with O, part, especially when the decomposition goes on under water, or where atmospheric oxygen is excluded, may combine with H and produce the hydrocarbon CH_4 — called marsh-gas, because sometimes bubbling up through marsh waters; it is the gas which burns and makes the flame of a wood fire. Other related hydrocarbons also might form. But the burning of this gas when complete ends in producing CO_2 and H_2O. This is the final result when plants decompose in the air, except minor results from the nitrogen (N) and sulphur (S) present, among which are making, with the nitrogen, ammonia, NH_3; and, with oxygen, nitrous acid (N_2O_3), and nitric acid (N_2O_5); and making, with the sulphur, hydrogen sulphide (sulphuretted hydrogen) H_2S, and with oxygen, sulphurous acid (SO_2) and sulphuric acid (SO_3).

In smothered combustion (as in making charcoal by burning wood under a cover of earth), nearly all the H and O disappear as CO, CO_2, and H_2O, without a consumption of all the carbon; and this happens when plants decompose under a complete covering of water or earth, because this excludes the air and confines the changes to the elements of the plants; and the more complete the protection, the greater will be the proportion saved of carbon and hydrogen, the combustible elements for the making of coal. With reference to the making of mineral oil or gas, it is to be noted that if the outside air is wholly excluded through overlying fine sediments, they may be produced by the direct decomposition of woody tissues or of animal oils. Thus, if the carbon of the wood ($C_6H_9O_4$ nearly) combines with all the oxygen, making thereby 2 CO_2, it will leave C_4H_9, and $2\,C_4H_9 = C_8H_{18}$, which is the composition of some mineral oil. So in animal oils, as oleic acid, $C_{18}H_{34}O_2$, on separating CO_2, there would be left $C_{17}H_{34}$, one of the ethylene oils; or from margaric acid, $C_{17}H_{34}O_2$, the product would be $C_{16}H_{34}$, or a combination of marsh-gas oils. Fossil fishes are often numerous in coaly beds that afford much oil. (D., *Min.*, 1868, p. 726.)

In the change to ordinary bituminous coal the loss in the hydrogen of the wood, proportionally to that of the carbon, is about *two fifths*, and that of the *oxygen* about *four fifths* — about 5·5 per cent of such coal (ash excluded) being hydrogen, and 12 to 15 per cent oxygen, with 80 to 81 per cent carbon.

The carbonaceous products from the decomposition of plants and animals give the black color to soils. In wet soil, other acid products sometimes form, called *humus* acids, from the Latin *humus, soil*, or *earth*.

The returning to the air of the constituents of a plant, by decay, in the form of carbonic acid and water, is restoring what was taken and used in the growth of the plant and balancing the account. The storing of part of the carbon and hydrogen in the rocks in the form of coal and mineral oil and gas was an abstraction of carbonic acid from the air, and commenced a debit account which use in combustion by man is doing only a little in the way of settling. Happily the world is better off for the purification of its atmosphere.

3. *Deoxidation, or the abstraction of oxygen from a compound by any oxidizing substance at hand.* — Most deoxidation in nature is done by organic substances through the process of decay above described. The affinity in the carbon and hydrogen of the plant for oxygen is so strong that it will take it away from iron oxides or salts, and many other kinds. It may take O from Fe_2O_3 and reduce it to FeO; so that if there is then an acid at hand for com-