SOME HAZARDS OF GRAZING IN NEW ZEALAND

by

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The history of animal production in New Zealand is the story of how a country which had no indigenous grazing animals and no outstanding pasture species developed grasslands which today produce more high quality dairy products and meat per acre than any other country in the world. It is impossible to conceive of any more exciting situation for students of animal and plant ecology. In this mathematical era it is rather old-fashioned to speak of the balance of nature. But although the statistician's formulae may give a more accurate presentation to those who can understand them to the uninitiated the old term still has some real significance. Speaking broadly, it may be said to stand for that flexible equilibrium which is the product of all the interactions within a biological complex that is free from outside interference. Strictly speaking, of course, no such situation exists, nor is every likely to exist, for it is just not possible outside of a laboratory to obtain complete freedom from outside influences. For example, the weather changes which occur from month to month in even the most equable climates have enormous effects on plant and animal populations. This is especially true of those small but important species which because of their size and habitat only obtrude on our notice through the often spectacular results of their operations. Nevertheless, it is true that in certain situations when a broad survey extends over a long period a fairly well defined equilibrium can be observed. Charles Elton expresses the idea quite well. Speaking of England, he says - "It so happens that we have lived a settled and somewhat isolated agricultural life longer in this country than many nations of the world, and seem to have shaken down into a roughworking balance with wild animals and plants."

It is well known that even small changes in such isolated biological communities may completely upset the "rough working balance". When, then, should we expect when a complicated association of animals and plants is transferred across the world into an environment in which they have never previously existed. For in the development of animal production in New Zealand that is what has happened.

Let us look at the situation in a little more detail. What are the important biological species which are responsible for our dairy and meat production. Some of them are obvious. Perennial ryegrass and white clover, Jersey cattle, Romney Marsh and Corriedale and Southdown sheep and other productive plants and animal species, nearly all imported. But those were not the only living importations. With them came the viruses, the bacteria, the worms, the insects, which we bulk together under the term "parasites". Everyone of these species must have reacted to the change in environment and every reaction in every species must have provoked further reactions in every other species, and each of these reactions and interactions makes some contribution to the environment of our grazing sheep and cattle. It is common knowledge to veterinarians that neither in England nor New Zealand does even the best pasture provide a perfect environment for the sheep and cattle which graze it. If we are to arrive at a proper understanding of the ailments of our grazing stock it will probably be necessary to study carefully the effects of the many and complicated changes which occur in their environment.

Probably the most important environmental factors are soil, plant species, weather and parasites. Any classification of pasture problems under these four headings would be inaccurate and misleading because in the great majority of cases two or more factors are implicated. To catalogue all the disorders of grazing animals and indicate which factors appear to be concerned in each case would certainly be tedious and would probably be unprofitable. I have, therefore, decided to use the four environmental factors as headings and under each in turn to discuss a few problems in which that factor alone is involved as well as some of the more complex problems in which the effects of other factors are super-imposed. In this way it is hoped that we may gain some in-

sight into the devious ways in which variations in the environment produce reactions in the grazing animal.

First, then, Soil:

Although soil acts as the vehicle for supplying many things to the grazing animal it is the primary source only of the minerals - all other materials being derived originally from air and water. We will, therefore, under this heading, confine our attention to problems of mineral metabolism.

As an example of the simpler type of mineral problem let us take the cobalt deficiency which occurs in fairly well defined areas of both North and South Islands. Although the ratio of cobalt concentration in soil and pasture is by no means constant it can be stated in general terms that a low cobalt concentration in soil produces a low cobalt concentration in pasture and this leads to characteristic symptoms in sheep and cattle. It is of interest to note that the soil cobalt deficiency produces no recognizable plant symptoms and apparently amongst animals only the ruminants are affected.

The functions of cobalt in the animal have not been determined. It is unlikely that it is an essential component of any tissue as it is retained in the body in extremely small amounts. The whole body of a sheep, for example, probably contains less than 0.1 mg. cobalt. It is known that cobalt deficiency can be corrected by dosing with liver which contains only 1/30th of the amount of cobalt which would normally be required. Recent work (Marston, 1945) has suggested that cobalt is necessary for the proper functioning of rumen micro-flora. It may be, then, that cobalt is required to enable the rumen micro-flora to produce a vital factor that is made available through the liver. This, of course, is mere speculation, but it will perhaps serve to show the complexity of what we chose as an example of the simpler type of mineral problem.

