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**THE DEPENDENCY OF THE UNITED STATES
ON FOREIGN MARKETS FOR STRATEGIC RAW
MATERIALS AND ITS EFFECT ON NATIONAL STRATEGY**

A Monograph

by

Lieutenant Colonel Robert M. Dudley

Field Artillery

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**School of Advanced Military Studies
United States Army Command and General Staff College
Fort Leavenworth, Kansas**

**Advanced Operational Studies Fellowship
First Term AY 88-89**

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REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED		1b. RESTRICTIVE MARKINGS	
2a. SECURITY CLASSIFICATION AUTHORITY		3. DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release; distribution unlimited	
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE		4. PERFORMING ORGANIZATION REPORT NUMBER(S)	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)		5. MONITORING ORGANIZATION REPORT NUMBER(S)	
6a. NAME OF PERFORMING ORGANIZATION School of Advanced Military Studies, USAC&GSC	6b. OFFICE SYMBOL (if applicable) ATZL-SWV	7a. NAME OF MONITORING ORGANIZATION	
6c. ADDRESS (City, State, and ZIP Code) Fort Leavenworth, Kansas 66027-6900		7b. ADDRESS (City, State, and ZIP Code)	
8a. NAME OF FUNDING / SPONSORING ORGANIZATION	8b. OFFICE SYMBOL (if applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER	
8c. ADDRESS (City, State, and ZIP Code)		10. SOURCE OF FUNDING NUMBERS	
		PROGRAM ELEMENT NO.	PROJECT NO.
		TASK NO.	WORK UNIT ACCESSION NO.
11. TITLE (Include Security Classification) The Dependency of the United States on Foreign Markets for Strategic Raw Materials and its Effect on National Strategy (U)			
12. PERSONAL AUTHOR(S) LTC Robert M. Dudley, USA			
13a. TYPE OF REPORT Monograph	13b. TIME COVERED FROM _____ TO _____	14. DATE OF REPORT (Year, Month, Day) 16 February 1989	15. PAGE COUNT 51
16. SUPPLEMENTARY NOTATION			
17. COSATI CODES		18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)	
FIELD	GROUP	SUB-GROUP	
		national strategy import reliance	
		strategic raw materials industrial mobilization	
		strategic resources strategic minerals	
19. ABSTRACT (Continue on reverse if necessary and identify by block number) <p>This monograph examines the dependency of the United States on foreign markets for strategic raw materials and how that affects national strategy.</p> <p>The paper initially examines what the classical theorists say about a country's requirements to provide needed materials to its army in order to prosecute a war and then looks at two historical examples of what happens to a country that goes to war without access to required raw materials. It then examines specific strategic raw materials needed by the United States, the sources of these materials, and the political alignment of these countries.</p> <p>The monograph concludes with a discussion of the national strategy the country must develop to ensure a continuous supply of required strategic raw materials are available during a national emergency.</p>			
20. DISTRIBUTION / AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT <input type="checkbox"/> DTIC USERS		21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED	
22a. NAME OF RESPONSIBLE INDIVIDUAL LTC Robert M. Dudley		22b. TELEPHONE (Include Area Code) (913) 684-2138	22c. OFFICE SYMBOL ATZL-SWV

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Unannounced	<input type="checkbox"/>
Justification _____	
By _____	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	



School of Advanced Military Studies
Monograph Approval

Name of Student: Lieutenant Colonel Robert M. Dudley
Title of Monograph: The Dependency of the United
States on Foreign Markets for
Strategic Raw Materials and its
Effect on National Strategy

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Accepted this 16th day of January 1989.

(A)

ABSTRACT

THE DEPENDENCY OF THE UNITED STATES ON FOREIGN MARKETS FOR STRATEGIC RAW MATERIALS AND ITS EFFECT ON NATIONAL STRATEGY. By Lieutenant Colonel Robert M. Dudley, USA. 51 pages.

This monograph examines the dependency of the United States on foreign markets for strategic raw materials and how that affects national strategy.

The paper initially examines what the classical theorists say about a country's requirements to provide needed materials to its army in order to prosecute a war and then looks at two historical examples of what happens to a country that goes to war without access to required raw materials. It then examines specific strategic raw materials needed by the United States, the sources of these materials, and the political alignment of these countries.

The monograph concludes with a discussion of the national strategy the country must develop to ensure a continuous supply of required strategic raw materials are available during a national emergency.

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PART I

INTRODUCTION

Since its foundation, the United States has been seen as a country with unlimited resources. For years, it was the supplier of raw materials to countries throughout the world, plus was able to supply its own industries with the vast majority of the raw materials they needed. Most early commentators felt that the United States would never run out of required resources. As Alfred Mahan stated in his book, The Influence of Sea Power upon History 1660-1783,

"The internal resources are boundless as compared with present needs; we can live off ourselves indefinitely in 'our little corner'." (12:42)

For years, this proved to be the case. The United States relied very little on imported raw materials, even during wars. Although the country did not maintain a large military complex prior to WWII, it was able to mobilize its industrial complex, and with the nation's vast resources, to expand its military power with very few worries.

Subsequent to the Second World War, however, the instruments of war have become increasingly more sophisticated. They now require a myriad of raw

materials that cannot be obtained solely in the United States. These minerals are expensive and are in great demand worldwide. As Michael Tanzer stated,

"For many generations fuels and non-fuel minerals have been a key factor in industrialization, war, and the international distribution of economic and military power. In the 30 years since the end of WWII, however, their significance has taken a quantum leap as their use and cost have grown more rapidly than the world economy." (19:15)

Because many of these minerals were found in less developed countries, there was competition immediately after WWII to monopolize them. The prize was the low-cost, high-profit minerals of the underdeveloped countries. Unfortunately, these countries had neither the economies nor the military power to stave off the foreign predators. Since the 1973 OPEC upheaval, however, many of the other Third World countries have tried to organize so they could follow OPEC's lead and raise prices and gain greater control of their own natural resources. (19:25-26) Unfortunately the United States has become dependent on foreign suppliers for many of the strategic raw materials necessary for national defense. This dependency coupled with competition throughout the world for these limited resources places the United States in a precarious position. The question that arises is, what effect does this dependency have on the United States? What must

the nation do to ensure it is not subject to resource blackmail in the event of a war? The answers lie in United States national strategy.

