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that this system requires institutions strong enough to hold the balance between the interests which press against each other. Such institutions can be sufficiently strong only if a sense of responsibility for the common good exists at least in large sections of the population. There is a lot of such sense in the United States, all surface symptoms of disintegration notwithstanding, but it can be preserved only as long as people believe that there is energy and competence at the top, and that therefore their restraint will bear fruit. The next few months will show whether this confidence will continue to exist without too much impairment. The outcome will be of great impor-

tance for Europe and Japan as well as for the United States. First of all, the traditional means of fighting inflation have shown a lack or at least a deficiency of effectiveness not only in America, and other countries may learn something valuable from the experience of the United States with the new methods. Secondly, the return to stability of inter-currency relations and non-protectionist trade policy depends largely on the solution of the American inflation problem without reduction of American purchasing power. Everything that causes confusion in the American economy is likely to result in economic calamities the world over.

US-Reliance on Foreign Mineral Resources

by Professor Karel Holbik, Boston *

The purpose of this paper is to explore one of the more subtle problems facing the United States. The problem concerns retaining economic and political power in the face of decreasing self-sufficiency in natural resources and raw materials.

Up to World War II the US was self-sufficient in most of its natural resources. For those few resources that were foreign and proved unobtainable during the war, synthetics were developed or substitutes found. During the War, the USA spared few costs in producing material goods required to sustain the war effort. This resulted in extensive exploitation and waste of natural resources and has accelerated their diminution.

With resources getting scarce in the US, it became necessary to seek additional foreign sources of supply. The obvious danger in such a policy is that in case of a war, foreign sources could be denied. To ease this danger, Congress authorized, through the Stockpiling Act of 1946, the creation of national stockpiles that would protect against shortages of natural resources if traditional sources of supply were not available in case of war. With the advent of the Kennedy Administration in 1960, a new look at the stockpile program was ordered. The end result was substantial stockpile reduction consistent with what is described as the nuclear era strategy. This strategy predicted either limited conventional war or nuclear exchanges. A protracted-war concept, in which natural resources would be denied the

US for an indefinite period, was ruled out. For most stockpiled items this meant lower stocking objectives.

Fortunately, science and technology are helping reduce the absolute requirements for natural resources so that the growth of these requirements is becoming proportionately less than the growth of population and the accompanying demand for more end products. The fact that new ways of conserving natural resources are being discovered does not mean, however, that the underlying concern can be laid to rest. The world must continue to find new sources and make the best use of what is available.

Substitution of resources has helped reduce dependence on foreign resources. Today one can substitute aluminum for copper in electrical transmissions, plastic for paper in containers, synthetics for cotton in fabrics, cadmium for lead in batteries, etc. To cut down on reliance and cost resulting from scarcity, one must continue to find ways of substituting abundant resources or chemically-produced substitutes for resources that become scarce as a result of depletion or price.

But although new methods and ideas can and will help reduce reliance on foreign sources for natural resources, they in no way eliminate reli-

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ance itself. It is therefore necessary to examine the situation of the United States in relation to some key metallic minerals in order to be able to judge US-reliance on foreign mineral resources.

US Mineral Resources

Demand for mineral resources will be doubtless increasing in the years ahead. Yet the danger faced in the future is not so much the absolute "running out" of resources but diminution of resources to the point where price is no longer attractive to the buyer at large. In this light, ten metallic minerals that are currently essential to US needs will be examined. The examination will be restricted to American dependency on foreign imports and a comparison of US requirements to those of the rest of the world. Further, a brief look into the future will be made and appropriate danger signals will be raised where necessary. The metals addressed are not all the key ones required for the nation's viability. They are chosen because they represent the changing pattern of reliance faced by the US. Figures used in describing production, consumption, and imports of metallic resources are based on "Commodity Year Book 1970".

Iron and Manganese Ore

In 1945 the US imported 1 mn tn. l. of iron ore, but in 1970 as many as 50 mn tn. l. were imported. Thus imports account for approximately 30 p.c. of all iron ore consumed in the United States. Canada and Venezuela provide over 80 p.c. of the iron imported. Although America's consumption of the

world's iron ore production amounts to 20.5 p.c., the rate of US consumption increase has been below the world's average. Technology has recently improved the country's position in regard to reliance on iron ore for steel production. Lower quality ore can now be used in regular production, and reuse of scrap products as well as reduction in waste have tended to reduce the amount of iron ore required per ton of steel produced. Additionally, ways are being discovered to extract iron ore from taconites, a hard siliceous rock containing about 25 p.c. of iron. These rocks are in abundant supply in the north central part of the US.

