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Note added in proof: in a recent paper, V. G. Hill (*Can. Mineral.*, 1958, **6**, 234) has found α for ZnS to have the very high values of 2.17 (fine crystals) and 2.37 (ground crystals). This is probably due to his use of a diffractometric technique, which we have found to be unsatisfactory for the study of ZnS, and also, in the case of the ground crystals, to pulverisation.

THE DISPERSION AND THE TEMPERATURE COEFFICIENT OF THE BIREFRINGENCE OF SELENITE*

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Values of the indices of refraction of selenite ($CaSO_4 \cdot 2H_2O$) precise to five significant figures have been published by Tutton (1). For his measurements he used prisms with the crystal axes oriented so that the method of minimum deviation could be used. The birefringence obtained by taking differences between the indices of refraction so determined has a rather large uncertainty in the second significant figure and shows no consistent change with wavelength.

Using multiple-wave plates cleaved from natural crystals we have made direct measurements of the birefringence ($n_\gamma - n_\alpha$). A diagram of the experimental arrangement is shown in Fig. 1. The crystal is mounted
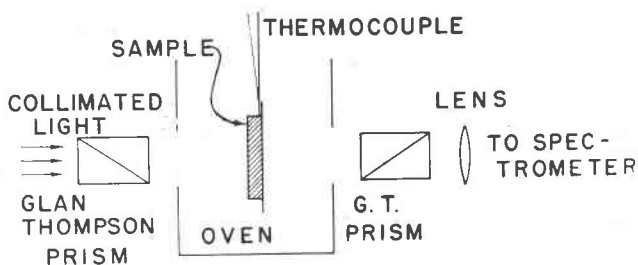

FIG. 1. Diagram of the apparatus for birefringence measurements.

normal to a collimated beam of light in a temperature controlled enclosure. The α and γ axes of the indicatrix are oriented at an angle of 45° to the transmission axes of a pair of Glan-Thompson prisms. An image of the crystal is formed on the slit of the spectrograph.

The crystal introduces a phase difference between the light vibration components parallel to the fast and to the slow axes. For those wave-

lengths for which the phase difference is an integral multiple of 2π no light will pass the analyzer prism if the analyzer and the polarizer are crossed. Thus dark bands occur in the spectrum at those wavelengths for which

$$\frac{2\pi}{\lambda}(n_\gamma - n_\alpha)t = m2\pi \tag{1}$$

where m is an integer, t the crystal thickness, and λ the wavelength. If the polarizer and the analyzer are parallel m is replaced by $m+\frac{1}{2}$. Measurements of wavelength and thickness give a direct value of the birefringence $(n_\gamma - n_\alpha)$. The accuracy is dependent on the correct identification of the order number and on the thickness measurement.

The order number, m, in Eq. (1) is easily obtained for thin sections by observations with a visual spectrometer. A crystal 0.67 mm. thick gave seven dark bands in the visible region. It was known that the birefringence was approximately 0.009. By solving Eq. (1) for the m value of a band in the center of the spectrum using $(n_\gamma - n_\alpha) = 0.009$, an approximate value of m close to an integer was found. When this was rounded off to the nearest integer it appeared that it was the only possible value, as $m+1$ and $m-1$ gave birefringences of 0.01 and 0.008. A crystal 2.45 mm. thick was then examined and m was evaluated by the same method using the results from the thinner crystal. Finally, taking birefringence values from a graph representing results from several moderately thin crystals, Eq. (1) was used to obtain m for the crystal 9.58 mm. thick. The values obtained for bands in different parts of the visible spectrum
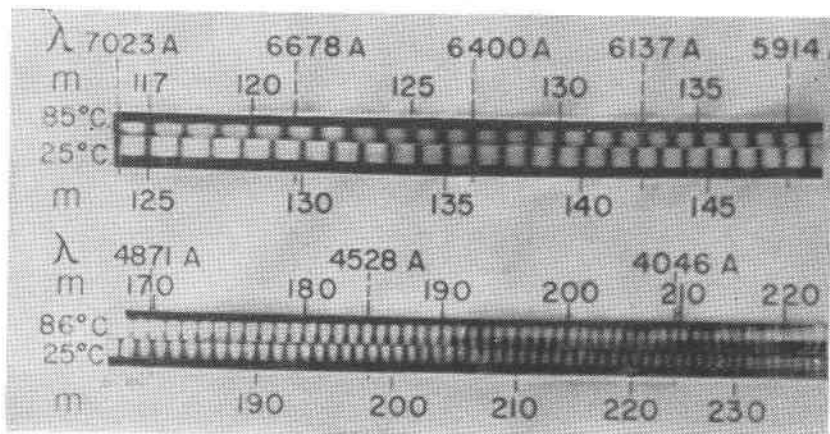

Fig. 2. Reproduction of spectrogram showing the multiple-wave plate bands. The comparison spectrum is from an iron arc. The selenite crystal was 9.58 mm. thick.

