

and employing manuka, stones, or rough timber for placing in these ditches when completely excavated! Further, as a last resource, the system of providing good surface-drainage, particularly for land to be laid down to pasture, could be employed. This method consists of ploughing the paddock in comparatively narrow lands, high in the centre and low at the sides, running with the natural slope of the land. Under-drainage in addition makes, of course, for greater soil-efficiency, and is of permanent benefit to the pasture and other crops. As a final emphasis of the importance of this subject, let it be stated that drainage is the first essential in the treatment of any soil, and without adequate draining the land cannot respond to any extent to any subsequent treatment it may receive. It cannot grow crops—pasture or otherwise—successfully. It may, then, well be asked, Are New Zealand soils as a whole growing as they should the staple crop of the country—pasture?

LIMING.

Next in importance to drainage in the rendering of soils fully productive is attention to the lime-requirement. Liming is almost unexceptionally required in New Zealand. The plenteous rainfall experienced; the abundance of decayed or decaying vegetable matter with which most soils of the country are supplied; the prevalence of large areas of swamp soils, stiff clays or clay loams, and porous non-retentive soils such as pumice; the preponderance of fern and manuka scrub, whose roots render the soil sour, over large areas of the country—these factors all account for the soils of the Dominion as a whole being acid. Lime is universally required to neutralize this acidity, and to replace the natural stores of calcium that, through the course of centuries, have been neutralized by the organic acids evolved as the result of the process of vegetable decay, and the bases that have leached from the soil owing to the copious rainfall of the past.

Of agricultural lime there are two forms—burnt lime and carbonate of lime (ground limestone). In general the former is more suited for soils well supplied with humus than for light sour soils deficient in humus, and, being more concentrated than the carbonate form, is better adapted for long haulage from the railway. Carbonate of lime, while highly suitable for all soils reasonably supplied with moisture, is specially adapted for sour soils deficient in humus, for, being a mild lime, it does not attack the small humus-supply, and does not therefore cause loss of nitrogen. As in 100 tons of carbonate of lime there is only 56 tons of calcium oxide (burnt lime), ground limestone would require to be applied to the soil in practically double the quantity of the burnt form to satisfy the lime-requirement of a soil; moreover, owing to this lesser degree of concentration, it cannot be hauled by road profitably to the distance that burnt lime can. When haulage is a negligible quantity, however, finely ground limestone of satisfactory price is more to be desired, all things considered, than burnt lime—due principally to its greater ease of handling, its greater safety in transit, and its non-caustic action on plant-food constituents of the soil. Increased quantity required per acre has nevertheless to be kept in mind. As to the quantity of lime required per acre, this depends upon the lime-requirement of a particular soil, gauged by means of a modified system of soil-analysis.