Second on our list of problem minerals comes copper. Here again a low copper status in soil leads to a low concentration in pasture and this to trouble in animals. There are, however, some notable new features. Copper deficiency does cause specific symptoms in some plants but as in the case of cobalt plants which appear normal may not contain sufficient copper for animal requirements. An interesting characteristic of copper deficiency is that it causes widely differing symptoms in different animals. In cattle it causes diarrhoea (Cunningham, 1946), in mature sheep little may be noticed, but lambs from copper deficient ewes show acute spinal trouble, (Bennetts and Beck, 1942). Copper is apparently an important link in the mineral chain. Iron cannot function in the animal in the absence of copper. The symptoms of copper deficiency in cattle can be caused by an excess of molybdenum (Ferguson et al, 1940), and they can be counter-acted by dosing with copper. No less interesting are the results of an excess of copper in sheep. If administered in small amounts over long periods copper accumulates in the liver and pathological changes occur in the structure of this organ. During this phase no clinical symptoms are usually noted. Then suddenly the liver appears to become saturated, and the copper concentration in the blood which had previously remained normal rises suddenly, red cells break down, the animal becomes jaundiced and dies. One of the unsolved problems of animal pathology is a condition in grazing sheep in which all the above changes occur apparently without any increase in the consumption of copper. It has been suggested that as an excess of molybdenum depletes the store of copper in the liver a deficiency of molybdenum may result in excess storage of copper in that organ (Dick and Bull, 1945). So far, however, no molybdenum deficiency in pasture has been demonstrated in areas where the disease occurs. It may be that a deficiency of some other mineral has the same effect.

Now let us look at an even more complex mineral problem. Variations in the concentration in the blood stream of the minerals calcium and magnesium have very spectacular effects on the operation of the nervous system. In milk fever there is a decrease in the concentration of calcium and coma occurs followed by death. In grass staggers the concentration

of magnesium falls and this is accompanied by extreme hyper-excitability and death follows. Now, though both calcium and magnesium are derived from the soil, milk fever and grass staggers are not due to deficiencies of these minerals in the diet, for they occur when cows are grazing pasture amply supplied with both of these elements. It is significant that both of these diseases usually occur shortly after calving and this fact has given rise to the suggestion that both diseases may be due to some disturbance in the very complicated control system which is exercised through the hormones secreted by the endocrine glands. Veterinarians in dairying districts have noticed that the incidence of these diseases is influenced by pasture condition during winter and spring, (Blakely and Dewes, 1942), and it seems likely that under special circumstances there are formed in the pasture substances with properties similar to the animal hormones, or substances capable of altering the rate of secretion of some of the hormones. Recent investigations of another reproductive problem have strengthened the feasibility of this hypothesis. Western Australian investigators (Bennetts et al, 1946) have shown that a locally developed early strain of subterranean clover causes reproductive abnormalities in sheep which are identical with those produced by the administration of oestrogenic hormones.

It will have now become apparent that mineral upsets in grazing animals may be due to something far more complicated than deficiency or an excess of the element concerned in the soil or pasture.

Fodder Plants:

As was inevitable our study of soil has already lead us to the consideration of plants. The sustained high quality of the best New Zealand pastures is due to the fact that for most of the year the plants remain green, grow rapidly and are kept short, conditions which normally pertain only to very young plants. While this type of food appears to be ideal for lactating ewes and unweaned lambs it does not seem to be so well suited to weaned lambs and calves. Recent investgations on rape feeding in Canterbury (Ewer and Bartrum, 1947) have shown that there is a positive correlation between the rate of growth of the lambs and the percentage of fibre constituents in the rape. Evidence is accumulating to show that weaned lambs and probably weaned calves thrive better on pasture somewhat more mature than that on which they are customarily grazed. The devising of a system of management to provide this type of pasture in autumn without reducing the carrying capacity is one of the major problems of animal management in New Zealand.

Because of the extreme dominance of our pasture species relatively little trouble is experienced in New Zealand from poisonous plants though some of the indigenous plants, such as tutu and Ngaio are occasionally eaten with fatal consequences and introduced toxic plants such as St. John's Wart also cause trouble in some districts.

Much more serious, however, are the losses which occur from plants which develop toxic properties under special conditions. In some cases these are well known, e.g. the development of ergot in ryegrass, paspalum and tall fescue. It is, however, perhaps worth mentioning in connection with the latter that though the characteristic sloughing of the foot can be caused by feeding fescue ergot, in the field the condition generally occurs long after the ergot has fallen and this condition still requires investigation.

