THE COMPOSITION OF THE ATOMIC NUCLEUS

Sir:

In recent papers on the atomic nucleus by Harkins,[1] Latimer[2] and Urey[3] various combinations of (1) helium nuclei, (2) additional binding electrons or cementing electron pairs and (3) additional protons and electrons are used to make up the isotopic weight, *i. e.*, the *mass* of the atom. However, it seems that the atomic number, *i. e.*, the *positive charge* on the nucleus, is more significant. If this charge is due to α-particles alone, which are after all the only nuclear fragments of appreciable mass obtained during radioactive decay, it follows that their number in the nucleus is equal to one-half the atomic number, $\alpha = AN/2$, where α is p_4e_2. If the number of protons and electrons corresponding to $AN/2$ α-particles is subtracted from the total number of protons and electrons in the nucleus of any isotope, there remains in *every case an equal number* of protons and electrons. This leads to the conclusion that Harkins' isotopic number must be interpreted as the number of neutrons, *pe*, or a proton and an electron.[4]

The simplest groupings of protons and electrons in the nucleus is therefore as

p_4e_2 or α, helium nuclei or α-particles—the number of which is equal to one-half the atomic number

p_2e or $\alpha_{0.5}$, half α-particles—only one of these occurs in each element with odd atomic number

pe or *n*, neutrons—the number of which is equal to the isotopic number, that is, the proton number minus twice the atomic number. This number ranges from 0 to 54.

With this concept it is also possible to harmonize Latimer's nuclear structure by modifying the number of α-particles to be $AN/2$ and substituting the proper number of neutrons for cementing electron pairs, thereby avoiding the difficulty of ascribing the same number of helium nuclei to different elements, and a different number of helium nuclei to the isotopes of the same element.

Isotopes differ therefore only in the number of neutrons and radioactive decay can be explained as follows

AN or $p - e$		Total no. of p and e	Composition as α and n	Nuclear change during decay
92	U I	$p_{238}e_{146}$	$\alpha_{46}n_{54}$	loss of p_4e_2 or α
90	U X$_1$	$p_{234}e_{144}$	$\alpha_{45}n_{54}$	loss of e or $2n$ and gain of $\alpha_{0.5}$
91	U X$_2$	$p_{234}e_{143}$	$\alpha_{45.5}n_{52}$	loss of e or $2n$ and gain of $\alpha_{0.5}$
92	U II	$p_{234}e_{142}$	$\alpha_{46}n_{50}$	loss of p_4e_2 or α
90	Io	$p_{230}e_{140}$	$\alpha_{45}n_{50}$	loss of p_4e_2 or α
88	Ra	$p_{226}e_{138}$	$\alpha_{44}n_{50}$	

and so on

[1] Harkins, *Phys. Rev.*, **38**, 1270 (1931).
[2] Latimer, This Journal, **53**, 981 (1931).
[3] Urey, *ibid.*, **53**, 2872 (1931).
[4] Langer and Rosen, *Phys. Rev.*, **37**, 1579 (1931).

This shows that during β-decay a half α-particle is formed from two neutrons, $2pe \longrightarrow p_2e + e$; inasmuch as two β-decays follow each other in rapid succession, the net result for the nucleus is the formation of an α-particle, $2p_ee \longrightarrow p_4e_2$.

Artificial disintegration could then be explained by the expulsion of neutrons and this would be possible only with Li^7, Be^9, B^{11}, C^{13}, O^{17} and O^{18}, etc., but not with Li^6, Be^8 B^{10} etc.

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THE ATOMIC WEIGHTS OF SELENIUM AND OF TELLURIUM

Sir:

The chemically determined values for the atomic weights of selenium and of tellurium have recently been questioned by Aston[1] on the basis of improved measurements with the mass spectrograph.

With the advantage of increased precision in the measurements of relative amounts of the isotopic constituents, Aston reports the following relative percentages: for tellurium, Te_{125} (6.6%), Te_{126} (20.9%), Te_{128} (36.1%) and Te_{130} (36.4%); and for selenium, Se_{74} (0.9%), Se_{76} (9.5%), Se_{77} (8.3%), Se_{78} (24.0%), Se_{80} (48.0%) and Se_{82} (9.3%). Corrected for packing effects and converted to the chemical oxygen scale these figures lead to respective atomic weights 128.03 $\pm$ 0.1 and 78.96 $\pm$ 0.04. The limits of error are those assigned by Aston. The atomic weights determined by chemical means are, respectively, 127.5 and 79.2.[2] These latter values have stood for over twenty years although subjected to frequent careful redeterminations by different workers.[3] Tellurium, in particular, has received more than usual attention due to its anomalous position with respect to iodine in the older arrangements of the Periodic Table.

Te_{125} is a new discovery. Its discovery, together with the discoveries of Ba_{136} and Sr_{87} also reported by Aston,[1] constitutes confirmation of

[1] Aston, *Proc. Roy. Soc.* (London), **A132**, 487 (1931).

[2] Table of International Atomic Weights, Report of the Committee on Atomic Weights of the International Union of Chemistry, THIS JOURNAL, **53**, 1627 (1931).

[3] Baker and Bennett, *J. Chem. Soc.*, **91**, 1849 (1907); Harcourt and Baker, *ibid.*, **99**, 1311 (1911); Marckwald and Foizik, *Ber.*, **43**, 1710 (1910); Flint, THIS JOURNAL, **34**, 1325 (1912); Dudley and Bowers, *ibid.*, **35**, 875 (1913); Dennis and Anderson, *ibid.*, **36**, 882 (1914); Staehler and Tisch, *Z. anorg. allgem. Chem.*, **98**, 1 (1916); Bruylants and Desmet, *Bull. soc. chim. Belg.*, **28**, 264 (1919); Bruylants and Michielson, *Bull. sci. acad. roy. Belg.*, [V] 5, 119 (1919); Bruylants and Bytebier, *Bull. Belg. acad.*, 856 (1912); Kusma and Kruhlik, *Trans. Bohemian acad. of Emperor Francis Joseph*, **19**, No. 13 (1910); Jannek and J. Meyer, *Z. Electrochem.*, **19**, 833 (1913); *ibid.*, **83**, 51 (1913); Bruylants and Dondeyne, *Bull. sci. acad. roy. Belg.*, [V] 8, 387 (1922); Bruylants, La Fortuen and Verbruggen, *Bull. soc. chim. Belg.*, **33**, 587 (1924 .