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Errata

Page i, Line 9: timeliness
Page 5, Line 26: \$8,589,000
Line 27: \$13,806,000
Line 32: Appropriation
Page 10, delete 1st line

FOREWORD

This paper was presented at the National Materials Policy Commission forum, sponsored by Stanford University, June 13 to 16, 1972. The forum was one of several held around the country to help formulate U.S. policy with respect to materials and especially minerals. It was written and delivered by Dr. Charles F. Park Jr., Professor of Geology and of Mineral Engineering at Stanford, and an internationally known geologist, mineral economist, and teacher.

Because of the timeliness and importance of Dr. Park's message, it was suggested by Charles F. Herbert, Alaska's Commissioner of Natural Resources, and a participant in the forum, that the paper be published and given wide distribution. Dr. Park and Dr. James Boyd, Executive Director of the National Commission on Materials Policy gave their approval for this, and Dr. Earl H. Beistline, of the University of Alaska, arranged for the publishing through the Mineral Industry Research Laboratory. Ernest N. Wolff and Nils I. Johansen, both of the Laboratory, acted as editors.

All indications are that the United States is going to need very much larger amounts of all nonrenewable resources in the future than are being used at present. Assuming that the population is stabilized at about 300 million people by the year 2000, and that the present per capita consumption of nonrenewable raw materials is maintained, then the nation will require 1/3 more raw materials than at present. If standards of living improve, the demands will be correspondingly greater. If standards of living in the ghettos are to be raised to those of the more affluent city suburbs, the demands will increase even more. Where are these materials to come from? Can we import them or must most of them be obtained locally?

According to the United States Bureau of Mines we now import some of 90 mineral commodities that we consume. The country depends entirely upon imports for several of these critically needed commodities, for example, manganese, tin, and chromium. Others, such as nickel, titanium in rutile, and fluorite are produced in part domestically, while a few such as molybdenum, phosphate rock, and sulfur are in surplus and are available for export. Imports of many mineral commodities have been increasing at the rate of about 1% a year; domestic production is unable to keep up with growing demands. The dependence of the United States on foreign sources for both metallic and nonmetallic materials thus is slowly increasing and gives cause for considerable thought and concern. Not only are we importing more; we are also curtailing our domestic output by restricting areas where prospecting and mining are permitted and by causing smelters to close. For example, at least 5 zinc smelters have closed in recent years and no new ones have been built. Growing imports contribute appreciably to an already serious adverse balance of payments and hence to the problems of inflation. Is the United States sure enough of its import sources so that it can afford to penalize or discourage production from its domestic deposits?

Competition among consuming nations for raw materials on a worldwide basis is growing rapidly. Japan furnishes a good example of the impact of industrialization on supply problems. From a minor consumer of nonrenewable resources before World War II, Japan has moved into 2nd place as the world's largest

consumer of zinc, and into 3rd place as the largest user of aluminum, copper, and tin. Between 1960 and 1970, a ten year period, Japanese consumption of aluminum increased almost 500%, of zinc 200%, and of copper 75%. A short time ago a Japanese Government estimate of future needs of copper showed that they expected to double consumption of this metal by the year 1975. Many other countries that previously have not been industrialized are making strenuous efforts in this direction; all nations seek to industrialize. Mexico and Brazil are examples of nations poised on the edge of extensive industrial developments and which are beginning to require much larger amounts of raw materials than formerly. When the future is so obviously a sellers' market, it makes sense for the buyers to take what steps they can to assure continuance of the flow of supplies from both domestic and foreign sources. Somebody is liable to get caught short.

All developing countries need jobs for the many unemployed in their cities, and industrialization seems to be the panacea they are seeking. But where can the necessary raw materials be obtained to support universal industrialization? If curves of consumption continue on their present projections for another decade or two, the demands for some commodities are going to be so large as to be impossible of fulfillment at any reasonable price. Universal industrialization is a utopian objective that has no chance of fulfillment and broad disruptions of supply patterns and destructive shortages may well result before this fact is understood. Some nations, most likely those now classed as underdeveloped, will always be primarily suppliers of raw materials to industrialized centers. This does not mean that these suppliers must be relegated to continuously low standards of living. What it does mean is that they are going to receive higher prices for their materials - how much higher is problematical. Many of the essential nonrenewable resources are produced in these underdeveloped countries which are now just beginning to recognize their abilities to obtain not only higher prices, but also a share in the profits of fabrication and marketing. The industrial centers of the future are going to give more to the producing suppliers. Indeed, even now, some people consider that raw materials for years have been among the greatest bargains on the world markets.

