TABLE I. Xe^{133} half-life from mass spectrometer abundance data.

Ratio of Xe mass ion currents×100	Time after first analysis (hr) 0	45.83	92.91	Xe^{133} half-life calculated (days)
133/(131+132)	34.60±0.005	26.91±0.006	20.79±0.015	5.263 5.276 5.270
133/(131+132+134+136)		7.022±0.01	5.430±0.02	5.276
			Average	5.271± 0.002

which involves comparative abundance data is good to 0.1 percent.

A small disk of uranium metal was irradiated and the rare gases extracted, purified, and analyzed within 10 days after the irradiation period. By comparing the abundance of the Xe^{133} isotopes with that of a stable xenon isotope (Table I) over time intervals of approximately two days, it was possible to follow the decay rate of Xe^{133}. Employing the decay equation $n=n_0e^{-\lambda t}$, where n is the concentration at time t, n_0 is the concentration at zero time, and λ equals $(0.6932/T_{\frac{1}{2}})$, where $T_{\frac{1}{2}}$ is the half-life of the isotope in question, and substituting, for example, the 133/(131+132) ratio obtained with the mass spectrometer at different time intervals for n/n_0, the half-life of Xe^{133} can be found by solving for $T_{\frac{1}{2}}$.

Previous authors[4–8,10] have identified the mass chain of the 5-day β-emitter as 133 by the following reactions:

$$\begin{aligned}
&(1)\quad Cs^{133}(n,\,p)Xe^{133}\\
&(2)\quad Ba^{136}(n,\,\alpha)Xe^{133}\\
&(3)\quad Te^{130}(\alpha,\,n)Xe^{133}\\
&(4)\quad Xe^{132}(d,\,p)Xe^{133}.
\end{aligned}$$

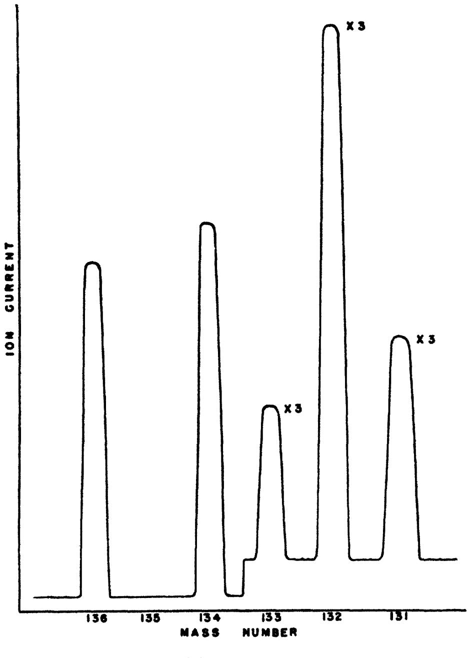

FIG. 1. Stable isotopes of fission product xenon, also $xenon^{133}$.

The mass spectrometer identification of Xe^{133}, see Fig. 1, together with abundance data for calculating its half-life is, of course, further direct evidence for the mass assignment of the fission chain leading to five-day xenon. Previous spectrograms by H. G. Thode and R. L. Graham[1] show no Xe^{133} because the uranium rods were allowed to stand for a number of months after irradiation to permit the various fission product chains to decay to the stable Xe^{131}, Xe^{132}, Xe^{134}, Xe^{136} isotopes.

The accurate half-life determinations possible from mass spectrometer abundance data for such isotopes as Xe^{133} and Kr^{85}, suggest that gases containing these isotopes be used in checking the efficiency of counters for absolute β-counting. Actually, the half-life values obtained for C^{14} by different workers vary from 4700 to 6400 years[12,13] largely because of difficulties in determining the efficiency of the counting equipment. There is a need, therefore, for gases convenient to handle for which the specific activity is accurately known.

We wish to thank the National Research Council of Canada for financial assistance and to acknowledge the use of facilities of the Chalk River Laboratories, particularly those of the Chemistry Division.

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Natural Abundance Measurements on Germanium*

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December 10, 1948

IN conjunction with the electromagnetic separation of stable isotopes at the Y-12 Plant of Carbide and Carbon Chemicals Corporation, Oak Ridge, Tennessee, it became necessary for the Assay Laboratory Department to develop methods for the routine isotopic analyses of enriched germanium samples. Review of the literature failed to reveal recent measurements of the natural isotopic composition of this element, and the results of Aston's[1] work are shown in Table I. To check the reproducibility of the method and to provide more accurate data on the natural composition, these values were redetermined.

For the routine method, the compounds used had to be reliably prepared from small quantities of material, yielding a reproducibly pure product. Germanium tetraiodide and germanium tetrafluoride met these requirements. The tetraiodide was distilled through a heated delivery tube, and germanium tetrafluoride was admitted into the instru-

TABLE I. Relative abundances of germanium isotopes from measurements on GeF_3 and GeI.

