soil or humus in which they grew. It was shown, however, by Liebig, that vegetable soil is exceedingly insoluble in water, and it is well known that plants have no power of taking into their interior any solid matter unless this be capable of solution in water. It was shown also that the amount of carbon in a crop may be increased two or threefold by the addition to the soil of substances containing no carbon whatsoever, such as mineral salts and ammonia. A still more convincing argument against this notion of the origin of the carbon of vegetation directly from organic matter in the soil, is afforded from the fact, established both by experiments specially made and by the observation of nature, that plants and crops have been, and in many places habitually are, grown upon soils which are either absolutely free, or which are practically and to all intents and purposes free, from organic vegetable matter. Very many such experiments have been made by the French chemist, Boussingault, who has grown plants from seeds in artificially prepared soils, which had been subjectsd to a red heat, and from which the whole of the organic carbonaceous vegetable matter had been so removed and burned away; and yet the plants have not only grown in these soils but have thriven and arrived at maturity. It is found moreover that many plants flourish best, in a a state of nature, upon soils which if not, like the experimental soils of Boussingault, absolutely free from organic matter, are yet to all intents and purposes free. Thus, according to Darwin, rich harvests of maize are yielded in the interior of Chili and Peru by soils consisting of the merest quicksand, never enriched by manure. According to Colonel Campbell the soil of the cinnamon-gardens at Colombo and where else the tree is cultivated is pure quartz sand, as white as snow. Dr. Schleiden again observes that "the oil palms of the western coast of Africa are grown in moist sea-sand; and that from the year 1821 to the year 1830 there were exported, as produce of these palm-trees, into England alone, 107,118,000 lbs. of palm oil, containing seventy-six million pounds, or thirty-two thousand tons, of carbon; these thousands of tons of carbon being furnished by trees grown in a soil that was practically free from organic or carbonaceous matter of any kind whatever."

Now-a-days, then, it is universally admitted that plants do not derive their supply of carbon from the soil in which they grow, but from the "fresh, transparent, intangible, fleeting air" in which their leaves are bathed—improbable as this appears at first sight. The atmostphere universally contains a small amount of carbonic acid gas, this being a gaseous compound of carbon with oxygen. The actual amount of this gas which is present in the atmosphere is exceedingly small, not amounting to more than four parts in ten thousand parts of air by volume; but in the aggregate the absolute amount is very large. "The weight of air overlying every square inch of the earth's surface is fifteen pounds; and this is what we mean by saying, as we commonly do, that the atmostpheric pressure is fifteen pounds on the square inch. Now, fifteen pounds on the square inch is 2,160 pounds on the square foot; so that every square foot of the earth's surface has overlying it 2,160 pounds of air; and these 2,160 pounds of air contain about one and a half pounds of carbonic acid gas, equivalent to very nearly half a pound of carbon. . . . . There are produced, in many cases, from an acre of land some two thousand pounds of carbon in a single season. Now, reckoning from feet to acres, we find that not merely at the first instant of the growth of the crop, but that during every instant of the period of its growth—at the end no less than at the beginning—there is overlying the acre of land furnishing these two thousand pounds of carbon some twenty thousand pounds of carbon in the form of carbonic acid, existing, though in such small proportion, in the air. Calculating in this way we find that the amount of carbon existing in the atmosphere, in the form of carbonic acid gas, is not only enormous in its absolute quantity, but that it is far in excess of the wants of vegetation, and far in excess, moreover, of the quantity of carbon contained in all living beings, both plants and animals, existing on the surface of the earth, and in inflammable carbonaceous minerals, such as coal, which exist buried beneath the surface. In this way, then, we come to the conclusion that by their contact with the air, plants are at any rate afforded the opportunity of getting that carbon which constitutes so large a proportion of their structure. The question now is, do they avail themselves of the opportunity afforded them—do they actually absorb carbonic acid gas from the atmosphere, and extract the carbon of the gas which they absorb? The evidence on this point dates from the latter end of the last century, when it was ascertained by the older chemical philosophers, and more particularly by Dr. Priestley, and by Saussure and Sennebier, that when growing plants are exposed under the influence of sunlight to air containing carbonic acid, they do, as a matter of fact, absorb some of this carbonic acid; and that having absorbed it they do not discharge it again into the air, but instead discharge only its one constituent, oxygen; the necessary inference being that its other constituent, carbon, is retained in their tissues."

It is, therefore, now universally admitted that plants obtain the carbon which they require from the carbonic acid gas existing in the atmosphere, that they have the power of decomposing this gas under the influence of sun-light, and that they retain the carbon and exhale the oxygen which together form carbonic acid. Plants are thus constantly removing carbonic acid from the atmosphere and adding oxygen to it; and this process is most properly to be looked upon as one of digestion and not of respiration, though it was long regarded in this latter light. On the other hand, animals are constantly abstracting oxygen from the atmosphere and adding carbonic acid to it. It follows from this that there is thus a "balance of organic nature," the vital action of plants being complementary to those of animals. The vital processes of the animal end in the production of carbonic acid, which is injurious to the organism and is expelled into the atmosphere. Plants, however, live upon carbonic acid, and in using it as food they liberate the oxygen which is absolutely essential to the life of animals

The conclusion of Dr. Olding's lecture treats in a clear and popular manner of the final destination of the carbon of vegetation. After showing that carbon, when actually burnt, unites with oxygen so as to reproduce carbonic acid, the lecturer pointed out that the process of decay of vegetable matter is really a process of slow combustion, consisting in the combination of the carbon of the plant with the oxygen of the atmosphere, and resulting in the production of carbonic acid. When we pass to the consideration of the vegetable matter which is eaten as food by different classes of animals, we find that so much of it as is actually digested by the plant-eating animal undergoes one or other of two principal changes. "A large portion of it gets oxidized in the body of the vegetable feeder, with the production of carbonic-acid, discharged principally from the lungs in the act of respiration. Another portion gets accumulated in his body, whereby it is fattened and rendered fit to become the food of the flesh-feeder. And when the flesh-feeding animal eats up the body of the vegetable-feeders, their vegetable-derived fat and lean that become assimilated in his body are found to suffer there a speedy oxidation. Store-animals, intended for food, increase gradually in weight; but hard-working animals, whether vegetable feeders like the horse, or mixed feeders like ourselves, or animal feeders like the hound, go on eating day after day, year after year, without any sensible increase of bodily weight—the carbonaceous matter of the food continually eaten sufficing only to replace that continually destroyed in the process of gradual oxidation or burning away to which the substance of our blood and tissues is ever subjected, in order that the temperature and activity of our bodies may be maintained. Accordingly, we find the air expired from the lungs of both vegetable and animal feeders to be charged with carbonic acid, produced by the oxidation of carbonaceous organic matter—furnished directly or indirectly by the vegetable kingdom out of aerial carbonic acid, and restored by the animal back into the same carbonic acid." The same process also serves to maintain the temperature of the animal body. When we burn carbon in the fire it evolves a very considerable amount of heat in its union with oxygen. The temperature produced depends upon the rapidity with which this oxidation is carried on; but the same amount of carbon will always produce the same amount of heat by its oxidation, whether the combustion be effected rapidly or slowly. And this is true not only when we actually burn charcoal on a fire, but in all cases of the combustion of carbon and of its conversion into carbonic acid by the act of oxidation. "Whether, then, we burn our charcoal rapidly in an open fire, so as to produce a high temperature, or whether we burn it in our bodies