OUTLOOK FOR PRICES AND SUPPLIES OF INDUSTRIAL RAW MATERIALS

HEARINGS

BEFORE THE

SUBCOMMITTEE ON ECONOMIC GROWTH

OF THE

JOINT ECONOMIC COMMITTEE CONGRESS OF THE UNITED STATES

NINETY-THIRD CONGRESS

SECOND SESSION

JULY 22, 23, AND 25, 1974

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OUTLOOK FOR PRICES AND SUPPLIES OF INDUSTRIAL RAW MATERIALS

MONDAY, JULY 22, 1974

CONGRESS OF THE UNITED STATES,
SUBCOMMITTEE ON ECONOMIC GROWTH OF THE
JOINT ECONOMIC COMMITTEE,
Washington, D.C.

The subcommittee met, pursuant to notice, at 10:07 a.m., in room 1202, Dirksen Senate Office Building, Hon. Lloyd M. Bentsen, Jr. (chairman of the subcommittee), presiding.

Present: Senator Bentsen.

Also present: William A. Cox, Lucy A. Falcone, Robert D. Hamrin, Carl V. Sears, and Larry Yuspeh, professional staff members; Michael J. Runde, administrative assistant; and Walter B. Laessig, minority counsel.

OPENING STATEMENT OF CHAIRMAN BENTSEN

Chairman BENTSEN. The hearing will come to order. These hearings have been called to consider the question:

> Can the United States obtain the materials to continue its economic expansion? * * * In area after area the same pattern seems discernible: Soaring demands, shrinking resources, the consequent pressure toward rising real costs * * * (and) the ultimate threat of an arrest or decline in the standard of living we cherish and hope to help others attain.

The words sound as though they might have been said today, don't they?

These dramatic and eloquent words were not written in 1974. They were published 22 years earlier in 1952 as the opening lines of a report to President Truman by the Materials Policy Commission chaired by William S. Paley. Despite that Commission's concern, the U.S. economy has grown and prospered since that time, and much of the world with it.

But these questions have returned in the 1970's. Added to them now are a deep concern about the preservation of a habitable environment and new apprehensions that foreign materials suppliers will try to obtain monopoly power from which to make unreasonable price demands against us.

I myself do not subscribe to the doomsday forecasts. However, these worries have taken more concrete form in the past 3 years as the prices of both mineral and agricultural raw materials soared to all-time highs. Prices on world commodity exchanges reached fantastic peaks in April 1974, just as U.S. price controls, which had kept most prices lower in this country, were expiring. Worldwide demand strained against inadequate production capacity in most sectors.

This morning we have a number of witnesses to appear before us to speak to some of these points and try to tell us if the Club of Rome's prophecies are going to come true, or whether we will have a better day tomorrow.

I would like to have Mr. C. W. Parry, vice president for corporate planning, Aluminum Co. of America, to come forward and be seated. And would these gentlemen also come forward and be seated. Duane Bloom, director of Earth Sciences; and Mr. Robert Pratt, president of Kennecott Sales Corp.

Gentlemen, in order that we might have a little better continuity and a little better inplay here, I am going to ask that each of you give your testimony in sequence, and try to limit it to about 15 minutes, and then we will have a discussion as to some of the questions that have been raised by the comments you have made.

I would like Mr. Parry to testify first and then Mr. Bloom, and then Mr. Pratt. You will certainly have the liberty of inserting additional information in the record.

Will you proceed, Mr. Parry.

STATEMENT OF C. W. PARRY, VICE PRESIDENT, CORPORATE PLANNING, ALUMINUM CO. OF AMERICA

Mr. Parry. My name is Charles Parry. I am vice president, corporate planning for Aluminum Co. of America.

I will make some shorter remarks as contained in my prepared statement, and then present my oral statement.

The continuing availability of raw materials is a matter of very great concern to our company, as well as to the Nation. In recent weeks we have provided testimony on this general subject for two other congressional committees. Specifically, we have discussed the prospects for present and long-range supplies of aluminum-bearing ores.

Because of the extreme importance of U.S. governmental response and action to help assure a continuing supply of raw materials, we greatly appreciate your concern with these matters and welcome this opportunity to report to this subcommittee and the Congress.

Aluminum is the most abundant metallic element in the earth's crust. Bauxite, one of numerous ores containing aluminum, historically has been the most economically desirable source of alumina—aluminum oxide—which is chemically refined from the ore and reduced electrolytically to produce primary aluminum.

There are four key facts to be noted about the raw materials from which aluminum is produced.

First, bauxite is extremely abundant. The U.S. Geologic Survey presently estimates 15.5 billion tons of reserves. I personally consider this quite conservative. And to put that into perspective, those reserves could supply the world smelter requirements for about 230 years.

Virtually all supplies of bauxite are located outside of the United States; in fact, the vast majority of them are between the two equatorial belts around the world. The exhibits in my prepared statement show the sources of bauxite and of aluminum production and of imports into the United States.

Second, bauxite ores vary in mineral content and also require special refining facilities. They vary with respect to mineral content and with respect to what is termed reactive silica and other elements of that nature not specifically the alumina content of the ore.

Third, bauxite has a specific and well-defined market. The fact is that the vast majority of bauxite is mined by and for integrated aluminum companies throughout the world. Bauxite, as is the case with most mineral ores, has no intrinsic value in the ground. It has value only when it's exploited, in the best sense of that word, taken from the ground and turned into a product which can be sold to the consumer. And the intrinsic value of that mineral becomes a function of the ultimate price that the consumer is willing to pay for it.

Fortunately, there are many alternative sources of aluminum ore. And I would like to discuss these in some detail, because we did not have time to get this detail into our written testimony.

There are five major nonbauxitic sources of alumina, which as I mentioned, is the refined chemical from which alumina is electrolytically separated.

First, clay is probably the best known of the nonbauxitic sources today. Alcoa has conducted much work over the years on processes to extract alumina from clay. The basic chemical reactions are very well known. And the Canadian aluminum company has done a great deal of work in this area. They have improved the process, and it is, given certain economic factors, a viable economic process today. It is an acid leaching process. Fundamentally, as I mentioned it has reached the semi-commercial stage already. There is absolutely no reason why Canada, for example, would not be capable of moving on in the commercial stage, in our estimation.

Another source of domestic nonbauxite ores is dawsonite. Dawsonites are fundamentally associated with the oil shale deposits throughout the Western United States. It is probably not one of the maior of the five nonbauxitic sources. It is concentrated, in our estimation at least, in deeper oil shale deposits in the west, and the concentration runs in the neighborhood of 3-percent aluminum content of the oil shale. If, in fact, a retort-in-the-ground technology for the development of these oil shales deposits were used, this would have the tendency to fix the dawsonite aluminum in those deeper deposits of oil shale and probably not make it economically feasible for mining.

The third source of nonbauxitic ores is a mineral called alunite. And I understand that Dr. Bloom is going to discuss this in great detail, so I won't spend much time on that, other than to say that the processes here and also the technology are known for the separation of alumina from this mineral.

There are two processes, two sources of alumina in the United States which are of primary interest at the present time to Alcoa. The first of these is a mineral called anorthosite. And we have purchased 8,000 acres in Wyoming containing an extremely large reserve of this mineral anorthosite. This one reserve alone has enough aluminum content to supply the present world aluminum industry for 75 years. This is not an unusual deposit in the United States; and for all intents and purposes the amount of anorthosite in the United States is essentially inexhaustible.

We made a very strong research commitment over the past months to the processes which are necessary for the commercial exploitation of alumina from this mineral. And we have been operating a pilot plant at our East St. Louis laboratory for several months now. And this pilot stage should be finished by the end of 1974, the end of this year. And we could at that time move on, as we expect to do, to commercialized development of this particular ore.

The fifth source of alumina in the United States is coal waste piles, or so-called culm piles, from coal mining activities. And these piles are, as you can imagine, deposited throughout the United States in all of the old mining parts of the country. Older coal piles which have been there for many years, we find, have around 30 percent alumina in them. The new coal washing plants lower the Btu content of these piles and make them probably less attractive for the separation of alumina.

Some of the greatest difficulties that we are finding in this is to locate the coal pile deposit in a concentration sufficient to justify the establishment of a separation plant. We would be prepared, subject to our locating a sufficient sized deposit of these coal piles, to move on in this process area, also subject to the economic dictates, once we have finished our laboratory pilot scale work. I expect that this will also be finished toward the end of this year or early next year.

In our work to develop processes to utilize alternative ores, we have not yet reached the stage where our cost estimates can be considered firm. We are, however, far enough along to get some very strong indications that alumina produced from several of these sources would be competitive with alumina from Jamaican bauxite under the new tax condition.

Chairman BENTSEN. Would you repeat that statement?

