THE HYDROGEN NUCLEUS OF MASS 2 (ISOHYDROGEN NUCLEUS p_2e) AS A UNIT IN ATOM BUILDING

Sir:

On the basis of the fact that the formula[1] $(p_2e)_z$ represents the most abundant atomic nuclei, and because the formula p_2e represents the general increment in composition of nuclei of odd atomic weight, the writer has considered the nuclear group p_2e to play a fundamental role in atom building. Also such a particle was supposed to possess a great advantage over the alpha particle as a unit in atom building since, on account of its smaller charge, it much more readily penetrates the potential wall around a complex nucleus. A part of this point of view is presented in fragmentary quotations from papers published[2] in 1921 and 1923. "Electron groups in which one negative electron alone is present may be even more fundamental in a certain sense" than the p_2e_4 group or alpha particle, "especially since the group p_2e corresponds to the minimum value of N/P for a nucleus stable both with respect to disintegration by ordinary means, and moderately stable with regard to aggregation" (*i. e.*, union with other nuclei). "If p_2e is the fundamental group, as the general considerations suggest, then its low abundance may be explained as due to the pairing of the negative electrons, two p_2e groups changing into one alpha particle." "The first step in the formation of an alpha particle may be the union of two protons with one electron to form the group p_2e, which is very difficult to break up, but readily unites with a like group to form an alpha particle. Sometimes it may add to a complex nucleus." The newer data give additional support to this idea. All atomic species may be divided into four series (Table I).

TABLE I

1. Even ($2R$) Series	2. Odd ($2R + 1$) Series
$(p_2e)_R e_S$	$(p_2e)_R(pe)e_S$
A. Thorium ($4\ M$)	R = either odd or even
R = even, S = even	if S = odd or even
B. Uranium	A. Beryllium ($4\ M + 1$)
R = odd, S = odd	B. Actinium (?) ($4\ M + 3$)
R, S, M = whole numbers	

The matching or non-matching of R and S in evenness or oddness is of fundamental importance.

TABLE II

DIFFERENCE OF COMPOSITION ON ANY LEVEL OF CONSTANT ISOTOPIC NUMBER (S = CONSTANT)

Level	Even series	Odd series
Zero	p_2e	p_2e
1 to 26	p_4e_2 ($= \alpha$)	p_2e

[1] p = a proton, e = an electron, z = atomic number, P = atomic weight or number of nuclear protons, N = number of nuclear electrons.

[2] *Phil. Mag.*, **42**, 334 (1921); THIS JOURNAL, **45**, 1426–1433 (1923).

The even series are merely extensions of the radioactive series, *since any level represents a series of alpha changes* (Fig. 1 and Table II).

All levels of the odd, and the zero level of the even, series exhibit the difference p_2e.

It is remarkable that every possible multiple of p_2e from 1 to 8 is now known.[3]

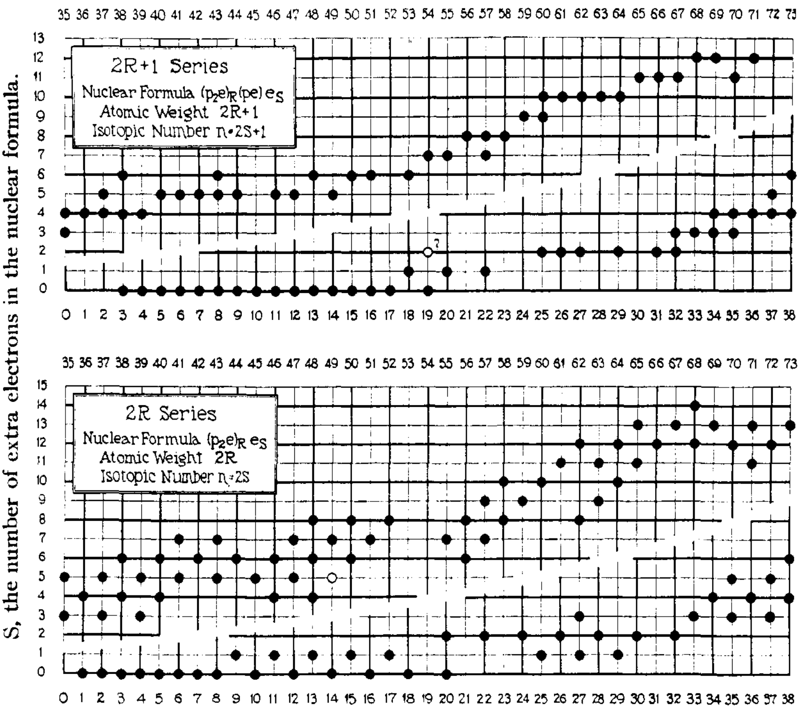

Fig. 1.—R, the number of p_2e units in the nuclear formula (atomic number $Z=R-S$).

The isohydrogen nucleus may be formed by the collision of a proton with a permanent or temporary neutron (pe), or by a three body single collision. In the latter case the wave length emitted should be about 0.001 Å. The nuclear spin of p_2e is probably zero, but may be unity in units $h/2\pi$, while that of the neutron should be $^1/_2$. There is much evidence which indicates that in the nucleus groups of the composition p_2e do not, in general, remain independent, but that they merge by doubling into units of the composition of alpha particles.

[3] Recent discoveries are: beryllium isotope $(p_2e)_8$, Watson and Parker, *Phys. Rev.*, **37**, 167 (1931); and a higher isotope of hydrogen, F. Allison (American Chemical Society meeting, September, 1931), and about 1/4000 of hydrogen of mass 2 in hydrogen, Urey, Brickwedde and Murphy, *Phys. Rev.*, **39**, 154 (1932).

The extra electrons of the formulas (Fig. 1) are therefore not the "extra" or "loose" electrons of the nuclues. The correct values of these are given in another paper (*Phys. Rev.*, **38,** 1280–1282 (1931).

It may be supposed that in the building up of complex atomic nuclei the following particles may attach themselves to an atomic nucleus provided they penetrate its potential wall: protons, electrons, neutrons if they exist, p_2e particles and alpha particles.

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CRYSTALLIZATION VELOCITIES

Sir:

Although it has long been known that the rate of crystallization from supercooled melts is greatly dependent on the particular compound used, the effect of molecular symmetry has not been investigated up to the present time. If there is such an effect, it should be most easily discoverable with organic compounds, whose structures may be postulated from x-ray and dipole moment measurements.

Recent measurements here on the linear crystallization velocity indicate that the symmetry of the molecule largely determines the rate of transition from liquid to solid. The maximum linear velocities of the most illustrative examples so far measured are tabulated.

MAXIMUM LINEAR VELOCITIES

Compound	Rate in mm. per minute	Melting point, °C.	Supercooling, °C.
o-Dichlorobenzene	2,200	−17.6	25
m-Dichlorobenzene	700	−24.8	25
p-Dichlorobenzene	20,000	52.9	25
1,2,4-Trichlorobenzene	25	17	25
1,3,5-Trichlorobenzene	7,500	63.4	26
1,1,2-Triphenylethane	Less than 1	54.0	50
1,1,1-Triphenylethane	77	94.8	33
1,2-Diphenylethane	700	51.2	34
1,1-Diphenylethylene	16	8.2	25
Diphenylmethane	530	25.1	27
Triphenylmethane	27	93.6	29

In view of the recent revival of interest in the subject of crystallization, this preliminary report is being given at this time to avoid possible wasteful duplication. It is planned to discuss the complete results in a paper later.

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