Range Distribution of the Uranium Fission Fragments*

The range distribution of the uranium fission fragments in air has been further studied[1, 2] by means of a differential ion chamber. The source was a deposit of uranium oxide of one mm air equivalent. The fission fragments were collimated by rectangular channels 17 mm long, and eight mm square. The parallel plate type detecting chamber, 2.1 cm distant from the source, consisted of a thin grill six cm in diameter, spaced three mm from the disk electrode connected to the amplifier grid.

The number of fragments traversing the distance between the uranium and the detection chamber was measured as a function of the pressure of the air in the chamber. The results are shown in Fig. 1. Two major groups are

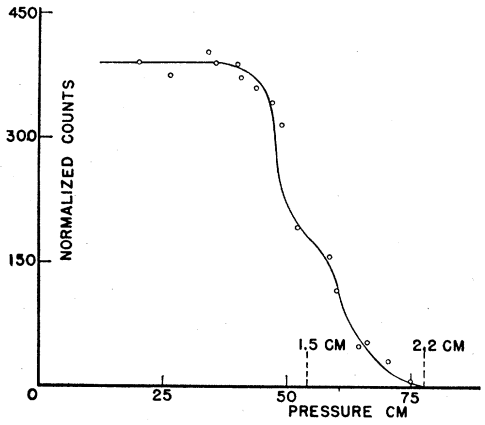

FIG. 1. Range of uranium fission particles in air.

indicated, one with a range of 2.2 ± 0.1 cm and the other with a range of approximately 1.5 cm. The two groups have approximately equal intensity.

The aid of the Research Corporation in this work is gratefully acknowledged.

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May 1, 1939.

* Publication assisted by the Ernest Kempton Adams Fund for Physical Research of Columbia University.

[1] Anderson, Booth, Dunning, Fermi, Glasoe and Slack, Phys. Rev. 55, 511 (1939).

[2] Booth, Dunning and Slack, Bull. Am. Phys. Soc. April 27, 1939.

Fission Products from Uranium*

Further experiments[1, 2] have been performed to study the radioactivity of the fission products from uranium irradiated with slow neutrons. The experiments have been of two types (1) using solid uranium oxide and collecting the products in Cellophane and (2) removing and collecting the gaseous products from uranium in solution. In the first case the uranium oxide, electrolytically deposited on thin copper sheets, was mounted in an evacuated aluminum

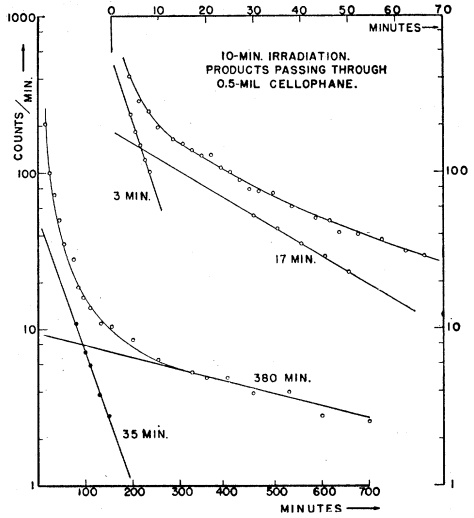

FIG. 1. Decay curves of products which pass through a 0.5-mil Cellophane sheet.

cylinder together with the collecting Cellophane. This cylinder was placed in paraffin near the cyclotron for an irradiation after which the Cellophane was removed and wrapped around a G-M counter for measurement of the radioactivity. With an irradiation of ten minutes the initial activity four minutes later was about 1500 counts/minute and the decay was followed for 24 hours. An analysis of the decay curves is consistent with periods of ~9 hr., 80 min., 32 min., 17 min., and 10 min. (shorter periods unresolved) in agreement with periods reported by others previously.[3, 4]

In order to eliminate one major group of fission products with a range of about 1.5 cm[5] the collecting foil was covered with a 0.5-mil Cellophane sheet which had an air equivalent of 1.4 cm as calculated from its mass and chemical composition. The products which passed through this thin foil showed periods of ~6 hr., 35 min., 17 min., and 3 min., as indicated in Fig. 1. The 10-min. and 80-min. periods are quite definitely absent.

The gaseous products were collected by passing nitrogen through an irradiated uranyl nitrate solution into a glass vessel designed to fit over the G–M counter and having a thin inner wall. Three different procedures were followed: (1) Nitrogen was passed through the solution during an eight-second irradiation and the activity of the products collected in the vessel measured immediately thereafter. Periods of 35 sec. and three min. were observed. (2) Nitrogen was passed through the solution into the collecting vessel during a 45-second irradiation. Two minutes later a stream of air was flushed through the vessel to remove any residual radioactive gas. The remaining activity showed periods of three min. and 20 min. which are attributed, therefore, to solid decay products from the short period gas. (3) The nitrogen was not passed through the solution until five minutes after a one-minute irradiation. The collection of any appreciable amount of the 35-sec. gas was avoided in this manner. This procedure yielded a radio-

