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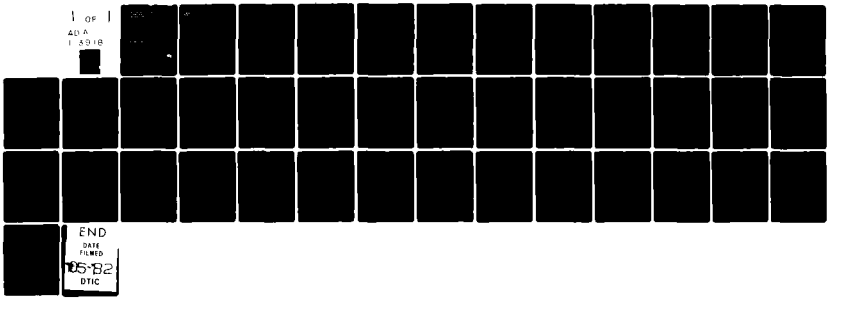

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STRATEGIC STUDIES INSTITUTE
US ARMY WAR COLLEGE
CARLISLE BARRACKS, PENNSYLVANIA

LONG RANGE PLANNING FUTURES GROUP

THE US STRATEGIC MINERALS POSITION — THE 1980'S AND BEYOND

15 NOVEMBER 1981

ACN 81055

The views, opinions and/or findings contained in this report are those of the author and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other official documentation.

DEPARTMENT OF THE ARMY
US ARMY WAR COLLEGE
STRATEGIC STUDIES INSTITUTE
CARLISLE BARRACKS, PENNSYLVANIA 17013

REPLY TO
ATTENTION OF

AWCI

21 APR 1982

Defense Technical Information Center
510 Duke Street
Cameron Station
Alexandria, VA 22314

Gentlemen:

Inclosed is your copy of the Futures/Long-Range Planning Group's report "The US Strategic Minerals Position--The 1980's and Beyond" by Dr. Alwyn H. King. Dr. King discusses the current US minerals position, describes what he terms a "materials vulnerability window," projects the potential for an improved US minerals situation beyond the current decade and concludes with recommendations. His writing is based on extensive research and a background involving minerals prospecting, mining and materials research and development.

The views, predictions, and conclusions expressed in this report are solely those of the author and do not necessarily reflect an official position, policy, or decision of the Futures/Long-Range Planning Group, the Strategic Studies Institute, the US Army War College, or any other agency.

Futures/Long-Range Planning Group reports are written to stimulate thought, raise questions, and provoke alternate points of view. Your opinions and critiques of these reports are valued resources which will assist the Group in its future endeavors. Therefore, I solicit your comments on "The US Strategic Minerals Position--The 1980's and Beyond." Please forward your thoughts to me at the above address.

Sincerely,

Thomas R. Stone

1 Incl
as

THOMAS R. STONE
Colonel, FA
Chairman, Futures/Long-Range Planning Group

(1)

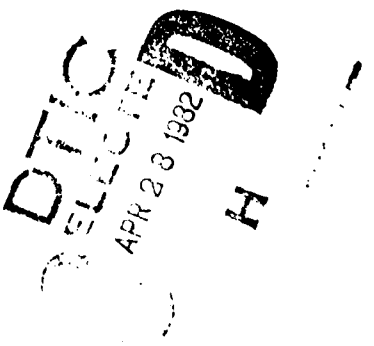
STRATEGIC STUDIES INSTITUTE
US ARMY WAR COLLEGE
Carlisle Barracks, Pennsylvania

THE US STRATEGIC MINERALS POSITION--THE 1980's AND BEYOND

by

Alwyn H. King

15 November 1981



DISCLAIMER

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ABSTRACT

Increasing world demand, depletion of known existing deposits, a growing militance among less developed supplier nations, and expanding Soviet power and influence will combine to make international competition for strategic minerals more intense in the 1980's and beyond. The current strong US dependence on foreign sources for a number of these minerals is of serious concern, and may in some cases reflect a potential vulnerability to foreign political, economic or even military pressures. While the current impact of critical materials availability on Army readiness and combat effectiveness is minimal, timely planning is essential to anticipate and prevent future materials-related problems.

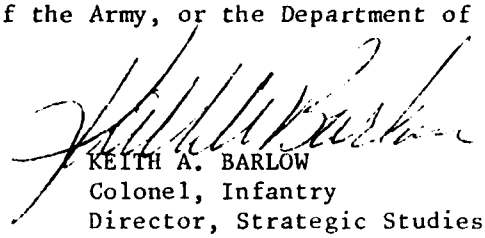
In some cases materials vulnerability problems may be alleviated by purely domestic initiatives, including stockpiling, recycling, increased R&D for substitutes and improved recovery processes, and revitalizing appropriate sectors of the US mining industry. For other critical and strategic materials, however, an almost complete lack of US reserves combined with the severe minerals deficiencies of our NATO allies and Japan may dictate an international approach.

Suggestions of an impending "resource war" make such cooperation with our allies and other market economy countries even more urgent. Some of the internationally-oriented initiatives which should be considered include strengthened cooperative agreements, or coalitions, with other materials consuming nations; bilateral trade agreements with US supplier nations; increased emphasis on US economic assistance to Third World supplier nations; and expansion of the NATO charter to include protection of sources of materials of critical and strategic importance to alliance members.

FOREWORD

This Futures/Long-Range Planning Group paper discusses the current critical and strategic minerals position of the United States, and projects the potential for improved US minerals sufficiency into the 1980's and beyond. The author foresees a "materials vulnerability window" extending at least seven years into the future, during which international cooperation will be essential to ensure continued access to foreign supplies, while domestic initiatives are emphasized to regain a satisfactory US posture of strategic minerals sufficiency.

This paper was prepared as a contribution to the field of national security research and study. As such, it does not reflect the official view of the US Army War College, the Department of the Army, or the Department of Defense.



KEITH A. BARLOW
Colonel, Infantry
Director, Strategic Studies Institute

BIOGRAPHICAL SKETCH OF THE AUTHOR

Dr. Alwyn H. King, (COL, AUS-Ret), is an economist and study manager at the Strategic Studies Institute of the Army War College in Carlisle, Pa. His academic credentials include an engineering degree from McGill University, an MS from Columbia, an MBA from Babson College, and a doctorate from Stuttgart Technical University in Germany. He has served in various command and staff positions in the Corps of Engineers active and reserve components, and in civilian life has been associated with Arthur D. Little, Inc., and the Brunswick Corporation Research and Development Laboratories. Dr. King has published extensively in the literature of both the physical and social sciences. Previous publications on this subject include "Materials and the New Dimensions of Conflict," (co-author), New Dynamics in National Strategy, Crowell Co. 1975, "Materials Vulnerability of the United States - An Update," SSI Special Report, 1977, and "The Role of Security Assistance in Maintaining Access to Strategic Resources," (co-author), Parameters, September 1978.

