Thus, letting ν_0' refer to the liquid, there is the relation

$$\nu_0' = \left(\nu_0^2 - \alpha \frac{Ne^2 p}{m}\right)^{1/2}$$

where N is the number of molecules per unit volume in the liquid, p the number of resonating particles of charge e and mass m in a molecule, and α times the polarization per unit volume is the Lorentz force, α being $4\pi/3$ for a spherical cavity. But α when calculated from the above observed frequencies in the gas and in the liquid comes out not around $4\pi/3$ but 0.20 for HCl and 0.16 for HBr. In fact, using $4\pi/3$ for α makes the last term larger than ν_0^2 for these molecules.

However, this calculation is made with 4.77×10^{-10} e.s.u. for e, that is, it assumes that the vibrating atom is H^+. But we know that HCl and HBr do not have this structure. Dennison has, indeed, introduced into band spectrum theory the "effective charge," which he finds for HCl to be $0.199 \times 4.77 \times 10^{-10}$ e.s.u (Phys. Rev. **31,** 503 (1928)). Using this value for e, and retaining $\alpha = 4\pi/3$, we now calculate $\lambda_0' = 3.578\mu$, in quite good agreement with our measured 3.595μ.

These results and others will be presented at greater length later.

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The Reflecting Powers of Atoms for X-rays of Different Wave-lengths

In the course of measurements of atomic F-curves[1] experiments have been made to find out whether the scattering power of an atom changes with the wave-length of the x-rays used. It might be expected that such a wave-length effect, if it exists, would be most conspicuous in the neighborhood of characteristic frequencies of the diffracting atom. With this in mind, the F-curves of NiO have been mapped for molybdenum, copper and nickel radiation and points have been determined upon the curves of the metals iron, copper and nickel for molybdenum, copper, nickel and iron rays. This has been done by comparing the relative intensities of powder lines from these substances with the intensity of a standard NaCl reflection. Though the scattering powers thus obtained are not necessarily correct in absolute value, nevertheless as long as the F of the standard NaCl reflection is either constant or changes in a regular fashion with increasing wave-length, the relationships they show amongst themselves will be significant.

Earlier measurements from this laboratory[2] have shown that the scatterings of metallic iron and copper for copper K-radiation are less than for the $K\alpha$ line of molybdenum. Additional observations have shown (1) that the scattering power of a particular atom decreases with increasing wave-length as this wave-length approaches a critical excitation value for the scatterer; (2) that F is a minimum for this longest exciting radiation; (3) that this number then rises to a maximum for a wave-length equal to that characteristic of the scatterer; and (4) that thereafter it appears to fall slowly with further increase in wave-length. Thus, for example, the approximate values of Table I are obtained assuming $F(220,\ \text{NaCl}) = 15.62$.

TABLE I.

Wave-length	Fe $F(110)$	Ni $F(200)$	NiO $F(220)$	Cu) $F(220$
Mo $K\alpha$	15.87*	—	18.28	14.28*
Cu $K\alpha$	11.48	13.70	15.83	11.53
Ni $K\alpha$	9.77	14.48	16.88	11.18
Fe $K\alpha$	13.45	—	—	—

* See footnote 2.

The absorption coefficients of the diffracting powders enter into these determinations. The sequence of Table I is obtained, however, whether either experimental coefficients are used or those calculated by the general formula of Jönsson.[3]

The usual theory of the intensity of reflection from ideally imperfect crystals, to

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[1] C. G. Darwin, Phil. Mag. **43,** 800 (1922); etc.; A. H. Compton, X-rays and Electrons (New York, 1926) Chap. V.

[2] A. H. Armstrong, Phys. Rev. **34,** 931 (1929).

[3] E. Jönsson, Uppsala Univers. Årsskrift, 1928.

which these data are legitimately referable indicates that F, the ratio of the scattering of an atom to that of a single electron, may be expected to be constant for constant values of $\sin \theta/\lambda$. In other words, it will be the same for a particular reflection no matter what wave-length is employed.

The observed departures from this constancy probably have more than one cause. Thus the minimum in F which occurs at the critical absorption wave-length of the scattering atom is most naturally accounted for if energy which otherwise would be coherently scattered is utilized in the production of the secondary radiation. At the same time, the fact that maxima in F are always obtained at characteristic wave-lengths of the scatterer suggests some sort of resonance. Such resonance, if it exists, cannot be sharp, however, for F falls away only slowly with longer wave-lengths.

It is apparent that photographs of RbBr made by Mark and Szilard[4] with strontium and bromine radiations are expressions of variations in F of the same nature as those just described.

Detailed results of these experiments will be published soon.

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H. Mark and L. Szilard, Zeits. f. Physik. **33,** 688 (1925).