with leaves; weight: 10,90 gr.-HCN: 0,0140 gr.; i. e. 0,13 %; in 100 internodes: 0,0108 gr.

Resuming, I am brought to the conclusion that in both species of *Prunus* examined (*P. Padus* and *P. Laurocerasus*), when the buds open, there appears in the shoots growing from them a steadily increasing absolute quantity of HCN-compounds, whereas the percentage changes little in the period examined. In this same period at least, and at any rate for a great part, these substances appear independently of the light. Neither is this prussic acid drawn from the internodes directly bearing the buds, and developed the year before. Whether it is supplied by more distant organs, or is formed in the growing twigs out of other substances, this remains to be shown.

It is also still a point of research in what form the prussic acid is contained in the growing parts. That it is necessary to macerate the killed organs before the total amount of hydrocyanic acid can be distilled off, speaks in favour of the presence of a compound that can be split up by an enzyme. Moreover, as the liquid distilled from etiolated as well as from green shoots of *P. Padus* and *Laurocerasus*, has an intense smell of benzaldehyde, it is very probable that these organs also contain glucosides of the amygdalin-type.

Physics. — "*Observations on the magnetic rotation of the plane of polarisation in the interior of an absorption band*". By Prof. P. ZEEMAN.

1. The difficulties of a complete theory of emission are partly avoided in a treatment beginning with the absorption, and this may have been the reason why VOIGT [1]) has followed this procedure, though it must be granted that in his method an explanation of the mechanism of the phenomenon as in LORENTZ's theory cannot be given [2]). In VOIGT's theory the separation of a spectral line by the action of a magnetic field is found as the separation of an absorption line.

Some particulars in this separation were anticipated by this theory [3]) and confirmed by experiment [4]).

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[1]) VOIGT. Wied. Ann. **67**, p. 345, 1899.

[2]) For a comparison of the advantages of the theories of LORENTZ and of VOIGT, see LORENTZ. Rapports, congrès, Paris T. III. p. 16, 33, 1900. en Phys. Zeitschr. **1** p. 39, 1899. cf. also PLANCK. Sitz.ber. Ak. Berlin, p. 470, 1902.

[3]) VOIGT. Drude's Ann. **1**, p. 376, 1900.

[4]) ZEEMAN. Versl. Akad. Amsterdam. Dec. 1899. Archiv. Néerl. (2), **5**, p. 237.

The long since known phenomenon of the rotation of the plane of polarisation and the magnetic separation of the spectral lines were closely connected [1]).

One result however of VOIGT's [2]) theory relating to the rotation of the plane of polarisation in the interior of an absorption band seemed to be in contradiction with the results of CORBINO [3]) or at least were not confirmed by the experiments of SCHMAUSS [4]) The theory of VOIGT requires a negative [5]) rotation of the plane of polarisation in the interior of an absorption band, CORBINO however only succeeded in observing a very small positive rotation.

It would be very remarkable however, if there existed a disagreement between theory and observation in this special field so closely connected with other well understood phenomena.

I have been experimenting already some time on this subject. In executing these experiments I have been aided in an excellent manner by Mr. HALLO.

I have succeeded in observing a negative rotation in the interior of an absorption band, the results of my observations being in perfect *qualitative* agreement with VOIGT's theory.

2. The method used in the following observations on the rotation in sodium vapour is principally the same as that which has been used by VOIGT [6]) in his demonstration of the double refraction of sodium vapour placed in a magnetic field. Already HUSSEL [7]) used it in a determination of the naturel rotation of the plane of polarisation in quartz, and also CORBINO in his first experiments on sodium.

By means of a system of quartz prisms (as has been used by FRESNEL in his experiment on the division of a plane-polarised ray into two circularly polarised rays) a number of horizontal interference fringes are formed in a spectrum. The light traverses the prism in the direction of the axis and the edges are horizontal and perpendicular to the slit of the spectroscope. The prism system (length 50 mm.) was placed in my experiments as near as possible before the slit of spectral apparatus and a small Nicol, used as analysator, behind the slit. The polarising Nicol was placed, of course, before the electro-

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1) cf. also LARMOR. Aether and Matter, p. 203.

2) VOIGT. Ann. der Physik. (4), **6**, p. 784, 1901.