Safeguarding the United States and its allies through deterrence, defending if deterrence fails, and ensuring United States access to critical resources, markets, oceans and space are three of our national security objectives. National strategy must be designed to meet and deal effectively with challenges to these objectives. With our increasing dependency on foreign markets for critical raw materials, a threat to the supply of these materials could weaken our military and jeopardize our ability to deter or prosecute a war.

This paper will examine the impact this dependency has on national strategy and how it must be structured to guarantee our national security. Initially the paper will examine what the major classical theorists say about the importance of the ability to provide needed equipment to the military. Next, historical examples will be cited to demonstrate what can happen to a nation that is too dependent on foreign suppliers for its raw materials. The study will then look at some of the critical materials needed by the United States to produce military equipment, where these materials are found, and what the political alignments are of these

countries. Finally, the paper will examine a strategy the United States must employ to ensure a sufficient supply of raw materials deemed critical to its national security is maintained.

PART II

THEORISTS

Although most early theorists did not address the impact of raw materials on warfare, they understood the economic aspect of warfare and the significance of providing an army with the equipment and stocks with which to wage war. The earliest known treatise on warfare was written around 500 BC by the Chinese warrior, Sun Tzu. In his book, The Art of War, Sun Tzu stated.

"War is a grave matter; one is apprehensive lest men embark upon it without due reflection." (17: 63)

As part of this reflection, he stated that one must appraise warfare in terms of five fundamental factors and compare seven elements to assess its essentials. (17:63) One of these fundamentals was doctrine, which he defined as,

"...organization, control, assignment of appropriate ranks to officers, regulation of supply routes, and the provision of principal items used by the army." (17:65)

Although warfare was primitive then, as compared to our standards, and did not consist of highly technical equipment, Sun Tzu realized as early as 500 BC that if a country was going to prosecute a war, it must have the ability to provide its army with the required supplies.

Following the Napoleonic era, Clausewitz and Jomini began to study warfare closely and have probably had more effect on contemporary military thought than any other writers. Although Clausewitz in his classic, On War, made a distinction between preparations for war and war itself (3:131) and questioned how far theory should carry its analysis of the means of war (3:144), it was obvious throughout his book that the results of this preparation were critical for an army to fight. These preparations included "making guns and powder out of coal, sulphur, saltpeter, copper and tin," etc.(3:144) which implies that the industrial capability of the country is critical to the country's ability to wage war. He also stated that it was possible to succeed without actually defeating the enemy forces on the field of battle. An enemy, he said, might be worn down over the duration of a war to bring about a gradual exhaustion of his physical and moral resistance. (3:93) Therefore, if the enemy had a limited supply of war stocks, or a limited capability of producing these materials, conceivably, an army could maneuver without ever seeking decisive battle and eventually wear down the opponent through a sheer lack of resources. An example of this was Wellington's campaign against Marshall Massena in Portugal during the Peninsular War of 1807-1814. With the impending invasion by the French

in 1810, Wellington refused to fight a battle unless he was certain of victory. Using a scorched earth policy and having his army fall back on successive defensive positions, he drew the French into an artificial desert. (6:132) Knowing that the French supply system was not very dependable, he figured that Massena could not live off the country if it was stripped bare. Using this strategy, Wellington eventually defeated Massena and forced his retreat from Portugal. Between September 1810 and April 1811, the French lost 25,000 men. One quarter were prisoners of war and 1500 were killed in battle. The remaining, over 15,000, were lost either to starvation or disease or to the Portugese guerrillas. (6:148)

Jomini also had a major influence on contemporary military thought. In his book, The Art of War, he discussed the essential bases of military policy which should be adopted by a government. Included in these bases were three critical factors. First, the material of war should be the best possible and available in abundance. Second, a government deciding to go to war must be able to provide the material means necessary to guarantee the success of the enterprise, and third, the country must have the financial capability to wage a long war. (9:48-51) Like Clausewitz, Jomini did not

connect these actions directly with the actual art of war. However, he also believed that a country's ability to provide the materials of war to its army was critical if it expected to be successful.

Perhaps the theorist with the most foresight was I.S. Block when it came to anticipating the expense of modern warfare and the problems a government would have in supplying an army. He wrote in 1899 that war had become impossible to support from a military, economic, and political point of view. (1:xi) In his view, war had become so costly, that mankind could no longer afford to pay for it. (1:xvii) He believed that the front would very quickly become a deadlock and that the outcome would depend on whether or not the people at home would be able to keep providing the men at the front with the necessities for life. ((1:xliv))

The question that all of these theorists were really addressing was whether or not a country could provide the necessary materials for its army to sustain combat. Although they did not specifically address raw materials in the prosecution of warfare, all four realized that the preparations for war and the ability for a country to sustain its army were critical to its ultimate success on the battlefield.

PART III

HISTORICAL EXAMPLES

History is replete with examples of countries going to war without the capability to sustain their military. This section examines two such cases, the Confederate States of America during the American Civil War and Japan during the Second World War.

