beam immediately upon entering the chamber were repelled to the metal cap, instead of to the collecting rod which was placed inside the nickel gauze. The x-ray beam, then, travelled through an absorbing layer of methyl iodide about 5 cm long before ions were produced that reached the collecting rod. The length of this absorbing layer can be estimated only very roughly. On the assumption that the path of absorption was actually 5 cm long, the corrections in Table I have been computed, using the absorption coefficients for methyl iodide given by Allison and Andrew and data to be found in the paper on the tantalum L series intensities.

TABLE I. *Corrected relative intensities of lines in the tantalum L spectrum.*

Line	Correction Factor	Rel. Int. 30.6 kv	Rel. Int. at High voltage
l	2.4	3.6	3.6
α_2	1.1	11.	11.
α_1	1.0	100.	100.
η	.85	1.1	1.2
β_4	.58	5.4	6.4
β_1	.55	51.	57.
β_3	.52	6.8	7.4
β_2	.49	20.	20.
β_7	.47	.4	.4
$\beta_5+\beta_{10}$	.46	.5	(.5)
β_9	.46	.4	(.4)
γ_5	.38	.5	.6
γ_1	.35	10.	11.
γ_6	.34	.2	.2
γ_2	.33	1.7	2.0
γ_3	.32	2.3	2.7
γ_4	.30	.7	.8

The writer feels that these corrections are not any more than approximately ten percent accurate for the lines of wide wave-length separation, since the thickness of the absorbing layer of methyl iodide can be estimated only roughly. Nevertheless, application of these corrections bring the measurements on tantalum into much closer agreement with the results of Jönsson[2] than previously reported. They are also in fair agreement with the results of Allison and Andrew when the intensities are compared at corresponding voltages, as the relative intensities of the tantalum α_1, β_1, γ_1, lines are, as corrected and at 20 kv, 100:45:8.7 in comparison with 100:43.7:9.1 as reported for the corresponding lines of tungsten.

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[2] Jönsson, Zeits. f. Physik **36**, 426 (1926).

X-ray Reflections from Oscillating Crystals

A few days ago B. Warren addressed to these columns a letter offering an explanation of the striking results of Fox and Carr,[1] who found that the Laue pattern of a quartz oscillator strengthened when the crystal was set into oscillation. Warren's explanation was so straightforward and plausible that the present writer decided to drop an alternative suggestion in the process of development even before the crucial tests proposed by Warren had been attempted.

Further discussion, however, threw some doubts upon the applicability of Warren's idea and so after indicating these I shall mention the alternative explanation which is easily capable of accounting for the facts, and which lends great interest to the experiments of Fox and Carr. The basis for Warren's interpretation is that there are probably a few strong lines of short wave-length in the incident radiation and that there is some jiggling of the crystal in the act of oscillating. An angle displacement introduced by the jiggle of less than one degree would bring many planes into the reflecting angle for such short wave-lengths and one might expect many spots not on the picture of a quiet crystal. Calculation shows however that since the reflection maxima have a width of several seconds, there should have been occasional strong spots from the quiet crystal. The experimenters make no mention of such spots. Moreover, the incident radiation filled an angle of almost two degrees. Under such conditions, rocking the crystal through less than one degree would have practically no effect on the total intensity of the Laue spots. True, a fraction of the spots might be enhanced but an equal number would be weakened. The tests proposed by Warren are surely still worth trying, but on the other hand a new suggestion is now in order.

My notion is to connect the phenomenon

[1] G. W. Fox and P. H. Carr, Phys. Rev. **37**, 1622 (1930).

under consideration with the known mosiac structure of crystals.[2] Quartz, it is true, occurs in fairly perfect ideal crystals and only selected pieces are suitable for piezoelectric oscillators. But the elastic motions during oscillation are of remarkable vigour. Their amplitudes are apt to be of the order of a wave-length of visible light. Now the shearing strength between adjacent "Zwicky" blocks is very low compared with that for two normal planes so that one might expect the oscillation to distribute the blocks through positions making appreciable angles with their equilibrium positions in the crystals at rest. In a block with 10^3 molecules on a side, a displacement of the outermost layer by one lattice spacing from its normal position would correspond to a rotation of about 8′. It will be shown that with the crystals used by Fox and Carr such a rotation would broaden the band of wave-lengths reflected in a spot to such an extent that the intensity of the spot could be increased 30 fold. This disturbance of the blocks becomes very plausible when one considers the fact that there is apparently a heat loss in the oscillator aside from the acoustic energy radiated into the air. Furthermore it is known that even the macroscopic motion of an oscillating plate is not uniform over its surface. First the crystal usually oscillates in more than one mode and the lowest—with the whole crystal in the same phase—need not be the strongest. Again different experiments have shown that there are often irregular quiet spots or unusually active localities on the face of an oscillator. Evidently the experiments of Fox and Carr may lead to important methods for studying the fine structure of crystals and the nature of piezoelectric oscillations as well.

An estimate of the effect can be made by the following argument. All sorts of simplifications are made in the interest of brevity but they do not affect the order of magnitude of the result in the case at hand. In particular the neglect of true absorption is justified by the fact that it will tend to influence the oscillating and the nonoscillating case in the same way, so that the relative intensity will be little changed by it except under special conditions. The reflected intensity $R(\lambda)$ from a crystal set to give a maximum reflection for the plane incident beam of intensity $I(\lambda_0)$ per unit wave-length range at wave-length λ_0 can be written

$$R(\lambda)=I(\lambda)(1-e^{-\epsilon TG(\theta)B})$$

where ϵ is the coefficient of secondary extinction for the most favorable angle, T is the thickness of crystal traversed by the beam (assumed constant for all rays reaching the particular spot at angles close to $2\theta_0$). $G(\theta)$ is the distribution function giving the chance that a layer of the crystal will be oriented at the angle θ close to θ_0—the consideration of one angle instead of three suffices for our present purposes. The angle over which a perfect crystal would have maximum reflection is called β so that the product $TG(\theta)\beta$ represents the effective thickness of the crystal at the angle θ. The Gauss function would be appropriate for $G(\theta)$ but we might as well choose a simpler one so long as $\int_{-\infty}^{\infty}G(\theta)d\theta=1$. The simplest is $G(\theta)=1/\delta$ when $|\theta-\theta_0|>\delta$ and is otherwise zero. In this case assuming the range 2δ so small that $I(\lambda)$ is constant the integrated reflected intensity, $\int R(\lambda)d\lambda$ is approximately $I(\lambda_0)\cdot(1-e^{-\epsilon T\beta/\delta})\cdot\lambda_0\cot\theta_0\cdot 2\delta$.

We see that for values of δ/β small compared with ϵT the reflected intensity is proportional to δ. Now β is about 5″ so that even for $\delta\approx 8'$, ϵT should be greater than 70 which means for millimeter thick plates $\epsilon>700$. This is a very moderate figure.

If we say that for the nonoscillating crystal the angular range δ of the blocks is about 15″ while under oscillation it goes to $\delta=8'$ we see that the reflected intensities are in the ratio 1 to 30. This is more than enough to account for the photographs published by Fox and Carr.

R. M. Langer

Mass. Inst. of Technology,
July 13, 1931.

[2] e.g. F. Zwicky, Proc. Nat. Acad. **15**, 816 (1929).

The Enhancement of Predissociation by Collisions

In continuing experiments upon the optical dissociation of iodine vapor it has been found that dissociation is produced in mixtures of iodine and argon (0.3 mm I_2, 3 cm A) by illumination with light of wave-length longer than 5100 A. Such light falls in the region of discontinuous band absorption rather than in the continuum and should produce as a pri-