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Gamma-Rays from Terbium 160*

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March 20, 1950

THE radioactivity of terbium 160, produced by neutron capture, was first reported[1] by Bothe as having a half-life of 73.5 days. Subsequently a specimen irradiated in the Oak Ridge pile was shown[2] to emit many electrons by the internal conversion of gamma-rays. Further spectrometric studies on a highly purified sample kindly made available by Dr. G. E. Boyd of the Oak Ridge National Laboratory, show all the lines previously observed and many additional electron lines. Photographic spectra have been obtained both by internal conversion and by photo-emission in lead and uranium.

A summary of the energies of the conversion electrons and the photo-electrons from lead is presented in Table I, together with their interpretation and the energy sums. The gamma-energies are shown collectively in Table II.

TABLE I. Electron energies from terbium 160.

Electron energy	Interpretation	Energy sum	Electron energy	Interpretation	Energy sum
32.9 kev	K^1	86.3 kev	194.7 kev	M^4	196.6 kev
36.9	Auger L	44.9	205.3	L^5	214.4
39.5	K^2	93.0	209.6	Ph–K^7	297.5
42.3	Auger M	44.4	228.0	K^6	281.7
71.0	Ph–$L_{1,2}^1$	86.2	243.4	K^7	297.6
73.4	Ph–L_3^1	86.4	273.0	L^6	282.1
76.3	Ph–L_1^2	92.1	282.4	Ph–L^7	297.6
78.0	$L_{1,2}^1$	86.6	289.0	L^7	298.1
79.0	L_3^1	86.8	293.5	Ph–M^7	297.4
82.5	Ph–M^1	86.4	296.0	M^7	298.0
84.7	M^1	86.6	303.0	Ph–K^9	390.9
86.1	N^1	86.5	321.6	K^8	375.2
108.4	Ph–K^4	196.3	356.6	K^{10}	410.3
122.5	K^3	176.2	788.4	Ph–K^{11}	876.3
127.3	Ph–K^5	215.2	823.0	K^{11}	876.0
143.0	K^4	196.6	866.0	L^{11}	875.0
161.4	K^5	215.1	873.7	Ph–K^{12}	961.6
168.0	L^3	176.6	908.0	K^{12}	961.7
180.8	Ph–L^4	196.6	953.0	L^{12}	962.0
187.0	L^4	196.2			

The 12 gamma-rays may be arranged on a rather simple level scheme as shown in Fig. 1. The observed and expected energies

TABLE II. Summary of the gamma-rays in dysprosium 160.

Arbitrary number	Energy kev	Arbitrary number	Energy kev
γ^1	86.5	γ^7	297.8
γ^2	92.6	γ^8	375.2
γ^3	176.2	γ^9	391.0
γ^4	196.4	γ^{10}	410.3
γ^5	214.7	γ^{11}	876
γ^6	282.0	γ^{12}	962

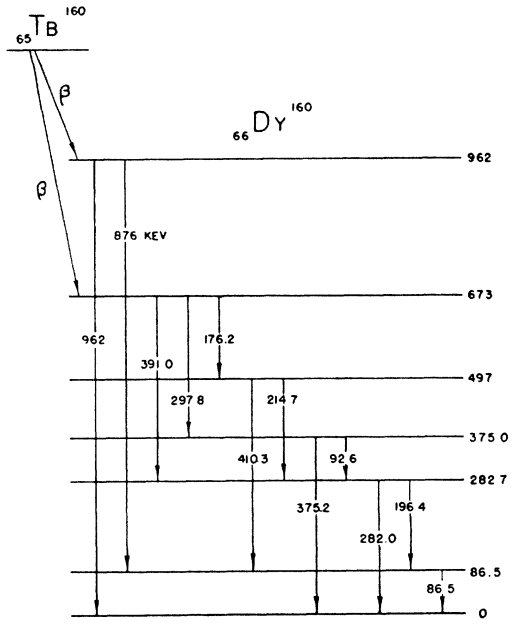

FIG. 1. Energy levels in dysprosium 160, following beta-emission from terbium 160.

for the possible transitions agree well within the experimental limits of accuracy. It is believed that the beta-spectrum consists of at least two electron groups whose maximum energies were reported first[2] as 882 and 546 kev and later[3] as 860, 521, and 396 kev, indicating a possible third group. The level scheme in Fig. 1 would be compatible with two beta-energies whose difference is slightly less than either of the reported sets of values as indicated. The beta-energy of lowest value would probably be accompanied by a gamma-ray of very high energy only slightly converted and hence not observable with the sample intensity available.

The half-life of the highly purified specimen followed through three octaves is found to be 76.0 days, confirming our previous report.

* This investigation was made possible by the joint support of the AEC and the ONR.
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Thermoelectric Voltage in Lead Telluride*

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March 6, 1950

WHEN an evaporated lead telluride film containing excess tellurium is baked in a vacuum, the resistance is first found to rise and after continued baking begins to drop. The thermoelectric power for the same film rises at first, then drops to zero at the resistance maximum, then reverses. The behavior of a particular lead telluride film is shown in Fig. 1. It is similar to the effect in lead sulfide observed by Hintenburger.[1] When lead telluride contains an excess of telliurium, conduction is by positive holes as is indicated by the positive thermoelectric voltage. Baking removes tellurium from the film. When stochiometric proportions are reached the thermal voltage reduces to zero and the