large excess of oxygen, when confined in artificial atmos­pheres that contain from 7 to 10 per cent. of carbonic acid, does not at all apply to the natural condition of the atmos­phere, which contains less than a thousandth part of that gas. We have already remarked, that carbonic acid is largely carried into plants with the rising sap ; and various facts seem also to prove, that, when plants are confined in close vessels containing carbonic acid, that gas enters the leaf in an elastic form. Other gases, as oxygen, hydrogen, and azote, under similar circumstances, also obtain admis­sion ; and fleshy leaves, in particular, take up, through the night, a volume of oxygen greater in bulk than themselves, which, according to De Saussure, they again give out when exposed to a bright sunshine. It is not yet determined in what way elastic fluids thus obtain admission into leaves, and are again expelled from them ; but the indiscriminate mode of their entrance and expulsion, at times, too, and under circumstances, in which vegetation is completely sus­pended ; their long retention in a bulk greater than the containing body, and other circumstances, which we have not room to detail, lead to the belief that the phenomena are quite distinct from those which properly constitute ve­getation, and are attributable to the conjoined operation of mechanical and chemical causes, aided by a certain condi­tion of structure in the vegetable organs.

When, in the experiments of M. de Saussure, plants were made to vegetate in atmospheric air, and placed alter­nately in sunshine and in darkness, the decomposition of carbonic acid in the former case so exactly balanced its pre­vious formation in the latter, that the air suffered no per­manent change either in purity or in volume. Even in sunshine, as the same author remarks, plants growing in close vessels continue to produce carbonic acid, and it is only because they then also decompose it, that they do not per­manently vitiate the air : hence, if a substance that attracts the carbonic acid as fast as it is formed be placed in the ves­sel, the air of the vessel no longer preserves its volume, nor its proportion of oxygen gas.

Professor Burnett recently made some experiments on the changes which growing plants produce on the air, and came to the conclusion, that the production of oxygen and its converse, the formation of carbonic acid, are the unvary­ing results of two different functions ; the former being the product of *digestion,* the latter of *respiration,* and both being vegetative functions dependent on vitality. The formation of carbonic acid, he states, is constant by day and by night during the life of the vegetable ; it is equal­ly carried on whether the plant is healthy or unhealthy; it is essential to its existence, and for the sustentation of its irritability; for, if deprived of oxygen, and confined in car­bonic acid gas, plants, like animals, quickly die. This function, which is performed chiefly by the leaves and pe­tals, though also in a less degree by the stems and roots, is, like the respiration of animals, attended with and marked by the conversion of oxygen into carbonic acid, and is in fact the *respiration* of plants.

Again, vegetables at certain times, and under certain circumstances, decompose carbonic acid, and renovate the atmosphere, by the restoration of its oxygen. This resto­ration, however, is dependent not on the respiratory, but on the digestive system. It in part arises from the decompo­sition of water, but chiefly from the decomposition of car­bonic acid, absorbed either in the form of gas or in combi­nation with water. And here again there is a marked analogy between the functions of respiration and digestion in plants and animals ; for to both is carbonic acid delete­rious when breathed, and in both it is invigorating to the digestive system when absorbed as food.

The presence or absence of light appears to have little or no influence on vegetable respiration ; but it produces very notable effects in the assimilating powers of vegetables, by enabling them to separate from the air and water those principles which are necessary for their support, and to liberate such others as may be too abundant in the crude aliment which they absorb. Thus digestion or assimilation tends to increase, respiration to decrease the solid materials of plants.

Mr. Ellis, who has written most ably on the influence which plants exert on the air, agrees with Burnett in think­ing that the function of nutrition is entirely distinct from that of respiration ; the former process being primarily car­ried on by the roots, and the matters ultimately rendered fit for assimilation in the leaves. The leaves themselves, he says, apparently exert two opposite actions in the differ­ent circumstances of shade and sunshine, or night and day. In the shade and through the night they convert oxygen gas into carbonic acid gas, which is easily detected, be­cause little or no purification of the air is then carried on. Even in sunshine, as De Saussure has shown, plants exert the same power in deteriorating the air ; but it is not then so readily discoverable, because the acid gas which is formed is at once decomposed by the direct agency of solar light, and the purity of the air is restored. The former process, by which oxygen gas is converted into car­bonic acid gas, he regards as the true respiratory process, essential to nutrition and growth ; the latter, as a chemical operation effected by the agency of light, and contributing immediately to the colour, odour, and certain other sensible properties of the plant.

Professor Liebig, who has recently made some observa­tions on this subject, maintains that plants derive their carbon exclusively from the decomposition of carbonic acid, chiefly, or often entirely, supplied by the atmosphere ; that they at the same time restore oxygen to the atmosphere ; that the decomposition of carbonic acid is arrested by the absence of the light, and then plants appear to produce and evolve carbonic acid ; that at night a true chemical process commences in consequence of the action of the oxygen in the air upon the organic substances composing the leaves, blossoms, and fruit ; that this is not connected with the life of the vegetable, but is in fact a process of oxidation. He also states, that the humus or fertile ingre­dient of the soil nourishes plants only by being a lasting source of carbonic acid, which it emits very slowly. The hydrogen which enters into the constitution of plants he thinks is derived from water, and the nitrogen from the de­composition of the ammoniacal salts contained in the soil.

Recent experiments have proved, that the quantity of carbon fixed by a plant exceeds that given off by the pro­cess of respiration ; and Dr. Daubeny has shown, that if a plant with leaves and stem be confined in the same portion of air, day and night, and duly supplied with carbonic acid during sunshine. It will go on adding to the proportion of oxygen present, so long as it continues healthy; the slight diminution of oxygen and increase of carbonic acid during the night, bearing no considerable ratio to the degree in which the opposite effect occurs during the day. Plants, then, must be regarded as the chief provision employed by nature to maintain the purity of the atmosphere of our globe.

Beside contributing to their *colour,* light, as we have seen, exerts a direct action on the substances which impart odour, taste, and combustibility to vegetables. These seve­ral qualities depend immediately on the oils, volatile and fixed, the resins, gum-resins, balsams, and turpentines, the alkalis and acids, the earthy and saline compounds, and the tannin, extractive, and other principles met with in the proper juices. It is probable that these substances are formed in the leaves and other corresponding structures, chiefly by peculiar secreting organs ; but either the functions of the organs, or the products which they yield, appear to experience great modifications and changes from the direct