Dr. P. ZEEMAN. *Measurement of the refractive index of incandescent platinum.*

1. It is of much importance for the general theory of radiation of glowing bodies to know what rays may emanate from the interior of a body. If, at ordinary temperatures, the angle of incidence does not exceed a definite (relatively high) limit, they will by total reflexion not be prevented from emanating, because the refractive index is relatively low. Supposing, that with increasing temperatures the refractive index increases in a high degree, then at last only those rays can emanate which are nearly normal to the radiating surface.

KOLAČEK [1]) by extrapolation, came to this conclusion from the experiments of KUNDT [2]) on the variation of the refractive indices of metal prisms with a temperature difference of about 90°.

On the other hand the observations of SISSINGH [3]),

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[1]) KOLAČEK. *Wied. Ann.* Bd. 39. p. 236. 1890.

[2]) KUNDT. *Wied. Ann.* Bd. 36. p. 824. 1889.

[3]) SISSINGH. *Dissertatie* p. 133, Leiden 1885. *Communications* etc. Nr. 1.

who found it impossible to measure a variation of the optical constants of iron, when the temperature varied from 15° to 120° and those of DRUDE [1]), who found only very minute variations, when experimenting with platinum in cold and in warm water and with silver and gold up to 200°, lead to a different conclusion. I have extended the investigation to the temperature of glowing platinum (about 800°), endeavouring to measure the variation of the optical constants by means of BABINET's compensator.

2. It would result from the figures given by KUNDT that with an increase of temperature of 100° the refractive index n of platinum increases 27 %. Hence it follows that, the principal azimuth H remaining the same (7), the principal incidence II must increase about 2.5° for every 100° the temperature increases. With the apparatus used it was impossible to observe at an angle of incidence greater than 65°. At this angle, a diminution of 9° in the difference of phase Φ of the reflected rays, polarized resp. in and perpendicular to the plane of incidence corresponds to an increase of 2.5° in II. And this again corresponds to 36 divisions of the head of the screw of the compensator (the head being divided into 50 parts). Hence according to KUNDT's observations for every 100° degrees increase of temperature, a displacement of this order should be expected. At 800° n would be about 3 times as great as at an ordinary temperature and about 5.5

[1]) DRUDE. *Wied. Ann.* Bd 39. p. 481. 1890.

revolutions of the screw would be required for the compensation. On the other hand: if I remained constant, H would decrease 3.5° for every 100 degrees rise of temperature. The principal azimuth at 65° then rises 2,5°.

Now it is possible, to measure a difference of phase, corresponding to 4 divisions of the screwhead, and a variation, of the reestablished azimuth of 0.3° [1]) with the apparatus used, if only the mirror be sufficiently smooth.

3. It will be clear by the following how the experiment was made. The *mirror* of platinum was the middle part of a strip of flattened platinum, about 50 mm. in length, 5 mm. in breadth, and 1 mm. thickness treated with different kinds of amaril-paper, up to Nr 0000. In this manner a tolerably good mirror was obtained and though the image of the slit of the collimator left something to be desired, the central black band in the compensator of BABINET, (homogeneous light being used), was of sufficient definiteness. The strip was heated by the electric current so that the reflecting part obtained the highest temperature.

4. *Adjustment of the mirror.* On a wooden board two brass stiles are fastened. In the upper part of one of the stiles the end of the strip of platinum (3) is clamped.

To the other end of the strip has been clamped a piece, the cylindrical continuation of which passes

[1]) SISSINGH. *Dissertatie* pag. 70 and subs.

through an aperture in the other stile. A spiral spring surrounding this lengthening-piece, presses the end of it outwards and keeps the strip stretched at the high temperatures. The mirror then retains its position as is verified by observing the reflected image through the telescope. The wooden board is fastened above the spectrometer on an adjustable platform. In order to obviate the difficulties in adjusting the mirror which might be caused by the stiffness of the leads for the current, the latter are immersed into mercury cups with which are also connected the wires fastened to the two above mentioned stiles.

5. As to the *method of observation*, the disposition of the instruments, the means employed for getting homogeneous light etc., used in the determination of the optical constants, I refer to former publications [1]).

6. The optical observations being finished, I determined the *temperature of the mirror* by measuring the intensity of the current necessary for melting little crystals of different salts, placed on the mirror. The melting points I took from LANDOLT's and BÖRNSTEIN's »Tabelle". It appeared that for a current of 80 Ampères the temperature was 800°. Then the central part of the strip was becoming red hot, but the emanating light did not yet interfere with the definiteness of the band in the compensator.

7. *Result.* It appeared that at this temperature and using red, yellow or blue light there was no ascertainable

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[1]) SISSINGH. *Archiv. Néerl.* T. XX p. 1. 1886.
ZEEMAN. *Archiv. Néerl.* T. XXVII p. 252. 1893.

change in *position* or *darkness* of the band in the compensator. Yet with the same mirror a rotation of the screwhead for 6 divisions and of the analyser for less than 1°, gave a perceptible change. Hence the influence of temperature is below these values. From this it follows that also by increasing the temperature to 800° the refractive index does not undergo a variation, comparable to that, which has been derived (2) from KUNDT's experiments on the behaviour of metal prisms in transmitted light (the temperature variation being only 90°). The precision of my observations is less than that of the observations mentioned in (2), but this only in a small degree can change our conclusion. I do not think, that it would now be of any use to investigate more closely the precise limits of the errors of measurement in this experiment resp. those in which I demonstrated the invariability of n. I intend to determine the value of the variation by making observations at the principal incidence and with a smoother mirror.

The investigation may also be extended to still higher temperatures by separating with the aid of a spectroscope behind the compensator the light emanated by the platinum from the homogeneous reflected light. However, with a view to the theories mentioned in (1) I think I may communicate already now the result concerning the insignificant change of I and H, or what comes to the same thing, of the coefficient of absorption ρ, and n. It is not to be doubted that at very high temperatures ρ as well as n must change: 1°. because according to the second low of thermodynamics a body [1]) absorbs those rays which it emits itself, 2°. because the distance of the molecules if there is a sufficient rise of temperature can undergo a sensible, and, if the body becomes liquid even a considerable change.

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1) Kolaček, l. c. p. 248.

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COMMUNICATIONS

FROM THE

PHYSICAL LABORATORY

AT THE

UNIVERSITY OF LEIDEN

BY

PROF. DR. H. KAMERLINGH ONNES.

No. 21.

Prof. Dr. E. COHN and **Dr. P. ZEEMAN.** Observations concerning the propagation of electrical waves in water [1])

(*Translated from: Verslagen van de Afdeeling Natuurkunde der Kon. Akad. van Wetenschappen te Amsterdam*, **28 September 1895**, *p.* 108—116).

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1) The greater part of the measurements were made at the laboratory of physics of Strassburg.

Eduard IJdo — Printer — Leiden.