about 23 percent of the incident electrons due to scattering out of the beam.

Previous experiments have been characterized by a spread in incident energy of the same order as the spread due to straggling in the foil,[3-5] or by the use of a sharp beta-spectrum superimposed on a continuous beta-spectrum, or both.[6] It was the purpose of this experiment to make unnecessary the corrections which have had to be applied to these experiments in order to compare with energy loss theory.

In Fig. 2 the experimental counts less the background of 45 cpm have been plotted together with the theories of Landau[7]-Williams[8]

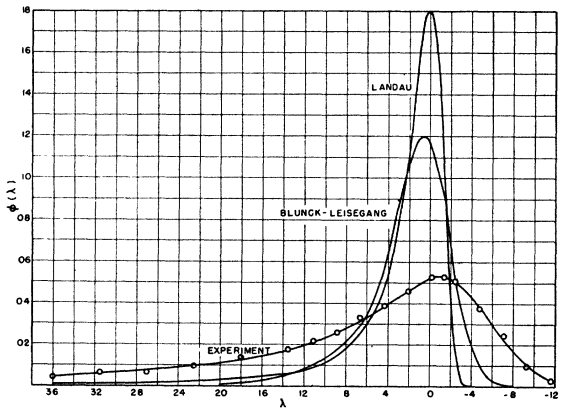

FIG. 2. Normalized energy loss distribution according to Landau, Blunck-Leisegang, and experiment.

and Blunck-Leisegang.[9] The variation in the most probable energy loss among the theories and the experiment of about 1.5 lambda-units is the same order as the experimental error and hence may or may not be significant. The width of the energy loss distribution is considerably greater than predicted by either theory, a result noted previously in the work of White and Millington[6] with mica foils. Here (in the notation of Landau[7]) λ is a dimensionless variable proportional to the energy loss, and $\Phi(\lambda)d\lambda$ is the normalized probability for an energy loss between λ and $\lambda+d\lambda$. The experimental curve has been normalized to unity in order to facilitate comparison with the theory. The electron energy before passing through the foil lies at $\lambda=-11.6$.

When completed, the spectrograph should have a resolution superior to that obtained here of about 0.5 percent without sacrificing the 1 percent of the solid angle from the source. Further experiments with the spectrograph and an electrostatic accelerating arrangement will permit measurement of electron straggling at any energy up to 2 Mev. A description of the spectrograph will appear in the literature in the near future.

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Radioactivity of Cerium

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A SEARCH for further isomers at the end of the 5th nuclear shell has led to a reinvestigation of the activities of $_{58}Ce_{79}^{137}$ and $_{58}Ce_{81}^{139}$. Within the experimental limitation of a lifetime greater than about a day, no isomeric activity was observed. This would be consistent with level trends discernible[1] from neighboring isomers of barium, xenon, and tellurium.

Normal and enriched samples of cerium isotopes were bombarded by neutrons in the piles at the Oak Ridge and Argonne National Laboratories. The compositions of the samples were:[2]

Sample 1: 0.19 percent (136), 0.25 percent (138), 88.48 percent (140), 11.07 percent (142);
Sample 2: 0.10 percent (136), 4.42 percent (138), 92.00 percent (140), 3.48 percent (142);
Sample 3: 8.94 percent (136), 0.81 percent (138), 84.98 percent (140), 5.27 percent (142).

All bombarded samples showed strongly the 30-day activity of Ce^{141}. A γ-transition of 145 ± 0.5 kev was found to be associated with this activity. The transition is converted in praseodymium, and the N_K/N_L ratio is approximately seven. These observations are in good agreement with the latest reported values of Freedman and Engelkemeir.[3]

Sample 2 showed lines in the electron spectrum from a 165.5 $\pm$0.5-kev γ-transition, most probably converted in lanthanum. These lines, when compared with those of the 145-kev transition in Ce^{141}, decayed with a long half-life of between 100 and 400 days. They are undoubtedly to be attributed to the 140-day Ce^{139} activity discovered by Pool and Krisberg.[4] Owing to the weakness of the activity, arising from only a 4 percent abundance of the capture isotope Ce^{138}, an approximate value of $\geqslant 4$ could only be determined for the N_K/N_L ratio.