CONFEDERATE STATES OF AMERICA

The American Civil War is an example in our own history that shows what happens when a country goes to war without possessing the ability to provide the necessary resources for its army. When the South seceded from the Union and the war began, the secessionists felt that the war would be short. Confederate soldiers enlisted for 12 months, but expected to be home early. (14:7) When the war started, however, stocks of goods in many of the Southern towns were low and, although the Northern blockade was not initially very effective, it did discourage importation of war necessities. (14:12) Consequently, at the beginning of the war, the soldiers had to furnish much of their own equipment. (14:15)

The problem that arose was how to obtain the needed equipment to fight the war. Unfortunately for the South, they had an almost militant aversion to shop work. (25:7) Everyone seemed to understand that manufacturing was important, but no one had an interest in becoming personally involved because of the typical Southern dream of becoming a planter. (25:13) The South did have a base for a strong iron industry in large deposits of coal and iron ore, but this was not exploited because of the dominance of cotton. (25:25) Consequently, at the start of the war, the bulk of Southern industry was small and extremely primitive compared to that of the North. (25:32) Eventually numerous industries began in all areas, but it is questionable whether they ever progressed beyond the experimental stages. (16:272) Since the Confederacy was so dependent upon imports, once the Union blockade did become effective, it was only a matter of time before it sapped the strength out of the South. (16:236)

With the extreme shortage of resources, the government was forced to divert the few resources available to the army and away from the civilian populace. However, this resulted in widespread discontent among the civilian populace and eventually resulted in large scale desertions because soldiers

resented the conditions that their families had to live in. (14:51) The South's inability to provide the necessary equipment to their army in order to prosecute a prolonged conflict resulted in their ultimate defeat. According to Charles Ramsdell,

"Some achievements on the battle front were very close to being miracles, but the difficulties which beset the people and the state and Confederate governments in the way of economic and financial and social problems far beyond the sound of guns, were greater even than General Robert E. Lee faced across the wooded hills of Virginia." (14:3)

Although the South won many tactical victories during the war, their inability to conserve, develop, and efficiently administer their resources doomed them from the start. They had not developed the industrial base, nor the resources to manufacture the necessities of an army, and the Union blockade prevented the importation of the quantity of goods and resources needed to win the war.

JAPAN IN WORLD WAR II

Japan offers the best 20th Century example of the results when a country goes to war without sufficient resources. For centuries, Japan had been isolated. However, in the Sino-Japanese war of 1894-1895, Japan won a remarkable series of victories. The Japanese defeated the Chinese in Korea and subsequently invaded

and occupied Formosa, southern Manchuria and the Shantung peninsula. This was the beginning of Japanese territorial expansion. (31:4-5)

Entering World War I on the side of the Allies, Japan attacked and seized German holdings in China, which led to further attempts by the Japanese to expand in that country. (31:5) Full-scale war broke out between Japan and China in 1937, resulting in a number of clashes between both United States and British personnel and the Japanese. This resulted in anti-Japanese sentiment in both American policy and public opinion. (31:7) When Japan signed the Tripartite Pact in 1940 with Italy and Germany, the United States identified her as an aggressor nation and curtailed oil and scrap iron shipments to Japan. By July 1941, America froze all Japanese assets in the United States and suspended all trade with Japan. Britain, Burma, India, and the Netherlands Indies followed suit. (31:8) It was clear that Japan was exposed and vulnerable because of her continued dependence upon basic raw materials derived principally from the southern areas of the Pacific. (4:46)

A study of the Japanese Cabinet Planning Board, dated December 1941 states,

"In the greatly changing world situation, the Empire is compelled to adopt a policy whose objective is the establishment of a self-sufficient position based upon its own strength, and then points out four things which make up the bottleneck of Japan's self-sufficiency. It lists rice, fuel, important war materials, and transport capacity. Under measures to obtain essential materials, it is indicated that rice must be secured from French Indochina and Thailand, oil from the Netherlands East Indies, tin from French Indochina and Thailand, copper from the Philippines, rubber and nickel from the south, etc." (4:46)

Since these countries were Japan's potential enemies, Japan realized that her economy could be destroyed at their will.

With Europe at war and with the United States unmobilized, Japan realized that she could not afford to hesitate in obtaining the resources she needed.

"To strike a paralyzing blow, wage a short defense, then negotiate a peace in which she would give up the farthest corners to which the surge of empire had carried her, but not yield the basic essentials, was Japan's plan of action." (4:47)

Japan assumed that the war would be a short one and that the United States would negotiate a peace after she grew tired and bored with the war. (4:49) Japan's plan looked to the acquisition of strategic raw materials. Specifically, the Japanese wanted to conquer a huge defensive triangle within which they could control the resources necessary to achieve their national objectives of creating a "New Asia". (31:28) Japan had no plan, however, to increase its industrial

output to match the massive economic weight of the United States. When the Japanese finally realized that they were in for a prolonged war, it was too late. (4:51) If the Japanese leaders had realized that they were in for a long war with America, it is questionable whether they would have launched the attack on Pearl Harbor.

By the end of 1942, high ship losses by the Japanese to submarines highlighted the growing danger of a blockade. Although the Japanese realized that they needed to increase their war production effort, their limitations of raw materials and the growing shortages of materials due to the blockade rendered some production capacity excess even before it was completed. (4:56) As the war continued, the United States began air attacks on Japanese industrial centers. However, the air attacks were not the cause of defeat.

"The defeat of Japan was assured before the urban air attacks were launched. The decline of Japan's war-making powers started before her industries were subjected to the main weight of the bombing attack during the months of March to August 1945. The insufficiency of the pygmy economy was the underlying cause of defeat. It has been estimated that even without air attacks, overall production in August 1945 would have been only half of that of the 1944 peak due to dwindling stockpiles of raw materials, cessation of imports, shortage of skilled labor, absenteeism, incompetent administration, and an ill-conceived and poorly executed dispersal program." (4:58)

As with the Confederate States in the American Civil War, Japan won some initial tactical victories, however, was not able to prosecute a prolonged conflict. Japan was basically a have-not nation that had planned on a short war. Consequently, the Japanese had made no effort to broaden the base of their economy and to match the industrial capability of the United States. Their late start in increasing their war capability coupled with the severe shortage of raw materials, doomed Japan from the start.

Thus, we have seen two examples of what happens when a country does not have the necessary industrial capability and raw materials and must depend upon other countries to supply these critical assets during a war. The Confederate States started a war with the Union which had a massive industrial and technological potential that literally crushed the South due to their total lack of industrial capability. Japan was forced into a militant policy to acquire needed resources in order to continue their policy of expansion; however, once the world powers resisted them, Japan was forced to fight a war she knew she could not win.

