ULTRA-VIOLET ABSORPTION OF CERTAIN MINERALS

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The experiments reported here extend the information concerning the absorption of light by certain transparent minerals through the ultra-violet region to 190$\mu\mu$. Limits of this transparency have been reported for many gems by Absalom,[1] and for several varieties of colored quartz by Tsukamoto.[2] They found little or no correlation between transparencies in the visible and in the ultra-violet regions. Holden[3] gives absorption curves for several varieties of quartz, including smoky quartz and amethyst, for the visible region. These are here extended to shorter wave-lengths, and in addition curves have been obtained from two samples of agate, one of opal, and several of mica.

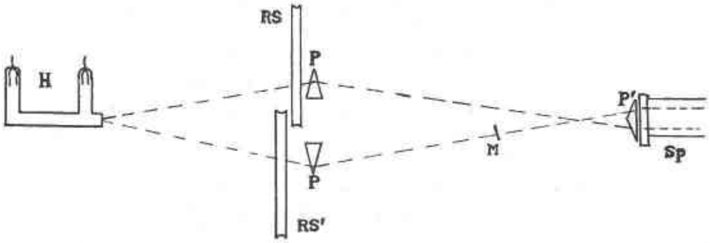

FIG. 1

H = Hydrogen discharge tube.
RS = Rotating sector, variable aperture.
RS' = Rotating sector, fixed aperture.
P, P' = Biprism.
M = Mineral section.
Sp = Spectrograph.

The apparatus was arranged as indicated in Fig. 1. The source of light is a hydrogen discharge tube of pyrex with heavy aluminum electrodes and a quartz end window, operated at a pressure of several mm. by a one kilowatt transformer. This gives a continuous spectrum throughout the 650$\mu\mu$ to 190$\mu\mu$ range. The

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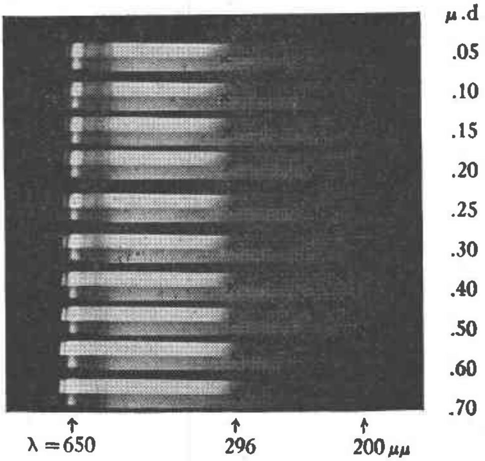
[1] H. Absalom, Ultra-violet transparency of colored media. *Philosophical Magazine,* **33,** p. 450, 1917.

[2] K. Tsukamoto, Transparency of colored quartz for the ultra-violet. *Revue d'Optique,* **6,** p. 478, 1927.

[3] E. Holden, Smoky quartz and amethyst. *Amer. Mineralogist,* **10,** p. 203, 1925.

Gaertner rotating sector photometer and quartz spectrograph are set up in the usual way. The beam of light from the lower biprism of the sector photometer passes through a thin section of the mineral to be studied before it reaches the second biprism, which is placed in front of the slit of the spectrograph. A series of photographs is then taken with different settings of the upper variable sector; the two beams from the sectors give adjacent records. If a point of equal density occurs on these records, the absorption coefficient for that wave length is given directly by the setting of the variable sector. A typical photograph is given (Fig. 2.).



Muscovite d = .018 mm.
FIG. 2

The absorption coefficient referred to is defined by the equation

$$I = I_0 e^{-\mu d}$$

in which I_0 = intensity of incident light.
I = intensity of transmitted light.
μd = absorption coefficient.
μ = absorption coefficient per cm.
d = thickness in cm.

Two rather dark specimens of smoky quartz gave identical curves which check for the visible region with those given by Holden.[4] The effect of the coloring material is the broad absorption

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[4] Note that since Holden's graphs are of percentage of transparency and the above relationship is a logarithmic one of absorption, his curves are reversed and have much steeper slopes for the same values.

band to which the color is due and abrupt absorption at 240$\mu\mu$. The amethyst curve is from sections cut from amethyst of rather deep but not dark color. There is in addition to the absorption band in the visible region an equally distinct one at 262$\mu\mu$ and in spite of increased absorption throughout the range the limit of transparency is lowered to 220$\mu\mu$ (Fig. 3).

Only one sample of opal of the right thickness was available. By transmitted light it is of a clear yellow color. Complete absorption in the shorter wave-lengths of the visible region occurs.

