since electrons with $l>0$ do not approach as close to the nucleus as do the $S$ electrons. Accordingly, in Tl II, the $6s\ 7s\ {}^3S_1$ level should be displaced much more than is the $6s\ 7p\ {}^1P_1$.

Neglecting $w_2$ then, and letting $r_1$ and $r_2$ be the nuclear radii of the two different isotopes, the difference in displacements is $\Delta w = 2Z(r_1^2 - r_2^2)$, if $V_0 = 0$. Experimentally, $\Delta w = 0{\cdot}2$ cm.$^{-1} = 10^{-6}$ atomic units. If we take $r_1 = 10^{-12}$ cm. and $r_2 = 9 \times 10^{-13}$ cm., then we obtain an effect of this order of magnitude. In any event, $V_0$ could be varied also, so that there seems to be no difficulty in accounting for the order of magnitude of the isotopic displacement on the hypothesis that the deviations from Coulomb's law near the nucleus are responsible.

My thanks are due Dr. Dirac for helpful discussion.

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[1] Schüler and Keyston, *Zeit. f. Phys.*, **70**, 1; 1931.
[2] NATURE, **128**, 34; 1931.
[3] See Unsöld, *Ann. d. Phys.*, **82**, 378; 1927.

### Hyperfine Structure of Thallium II.

THE hyperfine structure of Tl II has been investigated by McLennan [1] and co-workers and partially by Schüler and Keyston.[2] Certain discrepancies in the results of the former authors can be attributed mainly to the low resolving power of the instrument employed (3 metre grating). The absence of characteristic fine structures in the magnetic analyses of the same authors is probably of the same origin.

With the large grating and the Weiss magnet at the Physical Institute at Tübingen, we have investigated the magnetic transitions of the hyperfine energy levels of singly-ionised thallium employing field-strengths of

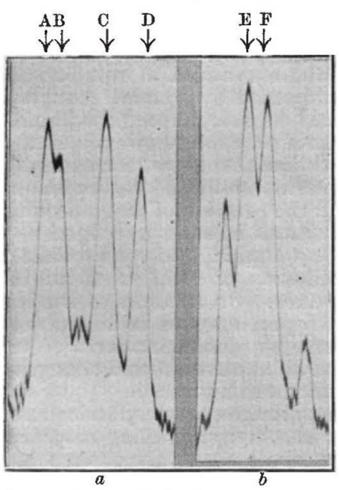


FIG. 1.—*a*, Perpendicular polarisation; *b*, parallel polarisation. H = 14,700 gauss.

15,000–43,350 gauss, in a manner similar to that employed by one of us [3] for the principal arc lines of thallium. A typical example of such transitions is the line λ 3092. In this case, the magnetic field disturbs only the ${}^1P_1$ levels (classified as $6s6p\,{}^1P_1 - 6s7s\,{}^1S_0$). The photometer curves, reproduced in Figs. 1 and 2 (magnification 30), made from fifth order plates, show quite clearly the effect of changing fields on the separations. In the perpendicular polarisation, the separation $AB$ increases while $CD$ decreases with increasing field; the sum of the two distances, however, remains practically constant. If the Paschen-Back effect were complete, the separations would be equal. The separation $EF$ in the parallel components decreases with increasing field strength and is not resolvable at 43,350 gauss.

The above analysis gives us a value of $0{\cdot}092 \pm 0{\cdot}002$A.,

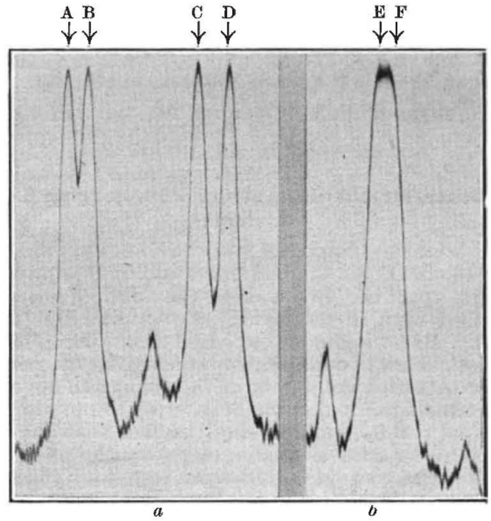


FIG. 2.—*a*, Perpendicular polarisation; *b*, parallel polarisation. $H = 32{,}500$ gauss.

or $0{\cdot}96 \pm 0{\cdot}02$ cm.$^{-1}$ for the hyperfine structure of the doublet λ 3092 in a zero field, and shows that the levels of $6s6p\,{}^1P_1$ are inverted.

A complete study of the Zeeman analyses of this and other lines of thallium II will be reported elsewhere.

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[1] McLennan, McLay, and Crawford, *Proc. Roy. Soc.*, A **125**, 570; 1929. McLennan and Durnford, *Proc. Roy. Soc.*, A **129**, 48; 1930. McLennan and Crawford, *Proc. Roy. Soc.*, A **132**, July 1931.
[2] Schüler and Keyston, *Zeit. f. Phys.*, **70**, 1; 1931.
[3] Back and Wulff, *Zeit. f. Phys.*, **66**, 31; 1930. Wulff, *Zeit. f. Phys.*, **69**, 70; 1931.

WE have recently published two communications [1] concerning an isotope displacement effect in the hyperfine structure of thallium II. On the other hand, in a recent paper on this subject,[2] J. C. McLennan and M. F. Crawford state that they have discovered no trace of an isotope effect. In order to avoid misunderstanding, we wish to point out that this apparent contradiction is entirely due to the fact that the resolving power of the grating used by McLennan and Crawford is insufficient to separate the lines due to the two isotopes. The smallest separation resolved by McLennan is $\Delta\nu = 0{\cdot}370$ cm.$^{-1}$; the largest isotope displacement is $\Delta\nu = 0{\cdot}280$ cm.$^{-1}$. With a Fabry-Perot étalon we were able to resolve separations of $\Delta\nu = 0{\cdot}040$ cm.$^{-1}$, that is, a tenth of the resolution obtained by McLennan.

When this fact is taken into consideration, the results are in complete agreement. McLennan's revised term analysis shows that the term which he previously denoted as $6s7p\ {}^1P_1$ is really a $1_1{}^0$ term of the complex group $5d^96s^26p$; this correction must therefore be made in the notation of the lines 5490 and 4765 which we investigated. This change is of