quite distinct, and which, though they commonly go on to­gether, may be easily separated, and the peculiar and spe­cific results of each better observed and estimated.

In the ordinary circumstances of growth, plants are ex­posed at the same time to both light and air; and each agent exerts on them peculiar and specific effects. If de­prived of air, when in a state of active vegetation, plants not only cease to grow, but soon die; but the exclusion of light is not followed by suspension of growth, and still less by death. Hence, in favourable circumstances as to heat and moisture, plants continue to vegetate even through the night ; and are frequently seen to grow in situations from which light is wholly excluded. They then lose, however, many of their peculiar and more active properties ; but they augment in size, and display their specific forms. Air, therefore, is essential to vegetation ; but light, though ne­cessary to the development of certain properties, is not essential to the growth of plants. It will be convenient to consider the functions of the leaves, first, in relation to air ; and, secondly, in relation to light.

The late Dr. Priestley led the way in pointing out the nature of the changes which the air suffers in vegetation ; but from not clearly ascertaining, at that early period, the composition of the air he employed, nor the extent of change it suffered, nor being fully aware of all the circumstances which might vary his results, he arrived at contradictory conclusions as to the effects which vegetation ultimately produces in the air. On the whole, however, he considered the atmosphere, when vitiated by other processes, to be pu­rified by the growth of plants. His illustrious contemporary, Scheele, by previously removing the carbonic acid from the foul air he employed, found that plants, by their vegetation, either in sunshine or in shade, constantly deteriorated the air. Similar results, as to the deterioration of the air, in ordinary vegetation, were obtained in many of the experi­ments of Ingenhousz, Senebier, Woodhouse, and De Saus­sure ; and they have since been extended and confirmed by Mr. Ellis in the work already referred to. By these ex­periments. It is proved that plants, like the seeds from which they have sprung, require, in the atmosphere in which they are set to grow, the presence of oxygen gas ; that, by their vegetation, they convert this gas into an equal bulk of car­bonic acid gas ; and that the azotic portion of the air, as well in volume as in composition, remains unaltered.

As the seed, in its germination, supplied carbon to unite with the oxygen of the atmosphere, so does the plant yield that element for the same purpose, during its vegetation. Most vegetable substances, either dead or living, solid or fluid, when placed in suitable circumstances as to heat and moisture, deteriorate the atmosphere by forming car­bonic acid gas ; and the experiments of Huber, Senebier, and De Saussure, show, also, that, when all the oxygen of the air has been consumed, they still yield carbon to unite with its other ingredient, so as to form carburetted azotic gas ; or, if hydrogen gas has been employed instead of azote, then carburetted hydrogen is formed. Neither the living state of a plant, nor the presence of oxygen gas, is essential to the separation of carbon from vegetable mat­ter ; and we may, therefore, presume that its separation is owing not so much to any attractive force exerted by the gas employed, as to some spontaneous change in the vege­table compound itself, whereby its carbon is enabled to com­bine with the gases that surround it, in the order of its affi­nity for them. In low temperatures, or when the plant is very dry. Its functions are more or less completely suspended, and tl>e formation of carbonic acid is then proportionately reduced ; while, on the contrary, a vigorous exercise of the vegetative powers gives rise to a corresponding production of that gas. In what state or form the carbon exists, at the moment of its combination with elastic fluids, is not yet known ; but it is probably held in solution by water, and acquires and retains its elastic state, only while in union with a permanently elastic body. It may further be asked, in what part of the plant does this union of its carbon with the oxygen gas of the air take place, and in what manner is it accomplished? In the living plant. It is chiefly by the leaf that carbonic acid is formed. To discover the mode and place in which it occurs, we must take into view not merely the change produced in the air, but the structure of the living organ by which that change is effected; for it is only by combining a strict regard to anatomy with our chemical knowledge, that we can ever hope to arrive at true physiological conclusions, and avoid the crude and fanciful notions that have too often usurped their name.

The leaf, then, is formed of a vascular system, of cellular tissue, and of a cuticular covering that invests it on all sides. To this organ the sap is brought by vessels which spring from the alburnum or wood, and which, after forming seve­ral fasciculi in the petiole, proceed to the base of the leaf, and there, by their expansion and distribution, produce a minutely reticulated structure. With these sap-vessels, proper vessels are every where associated, which appear to communicate with the sap-vessels, and to convey into the inner bark the sap which they receive. Grew considered the vessels, which form the reticulations of the leaf, to be of the same size in every part, and never to inosculate or an­astomose, except end to end, or mouth to mouth, after they have come to their final distribution. Malpighi, on the other hand, believed them to anastomose in every part : and, in regard to the minuter transverse fasciculi, given off from the longitudinal bundles, he has been followed by Dr. Todd Thomson, who, however, though he considers them as “ distinct vessels, uniting with the longitudinal bundles in a singular manner,” has never been able to determine “ whether there is any opening directly into the longitudi­nal vessel on which the extremity of the transverse vessel is applied.” It is during the course of the sap, through the two orders of vessels in the leaf, that it undergoes those changes in its properties which fit it for nutrition ; but whether these changes are effected in the sap-vessels, or the proper vessels, or partly in both, has not yet been de­termined.

The minute network formed by the vessels is everywhere filled up with cellular tissue, constituting the parenchyma of the leaf. The cells of this tissue contain fluids derived from the neighbouring vessels, and are likewise the seat of the green colouring matter. There must, therefore, be a ready communication between the vessels and cells; and this many have supposed to be accomplished by the medium of pores in the sides both of the cells and vessels. But the best observers represent the cells as close cavities, having no visible communication with each other. Were we even to admit the existence of pores, we should find it difficult to conceive how the contents of the cells could be set in motion and transmitted through their own sides, and those of the vessels also, so as to be conveyed and deposited in the several parts where growth takes place, with all the re­gularity we actually observe. To us no other means occur of accomplishing these operations, consistently with the in­tegrity of the cellular structure, than the exercise of those alternate functions of secretion and absorption, which, from so many other considerations, we have supposed to be car­ried on in every vegetating part of the plant.

The cuticular covering of the leaf is the organ through which, under different circumstances, the fluids that are exhaled and absorbed must pass ; and through which also both light and air exert their peculiar action on the vege­table juices. The structure of this organ has excited parti­cular attention, and the opinions held concerning it have been detailed in our former article. It is there described as being composed of a proper cuticle, beneath which is a vascular network, the vessels of which, springing from the