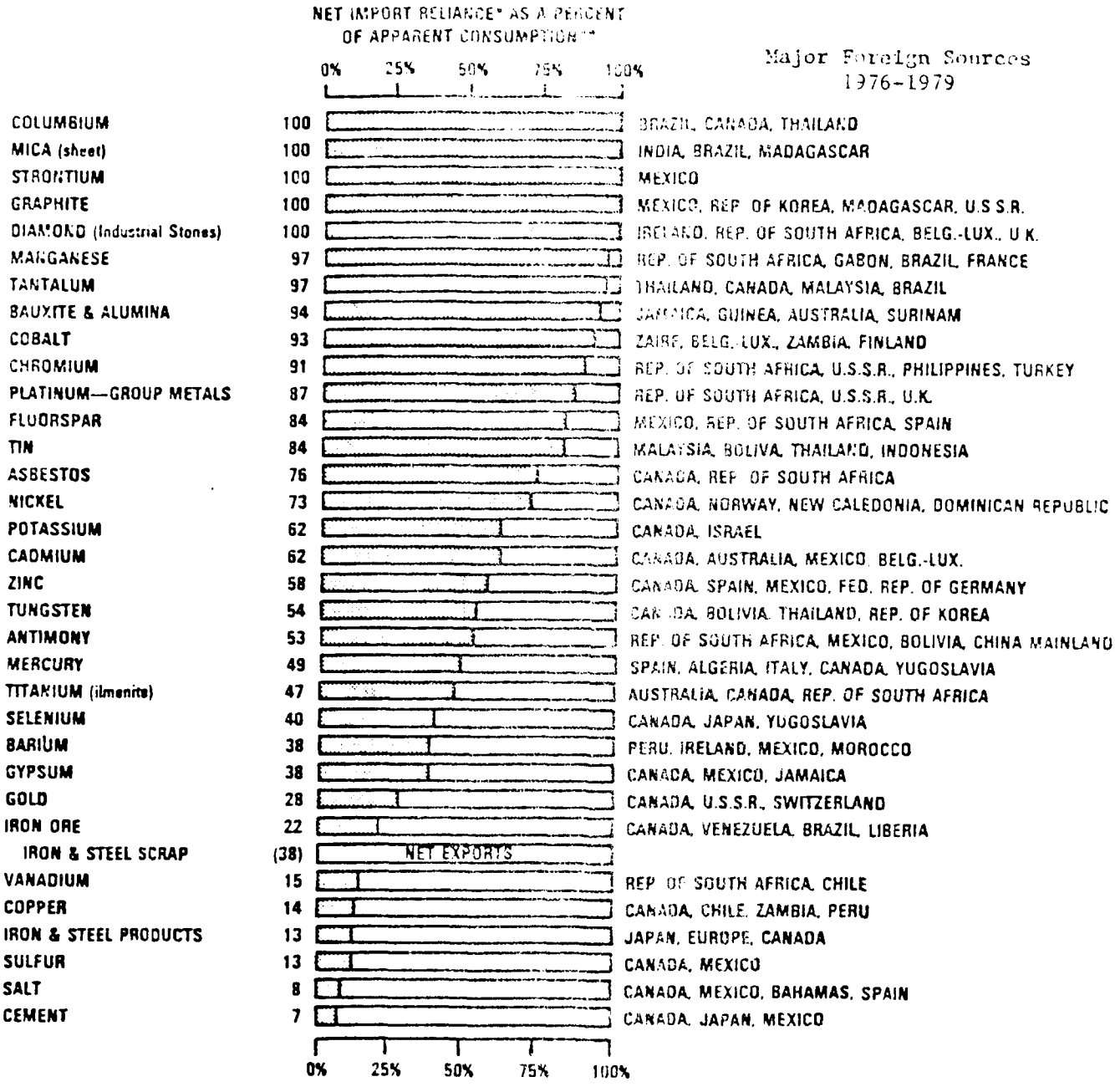
THE US STRATEGIC MINERALS POSITION--THE 1980's AND BEYOND

As international economic development progresses into the 21st century, increasing world demand and a corresponding depletion of existing high-grade mineral deposits can be expected to intensify competition for the world's strategic materials resources. A growing militance among the less-developed supplier nations in their quest for a new world economic order, and the simultaneous exercise of Soviet power and influence in the continuing East-West power struggle, will further aggravate the increasingly competitive environment and its potential for generating international conflict. The precise impact of these developments on US national security interests is not yet clear; the continuing high dependence of the United States on certain foreign mineral supplies is, however, a cause for concern.

The current impact of critical materials availability on Army readiness and combat effectiveness is minimal. The time to develop an awareness of potential problems, however, is before they become crises. Timely planning and appropriate action are essential for all elements of the Department of Defense, as well as other government and private agencies, to understand, anticipate and control materials-related problems, and to regain and maintain a strong US strategic minerals position.

THE ROOTS OF THE PROBLEM

There is no physical shortage of minerals in the earth's crust. It is variations in the concentration and distribution of economically recoverable mineral deposits which provide the potential for disruptive influences in future international relations. Although rich in mineral resources compared to most industrialized nations, the United States still imported, in 1980, more than half its domestic requirements for at least 20 important nonfuel mineral materials (see Figure 1). In some cases, importation of a large proportion of



*NET IMPORT RELIANCE = IMPORTS-EXPORTS ±ADJUSTMENTS FOR GOV'T AND INDUSTRY STOCK CHANGES.

**APPARENT CONSUMPTION = U.S. PRIMARY + SECONDARY PRODUCTION + NET IMPORT RELIANCE

Figure 1. 1980 Net Import Reliance for a Number of Important Nonfuel Mineral Materials

(From: Dr. John D. Morgan, [illegible], Bureau of Mines)[1]

US consumption of a mineral is based solely on economic factors; because of higher domestic labor costs or environmental restrictions, it is sometimes simply cheaper to purchase elsewhere than to produce locally. In several important cases, however, the reason for importing is a nonexistent or critically short domestic supply or an inadequate domestic production capacity. For these materials, US dependence on foreign suppliers has obvious strategic implications.

Conflicting assessments of the US materials situation are not uncommon among analysts and government policymakers alike. Evaluations of the current status and future implications of the US critical and strategic materials position vary. While the fact of US dependence on foreign sources of many critical materials is unquestionable, opinions differ on the degree to which such dependency represents vulnerability to economic or political coercion, the economic advantages versus the political risks of interdependence, and the policies and actions to be adopted by the United States to cope with possible materials-related problems.

