

do not include among the "essential needs" the requirements of war. If humanity finds it impossible to avoid war, we may as well assume that we shall be interested in survival rather than in progress. Nor do essential needs include an obstinate adherence to custom or convenience. If a plastic will take the place of a metal in any particular function, the use of metal in that function is not an essential need.

Consideration should not be given to temporary shortages which, like temporary surpluses, may result from changes in the business cycle. It is only by studying the long-term requirements that significant conclusions can be reached.

Nor should problems of national self-sufficiency be allowed to intrude. In scattering its beneficence nature has not taken note of national boundaries, and it is to be hoped that eventually our economic and political systems can be so adjusted as to ensure an equitable international distribution of mineral and of other resources.

Examined in these terms it is quite clear that there are in the world to-day no critical mineral shortages. But this temporary condition should not be allowed to induce a false optimism as to the future. The warning signals are flying. In a matter of this importance we cannot afford to do too little; we must not postpone our studies until too late.

### III

As has already been indicated, and as must be constantly recalled, we are hampered in our consideration of this subject by the fact that there are no reliable and complete statistics covering either the extent of our mineral resources or even the rate at which they are being currently consumed. This is true nationally and even more true of the international scene. Consumption fluctuates from year to year in accordance with the industrial activity prevailing in the individual countries and in many of these the statistical information available has only a nominal or shadowy relationship to the material facts. Our difficulties are increased by the particular consideration that there are no recent figures available, except in isolated instances, in regard to either reserves or consumption in the U.S.S.R. Any attempt, therefore, to estimate the world position must be critically viewed in the light of these gaps in our knowledge. Yet in this case ignorance is dangerous.

We do know, with reasonable accuracy, what proportionate amounts of aluminum, iron, magnesium, titanium and other metals are to be found in the crust of the earth. We know, for example, that for every 100 units of lead there are

200 units of zinc
400 units of uranium
480 units of copper
1000 units of nickel
1800 units of chromium
32000 units of titanium
248000 units of iron
400000 units of aluminum

The "Big Four" of the metal world - nickel, copper, zinc and lead - are relatively scarce. But this, however interesting, is of little real significance. What is important is the extent to which the various metals are to be found in economically or even in technically workable concentrations. For example, lead, zinc and tin are rarer constituents of the earth's crust than