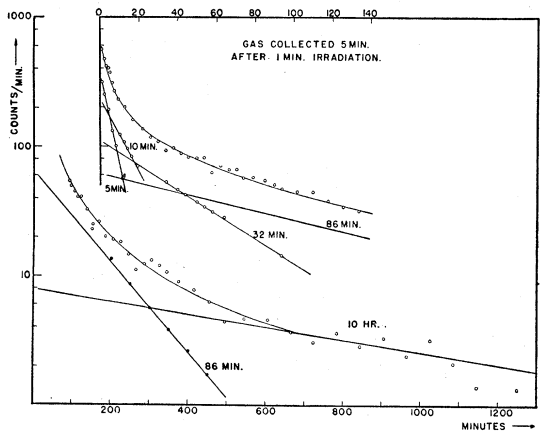

FIG. 2. Decay curves of gaseous products.

active product with a period of five min. A stream of air blown through the vessel 10 minutes after collection removed practically all trace of activity. It is therefore concluded that the product collected in this manner is a gas. A similar experiment was performed in which the activity was followed for 24 hours and the decay curve, Fig. 2, showed periods of 10 hr., 86 min., 32 min., 10 min., and 5 min.

The complete correlation of these data with those from other laboratories[3, 4, 6] cannot be made without further chemical separations and identifications, but some general conclusions may be drawn. There is evidence from these experiments that there are two gaseous products from uranium, one with a period of 35 sec., and the other with a five-min. period, the latter being much longer than indicated in previous reports. The 86-min. period has been quite definitely ascribed to Ba[3, 4] and here appears to be associated with the longer period gas. The 17-min. period has been ascribed to Rb[3, 4] and in these experiments comes from the shorter period gas. The decay of the products collected in Cellophane includes the periods arising from both gases whereas only the products associated with the gas with the shorter period pass through the 0.5-mil foil. The longer range fission products, therefore, may be assigned to a sequence Kr-Rb-Sr rather than to a Xe-Cs-Ba series.

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* Publication assisted by the Ernest Kempton Adams Fund for Physical Research of Columbia University.

[1] Anderson, Booth, Dunning, Fermi, Glasoe and Slack, Phys. Rev. **55**, 511 (1939).
[2] G. N. Glasoe and J. Steigman, Bull. Am. Phys. Soc., April 27, 1939.
[3] O. Hahn and F. Strassmann, Naturwiss. **27**, 11 (1939) and **27**, 163 (1939).
[4] Heyn, Aten and Bakker, Nature **143**, 516 (1939).
[5] Booth, Dunning and Slack, Phys. Rev. (in process of publication).
[6] Savitch, Comptes rendus **208**, 646 (1939).

Concerning the Nature of Radio Fade-Out

In *The Physical Review* of March 15, 1939, there appears a paper by Mr. L. V. Berkner under the above title. In this paper the author advances evidence and arguments against the view of Martyn, Munro, Higgs and Williams[1] that bright chromospheric eruptions are accompanied by a decrease in the electron density of the F_2 region of the earth's ionosphere.

Mr. Berkner spent some six weeks during January and February this year in Sydney and I had numerous opportunities of thoroughly discussing this point with him personally. After examining all our evidence, Mr. Berkner and I (on February 20th) prepared a joint report on the subject for the information of the Australian Radio Research Board, and of the Department of Terrestrial Magnetism of the Carnegie Institution, Washington. I quote herewith the part of the report which bears on this subject:

"We have made a detailed examination of the radio effects associated with bright chromospheric eruptions. The observations of the Department have been directed mainly towards the examination of ionospheric effects at the time of fade-out, those of the Board mainly to the effect over the whole period of the eruption.

"(*a*) We are agreed that a fade-out is best defined as an abnormal increase in the absorption of radio waves, and appears as an increase in the low frequency (or absorption) limit at which echoes return.

"(*b*) We find that fade-outs as just defined, do not always commence at the beginning of the solar eruption, but may appear during a later phase of the eruption.

"(*c*) F_2 changes are found which changes coincide with the commencement of the eruption. The changes so found consist of a decrease in the penetration frequency of the F_2 region, usually of amount less than one megacycle per second.

"(*d*) It follows that the fade-out does not always occur simultaneously with the change in the F_2 region. We have actually found one case[2] where the F_2 change (and the commencement of the eruption) preceded the fade-out by about two hours.

"The elucidation of the above points, which are not yet generally appreciated, has resulted in reconciling the apparent divergence of our views with regard to the experimental observations."

On the same date (February 20th) Mr. Berkner expressed his intention of withdrawing his paper and rewriting it. It now appears that, unknown to the author, his paper was already in the last stages of publication.

The purpose of this letter is to prevent unnecessary confusion meantime in the minds of other workers on this subject. No doubt the matter will be further elucidated by the author himself when he returns from New Zealand.

D. F. MARTYN

Australia House,
London, W. C. 2, England,
April 21, 1939.

[1] Martyn, Munro, Higgs and Williams, Nature **140**, 603–605 (1937).
[2] This case is illustrated by Fig. 8 in Mr. Berkner's paper, the eruption and F_2 change beginning together at 13.15 hours; the fade-out does not become evident until two hours later, and all three phenomena disappear in about 16.45 hours.