PART IV

RAW MATERIALS AND THE UNITED STATES

Now that we have looked at the theoretical and historical perspectives of this problem, let's examine the current situation in our own country. Although a complete analysis of every mineral the United States requires is beyond the scope of this paper, it is important to examine some of our requirements and determine the significant shortfalls.

NEEDS OF THE UNITED STATES

In spite of its abundance of raw materials, mineral experts believe that the United States is dangerously reliant on foreign imports for at least half of the 40 minerals that are considered critical to the nation's survival. (23:5) For example, the United States depends on foreign suppliers for over 90 percent of its columbium, manganese, bauxite/alumina, and tantalum; over 80 percent of its cobalt and tungsten; and over 70 percent of its chromium and nickel. (28:2) (See Table 1.) When one considers that our modern military programs are requiring more of these elements, the situation of our foreign dependence on strategic raw materials will only get worse, not better. (See Table 2.) For example, the Pratt and Whitney engine that

powers the F15 and F16 fighters require 5,366 pounds of titanium, 5,204 pounds of nickel, 1,656 pounds of chromium, 910 pounds of cobalt, 720 pounds of aluminum, 171 pounds of columbium, and 3 pounds of tantalum. (23:7) Of these seven minerals, only titanium is abundant in the United States. (See Table 1.) If the United States lost its suppliers of the other six materials, the nation would be in a dangerous position.

UNITED STATES SUPPLY BASE

The question then arises of the chance that the United States could be cut off from the strategic raw materials critical to its national security. Table 3 shows the countries from which we obtain our most necessary minerals. The US Department of Commerce categorizes each country either as a more developed country (MDC) or a less developed country (LDC). (27:795-797) Of the 28 countries in Table 3, 9 are MDC's, 18 are LDC's, and 1 is a territory of Great Britain. Basically, the LDC's equate to what we normally call Third World countries. Of the 9 MDC's, 6 are strong allies of the United States and one, Switzerland, is neutral, so there is little concern that politically, we would be cut off from them as a source of our supplies. The remaining two countries, Yugoslavia and the USSR, could very easily cut off their

shipments to the United States, although, only a small percentage of our critical raw materials are obtained from them. Consequently, they have little impact on our defense industry. Because a large percentage of our raw materials are obtained from the remaining 18 LDC's, it is important to determine the possibility of these countries politically blocking the flow of resources to the United States.

WARSAW PACT INFLUENCE ON LDC'S

Since most of the LDC's are nonaligned nations that are interested in their own economic development, there would most likely have to be some outside influence on their governments to pressure them into cutting off the supply of resources to the United States. Obviously, if our potential adversaries could develop this influence, it would be to their advantage if we ever went to war. The Department of State has examined the aid that the Warsaw Pact gives to non-communist LDC's. It reveals that the Warsaw Pact countries use their military sales and various aid programs to develop political influence in the LDC's, to expand trade, and to gain access to strategic raw materials themselves. (29:1)

Table 4 depicts the economic aid provided by the Warsaw Pact to non-communist LDC's. In the 1980's,

Moscow has largely pursued a policy of maximizing its returns from economic programs, characterized by shorter grace and repayment periods, higher interest rates, and hard currency repayments. This almost indicates that the USSR has been more interested in bringing hard currency into their country than in counting Third World countries. In 1984, however, Moscow provided nearly \$1.3 billion of credits to Arab states, which equates to 82 percent of their total economic aid for the year. This indicates that the Soviets' primary interest was to increase their access to key Middle Eastern states. (29:2) Consequently, the economic aid given to the 18 LDCs in this study was not that substantial.

One of the primary methods used by the Warsaw Pact to gain access to LDCs is academic training. In 1984, over 92,000 students from LDCs were in training in the USSR and Eastern European countries. (See Table 5.) The LDCs benefit from the Warsaw Pact's willingness to fund the training of LDC nationals without demanding immediate tangible compensation. In return, however, the Warsaw Pact wants access to potential leaders from LDCs and to personnel who may be willing to serve Communist political and commercial interests in the future. (29:6)

One of the brightest spots in the Warsaw Pact economic program for LDCs is the demand for technical services. (See Table 6.) In 1984, nearly 126,000 Warsaw Pact economic technicians served in the LDCs. Additionally, almost 20,000 Cubans supported Warsaw Pact projects in the Third World. (29:5)

"For Moscow, it has been one of the most direct economic methods to meet several important Soviet objectives in the Third World:

- * In client states, which employed about 11,000 Soviets in 1984, Moscow has been able to exercise direct influence over economic decision making by placing advisers at the highest levels within the economic establishment.

- * In oil-producing states, the USSR is thought to earn about \$150 million annually in hard currency by providing development services not necessarily related to aid projects.

- * By providing teachers and doctors free or at minimal charge to poorer countries, the USSR is able to maintain a presence in 15 LDCs without the expense of a major development effort.

- * Sending geologists to LDCs as part of a basic aid package has enabled the USSR to inventory the resources of 40 non-communist LDCs." (29:5)

This appears to be one of the most lucrative investments for the Warsaw Pact because with limited investment, they can gain considerable influence within the LDCs.

One of the major methods that the Warsaw Pact countries use to gain control of non-communist LDCs is through military sales. Table 7 shows arms transfers during the period 1979 to 1983. An examination of these

figures shows, however, that the Western powers hold a major edge over the Warsaw Pact when it comes to supplying arms to the countries upon which we depend for our strategic raw materials. (26:131-134)

The tables indicate that the Warsaw Pact countries have placed great emphasis on gaining influence within the non-communist LDCs. The question is whether or not this emphasis is threatening to the United States and its allies.

