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A new type of magnetic birefringence

It is well known that salts of cerium and other rare earths exhibit in aqueous solution a Faraday effect or magnetic gyration of light in the *opposite* sense to that shown by the great majority of fluids. The phenomenon has been explained by Ladenburg, Becquerel, and others as an effect connected with the paramagnetism of the ions and their orientation by the magnetic field. The study of magnetic gyration in paramagnetic substances generally therefore possesses great interest. Incidentally, also, the question arises if, as has been suggested by Ladenburg, the paramagnetic ions are orientated by the field, whether the solutions should not exhibit magnetic *birefringence* when observed in a direction transverse to the field. Investigations made on both these points have yielded very interesting results.

A magnetic birefringence of the kind suggested by the orientation theory is definitely shown by salts of cerium, praseodymium, erbium, and yttrium in aqueous solutions, when observed in strong magnetic fields. In every case, using light in the visible region of the spectrum, the birefringence is *negative*, that is, of the same sign as that exhibited by carbon disulphide; and appears to be proportional to the concentration of the solutions. Solutions of lanthanum and gadolinium, on the other hand, fail to exhibit the effect, though gadolinium is strongly paramagnetic. The effect in dilute solutions where it is observed is of the same order of magnitude as that exhibited by organic liquids of the aliphatic class.

So far, no investigation has been made of the variations of the effect with the wavelength of the light used or with the temperature. There appears, however, to be a significant parallelism between it and magnetic gyration in each of the substances studied. The fact that gadolinium salts exhibit neither a birefringence nor any marked magnetic gyration, though they are strongly paramagnetic, seems very significant. Evidently, the question whether the magnetic moment of the ions arises from orbital motion or spin of the electrons is all-important.

It may be mentioned in passing that ferric chloride solutions free from any suspended colloidal matter exhibit a noticeable magnetic birefringence.

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