The electron spectrum from sample 3 exhibited lines from a 257 ± 1-kev γ-transition, decaying with a half-life of approximately 2 days. These lines were not evident in the spectra from samples 1 and 2; and, therefore, the 257-kev transition cannot be ascribed to the activity of Ce^{143}, of similar lifetime. It is rather to be identified with the 280-kev γ-transition of 36-hour Ce^{137} discovered by Chubbuck and Perlman.[5] The activity in the present experiments was again too weak to obtain either an accurate determination of the position of the L conversion line, for an assignment of its conversion atom, or an accurate measurement of the N_K/N_L ratio, which was estimated to be ~ 4.

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Radiations from I^{126}

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IODINE 126 is known to decay with a half-life of 13 days, emitting negative beta-particles and gamma-rays.[1] However, the yields reported for the reactions $I^{127}(\gamma, n)I^{126}$,[2] $Sb^{123}(\alpha, n)I^{126}$,[3] and $Bi^{209}(d, \text{fission})$,[4] as determined from the I^{126} beta-activity, seem low. An investigation of the decay scheme of I^{126} has therefore been undertaken, and preliminary results are reported here.

The I^{126} was produced at MIT by the reaction $I^{127}(n, 2n)I^{126}$, and it was concentrated by a Szilard-Chalmers separation from the irradiated solid potassium iodate. The activity, with some inactive iodine carrier, was purified and finally converted to aqueous I_2 solution which was placed over a copper foil. The activity deposited itself onto the foil as a result of the reaction $2Cu+I_2\rightarrow 2CuI$.[5]

Tellurium K x-rays were observed in the decay of I^{126} by use of a proportional counter[6] and pulse height analyzer.[7] The counter had a 107-mg/cm^2 beryllium window, and it was filled to three atmospheres pressure with a mixture of 97 percent krypton and 3 percent ethane. The counting efficiency for tellurium K x-rays was about 90 percent. Figure 1 shows a typical I^{126} pulse height

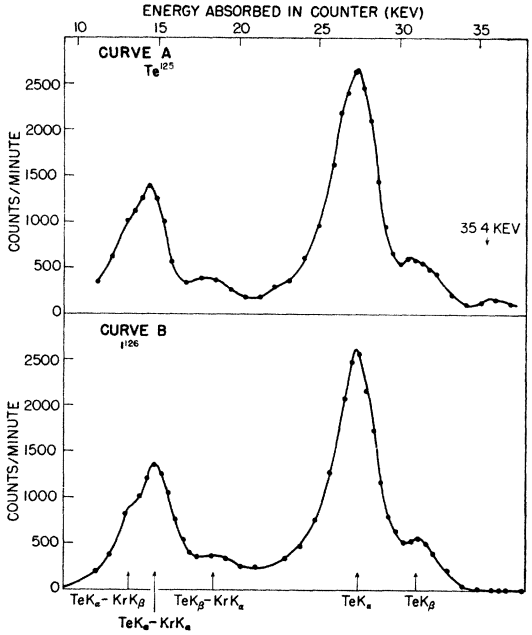

FIG. 1. Pulse spectra from x-rays of Te^{125} and I^{126}.

spectrum measured through sufficient beryllium to absorb the beta-particles and L x-rays. For comparison, the tellurium K x-ray spectrum resulting from the isomeric transition in Te^{125} is also shown. The correspondence of the two curves proves that the I^{126} radiations are tellurium K x-rays. Xenon K x-rays arising from internal conversion following β^- decay cannot contribute more than 2 percent of the x-ray intensity.

The absolute K-electron capture rate of an I^{126} sample was calculated from the x-ray pulse height distribution by the method previously described.[6] A fluorescence yield of 0.75 was assumed.[8] The L capture rate may be estimated[9] to be 12 percent of the K rate. The absolute beta-disintegration rate was measured for an I^{126} sample of known capture activity by correction of the measured Geiger activity for solid angle, absorption in air and counter window, back scattering, coincidence loss, and x- and gamma-activities. The ratio of the electron capture probability to the beta-decay probability for I^{126} was found to be 1.44 ± 0.15.