Eight of the LDC's are in Sub-Saharan Africa. This area had remained largely outside the East-West confrontation until 1975, when Portugal withdrew leaving a vacuum in the area. The USSR then began making inroads into the region and with the radicalization of Ethiopia in 1977, the region ceased to be a Western preserve. (2:106) However, it seems unlikely that there will be any major changes in the continuation of Western, and particularly European, influence in the area. Although the USSR did make some gain in Guinea and Zaire, both of these countries have cooled relations toward the Soviets. However, the Cuban military presence in the region guarantees the survival of a Soviet influence in the area. This is particularly true in Angola. (2:106) To help stabilize the area, the EEC signed the Lome Convention in 1979 and set up a

stabilization system for export receipts for basic product accepted the duty-free entry of most products exported by its African associated states, and increased its annual assistance to the region to \$4 billion. Consequently, the loss of Sub-Sahara Africa as a supplier of raw materials does not seem likely in the near future.

Seven of the LDCs are located in Latin America. This area has historically been defended by and economically dominated by the United States. Although there have been problems in Latin America, it is more stable than it appears and would probably provide little acceptance to cutting off exports to the United States. (2:160)

Of the remaining three LDCs, one is Turkey, which is an ally and a member of NATO. One is Thailand, which is also an ally; and one is China which, although it is a communist country, is at odds with the Soviet Union and has been warming its relations with the United States over the past few years.

When one examines the situation with the 28 countries from which we obtain the strategic raw materials we looked at in Table 1, the United States does not appear to be in danger of being politically

shut off from these sources. Many of the countries are major allies of the United States, and although the Warsaw Pact countries have increased their efforts in providing a myriad of types of aid to the LDCs in order to gain some form of influence with their governments, it does not seem at this time that they could place the political pressure necessary to cut our supplies. Economic aid, especially from the USSR, seems to be directed more at the oil producing countries than at the LDC's being examined in this paper. Although the Warsaw Pact is actively engaged in arms transfers, the Western countries hold a major edge in providing arms to the countries being studied. It appears that the major influence is provided through both academic training and technical services; however, at this time it is not sufficient to affect our political relations with these LDC's.

PART V

NATIONAL STRATEGY

Although information presented in the last section indicates that the United States does not appear to be at risk from having its foreign resources politically cut off, the government must take actions to ensure that the country is never in a situation where it could be cut off from the strategic raw materials *required for* our national defense. Therefore, a national strategy must be developed to ensure a continuous supply of those minerals deemed essential to national security is maintained. This strategy must include five programs. *The first two, political measures and military measures,* must be established to protect our current foreign supply bases. The remaining three programs; strategic stockpiling, substitutions, and mining, are necessary for the United States to reduce its dependency upon foreign suppliers and to become self-sufficient in providing its own strategic raw materials.

POLITICAL MEASURES

In order to guarantee continuous supplies of raw materials, the United States must maintain strong relations with the countries upon which we depend for these strategic raw materials. This requires

maintaining close political and military ties, along with providing economic assistance where needed. One problem that the country faces, however, is the nature of the regimes in power in these countries. The United States stance on the issue of human rights has hindered our efforts to establish closer ties with some governments. The United States, for example, is dependent upon South Africa for many of its raw materials; however, due to the South African policy of apartheid, the United States government has restricted its relations with that nation. Presently, the President can authorize trading for strategic raw materials, however, if the United States applies too much pressure on the South African government, they could very easily cut off the shipment of these raw materials in retaliation to our pressures.

MILITARY MEASURES

The massive military power possessed by the Soviet Union is obviously the biggest military threat to the United States. Not only has the USSR maintained a powerful land force that could actually invade and occupy countries that provide our needed resources, but it has developed a strong navy that could interdict our SLOCs bringing necessary strategic raw materials from overseas. Additionally, the Soviet Union could use

surrogate troops, such as the Cubans in Angola, to support revolutions and to prop up newly formed governments opposed to the West. (23:17)

What can the United States do to counter this threat? First, as an already existing part of our national strategy, the United States can maintain a strong military force that would deter Soviet intervention in regions deemed to be of "Strategic Importance" to the United States. With the discussions between the USSR and the United States today, there obviously is a dialogue between our two countries concerning important issues so each country will understand each other's concerns.

In addition to maintaining a strong military, the United States must also ensure that the Navy is provided the necessary support to not only prosecute an offensive war, but also to protect the SLOCs. As Alfred Mahan wrote,

"The ships that thus sail to and fro must have secure ports to which to return, and must, as far as possible, be followed by the protection of their country throughout the voyage." (12:26)

Although Mahan's observation is many years old, it is still valid today for a nation which depends upon the freedom of the seas to transport required raw materials. The United States could not afford to be caught in the

position that it was during World War II. Between January and July of 1942, 14 German U-boats sank 450 ships. (47:11) The United States Merchant Marine of today could not sustain such losses. Therefore, it must have a Navy capable of protecting its maritime assets at all times.

Tied closely to the strength of the Navy is the country's ability to project military strategic forces anywhere in the world to protect the vital interests of the United States. After the hostage crisis in Iran, the Rapid Deployment Joint Task Force was established to provide this strategic projection. Although the RDJTF no longer exists, the US Central Command was organized in 1980 to provide this capability in the Middle East. In an emergency, it can call upon nearly 400,000 troops from the Army, Navy, Marines, and the Air Force to conduct combat operations. The primary emphasis behind this force is rapid deployment. It plans for the employment of airborne, air assault, mechanized, and light infantry troops. The US Special Operations Command also provides forces such as the Army Rangers and Special Forces, that provide an additional capability to CENTCOM's conventional forces. (36:54) Although CENTCOM is designated for the Middle East, these forces must be capable for deployment anywhere in

the World in order to protect our national interests. This is particularly true in many of the Third World countries from which we obtain strategic raw materials. Therefore, the numerous commands, such as EUCOM in Africa and PACOM in the Pacific, must plan for the employment of forces in case of contingencies that threaten the country's resource base.

