The Isotopes of Uranium, Thorium and Thallium

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(Received October 8, 1932)

The magneto-optic method shows eight isotopes each for uranium, thorium and thallium

A MORE intensive study, by means of the magneto-optic method,[1] has been made of the isotopic composition of uranium, thorium and thallium. The technique employed has been described by Bishop, Lawrenz and Dollins.[2] Eight isotopes have been found for each of the three elements. These results are based upon the correspondence of the number of the characteristic minima of a compound to the number of isotopes of the cation. The approximate order of abundances of the isotopes has been determined from the concentrations at which the respective minima make their threshold appearances.[2] Each element was examined in at least three compounds as shown in Tables I–III. The probable masses[3] and the approximate order of abundance of the isotopes, together with the scale readings of the minima and the differential time lags with respect to carbon disulfide, are indicated in the tables.

TABLE I. *Scale readings and differential time lags with respect to carbon bisulfide of uranium isotopes in various compounds.*

Probable atomic mass of uranium isotopes	Probable order of abundance	UCl_4		UCl_6		$U(SO_4)_2$		$U_3(PO_4)_4$	
		Scale reading	Sec. $\times 10^9$	Scale reading	Sec. $\times 10^9$	Scale reading	Sec. $\times 10^9$	Scale reading	Sec. $\times 10^9$
240	3	29.43	−14.43	22.92	−7.92	22.99	−7.99	39.53	−24.53
239	2	29.54	−14.54	23.02	−8.02	23.11	−8.11	39.73	−24.73
238	1	29.62	−14.62	23.10	−8.10	23.19	−8.19	39.94	−24.94
237	5	29.65	−14.65	23.20	−8.20	23.27	−8.27	40.24	−25.24
236	8	29.73	−14.73	23.30	−8.30	23.37	−8.37	40.42	−25.42
235	6	29.83	−14.83	23.40	−8.40	23.48	−8.48	40.62	−25.62
234	4	29.91	−14.91	23.51	−8.51	23.57	−8.57	40.85	−25.85
233	7	30.00	−15.00	23.62	−8.62	23.65	−8.65	41.12	−26.12

TABLE II. *Scale readings and differential time lags with respect to carbon bisulfide of thorium isotopes in various compounds.*

Probable atomic mass of thorium isotopes	Probable order of abundance	$ThCl_4$		$Th(SO_4)_2$		$Th_3(PO_4)_4$	
		Scale reading	Sec. $\times 10^9$	Scale reading	Sec. $\times 10^9$	Scale reading	Sec. $\times 10^9$
236	5	26.10	−11.10	19.57	−4.57	36.00	−21.00
235	4	26.19	−11.19	19.65	−4.65	36.20	−21.20
234	3	26.28	−11.28	19.72	−4.72	36.35	−21.35
233	7	26.40	−11.40	19.87	−4.87	36.48	−21.48
232	1	26.50	−11.50	19.98	−4.98	36.64	−21.64
231	8	26.60	−11.60	20.10	−5.10	36.83	−21.83
230	2	26.70	−11.70	20.21	−5.21	36.95	−21.95
229	6	26.80	−11.80	20.30	−5.30	37.10	−22.10

The detection of these new isotopes, which were not noted in an earlier investigation,[4] is to

[1] Allison, Ind. and Eng. Chem. (Anal. Ed.) **4**, 9 (1932); Allison, Preprint, Amer. Inst. Mining and Metallurgical Engineers.

[2] Bishop, Lawrenz and Dollins, *Lead Isotopes*, Phys. Rev. **43**, 43 (1933).

[3] Bishop, *Radioactive Families*, Phys. Rev. **43**, 38 (1933).

[4] Allison and Murphy, Phys. Rev. **36**, 1097 (1930).

TABLE III. *Scale readings and differential time lags with respect to carbon bisulfide of thallium isotopes in various compounds.*

Probable atomic mass of thallium isotopes	Probable order of abundance	TlCl		Tl_2SO_4		Tl_3PO_4	
		Scale reading	Sec. $\times 10^9$	Scale reading	Sec. $\times 10^9$	Scale reading	Sec. $\times 10^9$
215	7	42.06	−27.06	29.67	−14.67	54.50	−39.50
213	8	42.19	−27.19	29.81	−14.81	54.64	−39.64
211	3	42.33	−27.33	29.91	−14.91	54.80	−39.80
209	6	42.40	−27.40	30.00	−15.00	54.98	−39.98
207	1	42.51	−27.51	30.08	−15.08	55.14	−40.14
205	2	42.65	−27.65	30.22	−15.22	55.30	−40.30
203	4	42.81	−27.81	30.32	−15.32	55.44	−40.44
201	5	42.95	−27.95	30.47	−15.47	55.64	−40.64

be attributed to more available time for their study and to further improvements in the technique. A reexamination of many other elements, it is believed, may reveal additional minima and hence additional isotopes. Such an investigation is contemplated in this laboratory.

We have pleasure in acknowledging our indebtedness to Dr. C. S. Piggot for much helpful cooperation, at whose suggestion these investigations were undertaken. We wish to express our appreciation to Miss Edna R. Bishop for collaboration in some of the work. We wish also to thank Mr. R. E. Wingard for valuable assistance in making observations.