3) CORBINO. Atti R. Acc. dei Lincei. Vol. 10 p. 137, 1901, Nuovo cimento Febbraio 1902.

4) SCHMAUSS. Ann. d. Phys. **2** p. 280, 1900.

5) The magnetic rotation in the vicinity of the band is positive in sodium vapour.

6) VOIGT. Wied. Ann. **67**, p. 360, 1899.

7) HUSSEL. Wied Ann. Bd. **43**, p. 498, 1891.

magnet (of the RUHMKORFF type). The spectroscope was a ROWLAND'S grating, for which I am indebted to the kindness of the Directors of the Dutch Society of Sciences at Harlem; it has a radius of 6.5 M., 10.000 lines to the inch and a divided surface of nearly 14 cm.

The grating was mounted for parallel light in the manner indicated by RUNGE and PASCHEN [1]). The source of light was in most cases the electric arc, in some the sun.

Using this arrangement of the experiment we can deduce immediately from the deformation of the interference fringes in the neighbourhood of the absorption bands, when the sodium vapour is under the action of the magnetic field, the value of the rotation of the plane of polarisation for different wave lengths. Fig. 1 of the Plate gives an idea of the aspect of the fringes in absence of the field in the neighbourhood of the sodium lines, rather much sodium being present in the flame between the poles. The observations were made in the second order.

3. In the experiments first to be described, the distance between the perforated poles was about 4 m.m. and the intensity of the field about 15.000 c. g. s. units. In this field was placed a gas flame fed with oxygen and a small quantity of sodium introduced in it by means of a glass rod. After removal of the polarisator and of the FRESNEL prism the two doublets, in which the sodiumlines are separated, in the inverse magnetic spectral effect were observed. Between the components of the doublet were seen the very narrow reversed sodiumlines due to the arc light itself.

The polarisator and the prism were now introduced in their proper places. The field of view was then crossed by the above mentioned (2) dark, nearly horizontal interference fringes.

I now wished to ascertain the deformation of the fringes by increasing continuously the quantity of sodium vapour, the field remaining constant. This method must be preferred for obvious reasons to the other which might have been followed also, viz: the examination of a flame with constant percentage of sodium under varying magnetic intensities.

The following observations refer to D_1:

If the quantity of sodium in the magnetic field was only extremely small, the interference fringe exhibited at the place of the reversed sodium line a protuberance — let us say *downward* — the lines of the doublet being somewhat stronger just above the interference fringe. In fig. 1 this behaviour is represented schematically.

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[1]) KAYSER. Handbuch. Bd. I, p. 482.

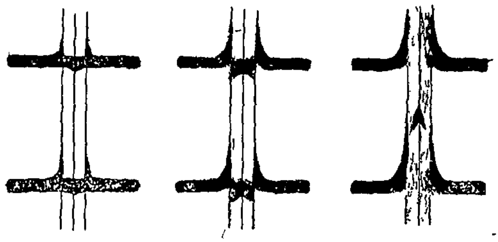


Fig. 1. Fig. 2. Fig. 3.

Increasing now the quantity of sodium (always remaining very small however, absolutely) the interference fringes moved upward along the components of the doublet, whereas the part of the fringe between the components seemed no longer connected to the exterior fringes and accepted the shape figured schematically in fig. 2.

Increasing still further the density of the vapour the interior part of the fringe slid downward with increasing velocity and then resembled an arrow with point directed upward, the parts more removed from the medium line fading away and disappearing (cf, the schematic fig. 3). At last the arrow entirely disappeared by the increase of the density of the vapour. It then became impossible to distinguish the fringes or any trace of structure in the field between the components. Rather much light was transmitted. The entire width of the components of the doublet was now about of the same order as the distance of their central lines.

A further increase of the quantity of sodium obscured the central part more and more (see further (8)).

The exterior fringes moved continuously upward while the density was being increased.

In a field of about 20000 units the downward displacement could be followed over a distance of more than the double of the distance between two fringes, corresponding to a *negative* rotation of above $2 \times 180^{\circ}$, say 400°. The distance between the poles was 4 mM.

Some more accurate data will be given on another occasion.

In the case of D_2 the phenomena were in the main of the same character.

