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Physics. — "*On the passage of light through the slit of a spectroscope.*" By Prof. P. ZEEMAN.

(Communicated in the meeting of June 26 1915).

Though the full resolving power of a spectroscope can be reached with an infinitely narrow slit only, we can get a near approach to it with a very narrow slit already.

This is evident, when with SCHUSTER [1]) we introduce the so-called "normal" width of the slit d defined by the relation $d = \frac{f\lambda}{4D}$, where f is the focal distance of the collimator objective with the diameter D and λ the wavelength of the incident light. For an exceedingly narrow slit the "purity" [2]) of the spectrum becomes equal to the resolving power. For normal width the purity is only 1,4 % below its maximum value. With a slit of twice the normal width we get about the double quantity of light, while the purity deviates 5,7 % only from the maximum value. More than four times the normal width of the slit must never be taken, for then the purity of the spectrum decreases rapidly, while even for an infinitely wide slit the intensity of the light never exceeds four times the value obtainable with normal width.

Resuming, we may conclude that for sufficiently intense sources of light a width of slit in the neighbourhood of $\frac{f\lambda}{4D}$ is the best. A narrower slit causes loss of light without gain in resolving power and a wider one already soon decreases the resolving power considerably. As example I choose a collimator with a lens, for which $D = 15$ cm., $f = 325$ cm., while λ may be 5×10^{-5} cm. Then we have $d = \frac{f\lambda}{4D} = 0{,}0027$ mm.

Some time ago [3]) I pointed out, that by very narrow slits the observation of the *polarized* components of magnetically resolved lines may be rendered very difficult. When gradually the slit was made narrower, the (electric) vibrations that are perpendicular to the length of the slit, are hardly transmitted at last.

It seems interesting to communicate some measurements concern-

[1]) A SCHUSTER The optics of the spectroscope Astrophys. Journ. **21**, 197. 1905.

[2]) SCHUSTER. l.c. See also e g ZEEMAN. Researches in magneto optics. p 7. London, Macmillan, 1913.

[3]) "On the polarisation impressed upon light by traversing the slit of a spectroscope and some errors resulting therefrom." These Proceedings p. 599. October 1912.

ing the width of slit necessary for the appearance of the mentioned polarisation phenomena. Then we can get an idea in how far we must expect disturbances caused by the narrowness of the slit.

With the arrangement shown in Fig. 1 the relative decrease in intensity of the horizontal vibrations may easily be measured.

Monochromatic green light falls upon a slit *S*, behind which a calcite rhomb *K* is placed at such a distance that two adjacent images of the slit are formed, one containing the vertical vibrations, the other the horizontal ones. By means of a nicol *N* the intensity of the two images may be made equal.

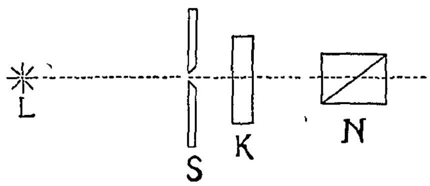

Fig. 1.

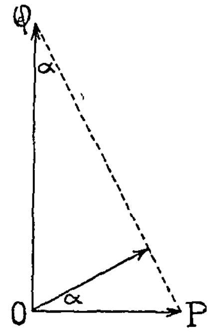

Fig. 2.

Let (fig. 2) OP and OQ be the directions of the vibrations in the two images. If the direction of vibration of the nicol is perpendicular to PQ, the condition for equal intensities of the two images will be tg. $\alpha = OP : OQ$. The ratio of the intensities of the horizontal and vertical vibrations is then given by tg.$^2\alpha$.

A first experiment was made with a slit (of platinoid) from a spectroscope with constant deviation of HILGER.

The results are contained in the following table:

green light

width of slit in m.m.	tang. α
0.010	1
0.004	0.5
0.002	0.3
0.001	0.2

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The value of the width of the slit for *tang.* $\alpha = 1$ is that for which the first extinction of the horizontal vibrations becomes perceptible.

A second series of observations has been made with a slit (also of platinoid) belonging to the collimator of an echelon spectroscope and for two different colours.

red light		*green light*	
width in m.m.	tang. α	width in m.m.	tang. α
0.0017	1	0.0015	1
0.0015	0.7	0.0013	0.6
0.0013	0.5	0.0010	0.5
0.0010	0.3	0.0007	0.3
0 0005	0	0.0004	0

Interesting is the difference in absolute width at which for the two slits the same phenomena occur. For, though the measurements may not claim great accuracy, yet the different behaviour in the two cases seems to be beyond doubt. Very probably the form of the edges of the slit is here of much importance. The variation with wavelength has the direction we should expect.

We also made some experiments with white light. When the slit is gradually narrowed the image formed by the horizontal vibrations becomes fainter and at the same time of bluish hue.

So we come to the result that with widths of slit often used with spectroscopes in laboratories, polarisation phenomena are already of some importance. The greater the ratio $\frac{f\lambda}{D}$ is taken, the less these appearances will be noticed. So with the 75 feet spectrograph of the Mount Wilson Solar observatory we surely shall not see anything of the mentioned polarisation phenomena.

Recently a problem connected with the passage of light through a narrow slit has been treated theoretically by RAYLEIGH in a paper: "On the Passage of waves through fine slits in thin opaque screens" [1]. But as is observed by RAYLEIGH: "It may be well to emphasize that the calculations of this paper relate to an aperture in an *infi-*

[1]) RAYLEIGH. Proc. R. S. London. Vol **89**. 194. 1914.

nitely thin perfectly conducting screen. We could scarcely be sure beforehand that the conditions are sufficiently satisfied even by a scratch upon a silver deposit. The case of an ordinary spectroscope slit is quite different. It seems that here the polarisation observed with the finest practicable slits corresponds to that from the less fine scratches on silver deposits".

With the last words RAYLEIGH refers to an observation by FIZEAU, who on scratching in a silver layer on glass perceived that the transmitted light was polarized perpendicularly to the direction of the scratch, if the width of the latter was $\frac{1}{1000}$ mm. If this width however was estimated at $\frac{1}{10000}$ mm. the polarisation was in the direction of the scratch, viz. the electric vibrations were chiefly perpendicular to it. With spectroscope slits the latter case does not occur.

It will be remembered that DU BOIS and RUBENS[1]) found with a wire grating a point of inversion for ultra-red light, just as FIZEAU observed with scratches.

Geology. — *"On the occurrence of nodules of manganese in mesozoic deep-sea deposits from Borneo, Timor, and Rotti, their significance and mode of formation"*. By Prof. G. A. F. MOLENGRAAFF.

(Communicated in the meeting of January 30, 1915).

The question whether deep-sea deposits, and more especially oceanic abysmal deposits, of earlier geological ages, take part in more or less appreciable degree in the formation of the existing continental masses, may be considered of prime importance for the solution of several geological problems. If answered in the affirmative, the conclusion at once follows that movements of the earth's crust must have taken place of an amplitude, sufficiently great, to bring deposits formed at a depth of 5000 metres or more, above the surface of the sea.

Some twenty years ago the opinion prevailed, that true abysmal deposits of former geological ages, had nowhere been proved, with certainty, to exist in the continental areas. It must be admitted that at that time, descriptions of occurrences of such abysmal deposits were scanty and far from convincing. This may have been partly caused by the fact, that fossil deep-sea deposits are not conspicuous

[1]) H. DU BOIS and H. RUBENS. Ber. Berl. Akademie 1129. 1892.