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The Field.

Familiar Talks on Agricultural Principles.

WHERE PLANT MATERIAL COMES FROM.

HAVING spoken pretty fully of the organic and inorganic elements of which plants are composed, it may be well now to say something in reply to the very natural enquiry, where these things are obtained. From what source or sources do plants get the material of which they are formed? As a general answer to this question, it may be stated that plants draw their supplies from the air, from water, and from the soil. Air and water consist of certain gases,—the soil is composed of various chemical substances, and plants are so constituted as to be able to take up and make use of the material which is adapted to the support of their life, and the promotion of their growth. Almost without a figure of speech, a plant may be said to have a hand, a mouth, and a stomach, so that it can help itself to nourishment, and be fed by what it consumes.

CARBON is derived chiefly from the air, but not wholly from that source. A supply of it is also obtained from the "vegetable mould" of the soil. It is in the form of carbonic acid that this necessary to plant life and growth is used. Carbonic acid is formed of carbon and oxygen, and though a narcotic poison, is absolutely necessary to the forms of vegetable life. The sparkling bubbles which arise on the uncorking of a bottle of soda water, and those which escape during the fermentation of beer, are familiar forms in which carbonic acid is found. It is one of the products of animal respiration, the air we expel from our lungs being largely charged with it. It is present largely when charcoal is burnt, and hence the fatal effects which sometimes arise from burning charcoal in a confined room. In various ways carbonic acid is constantly being generated both in the air and the soil. "Vegetable mould" is so acted upon by the atmosphere, that in the process of its decay, carbonic acid is produced, and is taken up and absorbed by the fine roots of plants. One way in which loosening the soil acts favourably upon growing crops, is thus explained. By letting in air, decaying vegetable matter is changed into a form in which plants can use it for their life and growth. When it is borne in mind that plants derive fully one-half of their dry bulk from carbonic acid, it will be seen how important a part in the vegetable world, is performed by this material.

THE OXYGEN of plants is obtained principally from water and carbonic acid. The water which plants imbibe consists in great part of oxygen, and the carbonic acid gas whence they derive their carbon, consists of seventy-two per cent. by weight of oxygen. The atmospheric air also contains twenty-one per cent. by bulk of oxygen. It also enters more or less into the composition of all the substances in nature. Oxygen is thus supplied in very large quantities, and is always found in far greater abundance than the wants of plants require.

HYDROGEN is mainly furnished by water, which consists of of oxygen and hydrogen, in the proportion of eight parts of oxygen to one of hydrogen. To furnish hydrogen, water must be decomposed. This is usually done by the extraction of the hydrogen, in consequence of which part or all of the oxygen is exhaled. Plants by their leaves, tissues, and roots, extract hydrogen from water and convert it to use. In the form of vapour, water pervades the atmosphere, and in the form of moisture it pervades the soil. Most vegetable structures contain water, and hence the sources whence plants can obtain this element are very numerous.

THE NITROGEN of plants is only a small portion of their substance, but it is always present in some degree, and in an essential part of the material of their life and growth. The chief source whence nitrogen is obtained is from ammonia, which is formed by the combination of hydrogen and nitrogen. It exists in considerable quantities in dung, while it is undergoing the heating process, and it is this which gives forth the peculiar pungent smell of the manure-heap. Many farmers like to detect the strong smell of their dung-pile, regarding it as a proof of the strength and value of the manure, but the lively odour tells the melancholy tale that the most precious qualities of the dung-pile are escaping Means ought to be adopted to retain this,—to "fix the ammonia,"—to make a prisoner of it, and compel it to do its part in enriching the land with plant-material.

So much for the chief sources whence the organic material of plants is derived. Inorganic material is obtained from the soil, which is made up of many different kinds of earth, the principal of which are *silicious* earth or sand, *argillaceous* earth, or clay, and *calcareous* or limey earth. It is by the mixture of these in various proportions that most of the different kinds of soil are formed. The soil upon the earth's surface rests on rocks which lie beneath, and from the crumbling of which the loose top earth has been formed. These rocks have been changed into soil by the action of heat, cold, water, and various gases. The sun's heat expands rocks and makes them somewhat porous. In this state, rain penetrates them, and tends to soften them. Frost converts the moisture into countless little wedges of ice, which split the outer crust into small fragments, and by such means the hardest rocks are crumbled to dust. Granite rocks contain silica, alumina, lime, potash, magnesia, and oxide of iron. Silicious rock or sandstone consists of small grains of silex, or sand stuck together, and varying in colour from white to red, according to the amount of oxide of iron which it contains. It is nearly or quite barren, except as mixed with other ingredients such as clay, lime, &c. Argillaceous or clayey rocks consist largely of silicate of alumina, together with other silicates, as those of potash, soda, and lime. Calcareous rocks are formed principally of carbonate of lime. Each of the kinds of earth above-mentioned makes a poor soil by itself. A mixture of the three is needful, and soils vary as one or other prevails or is deficient. But clay, lime, and sand are the foundation of all. To these various earths must be also added, a proportion of *humus*, or mould, a dark-coloured earthy matter, formed from the remains of vegetable and animal substances. This acts both as a resorvoir and supply of various substances which are necessary to the growth of plants. The richest natural soils are those which contain clay, sand, lime, and humus in due proportion. Low-lying valley lands are often found to be very rich in a state of nature, the overflow of streams washing down a supply of the varied materials of a fertile soil, and mixing them up together. What nature effects in this and other ways, art can also accomplish; and the formation and improvement of a good soil, is a main object of skilful farming.

Causes of Unproductiveness in Soils.

IN new or recently settled countries, the virgin soil will, with anything like reasonable treatment, maintain generally its natural fertility for a considerable number of years. Experience shows, however, that in the long run the tendency of cultivation, as mostly practiced, leads inevitably to the gradual lowering of the productiveness of the land. This is strikingly obvious to persons of long and extended observation, over large areas of the American continent. In many parts of our own Province this progressive exhaustion continues to go on, and in some places the soil, originally fertile in a very high degree, has become, by constant cropping and careless treatment, comparatively unproductive. The only remedy in such cases consists, of course, in thorough cultivation, a suitable rotation of crops, and the proper application of manure.

Soils, however, in their natural state—that is, before they have become subjected to the care and treatment of the husbandman—vary exceedingly in both their chemical and mechanical condition, and consequently in their productive powers. The causes which have produced these differences, and the means of imparting fertility to the lower grades of soil, have occupied, of late years, the earnest attention in the Old World of the best practical and scientific men. We propose in this article to condense some recent investigations made by Dr. Augustus Voelcker, the accomplished chemist of the Royal Agricultural Society of England, believing that the results will be alike interesting and suggestive to many of our readers.