Differing views of the situation are illustrated below:

> The degree of supply restriction entailed in price gouging or cartel-like action would not have a serious effect on US defenses. The portion of US consumption of critical materials required for defense production--generally 10 percent to 20 percent in the event of war and about one-half of that in peacetime . . . can be met from domestic production, stockpiling, and substitutes under any foreseeable supply restrictions.
>
> - Special Study of the Joint Economic Committee of the US Congress, December 1, 1980.[2]

> A shortage of critical materials, combined with a resulting dependence on uncertain foreign sources for these materials, is endangering the very foundation of our defense capabilities. These shortages are a monumental challenge to the Congress, the Department of Defense, the defense industry, and the civilian economy.
>
> - Defense Industrial Base Panel of the House Committee on Armed Services, December 31, 1980.[3]

MILITARY IMPLICATIONS

It is true, as observed in the first quotation above, that for most common materials the US military requirement represents a very small proportion of overall domestic consumption, and could no doubt be met from available supplies through allocations, priorities, and emergency release from stockpiles. Title I of the Defense Production Act of 1950, as amended, provides specific authority for priorities and allocations. Application of these provisions can alleviate most of the materials-related problems and delays commonly encountered in the development of materiel and weapons systems by the Army and the other Services. This is not the case, however, for all nonenergy materials, and for a few of the more exotic metals an almost complete lack of US reserves, coupled with a relatively high military requirement may be of strategic significance. For such materials, detailed study of the situation is essential, and continuous monitoring for a possible dependency/vulnerability relationship is particularly important so that changing conditions are recognized in time to be met with appropriate political, economic or military initiatives.

Conditions may change rapidly in either direction for a critical material or a critical supplier. A mineral may become less critical if new ore deposits are discovered, substitutes are developed, or improved technology permits economic exploitation of lower-grade ores. On the other hand, technological advances may bring about a significant increase in the economic or strategic importance of a specific material. Similarly, the economic or political vagaries of the international scene may affect, positively or negatively, the relationship between a critical material supplier and the United States.

CRITICAL MATERIALS

Two relatively unfamiliar metals which qualify for close and continuous scrutiny are tantalum and columbium. For the former, used extensively in electronic devices, as well as in high temperature alloys, US consumption for 1980 was equivalent to 170 percent of world mine production, with the excess coming from industry stocks and recycling. Demand is expected to increase at an annual rate of about 4 percent through 1990. The latter, columbium, is a metal of some economic and strategic significance today, which has the potential for great significance in advanced power generation systems of the year 2000 and thereafter. Principal current uses of columbium are as an alloying element in large-diameter pipeline steels, and ship-plate and heavy-machinery steels. The great future potential for the use of columbium lies in the fact that certain of its alloys are the most efficient superconductors known, with the capability of transmitting an electric current with zero resistance at cryogenic temperatures. Demand for this material is expected to increase at an annual rate of about 6 percent through 1990, with a much greater demand subsequent to 1990 when the full impact of superconductor technology development and application will be felt. For both tantalum and columbium, there is no US domestic mining industry, and a US mineral reserve base is nonexistent.[4]

Recent assessments of materials vulnerability are in general agreement as to which imported nonenergy minerals are most vulnerable to supply interruptions or coercive price increases potentially damaging to the US economy. Regardless of the criteria used in attempts to classify materials as to criticality, strategic importance, or vulnerability, certain minerals tend to turn up on the "most important" or "most vulnerable" lists. Chromium, cobalt, manganese, and the platinum group metals are identified most frequently, with tantalum, titanium, and columbium as leading contenders for vulnerability. Furthermore,

with the exception of titanium, US reserves of these same materials have been determined to be less than one-tenth of the quantities required to meet US anticipated cumulative demand to the year 2000.[5] When identified resources are considered, the forecast through 2000 appears somewhat more optimistic.* It must be remembered, however, that the successful exploitation of resources depends upon unspecified price increases and/or unpredictable advances in the technology of extractive metallurgy.[6]

Future defense and energy programs, with requirements for high temperature- and corrosion-resistant components, can be expected to generate increased demands for these materials. For example, the Pratt and Whitney F-100 turbofan aircraft engine, which powers the F-15 and F-16 planes, is reported to require 1656 lbs. of chromium, 910 lbs. of cobalt, 3 lbs. of tantalum, 5366 lbs. of titanium, and 171 lbs. of columbium.[7] The M-1 tank, although requiring smaller quantities of critical materials per engine, still represents a sizeable requirement for some of these materials, when considered in terms of future tank production rates.[8]

EFFORTS TO IMPROVE THE US MATERIALS POSITION

Awareness of the urgency of the strategic materials situation has been growing in both government and business circles in recent years. An interagency study, The Domestic Policy Review of Nonfuel Minerals, initiated by the Carter Administration in 1978, developed materials supply/demand relationships through the year 2000 and identified several imported minerals critical to the United States and its allies as being of greatest concern.[9] The study report, however,

*"Reserves" are defined as deposits economically recoverable under current technological and economic conditions. "Resources," more difficult to quantify, include deposits potentially recoverable given a significant technological development or price increase.

has been criticized for not conveying a sense of urgency about the seriousness of the situation, and for not identifying any practical solutions.

One result of such criticism has been enactment by the US Congress of the National Materials and Minerals Policy, Research and Development Act of 1980.[10] This Act required the President to report to the Congress his plan for a national materials policy to promote an adequate and stable supply of materials necessary to maintain national security, economic well-being, and industrial production. Passage of the Act led to a flurry of activity to comply with the Congressional mandate. The foremost action was the formation of a Cabinet council chaired by Department of the Interior.

A number of domestically-oriented initiatives, designed to alleviate the problem of US dependency on foreign materials suppliers and to avoid possible vulnerability to political, economic, and/or military coercion, have been proposed and are in various stages of implementation in both the government and private sectors. To be successful, most of them require imaginative research and development, the thoughtful dedication of legislative bodies, and the cooperation of the business and industrial communities. Some of these initiatives currently under consideration and some of the problems of implementation are discussed briefly below.

- Revitalizing the US mining industry by tax incentives and easing of environmental regulations.

With the words: "We cannot afford to continue following the perilous path of indifference leading to a serious mineral calamity. . . . We are in a resource war. We must begin today to establish a coherent national minerals policy. Our national security depends on it," Rep. James D. Santini (D-NV),

Chairman of the House Mines and Mining Subcommittee, introduced his National Mineral Security Act, an omnibus bill that he said would "establish a coherent national mineral policy to avoid the coming devastation of a major minerals crisis."[11] Submitted for consideration in May 1981, the proposed legislation has 39 co-sponsors.