Even though world production of iron ore is increasing at a faster pace than US production, the country appears to have an adequate supply of iron ore. The US will continue to import iron ore to supplement domestic production because of price advantages and the need to conserve domestic sources.

Manganese ore is a necessary ingredient in making steel and is therefore vital to any industrialized nation. The US imports more than 99 p.c. of its requirements and utilizes 3 mn tn. sh. of manganese a year. This consumption accounts for about 17 p.c. of the world's production. Central and South America as well as Africa are the primary sources for this ore. Only in the state of Montana does the US have any reserves and here they are only about 1 mn tn. There is, however, an estimated 80 mn tn. of low grade manganese ore in the US and indeterminate deposits of ore on the ocean floor from manganese-bearing nod-

Table
Source Distribution by Geographic Areas of US Selected Imported Raw Materials, 1968
(percent)

Raw Material	Canada	Latin America	Europe	USSR	Asia	Africa	Australia
Ferrous Metals							
Chromite	.	.	.	30	29	39	.
Cobalt	10	.	62	.	.	27	.
Iron Ore	60	31	1	.	.	7	.
Manganese Ore	.	29	.	.	5	56	4
Nickel	90	.	7	.	.	2	.
Tungsten	59	32	4	.	.	.	4
Nonferrous Metals							
Antimony	.	30	38	.	.	29	.
Bauxite	.	99	.	.	.	.	.
Copper	21	41	19	.	.	9	.
Lead	22	37	20	.	.	.	14
Tin	.	4	4	.	90	1	.
Zinc	53	27	3	.	6	1	.
Miscellaneous							
Fibers (Abaca, etc.)	.	64	.	.	24	10	.
Lumber	96	.	.	.	.	.	.
Petroleum	36	30	.	.	17	9	.
Rubber	.	.	.	.	84	15	.

Source: US Government publications.

ules. The cost factor currently requires full dependence on foreign sources, but technology could someday reduce this dependence appreciably.

Chromite Ore and Nickel

Chromite ore is used, for example, in stainless steel, jet engines, ammunition, armor plate and other defense-oriented products. All ore is imported. The US has been consuming approximately 1 mn tn. sh. a year which represents 22 p.c. of the world's production. Domestic sources are located in Montana. However, the US ores are low grade in content, and technology has not found a way to warrant their extensive use. Over 50 p.c. of the ore comes from Southern Africa. The remainder is imported from the Philippines, Turkey and the Soviet Union. In the Western Hemisphere, only Cuba appears to have any significant deposits. The United States is totally dependent on foreign sources without alternatives. In view of nonpractical Western Hemisphere sources and political conditions in several countries that are principal suppliers, there is justified concern over uninterrupted supply. But technology may solve some of the problem. There are now distinct possibilities for substituting lower cost chemical type ore for higher priced metallurgical ore in the stainless steel process.

The US produces only 10 p.c. of its annual nickel requirement of 160,000 tn. sh. The vast majority of imports (89 p.c.) comes from Canada and another 8 p.c. comes from Norway. The US consumes over 30 p.c. of the world's nickel production of 530,000 tn. sh. Estimates indicate that world consumption will be greater than production within the next 30 years. Although large deposits are known to exist in the Philippines, New Caledonia, Indonesia, Cuba, and the Soviet Union, it appears that only the latter two locations have deposits that can be mined economically. Unless more sources can be found for nickel, the world's supply of this mineral will have to be extracted from nickel laterite deposits. All the attendant problems in extractive metallurgy and environmental control will be present.

Cobalt and Bauxite

Cobalt is important to cancer treatment and the production of missiles, jet engines, motors, and other defense-related products. The US imports nearly 90 p.c. of its annual requirement of more than 9,000 tn. sh. Its annual usage is about 50 p.c. of the world's annual production. The Congo and Western Europe have been the principal source of supply. In recent years other metals have been found to replace cobalt for high temperature

super alloys and magnets. Less than ten years ago there was a prediction that cobalt would become scarce. Today, there is no great concern that this could be the case.