STRATEGIC STOCKPILES

The establishment and maintenance of a stockpile of strategic materials is one method used to minimize our dependency on foreign suppliers. In 1946, the Congress passed the Strategic and Critical Materials Stockpiling Act. The act defined strategic and critical materials as,

"Materials that (a) would be needed to supply the military, industrial, and essential civilian needs of the United States during a national emergency, and (b) are not found or produced in the United States in sufficient quantities to meet such need." (23:31)

Since then, a number of acts have been passed to update our needs and policies relating to stockpiling. The present goal of the United States is to maintain a stockpile that would last three years in an emergency. The stockpile is managed by the Federal Emergency Management Agency, which reviews the entire stockpile and changes to purchase or sales policy every four

years. (23:31) Table 8 shows the current condition of our stockpile.

As Table 8 depicts, we maintain only two of the 15 minerals we examined in Table 1 at or above their objective. Three others are within 90 percent of their goals. The remaining 10 minerals are stocked at less than 66 percent of their goal; seven of these are less than 33 percent. (28:10-181) If the United States expects to have a stockpile that would last three years in the case of an emergency, it is imperative that the country build up this stockpile before it is too late. The Congress must highlight this as a priority and act immediately to establish the required stockpiles.

SUBSTITUTION

Another method of eliminating our dependence on foreign suppliers is to find substitutions for strategic raw materials. The government began this initiative to start private industrial exploration. As a result of research in this area, George A. Keyworth II, White House Science Advisor, predicts,

"We're entering an era in which we'll not only shift away from reliance on increasingly scarce materials, but in which we can process common raw materials into exotic new compounds with astounding performance."
(23:27)

There are three broad categories of materials that will have an effect on our strategic raw material dependency: (1) ceramics, (2) metal alloys, and (3) polymers/composites. Ceramics are primarily made from silicon, one of the most common elements. Advanced ceramic materials have the feel of metal, but are lightweight and capable of withstanding high temperatures. They are now being used for some automotive and aeronautical applications and have the potential to revolutionize internal combustion turbine engine technologies. (23:27)

In the area of metal alloys, new technology has expanded the kinds of materials that industry can use for military applications. Processes such as ion beam implantation, laser mixing, and a combination of the two have produced metal alloys with new sets of properties. Old alloys are also being strengthened with new processes that resist corrosion or wear by as much as a thousand-fold. (23:28)

Polymers and composites have produced materials with a myriad of capabilities. Materials have been created that are tough, strong and better in some cases than metal. New polymers are being made that are resistant to high temperatures, do not react with chemicals and water, and can withstand high

temperatures. In fact, technology has advanced to the point where plastic engines have been developed. It has also been found that if processed properly, plastics can be made to conduct electricity as well as copper. Plastic batteries and other electrical components and equipment show great promise in numerous industries, including the aerospace industry. (23:28)

MINING INDUSTRY

The last area that needs to be looked at is that of the United States mining industry. This area can be examined in two spheres, land based mining and sea based mining.

Both the United States government and the mining industry should spend more money on modernizing the land based mining industry in order either to discover new mineral deposits or to exploit existing ones in the United States. However, estimates of the cost of such efforts run from \$250 million to \$1 billion. For example, Australia spent over \$500 million in the 1960's alone to develop the mining infrastructure in western Australia. (22:34) Consequently, to provide the mining industry an incentive to invest this kind of money in new facilities and technology, tax credits or other

allowances could be granted to companies who take this risk and try to increase their production capability.

Another potential of the United States mining industry is to expand current production, or at least research what potential reserves remain in the country. In order to expand current production, the government would need to open up large areas of federal lands to exploration and mining. Obviously, a study would have to be conducted to determine the effect on the environment. Based on the results of the study, a decision would need to be made whether to begin mining these areas or not. However, even if active mining was not started, the government at least needs to know what resources are available within the country. The government owns 34 percent of all United States territory and no detailed surveys of mineral resources exist. (23:35) But according to a 1979 study,

"Public lands offered the nation's best prospects for new discoveries of key metals -- including strategic minerals such as cobalt, manganese, chromium, titanium, and platinum." (23:35)

Based on this study, the government needs to begin a survey to determine potential resources in the country that would be available in a national emergency.

Sea based mining also needs to be examined. In 1983, President Reagan asserted United States

sovereignty over a zone stretching 200 miles from the coastline. This area, known as the Exclusive Economic Zone, is 86 percent as large as the nation's land area. Scientists believe that this undersea area has vast mineral deposits that could make the country self-sufficient in such critical elements as cobalt, chromium, manganese, platinum, and gold. (37:23) Table 9 shows the different types of deposits and what minerals are found.

Manganese nodules seem to be the most accessible and cost effective sea floor minerals. These nodules are found on the sea floor and are generally 1 to 10 centimeters in diameter. They consist mainly of particles of manganese and iron oxides, but also contain other minerals, to include concentrations of nickel, copper, and cobalt. Accumulations of nodules have been as high as 100 kilograms per square meter, but in most favorable mining areas, the concentration is between 10 and 30 kilograms per square meter.

Five international consortia were established in 1980 to explore and test-mine these manganese nodule bearing seabed areas. These consortia involved 23 international enterprises from seven countries. (See Table 10.) Results show that they present a potential source of strategic minerals that could discourage any cartel

action against the United States. (18:236) Since the five consortia are made up of only Western industrial nations, however, there have been United Nations sponsored proposals that insist a United Nations enterprise have the first choice of seabed-mining sites to remove this advantage from the control of the Western industrialized countries. (18:237)

In addition to the resources available in the deposits listed in Table 9, seawater has also been found to contain at least 30 important minerals to include salt, magnesium, bromine, iron, copper, lead, zinc, silver, gold, cobalt, nickel, diamonds, manganese, tin, aluminum, platinum metals, chromium, tungsten, mercury, columbium, tantalum, rutile, ilmenite, bismuth, uranium, and zircon. (18:238) Because of the expense of extracting these minerals, however, only the first three are currently recovered in large amounts.

Although undersea mining is new and faces a number of technical challenges, the important fact is that all of the seabased resources contain the potential to provide the United States with needed raw materials and ease its dependence upon Third World countries for required supplies.

