

Conservation and Engineering

IV. Industrial Raw Materials

The major raw materials on which our whole industrial civilization is based are metals; nonmetallic minerals such as sand, gravel, cement rock, salt, and sulfur; coal, oil, and gas for the generation of energy; and renewable materials—wood, fibers, and other plants. Water and air, which belong in this classification, will be discussed later. The abundant earth has always before yielded up more and more as man has sought to develop its resources, but it is perfectly obvious that this sequence cannot continue forever. The supply of these materials is finite; there seems to be no such limitation to the demand for them. Two examples will make clear the fact that we have already gone a long way on the path to exhaustion:

1. Copper was first found as native 100 per cent metal. By 1900 the usual ore was about 5 per cent copper; now in this country it is about 0.5 per cent.

2. Colonel Drake's oil well was 69 feet deep; today such wells are commonly 10,000 to 15,000 feet deep.

High-grade, easily accessible raw materials make for cheap production. As we rely more on low-grade inaccessible substances, we shall find ever higher costs and much greater difficulties in enjoying the fruits of our industrialization.

In the past we have turned increasingly to other parts of the world for raw materials, and we have thus avoided the immediate consequences of excessive consumption of our own. The oil of the Middle East, the copper of Chile, and the iron ore of Venezuela are typical. The whole trend of the times, however, is to greater industrialization in other parts of the world, and when this trend has brought that industrialization to appreciable proportions we shall have much more difficulty in importing these raw materials. Again, costs will increase, or bartering systems will arise that will perhaps shut us off completely from such sources because of our probable inability to offer anything in exchange.

There are some things we can do, and they are all matters particularly suitable for us as engineers to do.

1. Obviously we must turn to the development of lower quality, less accessible materials. The research

and development required to permit economical processing will require chemical engineering of the finest quality.

2. We must improve our exploration. The mining engineers, physicists, and oceanographers will be very important in such searching. The results of the International Geophysical Year showing rich deposits of manganese, iron, cobalt, and copper on the bottoms of the oceans are most reassuring. Estimates of the manganese found indicate that it is present to the extent of forty times the known world reserves.

3. We must make better use of materials, that is, waste less. We must keep *conservation* constantly in mind, and we must try to stop some of the appalling waste. In chemical processing we all know of the waste associated with pollution; we shall have to reduce this not only to eliminate the pollution but to recover materials. We ought also to try to reduce the waste associated with certain items over which we may have no direct control. It is difficult to imagine a greater dissipater of our national resources than the modern automobile—two tons of materials and 2 to 3 gallons of petroleum to transport a single individual to a ball game.

4. We must develop substitute materials. Over 5 per cent of the earth's crust is iron; aluminum is 800 times as abundant as copper. These will last a long time, and they will be more and more used. We must also develop additional synthetic materials from coal, oil, and gas to replace those now grown on land, since the land must be used more and more for food production. Coal, oil, and gas are certainly exhaustible as fuels, but as chemical raw materials they would last thousands of times as long. This suggestion is diametrically opposed to that of the President's Materials Policy Commission of 1952; that commission seemed to overlook the demands on the land which growing populations must make for food.

We engineers have the facts, the skills, and the methods to alleviate these problems. We should bring them to bear on our jobs, our communities, and our government.

H.B.