larger fasciculi, form at various points an oval ring, from whence go off two or more radiating filaments, which ter­minate at the cuticle in an oval pore, more or less elongated. It is by the vascular filaments, which thus terminate at the pores of the cuticle, that the exhalation of fluids is held to be performed ; and hence it is, that, in different plants, this function is more or less abundantly carried on, in propor­tion to the number of cuticular pores or stomata ; and that plants, and parts of plants, which have but few pores, per­spire little, and those that are destitute of pores not at all. Precisely the same coincidence between the number of sto­mata in leaves, and their power of absorbing fluids, has also been remarked ; and Μ. Decandolle believes that the vas­cular pores, on the surfaces of the leaves and of porous stems, are the organs by which the functions both of exhalation and absorption are alternately carried on, according to the existing condition of dryness or humidity in the surround­ing atmosphere.

Beside the function of exhalation. It has lately been maintained by Dr. Todd Thomson, who has bestowed great attention on the structure of the leaf, that the stomata are the organs by which the function of respiration in plants is performed. According to him, the pore is not a superficial aperture, but “ a short cylindrical tube, penetrating com­pletely through the cutis, and terminating in a cut de sac, which is impressed into a vesicle that appears to communi­cate with the oblong cells immediately beneath the cutis. But although the aperture penetrates the cutis, there is no opening through the epidermis, which, on the contrary, enters into the tubular part of the pore, and lines it throughout."@@1 In different leaves, the form of the pore, of its short tube, and of the vesicle beneath, are said to vary ; but the cuticle or epi­dermis dips down and lines the cavity in all. By the funnel- shaped pore above described, the air is said to be admitted into the vesicle situated beneath it : and as this vesicle probably communicates with the cuticular cells, which are in general filled with air, the aqueous contents of the cells that form the parenchyme of the leaf, are thus brought into immediate contact with the atmosphere.@@3

It can hardly, however, be admitted that the existence of stomata is indispensable to the production of that che­mical change in the air which constitutes respiration ; for, according to Decandolle and Rudolphi, the petals of flowers, the cuticle of fleshy fruits, the tunics of seeds, the stems and leaves of etiolated plants, most of the lower tribes of vegetables, and all roots and bulbs that grow beneath the soil, are alike destitute of stomata ; and yet the united experience of Priestley, Scheele, Ingenhousz, and De Saus­sure, bears testimony that all these parts are capable of acting on the air like porous leaves. Dr. Thomson indeed states that some of the lower tribes of vegetables, and cer­tain etiolated leaves, are really furnished with stomata : but even granting this to be the case, there still remain other parts of plants, which grow beneath the soil, and yet act upon the air, like porous parts that vegetate on the surface. Without denying, therefore, the probability that stomata may favour the exercise of the respiratory function, we are compelled to admit that surfaces, not yet discovered to have stomata, are capable of producing similar changes in the air.

But whether the air enter the stomata in order to be changed, or is merely changed at the surface of the plant ; or whether, by some unknown means. It permeate the cu­ticle, cells, and vessels, so as to act directly on the fluids they contain ; it seems certain that these fluids acquire the properties, which fit them for nutrition and growth, directly through the agency of the air. How, then, does the air act in producing such effects? No specific action can be as­cribed to its azotic portion, since that gas is not essential in vegetable respiration ; and when present. It neither suffers nor produces any known change. Neither can we suppose the effects produced to arise from the loss of carbon, for were it proved that this carbon is extracted directly from the juices contained in the vessels, rather than afforded by the fluids which they exhale, still the quantity given off is too minute to be considered as the cause of such remarkable changes ; and it is more reasonable to believe that they proceed rather from something derived from the air, than from anything given off from the plant. They have ac­cordingly been very generally ascribed to the *combination* of oxygen with the juices of the plant; this oxygen being partly supplied by the external air, and partly by the air con­tained in the spiral vessels of the plant.

Art. IV.—*Of the mode in which the Proper Juice is applied to the Purposes of Growth.*

It is only after the common sap has been duly changed in the leaf by the agency of the air that it is rendered fit for the formation of vegetable matter. For this purpose. It descends in the “ proper vessels,” which in trees are com­monly situate in the bark. If at this period, therefore, a circular portion of that texture be cut away, the proper juice is seen to issue from the *upper* lip of the wound ; but this soon ceases, and its accumulation in the vessels then forms an enlargement around that part. Sometimes the proper juices exude, and form concretions of a gummy, saccharine, or resinous nature on the surface of the bark, and sometimes they are effused into the sap-vessels or cells. Where the bark is young and succulent, the juices probably re­ceive some further change in their descent; for such stems act on the air like leaves, and, in some species of plants, which are destitute of leaves, the functions of the leaves are performed by the stem alone. In ordinary trees, how­ever, the bark is unable to form nutrient matter without the aid of the leaves, as an experiment of Hales distinctly shows. He removed circular portions of bark, half an inch in breadth, from a thriving branch of a pear tree, so as to leave several ringlets of bark, three quarters of an inch distant from each other. All these ringlets, except one, had a leaf-bearing bud on them, and all but this one swelled at their bottoms and grew; and the more leaves the bud produced, so much more did the bark on which it grew swell at the bottom, while the leafless ringlet did not swell or increase at all. From facts before stated. It also appears, that a portion of the nutrient matter that descends from the leaves is found in the alburnum, as well as in the bark; and this will be still more clearly shown when we come to treat of the re­generating powers of the alburnum.

In discoursing on the trunk of trees. It was stated that a layer of bark, called *liber,* and a circle of wood, named *alburnum,* are annually formed; and that between this liber and alburnum the new matter that adds to the bulk of the tree is deposited, and becomes organised. Malpighi believed the *liber* to form the new parts, and that these parts were afterwards converted into wood. Grew also con­sidered the new wood to be formed by the bark, but not the liber to be converted into wood. Hales, on the other hand, sup­posed the new wood to be formed by the old; while others have held that both bark and wood contribute to form new matter. Are, then, the new layers which are annually added to the tree formed by the bark, by the wood, or by both? By various experiments, which we have not room to detail, M. du Hamel endeavoured to show, first, that the bark is able to form new wood, and that this power resides not in its outer layers, but in the part called *liber;* secondly, that the *alburnum* is also able to produce new wood and bark, but that this power is not possessed by the older and more hardened vessels of the wood.

The process by which new vegetable matter is formed in trees is thus described by the same excellent writer. When a portion of bark has been removed from a tree, a glairy

@@@, Thomson's Elements of Botany, vol. i. p. 614

@@@’ Ibid. p. 622, 623.