Bauxite is the principal ore of aluminum. At one time the United States was practically self-sufficient in this ore. Today, only 12 p.c. of domestic production is met from domestic sources. The 15 mn tn. l. consumed in the US represent about 30 p.c. of the world's consumption. The United States' principal sources for bauxite ore are in the Western Hemisphere, namely Jamaica and Surinam on the Northeast coast of South America. Although the ore is becoming scarce in the US, it is abundant world-wide and one believes that there are many deposits in Africa and South America that have yet to be tapped. The US does not have serious concerns for this ore even if by some chance its supply is denied. There are ample supplies of other low grade bauxite clay in the US that could be used in aluminum production.

Lead and Zinc

Man's knowledge of lead antedates recorded history and lead was probably the first metal extracted from ore by smelting. Until World War II the US was self-sufficient in this mineral. Today over 45 p.c. of US consumption of 900,000 tn. sh. is imported. The US accounts for 25 p.c. of the world's consumption. Most of the imports come from the Western Hemisphere and Australia. In 1969 domestic production increased by 28 p.c. over 1968 which can be attributed to a change in the tax law.

The long-range forecast for this, the world's fifth most important mineral, is not encouraging. Reserves are not sufficient when compared to consumption and the prospects for additional discoveries of large deposits are not considered bright. The long-range technical escape from reliance on lead is not promising either. Some experts predict that lead will begin to become a scarce mineral around the year 2000. Conservation and reuse are essential if the supply of this mineral is not to be prematurely exhausted. On the other hand, substitute metals are being found for lead used in the production of batteries and paint.

Zinc is another mineral in which the US was self-sufficient prior to World War II. Today, only slightly more than 50 p.c. of US total consumption of 1.4 mn tn. sh. is produced domestically. About 27 p.c. of the world's consumption is accounted for by the US. Zinc is imported primarily from Canada, Mexico, and Peru. Although zinc, like lead, is beginning to become scarce world-wide, the long

term prospects for finding additional deposits or substitutes do show some hope.

Copper and Tin

In copper, the US was once self-sufficient. At the present time, about 25 p.c. of total domestic consumption (comprising about $\frac{1}{3}$ of the world's production) of 2.0 mn tn. sh. is imported. Currently Chile is the leading source of copper imports. Peru and Canada also export large quantities to the US. In the long term of 40 to 50 years the world's supply of high content copper ore appears to be in difficulty. However, technological advances have made it possible to extract low-content copper ore at competitive costs. A century ago, the copper ore that was mined in the US contained 3 p.c. copper; today, the ore being mined contains less than 1 p.c. copper. The price of copper has remained fairly stable despite utilization of lower grade ore. In view of this experience the prospects for ample quantities of copper over the next 50 years appear bright. The main danger to the US appears in that some of the principal suppliers of copper (Chile, Peru, Central Africa) have become politically unstable.

The last mineral to be considered is tin. Better than 99 p.c. of the US annual tin requirement of 54,000 tn. l. is imported. The country utilizes about 20 p.c. of the world's tin production. Malaysia supplies around 80 p.c. of the US requirement. Bolivia and Nigeria also supply substantial quantities. Substitution (which is an outgrowth of ex-

isting reliance on imported tin) and technological progress are making future requirements for this mineral less critical. If there were not a slowdown in the overall world requirement, it would be conceivable that tin would become scarce. New sources of exploitation, however, are being found in the sea and therefore should add to the world supply. Any cut-off of the American pipeline to the tin producers should not have drastic consequences because of large stockpile reserves and the technology to find tin substitutes.

Conclusion

The appetite for natural resources in the US grows greater every year and is becoming more discriminating in that it tends to consume and digest only what is necessary. Science, technology and management skills are all working together to extend the availability of natural resources. This cooperation is a recent development, and its results are both gratifying and calming to a concerned world. Based on these results over a relatively short period of time, the potential is within man's grasp for successfully meeting the greater challenges of depletion that lie ahead.

There is always a risk to be run if a nation doesn't have direct control of all its required resources. In the current world, the US no longer can be self-sufficient to the degree it was in the past. In recognizing this situation the country must become once again one of the world's leading proponents of freer trade.

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