

Using these values three further relations have been verified:

$$\begin{aligned}(1) d_{12}(36.6) &= C_{12}(36.0) \\ (2) (d_{11} + 2d_{12})/3(58.4) &= \alpha(56) \\ (3) d_{12} + d_{44} + d_{45}(123.6) &= C_{12} + 2C_{44}(123.0) \\ &= C'_{12} + 2C'_{44}(123.3)\end{aligned}$$

The existence of the four elastic constants in diamond has thus been definitely established.

We note that in diamond,  $d_{12}$  is nearly equal to, but distinctly different from,  $d_{45}$ . This is what is to be expected from the (42) equations given by Viswanathan<sup>10</sup>. This difference between  $d_{12}$  and  $d_{45}$  is due to the lattice-displacement term, which is small even in diamond. In the case of other cubic crystals having all the atoms at the centres of symmetry, such as sodium chloride, this lattice-displacement term is zero and hence  $d_{12} = d_{45}$ ; but  $d_{44}$ , in general, will not be equal to  $d_{45}$ . In diamond, the difference between  $d_{44}$  and  $d_{45}$  is large, as is to be expected from the pronounced covalent bonding.

The values of the four elastic constants can be calculated from the atomic force constants. The elastic constants have been evaluated otherwise by Viswanathan<sup>10</sup>, but the two sets  $C'_{ij}$  and  $C_{ij}$  have not been clearly analysed. Taking the average values of  $C_{11} = C'_{11}$  (=101.9) and  $C_{12} + 2C_{44} = C'_{12} + 2C'_{44}$  (=123.3) and combining these with Ramanathan's<sup>11</sup> evaluation of the force constants from the spectroscopic behaviour of diamond to calculate the two unknown force constants, we get:

$$d_{12} = 39.9; d_{44} = 54.5; d_{45} = 28.9 \times 10^{11}$$

The values for  $C_{12}$ ,  $C_{44}$ ,  $C'_{12}$  and  $C'_{44}$ , calculated on this basis, are given in the last row of Table 2. The agreement with the observed values is quite satisfactory, and affords further confirmation of our identification.

Accurate measurements of Young's modulus for diamond along the [100] and [111] directions would afford an additional test of the validity of the new theory of elasticity.

Work on other aspects of this problem is continuing and will be published in due course.

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### Fluorescence of Adsorbed Water

In previous communications<sup>1</sup> I have discussed what I called 'the reversibility of fluorescence by annealing' which I attributed in the case of chemicals and some pulverized minerals (anhydrite, desmine, colemanite) to adsorbed water, and in the case of the feldspars, which I studied in the form of larger pieces, to contamination by contact with the skin of the hand.

I have now observed the reversible fluorescence due to adsorbed water in feldspars which are sufficiently finely powdered, when the fluorescence destroyed by heating can also be regenerated by wetting or by long exposure to the air. Thus the greenish-blue fluorescence of these minerals can be attributed to adsorbed water which, in their natural state, is probably of magmatic origin. This explains the paradox that feldspars formed from the magma show a fluorescence that can be destroyed by heating; there is no evidence for radio photofluorescence in feldspars which might otherwise have explained this phenomenon.

The fluorescence of adsorbed water, first discovered by Ewles<sup>2</sup>, is fairly widely distributed in the mineral kingdom. It is characterized by a broad band in the blue with one or two peaks between 430 and 480  $\mu$ ; it can be destroyed by strong annealing and regenerated by weaker heating after a short exposure to damp air, and by longer exposure to the atmosphere at room temperature, as well as by wetting. In many cases the fluorescence in the natural state is also increased by weak annealing.

The bluish colour of the fluorescence is often changed to orange-yellow by annealing, due to the relative enhancement of a long-wave band; it is not clear whether this is due to another activator or to the formation of certain lattice defects. This effect has already been observed in the case of calcite by Kreutz<sup>3</sup> and Dérivé<sup>4</sup>, who also noticed the part played by water.

The reversibility of fluorescence by annealing has recently been found in alumina and silica under conditions which exclude any contamination; the only substances with which the powders were in contact, apart from the air of the room, being the interior of Jena glass tubes and platinum cleansed by heating to yellow heat.

Wawilow and Tummermann<sup>5</sup> have observed a bluish fluorescence of water that can be removed only with difficulty by repeated distilling. I have now found that freshly fallen snow and its melt-water, excited by ultra-violet light, display a bluish fluorescence with a peak at 430  $\mu$ , in sufficient agreement with the results of Wawilow and Tummermann. Those authors tentatively ascribe the fluorescence to oxygen, whereas Ivekovic<sup>6</sup> attributes it to organic impurities. It seems possible, however, that this fluorescence, too, may be due to the adsorption of water, not on a solid body but on the molecules of some impurity.

As to the fluorescence of skin<sup>1,7</sup>, which first led to a mistake in the case of the feldspars, the following observations may be added. The aqueous extract of heated skin is brightly fluorescent; on evaporation a brown deposit is formed which is only faintly fluorescent. Rewetting, however, immediately restores the fluorescence.

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