France the two celebrated philosophers Buffon and Du Ha­mel have both devoted a great portion of their useful lives to the investigation of the physiology of timber, and their writings on the subject have long been the text-books of arborists. In modern times the phenomena of the growth of plants have occupied the attention of many men, some of whom have eminently distinguished themselves in this particular branch of natural history, and to whose works we shall have occasion to refer in the course of this article. The master-mind, however, in these researches, and the one whose indefatigable labours have left but few of the mysteries of vegetable physiology undeveloped, is Mr Knight, who was for several years president of the Horti­cultural Society, and whose valuable papers on the growth of plants in the Philosophical Transactions leave little scope for further investigation on several of the most important questions.

Botanists divide plants into two classes; exogenous, which are those that increase in their growth by an annual acces­sion of matter externally ; and endogenous, which are those that increase in their growth by an annual accession of mat­ter internally : therefore in exogenous plants the exter­nal parts are the younger ; and in the endogenous it is, on the contrary, the internal parts which are of the latest growth. It is almost entirely of the exogenous plants that we shall have occasion to treat in this article, the whole of the timber trees classing under that head.

The horizontal section of the stem of a plant of this de­scription shows the perfect or heart wood occupying the central and larger portion of the area of the section. This wood must evidently, from what has been already stated, be of the oldest growth in the centre of the tree, and the several concentric layers must be younger in propor­tion to their distances from this centre. Around this per­fect wood there is seen a concentric belt of yet younger growth ; so young ns not yet to have attained to the ma­turity of the perfect wood. This belt is called the albur­num or sap-wood ; around it is another concentric belt, called the liber ; and this again is enclosed in the bark, or cortical substance, the liber forming an internal coating to the bark. The centre of the heart-wood is occupied by the pith ; and there is a communication between the pith and the bark, that is maintained by what are called the me­dullary rays, which, as their name expresses, radiate from the pith, in the centre of the perfect wood, to the external coating of the tree, the bark. The outer covering of the bark is sometimes called the epidermis.

We shall now proceed to describe, in a general manner, the process of the growth of the plant, and the gradual for­mation of these several portions. The germination of the seed is a mystery of nature yet undeveloped ; but when the seed has germinated, and the existence of the plant has commenced, the labours of physiologists have enabled us to trace the various processes by which its increase is ef­fected. Mr Knight has related, in the papers which we have already mentioned as having been published in the Philo­sophical Transactions, a series of most conclusive experi­ments made by him, in order to ascertain the course of the sap, the manner of its deposition, and the method of its in­fluence on the growth of the tree. He removed a ring of bark about half an inch in breadth, from a number of trees, and compared the growth of these trees with that of others not so treated. This was done early in the spring. The effects were, that although the branches shot, and the parts above the incisions in the incised trees did not appear to suffer, there was no increase in the parts below the incisions; and that while the upper lips made considerable advances towards establishing a reunion, the lower lips of the wounds remained without alteration. In the course of the summer the wood from which the rings of bark had been stripped, became dry and lifeless to some considerable depth beneath its surface, and several buds made their appearance below the incisions. In those trees in which a shoot produced by one of these buds was suffered to remain, the parts of the stem below the shoot very soon began to increase in size, while the part between the shoot and the annular incision still re­mained so nearly stationary as to be, in the autumn, almost a year’s growth less in diameter than the part of the stem above the incision. Mr Knight varied these experiments in many different ways, but in every case he found the re­sult to be the same ; that is, those parts of the stem and branches which were above the incisions, and had a com­munication with the leaves through the bark, increased ra­pidly ; while those below the incision scarcely grew at all, but remained with little perceptible change, until a new communication was obtained through the bark with the leaves of a shoot from some bud below the incision ; the increase of the timber thus evidently depending upon the growth of the leaves.

These experiments were so far conclusive as to establish that the current of sap which ran upwards from the roots, was not impeded in its passage by the annular incisions and the removal of the belt of bark ; but that it was probably the downward current which was interrupted, and also that it was this downward current by which the annual increase of the tree was effected. By a series of experiments with coloured infusions, Mr Knight traced the upward current through the pores of the wood beyond the annular incisions in the bark, and found that it had neither coloured the bark nor the sap between it and the wood. He traced the co­loured infusion along the leaf-stalk into the leaf, through one series of vessels ; and he observed another series of vessels which were conveying a colourless fluid in an opposite di­rection, that is, out of the leaf. He traced this second se­ries of tubes downwards, and found that they entered the inner bark, and, without having any communication with the tubes of the wood, descended through the inner bark from the very extremities of the leaves, apparently to the points of the roots. Mr Knight considers that there are two series of these descending tubes, one of which forms the new an­nual layer of alburnum, and the other the new annual layer of internal bark. It thus appears that the sap is conveyed upwards through the pores of some part of the wood, into the leaves, and that w hen there, probably by its exposure to light and air, and by the evaporation which takes place, it undergoes some peculiar process of elaboration which tits it for contributing to the sustenance and growth of the tree. It also appears that the cause of the growth is the deposi­tion which takes place in the downward passage of this per­fected sap. The sap, after this curious preparation in the leaves, is called cambium.

The same persevering physiologist then pursued his in­vestigations a step farther. He took trees, and not only removed a ring of bark, but also a ring of the younger wood, to such a depth as to cut through and remove the whole of the alburnum. These trees did not exhibit the slightest symptom of vegetation in the ensuing spring ; which fact evidently proved that the ascent of the sap had been prevented, and also that it had been prevented by the removal of the alburnum; for the previously-mentioned experiment had shewn that the removal of the bark was not attended with such an effect.@@1

It is the generally received opinion that the ascent of the sap through the alburnum is the reason that this gra-

@@@1 This experiment is continually making on a far more extended and therefore more conclusive scale, in the removal of the whole of the bark excepting the liber, from the cork oak, *Quercus Suber,* which takes place once in about eight or ten years, not only without injury, but with actual advantage, to the tree, which vegetates with increased luxuriance.