Mineral Resources— A Challenge to Extractive Metallurgy

by Walter R. Hibbard, Jr.

The following article is a slightly revised version of a speech delivered during the Extractive Metallurgy Division Symposium on Electrometallurgy held in Cleveland, Ohio, in December, 1968.

Last year the Bureau of Mines made a detailed study of the supply and demand for 80 mineral commodities—projected to 1980 and to 2000, with forecasts of new technology, changing use patterns, economics and other pertinent factors. The findings of this study are reported in testimony of the U.S. Bureau of Mines presented on March 21, 1968, before the Senate Subcommittee on Mining. With the exception of certain items such as tin, chromium and manganese, which we have traditionally imported, there are plenty of underground minerals available in the United States. The challenge lies in the economics of recovery and extraction. In the latter case, costs threaten to surpass the price. An example is the case of gold, where there is known to be as much gold in the ground as we have mined in the U.S. to date. A price of over \$100 per troy ounce might be required to cover the cost of its extraction. However, our ores are often mature, and as we reach the end of a deposit, the ore grade decreases continuously.

The evidence of the Bureau of Mines study points to an increasing dependence on overseas sources of supply, even in some cases where domestic ores may be treated profitably, but less so than overseas prospects. The suggested reasons for the trend toward overseas mining are:

1. Overseas ores are richer
2. Tax concessions are available overseas
3. Existing technology can be applied profitably
4. Labor is less expensive
5. Foreign markets are growth markets.

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If this trend continues, extrapolations out to the year 2000 indicate that the U.S. may be importing more and more of its requirements for major tonnage items, such as aluminum, iron, copper, zinc and gold. We have abundant geological resources of these elements lying idle in the ground.

The solution to the problem is new technology aimed at lower costs of mining and extraction and more efficient use and reuse of the materials now being discarded.

The primary need of mining technology is the development of massive high volume automated mining systems which provide low costs per ton of ore with commensurate safety devices and techniques. An NAS-NRC-NAE study on Rapid Excavation has just been completed which recommends an intensive development program.

The needs of extractive technology are similar: systems to handle large volumes of low grade ore at low cost. An opportunity to fulfill both needs lies in solution mining and electrochemical extraction.

There are technological trends in these directions. Copper tailings are now being reworked by heap leaching, and old underground diggings are being mined by open pit methods. Other opportunities still await solutions, such as the gold tailings in the Sacramento area which have never been cyanided.

In these technological developments, the role of the Federal Government is to:

1. Monitor the supply/demand ratios projected for the future.
2. Determine needs far enough in advance to allow time for solution.
3. Encourage industry to provide timely solutions.
4. Provide new technology where industry finds the risks and/or costs too high or where alternate investments are more attractive.

(The other role of the Federal Government, as the custodian of public lands, is to make sure that these

lands are managed in the best interest of the public.)

When industry is unable or unwilling to solve the domestic resource problem, then the government should decide what incentives are needed to persuade industry to act. New technology can decrease both the risks and the costs. Guaranteed markets can add to the attractiveness of a venture. R&D costs can be subsidized. All of these actions have an established precedence in other areas.

An example of such a precedent is the Department of Interior's Heavy Metals Program. An expansive horizon of carbon bearing gold ore in Nevada could not be cyanided economically by existing processes. The Bureau of Mines at Reno developed a treatment which permits economical recovery of the gold. Industry can now be persuaded to mine and extract the ore.

As soon as government has provided an adequate incentive, it should make it available to all and urge industry utilize its findings. This procedure should be selective and limited to national resource problems. Just because the Government has invested in uranium or gold does not justify an equivalent expenditure in competitive minerals such as coal or platinum. It is only necessary that: (1) the investment is related to national needs and (2) the Government withdraws as soon as industry is adequately stimulated. The Federal Government is presently applying this policy to helium. At one time, only the Government could afford to produce helium. Now, nearly half of the U.S. helium needs are provided by industry, and the Government is disposing of its helium recovery facilities as industry provides appropriate capacity. It is also noteworthy that the U.S. Bureau of Mines has been following this policy for the last several years.

In order to meet the long range needs for minerals, a significant increase in engineering manpower is required. Those of our universities which provide strong educational programs in extractive metallurgy require your support. Their needs are pointed out in a forthcoming report by the NAS-NRC-NAE Committee on Mineral Science and Technology.

The triumvirate—industry, government and university—must work together: industry to produce the necessary resources government to monitor supply/demand ratios university to provide manpower and basic research. Like the supports for the proverbial pot of gold, if all three legs are strong, it holds much for the future. If one leg is weak, it tilts, spills and holds but little. Strengthen this triumvirate and the pot can be filled with all the minerals we need for now and the foreseeable future.