Among the provisions of the proposed National Mineral Security Act are the creation of a Council on Minerals and Materials within the Executive Office of the President, a plan to improve mineral data collection and analysis, amended tax laws to assist the mining industry in making necessary capital investments, and amendment of the Administrative Procedure Act to achieve certain regulatory reforms. The implementation of these proposals would undoubtedly strengthen the US mining industry and help to reduce dependence on foreign supplies of some minerals. Major hurdles must be surmounted, however, in the enactment of this legislation since a sizable US constituency distrusts the motives of the mining industry in general, many doubt the existence of, or potential for a "resource war," and there is strong environmentalist pressure against any relaxation of existing regulations.

- Increasing research and development of domestically available substitutes for overseas materials.

The possibility of substitution varies from mineral to mineral and depends on such factors as physical properties, price, and available technology. Work on the development of substitutes is well under way in both industry and government laboratories, and acceptable substitutability for many materials is documented in Bureau of Mines publications. For some materials, however (e.g., chromium, cobalt, platinum), available substitutes are not economically viable

and/or do not meet acceptable performance standards. It is estimated that the development on a large scale of acceptable substitutes for these materials would require a minimum of 3 to 7 years of research effort.[12] These R&D efforts will benefit from a Bureau of Mines project designed to develop a general methodology for dealing with substitutability of nonfuel materials, as a guide for solving future substitution problems.[13]

- Increasing emphasis on the exploitation of domestically available low grade ores.

Increasing domestic production is a realistic alternative only for those minerals of which the United States has significant exploitable resources. Although a domestic reserve base is nonexistent for cobalt, chromium, and manganese, in all cases substantial subeconomic resources of ores of these materials are available (Fig. 2). The Bureau of Mines has developed extractive processes for many of these ores, and while not economically competitive at present, mines and processing plants could be established and held on a standby basis for emergency use. Time and money are again the crucial items. The exploitation of domestic deposits of these materials would require 5 to 7 years of lead time for exploration and development. Depending upon infrastructure requirements, the establishment of an operational mine could require many millions of dollars and 3 to 10 years of development effort. For some materials, government price guarantees under the Defense Production Act could stimulate domestic production and reopen existing mines with a considerable saving of both time and money. Bureau of Mines forecasts, for example, indicate a potential production of 6 million pounds of cobalt per year by 1990 (almost 1/4 of US projected demand for that year) by exploiting domestic low-grade ore deposits. The estimated

	Units	US Cumulative Primary Demand 1976-2000	US Identified Resources	Ratio of US Identified Resources to Cumulative Demand
CHROMIUM	Million Short Tons	18	11*	NA*
COBALT	Million Pounds	599**	1,700	2.8
COLUMBIUM	Million Pounds	322	300	0.9
MANGANESE	Million Short Tons	42	70	1.7
PLATINUM	Million Troy Ounces	22	90	4.0
TANTALUM	Million Pounds	64	3	0.1
TITANIUM	Million Short Tons	22	200	9.1

*Low-grade chromite ore; various percentages of recoverable chromium.
**1978-2000

Figure 2

COMPARISON OF US CUMULATIVE PRIMARY MINERAL DEMAND FORECASTS, 1976-2000, WITH US MINERAL RESOURCES. 6, 14, 15

Note: For the definition of resources, see footnote, p. 5.

possible domestic cobalt production for the year 2000 is 10 million pounds, about 28 percent of US projected demand.[14]

- Achieving stockpile goals for strategic materials (which would provide a 3-year emergency supply of the most critical items).

The Strategic and Critical Materials Stockpiling Act, as amended, requires the establishment of a stockpile of such materials* to protect the United States against costly and dangerous dependence upon foreign sources of supply in a period of national emergency. Historically, however, stockpile goals and inventories have not coincided. As of early 1981, stockpile inventories included $8 billion of required materials of a total of $20 billion cost to meet all goals. Five billion dollars in excess materials were available which could be sold. Even if all excess materials were disposed of promptly--highly unlikely due to market disruptions which would ensue--and with an also highly unlikely stockpile appropriation of $1 billion per year, it would still take 7 years to achieve all goals. In May 1981, the Reagan Administration authorized purchase of $100 million worth of strategic materials with funds made available by the 96th Congress, and requested an additional $120 million for Fiscal 1982.

- Encouraging increased conservation and recycling of materials.

Concern over materials shortages has led throughout industry to an increased emphasis on conservation in such areas as prevention of the corrosion of metals and wear reduction in moving parts of vehicles and equipment. A

*For the purposes of this Act, the term "strategic and critical materials" means materials that (1) would be needed to supply the military, industrial, and essential civilian needs of the United States during a national emergency, and (2) are not found or produced in the United States in sufficient quantities to meet such need.

"useful life" concept has emerged, emphasizing the idea that an unnecessarily short life of a product or a piece of equipment represents a waste both of the materials and of the energy expended in their production and manufacture. The science of tribology, involving improvements in wear control for greater product durability, is accordingly receiving greater attention.

Secondary sources, or recycling, can enhance domestic production to a significant degree for some metals (e.g., platinum, copper, nickel, tin). Some of the more critical materials, however, are either unsuited for recycling (manganese) or the collection and processing costs prohibit economical recovery (some forms of chromium and cobalt products and industrial wastes). As prices rise, secondary recovery processes become increasingly competitive and in the decades ahead recycling will provide an ever-increasing contribution to domestic critical materials production.

- Opening up more Federal lands to minerals exploration.

This is an extremely controversial subject, with the main battle lines drawn up between environmentalist groups on one side and representatives of the mining industry on the other. Broad policy differences also exist within the Federal Government bureaucracy. The General Accounting Office has charged that, in the United States, restrictions on the use of Federal land hinder exploration and development of domestic mineral resources, whereas other countries are actively encouraging and sponsoring exploration.[16] According to the Bureau of Mines, however, there is no evidence that land restrictions have affected domestic mineral production as yet because current production is using mineral reserves identified years ago.[17] A striking example of government bodies working at cross-purposes is the report that, in May 1981, Interior Secretary James Watt promised an American Mining Congress convention quick

action in opening substantial western public land acreage for minerals production. One week later the House Interior and Insular Affairs Committee ordered Secretary Watt to withdraw three wilderness areas in Montana from mineral leasing until 1 January 1984.[18] There are undoubtedly commercially promising deposits of strategic and critical materials within the 750 million acres of US public lands, but it is apparent that progress toward the development of mines which would ease the strategic materials situation will be slow and fragmentary. A reasonable estimate would be a 5 to 10-year time interval before significant mine production could be expected from these areas.

