## XVIII. *On the action of detached leaves of plants. By* T. A. Knight, *Esq. F. R. S. In a letter addressed to the Right Hon. Sir Joseph Banks, Bart. G. C. B. P. R. S.*

Read June 13, 1816.

DEAR SIR,

SINCE I had last the honour to address a communication to you, with a request that you would lay it before the Royal Society, I have repeated great part of the experiments which formed the subjects of my former Letters, with such additions and variations, as might probably lead to the detection of any erroneous conclusions which I might have drawn: but I have not been able to detect any errors, nor to add any thing very important to my former observations. I have, however, been able to ascertain a few new facts, which I think too interesting to be lost.

I endeavoured, in my former communications, to adduce evidence, that the matter, which becomes vitally united to trees, previously passes through their leaves; and I shall now proceed to state some facts, which, I trust, will prove, that a fluid possessing the power which I have attributed to the true sap, actually descends through the leaf stalks.

A slender knife was passed through some leaf stalks of the vine, about two thirds of an inch distant from their junction to the branch; and, down to that point, the leaf stalks were divided longitudinally, and a transverse section, about half an

inch long, was made through the bark opposite the middle of the leaf stalk. A similar transverse section through the bark, was made somewhat less than an inch distant below; and these sections were united by two longitudinal sections through the bark, which extended from the extremities of the upper transverse sections to the extremities of the lower; by which means, pieces of bark, about half an inch broad, and nearly an inch long, were separated from the adjoining bark. These were then detached from the alburnum, and surrounded by two folds of paper coated with wax on each side; by which all connection and communication with the tree, except through the divided leaf stalks, were cut off. The insulated pieces of bark, nevertheless, continued to grow, and extended downwards, and laterally, and in thickness; and thin layers of alburnum were deposited.

Leaves of the potatoe, without any portion of bark being attached to them, were taken from the plants, just at the period when the tuberous roots began to be formed; and I conceived that these leaves, consistently with my former experiments and conclusions, must contain portions of the living organizable matter, which would subsequently have been found in their tuberous roots. The leaves were, therefore, planted in pots, and placed under glass, where, being regularly and properly supplied with water, they continued to live till winter, though without emitting fibrous roots; and I then expected to find some small tubers at their bases. In this expectation I was disappointed; but the result of the experiment was not less satisfactory, the bases of the leaf-stalks themselves having swollen into conic bodies of more than two inches in circumference, and being found to consist of matter apparently

similar to that which composes the tuberous roots of the plant. The enlarged parts of the leaf-stalks remained alive in the following spring; but whether they are capable of generating buds or not, I have not been able to ascertain.

Leaves of mint were planted in the same manner as those above-mentioned; which grew, and continued alive through the winter, and were still living in the end of the last month, having assumed the character of the thick fleshy leaves of evergreen trees. Upon examining the mould in the pots, I found it to contain very numerous roots, which must have derived their medullary, and their cortical, and alburnous substances from matter which had emanated and descended from the leaves.

I had frequently observed, in former experiments, that the destruction of the mature leaves of young plants not only suspended the growth of the roots, but also the growth of the immature leaves; whence I inferred, in a former communication, that the organizable matter, which composes the young leaves, has always undergone a previous preparation in other leaves of the plant, either of the same, or preceding season; and I was thence led to expect that, under favourable circumstances, the mature leaves might be made to nourish and promote the growth of immature leaves, without the aid of roots. Several shoots of the vine, each about a yard long, were detached from the trees, and laid over a succession of basins of water, into which each of the mature leaves was in part depressed; and thus circumstanced, the young leaves continued to grow, and the points of the shoots to elongate; and all were alive, and in perfect apparent health at the end of a month. The water necessary to preserve the young leaves

must in this case have been derived from the mature leaves; and I entertain no doubt, but that the organizable matter which occasioned their growth, was derived from the same source. Intersection of the bark between the mature and young leaves was not attended with any injurious consequences, and the sap must, therefore, have passed to the young leaves through the alburnum.

Consistently with the preceding circumstances, if the mature leaves be destroyed, or taken off, the fruit ceases to grow, or, if full grown, remains without richness or flavour; and the power of feeding fruits in winter and early spring seems to be confined to evergreen plants. The orange and lemon tree, the ivy and holly, afford familiar examples of this; and where a genus of plants consists of evergreen and deciduous species, as that of mespilus and viburnum, the evergreen species alone nourish their fruit in winter and early spring.

The probable passage of the sap from the mature to the young leaves and fruit, may, I think, be easily pointed out, though decisive proof of its course will probably never be adduced. Having often detached the bark from the alburnum of the stems of young oaks, just at the period when the midsummer shoots were beginning to elongate, I observed, as others have done, that a fluid exuded from those parts of the surface of the alburnum, which are called (most improperly) the medullary processes, and from correspondent points of the bark, which resemble the medullary processes in organization. This fluid has been proved, by its power of rapidly generating an organic substance, to be the true sap of the tree, part of which, I conceive, at this period, to be passing from the bark to join the ascending current in the albur-

num; which current feeds the young succulent shoots and growing leaves. Subjecting the alburnum to a slight degree of pressure at this period, I found that a considerable quantity of liquid, being apparently the true sap of the tree, issued out laterally through the medullary processes, as well as longitudinally through the cellular substance of the alburnum: but the tubes of it continued empty, and their position was marked by depressions of the surface of the extravasated fluid. I endeavoured to ascertain, what proportion of water a given quantity of the alburnum of such oak trees contained at this period; and I found that 1000 parts lost by drying only 371 parts: which is not more than the weight of the water that the cellular substance appears capable of containing, entirely independent of the tubes. That the tubes, nevertheless, are not always empty, but that they act at other periods of the year as reservoirs for the sap, I have given an opinion in a former communication; and I am now in possession of facts which prove them to perform this office, even in the heart wood, to a much greater extent than I had ever at any former period suspected; and which incline me to believe, that the durability of the heart wood, as well as of the alburnum of the oak, will be found to depend to a great extent upon the period in which the tree is felled: but I propose to make my observations upon these points the subject of a future communication.

I am, my dear Sir, &c.

T. A. KNIGHT.