

certain more general points of view; and in such principles and laws we trace the first attempts to establish a science of Agriculture. But the many errors derived from false experience, and the fallacious inferences drawn even from correct observations, have always made the theory thus constructed disagree with, and even contradictory to the practice of the art; so that neither has the theory been confirmed by the practice, nor has the practical art derived any real advantage from the theory. No better proof can be needed than this, than until very recently no real science of Agriculture has existed.

But it is now universally felt that the time has at length arrived when the more empirical practice of the art of Agriculture is no longer sufficient. Agriculture, as an art, has probably reached its highest limits; the ingenuity of man has been exercised to the utmost in the mechanical labours of the soil, and in the treatment of cultivated plants; and it is altogether hopeless to expect any further improvements or inventions calculated to accomplish any great benefits in that direction. Nothing, in fact, remains to be done in this way. All the efforts, indeed, made at present to improve the practice of Agriculture are directed, consciously, or unconsciously, to the establishment of a science; and this can be accomplished only by a comprehensive study of the natural sciences and especially of chemistry.

The cultivators of the soil discovered the advantages of fallow, of the rotation of crops, and the necessity of manuring in an empirical way, that is by experience. But, notwithstanding these points have been known for thousands of years, yet the Agriculturist, up to the present moment, is obliged to act just the same as was done at the beginning, in spite of the existence of many universal defects in practice. People either have not dared to abandon the old methods, yet they have not been able to improve them, or their attempts to introduce improvements, being only based upon empirical experience, have failed, and the sacrifice of time, labour, and capital, have caused all deviations from the old beaten paths of practice to be looked upon with distrust. Agriculturists have come to regard it as a matter of course—as an established rule—that a farm, conducted upon theoretical principles, will yield less produce than it would in the hands of a purely practical Farmer.

In short, defects in practice are obvious enough upon many points; and yet theory has hitherto offered no assistance, because it has not been based upon correct principles. The art of Agriculture invented fallow, the rotation of crops, and manuring; but a true Agricultural science can alone bring them to perfection. This science may be subjected to two tests as to its truth or fallacy. First, it must not contradict well-established experience; and secondly, where practically applied, it must yield more favourable results than mere empiricism.

It is pretty generally known that the chief part of the mass of ordinary soil contributes nothing towards the nutrition of plants, and that the necessity of the soil to cultivated plants consists of the mechanical support it affords them, and in its constituting a medium for transmitting the salts and the water essential to their growth and development. Plants take a large portion of salts from the soil for their assimilation; consequently if these salts are not replaced, the land becomes unfit for their full development, and the produce of the crop is much deteriorated. Three ways are open to the Farmer to restore to the land its former nutritive powers. 1st. *By the operation of summer fallow.* 2nd. *By the application of manures.* 3rd. *By the land being left a certain time under pasture.*

By summer fallowing, a writer on Agriculture observes,—‘The desire for, and the necessity of rest, which nature has implanted in all animals when exhausted in long continued labour, has, no doubt, contributed much to the adoption of the practice of allowing the land to lie fallow. And although the parallel thus drawn between the functions of animal life and inorganic matter is neither correct nor logical, yet it has operated to establish the theory of fallow.’

The earth cannot sleep, nor are we warranted to assume that it could be agreeable or beneficial to it to be spared for a time the infliction of the plough; but the soil in most cases has the property of altering its state of aggregation, when left without ploughing, and of accumulating a large amount of the salts indispensable to the growth of plants, if left for a time without cultivation.

Summer fallows, as they are often made, are little better than half a fallow. The land should be continually stirred—not a weed allowed to grow, for if weeds are allowed to occupy the land, a crop of some description of cultivated plant might as well be grown.

We will next examine how the soil accumulates the salts requisite to cultivated plants during summer fallow. A soil may contain all the salts* necessary for the assimilation of plants, but being in a state of combination insoluble in water and inert. Many of these compounds are salts of silicic acid, and are designated ‘silicates,’ and these silicates are decomposed by the action of the carbonic acid of the atmosphere. Carbonic acid possesses an exceedingly powerful tendency to combine chemically with those bases which, in their free and uncombined state, are soluble in water, and when dissolved, manifest that peculiar taste denominated alkaline. By this change the silicic acid is liberated, and may be dissolved in water the moment it is liberated; and the bases, as potash, lime, and soda, having combined with the carbonic acid become carbonates, which are also highly soluble. It is thus shewn that a continual decomposition is going on; and if the minerals still present in the soil become decomposed so rapidly that the formation of alkaline salts and soluble silica keeps pace with the withdrawal of these substances in the crops, such a soil will always remain fertile. But this occurs very rarely, and scarcely ever in Europe. The continued stirring of the soil does not produce that benefit to the plants in a mechanical way that many persons suppose: it is from the greater surface that is exposed to the atmosphere which causes disintegration to take place more rapidly; consequently, the rougher the surface can be left, the quicker the operation.

Some there are that will state that there is no occasion to have summer fallow at all; others will as stoutly maintain the reverse. It is not my intention to defend the one or the other, as circumstances and situations must decide; however, I may mention that if many Farmers would give their land a summer fallow round, they would be great gainers by it, as they would then get their land thoroughly clean, which they are not likely to do by the hurried manner in which much land is prepared for the fallow crop.

2nd. *By the application of manures.* Continual harvests have, in the course of time, placed the soil in that state of exhaustion that neither summer fallow nor rotation of crops can restore it to the state of fertility requisite for the full development of cultivated plants without manure; consequently we must restore these constituents by that means. Plants take from the soil only inorganic matter, which we can restore to the soil in two ways; first, by burning the plants and using the ashes, and, secondly, in collecting the dispersed substances made by the use of plants, and restore them to the soil.

The first method cannot answer, as it would never do to cultivate plants for the purpose of consuming them by fire for manure; but because we expect to derive advantages from them, such as the nutrition of man and animals, and their employment in the arts, consequently, we are restricted to the second method, which is more circuitous.

It must be borne in mind that no plants can be employed with advantage as manure as long as they can be used for other purposes. We will briefly examine the various transformations they pass through during their use, in order to lose none of their inorganic constituents. Many plants are used for the nutrition of animals, which are finally consumed by man; others which are not fit for this purpose are used to litter animals, and for other economical purposes.

* Salts. The term salts is not limited to bodies possessing a saline taste. A great number of salts, including all those which are soluble in water, have not a saline taste. It is a term used for a combination of an acid and a base.