ever, the behavior of the ring is an indication of the presence of the γ-component.

It is concluded that carrot leaf carotene resembles carrot root carotene in its composition rather than the optically inactive carotenes hitherto found in most leaves.

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THE EFFECT OF THE SOLVENT ON THE POTENTIAL OF THE CHLORANIL ELECTRODE

Sir:

Since the original study of the chloranil electrode by Conant and Fieser,[1] it has been generally assumed both at Harvard and elsewhere[2] that "the potential of the saturated chloranil electrode against the hydrogen electrode is independent of the solvent (and has the value +0.664 volt at 25°")."[3]

This assumption is, of course, well founded provided the solution studied is really in equilibrium with the unsolvated solid chloranil and its hydroquinone. Since this electrode has been chiefly used in glacial acetic acid, the following observations seem important.

In the course of certain measurements in this solvent (to be published later) it appeared that if the value +0.664 volt was accepted for the chloranil electrode, all the potentials measured differed from those obtained in the same system when a hydrogen electrode was used. The discrepancy disappeared if the value +0.680 volt was assigned to the chloranil electrode. We therefore measured directly the effect of the solvent on the potential of cells without liquid junction and containing a hydrogen and a chloranil electrode, with the result that Conant and Fieser's value of +0.664 volt was confirmed in 50% aqueous alcohol, while in glacial acetic acid and in 50% aqueous dioxane the values +0.680 volt and +0.715 volt were obtained.

These differences are due to the fact—previously overlooked—that tetrachlorohydroquinone is solvated in certain solvents, as has indeed long been known.[4] The solid phase in equilibrium with the saturated solution in glacial acetic acid is principally $C_6Cl_4(OH)_2\cdot2AcOH$, while in contact with dioxane solutions the solid phase is $C_6Cl_4(OH)_2\cdot C_4H_8O_2$. From the observed differences of potential the free energies of solvation

    (1) Conant, Small and Taylor, THIS JOURNAL, **47**, 1959 (1925); Hall and Conant, *ibid.*, **49**, 3047 (1927); Conant and Chow, *ibid.*, **55**, 3745 (1933).
    (2) Hall, *ibid.*, **52**, 5115 (1930).
    (3) Conant and Chow, *loc. cit.*, p. 3748.
    (4) See, *e. g.*, König, *J. prakt. Chem.*, [2] **70**, 33 (1904).

may be readily calculated and are found to agree well with the physical properties of the solvates.

It is clear that the potential of the chloranil electrode may be assumed independent of the solvent only if the electrode materials remain unsolvated under the conditions of the experiment.

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THE VISCOSITY OF H²H²O

Sir:

The great difference between the conductivity of potassium chloride in H^2H^2O and in H^1H^1O which was found by Lewis and Doody [THIS JOURNAL, **55**, 3504 (1933)], made it desirable to ascertain the viscosity of heavy water. The time required to fill a pipet through a fine capillary, with a known head of pressure, was measured with a stop watch, the apparatus being enclosed in a constant temperature bath. At each temperature the heavy water was compared directly with ordinary pure water. The very close approximation to linearity between viscosity and isotopic composition is shown by the results obtained with water containing 70 and 90% of H^2. If η_1 and η_2 represent the viscosities of H^1H^1O and H^2H^2O, η_2/η_1 at 20° was found to be 1.249 by extrapolation from 90% and 1.244 by extrapolation from 70%.

The 90% sample was next compared with ordinary water between 5 and 35°. The results extrapolated to pure H^2H^2O show η_2/η_1 to be nearly linear with the temperature. The values interpolated at even temperatures are given in Table I, in which the first row gives the values of η_2/η_1 the second reproduces the values of η_1 given in "International Critical Tables," and the third the viscosity (in millipoises) of pure H^2H^2O obtained by multiplying the numbers in the first row by those in the second. We believe the results to be accurate within 0.5%.

VISCOSITY OF PURE H²H²O

t, °C.	5	10	15	20	25	30	35
η_2/η_1	1.309	1.286	1.267	1.249	1.232	1.215	1.198
η_1	15.19	13.10	11.45	10.09	8.95	8.00	7.21
η_2	19.88	16.85	14.51	12.60	11.03	9.72	8.64

These measurements of the viscosity, together with the measurement of the dielectric constant of H^2H^2O (accompanying communication), will permit the application of the Onsager equation to the conductivity measurements of Lewis and Doody. Since our experimental measurements of the viscosity were made, values of the viscosity of heavy water, at 20°,