The Farm

Lime as a Fertilizer.

Having treated of gypsum and salt, we now come to the third and last substance, whose action in the soil is mainly indirect, and is therefore not valued for plant food, viz., *Lime*. This substance is found in various forms, notably (1) slaked, (2) unslaked lime, (3) carbonate of lime, including limestone, chalk, oyster shells, marl, etc., (4) gas lime. When carbonate of lime is burnt, the carbonic acid is driven into the air, leaving behind the caustic or quick lime, and when water is added, slaked lime is formed. If the latter is left exposed to the air, which contains small quantities of carbonic acid, this acid re-unites with the lime, the carbonate again being formed, but it exists in a much more finely pulverized condition than limestone can be ground into by any known means. The same effect takes place in the soil, especially in vegetable soils, which are rich in carbonic acid. In this feature it strikingly resembles the soluble phosphate of lime, which takes up lime from the soil and immediately becomes insoluble. Gypsum—also called plaster and sulphate of lime—is also a common form in which lime is applied to the soil.

There being numerous marl beds in Canada, it would be well to draw special attention to this form of the carbonate of lime, which, in marls, is found in a finely pulverized condition, although not so fine as the carbonate to which the slaked lime reverts when it comes into contact with carbonic acid ; the finer the condition of the carbonate, the more active are its effects. The word lime will now always express our meaning, only bearing in mind that the finer the pulverization, the more active the effects.

Six marls from different parts of Ontario were recently analyzed by Prof. James, Ontario Agricultural College, and they contained an average of about 90 percent of lime (the carbonate), the highest being 94.69 percent, and the lowest 83.78. A sample of the Model Farm marl was also analyzed, and showed the low percentage of 42.98. Of the four marls recently analyzed by Prof. Kedzie, Michigan Agricultural College, each sample having been taken from a different county in the State of Michigan, the average percentage was 81—proving that our marls are richer than the American ; and the same thing can be said with reference to our phosphates. Michigan marls are richer in the carbonate of magnesium than ours, which is less valuable than the carbonate of lime. Marl may be applied at the rate of 25 to 75 bushels per acre, but about 100 bushels may be applied on muck beds or other soils having a large excess of vegetable matter, and even more on stiff clay soils.

Gas lime varies very much in composition, but usually contains about 33 percent of slaked lime, about 20 percent of the carbonate, with 10 to 15 percent of sulphate of lime; but there are also small pecentages of sulphide and sulphite of lime, which are useful for destroying insects, but may also destroy vegetation, unless exposed for some time to the air before being applied, until they are oxidized into sulphate of lime. The sulphide also, when exposed to moisture, changes into that disagreeably odorous gas called sulphuretted hydrogen, which puts flying insects to the wing. Some gas limes also contain traces of ammonia.

Specially noteworthy is the action of lime upon the vegetable matter in the soil. It hastens the decay of humus into its resultant compounds, carbonic and nitric acids ; it hastens the decomposition into ammonium salts, as well as the decomposition of ammonium salts into salts of nitric acid. However, lime cannot produce these changes in the least degree so long as the soil is water-logged. Not till the soil is thoroughly drained can lime cure the "sourness," and hasten the desired results. On clay, lime makes the soil more porous and friable, and enables it to exercise its absorbent powers more affectually.

In applying lime, a consideration of the composition of the soil is much more important than the composition of the crop. In many parts of Canada, notably Ontario and the Northwest, where the soil is largely calcareous, liming is not attended with so many advantages as in other countries, and the merits ordinarily attributed to lime do not apply so effectually.

From a practical standpoint, we know of no agricultural literature in which the subject is so ably treated and concisely expressed as in the tenth edition, recently published, of a work on "Practical Manuring," by Emil Wolff, Professor of Agriculture at the Agricultural College, Hoenheim, Germany, who bears an universal reputation as an authority on all agricultural questions. We make the following translation from his excellent work :

1. Quicklime, as a fertilizer, should be applied in a finely pulverized state, which takes place when it is gradually moistened with about one-third of its weight of water, thereby becoming slaked. This condition is speedily and perfectly attained by placing freshly burned lime into a basket and then setting the latter into a vessel containing water, completely covering the lime with water. After three or four minutes the air bubbles will subside, which is a sign that the lime has taken up as much water as it requires for slaking it. The basket is then taken out, the slaked lime being emptied into a heap, where it crumbles into powder in about fifteen minutes.

