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bacterium occurs invariably in malignant granuloma. In our opinion this seems to be the case, as may be concluded from the literature that appeared hitherto. Still, even if this be so, it would perhaps not by itself entitle us to consider that corynebacterium, beyond a shade of doubt, as the etiologic moment.

We purpose before long to write more at length about this subject in another publication.

EXPLANATION OF THE PLATE.

Fig. I   Smear from the spleen v. d. S. Gram-stain with counterstain.

„ II   48 hours' Bordet-culture, cultivated directly from the spleen of v. d. S. Gram-stain with counterstain.

„ III 18 hours' Bordet-culture after one transplantation. Gram-stain without counterstain.

„ IV Rod with branches from fluid Bordet-medium. Gram-stain with counterstain.

„ V 5×24 hours' ascites-agar-culture, grown directly from the spleen of v. d. S. Gram-stain with counterstain.

„ VI LOEFFLER's serum-culture transplanted after 12 weeks from original LOEFFLER's serum-culture, obtained from a gland of patient S.

Physics. — *"Measurements on the ultraviolet magnetic rotation in gases."* By Dr. J. F. SIRKS. (Communicated by Prof. KAMER-LINGH ONNES.)

(Communicated in the meeting of October 26, 1912).

1. To get an idea of the relative values of the various theories which have been developed to explain magnetic rotation, measurements may be made in the neighbourhood of absorptionbands and -lines in the visible spectrum with a view to ascertain whether the rotation has the same[1]) or opposite sign[2]) on either side of the absorptionband. With perfectly transparent substances one could extend one's observations over a much wider region of the spectrum so as to ascertain if the experimental results obtained in the ultraviolet, for which the rotatory constants are much greater, can be more satisfactorily represented by the one theory than by the other, and if, perhaps, a strong increase in the rotation takes place on approaching the ultraviolet region.

With gases, and in particular with hydrogen, where, on account of their simple molecular structure ordinary refraction of light can well be represented by the assumption of a single kind of ultraviolet electrons[3]), and for which the value of e/m may be obtained from the

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[1]) VOIGT, Magneto- und Elektro-optik p. 133.

    DRUDE, Hypothese des Hall-effektes, Lehrbuch der Optik p. 429, 1906.

[2]) DRUDE, Hypothese der Molekularströme, Lehrbuch der Optik p. 419.

[3]) ABRAHAM, Theorie der Elektrizität II, p. 261, 1908.

magnetic rotation in the manner indicated by SIERTSEMA[1]), the question arises as to whether ultraviolet measurements would not enable one to ascertain if this value of c/m is actually constanf, and thus justify such a simple assumption for the case of hydrogen. As the ultra-violet magnetic rotation has hitherto been investigated only for solids and liquids[2]), I was glad to accept the invitation extended to me by Prof. KAMERLINGH ONNES to endeavour to extend SIERTSEMA's[3]) measurements to the ultraviolet region of the spectrum with the same apparatus as the latter had used.

2. In order to obtain good results from the use of this apparatus absorption of the ultraviolet rays had to be prevented, hence quartz was chosen instead of glass as the material for the covers, lenses and prism, while the canadabalsam-nicols were replaced by GLAN's air layer nicols.

For preliminary experiments I used a fluorescent eyepiece filled with aesculin solution, but this was found unsuitable on account of the small intensity of the light. When I had a spectrograph at my disposal I was able to photograph the dark rotationband which occurs in the BROCH-WIEDEMANN method and which SIERTSEMA had used for purposes of adjustment, but in the ultraviolet the band was too broad and the spectrum was too feeble to allow the centre to be determined to the desired degree of accuracy. I decided there-fore to follow LANDAU and use a half-shadow method.

In this method a half-shadow analyser divides the field into two halves, whose planes of polarisation make a small angle of $2\delta^\circ$ with each other; if now a rotating substance is placed in the path of the rays between the nicols, and the rays from the analyser are received in a spectroscope, two spectra are formed, one above the other, in which the dark rotationband does not occupy the same position. If the angle of rotation for the position of the band in the one spectrum is a°, then in the other spectrum the band is at a place where the rotation is $(a + 2\delta)^\circ$. At a point at which the rotation is $(a + \delta)^\circ$, there is, for a special wavelength, the same intensity in the two spectra. On rotating the polariser the position

[1]) SIERTSEMA, These Proc. Vol. V, p. 413.

[2]) VAN SCHAIK, Proefschrift Utrecht 1882. JOUBIN, Ann. Chim. Phys. S. 6, T. 6, p. 78. 1889. BOREL, Arch. des Sc. Phys. et Nat. Genève, 16, p. 24, 1903. LANDAU Phys. Ztschr. 9, p. 417, 1908. DARMOIS, Ann. Chim. Phys. S. 6, T. 22, p. 247, 495, 1911.