Mr. PARRY. Yes, sir.

We are, however, far enough along to get some very strong indications that alumina produced from several of these sources would be competitive with alumina from Jamaican bauxite under the new tax conditions which they have imposed.

This takes into account, of course, transportation differentials, productivity advantages and other processing and distribution cost differentials. It does not, however, put a value on the risk advantages of alumina produced from a domestic ore compared with that derived from an offshore source.

Chairman BENTSEN. Political risk?

Mr. PARRY. A political risk, yes, sir. And also interruptions in transportation and other nonpolitical factors also. In other words, the existence of a mineral deposit off the shores of the United States has to some degree—and varying degrees, as a matter of fact—an inherently greater risk than one on the continental United States. There is no value put on that in this evaluation, cost evaluation.

There is one aspect to this development of an alternative domestic source which is of great significance to the bauxite-producing countries. If aluminum producers make large investments in processing plants to utilize nonbauxitic ores, this will create an economic reality which will inevitably slow the development of offshore bauxite reserves. Jamaica has implicitly used the existence of a very large investment base in bauxite and alumina facilities in that country to its advantage. A large investment base in nonbauxite processing plants would have a concomitant effect on further investments in bauxite, with very serious consequences for the economies of bauxite-producing countries.

Another very important factor with respect to the supply of aluminum in the United States is the recycling of aluminum scrap, which is a major and growing source of supply to our domestic system. The primary producers have always recycled internal and customer scrap.

There is in addition to that a very well established secondary aluminum industry in the United States. In fact, the secondary industry contributed about 20 percent of the total aluminum supply in 1973.

Widespread use of all-aluminum beverage cans and the growing need to process municipal solid wastes, has put an increased emphasis on recycling. And there are at the present time 1,200 recycling centers which reclaimed about 1.6 billion all-aluminum cans in 1973.

Having outlined briefly the present position with respect to aluminous ores and to recycling, I turn now to Alcoa's position with respect to recent Jamaican action on bauxite revenues to that Government.

My company and others that mine and process bauxite in Jamaica recently were in negotiations with that Government, aiming at increasing bauxite revenues to that country. We recognized that Jamaica had some very serious problems with respect to balance of payments, partly as a result of the actions of the oil countries, the Arab countries, or the OPEC nations, and partly as a result of the general inflationary aspects of the whole world economy. And Jamaica has a very heavy import balance. And this had a commensurate effect on their balance of payments. The aluminum companies operating in Jamaica recognize this and went into good-faith negotiations with the Jamaican Government to try to find a solution of that problem with the Government. The Government broke off these talks, violating our contracts, and unilaterally increased bauxite taxes and royalties by more than 700 percent.

Similar talks were carried out in June and this month with the Dominican Government, where Alcoa has operations. We made an offer to the Government and are awaiting a reply to that offer.

Bauxite is the most logical source of aluminum—Alcoa mines bauxite in seven countries on four continents—we are exploring and developing elsewhere.

We believe it is good business to act responsibly and be sensitive to the needs of host countries in which we operate.

We have had the longest involvement overseas in Suriname. Under the Brokopondo Agreement we built in Suriname a large hydroelectric complex to support an aluminum smelter and to provide part of the country's electrical requirements.

Under terms of the agreement, the power generating facilities eventually will pass to the Government.

In 1973, at the request of the Government, the agreement was amended to provide additional revenues for the country. Negotiations were amicable, and both parties benefited.

Such development works to the benefit of all concerned.

We believed we had a similar relationship with the Jamaican Government when we began negotiations in March. The extreme action taken by the Jamaican Government in violating the contract and unilaterally increasing taxes and royalties makes it virtually impossible to plan further investment in that country and to secure backing for them. Companies and institutions that provide funds for industrial development can no longer be expected to support foreign industrial development if contracts can be swept aside at the will of the host country.

You may not be aware, Senator, that the World Bank recently approved a $13.5 million loan to the Jamaican Government for road construction. It is very surprising to us they would do so in the light of Jamaica's recent actions.

Alcoa and two other producers have filed requests with the International Centre for Settlement of Investment Disputes to begin arbitration proceedings in the dispute. But the Jamaican Government has announced it will not be bound by any decision covering bauxite even though it was a signatory to the international agreement setting up the arbitration procedure provided in the contracts.

The foregoing leaves the industry in this position:

We can continue confrontation with the Jamaican Government, or we can get together and work out our problems. Alcoa is prepared to reopen negotations any time the Jamaican Government is willing to. However, we feel that we must step up development of domestic facilities to prove the commercial feasibility of United States aluminum-bearing ores.

We appreciate the subcommittee's interest.

We are seeking U.S. Government support of our development programs. We want to work together with other segments of the Government to optimize the economic aspects on these developments.

We urge the Government to begin immediately a raw materials policy to assure the nation of a continuing sufficiency of basic materials.

Most important, we believe that it is imperative to the well-being of the Nation and to all people, that the U.S. Government express itself on Jamaica's actions and use its influence to persuade other nations that actions such as that taken by the Jamaican Government will inevitably redound with adverse consequences for everyone concerned, both the host country and the United States. This is a mutual problem, it is not a one-way problem.

Thank you very much, Mr. Chairman. I will be pleased to answer any of the questions you have.

Chairman BENTSEN. Thank you, Mr. Parry.

[The prepared statement of Mr. Parry follows:]

PREPARED STATEMENT OF C. W. PARRY

Mr. Chairman and members of the committee, my name is Charles Parry. I am vice president, corporate planning for Aluminum Company of America.

The continuing availability of raw materials is a matter of very great concern to our company, as well as to the nation. In recent weeks we have provided testimony on this general subject for two other Congressional committees. Specifically, we have discussed the prospects for present and long-range supplies of aluminum-bearing ores.

Because of the extreme importance of U.S. Governmental response and action to help assure a continuing supply of raw materials, we greatly appreciate your concern with these matters and welcome this opportunity to report to this Committee and the Congress.

Aluminum is the most abundant metallic element in the earth's crust. Bauxite, one of numerous ores containing aluminum, historically has been the most economically desirable source of alumina (aluminum oxide), which is chemically refined from the ore and reduced electrolytically to produce primary aluminum.

My company and others that mine and process bauxite in Jamaica recently engaged in negotiations with that government aimed at increasing bauxite revenues to that country. Despite repeated good-faith offers by the producers, the government refused to negotiate mutually acceptable revisions in existing contracts between the government and the producers. Instead, the government acted unilaterally in violation of the contracts to legislate an increase of more than 700 percent in bauxite taxes and royalties.

Negotiations also were conducted during June and early July in the Dominican Republic, where our company is the only producer mining bauxite. Unfortunately, the government has not accepted Alcoa's offer and talks have been suspended for the time being.

Unilateral action by foreign governments violating contracts for vital resources has serious disruptive consequences for the U.S. economy and for world trade. Companies and financial institutions that provide funds for industrial development base their decisions on such contracts. If experience shows that contracts can be cast aside at the will of the host country, these institutions can no longer be expected to support foreign industrial development. The continued absence of strong United States Government reaction to such moves, of course, results in additional pressure on governments in other countries supplying raw materials to take similar action. This goes far beyond bauxite; it will extend to all types of raw materials.

There are four key facts to be noted about the raw materials from which aluminum is produced.

—Bauxite is extremely abundant.
—Bauxite ores vary in mineral content and often require specially designed refining facilities.
—Bauxite has a specific, well-defined market.
—There are many alternative aluminous ores, and technology for processing them exists.

Bauxite is abundant

The U.S. Bureau of Mines' current estimates of proven world reserves of bauxite are on the order of 15.5 billion tons—sufficient to supply all the world's smelters for more than 230 years at the current consumption rate. I have prepared a group of charts on bauxite sources and production. They are attached.

Over the past two decades, bauxite finds have exceeded the industry's growth rate. Since the last published U.S. Geological Survey in 1967, new finds have almost tripled the reserves. Enormous new reserves have been proven in Southeast Asia, South America and Australia. Australia's known reserves alone could supply the entire world's aluminum smelters for more than 70 years at current rate of use. There are untapped proven reserves in countries such as Brazil, which now ranks third in the world. There is no reason to believe that further bauxite discoveries will not be made at a rate comparable to that of recent years.

New bauxite finds have been so numerous there is no economic justification for developing all of them in the near term. Alcoa, for instance, recently terminated an exploration project in French Guiana and elected to allow options on bauxite deposits to lapse. The quantity and quality of the French Guiana ore and the cost of transporting it to a refining plant were not competitive in a world of abundant ore.

Most high-grade bauxite is found outside the United States. However, in this country there are bauxite reserves in Arkansas and Georgia, although they are minor compared to those in other nations. The United States produces only about three percent of the world's annual production. In addition, there are U.S. Government and individual company stockpiles of quality bauxite in this country.

