

arrangement described previously<sup>1</sup>.) The stationary decrease in the concentration of the absorbing chlorophyll molecules during the illumination is proportional to the light intensity, and (roughly) inversely proportional to the concentration of ferrous chloride. It increases at first with increasing concentration of ferric chloride and then becomes independent of it—showing that under these conditions each excited chlorophyll molecule reacts with Fe<sup>III</sup>. All these results agree with the assumption that the influence of light consists in shifting the equilibrium (I) to the right, that is, in speeding up the oxidation.

(4) These experiments show that ethyl chlorophyllide is reversibly oxidized by ferric chloride (that is, probably by Fe<sup>3+</sup>-ions) to some unstable intermediary product from which it can be recovered by reduction with ferrous chloride (that is, probably by Fe<sup>2+</sup>-ions), and that the oxidation is greatly favoured by illumination. These facts are obviously not without interest in connexion with the assimilation process, in which chlorophyll has to act as a catalyst for the reduction of carbon dioxide by light.

We wish to express our sincere thanks to Prof. F. G. Donnan for his kind interest in this work.

*Note added in proof.*

The formation of ferrous ions in the reaction between ethyl chlorophyllide and FeCl<sub>3</sub> can be proved directly by means of a spot test reaction with  $\alpha\alpha'$  dipyridyl. It has further been observed that the yellow solution of chlorophyllide, oxidized by FeCl<sub>3</sub>, changes to a green colour by addition of various electrolytes, for example, NaCl, CaCl<sub>2</sub>.

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Nov. 18.

<sup>1</sup> See, for example, *J. Chem. Phys.*, 4, 497 (1936).

#### Translocation of Solutes in Plants

In my experiments on the eradication of *Dichapetalum cymosum* (Hook) Engl., one of the most toxic plants of the Transvaal, I was led to the following technique for introducing copper into the stem of the plant. The stem and branches of the plant are entirely underground and only the leaves emerge above the soil. The stem may be up to 100 ft. long. For the purpose of eradication, the stem is freed from the surrounding soil to a depth of about 9 in. and then ringbarked on a length of 2 in. for a 1 in. stem. Around this ringbarked region a mixture of the following substances is packed: calcium chloride, copper sulphate and soil in the proportion 2 : 1 : 2. The hole is then filled up again with soil. The circulation of the copper is very rapid; within twenty-four hours, leaves 15 ft. distant from the main stem are practically dead or dying. The downward movement is much slower; it takes eighteen days to kill 104 inches of the stem. The movement of the copper was followed with the help of potassium ferrocyanide, and it was noticed that the translocation takes place essentially in the phloem, although in the ringbarked region it is first taken up by the xylem. Only after about eight days does the xylem show copper in the same degree as the phloem does after twenty-four hours.

In my laboratory experiments, I used the following method. A ringbarked young twig was pushed down

the stem of a glass funnel so that it emerged about 1 cm. at the lower end. This part was dipped into water. The ringbarked region was so arranged that it was situated in the conical part of the funnel. This region was then covered with a mixture of calcium chloride, copper sulphate and soil all finely powdered and mixed. The soil is necessary to prevent the formation of a hard cake; it seems also to induce rapid absorption, for without it the transport of copper is much slower. Results are obtained after twenty-four hours. The translocation in cut twigs is, however, far slower than in branches attached to the main stem, where a transpiration stream passes through them.

I have also tested the method on two species of *Acacia*, on *Burkea Africana* and *Ochna pulchra* ringbarked near the crown; in all cases I obtained a rapid movement of copper into the leaves.

These experiments were carried out with the sole object of finding a suitable method for eradication. The method has given very satisfactory results with *Dichapetalum cymosum*. The technique could, however, also be used for the study of the translocation of solutes as such. Instead of a toxic substance, sugars, nitrogen compounds, phosphates, etc., could be added to the mixture of calcium chloride and soil, and the different regions of the branch then could be analysed to establish the main path of translocation. Even if the calcium chloride reacts with some of the substances to be used (as it does with copper sulphate) the experiment will not be disturbed.

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#### Differentiation of Varieties of Eucalypts by their Essential Oils

IN continuation of our investigations into the occurrence of varieties of well-known species of eucalypts, *E. dives* and *E. radiata* (*E. numerosa*), *E. australiana*, etc., as determined by chemical analyses of the essential oils, we have made an interesting observation with *E. radiata* variety "A" which is considered worthy of early mention.

The occurrence of a number of varieties of *E. radiata* (*E. numerosa*) was investigated in 1930<sup>1</sup>. Young trees of the type and its varieties were raised from seed and the essential oils afterwards examined. These were found to be quite constant, with the exception of one tree of variety "A" which threw out two stems, each about 20 ft. in height, from the one root system. The leaves and terminal branchlets of each stem were examined separately and, to our surprise, they yielded different essential oils, one giving an oil indicative of variety "A" whilst the other was almost identical with what we prefer to regard as the type species. We are unacquainted with any record of a similar observation.

This observation provides additional evidence in support of our previous contention that the theory of the constancy of species, based upon the chemical composition of the essential oils, does not hold in every instance.

Full details of this investigation will be published in the *Journal and Proceedings of the Royal Society of New South Wales* for 1936.

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Oct. 14.

<sup>1</sup> *J. Proc. Roy. Soc. New South Wales*, 66, 181 (1932).