As shown in this section, the importance of a well developed national strategy is critical for the United States to guarantee its national security. The government must be able to maintain harmonious political relations with its current suppliers, plus maintain a credible military force that can deploy to trouble spots in the World to protect the sources of our raw materials. Additionally, the United States must maintain a navy with the capability of protecting the SLOC's through which these critical resources pass. At home, programs such as maintaining a viable strategic stockpile, while developing substitutes and increasing the country's mining capability are necessary to reduce dependency on foreign suppliers for strategic raw materials used for the country's national defense.

PART VI

CONCLUSION

The strategic importance of the critical raw materials used in our defense industry is undeniable. The United States can possess all of the tanks, ships, and planes that the citizens will permit the government to buy. However, if the country ever becomes involved in a prolonged conflict, it must be able to repair and replace this equipment, not to mention provide the vast assortment of supplies required to support the military. To do this, the country must have unhindered access to the raw materials needed in its defense industry.

Although the classical theorists never specifically addressed raw materials in their writings, they all realized that a country must be able to provide the necessary materials of war to its army in order to ultimately achieve success on the battlefield. History has shown that if a country did not have access to the resources required to support its war effort, the results were disastrous. In World War Two, the Japanese initiated hostilities to solve their need for natural resources. They eventually lost that war because they could not obtain the raw materials required for their war production effort.

The United States could very easily be caught in a similar situation if it does not take actions to become self-sufficient in critical raw materials. The United States is dangerously reliant upon foreign imports for at least half of the 40 minerals that are considered critical to the nation's survival. Many of the suppliers are Third World countries which are being actively courted by the Warsaw Pact through various aid programs. Although the current political situation between the United States and these countries does not appear to be threatened today, who knows what lies in the future.

In order to eliminate any question concerning the future national security of the United States, a national strategy must be formulated both to protect the existing foreign supply sources and simultaneously, to develop self-sufficiency. This strategy must include the development of strong political ties with these foreign suppliers and the maintenance of a strong military that can both deter Soviet military intervention in these countries, and if necessary, strategically project the force necessary to protect our vital interests abroad. As a maritime power, this must include the capability to protect the freedom of the seelanes through which these resources flow. Meanwhile,

the country must complete its three year stockpile of strategic raw materials. Additionally, the country must work diligently in developing substitutes for the resources the country lacks, and increase the mining industry's capacity to better exploit existing resources in the United States.

National strategy must be designed to meet and deal with the challenges to national security objectives. Although these objectives pertain primarily to the defense of the country, the government must realize that strategy does not just deal with the projection of military force, but it also deals with obtaining the critical resources used to produce that force. If the government fails to realize this critical fact, the United States could some day follow the historical path of Japan to disaster. The Japanese actually had excess production capacity during the war but lacked the raw materials for its operation. The United States has a large industrial complex that would be worthless without the raw materials with which to make it function.

TABLE 1

1987 NET IMPORT RELIANCE
OF SELECTED NONFUEL MINERAL MATERIALS
AS A PERCENT OF APPARENT CONSUMPTION
 (28:2)

<u>MINERAL</u>	<u>PERCENT</u>	<u>MAJOR SOURCES</u>
Columbium	100	Brazil, Canada, Thailand, Nigeria
Manganese	100	South Africa, France, Gabon, Brazil
Bauxite/ Alumina	97	Australia, Guinea, Jamaica, Suriname
Tantalum	92	Thailand, Brazil, Australia, Canada
Cobalt	86	Zaire, Zambia, Canada, Norway
Tungsten	80	China, Canada, Bolivia, Portugal
Chromium	75	South Africa, Zimbabwe, Turkey Yugoslavia
Nickel	74	Canada, Australia, Norway, Botswana
Zinc	69	Canada, Mexico, Peru, Aus- tralia
Asbestos	51	Canada, South Africa
Aluminum	24	Canada, Japan, Venezuela, Brazil
Beryllium	11	Brazil, China, Switzerland, South Africa
Titanium	8	Japan, USSR
Antimony	W (58 in 84)	Bolivia, Mexico, South Africa Yugoslavia
Vanadium	W (54 in 84)	Australia, South Africa, China USSR

W: Withheld; only 1984 statistics available.

TABLE 2

MAJOR MILITARY USES OF STRATEGIC MATERIALS
(23:8)

<u>MATERIAL</u>	<u>MILITARY USE</u>
Aluminum	Aircraft, Cartridge Casings, Missiles, Satellites
Antimony	Ammunition, Rocket Motors
Asbestos	Ammunition, Detonators
Beryllium	Aircraft, Helicopters, Jet Engines, Missiles, Nuclear Reactors, Space Navigation
Chromium	Ammunition, Armor Plate, Gun Barrels, Jet Engines, Stainless Steel
Cobalt	Aircraft, Jet Engines, Missiles, Rocket Motors, Stainless Steel
Columbium	Aircraft, Jet Engines, Missiles, Rocket Motors, Stainless Steel
Manganese	Ammunition, Stainless Steel, Water Treatment
Nickel	Aircraft, Armor Plate, Gun Barrels, Jet Engines, Rocket Motors, Stainless Steel, Submarines
Tantalum	Aircraft, Satellites
Titanium	Aircraft, Helmets, Jet Engines
Tungsten	Aircraft, Nuclear Reactors, Rocket Motors, Stainless Steel
Vanadium	Aircraft, Helmets, Nuclear Reactors
Zinc	Ammunition, Photography, Small Arms

TABLE 3
DEVELOPMENT STATUS OF COUNTRIES
 (27:795-797)