Bauxite is a varied material

"Bauxite' 'is a designation for many aluminum-bearing ores. These are heterogeneous mixtures of earthy material containing varying quantities of the oxides of aluminum, silicon, iron and titanium.

Because of the diverse make-up of bauxite ores, refining facilities are generally designed to process most efficiently a particular type of bauxite with specific physical and chemical characteristics.

Significant developments in refining technology are permitting the industry to economically produce alumina from lower-grade bauxites, which offers the net effect of increasing bauxite reserves by making previously undesirable ore usable.

Bauxite has a finite market

Practically all bauxite mined in 30 countries of the Free World is refined into alumina and used for primary aluminum production. About 40 of the Free World's aluminum producers have refining facilities and thus represent the principal market for bauxite-producing countries. The United States still is the largest alumina-producing country in the world.

A small percentage of alumina is consumed in the production of alumina chemicals, abrasives and refractory materials. Very few bauxite ores, however, are suited for the latter use, which is yet an additional restraint on available markets. Only a very small amount of bauxite is sold on the world market to the abrasive and refractory industries.

There are many alternatives to bauxite

Eight percent of the earth's crust is aluminum, more than all other metals combined. Bauxite has been the most economically attractive ore, but there are numerous other potential sources of aluminum. For example, the aluminum industry in Russia has minimal quantities of domestic bauxite, so it depends mainly on imported ore and alternate ores native to Russia. The U.S.S.R. has several plants that refine alumina-bearing nepheline syenite and alunite. Poland is constructing a refining plant that will use an acid method for reducing common clay to obtain alumina.

While high-grade bauxite may run more than 50 percent alumina, many commercial refining plants are based on bauxites with an available alumina content of only 30 percent. Experience in processing these lower grade bauxites makes ores of comparable alumina content, such as anorthosite, alunite and dawsonite—all abundant in the U.S.—attractive potential sources for the aluminum industry.

Alcoa and other U.S. aluminum producers have accelerated programs to develop commercial refining processes for a number of alternate ores. The technology for these processes exists, and they are becoming increasingly attractive as bauxite costs increase.

The Bureau of Mines reports reserves of non-bauxite alumina ores in the U.S. are virtually inexhaustible. Alcoa owns an 8,000-acre anorthosite deposit in Wyoming. It is estimated that the alumina content of this single reserve would supply the entire world aluminum industry for 75 years at today's rate of consumption.

Alcoa also is researching the possibility of using aluminum-rich industrial waste materials as a source of alumina. Fly ash from power plants and waste from coal processing residues, called "culm," are examples. The non-fuel part of some culm contains about the same percentages of aluminum oxide as the bauxite now being processed in Western Australia. In some of this material, fuel values may be sufficient to provide part of the energy requirements of the refining process—a significant factor in today's energy-short world.

There is no question that the United States could become self-sufficient in the production of alumina from domestic aluminous ores. Such action could severely retard development in some bauxite-producing nations that are highly dependent on revenues from bauxite production.

In our work to develop processes to utilize alternative ores, we have not yet reached the stage where our cost estimates can be considered firm. We are, however, far enough along to get some very strong indications that alumina produced from several of these sources would be competitive with alumina from Jamaican bauxite under the new tax condition. This takes into account, of course, transportation differentials, productivity advantages and other processing and distribution cost differentials. It does not, however, put a value on the risk advantages of alumina produced from a domestic ore compared with that derived from an off-shore source.

There is one aspect to this development of an alternative domestic source which is of great significance to the bauxite-producing countries. If aluminum producers make large investments in processing plants to utilize non-bauxitic ores, this will create an economic reality which will inevitably slow the development of off-shore bauxite reserves. Jamaica has implicitly used the existence of a very large investment base in bauxite and alumina facilities in that country to its advantage. A large investment base in non-bauxitic processing plants would have a concomitant effect on further investments in bauxite, with very serious consequences for the economies of bauxite-producing countries.

Recyling

In addition to new metal produced from ore, recycled metal is a major source of supply today and of increasing importance. Aluminum producers have always remelted scrap generated in their own plants. This represents a considerable portion of their shipments but is not included in scrap statistics.

The producers also reclaim scrap generated in customer plants and returned to them for recycling. In adidtion a large, well established and independent secondary industry has developed to reclaim and recycle this type of scrap aluminum, as well as that from junked autos, discarded consumer items, etc. Secondary aluminum accounts for some 20 percent of the total aluminum supply in this country. The widespread use of all-aluminum beverage cans in recent years has produced a major new source of post-consumer scrap. Aluminum producers, can makers and beverage companies have set up more than 1,200 reclamation centers across the country to reclaim beverage containers. An estimated 1.6 billion all-aluminum cans were returned for recycling in this country in 1973, representing enough metal to put storm windows on 500,000 houses or to supply the metal for all the aluminum engine blocks built for U.S. sub-compact cars last year.

An important new source of post-consumer scrap in the future will be from municipal solid waste. Several cities either have constructed or soon will construct modern plants to process and sort this waste to reclaim valuable metals, glass and other products, with the residue going into power plants to be burned as fuel. My company is participating in several activities aimed at developing technology for these plants. One such project is being carried out for the District of Columbia Waste Reduction Center by the National Center for Resource Recovery. Alcoa is furnishing a newly developed unit for extracting aluminum from the solid waste stream.

Alcoa's position

Having outlined briefly the present position with respect to bauxitic and other aluminous ores and recycling, I turn now to Alcoa's position with respect to recent Jamaican action on bauxite taxes. From the standpoint of overall world economics it seems to us that bauxite is the most logical source of aluminum for the world to use. Alcoa and its affiliates mine bauxite in seven countries on four continents, and we are continuing our bauxite exploration and development programs overseas.

We believe it is good business to act responsibly and be sensitive to the needs of host countries. The company's oldest overseas involvement—in Suriname, South America—is an example. Over the years, direct and indirect benefits accruing to that country and its people because of Alcoa's presence have been substantial. Likewise Surinane has provided a continuing and reliable source of raw material and employees for our company.

Under the historic Brokopondo Agreement, Alcoa built a large hydroelectric complex to support an aluminum smelter and also to provide part of the country's electrical requirement. Under terms of the agreement, the power generating facilities eventually will be owned by the government. In 1973, responding to the Suriname government's request, Alcoa and the government worked within the framework of the agreement to provide increased revenues for Suriname. This cooperative and mutually beneficial relationship between Alcoa and Suriname is based on 60 years of interdependence.

Such mutual interdependence provides the opportunity to combine the raw materials and available employees of developing nations with the technology, marketing and financial capability of developed nations—to the mutual benefit of both. It would seem that with bauxite we also have the vehicle for such an interdependency.

In the belief that such a relationship existed between the aluminum producers and the Jamaican Government, we began negotiations in March with the government. Jamaica faces serious reserve currency problems as a result of inflation. The producers recognized the nation's very real financial problem and willingly entered negotiations to increase bauxite revenues to an extent that would meet Jamaica's needs and which still would be absorbed by the industry.

When we were unable to reach a mutually agreeable solution, the Jamaican Government declared that changed circumstances justified their taking action in direct violation of existing contracts. Subsequently, bauxite taxes and royalties were increased, and the government has declared its intention to begin conversations leading to acquisition of company bauxite lands and equity participation in the operations. Such unilateral and extreme economic action by a government makes it virtually impossible to plan further investment in productive facilities and to secure financial backing for their development. It also is likely to produce static or declining bauxite revenues for Jamaica as producers turn to other bauxite sources or to alternate ores.

In response to Jamaica's action, Alcoa filed requests with the International Centre for Settlement of Investment Disputes (ICSID) to begin arbitration proceedings in the dispute with the Government of Jamaica under the provisions of our contract with the Jamaican Government. Similar requests have been made by two other producers. ICSID has agreed to arbitrate the dispute, but the Jamaican Government has announced that it will not be bound by any decision covering bauxite even though it was a signatory to the international agreement setting up the arbitration procedure.

The foregoing leaves the industry in a position as follows: We can continue confrontation with the Jamaican Government * * * or we can return to a state of mutual trust and working together to meet what, in the final analysis, are common objectives. Alcoa is prepared to reopen negotiations in good faith, believing that there is middle ground of mutual benefit on which agreement can be reached.

Events of the last few months, however, indicate that our responsibilities to our shareholders, employees and customers require that we develop as speedily as possible domestic facilities to prove the commercial feasibility of utilizing U.S. aluminous-bearing ores as substitutes for imported bauxite.

