Although, as Prof. Thoday states, they have disposed of certain criticisms of earlier work and have demonstrated a comparatively long-continued uptake of water by cut shoots in saturated air or in aerated water, yet the ultimate fate of the water absorbed is still an open question—experimental proof of its escape from the leaves under these conditions would clearly be no easy matter. If, as Lewis suggests, transpiration involves an active secretion of liquid water followed by evaporation, then it seems possible that the results of the experiments of Dixon and Barlee may be due to the persistence of this secretion in spite of the suppression of evaporation. If this is so, then the absorbed water must be held in the intercellular space system, and it would be interesting to know whether a cut shoot can be maintained under the conditions of these experiments sufficiently long for this accumulation of water to be definitely proved or disproved. An appreciable volume of water might be held in this way before obvious injection of the spaces supervened, and it would seem that this possibility cannot be ignored.

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[1] *Nature*, **164**, 541 (1949).
[2] *Sci. Proc. Roy. Dublin Soc.*, **22**, 211 (1940).
[3] Sresnevski, see Maximov, "The Plant in Relation to Water", 159 (1929).
[4] Discussion of the Faraday Soc., No. 3, 159 (1948).

The instability of a convex meniscus at its point of maximum curvature to which Dr. Wilson directs attention is interesting. It would presumably result in a flooding of the air-spaces once the limit were passed.

Lewis's observations, however, indicate that normally no layer of water is formed over the unwettable surface of mesophyll cells, even when water vapour from them condenses on a cover-glass immediately above. It is difficult, therefore, to accept the suggestion that exudation of water into the intercellular spaces might account for the water taken up by the shoots in Dixon and Barlee's experiments.

The smallness of the vapour-tension differences does not necessarily rule them out as a significant factor. The rates of water intake observed are low. Continued for many hours, these rates, low as they are, add up to an appreciable volume. In referring to the precautions taken to secure complete saturation, Dixon and Barlee (pp. 14–15) state that they have observed the process continuing in some cases as long as four days after the preliminary period of 20 hr. in supersaturated air. As the bore of their potometer capillary was 1 mm., a rate of 1 mm. per minute would mean nearly 5 c.c. in four days. This seems rather much to stow away unobserved in the intercellular spaces. A rough estimate of the volume of leaf tissue concerned can be obtained from Dixon and Barlee's data for a shoot of *Abutilon*, with nine leaves, of average area 100 sq. cm. Assuming a thickness of 0·1 mm., the total volume of the mesophyll would be about 9 c.c.; or if 0·2 mm. thick, 18 c.c.

Moreover, Dixon and Barlee record that, notwithstanding the thorough pretreatment of a shoot to ensure saturation, eosin applied to the cut end reached in many cases the finest ramifications of the veins, so that "the whole tracheal system of the submerged branch has been emptied by subaqueous transpiration".

It seems unlikely that water taken up in such amounts could all be retained.

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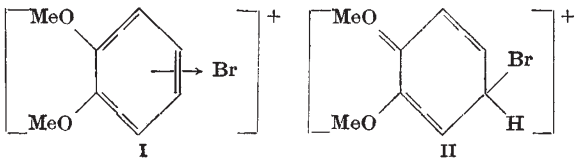
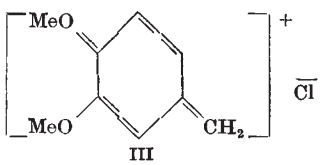
Nov. 9.

Veratrole and π-Complexes

The bromination of veratrole proceeds more readily than that of anisole, and this comparison has led Dewar[1] to propose that the former reaction employs the π-complex I rather than a complex of type II.

Dewar's argument is based on the assumption that formation of II is adversely affected by the methoxyl group in the *meta* position to the centre of attack, whereas both methoxyl groups facilitate the formation of I.





For many years chemists have attempted to relate rate of aromatic substitution to side-chain reactivity, and the considerable success they have obtained suggests that the criteria of aromatic substitution are associated with the individual carbon atoms of the benzene ring rather than with the π-orbitals of the ring as a whole. In the present instance, it is instructive to relate the rates of bromination of veratrole and anisole respectively to the rates of unimolecular alcoholysis of veratryl and anisyl chloride respectively. Ionization is the rate-determining step in the alcoholysis of these chlorides, and the rate of formation of the cation III provides a measure of the ease of formation of the complex II.

The alcoholysis of veratryl chloride is as many times faster than that of anisyl chloride as the bromination of veratrole is faster than that of anisole[2]. The rates of alcoholysis demonstrate that both methoxyl groups make a greater contribution to the resonance energy of the veratryl cation than to that of veratryl chloride, and one must conclude that both methoxyl groups in veratrole facilitate, simultaneously but not equally, the formation of complexes of type II. Thus, although evidence of the formation of π-complexes is accumulating, the rate of bromination of veratrole affords no evidence of the formation of the π-complex I.