[3]) SIERTSEMA, Versl. K. Ak. v. Wet, 24 Juni 1893, p. 31; 26 Jan. 1895, p. 230; 28 Maart 1896, p. 294; 24 December 1898, p. 280; 27 Mei 1899, p. 4.

of equal intensity of illumination is displaced along the spectrum. When using a discontinuous spectrum (iron arc, or HERAEUS quartz mercury arc) equal intensity has to be obtained between the halves for a definite line of the spectrum. From a series of photographs for different positions of the polariser LANDAU obtained that particular position in which there was equal illumination for a special wave length; the current was then reversed and the series of photographs repeated. Such a method of operating is tedious, but it has the great advantage of giving the required angle of rotation direct from the photographs without the measurements, which are required for determining wavelengths in a continuous spectrum.

3. In order to adapt LANDAU's method to the investigation of gases, the following modifications of SIERTSEMA's apparatus had to be made:

a. The polarising nicol had to be replaced by a half-shadow nicol, to which the slit was attached. When the half shadow was used as analyser, the great length (about 230 cm) of the high pressure tube brought the slit too far from the source, and the light was then too feeble.

b. Equal intensities had to be obtained by varying the current, as the half-shadow nicol attached to the rotating end of the experimental tube had to be maintained in a fixed position.

It was now possible, by slightly varying the current for successive photographs, to determine accurately, for different lines of the spectrum, the particular current, at which equal intensities were obtained. These currents are inversely proportional to the rotatory constants, and the constants can be expressed in terms of a standard line as unit.

A preliminary investigation was made to see if it was not possible to arrange the nicols outside the experimental tube. As the quartz covers were ordered of equal but opposite rotations, the measurements would have been simplified by attaching the analyser with a divided circle to the spectroscope, for I should then have been able to read the rotations directly. With the quartz plates placed between the nicols, however, perfect extinction could not be obtained, so that for the determination of VERDET's constant in absolute measure I was obliged to have recourse to a comparison with water, for which the constants have been determined by SIERTSEMA[1]) and LANDAU. It was of advantage then that there was nothing but gas between the nicols, thus eliminating the influence of repeated reflections and of the magnetic rotation in the quartz plates.

4. A diagram of the apparatus is given in Fig. 1.

L is a HERAEUS quartz mercury lamp, *A* a collimator, *C* and *D* the coils, *FF*

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[1]) SIERTSEMA. Arch. Néerl. (2) 6. p. 825. 1901.

the high pressure tube, B the small rotating endpiece, containing the half-shadow nicol and slit, E the large fixed endpiece, containing the analyser, G a screw with a wheel, by which with the steel wire H and the weight I the endpiece B may be rotated, PQ the spectrograph.

In series with the coils are:

The main switch A_1, two dial resistances W_I and W_{II} indicating to 0·01 ohm coupled in parallel, a manganin resistance across which is shunted a resistance box
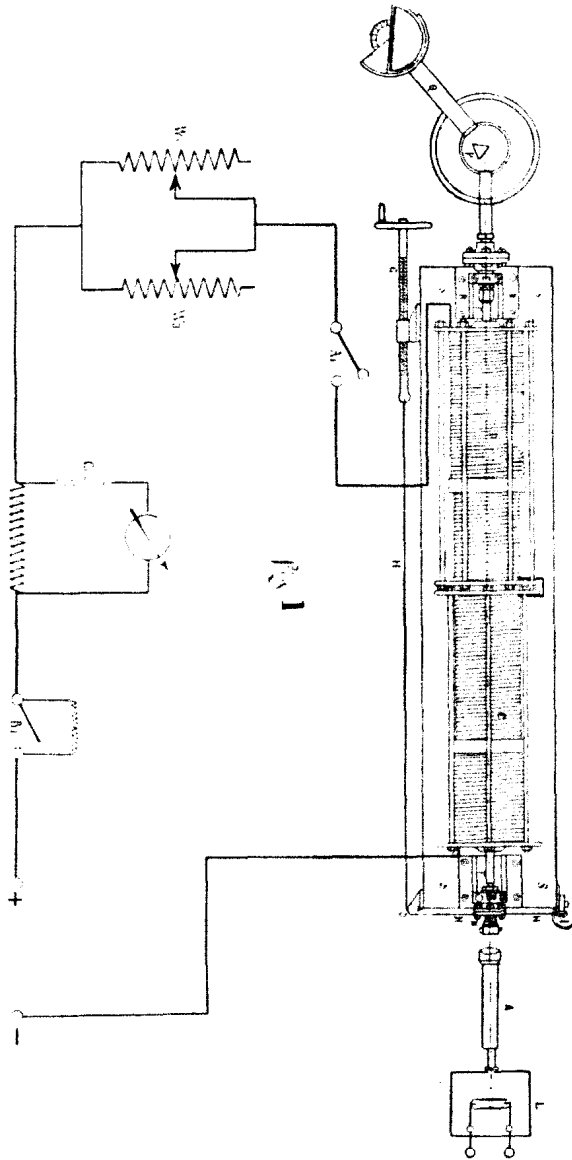

Fig. 1.

in series with a moving coil galvanometer (clock model) by HARTMANN and BRAUN, an auxiliary switch B_I in parallel with a sliding resistance, through which the current is switched before being broken so as to diminish the intensity of the spark.