- Encouraging seabed mining under the Deep Seabed Hard Minerals Resources Act, pending development of an acceptable Law of the Sea Treaty.

Very large quantities of mineral-bearing concretions ("manganese nodules") have been discovered on the deep floors of the Pacific, Atlantic, and Indian Oceans. These ocean-floor deposits are under intensive investigation by several consortia representing both US and foreign interests. While estimates are preliminary and still highly speculative, a figure of 76 billion tons of nodules has been reported. Mining of these resources could provide an important source of supply for two of our most critical materials, cobalt and manganese, as well as long-term supplies of nickel and copper. Analyses of Pacific Ocean nodules show approximately 24 percent manganese, 1.0 percent nickel, 1.0 percent copper, and 0.35 percent of cobalt. A projected ocean mining operation with a capacity of 3 million tons of nodules per year could, with appropriate processing plants, supply 51 percent of US manganese, and 100 percent of US cobalt requirements (based on 1979 consumption).[19]

While optimistic estimates predict that seabed mining could make the United States virtually self-sufficient in cobalt, nickel, manganese, and copper by the end of this century,[20] serious legal problems as to ownership and mining rights remain to be resolved. Given the size of investment required--about one billion dollars per project--companies are understandably reluctant to proceed until they can be assured of the security of their investment, and of nondiscriminatory access to seabed minerals under reasonable terms and conditions. The proposed Law of the Sea Treaty which presumably would determine such terms and conditions is under detailed review by the US Administration because of several "major areas of concern," including the following:[21]

1. It establishes a supranational mining company--the Enterprise--that could eventually monopolize production of seabed minerals.
2. It requires the United States and other nations to fund the first capitalization for the Enterprise in proportion to their contributions to the United Nations.
3. It compels the sale of proprietary information and technology now largely in US hands.
4. It limits annual production of manganese nodules and the amount a single company can mine for 20 years, creating artificial scarcities.
5. It creates a one-nation, one-vote international body governed by an Assembly and an Executive Council on which the Soviet Union and its allies have three seats, while the United States must compete with its allies for representation.
6. It contains provisions setting out the eligibility of "national liberation movements" to get a share of revenues of the Seabed Authority.

The Deep Seabed Hard Minerals Resources Act, passed by the US Congress in 1980, provides an international legal framework for US mining of the deep sea as an interim measure until an acceptable Law of the Sea Treaty enters into force. Only one industrial consortium,* however, is reported to have seabed mining in its current plans. It hopes for commercial production of manganese in the late 1980's.[22]

- Improving methods for the collection and utilization of minerals data.

A reliable information system is essential to all materials planning and policymaking. Accurate, timely, and relevant data concerning the availability of critical materials is required to permit the anticipation and analysis of materials problems, and the evaluation of appropriate governmental responses. Responsibilities for minerals information are shared by the Department of the Interior (primarily Bureau of Mines and Geological Survey) and the Department of Commerce. Because of the relationship of materials to the national security, the Department of Defense is also an interested and active participant in materials information collection. Under the impetus of the National Materials Policy Act of 1980, the DOD has reemphasized this interest and has:[23]

1. Assigned the Secretary of Defense staff augmentation representing both the industrial resources and research and development organizational elements, to complete the required tasks. This team will be working closely with the Department of Commerce representatives and other interested agencies fulfilling their responsibilities under the Act.

*Because of the large capital investment required and the risks involved, seabed mining is beyond the capabilities of most individual companies.

2. Secured the support of the Institute for Defense Analyses to assist in assessing the overall materials, minerals, and R&D situation and in further developing policy options.

3. Renewed and updated the charter and objectives of the Interagency DOD Materials Availability Steering Committee originally established in 1974.

4. Established contacts with Department of Commerce, Department of State, and the Central Intelligence Agency and reinforced the continuing dialogue with the Federal Emergency Management Agency and the Department of Interior.

5. Tasked the Army and other Military Departments, and the Joint Chiefs of Staff, to work with DOD on assessing the impact of import dependency on specific weapons systems including the subsystems and semifinished components and structures.

6. Tasked the Army and other Military Departments, and the Defense Advanced Research Projects Agency (DARPA), with the responsibility for developing a long-range DOD-wide materials substitute research and development plan to address our most critical needs.

All of the actions discussed above clearly have some potential for easing the US materials position; however, bureaucratic inertia and the numerous special interests involved have slowed progress in most cases; actual implementation of proposed actions is likely to be even slower. Illustrating the difficulties involved in implementing specific programs is the fact that one currently popular opinion maintains that the most pressing issues involve solutions to the domestic problems of an inadequate industrial base and insufficient domestic mining, smelting, and refining capacity. Access to materials, it is argued, is of little importance if we do not have the capability to process and fabricate the required components. While noting these important complementary problems,

others argue even more cogently that the fundamental problem is access. If the materials are not available, they maintain, the capability to refine and fabricate them is irrelevant.

The long-term resolution of the US materials dilemma will undoubtedly require implementation of some or all of these domestically-oriented proposals. It is apparent, however, that short-term actions involving foreign suppliers are also needed to ensure access to current sources of materials, as an "insurance policy" during the time required to achieve greater domestic self-sufficiency. Figure 1 reveals the major foreign sources of some of the nonenergy materials identified as most critical to the economic well-being (and thus the political and military posture) of the United States and our allies.

A MATERIALS VULNERABILITY WINDOW

Despite the domestically-oriented remedial actions currently under study and development, and a comprehensive plan for emergency materials management,[24] a mineral supply disruption within the next few years could place the United States in very serious jeopardy. Minerals expansion programs, including the development of ore reserves, mines, and smelters take years to implement. The lead time necessary for exploration and development of our limited domestic supplies of cobalt and other critical minerals is estimated at five to seven years. The development on a commercially usable scale of substitutes for cobalt, chromium, and platinum group metals, if indeed feasible, also would take time--an optimistic estimate is three to seven years. Seven billion dollars in new appropriations would be required to bring the national stockpile of 93 minerals up to its goals--seven years at $1 billion per year. The 1981 authorization was $100 million. It is apparent that, even if all domestic programs were agreed upon and initiated immediately - a near impossibility - the United

States would still face a "materials vulnerability window" extending at least seven years into the future.

