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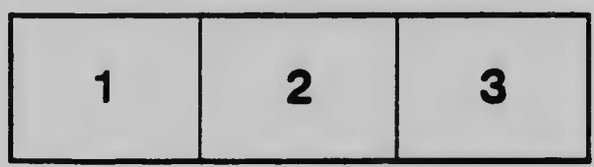

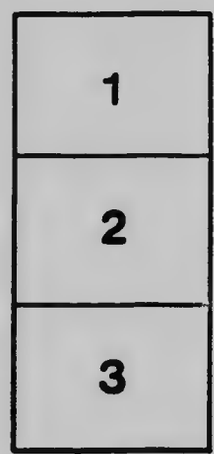

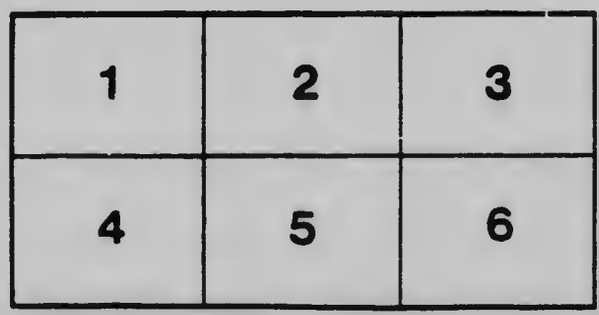

UNIVERSITY OF TORONTO STUDIES

PAPERS FROM THE PHYSICAL LABORATORIES

No. 64 | ON THE OPTICAL TRANSPARENCY OF CERTAIN SPECIMENS OF FLUORITE, BY J. F. T. YOUNG AND H. J. C. IRETON

[REPRINTED FROM TRANSACTIONS OF THE ROYAL SOCIETY OF CANADA, SERIES III, VOL. XIII]

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University of Toronto Studies

[illegible] OF MANAGEMENT

On the Optical Transparency of Certain Specimens of Fluorite

By MR. J. F. T. YOUNG, M.A. and MR. H. J. C. IRETON, M.A.

Presented by PROFESSOR J. C. MCLENNAN, F.R.S.[1]

(Read May Meeting, 1919.)

Recent researches in spectroscopy have shown the increasing importance of a complete study of the ultra-violet spectra of the elements, and attempts have been made to carry out such work at various times. Schumann, Handke and Wolff have employed the prism spectrograph, the optical train of which consisted of white colourless fluorite supplied by Zeiss. The range of this type of instrument depends of course on the transparency of the fluorite which, for thin plates, reaches a lower limit at about 1200 A.U. A second method employed for studying the Schumann region by Lyman, involves the use of a vacuum grating spectrograph. The grating must be specially ruled to throw the maximum of energy into the ultra-violet of one order of the spectrum and since its focal length is limited by the size of the vacuum chamber and the necessity of keeping the distance comparatively short to maintain intensity at the camera, it has been found in practice that the dispersion of the grating spectrograph is not greatly superior to that of the 60° fluorite prism spectrograph. This smaller dispersion of the fluorite spectrograph is, however, more than compensated by the increase in intensity which is always secured by such an optical train. In vacuum work this has its decided advantage, for the range of spectrum covered, in the study of weak sources and in the photography of the weaker lines in spectra, as well as in a shortening of the time of exposure to ordinary light sources.

It will be seen therefore that it is most desirable for the requirements of spectroscopy to locate a source of supply of pure quality colourless fluorite, the monopoly of which in pre-war days was held by Zeiss. Lyman has recorded in his work on absorption of crystalline solids that certain samples of a green variety of fluorite, from New Hampshire, U.S.A., were almost as transparent as that supplied by Zeiss, whereas all the other coloured varieties began to absorb strongly at about 1700 A.U. However, this New Hampshire source does not seem to have been developed, for at the present time there is a great

[1] Communicated by permission of the Admiralty by Professor J. C. McLennan, F.R.S.

shortage of fluorite suitable not only for spectroscopic trains, but also for achromatic combinations as well.

Source of Samples of Fluorite Tested for Transparency

Quite recently the Adam Hilger Co., Limited, obtained some samples of fluorspar from South Africa. These deposits which occur to the south of Ottoshoop, in the Zeerust district of the Transvaal, have apparently been worked for some time in connection with the supply of fluorspar for gold refineries and for steel making plants. The Geological formation appears to be of the nature of a large pipe in the dolomite of the Transvaal system. The spar is colourless and has been shewn by chemical analysis to be of great purity.