The industrial nations that are successful competitors for foreign produced raw materials will not only pay higher prices but will also stress mutual benefits of trade and cooperation - not just with words but with actions. Why should not a consuming nation such as the United States recognize this fact and enter into preferential and reciprocal trade agreements with the suppliers of raw materials whereby these countries are able to obtain the manufactured products they need at favorable rates and with the assurance that they will have first choice in times of tight markets. The European Common Market and its African Associate members appear to have worked out satisfactory agreements.

The days are gone when a company could move into a foreign land with foreign management and operators to extract and export the minerals for wages and nominal taxes. Many countries are beginning to look with a jaundiced eye at even some of their own tax benefit programs and incentives aimed at bringing in foreign capital to develop their resources. Rather, the preferred position where capital is needed is to combine domestic and foreign partners, with the foreign group contributing the capital and being repaid with raw materials. A few United States companies have recently indicated their willingness to help develop foreign mineral properties, recover their capital with a fair rate of return, and then turn the property over to the local government. Hopefully the companies will be able to continue to purchase the mineral or smelter output and their attitudes will create friendship between the producer and the consumer countries. Is such cooperation impossible or impractical? Why should it not be encouraged?

When operating in a foreign land, most companies sensibly attempt to maintain a "low profile", and in many places such a profile is necessary. The operations of the Japanese in British Columbia, Canada, are well worth serious examination. Many Canadian mines were financed by Japanese capital and their outputs go to Japan in Japanese vessels, yet they are run by Canadians with all Canadian personnel. They are considered to be, and really are, Canadian operations. More and more companies in the United States are being forced to this type of operation, which in many ways is better than the present system;

where qualified personnel are obtainable, the local people are proving more effective as operators than were the foreigners previously used. In many countries only limited foreign personnel may be employed by law. Bethlehem Steel Corporation mines in Brazil and Mexico are excellent examples of domestic and foreign partnerships where the operations are run entirely by domestic personnel.

What is the United States Government doing to foster better relations with the foreign governments upon whom we are increasingly dependent for our raw materials? What should it do? Would reciprocal treaties help? Certainly it is time that a definite and clearly stated and understood policy be formulated and circulated among all parties concerned. How can investment in foreign raw materials properties be encouraged under the present conditions of widespread nationalism and local anti-Americanism? Tax concessions would help and guarantees of investments against expropriation without adequate compensation are essential. Possibly the exemption of dividend funds earned on foreign operations would help.

While the problems of obtaining raw materials for the future from foreign sources are serious, conditions here at home appear little if any, better. What, if anything beside talk, is being done to encourage development of our domestic minerals industry in exploration, mining, and beneficiation and extractive metallurgy, as well as better recovery and use of scrap materials? In 1970 the United States Congress set a precedent by establishing a National Minerals Policy. This policy is a simple statement of the fact that the United States Government recognizes the need for raw materials and that the Department of Interior is instructed to suggest additional legislation and to report annually to the Congress on the state of the industry. By itself, this act means little, but it is a start. It is, however, only a start, and the policy needs supporting and specific legislation. Legislation of the type needed is now being studied and should be submitted to the Congress as rapidly as possible.

Why is the mineral industry such a stepchild? Several factors are in part responsible. The industry admittedly is a very small cog in our industrial machinery; though essential it

carries almost no direct political weight. It is highly diverse and lacks a truly effective organization that will speak with a strong voice for small and large companies and for such varied commodities as gold, cement, iron and steel, uranium and fertilizers. The mineral industry is highly complex, its management is generally conservative and anxious to keep out of the public eye, and much of the industry is so highly specialized that it is understood by few people. Mining, nevertheless, is essential to economic well being, and without adequate minerals our industrial plant would grind to a sudden and startling halt.

The point should be clearly obvious to everyone that non-renewable resources will be needed in larger amounts in the future. Also obvious to people who work in the industry is the fact that to date almost nothing has been done to assure these essential supplies for the United States. At times our government activities actually appear to be designed to discourage mineral development. People in the industry are worried and are trying to do what they can, but their efforts to date have been largely ineffective.