In other cases the toxic properties are developed under peculiar weather conditions as in the case of facial eczema and so called ryegrass staggers. In quite a few cases there is as yet little indication of the reasons for periodical toxicity, e.g., the photosensitization occasionally caused by rape, Japanese millet and crowfoot (Erodium moschatum) and the nitrite poisoning of mangolds and thistles. In a number of the above cases the chemical identity of the toxic agent has not been established and until this has been done it will be very difficult to devise means of making our fodder plants safe at all times. This will probably be achieved in two ways: by breeding new strains of plants and by learning how to provide them with safe envir-

onments.

Weather:

The study of plant life leads naturally to a consideration of weather. Its influence in producing toxic substances in plants has already been mentioned, but I should like to revert briefly to the case of facial eczema. Here the effect of weather appears to be a very complex one, operating over a long period. During dry summer periods pasture growth is depressed and intensive grazing results in almost complete defoliation and in an accumulation of animal excreta which cannot be utilized by the plants because of the dry conditions. If warm autumn rains follow and continue for a sufficient period all the requirements for rapid growth suddenly become available and the resulting pasture contains the toxic principle which causes the liver damage characteristic of the disease. It seems likely that it will be necessary to study the effect of weather conditions over long periods in connection with other problems. Our most important pasture species are perennials and their reaction at any given time is likely to be influenced by past as well as present weather conditions.

Weather can, of course, exercise direct effects upon animals as is disastrously illustrated when severe cold is experienced at lambing or following shearing. It is perhaps not as well known as it should be that cold wet spells can seriously affect the fertility of rams, particularly those of the Romney breed (Webster).

Another interesting condition in which weather appears to play a part is the incidence of rickets in hoggets grazing green oats or barley in Canterbury during the winter. This can be prevented by giving vitamin D (Fitch, 1944). Growing plants contain practically no vitamin D and grazing animals therefore depend for their supplies on the effect of light upon exposed areas of skin. As light rays fall more obliquely in areas furthest from the Equator they are there less effective in preventing rickets. But the fact that rickets seldom occurs in lambs grazing plants other than oats and barley in Canterbury makes it impossible to accept lower light incidence as the sole cause of the condition. It would almost appear as if the oat and barley plants contained some substance which neutralizes the effect of vitamin D.

Parasites:

So far we have been dealing with environmental factors which are mainly of importance through their effect on the quantity and the quality of the grazing animals food. Parasites make a more direct attack upon the animal, but they are themselves greatly influenced by the environmental factors - soil, weather and plant life. The term parasites is frequently confined to the group of internal parasites covered by the word "worms" and the external parasites which spend at least part of their lives on the animals' skins. As these will be dealt with in other papers I will confine my remarks to the smaller bacterial parasites. The grazing animal is particularly exposed to the attacks of these organisms as it spends its whole life in contact with its food which thus inevitably becomes contaminated.

There are two main methods of protecting animals against bacterial infection. They may be made immune to infection or they may be kept from contact with infection.

Contagious abortion serves as an excellent illustration of the first procedure. In this disease infection takes place through the eating of contaminated pastures in which the organism may remain alive for over a month. Fortunately a vaccine is now available which produces quite a solid immunity.

As an example of a bacterial disease which can be controlled by preventing contact with infection, foot rot of sheep may be mentioned. Here again the pasture and the soil become infected and infection is spread by contact between the feet and the infected ground. But in this case the infected organism seldom survives for more than a week

in the paddock. It is, therefore, quite feasible to prevent the spread of infection by ensuring that no healthy sheep enters a paddock less than a week after the last infected sheep has left it. By adopting this procedure and simultaneously treating all infected feet foot rot has been eradicated from a number of properties in Australia and there appears to be no reason why the procedure should not work equally well in New Zealand.

Susceptibility:

So far we have been considering environmental hazards of grazing. There are, however, certain pastoral problems which depend on the susceptibility of the animal and this may be due either to an inherited factor or to a physiological condition. As an extreme example, one might instance the inherited photosensitivity seen in some Southdown sheep. The exposed skin of these animals becomes intensely inflamed as soon as they are exposed to sunlight after grazing any green plants. It is thus impossible for them to live in a grass paddock.

There are, however, less obvious but probably more important examples, e.g., sleepy sickness occurs only in pregnant ewes and generally in those carrying twins, while trouble from worms is almost confined to young weaned lambs and calves. It is possible that the solution of such problems as "bearing trouble" and mastitis may depend as much on a study of the susceptibility of the animal as on an understanding of the environmental factors.