We appreciate the committee's interest in mineral resource supply, as well as the opportunity to appear here today. We are seeking government cooperation in developing industry capability for processing domestic ores. Further, we urge that the government begin immediately to develop a raw materials policy including proper income tax provisions aimed at assuring the nation of a continuing sufficiency of basic materials. But most important, we believe that it is imperative to the well-being of the nation and to all people, that the U.S. Government use its great influence to persuade other nations that actions such as that taken by the Jamaican Government will inevitably redound with adverse consequences for everyone concerned.

Exhibit A
PROVEN RESERVES OF BAUXITE

	1973 (1)	
	%	Tonnage (2)
Australia	30.3	4,700
Guinea	22.6	3,500
Brazil	12.9	2,000
Jamaica	6.5	1,000
Greece	4.5	700
Surinam	3.2	500
Yugoslavia	2.3	350
Guyana	1.3	200
Soviet Sphere*	4.0	620
**Of which:*		
U.S.S.R.	*1.9*	*300*
Hungary	*1.0*	*150*
All Others	12.4	1,930
Total	100.0	15,500

(1) Based on data provided by U.S. Bureau of Mines 1974
(2) Million Long Tons

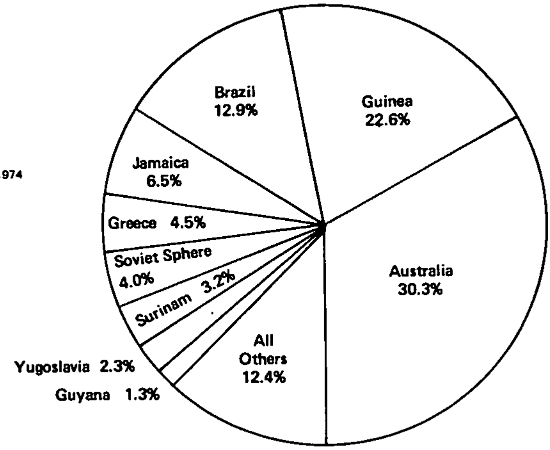


Exhibit B
BAUXITE PRODUCTION(1) - WORLDWIDE

Country	1973 (2) %	1973 (2) Tonnage(3)	1968-72 Average %	1968-72 Average Tonnage(3)
Australia	22.7	17,696	17.2	10,827
Jamaica	19.7	15,344	19.6	12,350
Surinam	10.1	7,840	10.8	6,780
U.S.S.R.	7.1	5,488	8.2	5,152
Guyana	5.3	4,144	7.1	4,499
W. Europe*	12.8	9,968	13.4	8,467
**Of which:*				
France	*4.5*	*3,472*	*5.2*	*3,288*
Greece	*3.7*	*2,912*	*4.0*	*2,501*
Yugoslavia	*3.3*	*2,576*	*3.7*	*2,305*
Other Soviet	4.9	3,808	4.8	3,043
Other Free World*	17.4	13,552	18.9	11,880
**Of which U.S.A.*	*2.7*	*2,118*	*3.3*	*2,101*
Total	100.0	77,840	100.0	62,998

(1) Including Non-Metal Products
(2) Preliminary
(3) 000 Short Tons

Data: U.S. Bureau of Mines (Published & Unpublished)

1973
(1968 - 72 AVERAGE)

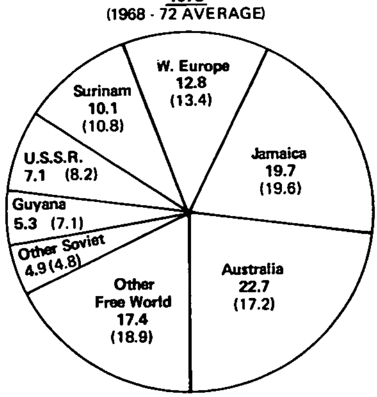


Exhibit C
ALUMINA PRODUCTION - WORLDWIDE

Country	1973 (1) %	1973 (1) Tonnage (2)	1968-72 Average %	1968-72 Average Tonnage (2)
U. S. A.	25.7	7,100	30.1	6,857
Australia	14.5	4,000	10.6	2,407
U.S.S.R.	9.4	2,600	9.7	2,220
Jamaica	9.1	2,500	7.5	1,707
Japan	6.9	1,900	6.2	1,416
Surinam	5.1	1,400	5.2	1,195
W. Europe*	14.6	4,043	12.9	2,929
**Of which:*				
France	*4.3*	*1,200*	*5.4*	*1,233*
W. Germany	*4.0*	*1,100*	*3.7*	*845*
Other Soviet	4.9	1,350	4.8	1,105
Other Free World*	9.8	2,707	13.0	2,964
**Of which Canada*	*4.5*	*1,250*	*5.2*	*1,185*
Total	100.0	27,600	100.0	22,800

(1) Preliminary
(2) 000 Short Tons

Data: U. S. Bureau of Mines (Published & Unpublished)

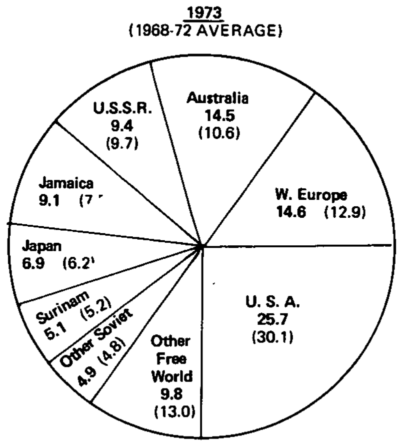


Exhibit D
U. S.(1) IMPORTS OF BAUXITE
BY SOURCE

Country	1973(2) %	1973(2) Tonnage(3)	1968-72 Average %	1968-72 Average Tonnage(3)
Dominican Republic	7.5	1,026	6.7	980
Guyana	10.2	1,388	6.7	970
Jamaica	52.2	7,106	54.8	7,965
Surinam	21.8	2,969	22.0	3,193
All Others*	8.3	1,129	9.8	1,428
**Of which:*				
Australia	*4.3*	*585*	*2.5*	*356*
Guinea	*1.1*	*143*	*3.1*	*458*
Haiti	*2.5*	*344*	*3.9*	*569*
Total	100.0	13,618	100.0	14,536

(1) Includes Virgin Islands & calcined
(2) Preliminary
(3) 000 Short Tons

Data: U. S. Bureau of Mines (Published & Unpublished)

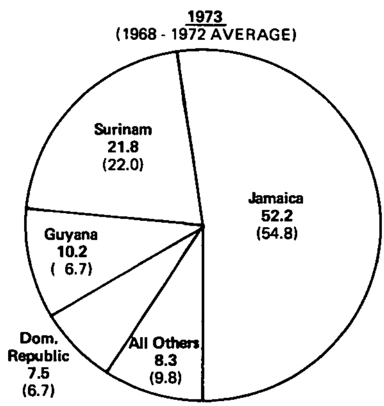
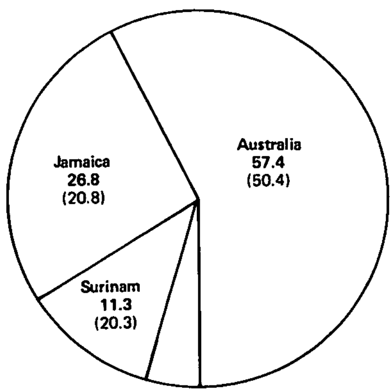


Exhibit E
U. S.[1] IMPORTS OF ALUMINA
BY SOURCE

Country	1973(2) %	1973(2) Tonnage(3)	1968-72 Average %	1968-72 Average Tonnage(3)
Australia	57.4	1,939	50.4	1,120
Jamaica	26.8	904	20.8	461
Surinam	11.3	380	20.3	452
All Others*	4.5	152	8.5	189
**Of which:*				
Canada	*0.6*	*21*	*0.7*	*15*
Guinea	*0.6*	*21*	-	-
Guyana	*1.0*	*33*	*1.2*	*27*
Total	100.0	3,375	100.0	2,222

(1) Virgin Islands included as U.S.
(2) Preliminary
(3) 000 Short Tons
Data: U.S. Bureau of Mines (Published & Unpublished)



GENERAL POINTS ON JAMAICA'S ECONOMIC POSITION

Chairman BENTSEN. I think I will proceed with some questions while your testimony is fresh in my mind.

I have some knowledge of the problems of Jamaica with their import costs going up from some $50 million to a $150 million. And I understand by the bauxite tax, that they will increase their revenues up to almost $200 million, is that correct?

Mr. PARRY. I believe at the present time about $225 million.

Chairman BENTSEN. I also note that they raise a lot of sugar in Jamaica, too, don't they?

Mr. PARRY. Yes.

Chairman BENTSEN. And I know that the price of sugar has gone up from a year ago, when it was around 10 cents a pound, to around 27 cents a pound as of last week.