<u>COUNTRY</u>	<u>DEVELOPMENT STATUS</u>	<u>REMARKS</u>
Australia	MDC	
Bolivia	LDC	
Botswana	LDC	Nonaligned
Brazil	LDC	
Canada	MDC	NATO
China	LDC	
France	MDC	NATO
Gabon	LDC	Nonaligned
Guinea	LDC	Nonaligned
Hong Kong		GB Territory
Jamaica	LDC	
Japan	MDC	
Mexico	LDC	
Nigeria	LDC	
Norway	MDC	NATO
Peru	LDC	Nonaligned
Portugal	MDC	NATO
South Africa	LDC	
Suriname	LDC	Nonaligned
Switzerland	MDC	Neutral
Thailand	LDC	
Turkey	LDC	NATO
USSR	MDC	
Venezuela	LDC	
Yugoslavia	MDC	Nonaligned
Zaire	LDC	Nonaligned
Zambia	LDC	Nonaligned
Zimbabwe	LDC	Nonaligned

TABLE 4
WARSAW PACT ECONOMIC AID TO
NON-COMMUNIST LDCs
(Millions of Dollars)
(29:2)

	TOTAL	USSR	EASTERN EUROPE
TOTAL	20,760	14,150	6,610
1954-78	11,185	7,675	3,510
1979	885	580	305
1980	1,130	815	315
1981	1,345	860	485
1982	1,840	1,190	650
1983	2,120	1,440	680
1984	2,255	1,595	660

TABLE 5
STUDENTS FROM LDCs TRAINING
IN WARSAW PACT COUNTRIES
1984
(29:6)

	TOTAL	USSR	EASTERN EUROPE
TOTAL	92,950	57,485	35,465
North Africa	5,375	3,290	2,085
Sub-Saharan Africa	30,490	17,895	12,595
East Asia	205	125	80
Latin America	11,130	8,140	2,990
Middle East	31,395	16,580	14,815
South Asia	14,355	11,455	2,900

TABLE 6

WARSAW PACT ECONOMIC TECHNICIANS
IN NON-COMMUNIST LDCs

1984
(29:5)

	TOTAL	USSR	EASTERN EUROPE
TOTAL	125,960	39,570	86,390
North Africa	67,315	10,965	56,350
Sub Saharan Africa	16,315	9,080	6,940
East Asia	60	15	45
Europe	75		75
Latin America	1,410	680	730
Middle East	33,110	11,365	21,745
South Asia	7,970	7,465	505

TABLE 7

ARMS TRANSFERS BY SUPPLIER AND RECIPIENT COUNTRY
CUMULATIVE 1979-1983
(MILLIONS OF DOLLARS)
(26:131-134)

SUPPLIER	TOTAL	WESTERN POWERS	WARSAW PACT	CHINA	OTHER
RECIPIENT					
Australia	1,530	1,510			20
Bolivia	205	15			190
Botswana	20	5	10		5
Brazil	500	470			30
Canada	1,770	1,730			40
China	520	320	130		70
France	350	330			20
Gabon	180	110		10	60
Guinea	30	20	5	5	
Hong Kong	-	-	-	-	-
Jamaica	-	-	-	-	-
Japan	2,560	2,550			10
Mexico	320	130			190
Nigeria	1,125	820	105		200
Norway	1,045	975			70
Peru	1,210	660	440		110
Portugal	260	240			20
South Africa	25	5			20
Suriname	15	5			10
Switzerland	830	720			110
Thailand	1,320	1,160			160
Turkey	1,865	1,765			100
USSR	4,630		4,190		440
Venezuela	780	700			80
Yugoslavia	690	80	480		130
Zaire	210	150		40	20
Zambia	260		200	10	50
Zimbabwe	275	190	5	20	60
TOTAL	22,525	14,660	5,565	85	2,215

Note: Western Powers include US, France, UK, FRG, & Italy
Warsaw Pact includes USSR, Czech, Romania & Poland

TABLE 8
STRATEGIC STOCKPILE STATUS
(28:10-181)

<u>MATERIAL</u>	<u>PERCENT OF GOAL</u>
Aluminum	0.3
Antimony	100.5
Asbestos	219
Bauxite	61
Beryllium	91
Chromium	65
Cobalt	62
Columbium	32
Manganese	96
Nickel	19
Tantalum	23
Titanium	13
Tungsten	99
Vanadium	8
Zinc	27

TABLE 9
SEABED DEPOSITS AND ELEMENTS
 (45:14)

<u>TYPE OF DEPOSIT</u>	<u>MATERIALS OR ELEMENTS</u>	<u>GEOLOGICAL SETTING</u>
Construction materials	Pebbles, quartz and carbonate sand, shells	Coast and Shelf
Placer deposits (sand and gravel containing heavy metals)	Iron Gold Platinum Tin Diamonds Rare earth elements Zirconium Titanium	Coast and near shore
Hydrocarbons	Petroleum Gas	Mainly passive continental margins and certain basins
Hydrothermal ore deposits	Iron Manganese Copper Zinc Lead Silver	Fracture zones, spreading centers, certain basins
Manganese nodules	Manganese Iron Cobalt Nickel Titanium Molybdenum	Deep sea (4,000 meters)
Phosphorites	Phosphorus Uranium Rare earth elements	Coastal (locally continuation of land resources) and nearshore, submarine plateau

TABLE 10

SEABED MINING CONSORTIA
(18:234)

<u>CONSORTIA</u>	<u>CONSTITUENT ORGANIZATION</u>	<u>COUNTRY</u>
Afernod	Centre Nationale pour l'Exploitation des Oceans	France
	Commissariat a l'Energie Atomique	France
	Bureau des Recherches Geologiques et Minieres	France
	Le Nickel	France
	France-Dunkirk	France
Kennecott Copper	British Petroleum	UK
	Consolidated Gold Fields	UK
	Mitsubishi	Japan
	Noranda	Canada
	Rio Tinto-Zinc	UK
Ocean Manage- ment	DOMCO	Japan
	INCO	Canada
	Metallgesellschaft	FRG
	Preussag	FRG
	Salzgitter	FRG
SEDCO	US	
Ocean Minerals	AMOCO	US
	Bos Kalis Westminster	Netherland
	Lockheed Missiles and Space Corporation	US
	Shell	UK/Nether-lands
Ocean Mining Associ- ates	Sun Company	US
	Union Miniere	Belgium
	US Steel	US

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