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Artificial Fertilizers.

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Chemistry may be described as that branch of science which investigates into the nature and properties of the elements of matter, and determines the manner in which they react upon, and combine with each other. If we hand over a grain of wheat to the botanist, he can discern in it nothing but a tiny, yellow, opaque and brittle seed, whereas, if we pass it to the chemist, he will discover by analysis that it is composed of a woody fibre, starch, gum, sugar, fat and protein. Again; ask a geologist to examine the soil, and he will designate the different ages to which it belongs and the various rocks from which it is derived, but, without the chemist, he is unable to determine the nature of its constituents, and hence cannot foretell, before any cultivation has been attempted, whether it is destined to be fertile, or of what kind of vegetation it is best able to promote the growth.

The application of chemistry to agriculture is thus naturally indicated; by its aid we obtain from the soil, from plants and from animals, at the lowest possible expenditure of time and money, the highest possible quantity of those substances indispensable to our physical well-being.

Production, in order to be cheap, must be rapid and plenteous, and we all know that the progress of unaided nature is methodical and slow.

Chemistry, by investigating the natural laws which govern the development of all living things, and by carefully observing the facts acquired by the practical experience of centuries, endeavours to provide the farmer with means by which he may assist and hasten the processes of nature. His work is, of course, still far from complete, but it has familiarized us with those elements which are essential to plant growth, taught us how those elements are distributed, shewn us what portion of them is or should be contained in our soils, and what soils are most propitious for different kinds of plants.

When our globe was launched into space, it was a liquid somewhat similar in consistency to molten glass, and, therefore, presented a vastly different appearance to that with which we are acquainted. It was made up of about sixty elementary bodies, so deposited, by order of weight or density, that the heaviest, such as gold, silver, lead and copper, were in the centre, while the lighter, such as calcium, aluminum and silicon, remained, and still exist, near the surface, where they have combined to form clays, limestones and sands.

Encircling its interior was a heavy, poisonous atmosphere, comprising all those elements which at a very high temperature assume the gaseous form—notably sulphurous, sulphuric, phosphoric, hydrochloric, nitric, boric and carbonic acids, with torrents of steam, and dense clouds of mercurial, antimonial, arsenical and other metallic vapors. When this mass began to cool, it probably resembled an immense glass ball' the solidified sides of which were uplifted by the bubblings of the intensely hot liquid mass within. These solid projections formed our mountains, and, passing from the transparent to the opaque, they gradually assumed the crystalline form. What is known as the earth's crust must have resulted from an extraordinarily forcible action consequent upon the fall of temperature. The vapors already alluded to were condensed into rain. The rain dissolved all the acid bodies, and these acids, attacking the alkaline crust, combined with its most powerful bases to form various salts. These salts soon underwent decomposition; some—such as sulphate of lime or gypsum—were deposited, while others, principally the chlorides, remained in solution and formed the seas. The neutralization of the stronger and more corrosive acids permitted the weaker carbonic acid to develop its activity, and it is this acid which has continued to play the most important part in nature in our own times. Held in solution by the running waters, it attacked and dissolved the various bases which existed in such large quantities in the mountains, and deposited them in the form of carbonates in the still warm valleys. This process of saturation, or neutralization, being entirely accomplished, chemical equilibrium may be said to have become established; the period of great geological catastrophes, therefore, came to an end, and the temperature of the earth gradually sank below the boiling point. A few volcanic disturbances continued, it is true, to occasionally convulse it; there was the upheaval, splitting asunder and complete overthrow of the most gigantic mountains, the drying up and the division of seas, and the formation of lakes of both fresh and salt water. As the temperature continued to cool, however, these disturbances became more and more rare, and there then commenced that formation of the soil which gave rise to the phenomena of vegetation.

VARIETIES OF SOIL.

It is the general custom to class arable lands according to the nature of their predominating constituents, and thus we allude to soils as sandy, clayey and limey.

Sandy soils are distinguished by their extreme porosity, and are frequently in such a fine state of division, that in the dry season the least wind will displace and scatter them in all directions. In such cases they are naturally sterile; but, when they are sufficiently moist, they facilitate and encourage the growth of an immense variety of plants of the lower order, which, by their eventual decomposition or putrefaction, form considerable deposits of that valuable substance called humus.

Such soils are more propitious than any others for the development of plants with very delicate or fine roots, such as barley, rye, oats, lucern, lupins, lentils and potatoes; but they require constant attention, and a large and regular quantity of manure, because their porosity permits them to absorb such an abundance of oxygen, that all their organic matter is rapidly burnt up.

Clayey soils are heavy and compact, and, when they contain more than fifty per cent. of pure clay, are onerous to work, and unprofitable to cultivate. It has, however, fortunately been discovered that the addition to them of so small a quantity as two per cent. of burnt lime suffices to so entirely change their nature and consistency, by transforming the silicate of alumina into a porous silicate and aluminate of lime, that it is now an easy matter in districts where lime is cheap and plentiful, to overcome this difficulty. In hot countries or in windy regions or in districts where the sub-soil is of a very permeable character, good clay lands offer great advantages, and although they periodically require the application of large quantities of reconstituents, they possess the faculty of retaining all the precious elements supplied to them, and of storing them up for the use of successive crops. When they contain a proportion of about ten per cent. of carbonate of lime, or chalk, they are the best of all soils for the extensive growth of such important plants as wheat, corn, clover, hemp, peas and beans, and of such trees as the chestnut and the oak.

Limey, or purely calcareous, are even lighter than sandy soils, and when, as is sometimes the case, they are very white and dry, they are absolutely barren. Such as these are, however, easily encountered, for we generally find them mixed with a sufficiency of clay to give them some degree of consistency, and render them available for ordinary purposes. Few soils are entirely devoid of lime, owing to the fact that all rocks contain it in greater or lesser proportion, and because it is transported in immense quantities by waters, in the form of bi-carbonate, and deposited. If it were otherwise, or if, in the absence of lime, other alkaline substances were not forthcoming, the acid principles secreted by all plants could not be saturated, and the inevitable result would be decomposition and death. In its pure form, however, lime is such an extremely strong base, that it is incompatible with life, and hence it is never allowed to exist in the soil, unless it be combined either with carbonic or silicic, or sometimes with sulphuric and nitric acids.

The general properties of every variety of soil are much influenced by colour; those which are white, and hence unable to absorb the solar rays, being invariably cold, whereas those which are dark are warm and fertile. In this regard both iron and manganese are of undisputed