The oxide of iron appears also to be a requisite ingredient. The proportion necessary for the formation of good soil, depends much on the nature of the climate, but more on the quality of the sub-soil, and its power of retaining or absorbing moisture. This alone may make a soil barren, which upon a different sub-soil would be exceedingly productive. When this is the case, drainage or irrigation offers the only means of permanent improvement.

Different vegetables also require different admixtures of earth. They require it, first, because it is necessary to their growth that the soil should be sufficiently stiff and deep to keep them firm in their place; and also that it should not be too stiff to permit the expansion and growth of their roots : and, lastly, that it should supply them with a constant quantity of water, neither too abundant nor deficient. Hence we may learn why different degrees of tenacity, depth, and power of retaining or absorbing moisture, are required in soils for different kinds of plants. Thus, in uncultivated countries, we find that certain vegetables affect particular situations in which they flourish spontaneously and exclusively; and it is only by imitating nature, and profiting by the instruction she affords, that we can hope to obtain advantageous results, or acquire certain fixed principles, to guide us in our attempts to bring barren lands into a state of profitable cultivation. When rocks contain, in their composition, a due proportion of silex, clay, and lime, they furnish soils whose fertility may be said to be permanent. The most fertile districts in England were made so by nature; their original fertility was independent of human operation.

Some small portion of the earths and alkalies is found by chemical analysis in plants: but it would be contrary to fact and analogy, to suppose that the earths, in a concrete state, form any part of the food of plants: the earths and alkalies which they contain, are in all probability formed by the process of vegetation, from more simple elements; for it is now ascertained, that the earths and alkalies are compound substances.

The principal elements found in plants are hydrogen, carbon, and oxygen; and by experiments of Gay-Lussac and Thenard,* it appears, that the hydrogen and oxygen in starch, gum, vegetable oils, and sugar, exist in precisely the same proportions that form water. Carbon, the other principal elementary substance found in plants, exists both in water and in the atmosphere. Water and the atmosphere contain in themselves, or in solution, all the elements necessary for the support and growth of vegetables. But, most soils are either too wet or too dry, too loose or too adhesive, to admit plants to extract these elements, in the proportions necessary for their growth. Manures, by furnishing in great abundance the hydrogen, carbon, or

* Recherches Physico-Chimiques.