

time been united. They but assume their primitive forms, and ascend into the air to be brought down in the shower, and to constitute materials for new tribes of plants. Thus the carbon of the cargoes of fuel consumed in cities, and that given out from the lungs of their inhabitants, and the ammonia which escapes from the smoking manure-heaps of the careless farmer, are made to contribute to the general vegetation of the country. In every plant that has been examined there is found, in addition to the portion composed of the substance we have been considering, a small quantity of incombustible ash. This ash, in the infancy of science, when observed, was imagined to be merely an accidental impurity, and without influence on the growth of the plant. Its proportion is very small, varying from one-half per cent. to ten or twelve per cent. of the weight of the dried plant. But modern investigation has shown that the four or five pounds of ashes that are left upon burning a ton of the wood of the oak are as essential to the life and health of the tree, as the materials that escape into the air. The celebrated Davy seems to have had some faint idea of the importance of these earthy matters to the plant; but it was reserved for that great philosopher, whose writings have done so much to direct the attention of all classes to the application of science to agriculture, Baron Liebig, to point out their true importance. It is now acknowledged that the matter which is left upon burning a plant, is essential to the existence of the plant; and though all the elements contained in its combustible part were supplied, it would, without the matter of the ash, be impossible for it to come to perfection.

An examination of the bodies of animals shows us the necessity of this arrangement; and if it were possible that the seed could vegetate and grow into the perfect plant, without extracting from the soil these matters, it would be useless to us for food. The incombustible, like the combustible part of plants, is composed not of one, but of several kinds of matter. When the ash, for example, which is left when the bulb or the tops of the turnip are burned, is examined by the means which chemistry enables us to employ, it is found to consist of at least ten different substances. Some of these substances are well known, as they are of great commercial importance, and generally made use of in the manufactures of this industrious province. Thus we find in the ash of the turnip a considerable amount of the substances—potash and soda; the former of which exists in the potashes, and the latter in the soda ash and barilla of bleachers. It also

contains the white substance, magnesia, which is met with in the shop of the apothecary, the well-known substance, lime, which is so highly valued as a manure by farmers, and the compound of iron, which gives the red colour to the soils formed by the crumbling down of trap. We also discover in it, chlorine, the active ingredient of bleaching liquor, and sulphuric acid, the oil of vitriol of the bleach green, and also another sour substance, called phosphoric acid, which is formed when a common lucifer match is burned, by the union of the once rare, but now well-known waxy-looking substance, phosphorous, with the oxygen of the air. It also contains silica, the earthy matter which forms the bulk of sand. The earthy, incombustible ingredients are only ten in number; and, in the combustible part, we have seen that only four substances are discovered; and yet out of these fourteen substances every plant, the poisonous hemlock, as well as the nutritious grain; the fragrant rose-tree, as well as the stinking garlic, procure their materials. In the hand of nature these materials are plastic beyond anything that we can conceive; by a simple change in the arrangement of two or three elements, an oil, which is a deadly poison, is converted into an innocent drug; and, as is every day performed in the sprouting seed, an insoluble and tasteless starch, converted into a soluble sugar. It is from the soil, in which the seed expands into the plant, that it must produce all the substances that we discover in its ash. Here, then, the connection between the plant and the soil, is as close as between it and the air. But there is an important difference to the practical farmer. In the atmosphere, the store of carbonic acid, water, and ammonia, it is inexhaustible; and it is the same at all times and in every country. A thousand agencies are at work, maintaining its purity, and securing the uniformity of its composition; but it is not so with the soil. If we examine the soil from one of our fields in the same manner that we examine the plants that grow upon it, we find upon burning it, that only a small portion is consumed, and that a large amount of incombustible matter remains. This matter, like the ash of the plant, is found to consist of several ingredients; but does not always contain the same number of substances; and its character is found to differ widely in different parts of the same country; and even in fields lying in the same neighbourhood. If we cast our eyes over a geological map, we will perceive that different parts of the country are shaded by different colours, which are used to mark the different kinds of rocks which prevail in them.