In the measurements the current varied from 10 to 40 amp. and was obtained from three 60 volt batteries of accumulators, coupled in parallel.

For the absolute determination of VERDET's constant the current was measured with an ammeter having three ranges (0—2, 0—20, 0—50 amp). This ammeter was calibrated on the potentiometer, and, moreover, when taking the photographs, the variation of the current was so chosen that the pointer of the instrument coincided with the graduations as during the calibration, so that the current is known with certainty to one-tenth of an amp. (one scale division = 0,5 amp.)

The pressure was measured on a SCHÄFFER and BUDENBERG metal manometer with a circular scale of 16 cm diameter, reading up to 150 kg/cm² by steps of $\frac{1}{4}$ kg/cm². The greatest difference between two independent calibrations did not exceed 0,1 kg/cm². We assumed therefore that the pressure is accurate to 0,1 kg/cm².

The manometer was coupled directly to the experimental tube, and, along with it, could be shut off from the rest of the apparatus by means of a tap. The rest of the apparatus consisted of a gascylinder and an airpump (a GAEDE vacuum kapsel-pump);
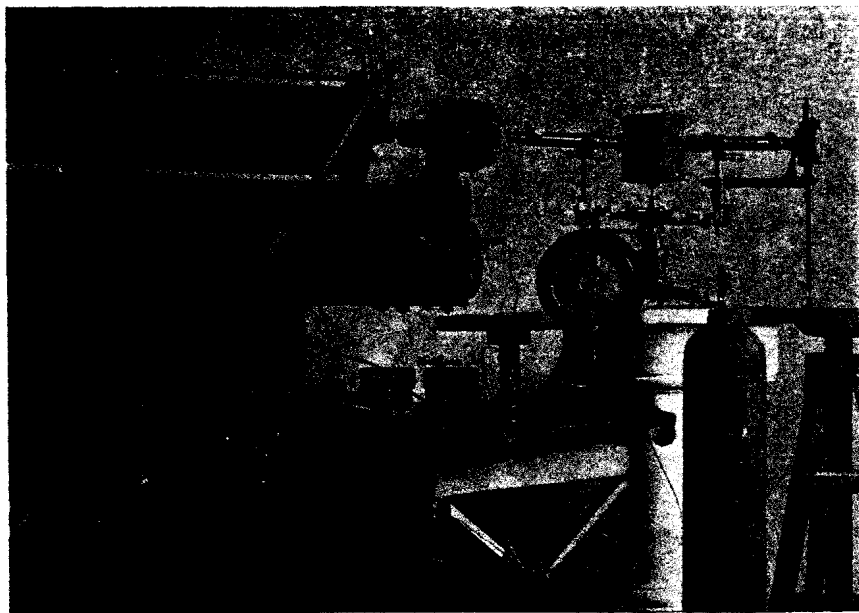

Fig. 2.

there was also an exit tap for the gas in the experimental tube, as it would not have been good for the nicols to expose them to the high pressure for days on end.

To guard against any displacement of the coils, the high pressure taps which were mounted before on the base of the coils, were now placed on a separate table. The temperature of the gas was regulated by that of a water jacket between the coils and the experimental tube. (These details are easily distinguishable in the accompanying photograph of the work room).

5. The following remarks may be made concerning the optical part of the investigation :

The collimator placed in front of the mercurylamp contained a single laevorotatory quartz lens, of 36 cm. focal length for the yellow mercurylight, and 3,6 cm. diameter. The breadth of the slit was 1 mm, and its length was reduced by means of a brass plate to 2 mm. so as to prevent troublesome reflection from the inner wall of the experimental tube. A circular opening of 1 mm. diameter was substituted later for this slit.

The quartz covers were 11 mm. thick, and their diameters were 26 and 22 mm. respectively.

The half-shadow (aperture 12 mm. by 12 mm.) with air separation, according to GLAN, had a half-shadow angle of about 2°. It was fixed in a brass mount, and this fitted closely into a brass cover, whose ribbed sides were soldered in a cylindrical tube. The gas had free access to the nicols through the openings, thus removing any possibility of displacement. To enable one to set the separating line of the half-shadow horizontal, the cylindrical tube was arranged so as to rotate in a ring attached to the endpiece. A tube, with a slit 11 mm. long and $^1/_2$ mm. wide, perpendicular to the separating line, was attached to the half-shadow half of the nicol.