For D_2 it was however characteristic that the stage of the nearly or entirely vanishing of the interior fringes was reached with smaller field, whereas also the shape of the interior fringe differed from the one observed in the case of D_1. Hence there exists also in this case a difference between D_1 and D_2, a difference already known to exist in the phenomena of reversal, of the separation by a magnetic field and of the rotation of the plane of polarisation in the vicinity of the absorption band.

4. It appeared possible to keep stationary each of the stages described in (3) during a considerable time. Excellent photographs could be secured with plates which were sensitised for yellow light with erythrosine silver. Instead of the gasflame fed with oxygen it was easier, in the case of greater distances between the poles, to use a Bunsen burner wherein common salt was introduced.

5. If the density of the vapour was maintained as constant as possible and if it and the fieldintensity corresponded to the circumstances represented in fig. 3 (3) then an *increase* of the field gave a motion of the arrow (fig. 3) (3) upwards, corresponding to a *decrease* of the negative rotation and reciprocally. It was possible to observe by eye observation very clearly this decrease when the field was changed e. g. from 18000 to 25000. If the circumstances were more in accordance with fig. 2 (3) then the same change of field produced a change only just perceptible of the negative rotation but in the same sense as mentioned in the case of fig. 3.

An enlarged reproduction of one of the photographs is shown in fig. 2 of the plate. The distance between the poles in this experiment was 6,3 mM., the field intensity about 14000 [1]). The negative rotation in the case of D_1 is somewhat less than 90°. In the case of D_2 yet only some traces of the interior fringes can be seen (3). The negative rotation is about 180°. In the photograph are seen also the reversed very narrow D_1-line and the broader D_2-line, which are due to the arc itself and have nothing to do with our subject.

6. The observations (3, 4, 5) agree qualitatively in an excellent manner with the conclusions from Voigt's theory. According to it, the negative rotation must be of the same order of magnitude as the positive one. This last was known from Macaluso's and Corbino's experiments to be very great. The enormous value and the sign of the negative rotation given in (3) may thus be regarded as a beautiful confirmation of the theory.

As much is this the case with the direction (5) of the change of the negative rotation with increasing field. In order to see this we must know the value of the quantity occurring in the theory $P = \frac{cR}{\vartheta}$ (R = fieldintensity, c and ϑ parameters of the absorptionband), for which the comparison must take place. It was possible to assign a value to P by comparison of the phenomenon with Voigt's figure 1 [2]).

[1]) The intensities of the field were measured by means of a bismuth spiral in the centre of the field. Probably the values given are somewhat too high. Measurements of the magnetic change of the spectral lines give lower values.

[2]) Annalen der Physik, **6** p. 789. 1901.

This figure gives $n\chi_0$ (χ_0 angle of rotation, n a mean value of the index of refraction) as function of a certain variable Δ, whereas our phenomenon is a representation of χ_0 as a function of λ. Reducing the abscis of the mentioned fig. 1 to $^1/_{20}$ or $^1/_{25}$ we obtain diagrams resembling in the main features fig. 2 of the Plate. To the greater observed negative rotation (3) correspond values of P, which can be estimated at 5 or 8. The smallest easily observed rotations in the used strong field are probably in the vicinity of the critical value $P = 1.73$.

7. The slope of the exterior interference fringes is greater towards the side of the greater wavelengths than towards the violet, at least so far as the rotation due to one band does not influence visibly the rotation due to the other. At the same distances, if not very small, of each of the two D lines the rotation at the side of the violet is greatest. The interior fringes also show a slight asymmetry, so e. g. the point of the arrow in fig. 3 (3) ought to be asymmetrical. The part at the side of the violet is predominating.

It is clear that these phenomena depend upon an asymmetry of the dispersion curve.

