twenty feet. In other experiments. It exerted a force suf­ficient to sustain a column of mercury at the height of thirty-eight inches ; a force, says he, five times greater than that of the blood in the crural artery of a horse. In the chief bleeding season, the sap continued to rise by night and by day, but more in the day, and most of ali in the greatest heat of the day; and when the sun shone hot upon the vine, a continued series of air-bubbles rose through the sap, so as to make a large froth on its top.

Such are the phenomena exhibited by the rising sap *be­fore* the appearance of the leaves : when they have shot forth, a great change is observed in its movements. It still, however, continues to rise through the trunk ; but if the wood be now pierced, none of it flows out, as it did in the bleeding season. In the excellent experiment of Dr. Wal­ker, already referred to, the birch tree continued to bleed from the 5th of March to the 24th of April, on which day it bled from every incision in its trunk, and every cut extre­mity of its branches. On the 30th of April, vernation or budding began, and the young leaves shot forth. As they advanced, the bleeding gradually lessened, till at length, on the 10th of May, when the leaves were fully expanded, ali the incisions, says Dr. Walker, which had yielded sap so freely, were everywhere dry ; and this, not from evapora­tion by the leaves, but from a general diffusion of the sap from the wood through the bark at that season. In confor­mity with these observations, Dr. Hales remarks, that, after the appearance of the leaves, the bark, which was before dry, and adhered to the wood, becomes lubricated with sap, and easily separates. Even after the bark has thus been brought to separate from the wood in a young tree full of sap, if all the leaves, says Du Hamel, be stripped off, the bark, in two days, will again adhere to the wood, and con­tinue to do so through the winter. These facts distinctly prove, that after the leaves have sprung forth, the sap of plants is no longer confined to the wood, but finds its way into the bark ; and we have next to trace its route into that texture.

M. De la Baisse and M. Bonnet traced the sap of plants from the extremities of the roots into the leaves and flowers; and when the plants were set in coloured liquors, the fluid was seen to pass from the vessels of the leaf into its cellular tissue, and the bark of the petiole afterwards to become tinged. The communication thus established between the wood and the bark, M. Bonnet considered to occur in the extreme ramifications of the leaf, where, as he supposed, the ligneous and cortical vessels mutually anastomose. In a plant of Euphorbia, set in a coloured liquor, Dr. Darwin observed the fluid to run along the inner ring of vessels in the petiole to the upper surface of the leaf; while on its under side, a white fluid was seen to return from the extre­mities of the same leaf, and to descend, by the exterior ring of vessels in the petiole, into the bark. In similar experi­ments on the apple branch, Mr. Knight followed the return­ing fluid through the bark, by the vessels of which it seemed to be conveyed to the roots. These facts show that the sap, which is observed in the bark, after the leaves have sprung forth, gets into that texture by passing through those organs.

The leaves, which thus form the organs of communica­tion between the wood and the bark, not only vary the course of the sap, but greatly influence its motion. Before their appearance, no natural outlet for its escape existed, and it therefore rose, continued stationary, or fell in the same vessels, chiefly according to variations of temperature. But when the leaves are developed, a large portion of the sap, in its passage through them, is thrown off by transpira­tion, and the remainder is conveyed into the bark ; so that, by these means, the vessels of the tree are emptied, and put into a condition to attract fresh portions of fluid. Hales accordingly found that amputated branches of trees, which were furnished with leaves, and set in glass tubes of water, attracted from fifteen to thirty ounces of water in the course of the day ; while similar branches, from which the leaves had been stripped off, imbibed, in the same time and circumstances, not more than one ounce. In like manner, a growing vine, which was perspiring abundantly by its leaves, ceased at once to yield sap from its stem, when cut over *be­low* the leaves. He found also that amputated branches, when plunged in water, imbibed from the small end to the great end as well as in the opposite direction ; that they imbibed also when deprived of their bark, but not when stripped of their leaves ; and that they would imbibe water from their small cut extremity, while still attached to the trunk. Hence it appears, that, after the period of verna­tion, the flow of the sap is promoted chiefly by perspiration from the leaves ; and, therefore, if the leaves be removed, or their perspiration counteracted by a cold and humid at­mosphere, then, as Hales found by experiment, the attrac­tion of fluid by the sap-vessels is proportionally diminished.

To find the force and velocity with which the sap moved in this more advanced stage of vegetation, Dr. Hales ce­mented branches of trees, furnished with leaves, in glass tubes filled with water, and then set the lower end of the tube in a vessel of mercury. As the water was attracted by the branch, the mercury rose into the tube, in one in­stance, to the height of twelve inches in seven minutes. When the mercury had reached its greatest height. It would hold to that height for several hours in a warm sunshine, which favoured perspiration from the leaves; but as the sun declined or set, perspiration decreased, and the mercury ceased to rise. So great at this season is the attractive force of the leaves, that if a notch be cut in the trunk of a tree through which the sap is rapidly flowing, yet will the notch remain dry ; “ because,” says Hales, “ the attraction of the perspiring leaves is much greater than the force of trusion from the column of water.” By other experiments he as­certained, that, when once the motions of the sap have been brought under the dominion of the leaves, the sap-vessels of the root no longer possess the same power of forcing the sap upward, as they did in the *bleeding* season ; but so long as the leaves throw off the sap, the roots more or less abun­dantly attract fresh supplies of it from the earth.

In these various motions of the sap, both before and after the bleeding season, Dr. Hales ascertained that the tree un­derwent no variation in its dimensions ; yet, whenever it rained, the stem very sensibly dilated, and when the weather again became dry. It subsided as much. “ This shows,” he adds, “ that the sap, in all stages of vegetation, is confined in its proper vessels, and does not confusedly pervade every interstice of the stem, as the rain does, and thereby dilate it.” Du Hamel also noticed this alternate augmentation and diminution in the size of trees, under the different states of a humid and dry atmosphere.

Beside this perpendicular ascent. there is also, in certain circumstances, a *lateral* motion of the sap. Dr. Hales cut four large gaps in the branches of different trees, at several inches distance from each other. The cuts were carried down to the pith, and opposed, in position, to the four pointe of the compass. If the cut branches were then amputated and immersed in water, they imbibed that fluid by their ex­tremities, but not so abundantly as before, and continued to give it off freely by their leaves ; if they remained at­tached to the tree, after such gaps were made in them, both the leaves and fruit of the branch flourished as well as those on other branches of the same tree ; proving, says Hales, a very free *lateral* passage of the sap, where the direct pas­sage had been several times intercepted. In these gaps, no moisture could, at any time, be either seen or felt, notwith­standing much fluid was passing by, because the stem, above the gaps, was in a strongly attracting state to supply the great perspiration of the leaves. Mr. Knight made similar