A GLAN-nicol, aperture 20 mm. by 20 mm. was used as an analyser; it was mounted in the same way so as to rotate in the larger endpiece of the experimental tube. The mount was provided with a circular scale of 180 subdivisions which was used in setting the nicols at a special angle to each other. For the absolute measurements the construction of the nicols was somewhat modified as the water entered the airspace, and the nicols no longer polarised. A brass window ($^1/_2$ mm. thick) was cemented between the halves of each nicol, and in this way the space between the nicols was protected on all sides by a layer of cement from ingression of gas or liquid.

As spectrograph was used a Société Genèvoise spectrometer with a CORNU quartz prism. The telescope tube contained a single quartz lens, of 36 cm. focal length for yellow mercurylight, and of 3.6 cm. diameter. The eye-piece was replaced by a camera, which was constructed in the workshop of the Delft laboratory by the master instrumentmaker Mr. P. VAN DEN AKKER; the accompanying diagram shows the arrangement drawn to a scale of one half :

B is a horizontal arm attached to the telescope stand ; C is a fixed semi-cylindrical brass drum, and D a similar semi-cylinder rotating about an axis coincident with the vertical central line of the photographic plate, by means of which it is possible to set the plate at an angle (usually 50`) to the axis of the camera

tube; E is the sliding holder for the dark slide (5,2 by 8,4 cm) and can be raised by means of a vertical screw (not shown) of 1 mm. pitch. The drums were slitted in such a way that only a strip of the sensitive plate 30 mm. long and
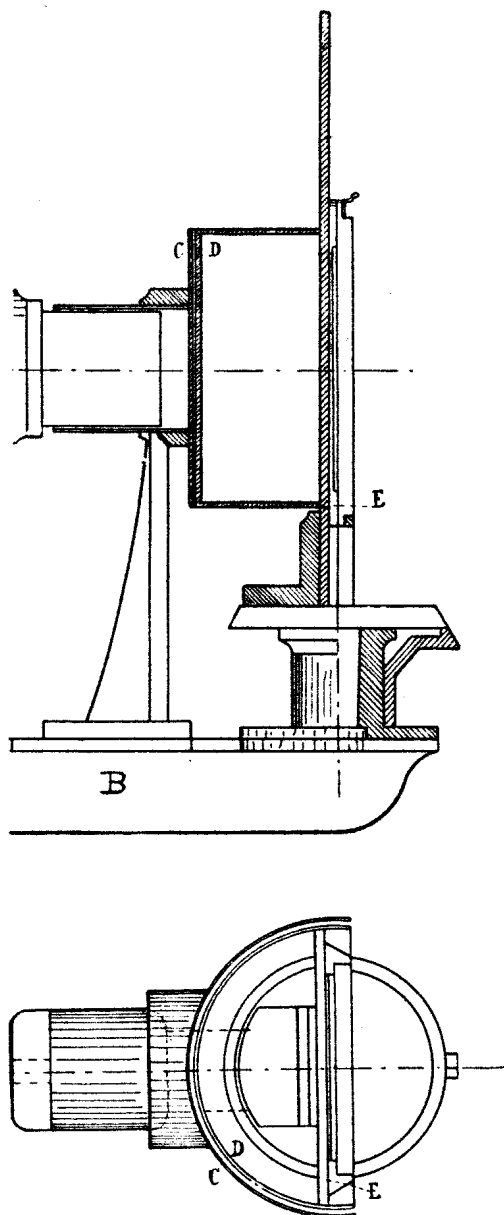

Fig. 3.

3 mm. broad was illuminated at each exposure. The double spectrum formed was about 15 mm. broad and was 25 mm. long for the range 4358 $A.U.$ to 2805 $A.U.$ Nineteen photographs could be taken one below the other on a plate 4.5 cm. by 6 cm. (Lumière Agfa-plates specially sensitive to extreme ultraviolet). The exposures

ranged from 1 to 18 minutes. Parts of the mercury-spectrum were photographed, and the cameratube was usually so adjusted by means of the divided circle of the spectrometer that the mercuryline to be photographed appeared in the middle of the plate. Immediately after the development of the plates it was examined in which photo the intensities of the halves were equal for a special line. This could be properly observed only when the illumination of the half-shadow slit was uniform, and for this reason the mercurylamp had to be kept burning in a vertical position.

On account of absorption photographs were taken

for oxygen up to and including 2654 A.U.
„ hydrogen „ „ „ „ 2378 „
„ carbon-dioxide „ „ „ „ 2482 „

For ultraviolet absorption by oxygen I find it stated[1]) that LIVEING and DEWAR found absorption from 2745 A.U. upwards in a tube 165 cm. long at a pressure of 85 atm. and from 3360 A.U. upwards in a tube 18 m. long at a pressure of 80 atm. In my experiments the oxygencolumn of 230 cm. at a pressure of 80 kg/cm² just let the line 2805 A.U. through and no more, while for a pressure of 40 kg cm² the limit of absorption was 2654 A.U.

