

observer on the rod. The same operation is gone through at the other end of the ground ; and if the two marks agree, the whole piece is on a level. But if the mark at the first station is at 3 ft. 9 in. from the ground, and 4 ft. 8 in. at the second, there is a fall of 11 inches from the first to the second station. A very little practice with the level will make any one handy with it ; but it is seldom necessary, except to intimidate the workmen by making them believe that the instrument will detect their tricks.

A very small descent is sufficient for the fall in pipe-drains. Cresy, the Civil Engineer, says that one foot in two hundred and twenty yards is enough : $\frac{1}{220}$! The deeper the water in the drain the less fall required : thus, deep rivers only want one foot in a mile. In very low lands I have found it necessary, sometimes to take the main a long way down into the ditch to gain a fall ; and I have seen, at Longleat, the Marquis of Bath's place in Wiltshire, an iron pipe carried under a mill-stream to take away the water from the drainage of a meadow on higher ground. But in all cases of this sort, the services of a competent engineer should be secured at once ; it will be found the cheapest plan in the long run.

The engravings of drainage tools, etc., will appear in the next number of the Journal.

LIME

The United States Department of Agriculture, in Bulletin No. 77, on the "Liming of Soils," gives the following summary on the methods of application and the conditions under which it should be applied :

The use of lime as a soil improver is very ancient, and its value for this purpose is generally recognized. Its action as a fertilizer is both direct and indirect.

There are many soils in which lime is deficient, notable in soils derived from granite, mica schist, and sandstone formations. On such soils lime is of direct value in supplying a necessary element of plant food.

The indirect value of lime is, perhaps, more important than its direct action, because, probably, the majority of cultivated soils contain sufficient lime to meet the direct demands of plants. Lime is of indirect value in unlocking the unavailable potash, phosphoric acid, and nitrogen in the soil.

Lime exerts a decided influence on the mechanical condition of soils, rendering heavy compact soils looser in texture and tending to bind particles of loose, leachy soils.

Lime is also beneficial in furnishing conditions in the soil favorable to the activity of the micro-organisms which convert the nitrogen of organic matter into nitrates, which are readily assimilated by plants, which decompose organic matter, and which assist leguminous plants to assimilate the free nitrogen of the air.

One form of lime, gypsum, has been shown to be a most effective corrective of black alkali, found in some of the soils of the arid portions of the United States.

The continued use of lime, unaccompanied by other fertilizers may prove injurious, especially on poor soils, since it converts the insoluble nitrogen, potash, and phosphoric acid compounds of the soil into forms which are rapidly taken up by plants or washed out in the drainage, and thus hastens the exhaustion of the supply of these substances in the soil. As the German adage states : "The use of lime without manure makes both farm and farmer poor." If the soil is not abundantly supplied with organic matter, its retentive power for water and fertilizers may be seriously reduced on account of the destruction of the organic matter by the action of too much lime. Soils are sometimes injured by the application of impure forms of lime, which harden like cement in the soil, or those which contain an excessive amount of magnesia.

It has been shown, that even many upland and naturally well drained soils, apparently in good condition otherwise, are so sour (acid) that most plants will not thrive on them. The application of caustic lime is the most economical and effective means of correcting this condition.

Lime may be applied in a variety of forms, among which are caustic, or burnt lime, or quicklime, which should contain at least 90 per cent of the actual lime (CaO) and is the most concentrated form of this material ; gypsum, or land plaster, in which the lime is in the form of the mild sulphate ; ground limestone and chalk, in which the lime is in the form of the mild carbonate ; different kinds of marl, containing varying proportions of sand and clay, and from 5 to 95 per cent of carbonate of lime ; wood ashes, which contain from 30 to 35 per cent of lime in the form of carbonate ; limekiln ashes, containing about 40 per cent of lime ; and waste lime from gas-houses, sugar beet factories,