from the steady motion, and the element of convection current is $-(2c^2KI\,\delta \log r/l\,\delta t_0)dt_0$. Thus if the electrons between the plates, beginning with those which left first, extend at time t from r_1 to r_2, r_3 to r_4, and so on, the convection current is

$$(2c^2KI/l)\,(\log r_1 - \log r_2 + \log r_3 - \log r_4 + \;.\;\;.\;\;).$$

We have now a complete mathematical basis for solving any particular problem. I shall consider the simplest, in which all the electrons (somewhat unphysically) are emitted normally with the same finite velocity, so that those which return are caught on the filament. Then the convection current is independent of t in cases (1) and (2), and no oscillations can be maintained. If $\nu = \frac{1}{2}\omega$, and if the cloud of electrons grazes the plate once in every period, the mode of maintenance is fairly obvious. The boundary lags a quarter period behind the applied potential. A small gap in the return stream then moves back, and if the time of grazing is a small fraction of the period, though large compared with the time an electron is in the strong field near the filament, a convection current nearly equal to I flows for a time $2f\pi/\nu$ after a further quarter period has elapsed. The convection current is thus opposite to the potential at the time being.

Many problems can be proposed and solved. I have worked out the theory of a magnetron in a condenser circuit with $\nu = \frac{1}{2}\omega$, the high potential being connected through a large choke. If the resistance R of the circuit is so small that RI can be neglected, the oscillations are nearly sinoidal (having harmonics of a lower order than the fundamental) and the frequency is given approximately by Kelvin's formula $LKC\nu^2 = K + C$. The amplitude of oscillating potential on the plate is

$$2fILC/RK\,(K + C).$$

When a triode maintains slow oscillations, a certain minimum reaction is needed, and the amplitude cannot be determined by a linear theory. There is nothing like this with a magnetron, but the amplitude is determinate, proportional directly to I and inversely to R.

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Combined Ascorbic Acid in Food-stuffs

THERE has lately been some discussion about the state in which ascorbic acid is present in natural food materials. Ahmad[1], and McHenry and Graham[2] observed that several fresh food-stuffs like cabbage, cauliflower, carrots, etc., give a higher ascorbic acid value on being cooked or boiled with water, as estimated by titration with the indophenol reagent. They conclude that at least part of the vitamin is present in the fresh food-stuffs in the combined state, from which the free vitamin is released on boiling with water. Van Eekelen[3], on the other hand, working with the potato, considers that the increase in the vitamin content on boiling is only apparent and not real, being due to the inactivation of ascorbic acid oxidase, which is normally present in these food-stuffs, by heat. We have carried out the following experiments in this connexion, which, we believe, demonstrate almost conclusively that the increase of the vitamin C value of certain food-stuffs on boiling cannot be accounted for on the oxidase theory, and that part of the vitamin in the natural food-stuffs is present in the combined state. All the estimations were carried out titrimetrically.

(1) Cabbage, when extracted with absolute alcohol in presence of anhydrous sodium sulphate, yields an extract, which, when heated for 4 minutes on a boiling water bath in an atmosphere of nitrogen, invariably gives an increased vitamin C value. Frequently the increase varies between 50 and 100 per cent. The alcoholic extract, on being heated at 36° for 10 minutes in an atmosphere of nitrogen, also shows a very considerable increase in vitamin C value, very often of the order of 50 per cent.

(2) Cabbage, on extraction with ether in the presence of anhydrous sodium sulphate, provides an extract, which, as such, gives practically no vitamin C value. On heating the air-dried ethereal extract in an aqueous medium on a boiling water bath for 4 minutes in an atmosphere of nitrogen, a considerable vitamin C value is obtained.

(3) Bel (*Aegle marmelos*), a common Indian fruit, gives alcoholic and ethereal extracts which behave similarly to those of cabbage, though the order of increase is not so great in this case.

(4) The increase in the vitamin C value of the aqueous extract of cabbage on boiling is shown also if the titration is carried out after mercuric acetate or formaldehyde treatment in order to remove interfering substances.

It is very unlikely that absolute alcohol and ether would extract the ascorbic acid oxidase from cabbage and 'bel', which might come out in an aqueous extract. Moreover, the oxidase, if extracted by alcohol, would scarcely be destroyed by 10 minutes' exposure to 36°, a treatment which produces a very considerable rise in the ascorbic acid value. Ether can apparently be made use of in separating the free ascorbic acid from the combined ascorbic acid in cabbage, the former being insoluble and the latter soluble in this solvent. It has been found that the aqueous extract of cabbage, on being made 0·2 per cent acid with hydrochloric acid and allowed to stand for an hour, also gives a considerably increased vitamin C value, which would indicate that gastric juice would split the combined ascorbic acid of food-stuffs fairly effectively. Ripe and unripe mangoes have not yielded an increased vitamin C value under the above treatments. It would seem, therefore, that not all food-stuffs contain the vitamin in the combined state.

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[1] Ahmad, NATURE, **136**, 797 (1935).
[2] McHenry and Graham, NATURE, **135**, 871 (1935).
[3] Van Eekelen, NATURE, **136**, 144 (1935).

Petroleum-soluble Fluorescent Constituents of Leaves

WHEN petroleum ether extracts of dried leaf material are passed through Tswett adsorption columns composed of magnesia and siliceous earth, the leaf pigments are adsorbed, and colourless solution percolates through the column[1]. The very first portions of the percolate contain colourless hydrocarbons recoverable in crystalline form. Other