6. Measurements of the rotatory dispersion were commenced with :

Oxygen.

Before the experimental tube was filled and closed, the nicols were set at an angle previously calculated. The cameratube was then replaced by a telescope in order to ascertain what current strength gave equal intensities of the halves of the green or the violet mercury line. By a slight torsion of the experimental tube equal intensity was usually obtained for the blue-violet line 4358, with a current of about 35 amp, a gas pressure of 85 kg/cm² and an angle of 92° between the nicols. The necessary current strengths for the ultra-violet lines could then be calculated roughly by extrapolation from the dispersionformulae given by SIERTSEMA. If I is the value of the current thus calculated, photographs were usually taken with currents of from $(I - 2)$ and to $(I + 2)$ amp. and a series of careful exposures were then made at intervals of $^1/_{40}$ or $^1/_{50}$ I amp. between the values of I given by the first photographs. A current of 1 amp. gave a galvanometerdeflection of 1 cm. so that with the currents used a change of 3 to 8 mm. in the galvanometerdeflection could just be distinguished on the negative by an appreciable difference in darkness.

As the original negatives were too weak for reproduction, I prefer to give a drawing of a series of 7 photographs of a portion of the mercuryspectrum (4047—2755 A.U.) with hydrogen at 19°,5 and

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[1]) KAYSER, Handbuch. Band III. p. 357.

76 atm.[1]). Equal intensities for the line 3130 (in the centre of the plate) occur between the 4th and 5th exposure from above. The variation of the current was $1/2$ amp.

$\mathcal{J} = 18.7\,amp$
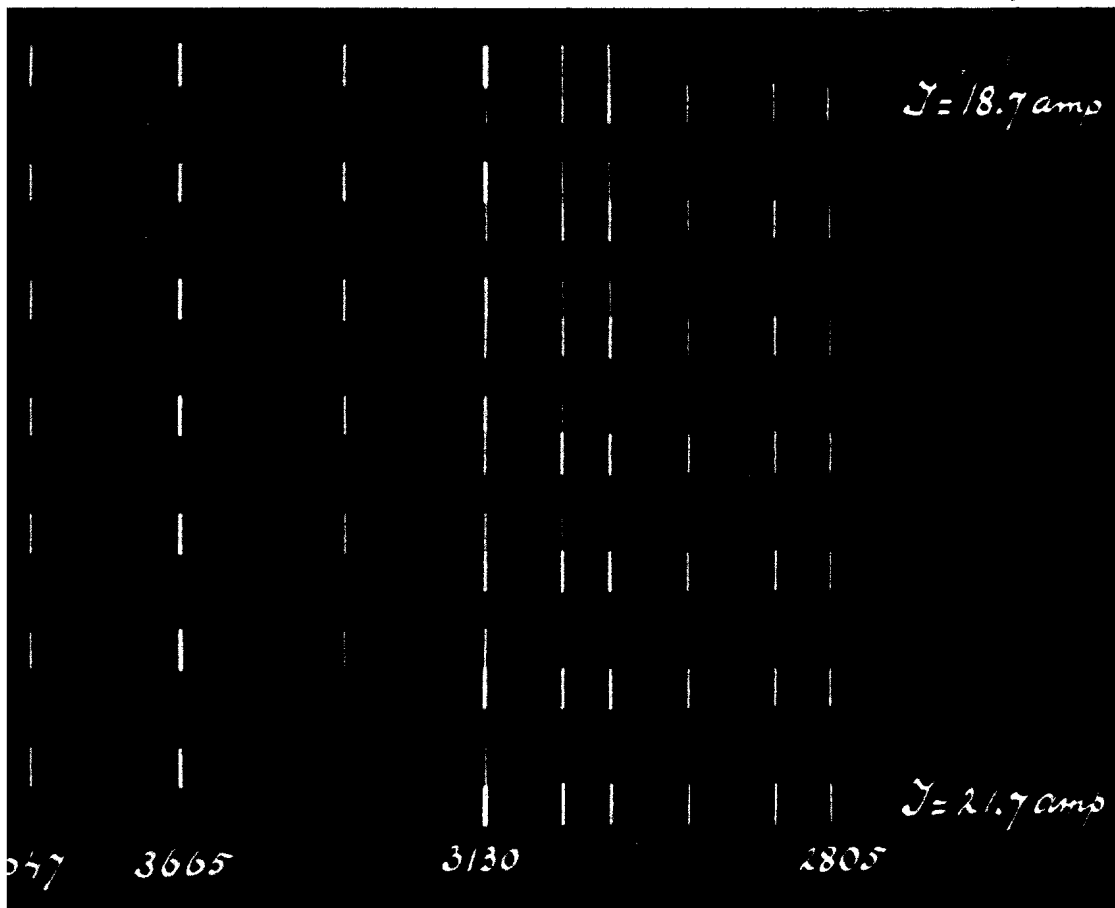
$\mathcal{J} = 21.7\,amp$

3665 3130 2805

Fig. 4.