JAMAICA'S NEW BAUXITE TAX WILL BE PASSED THROUGH TO THE CONSUMER

Let me ask you how this reflects on American prices. What does it mean to the American consumer, this new tax? Where as that bauxite tax was less than $2, now it has been raised to around $12 per ton.

Can you give me some idea of what that means in the way of the increase in the cost per ingot of aluminum in the United States?

Mr. PARRY. It is a flow through of taxes to the ultimate consumer which would mean an increase in aluminum of about 2.2 to 2.25 cents per pound of aluminum produced.

Chairman BENTSEN. As related to what? Give me the percentage of increase.

Mr. PARRY. Aluminum prior to August 2 is selling at 33.5 cents a pound. Put it in that magnitude, it would be some 8 percent increase in the price.

Chairman BENTSEN. Some 8-percent increase in the price?
Mr. PARRY. Aluminum produced from that ore; yes, sir.

PASS THROUGH IMPACT OF HIGHER ALUMINUM PRICES

Chairman BENTSEN. How would that flow through to the ultimate consumer? Let's talk about, if you are trying to build a house and want aluminum windows, what kind of an increase would you anticipate there in cost?

Mr. PARRY. I am not really prepared to answer that one, Mr. Chairman. I can get that figure for you. But I would guess that there is an increased markup as you move toward the final product, so that the end result in producing a final product in aluminum such as aluminum storm windows or aluminum doors would be in excess of that 8 percent. But I am really not sure how much. I would think it might approximate double that. And you would find an increase of, say, 15 percent on that one single element alone.

Chairman BENTSEN. I don't understand how this can follow through to be more than 8 percent. Why does it markup that much more if you just have in the beginning an 8-percent increase?

Mr. PARRY. Because of the flow through of material usage into a final product creates, for example, an increase in the amount of material used to produce one pound of end product. And you get, as you move up the fabricating scale and toward the end consumer, you get a utilization of an increase—say 1 pound of storm windows creates a need for more than 1 pound at the other end, until you have filled up the scrap cycle in the meantime. I think there is one very important point——

Chairman BENTSEN. If you say so, Mr. Parry.

INCREASED PRODUCTION COSTS FOR ALUMINUM WILL NOT NECESSARILY PASS THROUGH TO THE CONSUMER

Mr. PARRY. I think there is perhaps a more important economic point, Senator, and that is that an increase in the cost structure of the production cost for aluminum is not necessarily passable through to the consumer. That was one of the assumptions which the Jamaican negotiators used in their arguments with us, and we attempted to show to them, prove to them in any way that it was possible—and they chose either to ignore or not to accept our arguments—that alumina is a derived commodity and it is in the marketplace competing with steel, plastics, wood, and copper.

Chairman BENTSEN. But you are still substantially below copper, aren't you?

Mr. PARRY. For certain applications, yes, we are. Copper doesn't compete with certain transmission line requirements, for example. But we meet head on in the marketplace for the use of radiators in automobiles, for example. And the ability to use aluminum is a competitive situation. To make the calculation and then to assume that we can in fact pass this along to our consumers may in some areas be correct, but in many others will not be correct.

WHAT ACTION SHOULD THE U.S. GOVERNMENT TAKE TO COUNTERACT THE JAMAICAN ACTION?—ALCOA'S VIEW

Chairman BENTSEN. Let me ask you this, then.

You say that in the long run the tax hike redounds to the detriment of Jamaica, but in the short run it apparently operates to their profit, and also resolves some of their balance of trade problems. What action would you ask the United States to make, the Government itself, in order to try to impress on the seriousness the long-term problems that they face in abrogating contracts?

Mr. PARRY. I think simply to reiterate to the Government of Jamaica that the United States Government in its pursuit of its own self-interests with respect to raw material supplies that are required for the maintenance of our economic well-being, that the Government of the United States simply cannot be dependent upon such actions as we have seen with respect to Jamaica. The country is subject to some very severe problems in many other areas, too, with respect to tin, chrome, and a number of other raw materials, and a number of basic minerals of which we do not have a sufficiency here in the United States to supply our needs. I think the U.S. Government has to make it plain that there is an increasing interdependence in this world, and that this interdependency is a two-way street, and that we cannot have unilateral actions without a commensurate economic effect on those countries, not short run, Senator, but probably long run.

Chairman BENTSEN. How many aluminum companies do we have in America? Alcoa, Reynolds, Kaiser——

Mr. PARRY. Alcan, Revere Copper and Brass, and Anaconda.

ARE GOVERNMENT TO GOVERNMENT NEGOTIATIONS WARRANTED TO HANDLE CARTEL PROBLEMS

Chairman BENTSEN. Do you feel in this kind of a situation that we ought to resort to a government to government bargain, or do you think it should be done by the companies? And if it is done by the companies, what do you do about the antitrust provisions?

Mr. PARRY. We face that. And with the agreement of the Justice Department, we had an observer at all of our combined negotiations with the Jamaican Government in order to eliminate the possibility of any antitrust problems.

I don't believe that the U.S. Government should necessarily do the negotiating for the aluminum companies.

Chairman BENTSEN. That has been suggested in the oil situation.

Mr. PARRY. Yes; I am sure that it has. I have read also that it has. And I don't believe that is necessary in the bauxite situation. I think that the Government should be the facilitator in this instance, not necessarily the activator in these negotiations. But I believe that——

Chairman BENTSEN. How do you draw the line?

Mr. PARRY. It is a very difficult thing to do. It is a line I expect that is drawn in our political process every day, however imperfectly. And I only recommend that the Government in fact at least make its wishes known with respect to Jamaica. Jamaica is just the first, Senator, there are going to be others if they can get away with it.

Chairman BENTSEN. You have got the nationalization of Reynolds' holdings in Guyana, haven't you?

Mr. PARRY. That is about ready to be precipitated; yes.

LDC CONTROL OF BAUXITE HOLDINGS WILL NOT DISRUPT BAUXITE SHIPMENTS TO THE UNITED STATES

Chairman BENTSEN. Do you think these things will cause a disruption in the shipment of bauxite to the United States?

Mr. PARRY. I don't foresee that necessarily, no, sir. I think the aluminum companies in each of these areas have little or no—particularly with respect to Jamaica, where we have such a large investment—immediate alternative but to continue operations in Jamaica.

Chairman BENTSEN. What would these nations do—what would these nations do—what would Jamaica do, and Guyana do, for example, if in turn you said you wouldn't take their shipments, where would they go for smelting capacity?

Mr. PARRY. Well, Jamaica has plans that they have announced to enter into a consortium with the Government of Trinidad, I believe, and with the Government of Guyana, to build an aluminum smelter on the island of Trinidad.

Chairman BENTSEN. How long does that take and how do you raise capital for something like that in a capital short market?

Mr. Parry. I would think that they might have difficulties raising capital anywhere in the world for that development. But I don't know their plans with respect to financing.

They also have the problem of marketing the output. The marketing of aluminum is not a simple matter. It is a very complex marketing situation that has been developed by the integrated and nonintegrated aluminum companies throughout the world. And it would not be an easy task for them to enter into this market.

ALCOA CAN BUILD A COMMERCIAL SIZE PLANT TO REFINE ALUMINA FROM NONBAUXITE ORE IN 3 YEARS

Chairman BENTSEN. Let me look at your problems here a little bit to better understand them. When would you anticipate being able to have commercial production from your smelters with nonbauxite ores, how long a timespan would that take?

Mr. PARRY. For Alcoa in our present position it would take probably 2 years after the end of this year, when we get to some of our design parameters developed—2 to 3 years, probably, in order to both make concrete these design parameters and also to build a plant.

Chairman BENTSEN. Let's look at a situation where you build the plant. What kind of investment are we talking about?

Mr. PARRY. If there were a simple, Bayer process such as that for extractions of alumina from bauxite, I would have no difficulty in answering that question. So my answer is going to be a little hedged simply because we don't have the sites at this moment. The typical output of an aluminum plant in the world would be in the neighborhood of 500,000 tons of output per year. And with the processes that we have at the present time, and the indications, admittedly it would be about $400 to $500 per ton. And we are talking about $250 million for a 500,000 ton plant, yes.

ALCOA WANTS ITS NEW INVESTMENT TO BE PROTECTED BY THE GOVERNMENT

Chairman BENTSEN. Let's look at your board of directors now. You have gone to them and you have asked for a capital commitment to build this kind of a plant. What is your situation if you build it and then the Jamaicans decide that they will lower the price to see if they can't put you out of business on your plant?

Do you run a risk in that regard?

Mr. PARRY. We certainly do, Senator. And herein lies the rather unfortunate aspect of this whole process. As I mentioned earlier, bauxite is the most logical source of alumina in the world today. It lies principally, with the exception of Australia, in the developing countries of the world. And it behooves the future peace of the world, it seems to us, to mutually develop these deposits in our mutual interest between our two countries.

