Now the atomic volume of an element increases in all families with its atomic weight or number. In a family or group of metals, the heat of sublimation (or in the absence of precise data, the heat of vaporization at the N.B.P., which runs parallel to it) *decreases*, with a few exceptions, with the atomic number; Table 6 demonstrates this fact for the I, II, III and IV group of metals (including the half metals: Si, B and C). Therefore, the combination of these two factors in metals, namely, *increase* in volume per atom and *decrease* of binding energy per atom, accounts for the compression of the metals with increasing atomic weight. Furthermore, the single

TABLE 6.—EXPERIMENTAL HEATS OF VAPORIZATION OF METALS* AT THEIR N.B.P.

Group I	Group II	Group III	Group IV	Experimental heats of sublimation of solid noble gases at 0°K, (cal/g.atom)
Li 32,190	Be 70,400	B 128,800	Ge 210,000	He 25 ↑
Na 21,280	Mg 34,470(!)	Al 70,200	Si 90,000	Ne 450 ± 10
K 18,530	Ca 36,740	Ga 61,200	Ge 79,900	Ar 1850 ± 12
Rb 16,540	Sr 33,610(!)	In 54,100	Sn 69,400	Kr 2590 ± 50
Cs 15,750	Ba 35,670	Tl 38,740	Pb 42,880	Xe 3830 ± 50
Fr (15,200) ↓	Ra (27,400) ↓	↓	↓	Em (4700)

NOTE: Arrow indicates direction of decrease.

* The metal data were taken from D. R. STULL and G. C. SINKE's, *Thermodynamic Properties of the Elements*, Advances in Chemistry Series, No. 18, Amer. Chem. Soc. Washington, D.C. (1956), and LEO BREWER's chapter in Vol. 19B, Div. IV, Manhattan Project Tech. Sc. of National Nuclear Energy Series, McGraw-Hill, New York (1950). For noble gas data: see reference (11).

valence electron of the alkali metals, on its large satellite orbit, is responsible for the larger atomic volume of the alkali metals vis a vis the II, III or IV group metals with their successively smaller orbitals; this fact coupled with their smaller binding energy (see Table 6) explains the much greater compressibility of the alkali versus the alkaline earth metals. The latter have again greater compressibilities than the transition metals with their many metallic valence electrons.

In the case of the noble gases, however (see also Table 6) the energy required to separate the noble gas atoms in the solid lattice *increases together* with their atomic volume (see Table 1), with the overall effect that the compressibility decreases as shown in Figs. 1 and 2 or in Table 3. The hard core of the xenon atom, with its complete valence shell, is much less compressible than the cesium atom. The helium isotopes, with their solid atomic volume of 20 cm^3, are even more exceptional, because they are about three times "puffed up" over and above the atomic volume of 6 cm^3, expected for He from the volumes of the other noble gases and the usual *decrease* in volume with atomic number observed in all other families of elements. This fact coupled with the extremely small energy of the lattice of about 25 cal/g atom (see Table 6) explains how small pressures compress this element more than any other!