elements which have been enumerated are to be found in compounds of undisputed mineral origin. Nor could it be otherwise; both plants and animals derive their substance from the mineral world which surrounds them.

I have just now stated, that among the twelve or fourteen elements which have been mentioned, there are four which predominate in the composition of vegetable and animal matter; that is, if the vegetable and animal kingdoms be taken as a whole, and those individual plants and animals which exhibit a preponderance of some other element be regarded as exceptional cases. These four elements, let me repeat it, are carbon, hydrogen, nitrogen, and oxygen. They differ from the rest, not only by the prevailing quantity in which they are present, but also by the distinguishing peculiarities exhibited in several other points. If animal or vegetable matter be exposed to a high temperature, free access of atmospheric air being admitted, we find that a part of it is dissipated, while another portion cannot be volatilized, and is no longer affected by the process of heating. Now, analysis shows that in this case it is exactly the carbon, hydrogen, nitrogen, and, to a considerable extent, also the oxygen, which are carried off, while all the rest, whatever their nature may be, remain behind. Take as an illustration the bone of an animal. It contains carbon, hydrogen, nitrogen, oxygen, phosphorus, and calcium. The three former, together with a portion of the oxygen, are present in bones in the form of gelatin or glue; the rest of the oxygen, together with the phosphorus and calcium, in the form of phosphate of lime. Now, if this bone be heated in the air, the whole of the gelatin is gradually burnt off, nothing but phosphate of lime remaining behind. I hold in my hands two pieces of bone of about the same size—the one fresh, still contains the gelatin; the second has been subjected to the action of heat. They are very similar in shape and external appearance; a difference, however, will become at once perceptible if you compare their weights—the burnt being much lighter than the unburnt bone.

A similar behaviour is exhibited by all vegetable and animal substances. When submitted to combustion, their carbon is converted into carbonic acid, their hydrogen into water, whereby the greater part of their oxygen is volatilized; the nitrogen escapes as such, the rest of the elements remains behind, in the form of what is generally called the ash of animal or vegetable matter. And this effect is by no means exclusively produced by combustion. All vegetable and animal matter, when no longer under the influence of vitality, undergoes gradually a similar change, becoming subject to those grand processes of destruction, daily accomplished under our eyes, which are designated by the terms "decay" and "putrefaction." The ultimate result of these processes is similar to that of combustion.

We might accordingly distinguish the elements which enter into the composition of plants and animals as *volatilizable* and *fixed*, or, if you please, as *atmospheric* elements and *earthy* elements; for, when separated in these processes of destruction, the former mingle with the atmosphere, while the latter mix with the mineral matter of the soil. The distinction in vegetables and animals of atmospheric and earthy elements appears even more appropriate if we glance for a moment at the mode in which plants and animals are formed. The researches of agricultural chemistry have shown, that, while the growing plant finds ample stores of all its fixed elements in the mineral constituents of the soil, it is the atmosphere from which it derives its carbon, hydrogen, nitrogen, and oxygen,—the very elements which, as we have seen, the dying plant returned to the atmosphere. The animal, feeding as it does on plants, likewise receives, although less directly, its carbon, hydrogen, etc., from the atmosphere. The distinction of atmospheric and earthy elements, therefore, appears perfectly justified, whether we regard the ultimate results of their destruction.

Both the atmospheric and the earthy elements combine with each other to form a great variety of compounds, which are called the "proximate constituents of plants and animals." Starch, sugar, the various vegetable and animal fats, the great number of acids occurring in plants and animals, such as tartaric, citric, malic, benzoic, hippuric, and uric acids, the host of