. This procedure was followed as each new paddock was brought into the rotation. Back-grazing of the "break grazed" areas was permitted since this is the only practical way of using the system in New Zealand.

In order to overcome any side issue effects of the two grazing systems such as influence on botanical composition, the half of any field which had been "break grazed" at the previous grazing was "paddock grazed" the next time the field entered the grazing cycle, and vice versa.

The size of the daily break was determined by the amount of grass available in relation to appetite of the cows during the previous twenty-four hours. A high degree of grass utilisation was aimed at. If pasture was obviously being wasted in one twenty-four hour period, the strip was reduced during the next. On the other hand, since maximum per cow yields were desirable, the strip area was increased if it was considered that the allocation on the previous day had been too small to allow full intake. Although daily milk weights were used as a guide to this latter point, decisions had to be largely subjective so that it is impossible to appraise precisely the extent to which the double aim of full feeding and full utilisation was actually reached. It is important to note that the paddock-grazed herd did not move from its half until the break-fed herd had fully covered its area.

No pre-set plan of paddock rotation was followed. Choice was determined by the usual empirical methods typical of controlled grazing aiming at good grass utilisation and high per cow yields.

RESULTS.

Grazing Observations.

No difference in the relative efficiency of utilisation was observed between each half following completion of any one grazing cycle, nor was any difference in recovery rate noticed. At no time was it necessary to use the mower to top either half to maintain an even cover. On only one occasion and on one field were dry stock followers needed to clean up any field after grazing by the milkers. Half the total area was cut for silage during the experiment. Fields not needed at various times by the milkers were grazed out by yearling heifers—a total of 583 heifer grazing days being involved. Production per acre averaged 220 lb. fat for the 147 days.

Based on these figures for silage, young stock and total yield, and on close observation during the whole of the trial, it was considered that overall efficiency of use of available feed was of an extremely high order and that no difference existed between the two grazing systems. It must be noted in respect to this conclusion—admittedly largely subjective—that the paddock grazed cows remained on their half in each case for a considerably longer period, amounting to

several days during every grazing cycle, than they would normally be permitted to do by most dairymen under commonly practised rotational grazing aimed at high production. Over the whole experimental period the average number of daily breaks recorded per paddock by the break grazed herd was 4.2 with a range of from 2 to 7. Thus the rotated herd remained in any one field from 2 to 7 days with a mean of 4.2 days. It must be stressed that these long periods in the one field, during which the paddock grazed cattle were forced to eat food rejected earlier, was hardly likely to have improved production prospects of the control herd.

On the question of full feeding of the break-fed herd, yields per cow were good. Live weights increased by 100 lb. These facts, together with supporting evidence from grazing and ruminating times and ratios, support our belief that the "break-fed" cows were indeed fully fed on grass.

PRODUCTION RESULTS:

Milk and butterfat production results are summarised in Table 1. These are based on individual milking weights and daily butterfat tests recorded throughout the trial.

TABLE I: Per Cow Yields (147 days)

	Paddock Grazed	Break Grazed
Milk (lb.)	4003	4023
Fat (lb.)	174.8	175.0
Test	4.40	4.41

There was no treatment effect. Agreement within twin sets was very good. For those interested in experimental precision associated with the use of identical twins in production experiments, the treatment $\times$ set interaction plus error amounted to only 3.0, 4.5 and 4.1 per cent. for milk, fat and test respectively. Thus, not only did the animals, irrespective of genotype, react uniformly to the two grazing treatments, but the error term was extremely small. Twin set differences accounted for over 95 per cent of the total variance in each production measurement.

Quite obviously the experiment has answered the question set in the negative. "Break grazing" did not result in the production of any more milk or fat from the same fields of pasture than "paddock grazing." Since the areas involved and the number of cows used were identical, "break grazing" also resulted in exactly the same yield of milk and fat per acre as "paddock grazing."

While differences in total yield were thus unaffected, daily fluctuations did occur. These are of special interest. Daily milk production of the "break-fed" herd was much more uniform than that of the "paddock fed" herd. The latter showed consistent fluctuations of considerable magnitude. Yield tended to rise at the first two or three milkings after entry into a new field, falling thereafter so long as the herd remained in the same field. Smaller daily fluctuations were observed in the yield of the "break-fed" cows. These showed no systematic variation but were typical of the normal variation in the daily milk yield of a herd offered fresh pasture each day. That the variations in the behaviour of the "paddock grazed" cattle were not random but highly systematic and due to treatment, was tested statistically with highly significant results.

On a weekly yield basis the lactational curves for milk of the two groups did not show any consistent differences, while the monthly curves—as will be obvious from the total production figures—were virtually identical.

Daily variations in butterfat yield exhibited no systematic trend in either herd. Even the large daily variations of the "paddock grazed" herd in milk yield were ironed out by compensatory rises or falls in butterfat test.

GRAZING BEHAVIOUR RECORDS:

Standard grazing behaviour observations were recorded on five separate days in the hope that the resulting information might help interpretation of production results. Observations were made on one field on the first and sixth days of grazing; and on another on the first, third and fifth days. The resulting data have been summarised as follows:—

1. The "break-fed" cows exhibited greater variability in both grazing and ruminating times than their "paddock grazed" mates.
2. Grazing time of each herd increased with the time required to graze out the paddock.
3. Rumination time of the "break-fed" herd increased markedly as grazing proceeded from the first break to the last; there was no definite trend with the "paddock grazed" herd.
4. Over the five observation days, the "break-fed" cows grazed 34 minutes less per day but ruminated 38 minutes longer on the average that did their "paddock grazed" mates. Each herd thus did practically the same amount of work.

