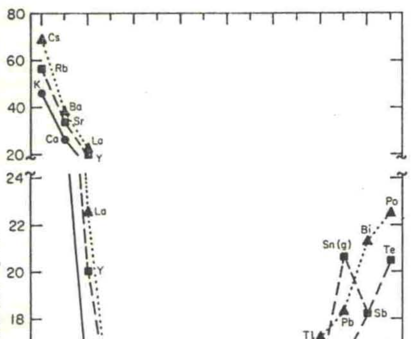

FIG. 11. Atomic volume of the elements of the fourth, fifth, and sixth periods of the Periodic Table.

atomic number, the elements in the fourth period appear to behave slightly differently from those in the fifth and sixth periods. This is especially evident for the atomic volumes of manganese, iron, cobalt, and nickel.

The atomic volumes of the rare-earth metals are shown in Fig. 10b. It is noted that the atomic volumes decrease in a smooth fashion with increasing atomic number except for cerium, europium, and ytterbium. The large anomalous values for the atomic volumes of europium and ytterbium reflect the divalent nature of these two metals. The anomaly at cerium is probably due to the tendency of cerium to become tetravalent.[41] The atomic volumes for both γ-Ce (the normal room-temperature face-centered cubic form) and α-Ce (the low-temperature or high-pressure denser face-centered cubic form) are shown in Fig. 10b. The large difference in volume (17.7%) between these two phases is immediately evident in this plot. The cusp at gadolinium, which is quite obvious in this plot, is found in almost all of the plots of the lattice parameter (which is directly related to the volume) versus atomic number.[42,43]

[41] K. A. Gschneidner, Jr. and R. Smoluchowski, *J. Less-Common Metals*, **5**, 374 (1963).

The atomic volume varies between 3.397 cm^3/g-at for diamond and 69.19 cm^3/g-at for cesium if one considers only the measured or experimental values. However, the estimated value for francium, 73 cm^3/g-at, is even larger than that of cesium.

Estimated Data. The atomic volumes of promethium, francium, and radium were estimated from plots of the atomic volume versus the atomic number of the rare-earth, alkali, and alkaline-earth metals, respectively. The first is an interpolated value and the latter two are extrapolated estimates.

V. Melting Point and Heat of Fusion

7. International Practical Temperature Scale

The international practical temperature scale was first recommended in 1927 by the International Committee on Weights and Measures, and since then has been universally accepted. In 1948 this scale was revised and in 1960 the text of the 1948 agreement was revised, which resulted in a few minor changes in the 1948 scale. These changes included the addition of indium as a secondary fixed point, the deletion of antimony, the revision of the melting points of tin, cadmium, and zinc, and the change of the melting point of zinc from a secondary fixed point to a fundamental and primary fixed point. The data in Table VIII reflect the 1960 revisions, except for the standards that have transition temperatures below the mercury point. The low-temperature standards were omitted, since Table VIII is intended to show only those elements which have been designated as practical temperature standards from the elements which are considered in this review.

At the time the 1927 international practical temperature scale was adopted, it was in very close agreement with the thermodynamic scale. Because of improvements in determining the thermodynamic scale, the difference between these scales is now measurable and significant. At the zinc and sulfur points 0.07° must be added to the international practical

[42] K. A. Gschneidner, Jr., "Rare Earth Alloys," p. 10. Van Nostrand, Princeton, New Jersey, 1961.

[43] K. A. Gschneidner, Jr., *in* "Progress in the Science and Technology of the Rare Earths," Vol. 1, p. 222. Pergamon Press, New York, 1963.