In some cases materials vulnerability problems may eventually be alleviated by purely domestic initiatives, including stockpiling, recycling, increased R&D for substitutes and improved recovery processes, and revitalizing appropriate sectors of the US mining industry. For other critical and strategic materials, however, an almost complete lack of US reserves combined with the severe minerals deficiencies of our NATO allies and Japan may dictate an international approach. The existence of a US materials vulnerability window, at least through 1988, also points up a need for immediate action to at least insure continued access to our present sources of supply, pending accomplishment of the longer-range objective of an adequate degree of materials self-sufficiency. The possibility of an impending resource war makes cooperation with our allies and other market economy countries even more urgent.

Through a combination of economic initiatives, political maneuvering, and outright military aggression, the Soviet Union is approaching a position from which it could at the opportune moment implement a successful strategy of resource denial against the United States and its allies and friends. While proponents of the "resource war" theory may overestimate the dangers at this time, there is no doubt that the ongoing aggressive Soviet minerals policy, plus the continuing growth and threat of Soviet military might, could soon result in a situation wherein great damage could be done to the Western World economy without firing a shot or launching a missile. Whatever their intentions may be, Soviet initiatives are increasingly encircling the energy resources of Southwest Asia and the nonfuel mineral-producing areas of southern Africa.

From a strategic materials standpoint, then, the economic welfare and security of the United States and its allies and friends may soon rest solely on the goodwill and benign intentions of the Soviet Union. Since Soviet intentions are at best unpredictable (and at worst Machiavellian), it behooves the United States to concern itself with Soviet capabilities, and take the necessary steps to limit those capabilities, particularly during the current period of exposure to the materials vulnerability window of the 1980's.

To preclude Soviet exploitation of its favorable materials position, the United States must take certain steps to minimize the vulnerable aspects of materials dependence. Foremost among these are the implementation of a coordinated and effective national energy policy, an equally effective national materials policy, and the maintenance of a sufficient posture of military strength to command respect in international negotiations.

INTERNATIONAL AGREEMENTS, AND DEFENSE IMPLICATIONS

The realities of present world power relationships dictate clearly that the United States is unable to insure attainment of its strategic objectives by depending solely on its own military forces. Alliances, coalitions, and the cooperation of friendly states are essential. It is equally true, under the current interdependent world environment, that the contributions of allied and friendly states would be essential to a collective effort to maintain access to strategic resources in the event of a determined Soviet resource denial effort. The need for a US three-ocean navy has been emphasized, able to deploy superior forces on the surface, underwater, and in the air to meet the various threats to essential sea lines of communication (SLOC's). Until such a naval capability is realized, however, the cooperation of friends and allies is indispensable.

Some of the international alternatives which should be considered, most of which have received little serious treatment in ongoing critical materials discussions, include:

1. Strengthened cooperative agreements, or coalitions, with other materials-consuming nations.

Assessments of strategic materials vulnerability must consider not only the position of the United States, but also that of its allies. For most minerals, Western Europe and Japan are even more dependent on imports than is the United States. As world demand increases, and readily-available supplies decline, access to nonfuel minerals will become an increasingly important component of the economic health and national security of all industrialized nations. In such an environment, a climate of cooperation may change to competition, and the bonds of mutual interests among the nations of the non-Communist world may deteriorate.

--The European Community has recognized the potential problem of growing competition for critical materials by calling for increased cooperation, as follows:[25]

> Relatively close coordination of competition policies should be arranged between the relevant authorities in the United States, Japan and the Community; this has not been the case up to now. Appropriate measures are needed to bring about an international dialogue on competition policy, with a view to achieving cooperation in this field.

Because of its inescapable leadership role in the Western World, and because it is much more self-sufficient in materials than its friends and allies, US policies and actions will have a decisive influence on the cohesion of the free world community.

--The International Energy Agency (IEA) was created by the United States and other principal oil importers, to share oil information and to allocate scarce supplies among member nations in the event of a major oil shortage. A similar coalition of nonenergy materials consuming nations could enhance cooperation and plan coordinated response to possible future materials supply emergencies.

--Many of the materials consumer nations, including the United States, have small or subeconomic deposits of critical materials. Following the example

of the EEC, where protection and support for subeconomic farms has actually produced agricultural surpluses, an International Minerals Agency (IMA) could promote collective self-sufficiency in the particularly vulnerable minerals. Through economic cooperation, and the application of advanced technology, subeconomic mineral resources could be exploited to develop international buffer stocks of critical materials at least adequate for emergency military requirements.

--At present, no comprehensive assessment of the military requirements of NATO and Japan, for a plausible conflict scenario, is available. The development of such data, complete with projections of how these requirements could be met from emergency stocks and by production from secure sources, would be an appropriate task for the IMA.

2. Increased emphasis on US economic support funding (formerly known as security supporting assistance (SSA)) to Third World minerals supplier nations.*

--Under the provisions of traditional SSA programs, US funding was authorized to provide economic assistance to countries experiencing political and economic distress where US security interests might be jeopardized (e.g., the Middle East). This type of funding should be increased in both amount and scope, and extended on a selective basis to minerals supplier nations, even where no immediate threat exists to US security interests, but where the political or economic climate is such that there is a danger of a cut-off of US supplies of critical materials.

--This extended economic support could encompass a number of mutually beneficial activities, such as assistance in mining a strategic material, development of the logistical infrastructure of a developing country, and other economically-oriented assistance directly affecting the economic stability--and thus the security--of the recipient country. Benefits of such

*The term "security supporting assistance" (SSA) was abolished effective 30 Sep 1978, by Section 10 of the International Security Assistance Act of 1978, 92 Stat. 735.

aid could accrue to the United States in several ways. Improvements in the logistical infrastructure in areas of strategic importance to the United States would be a distinct advantage in the event of conflict in the area. Most importantly, increased economic and trade interdependence with critical materials suppliers would reduce the likelihood of economic coercion directed against the United States, contribute to the economic stability of the supplier nation, and help to ensure US access to critical and strategic materials.

--There is currently no express authority to procure strategic stockpile materials by bartering defense goods and services. Appropriate amendments to the Arms Export Control Act and the Foreign Assistance Act of 1961, as amended, would be required to introduce such procedures on a significant scale.

3. Bilateral trade agreements with US materials supplier nations.

--Ideally, UNCTAD negotiations, and the services of such economic instrumentalities as the World Bank and the International Monetary Fund, should provide an equitable world economic order within which each nation would produce those commodities best suited to its stage of technical and economic development. Free trade would be the universal rule, and all nations would prosper. The vagaries of the human condition, however--including, but by no means limited to, Soviet economic machinations and politico-military pressures--have thus far precluded such a logical development. While still pursuing the ideal within the framework of international deliberations, the United States must, in its own self-interest, take interim measures to insure availability of essential materials.