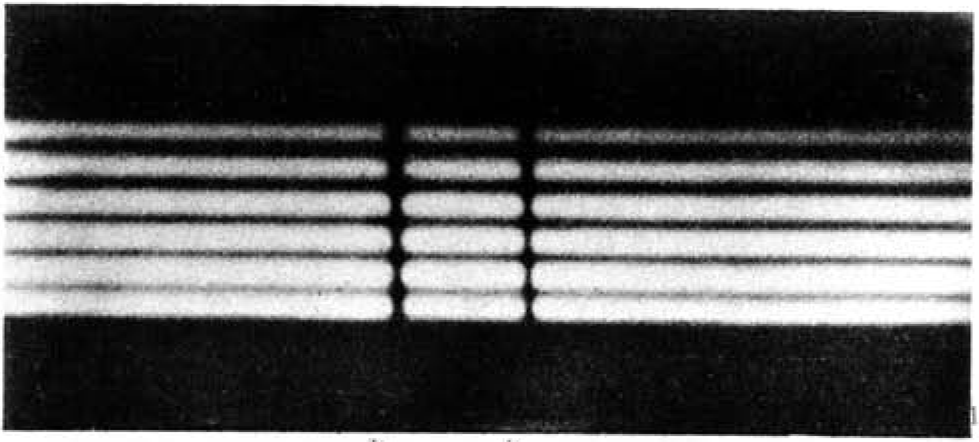
8. With very dense sodium vapour, hence under circumstances which are beyond the last stage of (3), I observed phenomena very probably identical with those observed by Corbino. In my first experiments with those dense vapours I thought it absolutely necessary for securing sufficient intensity to widen the slit beyond the width used in the already given experiments. I now see however that this is unnecessary.

Using these very dense vapours one sees in the absorption band a horizontal part of an interference fringe, which seems to have undergone a very small displacement *upwards* by the action of the field. These horizontal parts are more ill-defined and broader and the whole phenomenon in the bands is darker than under the circumstances described in (3), (4), (5).

Figs. 3 and 4 of the Plate will give a clearer impression of the change in the phenomenon than a long description.

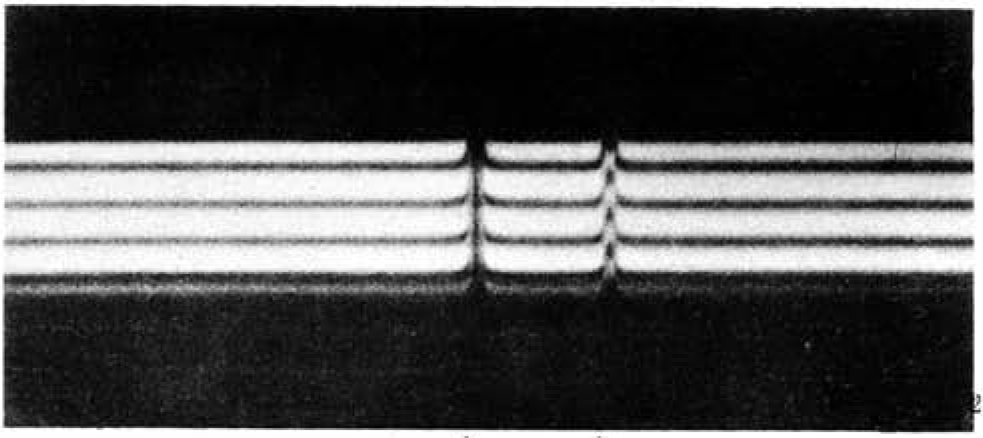
Fig. 3 was obtained with a field of 4500 units and much sodium. I have made some measurements, according to a method not to be given here, concerning the displacement of the central (in horizontal and vertical direction) part of the interference fringe, and I have found a displacement, which would correspond to a *positive* rotation of about 8° with both D-lines. Fig. 4 was taken with a field of 10700 and much sodium. The exterior interference fringes are very clear and much deformed; the rotation in the parts adjacent to the absorp-

P. ZEEMAN. Magnetic Rotation in the Interior of an Absorption Band



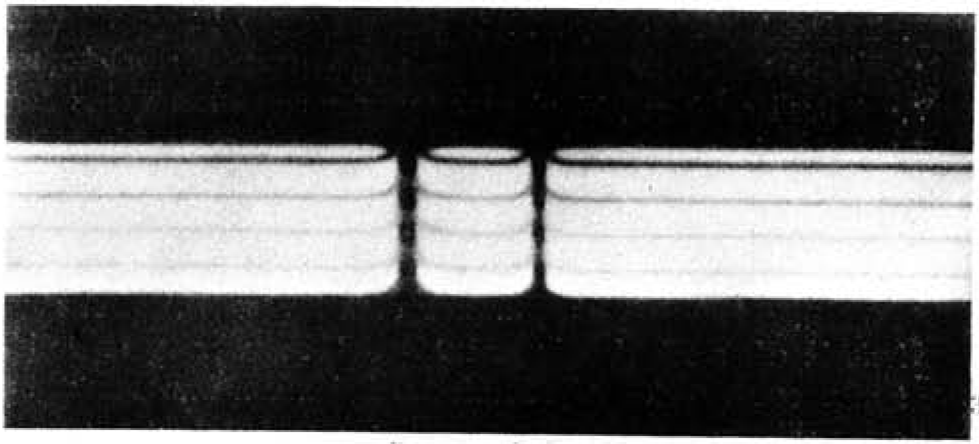
1.