Now, having said that, if we are forced because of risk conditions to invest very large sums in domestic production facilities, I am sure that we will simply be coming to the political process to gain protection for that.

Chairman BENTSEN. We face the same problem when we talk about the gasification of coal, we go ahead and spend $500 million for a coal gasification plant, and we are supposed to be able to produce gas at about $1.46 an mcf. And then we have the OPEC country saying, all right, we will take care of that kind of substitute, we will lower the price on oil temporarily while we economically wreck those plants, and then we will jack our prices back up again.

Are we going to get ourselves in the kind of situation where industry is going to have some kind of protection in that regard?

Mr. PARRY. My company is a free trade company. We have been so for many years and expect to continue to be so. However, for our own protection, I am sure that we would have to ask for some kind of relief in that instance. We simply can't make those kinds of investments otherwise.

Chairman BENTSEN. What kind of relief are you talking about? Are you talking about some kind of a floor, some kind of a tariff?

Mr. PARRY. I would expect it would have to be some kind of an equalization mechanism so that our costs would be protected—our plant, the output of our plant would be protected—against the output when such taxes are in fact reduced. I suppose the formal economic mechanism would be some sort of either a quota or a tariff, both of which in this particular instance would be unfortunate for the host countries outside of the United States.

Chairman BENTSEN. Would an antidumping provision apply against raw materials?

Mr. PARRY. Unfortunately there isn't the kind of market, indigenous market for materials in order to establish a stable price which would come under the normal provisions of the antidumping legislation.

ALCOA CAN PRODUCE ALUMINUM FROM COAL WASTES AT ECONOMIC PRICES

Chairman BENTSEN. Do your studies show that the production of aluminum from coal mine wastes could be done profitably at the present time? What is your present price, around 33 or 34 cents a pound?

Mr. PARRY. 33½ cents a pound, and 36 cents has been announced.

We think that it can, Senator. We are at a very early stage on the coal pile development. And we have people in the field today, and also consulting arrangements, attempting to determine the geographic location and the geographic concentration of such piles so that we could try to put together an economical size unit which would substantiate a processing plant. And one of the problems is the variability of alumina content in various so-called piles around the country. These piles, of course, are hundreds and hundreds of thousands of tons. They are very large. And the sampling problem is very large. And we can't do it as quickly, for example, as we proved the alternative process for the processing of the material. In other words, it is more of a field sampling problem and a field identification problem than it is one of technological processing.

I might add that there is a residual fuel value in those piles which we would hope to be able to exploit, and which would become a source of energy for the United States. And those are in fact being investigated from simply the fuel characteristic alone, because when coal triples or quadruples in price, the coal content, the coal piles, becomes economically attractive.

ALCOA THINKS FEDERAL R. & D. AID IS DESIRABLE, BUT THE TAXPAYER WILL RECEIVE NO RIGHTS

Chairman BENTSEN. You referred to Government assistance. Are you talking about that in trying to help on research and development for new processes, and utilizing the alternative sources?

Mr. PARRY. We are presently working with the Bureau of Mines and other sections of the Department of the Interior in the development of these processes. And we have a very good relationship going with those agencies right at the moment.

Chairman BENTSEN. Does the taxpayer keep an interest—if you develop a new process, is there a payoff to the taxpayers in general by the investment the Government has made or not?

Mr. PARRY. There is a potential protection to the U.S. Government in not being in a position that it can in fact be blackmailed in getting the resources which it requires in order to maintain the economic health of the United States. It seems to me that that is the payoff to the Government in this particular instance.

Chairman BENTSEN. You have a great use of electricity, of course, in processing?

Mr. PARRY. Yes.

ALUMINUM COMPANIES FACE HIGHER ENERGY COSTS

Chairman BENTSEN. And you have seen a substantial escalation in price there, too. In part I guess you are shielded where you have hydroelectric power. But otherwise aren't you looking forward to a very substantial increase in the price of aluminum use from the input of electricity and what the costs are going to be?

Mr. PARRY. We are. And we have been facing these over the past 2 or 3 years in which our nonowned electric facilities, the energy which we purchase from utilities, have been undergoing the common kind of problems that all utilities have been subjected to throughout the country; namely, an escalation of their fuel prices. And, of course, these fuel price increases and escalations have been passed on to the aluminum industry. We are, as you mentioned, however, shielded to some extent by our own facilities, such as we have in your home State of Texas.

Chairman BENTSEN. Are you building any additional smelters in this country or not?

Mr. PARRY. Yes; we are. We have a smelter under construction in Anderson County, Tex., at the present time, utilizing Alcoa's new smelting process, which saves approximately 30 percent of the energy in the production of primary aluminum. That will be ultimately a 300,000 ton aluminum smelter.

Chairman BENTSEN. What danger do we have, because of the cost of energy—say you are transporting bauxite to Jamaica and one of these other countries—of seeing these smelters moved to places like Saudi Arabia where they are flaring natural gas.

Mr. PARRY. We know the industry is investigating Saudi Arabia very actively. And we know that there are plans at least partly developed on the part of the several Japanese companies to establish facilities in Saudi Arabia. Saudi Arabia has a very attractive gas price. It is flare gas at the present time, and any realization of it is a net plus to the country. I am not sure they really need the cash at the present time. They need industrial development more. And this is an opportunity of course for them to do that.

There are some problems associated with operating in that country. There are transportation problems—it is far from the market—and there are some grade problems, quality problems, which might result, depending on the type of facility put in.

And there is a smelter in Bahrain which has had these kinds of quality problems operating in the sandy Middle East as it were.

I would say there is a good possibility, Senator, that the economic realities that we are facing might well throw that balance from a domestic smelter location to a foreign smelter location.

Chairman BENTSEN. And we would face the same kind of problems when we talk about fertilizer, and anhydrous ammonia, for example, of that kind of a plant being moved to the source of energy.

Mr. PARRY. Yes, sir, exactly the same problem.

ALCOA PROPOSES TAX POLICIES TO AID THE ALUMINUM INDUSTRY

Chairman BENTSEN. You refer in your oral statement to having some kind of tax incentives possibly to develop self-sufficiency.

What kind of tax incentives were you referring to?

Mr. PARRY. I am not sure that I mentioned that, Senator. But I think, in view of some of the things that are occurring with respect to bauxite ores overseas, that we will continue to need tax incentives here in the United States, particularly in the form of——

Chairman BENTSEN. I think you referred to income tax policies.

Mr. PARRY. Yes.

Primarily, Senator, it centers around the ability in this time of very rapid inflation, particularly with respect to construction costs, the ability to recover the very rapidly increasing costs of our plant construction facilities.

In addition, we feel that domestic aluminum ore should probably carry some kind of incentive in the tax structure in order for this inherent inequity with respect to bauxite—which again is the logical source of alumina—in order to provide this kind of protection for the United States.

DO HIGH ALUMINUM INDUSTRY PROFITS WARRANT TAX HELP?

Chairman BENTSEN. You have had a very substantial increase in profits in the metal industries recently. Is it realistic to talk about some kind of tax consideration in view of that?

Mr. PARRY. Well, I think one of the problems that the bauxitic metals industry has faced is that it has been in such a depressed period for so many years that when we start to approach the level of profitability which would substantiate further expansion, it looks like the profits are enormous. It is not too dissimilar from the question of how is your wife, and then the further question, compared to whom? Profits are not meaningful other than in relative terms to investment and to competitive materials and competitive financing.

The aluminum industry over the past 5 to 6 years has not in any one of these years obtained a level of profitability which would justify for our shareholders the dedication of those funds, those internal funds primarily, and also the increase in debt which the industry has experienced. The aluminum industry is very highly capital intensive, and to substantiate anything approaching its historical rate of growth requires great amounts of debt financing in addition to the reinvestment of retained earnings, because the industry has traditionally maintained a very low dividend profile substantiated by the increased frozen equity value.

Our profitability over the past 10 years has not been sufficient to substantiate the kind of investments we have made.

Chairman BENTSEN. Let's get to that.

What kind of return on equity have you been making over the last 10 years on the average?

Mr. PARRY. It has averaged around 4½ to 6 percent. Last year it got up to about 7½ percent. It is above that at the present time in the first half of this year. But it still has not attained our corporate goal, not once in that period of time. It is hovering around 5, 6, 7 percent during that period. And the return on total capital employed——

Chairman BENTSEN. What is your corporate goal?

Mr. PARRY. Our corporate goal is 16 percent return equity at the present time.

Chairman BENTSEN. That is above the average industry's return on equity now.

Mr. PARRY. It is about equal to it.

Chairman BENTSEN. I would argue a little with you on that one.