Experimental Arrangements for Testing

The fluorite spectrograph specially constructed for vacuum work by McLennan, Ainslie and Fuller[1] was used to test samples of this fluorite over the spectrum range available which was to below 1400 A.U. The source of light used was the vacuum carbon arc in the type of lamp developed by McLennan, Ainslie and Fuller. The only difference in the experimental details adopted was that a small absorption chamber to contain the fluorite samples was inserted between the arc and the slit of the spectrograph. The whole apparatus could then be evacuated and spectrograms taken of the light transmitted by each sample. The time of exposure was from 30–45 minutes, a steady carbon arc being maintained by a current of 10 amperes at 100 volts. At frequent intervals spectrograms were taken with no fluorite in the absorption chamber in order to test the light from the source. In every case these spectrograms showed the carbon bands at $\lambda = 1464$ A.U and at $\lambda = 1430$ A.U. Schumann plates prepared by the Adam Hilger Co. were used throughout the experiments.

The following table is a summary of the tests.

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[1] McLennan, Ainslie and Fuller, Proc. Roy. Soc. Jan., 1919.

TABLE 1

No.	Source	Thickness	Colour and Characteristics	Lowest Wave-length Transmitted
1	Zeiss	0·57 cm.	Clear, white and fleckless.	1400 A.U.
2	"	0·55 c.m.	" " "	1550 A.U.
3	"	0·58 cm.	" " "	1500 A.U.
4	S. Africa	0·60 cm.	White, fleck across centre, a few starts, not cloudy	1563 A.U.
5	"	0·82 cm.	White, slight flecks, no starts, clear	1563 A.U. (faintly)
6	"	1·07 cm.	White, flecked	1563 A.U. (very ")
7	"	0·65 cm.	White, a few flecks, not cloudy	1550 A.U.
	Recut of 7			
	(a)	0·2 cm.	" " "	1430 A.U.
	(b)	0·4 cm.	" " "	1464 A.U. (faintly)
8	S. Africa	0·89 cm.	White, flecks and starts, fairly clear	1550 A.U
9	"	0·54 cm.	White, very cloudy, and flecked, no starts	1900 A.U.
10	"	0·70 cm.	White, slightly cloudy, a few starts	1550 A.U.
11	"	0·96 cm.	White, slightly cloudy and flecked	1550 A.U.
12	"	1·21 cm.	Very clear, a few starts and flecks	1550 A.U.
13	"	1·30 cm.	White, slightly cloudy a few flecks and starts	1550 A.U.
14	"	2·09 cm.	White, cloudy, large starts	1900 A.U.
15	"	2·05 cm.	Very white, clear, no starts	1550 A.U.
16	"	2·17 cm.	White, very cloudy, large starts	1550 A.U.
17	"	2·01 cm.	Purplish tint, clear, small starts	1650 A.U.
18	"	2·68 cm.	Slight purplish tint, slightly cloudy, a few large starts	1650 A.U.

The samples of fluorite described in this paper were supplied by the Adam Hilger Co., and the investigation was carried out in the Admiralty Physical Laboratory, South Kensington.

The illustration Plate I shows spectra of the carbon arc radiation transmitted by various types of fluorite (*a*) transmission to 1900 A.U., (*b*) to 1656 A.U., (*c*) to 1550 A.U., (*d*) to 1464 A.U., (*e*) the carbon arc through the optical train of the spectrograph only.

SUMMARY

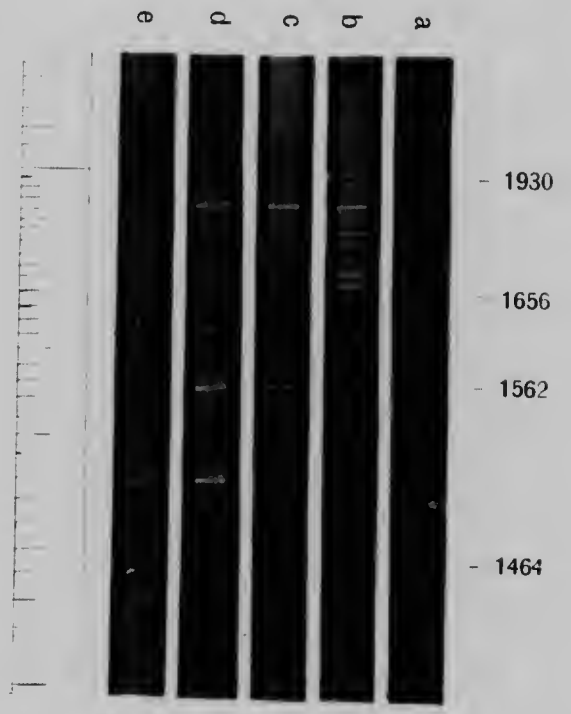
It will be seen from the above table that many of the samples compare favourably with the fluorite supplied by Zeiss for spectro-

scopic purposes and most of it would be suitable for use in constructing achromatic combinations.

There does not seem to be any direct connection between the transmissive properties for ultra-violet light and its physical characteristics, such as flecks, clouds or starts.

It would seem that we need no longer be dependent on foreign sources of supply with such a source as the South African one available.

April 15, 1919.


e
d
c
b
a
1930
1656
1562
1464

UNIVERSITY OF TORONTO STUDIES

Papers from the Physical Laboratories

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