Considering this information in relation to the studies of Hancock on the interaction of grazing behaviour, intake, production and pasture type, a reasonable interpretation is that the data supports strongly Hancock's contention that the dairy cow is capable of adjusting herself to wide extremes of pasture types and qualities by varying her grazing and ruminating performances to satisfy her productive urge and requirements. In this experiment, a noticeable deterioration in quality of pasture occurred fom the first to the last day of break grazing in a paddock. This apparently led to both increased grazing time and increased work of digestion (ruminating time) of the "break grazed" cows as they proceeded from the first to the last break. Over the same period the "paddock grazed" cows had initially both a short grazing and ruminating time when ample feed was available, but as this disappeared they adjusted themselves to the reduced supply by increasing the time spent in search of food. Ruminating time did not increase markedly in this herd with time, probably due to the fact that the rank herbage characteristic of the break grazing system in the last breaks of any one field just could not exist. In other words, as indicated by the overall smaller ruminating times, the overall feed quality of the "paddock grazed" cows was superior though its quantity may have been less.

LIVE WEIGHT CHANGES:

Live weight changes of the two herds during the experimental period were similar. The "break-fed" cows weighed 16lb. less at the commencement, and 20lb. less at the end of the time. The average live weights of each herd increased by approximately 100lb. over the five months of the trial.

DISCUSSION:

The major conclusion inevitable from this trial, that "break grazing" per se resulted in no greater production either per cow or per acre than "paddock grazing," is in such sharp conflict with the production benefits claimed by European workers that some discussion is warranted. All overseas workers claim increased milk production per acre of the order of 15 to 30 per cent. from "break grazing" over that obtained under systems of "rotational" or extensive grazing.

While it is not to be expected that experimental results obtained under different climatic and pastoral conditions should agree very closely, it is reasonable to argue that the two systems are sufficiently different in principle to yield unequivocal results wherever they are used.

In this connection, the results of the trials of the Hannah Dairy Research Institute (3), on which widespread advocacy of break grazing in England has been based, are worth examining. The second year's experiment at this Station and that reported in this paper are so similar in several essentials that they might well have been replications of the same experiment carried out, 11,000 miles apart.

1. The trial lasted 147 days at Ruakura and 140 days at Hannah.
2. Stocking rate was approximately 50 cows per acre per day at Ruakura and 30 to 65 at Hannah.
3. The days in each paddock averaged 4.2 at Ruakura and 4 at Hannah.
4. The "break-fed" and "paddock grazed" herds yielded precisely the same amount of fat corrected milk—28.8lb. per day at Ruakura; and precisely the same—29.1lb. at Hannah.

Yet, the Hannah experiment resulted in a greater yield per acre from break grazing of 33 per cent. This was because the same number of cows, yielding the same amount of milk, were grazed on the same initial pasture subdivided at the ratio 4:3 with the "break-fed" cows getting the smaller area. This design was justified on the tacit assumption that the needs of the "break-fed" cows could be satisfied on the smaller area—an argument which involves the additional assumption that break grazing does in fact lead to more feed per acre being utilised.

It will be obvious, however, that with such a difference in carrying capacity, it is not possible to assess just how much—if any—of the additional output of the Hannah experiment was due to the grazing system. The results from this Ruakura trial, together with the mass of data from New Zealand sources, illustrative of the powerful effect of carrying capacity per se as a controlling factor in production per acre, at least suggests that this factor and not grazing management must have been the cause of the increased per acre yield under "break grazing."

In conclusion, it is stressed that this paper has not been presented as a complete, final, or even satisfactory answer on this complicated aspect of pasture utilisation by dairy cattle. Rather it is hoped that despite its many deficiencies it will stimulate, if not provoke, a profitable discussion. At the very least the results are challenging. The authors will welcome suggestions as to how the problem may be followed up with profit. Many alternative approaches have already occurred to them. Others will, we are sure, be suggested by this meeting. After all, critical and constructive discussion of work in progress is the main justification for the existence of this Society.

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Discussion

Mr. STICHBURY: Do the Ruakura results indicate that farmers will get the same results with set and break grazing as the Ruakura workers did?

Dr. STEWART: In his paper Dr. McMeekan criticised English workers on the score that they predetermined their results by having different stocking rates on the two areas used for break and paddock-grazing. I think a somewhat similar criticism may be levelled at the Ruakura results even though the stocking rates were the same in each case, namely, that the stock were not moved from the paddock-grazed area until the break-grazed area was finished. Dr. McMeekan has admitted that under normal circumstances he would have shifted the paddock-grazed animals before he did so in the experiment. I am of the opinion that Dr. McMeekan predetermined his results by not shifting his animals from the paddock-grazed area until the comparable break-grazed area was finished. If animals had been shifted when, in his opinion, the paddock-grazed area was finished by his admission there would have been some breaks left in the break-grazed field. Reserves would thus have accumulated and during the short period of the trial to me it seems likely that an excellent case might have been made for break-grazing. There are a number of considerations which have not been taken into account such as the most desirable amount of cover to leave on a field, how desperate the need for feed at a particular time and so on. These must be borne in mind and if break-grazing permits some control over these considerations, then it may be worthwhile on these scores alone.

Mr. McMEEKAN: The paddock was grazed much more closely than usually done but still the production was the same as the break-grazed group.

Dr. MITCHELL: The amount of feed may have been the same for both groups but was it physiologically the same?

Dr. McMEEKAN: The paddocks looked the same under two systems, when the cows were taken out. The time spent in cudding was different for the two groups.

Mr. McFARLANE: The amount of feed may have been the same when the cows went in but a difference may have developed under the two systems before the paddocks were changed. Was intake measured in the trial?

Dr. McMEEKAN: No, but the experiment is to be repeated with intake measurements.