Mr. PARRY. I think within 1 percentage point, Senator, it probably approaches it. That is what it has been running over a period of years. But if you take the aluminum industry return, we have not exceeded the manufacturing average once in the last 15 years.

Chairman BENTSEN. And yet you are saying that the industry has made very substantial capital investments over the last 10 years in productive capacity?

Mr. PARRY. Yes, because it believes—firstly, I suppose you would have to go back historically to the industry to find that kind of dedication to a singular kind of company, we intend not to be diversified, we intend to be aluminum companies, as it were.

And secondly, I suppose, it is a hope that the strategies which we are prepared to adopt individually will result in a recovery of profitability by the industry. And that has not proved true until about the present time when we are starting to approach that level.

ALUMINUM INDUSTRY CANNOT MEET ITS DEMAND

Chairman BENTSEN. Let me ask you, then, with your capacity as related to demand today, are you able to meet the demand? And if not, what kind of delays are you having on orders?

Mr. PARRY. No, we are not meeting the demand today. There is an insufficiency of aluminum in the United States. We believe there will continue to be an insufficiency in the next 10 to 15 months. In the meantime the expansion which is presently underway we believe will tend to balance the demand picture in the United States.

Chairman BENTSEN. You don't see a lessening in demand, you think your productive capacity in the industry will increase enough to take care of it, is that correct?

Mr. PARRY. I believe it will.

Chairman BENTSEN. But you expect demand to stay high?

Mr. PARRY. Yes, we do.

Chairman BENTSEN. Your testimony is very interesting, Mr. Parry. And I would like to continue. But we have some others that I would like to call on at this time.

Mr. Bloom, would you proceed, sir.

STATEMENT OF DUANE N. BLOOM, DIRECTOR AND CHAIRMAN OF THE EXECUTIVE COMMITTEE, EARTH SCIENCES, INC., GOLDEN, COLO.

Mr. BLOOM. Mr. Chairman, my name is Duane Bloom. I am the chairman of the executive committee——

Chairman BENTSEN. Let me interrupt, Mr. Parry, to say to the press that we did invite a number of witnesses, from Jamaica for example, to hear their side of the initial dispute. And we understand that they are having the European Common Market conference in Jamaica at the present time concerning the sugar situation, and those witnesses were not able to testify, but we hope to have them later.

JOINT VENTURE PROJECT TO REFINE ALUMINA FROM ALUNITE

Mr. BLOOM. Our company is a joint venture participant with the National Steel Corp. of Pittsburgh, Pa., and the Southwire Co. of Carrolton, Ga.

The primary purpose of this joint venture is the discovery, delineation and development of alunite deposits for the production of alumina.

We were asked to participate in this hearing, I believe, because of this alunite venture, which appears to be headed for the first large-scale commercial exploitation of a domestic nonbauxitic alumina deposit.

I believe a discussion of alunite and its probable impact on the alumina industry should be regarded as an important part of these hearings.

As an opening statement, I believe it would be appropriate to introduce you to the facts concerning the Alunite Venture. Because the program extends over a 4-year period and covers work in many disciplines, my statement must be somewhat generalized, in reference to the technical portions of the program.

NATURE OF ALUNITE

Alunite is a mineral consisting of four industrial chemicals in approximately the following proportions: One part alumina, one part sulfuric acid, one-half part potassium sulphate, and one-half part water. The pure mineral contains 37 percent alumina. In nature, sizeable deposits in excess of 30 percent alunite are very rare. The guidelines established in our initial search was for a deposit of over 100 million tons with a minable grade of over 30 percent alunite.

The promise of this material is not an especially high alumina content, but rather the ease of treatment. It is one of the three potential alumina sources that are not alumino-silicates, the others being bauxite and dawsonite. It is the aluminum-silicon-oxygen combination that makes other alternatives costly to process.

Dawsonite, mentioned by Mr. Parry, is a by-product of oil shale, or a potential by-product of oil shale, and thus is dependent on the economics of that potential industry.

High grade bauxite deposits are becoming rarer, and they do require large capital input into remote and often insecure areas.

EASILY ACCESSIBLE BAUXITE DEPOSITS ARE BECOMING RARER

Chairman BENTSEN. Did you say that high grade bauxite deposits are becoming rare?

Mr. BLOOM. Rarer, is what I meant. In areas where they are easily accessible, they are becoming rarer.

Chairman BENTSEN. Do you agree with that, Mr. Parry?

Mr. PARRY. With the qualification easily accessible, depending on what kind of interpretation you put. We have made some interesting finds in Brazil recently, Alcan, ourselves and several of the other companies at the same time, which are a high grade.

But Mr. Bloom is correct, they are way up the Amazon River, and it would be kind of difficult to develop.

Chairman BENTSEN. Do you have some deposits in Australia?

Mr. PARRY. Yes; we do. They are not high grade, but they are economical.

Chairman BENTSEN. All right.

Mr. BLOOM. Low grade bauxite deposits that have been passed up in the past generally have a high iron or alumino-silicate fraction, which again leads to higher processing costs.

As far as we could determine in 1969, when this venture was begun, there were no known deposits in the United States meeting our criteria. Apparently for this reason. Report No. 278 of the National Materials Advisory Board which was published in 1970 concluded that alunite had "little potential of being a major raw material of aluminum in this country". In the year that statement was made, the NG alunite deposits were discovered 60 miles northwest of Cedar City, Utah, in the southern portion of the Wah Wah Mountain range. Initial evaluation indicated that these deposits were very large, and in 1971 Earth Sciences; National Steel, and the Southwire Co. began a joint effort to explore and develop them. This area of intensively alunatized rock is in the desert country of southwest Utah. The development of the deposits will include the construction of a 25-mile railroad spur off of the Union Pacific Railroad to a plantsite which will be located at the deposit. Water will be supplied by an acquifier which was recently located in the area. Energy will come from low sulfur coal deposits located just to the northeast of the alunatized area. The sulfuric acid, which will be generated by the process, will probably be reacted with phosphate rock from southeastern Idaho, directly to the north. Phosphate deposits for this purpose were recently acquired by the joint venture.

Drilling and trenching on the property has proven in excess of 100 million tons of ore grading between 35 and 40 percent alunite. In addition, another 600——

FERTILIZER BYPRODUCTS—SULFURIC ACID AND POTASH

Chairman BENTSEN. Let me interrupt you to understand this a little bit.

The fertilizer byproduct, is that a potash byproduct?

Mr. BLOOM. There will be a potash byproduct and a sulphuric acid byproduct. The sulphuric acid, it is anticipated, will be reacted with phosphate rock, as is done with most of the sulphuric acid produced in the world.

Another 600 million tons of similar grade ore have been placed in the probable category on this property. It appears that the initial plant planned for this deposit, 500,000 tons of alumina per year, could be expanded by a factor of 10, and using ore from this area, could operate for about 20 to 30 years, supplying nearly one-sixth of all the aluminum used in the United States during that period.

The estimated recoverable alumina in the NG deposit alone approximates 90 million tons. This is truly an immense deposit which I believe will play a significant role in the future of the U.S. aluminum industry.

Chairman BENTSEN. Let me ask you again about the fertilizer. It was just 2 years ago that phosphate and potash were a heavy burden on the market, and they were having a very difficult time selling it. And in Guiana the government was trying to put a floor under this.

Now, do you look forward in the future to having no problem in disposing of these byproducts?

Mr. BLOOM. In a little while I was going to get into the economics of the deposits and I think I can explain this at that point.

Chairman BENTSEN. All right.

BYPRODUCTS NOT ESSENTIAL TO ECONOMIC FEASIBILITY

Mr. BLOOM. The byproducts are not a requirement for economic feasibility.

Several processes for treating the alunite ore have been tested in the laboratory and in small scale pilot operations.

In addition, the Soviet Union has a full scale commercial operation at Kirovabad in the Republic of Azerbajan. The basic process selected is very straightforward. It consists of benefication section to produce a synthetic bauxite, and a simplified Bayer plant for the production of alumina. Data on this process is presently being collected in a 10-ton-per-day pilot operation in Golden, Colo.

I could mention a few of the proven steps that are being used. There is a roast to drive off water, followed by another roast to drive off the sulfur, which is chemically combined with alumina.

Chairman BENTSEN. You have probably made as exhaustive a study as anyone on what the Soviets have done in this process.

Mr. BLOOM. Yes, sir.

Chairman BENTSEN. How would you evaluate their technology at the present time on this particular process? Do you think it is beyond ours, or advanced enough?

ALUNITE PROCESS NOT THE SAME AS THAT OF THE U.S.S.R.

Mr. BLOOM. I don't think that we will be using their technology—we may use portions of their process, but the processes that we are testing right now in the pilot plant are not in accordance with their procedure.

