TABLE III. *Radioactivity induced in molybdenum by neutron bombardment.*

BOMBARDMENTS	OBSERVED PERIODS			
Slow neutrons	—	24 min.	64 hr.	—
Fast neutrons	17 min.	—	64 hr.	several days
Sign	e^+	e^-	e^-	—
Chemical test	Mo	Mo	Mo	—
Assignment	Mo^{91}	Mo^{101}	Mo^{99}	?
Upper limit derived from K–U plot	1.8 ±0.4 Mev	1.3 ±0.1 Mev	1.0 ±0.1 Mev	—

belong to Y^{90}, but the discrepancy between the upper limits obtained is far beyond the experimental error. With fast neutrons one more short period of about 30 min. has been observed. The results obtained so far on columbium are still too ambiguous for publication, because the activity is usually very weak and moreover the chemistry of it is very difficult.

The results obtained when molybdenum samples were bombarded by neutrons are given in Table III.

No trace of the 36 hr. period reported by Fermi and his collaborators was found.

It is a pleasure to express our thanks to Professor E. O. Lawrence for the privilege of using his cyclotron. Thanks are also due to Dr. Y. Nishina and Professor K. Kimura for their valuable help and encouragement. We wish to acknowledge the assistance given to us by Mr. K. Shinma, Mr. F. Yamasaki and Mr. N. Mori. The experiment has been aided by grants from the Research Corporation, the Chemical Foundation, the Josiah Macy, Jr., Foundation, the Japan Society for the Promotion of Scientific Research, the Oji Paper Manufacturing Company, Mitsui Ho-Onkwai Foundation, Tokyo Electric Light Company and the Japan Wireless Telegraph Company.

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Internal Conversion of γ-Rays in Element 43

Radioactive element 43 has been examined in a magnetic spectrograph, and is found to have three internally converted γ-rays. Segrè and Seaborg,[1] in studying the radioactivity of element 43, discovered a new six-hour period, and noticed that the electrons emitted by it gave an absorption curve characteristic of a single energy group rather than of a continuous distribution as in a normal β-ray spectrum. They kindly prepared a sample of this material for the magnetic spectrograph and the accompanying photograph was obtained (Fig. 1). The two lines

FIG. 1. Magnetic spectrogram of electrons emitted by radioactive element 43.

are due to internal conversion in the K and L shells of element 43 and have the proper separation for an element in this neighborhood. (The fine scratch is a fiducial mark.) The γ-ray energy is 129 kev. This isotope is formed by the β-decay of radioactive molybdenum.

The long-lived isotopes of element 43 formed directly by deuteron bombardment of Mo were also tried in the spectrograph and gave lines corresponding to γ-rays of 87 kev and 184 kev. They are chemically element 43, but it is not yet known with what periods they are associated.

Other cases of internal conversion which have been reported are Ga[2] and Cd[3]. Ga has been photographed in the spectrograph, but Cd has not yet been tried. The author has also found internal conversion of a 230 kev γ-ray in a new 30-hour Ba isotope by absorption measurements, but at present, the activity is too weak to photograph. The electrons, x-rays and γ-rays have all been observed for this Ba, and there are no natural β-rays associated with it. A theoretical discussion of internal conversion has been given by Dancoff and Morrison.[4]

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[1] Complete explanation to appear soon in *The Physical Review*.
[2] L. Alvarez, Phys. Rev. **53**, 606 (1938).
[3] Ridenour, Delsasso, White, and Sherr, Phys. Rev. **53**, 770 (1938).
[4] S. M. Dancoff and P. Morrison, Phys. Rev. **54**, 149 (1938).

Location of Resonances in Boron Plus Proton Reactions

Gentner[1] has found the gamma-ray resonance in the reaction

$$_5B^{11}+{}_1H^1\rightarrow{}_6C^{12}+\gamma$$

to be at 180 kev. Allen, Haxby and Williams[2] place the alpha-particle resonance in the reaction

$$_5B^{11}+{}_1H^1\rightarrow{}_4Be^8+{}_2He^4$$

at 159 kev and the gamma-ray resonance at about the same voltage. A recent paper by Oppenheimer and Serber[3] has prompted new measurements of these resonances.

The alpha-particle and gamma-ray yields from the above reactions have been measured simultaneously with protons of energies up to 200 kev and thick boron targets. These measurements show that the two resonances coincide to within 1 kev and occur at 165±4 kev.

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[1] Gentner, Zeits. f. Physik **107**, 354 (1937).
[2] Allen, Haxby and Williams, Phys. Rev. **53**, 325 (1938).
[3] Oppenheimer and Serber, Phys. Rev. **53**, 636 (1938).

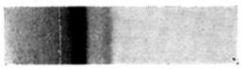

FIG. 1. Magnetic spectrogram of electrons emitted by radioactive element 43.