

treatment of sulphide ores. The electrolytic refining of metals has not only increased the purity of the product but has been responsible for the recovery of many new and rare metals as by-products. Cobalt and metals of the platinum group are recovered from the copper-nickel ores of the Sudbury area, while cadmium, bismuth, indium, thallium and other rare metals have been recovered from lead-zinc refineries. The introduction of dust precipitators and baghouses into the smoke stacks of smelters and roasters has resulted in the reclaiming of large quantities of metals that have been volatilized or vapourized. The development of processes for the manufacture of sulphuric acid from the smelter gases resulting from the treatment of sulphide ores is now established practice. A large part of the world's requirements of magnesium and magnesia are now extracted from sea water, a procedure that was considered fantastic when it was first proposed less than 50 years ago.

These are merely examples of past achievement in a field in which further progress can be confidently anticipated. In the future, as higher grades of ore are depleted, more attention must be given to the treatment of complex and low-grade ore bodies by leaching or other chemical methods. Further study must also be given to the possibility of obtaining minerals from sea water.

In addition to the search for new ore bodies and the improvement of our processes of extraction and treatment, greater study must be given to the possibilities of conservation and substitution.

Under the heading of conservation there are two steps of obvious importance. The first is the re-use of metal scrap. Among the more highly industrialized countries scrap to-day plays a role of real and increasing importance. The chief sources of supply are the obsolescence of manufactured metal products and the waste that results from machining and other steps in fabrication. In the latter case careful segregation and handling of the waste permits its direct return to the melting furnaces. Waiting for metal products to become obsolete is a slower process but in those countries that have long been industrialized the supplies of obsolescent or obsolete material are playing a more and more important part as a continuing source of metal reserves. In typical recent years scrap provided 49% of the iron, 42% of the lead, 34% of the copper, and 13% of the zinc used in the United States.

The second step in conservation is the prevention of corrosion by the use of preventive coatings of some other metal or of one of the resin compounds, or by the creation of new alloys that resist the corrosive influence of the elements. Much work has already been done in this field but much more remains to be achieved.

Closely related to conservation is substitution, and substitution is being achieved in a rapidly increasing variety of forms and instances. Technical developments in manufacturing often permit the substitution of metals that are in plentiful supply for others that are relatively scarce. The use of aluminum and magnesium in transportation and other fields as a substitute for steel is an example of this process. These metals and their alloys have also been applied to many structural and building uses in which strength is not of paramount importance. The use of aluminum as a substitute for copper in electrical transmission lines has effected a tremendous saving of the scarcer metal. Where lightness is a factor in design, both aluminum and magnesium are being used with marked success in the castings industry. The knowledge and skill of the metallurgist are now being