As the ammeterreadings, or the galvanometerdeflections corrected to angular deflections, are, for constant gasdensity, inversely proportional to the required VERDET's constants, the relative rotatory constants can be calculated from such photographs; in this the constant for the violet line 4358 A.U. is usually chosen as unity. The relative rotation is then obtained from:

$$\varrho = \frac{R_\lambda}{R_0} = \frac{I_0}{I_\lambda} = \frac{\alpha_0}{\alpha_\lambda}$$

[1]) The line 2805 is the second from the right, not the first as is erroneously shown in the figure. Horizontal distances are magnified four times, and vertical distances about seven times. Differences in intensity are indicated by differences in breadth.

in which R_0 is VERDET's constant, I_0 is the current in amp, a_0 is the corrected galvanometerdeflection for the wavelength 4358 A.U., and R_λ, I_λ and a_λ relate to the other mercurylines. As, owing to small leaks and to temperature fluctuations, the readings of the manometer did not remain perfectly stationary, the dispersion was calculated from

$$\varrho = \frac{R_\lambda}{R_0} = \frac{a_0 d_0}{a_\lambda d_\lambda} = \frac{a_0 p_0\,(1+\beta t_\lambda)}{a_\lambda p_\lambda\,(1+\beta t_0)} = \frac{a_0\,p_0}{a_\lambda\,P_\lambda},$$

in which d_0 is the density, p_0 the pressure and t_0 the temperature of the gas during the measurement with the line 4358, the subscript λ denotes the other wavelengths, β is the pressurecoefficient (taken from AMAGAT's observations), and F_λ is equal to $p_\lambda\,\{1 + \beta\,(t_0 - t_\lambda)\}$.

Since P_λ does not differ much from p_0, deviations from BOYLE's law need not be taken into account. For the reduction of the observations at the lower pressure from 2805 to 2654 A.U. the rotation for the line 2805 was first taken to be unity, and the relative dispersion was then obtained by multiplication by $\frac{R_{2805}}{R_0}$.

The oxygen used was supplied by the "Oxygenium" Company, Schiedam. It was analysed in a HEMPEL absorptionbulb filled with copper gauze, moistened with a solution of ammonia and ammonium carbonate. For the gas with which the most reliable results were obtained, 97 °/₀ of oxygen was found.

The following table is from the photographs, obtained on the 21st to the 25th of May :

T A B L E I.

λ in A.U.	pressure in atm.	temp. in °C.	galv. deflect. mm.	f
4358	83.8	17.4	335.9	1.00
4047	83.8	17·2	304.9	1.10
3665	83.2⁵	17.5	258.2	1.31
3130	84.9	16.9	184.2	1.79 '
2805	82.5	17.4	152.3	2.24
2805	40.9	16.7	314.1	—
2755	41.3	17.1	301.9	2.31
2654	41.0⁵	16.5	280.1	2.50

The pressurecoefficient was taken to be 0.0046 for an initial pressure of 84 atm. and 0.0042 for a pressure of 41 atm. These values were obtained by extrapolation from AMAGAT's observations [1]).

Hydrogen.

7. The first series of measurements were made with double purified hydrogen, supplied by the "Oxygenium" Company ; analysis in a HEMPEL explosionbulb showed no impurity. With a view to absolute determinations measurements were subsequently made with a cylinder of very pure hydrogen which had been prepared in the Leiden laboratory by freezing out the impurities at low temperature.

Measurements dated 24 h to 29 h of May with the first gas gave the following results:

TABLE II.

λ in A.U.	pressure in atm.	temp. in ° C.	galv. deflect. mm.	R_λ/R_{4047}
4047	54.1	15.8	373.8	1.00
3665	56.8	15.2	288.1	1.235
3130	57.1	14.9	197.1	1.79
2805	52.8	15.7	159.6	2.40
2654	57.8	15.9	126.9	2.755
2535	56.1	16.5	115.2	3.14
2482	56.4	16.4	107.0	3.355

The nicols were set beforehand at an angle of 92°. The exposures varied from 1.5 to 10 minutes. The pressurecoefficient was taken to be 0.0037 and no correction was applied for deviations from BOYLE's law.

A higher pressure was obtainable with the Leiden hydrogen, and the nicols were accordingly set at an angle of 92°.5 for that series of measurements. Currents were measured with the ammeter already described. (range 0 to 50 amp, 1 scale division = 0,5 amp).