What is the total Federal Government budget for mineral exploration and for fundamental research in mining and extractive metallurgy? A very small part of the money given to the Geological Survey and the Bureau of Mines goes for these purposes. The figure is difficult to obtain, but for exploration is probably less than the Geological Survey received in 1972-73 for study of earthquake hazards - \$8,589,00, environmental impact - \$13,806,00 and the Eros program - \$10,646,000. It is less than the money appropriated for mine safety, for many other activities marginal to mining, and is but a tiny fraction of the amounts appropriated to keep farm lands out of production. Is either the Geological Survey or the Bureau of Mines devoting a major part of its appropriation and manpower to research in exploration and in the techniques of raw materials extraction and use? These activities with few exceptions appear to be of marginal interest. Mining is every bit as essential as is agriculture, yet government interest and support of agriculture far exceeds anything ever dreamed of in the minerals fields.

Many companies spend large amounts of money exploring for mineral deposits, but this money is not spent to develop new

methods of exploration and very little of it goes for study of new methods of extraction or smelting. In order to remain in business, companies must obtain results quickly; they simply cannot afford the scale of research that is required. The needs of the future transcend the abilities of any company, no matter how large and how wealthy; these are matters that directly affect all segments of the public and they legitimately require government support which is not now being given. What is needed is a group of the very best brains obtainable to devote their time and energies to both research and development in the minerals fields. Knowledge, imagination, capacity for original thinking, drive, and the time in which to operate are necessary. Such talented people are admittedly few and far between, but they do exist. At present they are largely unsupported in the minerals industries; they quickly become disenchanting and many either give up or change professions. As an example, in exploration, how much time is being given to structural or other integrated studies in relation to the localization of ores, to the practical study of metallogenic provinces and epochs, to regional zoning, and to the examination of many other subjects that may lead to ideas as to places to explore? Rather than study these field oriented subjects, highly touted electronic and other laboratory devices, many developed with government support, proliferate, and basic field problems are forgotten. Many man hours of work are being given to these devices; they are the current vogue and are far easier to finance than are field studies. Many of these instruments are useful tools, and should be accepted as such. They are, however, still tools, and any intelligent person can learn how to operate one of them in six months or less. While these devices and the techniques of using them are valuable, they are far from the original thinking that must be devoted to the discovery of resources if new districts are to be found. Unfortunately, exploration for ore deposits has, in the minds of many geologists, become either a routine technique or a laboratory oriented science. As a result, exploration is in a deep and narrow rut.

While exploration has been used as an example, mining and extractive metallurgy are in even worse conditions. Not only has little financial support been extended to these fields, but

by making highly attractive research grants to physical metallurgy, students who ordinarily would have studied here have been enticed away. Government support of physical metallurgy has been so extensive and so liberal that many people erroneously have been led to believe that the other fields are relatively unimportant.

The Federal Government should also give serious thought to the conservation of minerals? How can lower grade ores be better mined and recovered. When a mine is closed because of low grade ore, it tends to remain closed and the marginal mineralization is lost. Any of this mineral that can be saved is a step in the right direction.

Who is to say where the nonrenewable resources will be obtained in the future and what will the future needs be? We depend upon excellent, but frequently overworked and misunderstood statistics - statistics compiled in Washington by hard working and conscientious people in the Bureau of Mines. Many of these statisticians are able, and these comments are not meant to detract from their considerable accomplishments. However, their numbers are inadequate and many are untrained in the minerals fields. They have difficulty, for instance, in understanding and estimating additional reserves that may become available when a commodity increases in price a few cents a pound. Neither do many clearly understand the meaning of "geological reserves", of the causes of localization of minerals, and under what conditions additional amounts of a commodity are likely to become economic. What is required is an organization of broadly trained specialists in mineral economics who are familiar with all aspects of mineral production and who have a knowledge of statistics. Where are such mineral economists now being trained?

As would be expected where an industry has been severely and continuously criticized by much of the everyday news media and neglected by government, the programs of education in the minerals fields are everywhere in difficulty. Total enrollments continue to drop and many formerly active departments have been abolished, partly because money in tight university budgets has been diverted to places where larger numbers of students

are enrolled and to the newer and more glamorous fields such as those now associated with the environmental subjects, and partly because of plain lack of interest and knowledge of the fields. All universities need money these days and where better to save than to cut out unpopular mineral industries programs?

Government has been most liberal with funds for agriculture, atomic energy, space exploration, foreign aid, and public health, as well as many others. Why should not at least some small support be extended to an equally strategic and critical industry such as mining? Many of the remaining university departments that emphasize exploration, mining and extractive metallurgy are being closely scrutinized by university administrators who have to make ends meet. Only a few strong viable departments are really needed, but if even this few is to survive and flourish, both scholarships and research funds are badly and quickly needed. Something should be done quickly to modernize the programs, to make them progressive, attractive, and challenging to good students and good faculty and to encourage research and graduate studies.

