LETTERS TO THE EDITOR

Prompt publication of brief reports of important discoveries in physics may be secured by addressing them to this department. Closing dates for this department are, for the first issue of the month, the twentieth of the preceding month; for the second issue, the fifth of the month. The Board of Editors does not hold itself responsible for the opinions expressed by the correspondents.

On the Nuclear Radius

According to Eastman's[1] interpretation of Heisenberg's equation, we have $r'=r_0M^{\frac{1}{3}}$, where r' is the nuclear radius, r_0 a proportionality constant, and M the isotopic weight. In this connection, it was considered interesting to plot in Fig. 1 the nuclear radius r' against $A^{\frac{1}{3}}$, where A is the chemical atomic weight of the product nucleus, chosen because it gives a convenient average of isotopic weights and relative abundance of isotopes. The nuclear radii for elements of light weight were calculated from Pollard's[2] barrier heights according to $r'=2Z^*e^2/U$, where U is the barrier height, and Z^* the atomic number less two. These values are in good agreement with those suggested by Riezler.[3] The barrier heights observed by Duncanson and Miller[4] and those to be had from Klarmann's[5] results were not included in Fig. 1, since it was felt that with other workers, disagreeing as to the shape of the potential barrier curve, the results would not be consistent with those obtained by Pollard. In fact, in calculating U for C and Al, Pollard used a somewhat different method, and it is seen that r' for these elements falls somewhat off the curve. The radii for the heavier radioactive elements were computed from Gamow's equation[6]

$$\lambda=(h/4mr'^2)\exp\left(-4\pi[2m]^{\frac{1}{2}}/h\right)\int_{r'}^{r^*}(2Z^*e^2/r-E)^{\frac{1}{2}}dr,$$

where $r^*=2Z^*e^2/E$, λ is the decay constant, m the mass of the alpha-particle, E the energy of the alpha-particle. The radius, r', is here defined as the lower limit of the integral. For the purposes of this calculation the integral was graphically evaluated thus avoiding the errors found in the approximation. From Fig. 1, it will be noted that r' is linearly dependent on $A^{\frac{1}{3}}$, and not proportional as given by the theory above, not only for the light, but also for the heavy nuclei. Also, although the slope of the lines for the light and heavy elements may be taken as parallel, they do not form a continuous curve. When r' is plotted against the first power of A, a smooth curve, not a straight line, is obtained for the light elements. When r' is plotted against the atomic number, a random distribution of radioactive nuclei is obtained, which must be analyzed into distinct family components for a semblance of order. Thus it is seen empirically that the best results are obtained by plotting r' against $A^{\frac{1}{3}}$. Analysis of the figures in Table I leads one to note that roughly, with the exception of RaAc, those elements furthest off the curve give off complex radiation. In these cases of complex radiation, only the strongest group was used in the calculations. The elements, Pa, Ac C′, Th, and Th C′ were omitted because of discrepancies in the observed values of the decay constant.

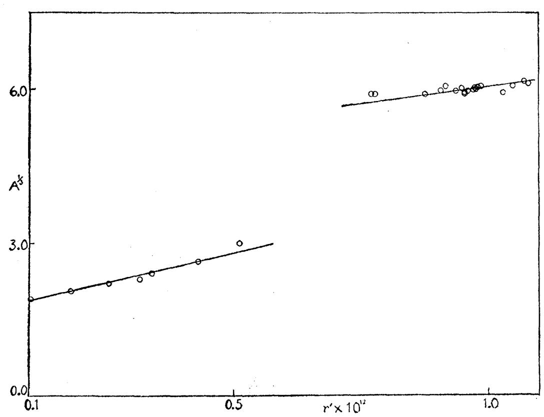

FIG. 1.

TABLE I.[7]

Parent nucleus	r'	Parent nucleus	r'
Li	0.10×10^{-12}	Ra C	1.03×10^{-12}
Be	.18	Ra C′	0.95
B	.26	Ra F	.88
C	.32	Ra Ac	.92
N	.34	Ac X	.95
F	.43	An	.91
Al	.51	Ac A	.94
U_1	1.07	Ac C	.78
U_2	1.08	Ra Th	.99
Io	1.05	Th X	.97
Ra	.98	Tn	.97
Rn	.98	Th A	.95
Ra A	.96	Th C	.77

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[1] Eastman, Phys. Rev. **46**, 1, 744 (1934).
[2] Pollard, Phil. Mag. **16**, 1131 (1933).
[3] Riezler, Proc. Roy. Soc. **A134**, 154 (1931).
[4] Duncanson and Miller, Proc. Roy. Soc. **A146**, 417 (1934).
[5] Klarmann, Zeits. f. Physik **87**, 411 (1934).
[6] Gamow, *Constitution of Atomic Nuclei and Radioactivity*, p. 49 (Oxford, 1931).
[7] Data secured from: *International Radium Standards Commission*, J. Am. Chem. Soc. **53**, 2437 (1931); Rutherford, Chadwick and Ellis, *Radiations from Radioactive Substances* (Cambridge, 1930); Gamow, *Constitution of Atomic Nuclei and Radioactivity* (Oxford, 1931); Kovarik and Adams, Phys. Rev. **40**, 718 (1932); Gratias, Phil. Mag. **17**, 491 (1934); Walling, Zeits. f. physik. Chemie **10** (6), 467B (1930); Collie, Proc. Roy. Soc. **A131**, 541 (1931); Soddy, Phil. Mag. **12**, 939 (1931); Gleditsch and Foyn, Am. J. Sci. **24**, 387 (1932); Jacobsen, Nature **133**, 565 (1934); Fesefeldt, Zeits. f. Physik **86**, 9–10, 605 (1933); Barton, Phil. Mag. **2**, 1273 (1926); Briggs, Proc. Roy. Soc. **A118**, 549 (1928), **A139**, 638 (1933), **A143**, 604 (1934); Geiger, Zeits. f. Physik **8**, 45 (1921); Laurence, Trans. Nova Scotia Ins. Sci. **17**, I, 103 (1927); Rosenblum, Comptes rendus **190**, 1124 (1930), **193**, 848 (1931), **194**, 1154 (1932), **195**, 317 (1932); Laurence, Proc. Roy. Soc. **A122**, 543 (1929); Rosenblum and Dupouy, Comptes rendus, **194**, 1919 (1932); Rosenblum and Chamié, Comptes rendus, **196**, 1663 (1933); Rutherford, Wynn-Williams and Lewis, Proc. Roy. Soc. **A133**, 351 (1931); Rutherford, Ward and Lewis, Proc. Roy. Soc. **A131**, 684 (1931); Rutherford, Wynn-Williams and Bowden, Proc. Roy. Soc. **A139**, 617 (1933).