Conclusion:

Many of you may now have reached the conclusion that grazing in New Zealand is as much beset by hazards as the most diabolically planned golf course. But who ever heard of a good golfer giving up the game because of the hazards. By no means all of even the serious problems associated with grassland farming have been mentioned, but when they have all been allowed for, it still remains true that New Zealand pasture is capable of producing high quality meat and dairy products more economically than any other stock food in the world. While this is no excuse for ignoring the problems of grazing it makes it necessary for us to consider them realistically and to seek solutions which will still further increase the economic efficiency of animal production in New Zealand.

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DISCUSSION ON DR. FILMER'S PAPER:

MR. WARD: I was wondering whether Dr. Filmer would include in his paper a consideration of the question of quantity of feed in the sense of spring flush of which we hear quite a lot. There have been suggestions that sudden flushes of feed in dairy cattle produce upsets perhaps causing mastitis.

DR. FILMER: Mr. Ward is in a better position to answer that than I am because he has data for various districts. I will ask him whether there is any data indicating that mastitis is more common in districts where that sudden flush occurs than in districts where it does not.

MR. WARD: I must admit in reply that we have no data indicating that mastitis is more common in certain areas but I have heard Dr. Filmer express interesting views on this problem. It is an important question to many dairy farmers and one that is frequently asked and it does concern the question of grazing and grazing hazards. However, the question does lead on to pasture management and perhaps I should have asked Dr. McMeekan. But in dealing with the quantitative functions of grass and mineral deficiencies this problem did arise.

DR. FILMER: Personally I do not think that quantity of pasture is likely to affect the incidence of mastitis. It is quite possible, however, that in spring pasture active substances may be developed under conditions which at present we do not understand. I referred in the paper very briefly to the Australian trouble with sheep. There they have quite definitely shown that at certain times of the year there is developed in the early strain of subterranean clover a substance which acts either as an oestrogenic hormone or activates such a hormone within the animal. If that can happen in one pasture it may happen in another. I feel that some of our spring problems could turn out to be due to the development of something of that sort with our spring pasture upsetting the extremely complicated hormonal balance in the animal. Mastitis could perhaps be influenced in that way but so far as I am concerned I have no evidence and therefore I deliberately left it out of the paper.

MR. GERRING: In the Waikato we do see what we refer to as storms of mastitis - you see 50 per cent or more of the herd infected; that is not uncommon, and it would not be picked up by statistics because it applies to individual herds. Does Dr. Filmer not think that our most rational approach to the problem is to advocate the restriction of intake of the young rapidly growing grass and to stress the value of hay? The feeding of hay restricts the intake of the rapidly growing grass.

DR. FILMER: The difficulty that I see in that suggestion is to get cows to eat any quantity of hay during the spring time when there is lots of grass about. Professor Riddet does, I understand, practise a system at Massey which may help. He finds that with his 2 year old heifers he can steam them up by increasing their pasture intake right up to calving, and this increases their production xxxxxxx but he cannot do that with the older cows. He keeps them short before calving and feeds as much as possible from calving on, putting them in the best pasture he has, and he has experienced no trouble. We tried at Ruakura to produce a storm of mastitis by suddenly sending cows from a very poor pasture to a very good pasture but it failed.

MR. RANSTEAD: There is one other hazard in regard to spring flush and that is bloat if you keep the cows on the spring flush and let them have it ad lib when they calve. I have experienced a lot of trouble in some seasons with bloat and I was wondering if Dr. Filmer had any suggestions.

DR. FILMER: I read recently the summary of recommendations made by an American committee on bloat and they contained only what was taught thirty years ago, that you should not turn hungry cows on to pasture with a lot of clover in it. I understand that injecting Adrenalin is working like a charm as a cure.

MR. CANDY: I have had losses associated with bloat. One thing I have noticed is that bulls and young stock grazing on pastures that will produce bloat, get blown, but up to date I have had no losses. It is only in the milking cattle that have that break from the pasture during the milking period that deaths occur. 90 per cent of my trouble is associated with the 2 year old heifers. We have attempted to feed hay as has been mentioned by a previous speaker. We have it in racks at that period of the year; it is the only way in which we can get them to take some. I have been considering the question as to whether during that period of the year it would be advisable to have only half the herd brought in from the pasture at a time so that at no time would they be away from the pasture for more than an hour. My reason for thinking that is based on my remarks relative to the other stock