not appear to give too big an effect. This contrasts with the radiative effect where the observations[5] indicate that for 10^8–3.10^8 volt electrons the theoretical value is too big by at least a factor of 2. The data are, however, not sufficient to enable us to say definitely that the scattering formula holds where the radiative formula fails, though such a conclusion would seem to be corroborated by the observations of Anderson and Neddermeyer[5] on the production of secondary electrons by high energy cosmic particles (assuming the latter to be electrons). Such a result would mean that when an electron is subjected to the field of a moving nucleus the effective intensity of the components of the perturbing force with frequencies of the order of mc^2/h is less than that required by existing theory, while the intensity of the components which determine the scattering, *viz.*, those with infinitely small frequencies, is correctly given. Since the frequency mc^2/h has no special significance in classical theory this would be difficult to interpret on a classical basis.

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February 16, 1935.

[1] Oppenheimer, Phys. Rev. **47**, 44 (1935).
[2] Weizsaecker, Zeits. f. Physik **88**, 612 (1934).
[3] Williams, Phys. Rev. **45**, 729 (1934).
[4] This statement was meant merely as an indicator of the nature of the possible failure of the Fourier analysis treatment, and not necessarily as a practicable procedure. There is a difficulty that while in classical theory we can under these conditions give a definite meaning to the force as acceleration divided by ordinary electron mass, this is not possible in quantum theory because of the different reaction of the electron in different collisions.
[5] Anderson, Phys. Rev. **44**, 406 (1933).
[6] Anderson and Neddermeyer, International Conf. on Phys., London, 1934.
[7] In the case of scattering the general expression for the lower limit is $\hbar/mc\xi\theta'$, where θ' is such that an electron traversing the plate suffers on the average one collision in which it is deflected through more than θ'.

Induced Ultraviolet Fluorescence and Its Release by Visible Light

In the course of investigations on the detection of induced radioactivity and of extremely weak ultraviolet radiation we have recently observed that the ultraviolet fluorescence of certain substances following their exposure to and their removal from roentgen or gamma-irradiation persists for unexpectedly long periods of time. This ultraviolet fluorescence, furthermore, is conspicuously increased if the irradiated compounds be exposed to visible light. This is in agreement with an observation made by W. Kudrjawzewa.[1]

Of twenty-five compounds we have thus far examined sodium chloride, potassium chloride, rocksalt and fluorite crystals exhibit these effects most clearly. Impurities inhibit, but previously repeated recrystallization facilitates the subsequent induction of ultraviolet fluorescence. Heating the crystals impairs their fluorescence which, indeed, is completely stopped by dissolving the compounds in distilled water.

A photoelectric Geiger-Müller-counter tube equipped with a cadmium electrode and a quartz window has been used for measuring the ultraviolet fluorescence. This counter is very sensitive to ultraviolet radiation and hardly responds to visible light. The ultraviolet light has also been registered by means of the darkening produced on Eastman hypersensitive panchromatic dry plates.

The fluorescent effects described have been elicited in the following way: Samples of crystals were exposed to radon (100 millicuries, $1\frac{1}{2}$ mm brass filter, close distance) or to roentgen rays (200 kv, cardboard filter, 40 cm focal distance, 25 r/min.) for periods of time ranging from a few seconds to ten hours. A few particles thus irradiated cause discharges in the Geiger counter; in general, the number of counts is proportional to the intensity and to the duration of the primary irradiation; but, in each case, it is found that illumination by visible light at once results in a tremendous increase of the counts. Thus, samples primarily irradiated for only a few seconds may require the stimulus of visible light before their acquired property of ultraviolet fluorescence becomes demonstrable with the counter. On the other hand, samples irradiated for several hours produce counter discharges in the dark even though they be removed from the counter window by as much as one meter. In this case, illumination by visible light so greatly increases the number of counts that satisfactory observations can only be made by placing the irradiated substance several meters from the window.

The counter discharges are completely stopped when a thin glass plate, 0.2 mm thick, is interposed between the material and the counter window. Spectrographic examination by means of a Leiss quartz monochromator in the case of sodium chloride, shows that the emitted radiation has one maximum in the neighborhood of 2450A. This agrees with Kudrjawzewa's[1] findings and is also of interest because J. O. Perrine[2] demonstrated that sodium chloride fluoresces in this same region as long as the substance is directly exposed to roentgen rays.

The ultraviolet fluorescence subsequent to primary gamma or roentgen irradiation, undergoes decay, very likely of the exponential type. The half-life of induced ultraviolet fluorescence ranges from a few minutes to many days depending upon the intensity and duration of exposure to the primary source of irradiation. The half-life, furthermore, is shortened if the substance is illuminated by visible light, which, if sufficiently intense, completely stops the emission of ultraviolet light, although the latter may again be detected after the substance has been allowed to rest in the dark.

The response to visible light is, moreover, characterized by lag, which increases as decay progresses. There is almost no measurable lag following either the onset or the cessation of visible illumination during the early life of induced ultraviolet fluorescence. But, lag in both respects becomes more prominent as time, measured from the moment at which the substance is removed from exposure to the primary radiation, continues to elapse.

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Cleveland, Ohio,
March 12, 1935.

[1] W. Kudrjawzewa, Zeits. f. Physik **90**, 489 (1934).
[2] J. O. Perrine, Phys. Rev. **22**, 48 (1923).