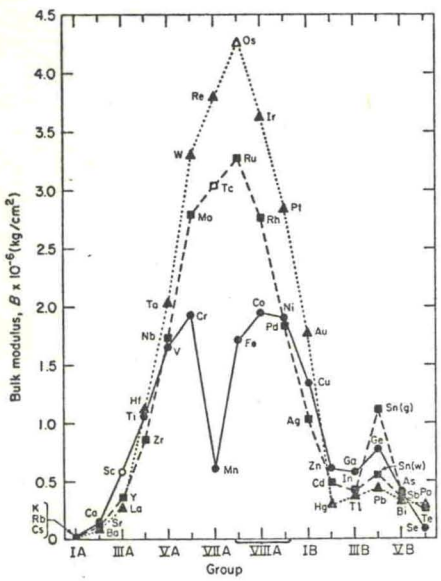

FIG. 6. Bulk modulus of the elements of the fourth, fifth, and sixth periods of the Periodic Table. Open points are estimated values.

of the isothermal compressibility as the pressure approaches zero. Also included in Table V are the estimated values for the elements for which these two quantities are unknown.

The bulk modulus for the fourth, fifth, and sixth periods is shown in Fig. 6. The general trend as one proceeds across one period is similar to that noted for Young's modulus and the shear modulus. The one anomaly, which is very evident, is that manganese has a much smaller bulk modulus than its neighbors. The bulk modulus for the rare-earth series of metals is shown in Fig. 5b. It is evident that a smooth curve can be drawn through the data points if the data points for cerium, samarium, europium, and ytterbium are ignored. The low values for europium and ytterbium are not surprising since these metals are divalent.[13] The value for cerium is probably anomalous because cerium undergoes a polymorphic transition at moderately low pressures—at 7720 kg/cm^2. There is no apparent explanation for samarium's anomalous behavior.

Estimated Data. Of the four elastic properties the bulk modulus (or compressibility) has been determined for more elements than any of the remaining three. Because of this, the bulk modulus was estimated using various extrapolation and interpolation techniques based on the periodic nature of the physical properties of the elements. From the estimated and experimental bulk moduli the other elastic properties were then estimated by making use of the interrelationships among these properties, as described earlier in Sections 3–5.

From the variation of the bulk modulus with the group number in the Periodic Table (Fig. 6) the bulk modulus was estimated for technetium and osmium. If one assumes that the bulk modulus increases between molybdenum and technetium at the same rate that it does between tungsten and rhenium, then an estimated value of 3.19×10^6 kg/cm^2 is obtained for technetium. The mean value of the bulk moduli of molybdenum and ruthenium leads to another estimated value for the bulk modulus of technetium, 3.02×10^{-6}. These two values, when averaged with a third estimated value (see below), give the final estimated value shown in Table V. The percent increase technique was also used to obtain one of the estimated values for osmium; in this instance the percent increase between iridium and osmium was assumed to be identical to that between rhodium and ruthenium. The bulk modulus for promethium was estimated from the plot shown in Fig. 5b for the rare-earth metals. The value for pro-

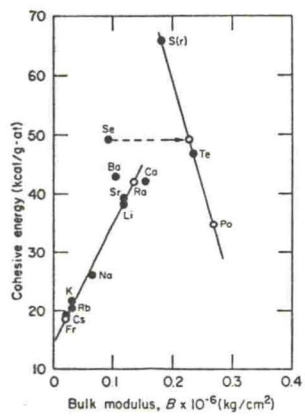

FIG. 7. Bulk modulus versus the cohesive energy of the alkali and alkaline-earth metals, and the calcogens. Open points are estimated values.