The requirement for phosphoric acid in the diet of cattle can be summarised as follows: For growth and for non-milking, empty, or pregnant cows a pasture containing 0.5 per cent. of phosphoric acid supplies more than enough of this mineral; for high milk production the pasture should contain 0.7 per cent.

Supplies from Pasture

How far does New Zealand pasture meet these specifications?

A few typical figures for phosphoric acid content of pastures, taken from many published by B. C. Aston and his colleagues, are shown in table II below.

All these pastures clearly meet the requirements laid down for phosphoric acid for catlte. They are the good pastures of the Dominion, and those on which it is profitable and desirable to carry milking cows. Certainly no justification exists for feeding phosphatic supplements to cows on such pastures.

The value of mineral supplements can be examined in another way by calculating the quantities of minerals provided by mineral licks and comparing them with the intake from pasture. That has been done in table III. The composition of the lick has been assumed to be half bone flour and half agricultural salt, and consumption of this lick would be, on an average, 5oz. a head a week. The pasture has been assumed to contain 0.8 per cent. of phosphoric acid, 1 per cent. of lime, 0.28 per cent. of soda, and 1 per cent. of chloride, which is the approximate composition of a normal good pasture. The daily consumption of pasture has been taken as 25lb. of dry matter.

It is obvious that the contribution made by the lick is insignificant, though the lick used in the example contains as much phosphoric acid as it is feasible to incorporate. Many licks contain much less phosphate. It is evident, too, that good pasture is an adequate source of minerals and that there is no justification for attempting to add more to the ration.

Poorer Pastures

In New Zealand there are areas where pasture improvement and pasture quality are limited by low fertility and low available supplies of phosphate in the soil. On such areas the phosphate content of the pastures is below the level of 0.7 per cent. of phosphoric acid needed for milking cows. It is rare and undesirable for milking cows to be run on such pasture, where the feeding quality would be insufficient to support a profitable level of milk production. Limitation of production in such cases would be caused primarily by the low feeding value of the pasture—its low available protein and carbohydrates and its low digestibility—and not by low mineral supplies. The addition of minerals to such a pasture does not increase the amount of protein or of other constituents like carbohydrate which the animal can obtain from the grass.

In the past, cases of phosphorus-deficiency disease have been reported in milking cattle on such unimproved lands. The disease occurred in Taranaki and Wairarapa districts, and symptoms were relieved by feeding bone meal. Only in such cases, where a deficiency is actually recognised, are mineral supplements justified. Even then, however, treatment by licks is obviously only a temporary expedient and a grossly uneconomic one, as topdressing with superphosphate would increase the phosphate content of the pasture and relieve symptoms of the deficiency, and at the same time greatly improve the carrying capacity and productivity of the area.

There is no necessity to go exhaustively into requirements and supply of other minerals such as lime, magnesia, potash, and chloride, as it can be shown similarly that they are provided in good pasture in quantities adequate for all the needs of even heavily-milking cows.

Minerals for Sheep

The question of minerals for sheep is similar to that for cattle, but the requirement is lower because the product harvested is lower in mineral content. The phosphoric acid requirement of a young growing sheep is about 3.5 grammes a day, which would be supplied in good pasture containing 0.5 per cent. of phosphoric acid. The requirement of a ewe producing about 3 pints of milk a day is 8½ grammes daily, which would be provided in good pasture containing 0.6 per cent. of phosphoric acid. These calculations have been made with due regard to the amount of food eaten and to the fact that some of the phosphoric acid in the fodder may not be absorbed into the body from the digestive tract.

On poorer pastures with lower phosphate content, growth or milk production could not be maintained at the same level as on good pasture. But lack of phosphorus is not the limiting factor; it is the poor quality of the pasture, its low digestibility, and its low content of proteins and carbohydrates. Workers in South Australia have shown that phosphate supplements for sheep run on areas extremely deficient in phosphorus do not cause any improvement in rate of growth or wool production. When parts of the same area were topdressed with superphosphate, however, the growth of the sheep did improve in direct relationship to the improvement in quality of pasture.

The conclusion reached was that there was no justification for the use of phosphatic licks for sheep, even in districts where low soil phosphate and low rainfall produced a herbage very low in phosphate. That conclusion is equally valid in New Zealand, where there are no areas as deficient in phosphate as that on which the South Australian work was done.

In table IV the amount of extra minerals supplied to a ewe by a lick is shown, as was done for a cow in table III. The same composition of lick and

TABLE II

Phosphoric Acid in a Random Selection of New Zealand Pastures.

Species of Pasture	Origin	Manurial treatment	Percentage P_2O_5 in Dried Pasture
Red Clover	Rotorua	Unmanured	0.75
White Clover ..	Rotorua	Unmanured	0.80
Cocksfoot	Rotorua	Superphosphate	0.87
Mixed	Wairoa	Superphosphate and lime	1.12
Mixed	Canterbury	Probably superphosphate	0.94
Mixed	Waikato	Probably superphosphate	0.77 to 1.45
Mixed	Poverty Bay	Probably superphosphate	0.67 to 1.13

TABLE III

Weekly Intake of Minerals Obtained by a Milking Cow from Lick and Pasture.

	From 6oz. of Lick (grammes)	From 175lb. of Pasture (grammes)	Required for a 3-gallon cow (grammes)
Phosphoric acid (P_2O_5)	19	633	420
Lime (CaO)	26	791	224
Chloride (Cl)	51	791	122
Sodium (Na)	34	198	70

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