THE MAGNETIC ANISOTROPY OF CARBON DISULPHIDE*

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The anisotropies in the molar magnetic susceptibilities of OCS and CO_2 have recently been recorded as $-8{\cdot}4\times10^{-6}$ e.m.u.[1] and -6×10^{-6} e.m.u.[1,2] respectively. From these data Taft and Dailey[1] predicted that the magnetic anisotropy of CS_2 would be larger than that of OCS. In the present work we have used the Cotton–Mouton effect to obtain an experimental estimate of the magnetic anisotropy of CS_2.

Solutions of carbon disulphide (b.p. 46°) in carbon tetrachloride were prepared and were found to exhibit the following magnetic birefringences at 20° and with sodium light.

$10^5 w_2$	1177	2408	2569	3168	3927	4526
$-10^{15}\Delta C$	5·9	12·2	13·2	15·7	20·0	23·8

whence $10^{12}\Sigma\Delta C/\Sigma w_2 = -0{\cdot}51$

The weight fraction of the solute is here denoted by w_2; ΔC is the difference between the magnetic birefringences of the solution and the solvent.

The magnetic birefringence of carbon tetrachloride cannot be detected with the present apparatus.[3] Techniques used have been described previously.[4]

The molar Cotton–Mouton constant of carbon disulphide as a solute in carbon tetrachloride emerges as $-0{\cdot}73\times10^{-15}$. Burge and Snellman[5] have earlier reported a value of $-0{\cdot}8082\times10^{-15}$ in the same solvent but at a wavelength of 5461 Å.

If the anisotropy* (b_1-b_3) in the electro-optical polarizability of CS_2 is known and the magnetic-field dependence of its polarizability[6] is neglected, the magnetic anisotropy‡ (k_1-k_3) of CS_2 can be calculated using the relationship

$$_\infty(_mC_2) = (4\pi\mathbf{N}/45\mathbf{k}T)(b_1-b_3)(k_1-k_3) \qquad (1)$$

where $_\infty(_mC_2)$ is the molar Cotton–Mouton constant of CS_2 at infinite dilution in carbon tetrachloride.

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‡ The 1-direction is taken to be that of the molecular axis.

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The anisotropy in the optical polarizability of CS_2 as a solute in carbon tetrachloride has been deduced from Kerr effect measurements[7] as $7 \cdot 5$ Å^3. When our experimental Cotton–Mouton constant is considered in equation (1) together with this polarizability anisotropy, the molecular magnetic susceptibility anisotropy of CS_2 emerges as $-2 \cdot 3 \times 10^{-29}$ e.m.u.

We conclude that the anisotropy, $K_1 - K_3$, in the molar magnetic susceptibility of CS_2 is -14×10^{-6} e.m.u. From this value of the magnetic anisotropy and a mean molar susceptibility[8] of $-42 \cdot 2 \times 10^{-6}$, K_1 and K_3 appear as $-51 \cdot _5 \times 10^{-6}$ and $-37 \cdot _5 \times 10^{-6}$. As predicted,[1] the magnetic anisotropy of CS_2 exceeds those of CO_2 and OCS.

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