selected not being such as the soil, at any time, could permanently sustain.

When this deterioration, arising from the dying out of the sown grasses, has reached its utmost point, the sward begins gradually to improve, natural grasses suited to the soil spring up in the blank places, and from year to year the produce becomes greater and greater, and the land yields a more valuable pasture. Practical men often say that to this improvement there are no bounds, and that the older the pasture the more valuable it becomes.

But this is true only within certain limits. It may prove true for the entire currency of a lease, or even for the lifetime of a single observer, but it is not generally true. Even if pastured by stock only and never mown, the improvement will at length reach its limit or highest point, and from this time the value of the sward will begin to diminish.

This, again, is owing to a new change which has come over the soil. It has become, in some degree, exhausted of those substances which are necessary to the growth of the more valuable grasses—less nutritive species, therefore, and such are less willingly eaten by cattle take their place.

Such is the almost universal process of change which old grass fields undergo, whether they be regularly mown or constantly pastured only—provided they are left entirely to themselves. If mown they begin to fail the sooner, but even when pastured they can be kept in a state of full productiveness only by repeated top-dressings, especially of saline manure—that is, by adding to the soil those substances which are necessary to the growth of the valuable grasses, and of which it suffers a yearly and unavoidable loss. Hence, the rich grass lands of our fathers are found now in too many cases to yield a herbage of little value. Hence, also, in nearly all countries, one of the first steps of an improving agriculture is to plough out the old and failing pastures, and either to convert them permanently into arable fields, or, after a few years' cropping and manuring, again to lay them down to grass.

But when thus ploughed out, the surface soil upon old grass land is found to have undergone a remarkable alteration. When *sown with grass seeds, it may have been a stiff, more or less grey*, blue, or yellow clay—when ploughed out it is a rich, brown, generally light and friable vegetable mould. Or when laid down it may have been a pale-colored, red, or yellow sand or loam. In this case the surface soil is still, when turned up, of a rich brown color—it is lighter only and more sandy than in the former case, and rests upon a subsoil of sand or loam instead of one of clay. It is from the production of this change that the improvement caused by laying land down to grass principally results. In what does this change consist? and how is it effected?

If the surface soil upon stiff clay lands, which have lain long in grass, be chemically examined, it will be found to be not only much richer in organic matter, but often also poorer in alumina than the soil which formed the surface when the grass seeds were first sown upon it. The brown mould which forms on lighter lands will exhibit similar differences when compared with the soil on which it rests; but the proportion of alumina in the *latter being originally small, the difference in respect to this constituent* will not be perceptible.

The effect of this change on the surface soil is in all cases to make it more rich in those substances which cultivated plants require, and therefore more fertile in corn. But strong clay lands derive the further important benefit of being rendered more loose and friable, and thus more easily and more economically cultivated.

The mode in which this change is brought about is as follows:

1. The roots, in penetrating, open and loosen the subjacent stiff clay. Diffusing themselves every where, they gradually raise, by increasing the bulk of the surface soil. The latter is thus converted into a mixture of clay and decayed roots, which is of a dark colour, and is necessarily more loose and friable than the original or subjacent unmixed clay.

2. But this admixture of roots effects the chemical composition as well as the state of aggregation of the soil. The roots and stems of the grasses contain much inorganic—earthy and saline—matter which is gathered from beneath, wherever the roots penetrate, and is by them sent upwards to the surface. A ton of hay contains about 170 lbs. of this inorganic matter. Suppose the roots to contain as much, and that the total annual produce of grass and roots together amounts to four tons, then about 680 lbs. of saline and earthy matters are every year worked up by the living plants, and in a great measure permanently mixed with the surface soil. Some of this, no doubt, is carried off by the cattle that feed, and by the rains that fall, upon the land—some remains in the deeper roots, and some is again, year after year, employed in feeding the new growth of grass—still a sufficient quantity is every season brought up from beneath, gradually to enrich the surface with valuable inorganic matter at the expense of the soil below.

3. Nor are mechanical agencies wanting to increase this natural difference between the surface and the under soils. The loosening and opening of the clay lands by the roots of the grasses allow the rains more easy access. The rains gradually wash out the fine particles of clay that are mixed with the roots, and carry them downwards, as they sink towards the subsoil. Hence the brown mould, as it forms, is slowly robbed of a portion of its alumina, and is rendered more open, while the under soil becomes even stiffer than before. This sinking of the alumina is in a great measure arrested when the soil becomes covered with so thick a sward of grass as to break the force of the rain-drops or of the streams of water by which the land is periodically visited. Hence the soil of some rich pastures contains as much as 10 or 12, of others as little as 2 or 3 per cent. of alumina.

4. The winds also here lend their aid. From the naked arable lands, when the weather is dry, every blast of wind carries off a portion of the dust. This it suffers to fall again as it sweeps along the surface of the grass fields—the thick sward arresting the particles and sifting the air as it passes through them. Everywhere, even to remote districts, and to great elevations, the winds bear a constant *small* burden of earthy matter; but there are few practical agriculturists who, during our high winds, have not occasionally seen the soil carried off in large quantities from their naked fields. Upon the neighbouring grass lands this soil falls as a natural top-dressing, by which the texture of the surface is gradually changed and its chemical constitution altered.

5. Another important agency also must not be overlooked. In grass lands insects, and especially earth-worms, abound. These almost nightly ascend to the surface, and throw out portions of finely-divided earthy matter. On a close shaven lawn the quantity *thus spread over the surface in a single night often appears surprising*. In the lapse of years the accumulation of the soil from this cause must, on old pasture fields, be very great. It has often attracted the attention of practical men, and so striking has it appeared to some, that they have been inclined to attribute to the slow but constant labour of these insects, the entire formation of the fertile surface soils over large tracts of country.

I have directed your attention to these causes chiefly in explanation of the changes which by long lying in grass the surface of our stiff clay lands is found to undergo. But they apply equally to other soils also—the only difference being that, in the case of such as are already light and open, the change of texture is not so great, and therefore does not so generally arrest the attention.

Upon this subject I may trouble you further with two practical remarks:

1. That the richest old grass lands—those which have remained longest in a fertile condition—are generally upon our strongest clay soils. This is owing to the fact that such soils naturally contain, and by their comparative impermeability *re*-tain, a larger store of those inorganic substances on which the valuable grasses live. When the surface soil becomes deficient in any of these, the roots descend further into the subsoil and bring up a fresh supply. But these grass lands are not on this account exempt from the law above explained, in obedience to which all pastured lands, when left to nature, must ultimately become exhausted. They must eventually become poorer; but in their case the deterioration will be slower and more distant, and by judicious top-dressings may be still longer protracted.

2. The natural changes which the surface soil undergoes, and especially upon clay lands when laid down to grass, explain why it is so difficult to procure, by means of artificial grasses, a sward equal to that which grows naturally upon old pasture lands. As the soil changes upon our artificial pastures, it becomes better fitted to nourish other species of grass than those which we have sown. These naturally spring up, therefore, and cover the soil. But these intruders are themselves not destined to be permanent possessors of the land. The soil undergoes a further change, and new specimens again appear upon it. We cannot tell how often different kinds of grass thus succeed each other upon the soil, but we know that the final rich sward which covers a grass field when it has reached its most valuable condition, is the result of a long series of natural changes which time only can bring about.

The soil of an old pasture field which has been ploughed up, is