--These measures could include bilateral trade agreements with selected materials suppliers, stressing the importance of the interdependent

consumer-producer relationship, and the mutual benefits to be derived from having a stable, dependable market for critical materials at a fair and predictable price.

--A complicating factor in the formulation of such agreements could arise from a growing desire on the part of most mineral suppliers to achieve a higher degree of local processing of ores before export. This is a declared policy in many cases, and is observed not only in Third World primary minerals producers, but also in the rich producer nations (Canada, Australia) and even the USSR. In the short term, this policy will cause problems for the US primary processing industry. In the face of this competition, some US processors will be required to scale down their operations, unless they possess some special skill such as the treatment of low-grade or difficult mineral concentrates, or high rates of recovery for marketable by-products.

--In the long-term, these basic industries could be expected to decline in the industrialized nations, and the switch to processing at origin will only accelerate these changes.

--Trade agreements to purchase processed materials must be made selectively and with caution, to avoid excessive degradation of US domestic processing capabilities. Where appropriate, provision should be made for maintenance of the minimum essential processing plant on a standby basis, by government subsidy if necessary, to insure the continuing ability to process our own or other available raw materials in case of emergency.

--Rather than attempting to discourage minerals processing at the source, technically-experienced US companies should bid to design, install and, if possible, to operate the new plants, with maximum possible support from

the US Government, including all feasible diplomatic initiatives to preclude later expropriation or other problems with the host government.

4. Expansion of the NATO charter to include protection of sources of materials of critical and strategic importance to alliance members.

--Governments of the NATO alliance nations were formerly mostly Christian-Democratic in orientation, and staunch, dependable allies against the Soviet and Warsaw Pact threat. With the accession to power of fragile coalitions in many cases, and a growing affluence and complacency in Western Europe, indications of a certain divergence of interests and priorities have appeared. A question arises as to whether the commonality of perspective between the United States and its NATO allies is sufficient to support cooperative action to protect and secure critical resources.

--Traditionally, NATO members have been reluctant to extend the alliance boundaries and responsibilities, even under the impetus of oil embargoes and threats to the Persian Gulf sources of their vital petroleum imports. Out-of-area operations have taken place, but these were not officially sanctioned as alliance activities. France and Belgium, for example, still have interests in Africa which they have not abandoned; when trouble has erupted, they have intervened--and the United States has on occasion furnished airlift to support them.

--What is needed at this time, however, and for the duration of the materials vulnerability window, is a firm commitment on the part of NATO members to active, cooperative efforts to secure critical SLOC's, to ensure access to strategic minerals for all member nations, and if necessary to deny geographic and economic resources to an enemy.

--Historically, the major (and only consistent) motive for a country participating in an alliance, or engaging in coalition warfare, has been that country's pragmatic view of its own interests. Thus, it is in the best interests of the United States, and indeed of all concerned, to convince the NATO membership that it has vulnerable trade, energy, and mineral flanks outside of its immediate geographical area, which warrant an increased commitment of resources and a determined, cooperative power projection capability for their defense.

--In a similar vein, an all-oceans naval alliance has been proposed by Ray S. Cline of Georgetown University, which would in effect comprise a global extension of NATO's multination Standing Naval Force Atlantic, with additional membership to include among others Japan and South Africa. The strategic task of this combined naval force would be "cooperation to protect in peacetime or in war the sea lanes of the trading nations of the free world, not only the advanced industrial giants but the most indispensable suppliers of raw material resources."[26]

CONCLUSION

Stockpiling appears, upon cursory examination, to be a readily available means of assuring adequate critical materials supplies during periods of emergency. Achievement of the designated stockpile goals, then, should provide the immediate and short-term solution to our materials problems. The political and economic facts of life, however, change this optimistic picture. A rapid acquisition of stockpile requirements drives up prices of the materials concerned, contributes to inflationary pressures, and is opposed by a sizable constituency in the Congress and in industry. Conversely, selling off unneeded stockpile surpluses drives prices down and is opposed by domestic minerals producers. A compromise

policy results in a very moderate rate of materials acquisition ($100 million in FY 1981), which makes the building of a national materials stockpile an extremely long-range solution at best.

Accordingly, the international initiatives discussed above become the optimum approach to the immediate problem of insuring continued access to present sources of supply. Here, as is the case for domestically-oriented remedial measures, no general solution exists for all materials or all circumstances. Each critical material and each critical material/supplier country combination presents a unique set of problems requiring separate study, analysis, and action. Political, economic and sociological factors, and interactions between supplier countries add to the complexity of choosing the appropriate US diplomatic initiatives.

Four of the critical minerals mentioned earlier (chromium, cobalt, manganese, and platinum) serve to illustrate one of the most intractable problems in the application of US diplomacy to insure continued access to resources. With most world reserves and principal US suppliers located in southern Africa (and the Soviet Union) and the prevailing political and racial disharmony in that region, the basic problem is how to remain on positive terms with all suppliers, without unwittingly adding tinder to an already inflammable situation.

Here, the United States must walk a middle road. Too close an association with, and apparent support for, black nationalism could encourage increased violence and open conflict, with the Soviet Union standing ready to exploit any opportunity. On the other hand, a close alliance with the South African government would offend the US black population, as well as the black African nations, and could even lead to invited participation of the Soviets in interracial warfare. Under these difficult circumstances, the best policy for the

United States seems to be a maintenance of the status quo, complete with all its political stresses and strains and racial tensions, but with continued US access to indispensable material supplies.

It is noteworthy that, in many cases, the black nations of Southern Africa have demonstrated greater pragmatism than has the United States, and the realities of economic interdependence have prevented strong ideological conflict with the Republic of South Africa. At least during the period of the materials vulnerability window, the United States should follow this example. Of the international initiatives suggested in this discussion, a pragmatic and even-handed application of bilateral trade agreements would appear most promising.

For other strategic materials suppliers in other regions of the world (Canada, Mexico, Brazil, Australia), each represents its own set of problems and each will require its own separate evaluation and solution. In all cases, the fundamental objective is to insure a continuing supply of critical strategic materials until the United States can implement the necessary domestic programs to regain and maintain an acceptable strategic materials position.

To summarize, the US critical and strategic materials position, and some suggestions for improvement of the situation, may be stated as follows:

1. There is no physical shortage of minerals in the world today, or for the next several decades, at least. The concentration and distribution of critical materials is the basic problem.

2. The United States is heavily dependent on foreign suppliers for critical and strategic materials, in some cases to the point of vulnerability to supply disruptions which could seriously endanger our economic welfare and even our national security.