TABLE I. THE BIREFRINGENCE $(n_\gamma - n_\alpha)$ OF SELENITE

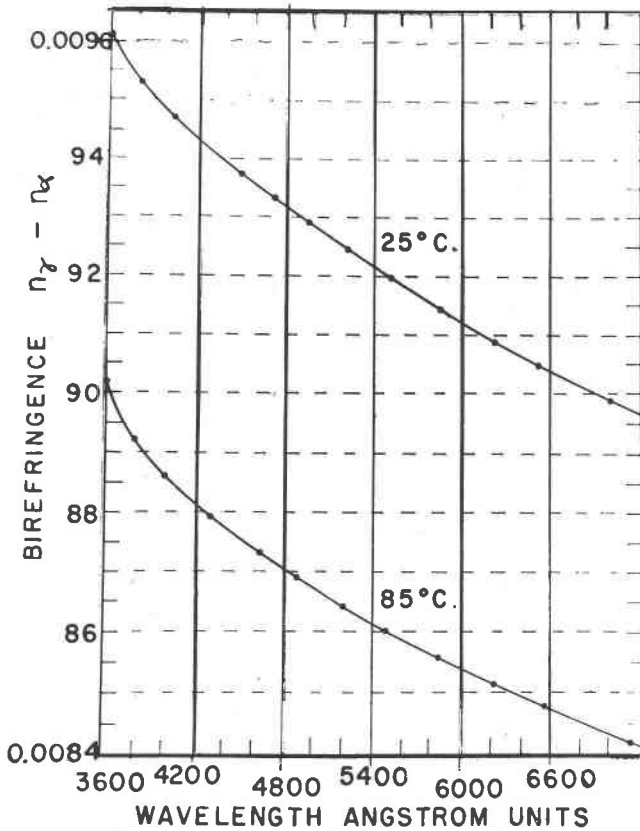| 25° C.			85° C.		
m	λ	$n_\gamma - n_\alpha$	m	λ	$n_\gamma - n_\alpha$
256	3597A	0.009612	240	3600A	0.009019
240	3808	9540	225	3803	8932
225	4034	9474	212	4004	8861
200	4490	9374	195	4318	8790
190	4706	9333	180	4644	8725
180	4945	9291	170	4894	8685
170	5209	9244	159	5205	8639
160	5506	9195	150	5490	8596
150	5840	9145	140	5853	8553
140	6220	9090	131	6223	8510
133	6519	9050	124	6546	8473
123	7000	8987	113	7135	8416

FIG. 3. $n_\gamma = n_\alpha$ as a function of wavelength at 25° C. and 85° C.

were consistent with each other when rounded off to the nearest integer. Having identified m for a given band at room temperature, the value of m at a different temperature was determined with a visual spectrometer by counting the bands that move by the cross hairs as the crystal is heated. The bands were then photographed with a ten foot diffraction grating spectrograph.

Figure 2 is a reproduction of spectrograms obtained with a crystal plate 9.58 mm. thick held at two different temperatures. An iron arc comparison spectrum was used for plate calibration.

The measurements on some of the bands are summarized in Table I. The values of $(n_\gamma - n_\alpha)$ recorded were checked by measurements on a crystal plate 12.27 mm. thick. The values obtained from a single spectrogram are self consistent to the fourth significant figure, but they differ slightly in the third figure from one determination to another. Probably one reason for this lack of adequate temperature control. Although the temperature indicated by the thermocouple did not fluctuate more than 0.5° C. during a run, the temperature error is probably greater than this because the thermocouple was not imbedded in the crystal.

Figure 3 shows $(n_\gamma - n_\alpha)$ plotted as a function of wavelength over the range 3600 Å to 7200 Å for temperatures of 25° C. and 85° C. The mean value of the temperature coefficient of birefringence over this range is $-1.00 \times 10^{-5}/°$ C. with an estimated uncertainty of 8 per cent.

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CALIBRATION SIGHTS FOR X-RAY POWDER CAMERA

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The calibration sights have a twofold purpose. They permit determination of film shrinkage by direct measurement, provided the film has been developed with care so that film shrinkage will be uniform. They permit centering the film on the measuring device so that the midpoint of the x-ray diffraction rings comes at a convenient reading, say 100.00 mm. (Fig. 1). This procedure eliminates the need for finding the midpoint by reading ring positions on both sides of the punched hole. It simplifies the