

In a third set of experiments, conducted in the same manner, the under surface brought into contact with the prisms, consisted of mica, rendered nearly cylindrical by being bent over a cylindrical surface.

From the irregularity in the form of the mica, that of the colours was also irregular; but they served to show the increase of extent to which such appearances may be rendered visible by corresponding change of the angle of the prism.

Dr. Herschel is consequently of opinion, that any one who could object to the admission of critical separation as the cause of the phenomena under consideration, cannot have paid sufficient attention to the modifying power of the subjacent reflecting surface, which is so essential to their formation.

If any one is disposed to assume that the rings must arise from some other cause than critical separation, unless it can be shown how rays critically separated can reach the eye, the author thinks it is not to be expected that *he* should trace them through a most intricate complication of reflections from curve to curve, when it has been shown, in the second part of this paper, that even with streaks produced by contact of two plain surfaces, it would be an endless attempt to follow them. He accordingly thinks it sufficient to have proved, to his own satisfaction, two essential points; first, that colours separated critically may be formed into rings, when modification will increase the field of visibility to any extent beyond the limits of critical separation.

Enough (says the author) has been said to prove that the phenomena of coloured rings, and other phenomena that have been ascribed to certain fits of easy reflection and easy transmission, admit of the most satisfactory explanation, by substituting the solid principle of the critical separation of the different colours, in the room of these fits.

On the Parts of Trees primarily impaired by Age. In a Letter from Thomas Andrew Knight, Esq. F.R.S. to the Right Hon. Sir Joseph Banks, Bart. K.B. P.R.S. Read March 22, 1810. [Phil. Trans. 1810, p. 178.]

In the first communication which Mr. Knight made to the Society in the year 1795, he showed that the period to which the existence of any one variety of fruit could be prolonged by grafting, was limited; and that any portion detached from an old tree, and transplanted upon a young stock, was not thereby restored to what can, with propriety, be called a young tree.

Mr. Knight's endeavours have, since that time, been directed toward ascertaining which of the several organs it is that first fails in the performance of its proper office in consequence of age, and the result of his experiments forms the subject of the present letter.

In the prosecution of these inquiries Mr. Knight bears constantly in mind the analogy that subsists, in many respects, between the organs of animals and those of vegetables; for though it may not be in his power to avail himself of any assistance to be derived from

such considerations, it is not improbable that, on the contrary, some new light may be thrown upon the functions of the animal economy by investigations respecting those of vegetables, where the necessary experiments may be repeated any number of times, and where the influence of efficient or defective organs may be observed with the most deliberate attention.

The parts separately noticed on the present occasion, are the roots, the stem, and the leaves. The roots and leaves have been compared by all naturalists, both ancient and modern, to the intestines and lungs of animals. The analogy also, between the sap of vegetables and the blood of animals, is very obvious; and the circulation of sap in the former, as far as is necessary to, or consistent with, their state of existence, is very satisfactorily established by the experiments formerly communicated to us by Mr. Knight, in addition to those made by other naturalists.

With respect to the roots, no experiments appeared wanting to determine that no defect in the action of this organ occurs from age, and consequently that the debility and diseases of old varieties of fruit were not derived from this source. The duration of roots, in old coppices, that are felled at stated periods, appeared to the author sufficient to establish that the quantity of produce is not diminished by *age* of the roots. The inability also, of a seedling stock to give the character of youth to an inserted bud or graft, seemed to prove how little is effected by undoubted *youth* of the root.

Mr. Knight ascertained, however, by an experiment of an opposite nature, that the *stock* may be affected by the *graft*. By planting cuttings of some very old varieties of apple, he obtained stocks which would soon have manifested the usual appearances of age. At the end of two years these were grafted, at about two inches from the ground, with new and luxuriant varieties; and at the end of five years the roots were examined, and were found to contain ten times as much alburnum as they would probably have contained if they had not been grafted; and they were also wholly free from disease.

Another kind of experiment was next made upon the effect of grafting young wood upon old, the old having first been grafted upon a young stock, in a situation where it would not have survived the second or third year. But when a portion of an old golden pippin was thus included between two portions of a crab, the wood was found to grow just as well, and to be just as healthy as the stock and branches.

In other experiments the author tried the effect of placing young grafts upon old ones, that had long since become cankered. The old ones being cut off at the distance of a foot from their original junction, he regrafted them with new and healthy varieties, and he found that they became, in consequence, perfectly freed from every appearance of canker.

The author having thus ascertained that the debilities of old varieties of fruit-trees did not originate in any defective action of the

bark or alburnum of either the stem or the root, he proceeded to investigate the states of the leaf, and of the succulent annual shoot. With this view various grafts of the golden pippin, which were known to be liable to decay, were inoculated with buds of new varieties; and in the ensuing winter their own *natural* buds were removed, and those that had been inserted were alone allowed to remain. As soon as the leaves of these began to appear, every symptom of disease was removed; and each part of the branch of the golden pippin thus regenerated, appeared to perform its office as well as the wood and bark of the seedling stock could have done without this intermediate graft of old materials.

Since the vigour of youth, or debility and diseases of old age, appeared thus to depend on the quality of the leaf through which the sap of plants circulates, in the same manner as the blood of animals does through their lungs, Mr. Knight considers the consequence of defective leaves, according to his former views of the functions they perform, of preparing and assimilating the sap transmitted through them; and he observes, that the deficiency of power in the leaves is (as might be expected) most apparent where the redundancy of sap is the greatest; for he finds that the grafts of old varieties are most diseased in rich soils, or when they are applied to vigorous stocks; and the defects appear to arise from an accumulation of fluid in the extreme branches and annual shoots, beyond what can circulate with effect through the imperfect leaves that are produced by extremities debilitated by age.

In support of this opinion, of an essential difference between the leaves of young and of old varieties, Mr. Knight observes, that there is an evident alteration in the character of leaves visible in the same variety, between those of two years and those of twenty years old; and that it is consequently highly probable that still further changes have occurred in the course of two centuries.

From these results respecting the importance of the leaves to the well-being of vegetables, the author ventures to suggest the probability, that the debilities of old age in animals may arise from a similar source, and may be traced to injury primarily sustained by the lungs.

It is not merely upon general analogy that such an opinion may be supported, but in particular instances of long life in men and in domesticated animals, it is observed that those individuals longest retain their health, and are most able to bear excessive labour without injury to their constitution, in whom the chest is manifestly most capacious.

On the Gizzards of Grazing Birds. By Everard Home, Esq. F.R.S.
Read April 4, 1810. [*Phil. Trans.* 1810, p. 184.]

Since the organs of digestion in those quadrupeds which live wholly upon grass differ considerably in their construction from those