3. Given time and the provision of necessary funding, US technology and normal functioning of a free market economy would solve US critical materials problems. International political and economic pressures, however, plus the threat of a Soviet-sponsored resource war, indicate that sufficient time may not be available, and interim measures are necessary to assure essential material supplies.

4. Each combination of critical material and critical material supplier country requires its own separate evaluation and appropriate policy or action, among which may be:

a. Strengthened cooperative political, economic, or military agreements or coalitions,

b. bilateral trade agreements,

c. US economic assistance programs, or

d. expanded NATO charter protection.

From an Army viewpoint, the US strategic minerals position poses no immediate concern. Aggressive application of Title I provisions of the Defense Production Act can adjust priorities and allocations for most materials so that the relatively small military portion of overall US consumption can be met. Future availability problems may be encountered, however, for cobalt, chromium, manganese, and platinum, the key minerals highlighted in this report--and later, possibly, for columbium and tantalum. For such materials, preventive action is indicated. Army Program Managers, in close coordination with DOD materials specialists and Bureau of Mines and Department of Commerce representatives, must analyze current and projected supply/demand relationships to insure future availability of an adequate quantity (and quality) for their programs.

As has been emphasized, the strategic and critical materials arena is a dynamic one. Political and/or economic conditions may change rapidly affecting the price or availability of a critical material, or the stability or accessibility of its supplier country. For example, Rhodesia, possessing about 1/3 of the world's reserves of chromium ore, was formerly an important supplier of chromium to the United States. Imports ceased in 1967, with the imposition of UN sanctions against Rhodesia; began again in 1971, permitted under the Byrd Amendment to the FY 1972 Armed Forces Appropriation Authorization; ceased again in 1977 upon repeal of the Byrd Amendment; and resumed in December 1979 with the establishment of newly-independent Zimbabwe. Technological developments can cause equally drastic (but usually more gradual) changes in the critical materials picture, as is expected for superconducting technology in the case of columbium.

Published information concerning political and economic trends and their impact on the materials situation often lag several months behind real-time events (e.g., Figure 1, taken from 1981 Bureau of Mines data, does not list Zimbabwe as a supplier of chromium.). Accordingly, the choice of options to insure continued access to a critical material requires a detailed assessment of the current politico-economic situation in each specific case. Determination of the specifics of the policy to be followed and the program to be implemented demands a dedicated study effort for each material/supplier combination, encompassing input concerning current import data, mine production figures for countries concerned, current trade agreements, and details and conditions of ongoing security assistance or other military cooperation or aid programs.

Finally, military action cannot be completely ruled out. In a worst-case scenario--if a resource war in fact materializes and all else fails--the Rapid

Deployment Joint Task Force must be prepared to intervene. For all critical materials supplier countries where such action is feasible, contingency plans should be worked out in advance to protect and insure US access to critical materials and essential lines of communication.

It is apparent that the United States is in a vulnerable position vis-a-vis the Soviet Union in the area of critical and strategic materials availability. US current and projected dependence on foreign suppliers for scarce natural resources represents a definite disadvantage in terms of the international strategic balance of power. Although there are signs of some weakening in the Soviet posture of self-sufficiency in petroleum and other important minerals between now and 1990, it is likely the USSR will continue to enjoy a distinct advantage in most aspects of materials availability through the turn of the century. The domestic and internationally oriented actions discussed above can help to redress the critical materials balance and support the resumption of a US position of power and leadership in the world community.

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Strategic minerals; Strategic and critical materials; Resource war; US materials vulnerability; International cooperation.

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This paper discusses the current critical and strategic materials position of the United States, and projects the potential for improved US minerals sufficiency into the 1980's and beyond. In some cases materials availability problems may be alleviated by purely domestic initiatives, including stockpiling, recycling, increased R&D for substitutes and improved recovery processes, and revitalizing appropriate sectors of the US mining industry. For other critical and strategic materials, however, an almost complete lack of US reserves combined with the severe minerals deficiencies of our NATO allies and Japan may

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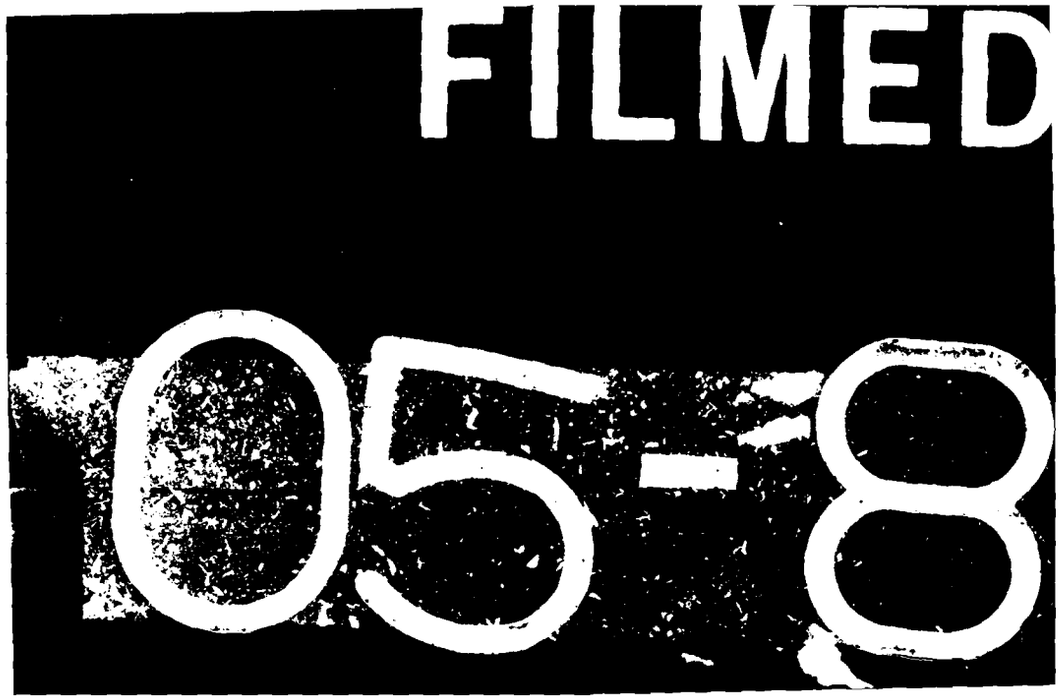
20. Abstract (cont'd). dictate an international approach. The author foresees a "materials vulnerability window" extending at least seven years into the future, during which international cooperation will be essential to insure continued access to foreign supplies, while domestic initiatives are emphasized to regain a satisfactory US posture of strategic minerals sufficiency.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