

ter of national interest. From the produce of live-stock in this country, a large part of the subsistence of the people, of the materials of our manufactures, of the profits of the farmer, and of the revenue of the landholder, is derived. In many parts of the kingdom tillage is difficult or impracticable, and the only valuable production is live-stock; and it is not too much to assert, that half the rental of the British Islands is derived from this source. These considerations will make it appear, how much the study and advancement of this department of rural economy merit the attention of those who seek to widen the channels of native industry.

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ON THE ORGANIC MATTERS IN SOILS.

In my last, resumed Science as Practice took his wonted place beside him, as a student, after the labors of the day had closed, I entered into the subject of the various earthy matters of soils, and their uses to vegetation. These earths are called the inorganic constituents of soils, from their being original mineral substances, and not produced by the organs or agency of any plant or animal.

We come now to consider the organic parts of soil: that is, those substances which are composed of dead vegetable or animal creation—substances which, in fact, have resulted from, and once formed part of the organism of living plants or animals. Thus, if a tree or an animal die, their substance decomposes and mingles with the earth. Their remains are organic matter. They form a substance which the chemist cannot imitate artificially any more than he can any of the various forms of organic substances, such as woody fibre, gum, starch, sugar, &c. The chemist can imitate nearly, if not quite, all of the mineral and earthy substances found in nature; but organic matter is of a higher stamp—it has lived—the functions of life have been exercised in that decomposed vegetable or animal mass of decay, and it is beyond the chemist's imitative art.

Organic matter in a soil is destructible by heat. Heat a handful of any soil red hot, and it will lose from one to ten per cent. in weight. The organic matter has been destroyed. This substance may be divided into three states, viz. the *undecomposed*, which may be seen with the naked eye, such as roots, fibres, &c.; the *decomposed*, or that portion which is no longer distinguishable from the ordinary earth; and the *soluble*, or that portion which will dissolve out by boiling either in water alone, or with water and an alkali, such as carbonate of soda.

As I conceive the amount of organic matter in a soil to be intimately connected with its fertility, and a subject which ought, therefore, to be thoroughly understood, I will give some detail and explanation in this chapter, of

1st, The origin of organic matter.

2nd, The various states into which chemists divide it; and the various names by which they are called.

In the next chapter, I will dwell upon the mode of its action in the soil; how it feeds plants; and how it may be increased in a soil.

1st, As to the origin of organic matter in soils.

We see a magnificent tree rearing its massive trunk into the air and spreading abroad its gigantic branches, covered with luxuriant foliage; or we see a noble animal, full of life and vigor, spurning the earth beneath its feet, and we know that in them exists the organic matter of soils. We know that they themselves will become, at some future day, that organic matter itself; for that matter is composed of and derived from dead and decomposed animal and vegetable masses, which were once the verdant and buoyant organisms of Life.

But we ask whence did these animal and vegetable matters, in soils, which once lived, derive their substance? They have left to the soil a mass of actual matter, possessing substance, bulk and form; whence did they obtain this substantial, bulky mass? The first answer that occurs to us is, that they fed upon food, and that that food was obtained from the earth; and by those functions *assimilated and converted* into their outward form, and these forms became the organic matter of soils.

This is true, so far as it goes—but it does not get to the bottom of the truth—the origin of organic matter. This answer merely says that a certain race of animals, whose remains moulder in the earth, derived their substance from living vegetation; and that a certain generation of plants, which have died and rest in the soil, drew their matter from that soil originally. This is true—but whence did those plants which fed the animals, and the soil which maintained the plants, derive their organic matter? Where did organic matter begin?

A time has been when organic matter did not exist in any soil. A time was, if we may judge from the traces and evidences which still exist, when this Globe was in a liquid fusion, at a red heat.—Geologists and learned men are agreed on this point. Organic matter could not then have existed. The great heat would at once have burnt it up.

Again, take a piece of organic matter—a piece of wood, or a bone, for instance, and set it on fire, it will entirely disappear, except a little *ashes*, which we call its incombustible part, and which consists of earths and alkalis principally, (such as sand, potash, lime.) Where has the substance of this wood, or this bone, gone? Where is the *bulk* of that piece of organic matter? We do not see it, it is true, but it must exist somewhere. Matter cannot be annihilated—it cannot cease to exist. In an altered form the substance of that wood or bone still is. It still is matter;

it still possesses form, bulk, weight, and still occupies space. But it has vanished in the air. In a gaseous form, mingling with, and existing in, the air, the substance of that piece of wood or bone may still be found, though imperceptible to the naked eye. Thus the elements and constituents of organic matter can exist in air as well as in earth.

We conclude from observation that the elements of all organic matter exist in a gaseous form; and by analysis we learn that all such matters (with extremely slight exceptions) are formed of the four elemental substances, *carbon, oxygen, hydrogen and nitrogen*. In whatever of the endless variety of forms organic matter exists—in vegetable life, from the cedars of Lebanon, bending under centuries of years, to the tiny floweret, whose evanescent loveliness dies in an hour, and from the delicious fruit to the nauseous poison—or in animal organism from the monstrous whale to the animalcule a million times smaller than a gnat—in all its forms, it is composed of two or more of these four substances, in various combinations and proportions.

[NOTE.—These substances are four of the fifty-two simple substances which compose the world and all the forms of existent matter. These four form all the air, all the water, and we may add, all the vegetable and animal substances of the Universe within the ken of man.—They also enter very largely into the composition of the mineral kingdoms. They are called *simple substances*, in distinction to *compound substances*, because chemists cannot divide them, cannot resolve them into any other substances. Thus wheat is a *compound* body. It can be divided into 455 parts of carbon; 431 parts of oxygen; 34 parts of nitrogen; 57 parts of hydrogen; and 23 parts of ashes in 1000 parts of wheat. If you take any of these substances, of which wheat is thus composed, *carbon*, for instance, you cannot thus divide it. Burn it, it forms carbon in the air. Boil it, nothing can be extracted from it but simple carbon. Apply any test, or any chemical agent, nothing can be obtained from it—it is a *simple* substance—*one* substance—*carbon*. Carbon exists in pure charcoal, or rather pure charcoal is entirely carbon. Carbon exists in the atmosphere in the form of carbonic acid gas.—*Oxygen* is one of the most abundant things in nature. It cannot be distinguished from the common air by the eye or smell.—Every nine pounds of water contain eight pounds of oxygen. Every 100 volumes of air contain 21 volumes of oxygen.—Wheat, as we have seen, is nearly one-half oxygen and the other half carbon; and so of nearly all vegetable substances. *Hydrogen* forms the ninth part of water, and is a small constituent of vegetable and animal matter. *Nitrogen* forms 79 volumes out of 100 of the air we breathe (the remaining 21 being oxygen). It enters into the composition of some vegetable and most animal substances.