Mass	70	72	73	74	76
GeF_3^+	20.60	27.38	7.83	36.40	7.78
Mean Dev.	±0.06	±0.08	±0.06	±0.10	±0.05
GeI^+	20.65	27.43	7.86	36.34	7.72
Mean Dev.	±0.04	±0.02	±0.04	±0.05	±0.01
Aston[a]	21.2	27.3	7.9	37.1	6.5

[a] See reference 1.

ment through a capillary leak. Ionization in the Nier-type mass spectrometer was accomplished by slow electron bombardment of the vapors. The ions thus formed were accelerated by a potential of 2000 volts and separated with the conventional sector magnet. The resulting ion currents were measured with an FP54 electrometer tube, balancing the potential developed across the grid resistor with a potential from a precision potentiometer. The ion currents were also recorded by use of a Victoreen VX-41 electrometer tube, driving a standard Brown Electronik Recorder. The vacuum was approximately 5×10^{-7} mm of Hg, and the resolution in all cases was perfect.

In the case of the tetrafluoride, the measurements were made upon the GeF_3^+ ion, and the GeI^+ ion was used for measurements when the tetraiodide was distilled into the instrument. The results obtained with these compounds are shown in Table I.

The abundances, using GeF_4, are the result of three samples in two instruments and the GeI_4 measurements of two samples in one instrument. It was found that variations between instruments and between ion sources in the same instrument were larger than variations between samples. Investigation of the mass region, adjacent to the measured ions, revealed it exceptionally free from interfering ions of other materials.

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* This document is based on work performed for the AEC by Carbide and Carbon Chemicals Corporation, at Oak Ridge, Tennessee.

[1] Aston, *Mass Spectra and Isotopes* (Edward Arnold and Company, London, 1944), p. 154.

Erratum: Significance of the Radioactivity of Potassium in Geophysics. II

[Phys. Rev. 74, 831 (1948)]

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December 15, 1948

THE sentence at the end of the second paragraph on page 832 should read:

"In addition, to account for the large amounts of atmospheric argon, it should then be assumed that all argon produced in a 40-kilometer deep crustal layer, since the origin of the earth, has escaped into the atmosphere."

Not ". . . that all argon was produced in a 40-kilometer deep crustal layer, since the origin of the earth has escaped into the atmosphere."

Erratum: Line Shapes in Nuclear Paramagnetism

[Phys. Rev. 74, 1184 (1948)]

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A FACTOR $\frac{1}{2}$ should be supplied to the right member of each of Eqs. (8), Eq. (10), Eq. (11), and the first of Eqs. (1) to make these formulae accurate for frequency ν in the vicinity of the resonant frequency ν_0. The graphs in Figs. 2 and 3 will then read properly if ordinates are measured in units of $\frac{1}{2}\chi_0\omega_0T_2$.

It should be emphasized that the approximations $\nu/(\nu'+\nu)\cong\frac{1}{2}$ and $\nu'/(\nu'+\nu)\cong\frac{1}{2}$, which hold near resonance and lead to the special forms (3), (4), and (5) of the Kronig-Kramers relations, are evidently not valid at $\nu=0$. Thus the forms of $\chi'(\nu)$ derived from these approximations do not reduce to χ_0 at $\nu=0$ as stated in the paper, but should reduce to $\frac{1}{2}\chi_0$ instead. Supplying the above-mentioned factors $\frac{1}{2}$ takes care of this point, which the authors regrettably overlooked.

On the Numerical Calculation of the Internal Conversion in the *K*-Shell; the Electric Dipole Case

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October 25, 1948

THE accurate calculation of internal conversion coefficients is a problem in which recent experimental advances have stimulated considerable interest. Some months ago at the instigation of members of the staff of the National Research Council of Canada at Chalk River, the writers undertook an extensive tabulation of such coefficients in connection with a computational program at the University of Toronto. Recently, it has been learned that similar calculations are being done with the aid of the Harvard Mk II computer. Accordingly, further work here has been suspended pending publication of the Harvard calculations. However, the results which the writers have

TABLE I. Values of the coefficient $2I_k$ for the two electrons of the *K*-shell.

θ \ Z	89	84	79	74	69
0.05	0.00007429	0.00006297	0.00005390		
0.10	0.0002008	0.0001667	0.0001393		
0.15	0.0003772	0.0003056	0.0002530		
0.20	0.0005938	0.0004769	0.0003941		
0.25	0.0008497	0.0006773	0.0005611		
0.50	0.002706	0.002228	0.001825	0.001485	0.001198
0.70	0.004922	0.004112	0.003405	0.002797	0.002280
1.00	0.009736	0.008304	0.006956	0.005810	0.004805
1.50	0.02248	0.01956	0.01687	0.01440	0.01214
1.70	0.02949	0.02593	0.02253	0.01936	0.01642

Note. In the above Table, $2I_k$ denotes the fraction of photons with energy $h\nu$, emitted by the nucleus, which are absorbed by either of the two electrons in the *K*-shell with ejection of the absorbing electron from the atom. No allowance for screening effects has been made.

The parameters Z and θ denote, respectively, the atomic number and the ratio $mc^2/h\nu$, where mc^2 is the smallest relative energy of a free electron. The value 1/137 has been taken for the fine structure constant.