People in recent years have rediscovered the environment and, without studied consideration of the consequences, have decided that things must change, not at a reasonable rate but at once under a crash program. Many well meaning organizations, commonly made up of reasonably affluent educated middle class people, have formed highly vocal and effective lobbies aimed in part at establishing clean air and clean water, but also at preserving in primitive condition for posterity, very large areas of government owned lands. How far toward "preservationism" can the United States afford to go? Our standards of living require that our resources be used. What is wrong with the concept of multiple use of land?

Certainly mining has made thoughtless mistakes in judgment in the past and is now being forced to correct these past errors. Industry can no longer allow sulfur smoke to escape unhindered into the atmosphere, "acid mine waters" to drain into the waterways, nor dusty tailing piles to blow around. It is being pressured to landscape in an acceptable manner such

things as abandoned open pits and tailing dumps. Bulldozer cuts and other ways of defacing the countryside must be avoided as far as possible. These corrections make good sense from a national standpoint but the cost of the changes and the time involved in their implementation must both be taken into consideration. We cannot afford to shut down the minerals industries and must remember that when the final products are sold they must still be competitive with foreign products. To clean up the environment takes time, is going to be very expensive, and is bound to divert funds from badly needed exploration and research. It should also be pointed out that some of the techniques necessary to attain the desired environmental standards are as yet imperfectly developed.

Other raw materials affect our daily lives and yet are seldom understood by most people. Such products include limestone and the aggregate materials, sand, gravel, and crushed rock, used in the making of cement and concrete. Cement and aggregate are needed for all types of construction but in many places are almost unobtainable without long and expensive transportation charges. People in urban, or even in suburban areas, object to the noise and dust of quarrying. As a result, cement and aggregate at times must be hauled long distances at almost prohibitive costs. As urban areas expand, the rebuilding of ghettos and city centers thus becomes increasingly costly and difficult. The construction of roads and other essential means of transportation also consumes tremendous amounts of concrete and steel, and is becoming more costly and time consuming. When the cost and the time involved in the construction of a transportation system such as "BART" in the San Francisco Bay area are examined, one can only wonder at the practicality of attempting to rehabilitate the city centers.

In order to operate effectively, the Environmental Protective Agency should establish definite and practical rules and guidelines that are well publicized and are acceptable to both states and companies. Double standards, federal and state, create innumerable difficulties, as is clearly shown by the prohibitive sulfur emissions standards set up by several states. The accepted rules should include ambient air standards, a permit program to regulate the discharge of nontoxic wastes into waterways, a

permit program to regulate the discharge of nontoxic wastes into waterways, and minimum acceptable standards for reclaiming and landscaping abandoned workings and tailing dumps. These regulations must be established and mine operators must be assured that they will not be changed quickly and without recourse or notice as has been done in the past.

The mining industry is a very old and conservative one. Many, but fortunately not all of the people who run it resist change. They know how to live with and operate under the old mining laws and rules and the old environmental standards; the conservative tendency is always to resist change when the present system is working well. Some do not want change and will resist; others recognize and welcome the necessity for change. The tremendous increase in population density and the upgrading of living standards throughout the world clearly mean that change is inevitable and will continue. Government and industry working together should see to it that these changes are in the direction of maximum benefits to the nation as a whole.

Another place where action is needed is in the field of solid waste management, particularly as this refers to scrap metals and recoverable raw materials wastes. The economics of scrap, especially iron and steel, have been such that collection and reuse have been profitable only during times of high prices. This has led to spotty recovery and to the use of heavy scrap while the lighter and dirty scraps have been allowed to accumulate in unsightly junkyards and automobile "graveyards". Recently depositories for scrap metals, especially flattened cans, and discarded bottles, have been organized in various cities and are receiving a high degree of cooperation from housewives and other users of these materials. The iron and steel industry also has developed shredding methods that are beginning to make inroads into the junk piles of old automobiles. Efforts toward more effective use of scrap should be expanded. Surely better means of collecting and reusing scrap can be devised than have so far appeared.

In conclusion, the United States Government should establish clearly understood policies relating to the environment and to international relations with the objective of assuring the

future mineral needs of the nation. Financial aid also should be extended to strengthen education in the minerals fields, to improve exploration, extraction, and technology in all of the fields, to better the available statistical information, to encourage conservation and reuse of materials, and to better the disposal of mineral waste products. Changes are going to be both continuous and at times rapid and some means of maintaining a pool of readily available and up-to-date information should be established.