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Physics. — *"On the double refraction in a magnetic field near the components of a quadruplet."* By Prof. P. Zeeman and J. Geest.

On a former occasion the results were communicated to the Academy, of an investigation on the magnetic rotation of the plane of polarization in sodium vapour, in the immediate neighbourhood of the absorption lines.[1])

In the case of very thin vapours this rotation appeared to be positive outside the components of the doublet, in which the original spectral line is resolved by the influence of the magnetic forces; between the components, however, it becomes negative and very large. In these experiments the light of course passed through the vapour in the direction of the lines of force.

In the same way, if the light is transmitted through sodium vapour in a direction normal to the lines of force, we may expect from the examination of the immediate neighbourhood of the components, in which the spectral line is split up by the magnetic forces, results which are of theoretical importance.

Voigt has deduced from his theory of magneto-optical phenomena the existence of a double refraction, which must be produced in isotropic media, as soon as they are placed in a magnetic field, but which should only be observable in the neighbourhood of an absorption line.[2]) Voigt, together with Wiechert, has observed, that plane polarised light of a period near that of the lines D_1 and D_2, is no longer plane polarised but has become elliptically polarised when it has traversed the flame, there being generated a difference of phase between the components vibrating parallel and those vibrating perpendicularly to the field.

This elliptical polarisation was demonstrated by the above mentioned physicians with the aid of a Babinet compensator, using a flame with *much* sodium and a small Rowland grating.

The object of our investigation of the magnetic double refraction was to examine the phenomena, which show themselves, if, beginning with very small vapour densities, the quantity of sodium is gradually increased. The present communication deals only with the line D_1 in the case of very small densities. This line is resolved into a quadruplet by the action of the magnetic field.

The grating employed for this investigation and its mounting for

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[1]) Zeeman. Proc. Roy. Acad. Amsterdam Vol. V p. 41, 1902, cf. also Hallo Dissertatie Amsterdam, 1902.

[2]) Voigt. Göttinger Nachrichten. Heft 4. 1898; Wiedemann's Annalen. Bd. 67. p. 359, 1899.

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parallel light (which was necessary also now) have been described already more than once. [1])

The light from an arc-lamp or from the sun passed successively through a Nicol's prism, whose plane of vibration was inclined at an angle of 45° to the horizon, the magnetic field with its lines of force normal to the beam, a second Nicol at right angles to the first. Between the Nicols the BABINET compensator was placed, the edges of the two prisms being horizontal. An image of the compensator was formed on the slit of the spectral apparatus; in the middle of this image the central dark interference fringe, surrounded by the coloured ones, was seen. In the spectrum a pair of dark interference fringes are observed and with the field off, only the fine absorption lines of the vapour are seen. Generally the reversed sodiumline is observed already in the spectrum of the arc-light itself and then the presence of sodium vapour between the poles makes of course no difference at all. In order to obtain the degree of sharpness of the interference fringes, necessary for this part of the investigation, we tried several compensators. Sufficient results were obtained with a BABINET compensator of which the prisms had angles of about 50′, obtained from the firm STEEG & REUTER.

The light passed the flame (a gas flame fed with oxygen) over a length of nearly $1^1/_2$ cm. If the field had an intensity of about 23000 C. G. S. units, the quantity of sodium in the flame being very small, the image observed was very similar to that represented in Fig. 1. The latter is constructed with the aid of photographic negatives and of eye observations. The whole phenomenon is of course very delicate as it only extends to the region of the magnetically broadened D_1 line; moreover it depends very much on the quantity of sodium present. We did not yet succeed in getting negatives, which showed the parts which are of very unequal intensity all equally well.

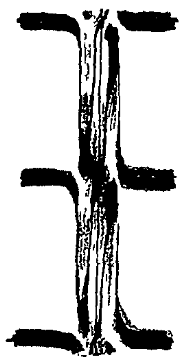

Fig. 1.

Already some time ago Prof. VOIGT was so kind to inform one of us of the result, which according to his theory may be anticipated in the case of a quadruplet.

This conclusion is easily arrived at, if the calculation be simplified by applying a certain approximation, the soundness of which cannot be judged a priori, because constants appear whose numerical value is not yet known. With this reservation the behaviour predicted

[1]) ZEEMAN l.c. and Arch. Néerl. (2) 5. 237. 1900.

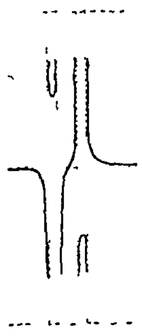
Fig. 2.

by theory is represented in Fig. 2. The dotted vertical lines are the four components of the quadruplet.

In comparing the figures 1 and 2 one must take into consideration, that in Fig. 2 is represented the shape of the fringes, which arise from a single horizontal band. In Fig. 1 in the central part of the field also occur parts, originating from fringes lying above and under the middle. The vertical medium line of Fig. 1 corresponds to the almost ever present absorption line due to the arc light and is thus in no way connected with the phenomenon which occupies us.

The agreement in the region between the two interior components of the quadruplet is undoubtedly of great importance. The whole form of the double curved line may certainly be regarded as a confirmation of theory. How far the darker parts between the exterior components in the middle of Fig. 1 correspond to the U-shaped parts of Fig. 2 is at present not yet to be decided.

Chemistry. — "*The course of the melting-point-line of alloys.*" (Third communication). By J. J. VAN LAAR. (Communicated by Prof. H. W. BAKHUIS ROOZEBOOM).

I. I have shown in two papers (these proceedings Jan. 31 and March 28, 1903) that the expression (see the second paper):

$$T=T_0\,\frac{1+\dfrac{\alpha x^2}{(1+rx)^2}}{1-\theta \log(1-x)}\ , \quad . \ . \ . \ . \ . \ . \ . \ . \quad (1)$$

very accurately represents the solidification temperatures of *tin-amalgams*. This equation may be derived from the general expressions for the molecular thermodynamic potentials of one of the two components in solid condition and in the fluid alloy.

I also pointed out (in the first paper), that already the simple formula

$$T=\frac{T_0}{1-\theta \log(1-x)} \quad . \ . \ . \ . \ . \ . \ . \ . \quad (2)$$

qualitatively represents the course of the melting-point-line perfectly. This is simply done by not omitting the logarithmic function $log\,(1-x)$. Though it is a matter of course, that $-log\,(1-x)$ can only be replaced by x, or $x+\frac{1}{2}x^2+$ etc. in the case that x is very small, it