the resultant sign of this 'field effect' term can be decided from inspection of a structural formula.

In connexion with a recent note published by Ingold[4], one must point out that the perturbation of the electronic state of a covalent bond by the inductive effect of another pole or dipole should not be regarded as involving any exchange degeneracy of the normal state of the bond. One may suggest that a criterion for the existence of this 'exchange degeneracy' between different parts of a molecule may be that chemical reactivity at one of the points so affected does not proceed at the rate required by the simple activation hypothesis[5].

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[1] Ingold and Rothstein, *J. Chem. Soc.*, 1217; 1928.
[3] Nathan and Watson, *J. Chem. Soc.*, 1248; 1933. NATURE, **133**, 380, March 10, 1934.
[3] Waters, *J. Chem. Soc.*, 1551; 1933.
[4] Ingold, NATURE, **133**, 946, June 23, 1934.
[5] Cf. Hinshelwood, *J. Chem. Soc.*, 1360; 1933.

Magnetron Oscillations of a New Type

DURING the last year, a new type of magnetron oscillations has been widely used in the Philips' laboratories. These oscillations are obtained by raising the magnetic field above the critical cut-off value in a split anode magnetron. Preferably four anodes are used, which are connected together in opposite pairs, in order to obtain two outside connexions.

It can be shown theoretically that when once a small oscillating potential is set up between the two anodes of an ordinary split-anode type, or between the two pairs of anodes of a four-plate magnetron, electrons can reach the anodes after a spiral path with constant angular velocity (equal to $2\pi f$ in the two-plate magnetron, and equal to πf in the four-plate magnetron), with a linear velocity much smaller than that which corresponds to the D.C. potential of the anodes, so that strong oscillations can be built up. The frequency is determined approximately by the following equation:

$\omega = 2V_a/r_a^2H$ for a two-plate magnetron, and
$\omega = 4V_a/r_a^2H$ for a four-plate magnetron.
(Note the inverse proportion to H.)

These theoretical formulæ are well confirmed by experiment.

In the case of a four-plate magnetron, the filament or the filaments should preferably be arranged eccentrically to facilitate the starting up of the oscillations. More than four anodes would yield a still higher frequency, but would require more eccentricity of their filaments. Hitherto four anodes have been found to be the most preferable configuration and efficiencies of 50 per cent and more with energies of 50 watts can be easily obtained for a wave-length of 60 cm. With a diameter of 1 cm., strong oscillations of this type are obtained down to 40 cm. (output 30 watts). There is no doubt that decreasing the diameter will yield much smaller wave-lengths, though with less energy.

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Atomic Constants deduced from Secondary Cathode Ray Measurements

IN a recent paper[1] published under the above title by Andrews, Irons and me, values of the kinetic energies of secondary cathode rays were tabulated and compared with the values to be expected theoretically (that is, from the Einstein photoelectric equation and the accepted data of X-ray spectroscopy).

Our values of the kinetic energies were deduced from measurements of rH (r = radius of curvature of the path of an electron in a field of H gauss perpendicular to the plane of the path). In order to deduce the kinetic energies from the magnetic deflections, and to express them in a form suitable for comparison with X-ray data, it is necessary to assume values of the fundamental constants e, e/m_0, and h. In the paper we took $e = 4{\cdot}770 \times 10^{-10}$ E.S.U., $e/m_0 = 1{\cdot}759 \times 10^7$ E.M.U./gm., and $h = 6{\cdot}543 \times 10^{-27}$ erg. sec. Our energy values came out, on the average, and on the whole very consistently, about 0·5 per cent higher than those deduced from X-ray data. For the latter we took the standard 'crystal' values; if 'ruled grating' values are used, the discrepancies are still greater.

It is the main purpose of this note to point out that a remeasurement of our instrumental constants has revealed a small, but appreciable, error affecting all the measurements listed in the paper. There appear to have been two sources of error, each less than 1 part in 2,000, but unfortunately both in the same sense, namely: (1) a small error in the setting of the field coils, and (2) an error in the allowance made for an uncompensated component of the permanent magnetic field in the laboratory. The combined effect of these, expressed as a percentage of rH, obviously varies with the field in use, but 1 part in 1,250 (0·08 per cent) may be taken as a satisfactory average value for the fields used in the greater part of the work. Repetitions have been made of typical experiments at different stages of the earlier work, and it seems certain that the experimental conditions and instrumental constants have remained unaltered throughout the whole series.

In the region with which we are dealing, kinetic energy is very nearly proportional to $(rH)^2$, therefore the quoted energies, as determined in our experiments, all require to be reduced by 0·16 per cent. This reduces the discrepancy between 'photoelectric' and 'crystal' values to a little more than 0·3 per cent.

It may also be pointed out that if we take $e = 4{\cdot}768 \times 10^{-10}$, $h = 6{\cdot}547 \times 10^{-27}$ (Birge's later values) and $e/m_0 = 1{\cdot}757 \times 10^7$ (a value which is low compared with those accepted until quite recently, but which is now showing definite signs of becoming fashionable), the discrepancy is still further reduced by another 0·22 per cent—that is, to an order of magnitude compatible with quite optimistic estimates of experimental errors.

I have pleasure in thanking Profs. R. T. Birge and A. E. Ruark for their kindness in communicating to me privately some of their results bearing on this work.

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July 3.

[1] Robinson, Andrews and Irons, *Proc. Roy. Soc.*, A, **143**, 48; 1933.