The exposure for the last two ultraviolet lines 2399 and 2378 A.U. was 18 mts, the current was kept constant at 10 amp. for an hour. On account of the heating of the coils not more than three exposures could be made in any one series. The following are the results of these measurements :

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[1]) WüLLNER. Experimentalphysik. 5te Aufl. Band II. Tab. p. 138.

TABLE III.

λ in A.U.	pressure in atm.	temp. in °C.	amp.	ρ
4358	93.8⁵	18.6	35.74	1.00
4047	93.9	18.3	30.18	1.18
3665	90.0	18.7	25.65	1.45⁵
3130	88.1	17.9	17.70	2.14⁵
3130	76.0	19.5	20.45	—
2805	75.2	19.8	15.69	2.83
2654	75.5	19.7	13.44	3.29
2535	74.9	20.9	12.19	3.67
2482	75.0	20.5	11.44	3.90⁵
2399	74.7	19.3	10.44	4.27
2378	74.8	19.3	10.19	4.37

By calculating values of R_λ/R_{4047} from these measurements we can compare the results obtained with the Leiden and with the Oxygenium hydrogen:

TABLE IV.

λ in A.U.	R_λ/R_{4047} Leiden	R_λ/R_{4047} Oxygenium
4047	1.00	1.00
3665	1.23	1.23⁵
3130	1.81⁵	1.79
2805	2.39	2.40
2654	2.78	2.75⁵
2535	3.10⁵	3.14
2482	3.30	3.35⁵

As the photographs for the last ultraviolet lines were much sharper for the Leiden hydrogen, I have used the values obtained with it for the construction of the dispersion curves.

Carbon-dioxide.

8. For this the rotatory constants are greater than for the other gases. The measurements were made at a pressure of 27 atm. as at higher pressures small temperaturefluctuations gave rise to currents in the gas, which rendered the image of the slit indistinct.

Commercial carbon-dioxide was used after purification by distillation; analysis in an absorptionbulb, filled with iron gauze and potassium-hydroxide, showed 96°/₀ CO_2.

The results of the experiments are here given:

TABLE V.

λ in A.U.	pressure in atm.	temp. in ° C.	galv. deflect. mm.	R_λ/R_{4047}
4047	25.3⁵	16.1	336.1	1.00
3665	27.3	17.5	277.9	1.22⁵
3130	27.3	17.5	189.9	1.79
2805	27.2	17.2	149.8	2.27⁵
2654	27.2	16.5	129.6	2.61⁵
2535	27.3	16.2	114.6	2.95

Exposures ranged from 1.5 to 10 mts. An additional series of photographs of the green and the blue-violet mercurylines was also made upon Agfa-chromatic plates in order to afford a comparison with SIERTSEMA's results. The correspondence was found to be very good:

TABLE VI.

λ in A.U.	R_λ/R_{5461}	R_λ/R_{5461} (after SIERTSEMA)
5461	1.00	1.00
4358	1.60⁵	1.60
4047	1.87	1.87

Determination of the absolute rotatory constants.

9. It has been mentioned already that the arrangement of the apparatus for the half-shadow method does not allow of a direct measurement of the angle of rotation, so that a calibration with water is necessary for an absolute determination of the rotatory constants. If the rotatory constant for the wave-length λ at a definite pressure and temperature is R_H for hydrogen and R_W for distilled water and if the currents used for the two photographs were I_H and I_W amp. respectively, then

$$R_H = \frac{I_W}{I_H} R_W.$$

In this formula the currents must be known with the same relative accuracy. As the rotation by water for the mercuryline 4358 A.U. is about 25,3 times greater than for hydrogen(100 kg/cm² 17.°5), the ammeter ranges used were 0 to 2 and 0 to 50 amp. After filling the experimental tube with water I found, contrary to expectation, that the 230 cm. column transmitted the ultraviolet only up to the wavelength 3665 A.U., while LANDAU with a waterlayer of 1 cm. was still able to obtain photographs of the iron line 2496 A.U. I finally used only the line 4358 for these measurements. The exposures were two minutes for hydrogen and five for water. On account of the repeated fillings of the experimental tube the pressure obtainable from the Leiden cylinder of hydrogen sank to 75 kg/cm², so that the currents used for the gas were about 34 times those required for the water photographs.

