brum positions: equation (1), being the equation of motion for the ions, can now be discarded, and the w term drops out from (2). The solutions of (2)–(6) are then simply the light waves suffering only refraction due to electrons (velocity $= c/\sqrt{\epsilon_\infty}$); these solutions are also represented by a dotted line in the graph. The complete equations (1)–(6) thus obviously describe the combined system: lattice vibrations + radiation field. As regards the former, the equations should lead to the retardation effect, and, as regards the latter, they should lead to the infra-red dispersion.

The solutions of the equations (1)–(6) are the longitudinal and transverse vibratory modes plotted as solid curves in the accompanying graph. The longitudinal lattice modes are seen not to be affected by the retardation effect. As regards the transverse solutions, the situation can be interpreted roughly as follows. At the intersection point O , the light wave and the usual transverse lattice modes have the same frequency and are in resonance, corresponding thus to the strongest mutual perturbation. The resonance tails off towards the right, where we find, indeed, a branch of the transverse solutions approaching the usual transverse lattice modes. On the other hand, the transverse vibrations as usually understood are non-existent on the long-wave side of the resonance point O .

The optical waves, which now experience infra-red dispersion, must clearly also be among the solutions. In fact, both branches of the transverse solutions satisfy the relation:

$$\frac{4\pi^2 c^2}{\omega^2 \lambda^2} = \epsilon_\infty + \frac{\epsilon_0 - \epsilon_\infty}{1 - (\omega/\omega_0)^2},$$

which we recognize as the infra-red dispersion formula; hence all the transverse solutions must be none other than the optical waves. The unexpected conclusion thus follows that a number of what would be considered as optical waves in crystal optics are identical with the transverse lattice vibrations in the theory of ionic crystals. If the graph is turned through 90° , the relation to the familiar dispersion curve (for no damping) becomes obvious: the region between

the usual longitudinal and transverse lattice frequencies is the region of perfect reflexion in optical theory, and the transverse lattice waves are the optical waves immediately below the dispersion frequency ω_0 .

The mathematical considerations are given in a paper to be published shortly⁷, where the nature of the energy density (that is, whether mechanical or radiative) for the solutions is also investigated.

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Crystal Structure of Valentinite and Complex Antimony (III) Fluorides

IN connexion with a study of the stereochemistry of lead¹, some compounds of trivalent antimony were also discussed. In this discussion it was erroneously stated that the structure of the orthorhombic modification of antimony trioxide, valentinite, is built up of finite molecules. As is obvious also from the figure in that paper (Fig. 4, p. 15), Buerger and Hendricks's original description of the structure² with infinite double chains of the composition Sb_2O_3 is quite correct. Unfortunately, in the new edition of Gmelin's *Handbuch*³, the structure is described as in my paper.

In both the orthorhombic and the cubic modifications⁴ of Sb_2O_3 , there are three short Sb—O bonds of length 2.0 Å., but also some longer Sb—O distances of 2.5–2.6 Å. in the orthorhombic form and 2.9 Å. in the cubic one, which may correspond to weaker secondary bonds. In the structure of $\text{KSb}_4\text{F}_{13}$ ⁵, four SbF_3 groups with Sb—F = 2.0 Å. are arranged around the thirteenth fluorine atom with F—4Sb = 3.0 Å. Further, between an antimony atom in one group and two fluorine atoms in another group, there are Sb—F distances of 3.0 Å. Thus the antimony atom is surrounded by six fluorine atoms, three at a distance of 2.0 Å. and three at 3.0 Å., and a distorted octahedral arrangement is formed just as in the cubic modification⁴ of Sb_2O_3 .

However, in the structure of CsSb_2F_7 ⁶, there is quite a different arrangement. Here no SbF_3 groups are found. The antimony atom forms four bonds with a mean Sb—F distance of 2.2 Å. Thus the Sb—F distances in the Sb—F—Sb bridge are of approximately the same length as the three other Sb—F bonds. In $\text{KSb}_4\text{F}_{13}$, in SbF_3 ⁷ and in the two modifications of Sb_2O_3 , it seems reasonable to assume that the three short antimony bonds are p -bonds. However, the distorted tetrahedral arrangement in CsSb_2F_7 must evidently correspond to another type of bond.

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