The potassium salt has the same crystal form as the others and qualitative analysis shows the presence of potassium, chlorine, fluorine and iodine. The investigation of this and other polyhalides containing fluorine is being continued and will be reported in detail later.

MORLEY CHEMICAL LABORATORY
WESTERN RESERVE UNIVERSITY
CLEVELAND, OHIO

HAROLD SIMMONS BOOTH
CARL F. SWINEHART
WILLIAM C. MORRIS

RECEIVED APRIL 30, 1932
PUBLISHED JUNE 6, 1932

THE ATOMIC WEIGHTS OF H(2) AND Be(9)

Sir:

Among the lighter elements there are two whose atomic weights are of especial interest at this period, H(2) and Be(9). Since H(2) is a probable nuclear building unit and is also the simplest complex nucleus reported to date (excluding neutrons) an accurate knowledge of its atomic weight gives a measure of the interaction energy of two protons and one electron, which energy may be a fundamental unit of the nucleus.

Another such unit may be the proton–electron interaction energy obtainable from the difference in mass of the neutron(1) and an atom of H(1). The accurate mass of Be(9) is necessary in calculating the mass of the neutron(1) [Chadwick, *Nature*, Feb. 27, 1932].

Until these atomic weights have been accurately determined we may predict values, that for H(2) being obtained by a simple calculation, based on the assumption that the lighter $4N + 2$ elements contain N α particles and one H(2) nucleus. Aston [*Proc. Roy. Soc.* (London), **A115**, 487 (1927)] gives for the packing fractions of Li(6) and B(10), 2.00 ± 0.10 and $1.35 \pm 0.05 \times 10^{-3}$ mass units (probable errors are assumed to be $^1/_3$ maximum allowable error). Using the packing fraction for helium, 0.54 ± 0.03, we obtain from the data for Li(6)

$$4(0.54 \pm 0.03) + 2A_1 = 6(2.00 \pm 0.10) + D_1$$
$$\text{or } A_1 = (4.92 \pm 0.36) + D_1/2 \qquad (1)$$

and for B(10)

$$A_2 = (4.59 \pm 0.37) + D_2/2 \qquad (2)$$

where A_1 and A_2 represent the packing fraction of H(2) and the D's the mass defects of Li(6) and B(10) with respect to He(4) and H(2). Although these equations do not uniquely determine the packing fraction of H(2), they set a lower limit to its atomic weight at $(2.0098 + D_1 \pm 0.0007)$ from (1) and $(2.0092 + D_2 \pm 0.0007)$ from (2). From a consideration of the binding energies in some of the lighter nuclei, we may estimate values for the mass defects of Li(6) and B(10) to be $D_1 = 1.2 \pm 0.4$ and $D_2 = 2.4 \pm 0.6 \times 10^{-3}$ m. u. These values give H(2) an atomic weight of 2.0110

± 0.0011 from (1) and 2.0116 ± 0.0013 from (2); mean *2.0113 ± 0.0012* (mass spectrograph scale). The agreement is satisfactory. This gives $4.3 \pm 1.2 \times 10^{-3}$ m. u. for the binding energy of the H(2) nucleus.

The chemical atomic weight of beryllium determined by Hönigschmid [*Ber.*, **55B**, 4 (1922)] is 9.018 ± 0.002. This is almost certainly too high, for while beryllium exists to 99.95% as Be(9) and to about 0.05% as Be(8) [Watson and Parker, *Phys. Rev.*, **37**, 167 (1931)], no isotope of mass number greater than 9 has been reported. Assuming the nucleus of Be(9) to contain 2 α particles, 1 proton and 1 electron, an upper limit for its atomic weight is 9.011 (chemical scale). This value has neglected the binding occurring between the constituents of the nucleus, which from disintegration experiments [Chadwick, *Proc. Roy. Soc.* (London), **A130**, 463 (1931)] has a value $5 \pm 2 \times 10^{-3}$ m. u., which is about that expected from the differences in mass defects of corresponding members of the $4N + 1$ and $4N$ series. Assuming this as a mass defect for Be(9), its atomic weight becomes 9.006 ± 0.002, and correcting for 1 part in 2000 of Be(8) gives *9.005 ± 0.002* for the atomic weight of beryllium. Since this is 0.013 m. u. less than the present chemical value a redetermination is necessary.

From the probable value of the mass of Be(9) and Chadwick's disintegration experiments we can make a rough estimate of the mass of the neutron(1), which indicates that it is little different from that of its isobar, H(1). If neutrons are formed exothermically from protons and electrons, it would seem highly probable that their formation could be effected in the laboratory and the energy change detected as radiation. The existence of H(2) nuclei [Urey, Brickwedde and Murphy, *Phys. Rev.*, **39**, 164 (1932)] and neutrons(1) suggests that all known atomic nuclei could originate from protons and electrons through a succession of *two body collisions, e. g.*, 2H(2) nuclei $\longrightarrow$ 1 α particle, etc.

CHEMISTRY DEPARTMENT
UNIVERSITY OF CALIFORNIA
BERKELEY, CALIFORNIA
NORMAN S. GRACE

RECEIVED MAY 5, 1932
PUBLISHED JUNE 6, 1932

KINETICS OF THE THERMAL DISSOCIATION OF GASEOUS ETHYL BROMIDE

Sir:

More exact experimental data on simple reactions are urgently needed for testing theories of unimolecular reactions, particularly with reference to the falling-off of the rate-constant at low pressures. The reaction

$$C_2H_5Br = C_2H_4 + HBr$$

has been studied for several years in this Laboratory, and a preliminary