

MEANS OF INCREASING THE PRODUCTIVE POWERS OF SOILS.

The means at our command of increasing the productive powers of soils may be comprehended under the following general heads:—

1. Supplying to the soil those organic and earthy substances which may be required.
2. Altering its texture, depth, and properties, by tillage and other means.
3. Changing its relation with respect to moisture.
4. Changing its relation with respect to temperature.

Vegetable and animal matters, in a decomposing state, appear to act in various ways in increasing the productive powers of the soil. They improve its texture, and they may be supposed to increase its power to absorb and retain moisture; but above all, they supply that matter, which, in whatever form conveyed to the organs of plants, tends to nourish them. This matter being absorbed by the roots of the plants, it must be supplied when exhausted.

Experience has in every age accordingly taught the husbandman to supply those substances to the soil; and the doing so forms one of the most important means at his command of maintaining or increasing its fertility.

Besides the animal and vegetable matter which is mixed or combined with the mineral part of the soil, and is essential to its productiveness, the mineral parts themselves, it has been seen, require to be mixed together in certain proportions, and in certain states of division, in order to produce the greatest degree of fertility.

Silica and alumina form the principal mineral part of the soil. If one or other of these earths be in excess, the soil is defective in its composition. If the alumina prevail, the soil is too adhesive; if the silica prevail, it is too loose. A medium is seen to be the best; and although the precise proportions in which the alumina and silica should exist have not been determined, it is safer that there be a tendency to an excess of alumina than of silica. Further, the fertility of the soil depends on the state of mechanical division of these minerals.

It would appear, then, to be a mean of improving the composition of a soil, to add to it siliceous matter when it is found to be too stiff, and aluminous matter when it is found to be too loose; and, further, to reduce these substances to their greatest degree of mechanical division.

Sometimes, accordingly, we have the means of improving the constitution of soils, by mixing sand with clay, or clay with sand. But in practice, the direct mixing of these two substances for the purpose of producing a soil of better texture is rare; *first*, because the expense of this species of improvement is considerable; and *second*, because, in the state in which sand and clay are usually available for this purpose, it seldom happens that the aluminous matter of the one, or the siliceous matter of the other, is in that state of minute division which is favourable to fertility.

It is otherwise with the earth lime. This can, in all cases be reduced by heat to that state of minute division which is favourable to the productiveness of soils; and hence it can always be applied with benefit to those soils in which it is wanting.

Lime is sometimes mixed, in its natural state, with aluminous and siliceous matter. It then forms marl, a substance which is frequently applied to soils to improve them. It is chiefly to the lighter soils that marl is suited; for then, not only is lime supplied, but alumina, which improves the texture of the soil. It is

by means of this mixture that some of the greatest improvements on siliceous sands that have taken place in Europe have been effected.

There are cases in which even calcareous matter is in excess in soils. This occurs especially in districts where the chalk formation exists. When the earthy stratum resting upon the chalk is very thin, the chalky matter becomes mixed with it, and being then in excess, forms a barren soil.

An obvious method of amending the composition of a soil of this kind is by adding any of the other earths, whether siliceous or aluminous. We need not here scruple to apply them, because the clay is coarse or the sand gritty. We may add them in almost any form in which they can be conveniently procured; for the effect will be to improve the composition of the soil.

There is another case in which, in like manner, siliceous and aluminous matter may be applied directly in almost any state in which they can be found. This is in the case of peat. Here the vegetable matter is in excess, and the addition accordingly of any of the earths is an amendment of the composition of the soil.

We see, then, that the composition of soils may be improved by the addition of animal and vegetable matter, and also, in many cases, by the addition of those earths in which they may be deficient, and, in an especial degree, of lime, which we can always apply in the form of minute division best suited to improve the composition of the soil. This is the first of the means referred to of adding to the productive powers of soils, and will be considered in detail under the head of Manures, and other branches of the management of the farm.

The *second* mode referred to of increasing the productive powers of soils, is that of altering their texture, depth, and properties, by tillage and other means.

The mere effect of that comminution of the parts of the soil which it undergoes in the common operations of tillage, is seen to have a beneficial influence on the productive powers of the soil. Whether the soil imbibes from the atmosphere anything besides aqueous vapour or not, it is known that the exposure of the matter of the soil to the atmosphere, and the comminuting of its parts by tillage, add permanently to its fertility. Thus we learn from experience the good effects of tilling lands well. Soils once tilled are rendered for the most part more productive by the process. Peaty turf, if suffered to remain in its original state, may continue to produce nothing but heath and the most useless plants; but, if merely ploughed, and exposed to the influence of the atmosphere; it will at once tend to produce grasses of a better kind, and of greater variety; and, again, if a subsoil of coarse clay be exposed to the atmosphere, it is generally at first very unproductive; and it is not until after long exposure, that it becomes productive. This is most remarkable in the case of clay-marl, a substance in itself containing the materials of a fertile soil, but which is often barren, until after pulverization and the influence of the atmosphere.

It is, indeed, conformable to analogy, as well as to experience, that soils should be improved by pulverization and exposure to the atmosphere. In our examination of the constituent parts of soils, we have seen that their fertility is in a great degree indicated by the proportion of minutely divided earthy matter which they contain. The effect of tillage, therefore, may be reasonably supposed to promote this division, both by the mechanical action of our instruments, and by exposing the particles of the soil to the action of the air.

Another purpose sometimes promoted by tillage,