OPTICAL NOTES (I): ON A SPECTROSCOPIC APPLICATION OF TALBOT'S INTERFERENCE FRINGES

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A HAND spectroscope with direct vision is often added to some optical measuring instruments without scale, and to make measurements with it by using an artificial luminous source such as petroleum lamp or coal-gas flame, it is only requisite to mark out with a sufficient degree of accuracy points of definite wave-lengths in the continuous spectrum produced. This can be accomplished by the elegant method of Kirchhoff and Bunsen, or in a variety of other ways. One of these, depending on Talbot's interference fringes, will be here described. It requires quite simple apparatus, but is sufficiently good for certain kinds of investigation, especially for students' practice in a physical laboratory. I confine myself to my experiments made in connection with Pulfrich's "Totalreflectometer for chemists," but it is believed that the method can be applied with advantage under other circumstances.¹

My spectroscope was of exactly the same type as that described by Pulfrich in his paper on "Das Totalreflectometer und seine Verwendbarkeit für weisses Licht," but without the scale. To produce the fringes, quite ordinary cover glass plate was employed, being put between the prisms and Ramsden's eye-piece, after having been fixed with wax, as shown in the annexed figure, to a small tube fitted to the eye-piece. Its straight edge (obtained by simply cutting with diamond) could be by rotation made parallel to the slit of the spectroscope.

In counting the fringes, I took as origin the bright Na lines appearing in the continuous spectrum of a luminous flame of coal gas, in which a piece of fused sodium chloride was suspended.

The wave-lengths corresponding to the fringes were indirectly determined by measuring first the angles of emergence from the

¹ For example, Rubens, Wied. Ann., Bd. 45, p. 238.

total reflectometer prism for the principal Fraunhofer's lines, and then those for the fringes. The former were platted with reference to the known wave-lengths of the lines and the values for the fringes were obtained by interpolation. Since an angular difference of only $1'$ could be measured on the divided circle, the angles of emergence had to be carefully determined; also smoothing of the curve and interpolation had to be repeatedly and carefully done.

The following is an example :

λ corresponding to the fringes.

No. of Fringes.	Using a Prism of Crown Glass.	Using a Plate of Flint Glass.	Values Adopted.	No. of Fringes.	Using a Prism of Crown Glass.	Using a Plate of Flint Glass.	Values Adopted.
-18	0.000670	0.000672	0.000670	+ 3	0.000580	0.000580	0.000580
-15	656	656	656	+ 6	569	568	569
-12	643	642	642	+ 9	559	557	558
- 9	629	629	629	+12	548	547	548
- 6	616	616	616	+15	539	538	538
- 3	604	604	604	+18	528	529	529
0	591	592	592	+21	520	520	520

Fig. 1.

The indices of refraction of the total reflectometer prism for the wave-lengths corresponding to the fringes may be interpolated from the values given by Pulfrich for the principal Fraunhofer's lines, or what comes to the same thing, determined by making use of a body with known indices of refraction for different wave-lengths. I took a quartz cube, for which Mascart's measurements were assumed, and obtained the following values, with which Pulfrich's perfectly agree.

Indices of refraction of the total reflectometer prism corresponding to the principal Fraunhofer's lines ($18^{\circ}.8$ C.).

	A	B	C	D	E	F
Tsuruta.	1.60702	1.60854	1.61032	1.61511	1.62136	1.62705
Pulfrich.		1.60854	1.61031	1.61511	1.62141	1.62703

Whence by graphical interpolation I obtained the following values :

Indices of refraction of the total reflectometer prism corresponding to the fringes (18°.8 C.).

No. of Fringes.	λ	Index of Refraction.	No. of Fringes.	λ	Index of Refraction.
-18	0.000670	1.6095	+ 3	0.000580	1.6161
-15	656	1.6103	+ 6	569	1.6169
-12	642	1.6112	+ 9	558	1.6179
- 9	629	1.6121	+12	548	1.6190
- 6	616	1.6130	+15	538	1.6201
- 3	604	1.6139	+18	529	1.6211
0	592	1.6149	+21	520	1.6223

Now to test the method, indices of refraction of different substances were determined; the following example gives the means of two series of measurements made with a plate of crown glass on different days, but at nearly equal temperatures (18°.8 and 19°.4C.), once with the sun's light and then with a coal-gas flame.

Solar light.

A	B	C	D	E	F
1.52619	1.52706	1.52808	1.53087	1.53406	1.53708

Coal-gas flame.

No. of Fringes.	Index Obs.	Index Interp.	No. of Fringes.	Index Obs.	Index Interp.
-18	1.5275	1.5276	+ 3	1.5313	1.5312
-15	1.5280	1.5281	+ 6	1.5316	1.5318
-12	1.5285	1.5286	+ 9	1.5323	1.5323
- 9	1.5290	1.5291	+12	1.5328	1.5329
- 6	1.5295	1.5296	+15	1.5334	1.5334
- 3	1.5300	1.5301	+18	1.5339	1.5340
0	1.5306	1.5307	+21	1.5346	1.5346

The numbers in the column "Index Obs." were concluded from the measured angles of emergence, while those in the column "Index Interp." were interpolated from the curve obtained by plotting the values of the first table on the assumption of the formerly determined wave-lengths for the fringes.

GÖTTINGEN, August 4, 1902.