Beta-ray spectrometer measurements made by Alburger demonstrated, in agreement with earlier data,[1] the existence of two beta-transitions of energies 1.24 ± 0.02 Mev (~25 percent) and 0.85 ± 0.03 Mev (~75 percent), and of conversion electrons of a 0.382 ± 0.004-Mev gamma-ray.

Gamma-ray energies were measured with a scintillation spectrometer, in collaboration with E. der Mateosian. A 640 ± 20-kev gamma-ray line was found, low in intensity compared with the previously known 390-kev line. The energies of the two lines were established by comparison with the gamma-rays of Cs^{137} (663 kev) and of Au^{198} (411 kev). In addition, a faint line was observed of energy corresponding to annihilation radiation.

With an I^{126} source, coincidences were observed between pulses from two NaI(Tl) scintillation counters placed at right angles and shielded from each other by 4 mm of lead. Measurements with copper and lead absorbers showed that approximately one-half the observed coincidence rate represented x-γ events and one-half γ-γ events. A comparison of the coincidence rates at 180° and at 135°, when both counters were covered with 3 g/cm² of lead absorber, established the presence of annihilation radiation. A preliminary estimate of 2 percent positron decay may be deduced from the data. Beta-gamma coincidences were measured with the use of a Geiger counter and a NaI-scintillation counter. Comparison of the β-γ coincidence counts per β-count for I^{126} and for Au^{198} (which has a 960-kev beta-transition followed by a 411-kev gamma-ray) and coincidence absorption measurements showed the following: (1) the 1.24-Mev betas do not coincide with gamma-rays and therefore presumably go to the ground state of Xe^{126}; (2) the 0.85-Mev betas are followed by a single gamma-ray transition, probably the observed 0.38-Mev gamma. The γ-γ coincidences and the 640-kev gamma-ray must therefore be in the electron capture branch. The coincidence work was done in collaboration with Dr. A. W. Sunyar.

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Angular Distributions of the Two Gamma-Rays from $Li^7(p, \gamma)Be^8$ Reaction*

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THE separate angular distributions of the 14- and 17-Mev gamma-rays from $Li^7(p, \gamma)Be^8$ reaction have been studied at two proton bombarding energies. From these measurements it has been possible to draw certain conclusions concerning the angular momentum of the energy levels involved. Earlier published experiments[1-5] have left considerable uncertainty both with regard to the angular distribution and to the nature of these levels.

The two gamma-ray lines were resolved using the gamma-ray pair spectrometer.[6] The angular aperture of the spectrometer was limited to ±7 degrees; then, by varying the angular position of the spectrometer with respect to the target and incident proton beam, it was possible to measure the intensity of each of the lines as a function of angle. A Pb radiator of 84 mg/cm² was used in the spectrometer.

The two proton bombarding energies were 0.50 ± 0.03 Mev and 1.15 ± 0.05 Mev. At the bombarding energy of 0.50 Mev a thick target was used, yielding mostly 440-kev resonance radiation. At the proton energy of 1.15 Mev a target thickness of 250 ± 50 kev was used. This yields mainly "nonresonant" radiation. For each proton energy, observations were made of the intensities of the two gamma-ray components at three angles of emission. Two stationary Geiger counters were used to monitor the primary beam intensity.

The data may be considered in two different ways. One may first obtain the ratio of intensity of the 17- to 14-Mev component at each angle of observation. For isotropic distributions this ratio should be independent of the angle. One may also obtain the variation of intensity of the individual gamma-ray components as a function of the angle, thus obtaining the separate angular distribution functions. Because of corrections for gamma-ray absorption in the target and the necessity to rely on the counters for long time stability, these values are less accurate. The results are given in Table I.

Within the limits of error, the resonant radiation is isotropic for both components. This is in agreement with the results of Devons and collaborators,[1,2] who find that under these conditions the total radiation differs from isotropy by only 4 percent and also that a pair spectrometer measurement indicates each component to be isotropic to within the accuracy of their measurements (about 20 percent). These results are in sharp disagreement with those of Nabholtz, Stoll, and Wäffler,[3] who obtained the value of 2.2 for R_{90}/R_0 using photographic plates and the $C^{12}(\gamma, 3\alpha)$ reaction for energy discrimination.