2. The quicker the lime slakes, the greater is the heat developed, the volume thereby also becoming greater, and the better the lime becomes as a fertilizer ; but many poor limes, such as those containing high percentages of magnesia, also produce excellent effects, when reduced to a thoroughly pulverized condition. When the lime is too weak, or, containing much clay, is "burnt to death," it does not pulverize completely, larger or smaller hard lumps remaining in the mass, and it is then not so valuable as a fertilizer.

3. If the lime is to be preserved for some time before it is employed as a fertilizer, it is usually hauled immediately to the field where it is afterwards to be strewn, without first being slaked. Here it is thrown into small heaps, which are well covered with earth, nothing further being done than filling up, from time to time, any cracks that may open in the covering of earth. After a few days or weeks, according to the weather, the lime becomes pulverized. When the time for spreading arrives, the covering is removed, and if any unslaked lumps are observed, they are sprinkled with water in order to pulverize them.

4. The lime is spread by hand, or a suitable shovel may be used, and the work should be done in a still atmosphere and in dry weather. No pains should be spared in spreading the lime as evenly as possible over the surface of the ground.

5. The best time to apply is in autumn on the stubble, the land forthwith being lightly plowed; but it may also be applied in spring, providing the application be made shortly before seeding, and when the ground is sufficiently dry.

6. The quantity per acre may be 800 to 1,600 pounds, but more is often applied. It is better to apply small quantities often than too much at once. Too much liming may act injuriously several years after the application, the soil being first stimulated too much, and is then more easily exhausted.

7. A tough clay can stand much more lime than a light sandy soil, the latter standing the more the richer it is in humus. Upon a soil rich in humus, but poor in lime, this fertilizer is specially valuable. The existence of certain weeds, notably the sorrel, is a sign that the soil is greatly in need of liming.

8. Poor soils should not be limed. Lime produces the most favorable effects on land where barnyard manure was applied one or two years previously, another application of manure following soon after. The effects of lime last several years, but it cannot replace barnyard manure, although it heightens and assures its effects, and moreover brings the dormant powers of the soil into action.

9. On all cultivated plants, lime often produces strikingly favorable effects—always when it is lacking in the soil, or exists only in minute quantities, under different climatic conditions. It is applied in autumn with favorable results on clover aftermath for fall crops, for summer crops seeded with clover, and for potatoes and turnips. In the last case, barnyard manure should also be provided, but the lime should not be applied at the same time as the manure. A liberal application of lime highly promotes the growth of clover and other leguminous plants ; many a soil will hardly produce clover until limed, and an average yield is appreciably increased.

10. Pastures, when they are not too wet, may be limed with advantage. Moss, where it exists, disappears, and the nutrient foliage-plants develop more luxuriantly. For this purpose, either slaked lime may be applied by itself, or helped by an application of a strong compost, composed of good soil interlayered with some bone-meal and wood ashes, or, when the ashes are not available, other potash salts may be substituted, this mass being mixed with all kinds of vegetable refuse and allowed to decompose for some time before applied to the pasture.

11. The so-called "moor lime," which is finely pulverized, and is often almost pure carbonate of lime, not unfrequently found as under-strata, or in the vicinity of extensive peat-mosses, is also very well adapted for composts when mixed with humus, night-soil, bone-meal, wood ashes, etc., and makes a strong manure for pastures and cultivated fields.

12. It is also well known that marl is a most excellent substitute owing to its large percentage of lime. Greater or less quantities of marl may be applied according to its percentage of lime, in conjunction with the composition of the soil. A clayey and a vegetable soil can stand much more marling than a sandy soil, or a soil deficient in humus ; sandy soils must be marled with caution, and light quantities must be applied, particularly when the so-called sand or lime marls are used, while a clay marl may be applied in greater quantities under such circumstances. By close observation of the composition of the soil, as well as that of the marl, so by cautious employment, of the latter and when the soil has, before and after the application, received a liberal dressing of yard manure, it need not be feared that, after a few favorable seasons, any injurious effects will follow ; rather more after a longer or shorter time, the application may be repeated with good results.

Wet lands should be drained because we cannot unlock the fertility of the soil unless air takes the place of the water, says Prof. Scott, in the *Agricultural Gazette*. We drain to let water into the soil, as much as to take it out—not merely to carry off the surplus water, but to make the fertilizing rain filter through the soil. Amongst other effects, draining improves the texture of soil by making it porous, drier, looser, and more friable ; it makes land more easily worked ; it raises temperature of the soil ; it enables a greater variety of crops to be grown ; it gives an earlier seed-time and an earlier harvest ; and it makes manure more effectual. And even this does not exhaust the practical advantages of draining wet lands.