

Background Eradication of Nuclear Emulsions by Accelerated Fading of the Latent Image

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IN a continuation of our studies¹ on the fading of the latent image of alpha-particle tracks we have observed that conditions of temperature, humidity, and the presence of hydrogen peroxide have a pronounced effect on the rate. As shown in Fig. 1, the normal fading over a period of 20 days can be duplicated in the course of several hours by maintaining the exposed emulsion in an atmosphere saturated with water at 35°C. Storage in freshly distilled water does not destroy the latent image. The destruction of the latent image is further accelerated by augmenting the H₂O₂ concentration of the atmosphere in which the plates are stored. After exposure to 10⁷ α-particles from RaF, the latent image is completely obliterated by keeping the emulsion over 3 percent hydrogen peroxide at 25°C for 4 hours. After 1–2 hour desiccation of the eradicated emulsion over CaCl₂, sensitivity is restored and tracks develop from new exposures with normal mean grain spacings.

This phenomenon permits the eradication of the accumulated latent images of the alpha-tracks and stars produced by traces of Ra and Th normally present as impurities in the emulsion. By continuing the exposure of the dry eradicated plate the rate of track growth can be studied accurately. Quantitative recording, without apparent fading of the track structures, can be maintained for periods exceeding 2 months. Under these conditions single α-tracks accumulate at a rate of 8–100/cm²/day, depending on emulsion purity and thickness. Low energy α-ray stars originating from decay of Ra Th in the emulsion layer generate ~0.3 multiple events/cm²/day. Near sea level, the controlled exposure indicates a daily rate of long proton and meson tracks of 0.03–0.06/cm²; and a population of 0.0005/cm² nuclear evaporations induced by cosmic radiation.

This method is applicable only to fine-grained nuclear type emulsions as Eastman NTA and Ilford Conc. With coarse-grained, light-sensitive emulsions as x-ray films and process plates the H₂O₂ vapor produces the well-known pseudophotographic effects.² Loading fine-grained

emulsions with borax and lithium sulfate inhibits the destructive action of H₂O₂ on the latent image. Background eradication must therefore precede loading. Details of the method and a mechanism for spontaneous fading based on *in situ* H₂O₂ generation by the action of densely ionizing radiations on water in the gelatin will be reported on in the future.

¹ H. Yagoda and N. Kaplan, Phys. Rev. 71, 910 (1947).

² H. Yagoda, Am. Mineralogist 31, 87 (1946).

Coincidence Study of Gold¹⁹⁸*

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THE radiations from Au¹⁹⁸ have been studied by many investigators.^{1–5} Some experiments² have purported to show effects from only one gamma-ray of energy 0.4 Mev. On the other hand, considerable evidence¹ has been compiled which would indicate that more than one quantum per disintegration is emitted in the de-excitation of Hg¹⁹⁸, the residual nucleus. Results of gamma-gamma coincidence experiments have also been at variance. Norling³ and Jurney and Keck⁴ of the Indiana University group have found no gamma-gamma coincidences in the disintegration of Au¹⁹⁸. These results would support the view that only a single gamma-ray is present. Other investigations⁵ have shown genuine gamma-gamma coincidences to exist.

In order to reinvestigate the radiations from Au¹⁹⁸ by coincidence techniques, metallic gold was irradiated by slow neutrons in the Clinton pile. Chemical purification was carried out to remove possible impurities of calcium, iron, phosphorus, and platinum.

Using two matched G-M counters in a coincidence circuit with a resolving time of 0.10 microsecond,⁵ gamma-gamma coincidences were measured in Au¹⁹⁸. The gamma-gamma coincidence rate was found to be (0.103±0.007) × 10⁻³ gamma-gamma coincidence per gamma-ray recorded in the gamma-ray counter. This result should be particularly reliable, since, owing to the short resolving time, the background of accidental counts was virtually negligible for counting rates of 10,000 singles per minute in either counter. Cascade emission of gamma-rays in Au¹⁹⁸ is thus established. For the same single counting rate and from the observed gamma-gamma coincidence rate, it is estimated that at a resolving time of one microsecond, the background of accidental coincidences would be approximately four times the number of genuine coincidences recorded in any particular period of time. This ratio emphasizes the importance of short resolving times.

The beta-gamma coincidence rate of Au¹⁹⁸ was measured as 0.19 × 10⁻³ coincidence per beta-ray recorded in the beta-ray counter and was independent of the beta-ray energy. A delay of a few tenths of a microsecond has been reported in the emission of the 0.4-Mev gamma-ray which follows beta-emission.⁶ In the course of measuring beta-gamma coincidences in the present experiment, the re-

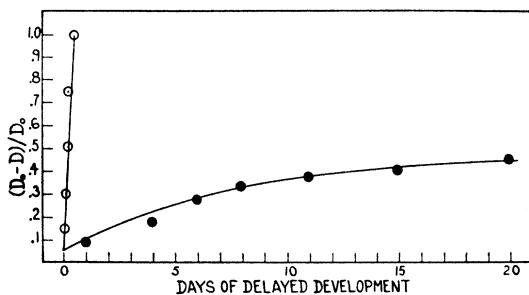


FIG. 1. Rate of latent image fading under differing storage conditions. ● ambient conditions, 25°C, low humidity; ○ eradication conditions, 35°C, saturation humidity.