In this way I obtained for

$$\text{Hydrogen } (73.9 \text{ atm. } 16°.9.) \quad I_H = 37.72 \text{ amp.}$$
$$\text{Distilled water} \qquad\qquad I_W = 1.145 \text{ amp.}$$

According to SIERTSEMA $R_W = 0.02495'$ for $\lambda = 4358$. From my measurements we may calculate $I_H = 32.88$ amp. for a pressure of 85 kg and a temperature of 9°.5, whence it follows, that $R_H(85$
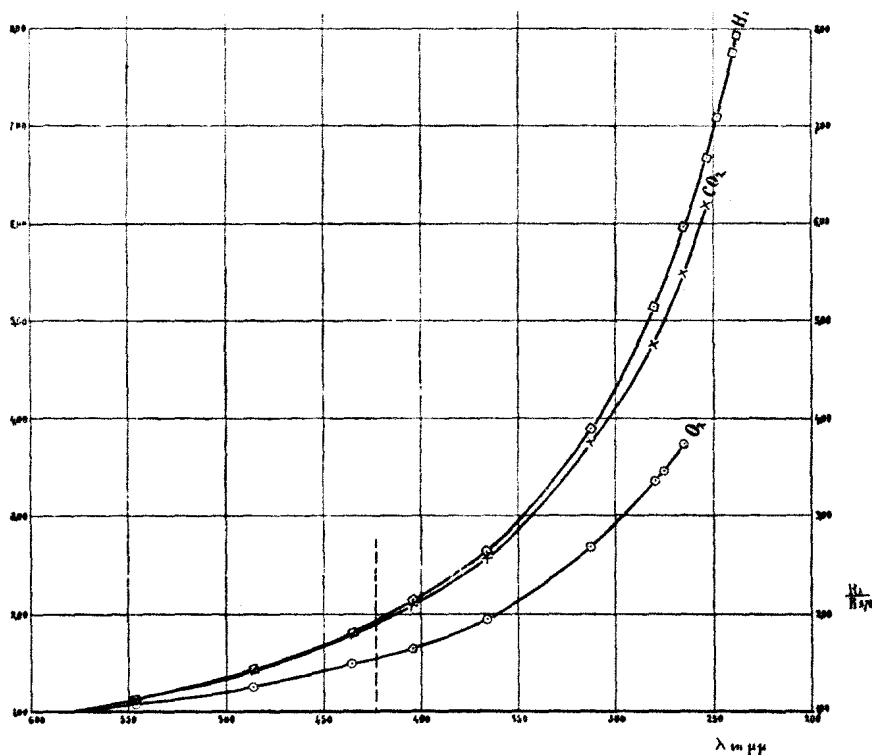

Fig. 5.

kg/cm² 9°.5) = (869 × 10⁻⁶)'. This agrees well with the value given by Siertsema: (863 × 10⁻⁶)'.

kg/cm² $9°.5) = (869 \times 10^{-6})'$. This agrees well with the value given by Siertsema: $(863 \times 10^{-6})'$.

10. This led me to unite my results for the three gases with Siertsema's, and to plot the dispersioncurve for each for the visible and ultraviolet regions. The rotatory constant for the yellow mercuryline (mean wavelength 5780 A.U.) was taken to be unity; along the axis of abscissae are plotted wavelengths in $\mu\mu$, and along the axis of ordinates the following relative rotations:

T A B L E VII.

λ in $\mu\mu$	R_λ/R_{578}		
	Oxygen	Carbon dioxide	Hydrogen
578	1.00	1.00	1.00
546	1.08	1.12⁵	1.12⁵
486	1.26⁵	1.43⁵	1.44
436	1.50	1.80⁵	1.81⁵
404.5	1.65⁵	2.10	2.15
366.5	1.96⁵	2.57	2.64
313	2.69⁵	3.76	3.90
289.5	3.36⁵	4.77⁵	5.14
265.5	3.75⁵	5.49	5.97⁵
253.5		6.19⁵	6.67
248			7.09
240			7.76
238			7.94

The dotted line at 423 $\mu\mu$ gives the limit of Siertsema's observations.

It is to be remarked that the oxygen-curve deviates considerably from those for the other gases, but that there is no sudden change as the ultraviolet absorptionregion is approached, and that the difference between hydrogen and carbon-dioxide begins to be good appreciable in the ultraviolet region.

On the assumption that ultraviolet refraction in hydrogen satisfies a formula of the type

51

$$n^2 = A + \frac{B}{\lambda^2 - \lambda^2_m}$$

in which λ_m, the wavelength of the ultraviolet free vibration, is taken to be $0,087 \mu$ [1]), the following values have been calculated for e/m:

λ in $\mu\mu$	$e/m \times 10^{-7}$ for H_2 (85 kg $9°.5$)
589	1.77
405	1.78
313	1.81
265	1.85⁵
248	1.86
238	1.87⁵

The increase here found for e/m does not accord with the assumption of a single ultraviolet free vibration.

I must, in conclusion, offer my warmest thanks to Prof. Dr. H KAMERLINGH ONNES for inviting me to undertake this investigation and for placing the necessary high-pressure apparatus at my disposa, and also to Prof. Dr. L. H. SIERTSEMA for granting such excellent facilities for the work and for the unflagging interest with which he has followed the investigation.

Delft, October 1912.   *Physical Laboratory of the Technical University.*

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[1]) SIERTSEMA and DE HAAS. These Proc. Vol. XIV. p. 603.

(December 30, 1912).