D D_1



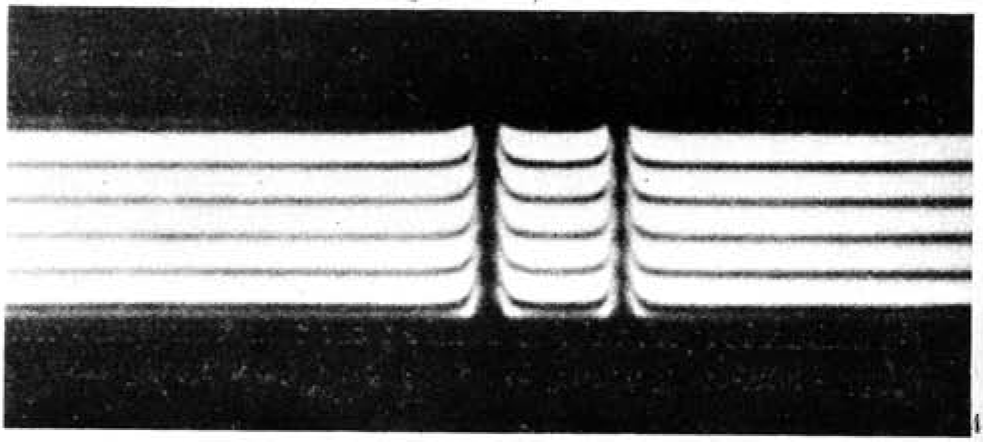
2.

D_2 D_1



3.

D_2 D_1



4.

tion band surpass 180°. The interior interference fringes are very indistinct. Their appearance would suggest that in the case of D_1 in Fig. 4 the stage has been scarcely surpassed, reached for D_2 in fig. 2.

This however cannot be the case because there was too much sodium in the flame. A comparison with fig. 2 will show that the lines are much broader in fig. 4. Measurements taken on other negatives gave me for fields of 11000, displacements of about $^1/_{16}$ of the distance between two fringes, corresponding to a positive rotation of 11°. Hence the displacements in these cases are precisely of the same order of magnitude as in CORBINO's experiments. The paleness of the boarders of the band is easily accounted for by the remark that there the intensity one of the circularly polarised rays largely exceeds the other.

I do not believe that these facts are in contradiction with theory. It is true that it requires for very high values of P a value zero for $(n\lambda_0)_r$. If we must take as the locus of the fringe the mean vertical height, then really the rotation would be positive. It seems possible that with those broad fringes the case is different. It is also possible that the circumstances, assumed in the theory are not wholly realised in the experiments with dense vapours. I am making some new experiments about this subject and therefore shall not discuss further the different possibilities.

EXPLANATION OF THE PLATE.

The Plate gives about sixfold enlargements of the photographs.

Fig. 1. Interference fringes and absorption lines in absence of the field and rather much sodium. (2)

Fig. 2. Same lines. Field intensity about 14000, little sodium. (3) (5)

Fig. 3. Same lines. Field intensity about 4500, much sodium. (8)

Fig. 4. Same lines. Field intensity about 10700, much sodium. (8)

Anatomy. — "*A new Method for demonstrating cartilaginous Mikroskeletons.*" By Prof. J. W. VAN WIJHE.

It is a well-known quality of cartilage that it firmly retains certain anilinstains. Taking advantage of this quality, I have for some years endeavoured to find a stain, which will remain permanent in the cartilage, after it will have been entirely extracted out of the other tissues. If the object is made transparent in canada balsam, the cartilaginous skeleton will then be seen as if it were prepared. I was more or less successful with most of the so-called basal anilin-pigments, best of all however with methylene-blue, and so I was induced to use this latter stain exclusively.