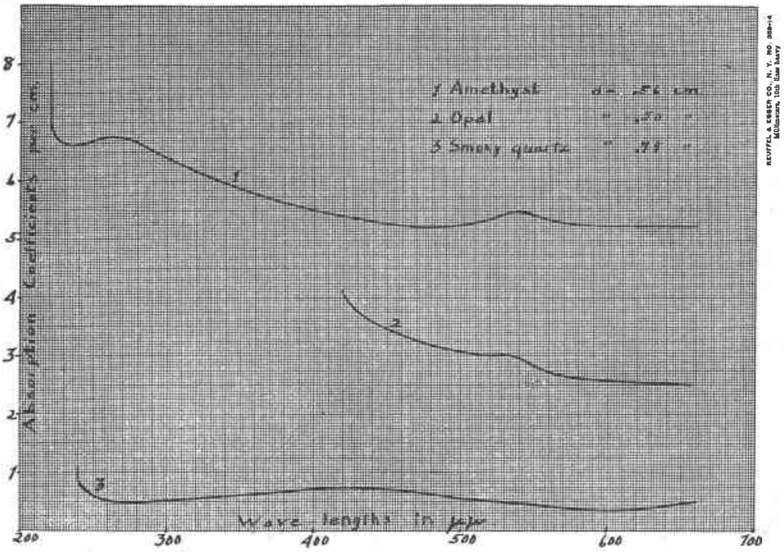

FIG. 3

The agates tried also show a considerably decreased limit of transparency which may be due to the change in structure as well as to the impurities present. Both pieces are of translucent brownish yellow, with lighter portions. From specimen 1 (Fig. 4), curve *a* was taken through a slightly milky portion, *b* through a part that was of decided yellow color. The change in shape of the curve indicates a different coloring substance rather than mere dilution. Specimen 2, of darker brown but with clearer portions than 1, gives, through one of the latter, a curve very similar to 1*b*. Absorption by the darker portion was so great that a curve could not be obtained.

The curves for biotite and muscovite are included for comparison (Fig. 5); it was of course simple to extend the values to higher values of μ since d could be made small. For this reason points on the curves can be more easily checked and are more dependable. Faintly colored specimens of pink and green muscovite also were photographed but without significant differences.

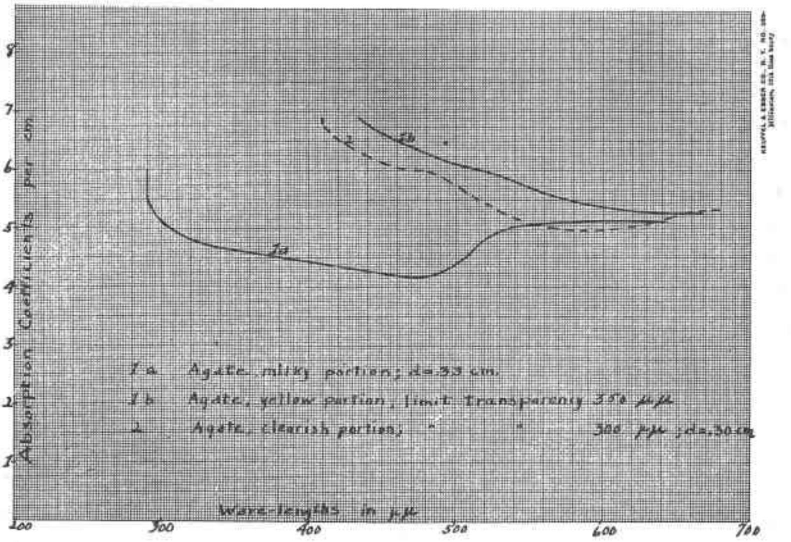

FIG. 4

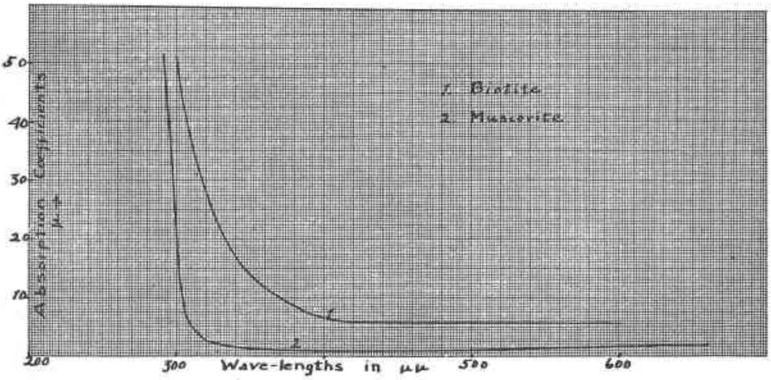

FIG. 5

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