Chairman BENTSEN. You don't run into some kind of a licensing problem?

Mr. BLOOM. We may become involved in licensing some of their technology. They have different requirements for potassium sulfate than we have, therefore they use a large amount of potassium hydroxide in their process, producing a larger amount of potassium sulfate than we will produce. We don't feel that this is marketable in the United States in the quantities that they produce.

The sulfur that is evolved from the process will be fed to a sulfuric acid plant. These two steps, the hydration roast, and the sulfur evolution, make it possible to dissolve the potassium sulfate with water, which leaves a crystalline, highly porous, highly activated alumina. The alumina is dissolved and precipitated in an atmospheric pressure, simplified Bayer plant which has a very short digestion time.

The purpose of this pilot plant is to demonstrate the production of cell grade, sandy alumina which is interchangeable with alumina from other Bayer plants in the United States.

The second purpose is to produce byproducts for use in marketing studies.

Finally, we are accumulating engineering data which is necessary to construct a commercial plant. The Parsons Jurden Division of the Ralph M. Parsons Co., acting as a consultant to the project, will prepare the final feasibility study to be used in senior financing.

Based on a preliminary feasibility study, the joint venture is planning an initial operation, assuming 10,000 tons per day of alunite rock, which will produce 500,000 tons per year of alumina, 250,000 tons per year of sulfate of potash, and 450,000 tons per year of sulfuric acid.

There is a high probability that this acid will be reacted with phosphate rock. In this case it would use 800,000 tons of phosphate rock and mage 550,000 tons of triple super phosphate fertilizer.

ALUMINUM TREATED IN A SWAP ARRANGEMENT

Chairman BENTSEN. Let me understand this, now. You would manufacture the alumina in Utah?

Mr. BLOOM. Yes, sir.

Chairman BENTSEN. And your smelter is in Kentucky?

Mr. BLOOM. That is the location.

Chairman BENTSEN. And it is economic to transport it there?

Mr. BLOOM. It is quite probable that the alumina will be treated in a swap arrangement and not shipped all the way to Kentucky.

Chairman BENTSEN. Is it public information what this plant would cost you in Utah?

$120 MILLION INVESTMENT NEEDED TO START THE PLANT

Mr. BLOOM. The alumina, potash, and sulphuric acid portions of the plant will cost approximately, the preliminary feasibility study indicated, $120 million.

Chairman BENTSEN. It is being worked on?

Mr. BLOOM. The financing is being worked on.

Chairman BENTSEN. It is being worked on?

Mr. BLOOM. There appears to be a probability that it will be financed. It won't be financed by Earth Sciences alone.

Chairman BENTSEN. Good luck.

Mr. BLOOM. The present schedule calls for the plant to be constructed by late 1977, or 1978. The final phosphate products, that will be produced, are going to be selected on the basis of marketing studies and negotiations being carried on presently.

Based on 500,000 tons of alumina per year production rate, the operating life of the plant will be hundreds of years.

Consideration is being given at present to doubling the size of the initial plant.

Chairman BENTSEN. What you are saying, then, is that you can produce it from alunite at 30 cents a pound, and it will be profitable.

Mr. BLOOM. We would be producing alumina. Without byproducts from the alunite, and before the Jamaican changes in their royalties and taxes, it appears that alunite can be used as a source of alumina competitive with bauxite operations that are going on, and have gone onstream recently. Byproduct credits are expected to significantly reduce the net cost of alumina below this figure.

Chairman BENTSEN. So you were going to take the risk even before the Jamaican situation, but the Jamaican deal probably redounds to your benefit and it proves more economically feasible, is that right?

Mr. BLOOM. I think we probably anticipated that this type of situation was going to come about. But it did not play a part in our decision to go ahead with the domestic alternative.

ADVANTAGES OF ALUNITE TO THE ALUMINUM INDUSTRY

I could mention a few of the advantages that accrue from the use of alunite as an alumina source which I feel might be of interest.

First of all, there is abundant domestic alunite. We have located large quantities in the last 4 years; inferred reserves are measured in billions of tons. This would represent hundreds of millions of tons of recoverable alumina.

The economics of an alunite industry for the production of alumina appear to be comparable to those of new bauxite deposits without byproduct credits, and are more favorable when reasonable credits are applied.

Third, the tailings disposal problems with alunite appear insignificant. The tailings are clean, crystaline quartz sands. This tailings disposal is a major problem or a significant problem common to other aluminum source materials, including bauxite and dawsonite.

Fourth, processing by means of tried and true Bayer plant technology should produce alumina with characteristics acceptable to existing aluminum smelters. This is in contrast with some of the newer processes that have been developed which certainly produce high quality alumina, or can be made to produce that, but they will not produce the same alumina that is being produced by Bayer plants.

Chairman BENTSEN. Let me interrupt you again.

Back to this point. As I understand you, you felt that this process could be used profitably before the new taxes by the Jamaican Government, which are probably about 36 percent.

Mr. Parry, do you agree with that?

ALCOA BELIEVES THAT ALTERNATE ALUMINA PROCESSES ARE ECONOMICAL ONLY WITH THE JAMAICAN TAX

Mr. PARRY. It would be inappropriate for me to comment on their alunite process, Senator, because I just don't know enough about it. I do know that our studies with nonbauxitic materials would indicate that we probably wouldn't go ahead—in fact I can state categorically that we would not have gone ahead with the establishment and development of commercialized processing here in the United States, without the drastic increases in taxes that we are now facing, plus the uncertain future with respect to what is going to happen to these taxes again in the future. Because, once having been confronted by a policy of unilateral action, one faces an uncertain risk in the future.

Chairman BENTSEN. But surely a company of your size has been doing a lot of R. & D. and has some awareness of this process.

Mr. PARRY. Alunite, yes, sir.

Chairman BENTSEN. But not sufficient information, you feel, to comment on their plans.

Mr. PARRY. I would suspect that their process is, as Mr. Bloom said, economical at this point in time. Whether it would be economical before such tax increases I don't think I would care to comment.

ALUNITE ADVANTAGES OUTWEIGH DISADVANTAGES

Mr. BLOOM. I think it might pay to point to a disadvantage or a potential disadvantage of alunite. The lower grade of alumina in alunite, which is around 15 percent, appears to have serious disadvantages. But I think that this probably is not as strong a disadvantage as it appears to be, since grade is only one factor in the profitability calculations. Other factors such as infrastructure requirements, energy and raw material supplies, proximity to markets, uniformity of the material being processed, reagent, consumption and environmental considerations are equally as important as the factor called grade.

We would say that this situation appears analogous to the taconite iron ore situation 25 years ago. Although taconite was only one-half the grade of the hematite high grade ore which that industry had been accustomed to, it was found that it could be processed competitively, and now taconite pellets supply a major portion of the iron ore market. We in the Alunite Joint Venture feel that the western United States may ultimately be to aluminum what the Southwest has been to copper and what Minnesota, Wisconsin, and Michigan have been to iron ore. I believe that one of the major questions that is facing the U.S. aluminum industry today is whether to continue the risk of making ever increasing investments for facilities in foreign lands, where legal protection can dissolve with a change in government or a shift in international relations. Ever increasing investments made under these conditions subject the companies to ever increasing foreign pressures.

This is as was explained by Mr. Parry in reference to Jamaica.

For many years the United States has known that it could not depend on bauxite as a domestic alumina source. It does appear that alunite is now competitive as the domestic alternative.

Chairman BENTSEN. I think that that is your point. You stated that alunite is competitive, and it was competitive even before the tax increases. You feel that we have a source where we could develop self-sufficiency in this country.

Mr. BLOOM. Yes, sir.

Chairman BENTSEN. Is that a fair summary?

Mr. BLOOM. Yes, sir.

Chairman BENTSEN. Thank you very much, Mr. Bloom.

Mr. Pratt, will you please give us your testimony.

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STATEMENT OF ROBERT N. PRATT, PRESIDENT, KENNECOTT SALES CORP.

Mr. PRATT. Mr. Chairman, as you may know, Kennecott is the leading producer of copper in the United States, the number two producer of molybdenum and gold and an important source of silver, lead, and zinc. Kennecott is also the largest domestic coal producer through its subsidiary, Peabody Coal Co., and a major supplier of high-quality iron and titanium slag through other interests.

Before commenting on the copper industry, I wish to say that I appreciate the opportunity to appear before the subcommittee and that I commend the subcommittee's decision to examine this area of the U.S. economic scene.

In the interest of time my remarks will be somewhat abbreviated from those that are contained in my statement.

Considering that primary metals alone, account for some 3 percent of U.S. Gross National Product, and that probably 75 percent of our GNP is affected by the minerals industries, it makes good sense for the Congress to examine from time to time the prospects for the Nation's supply of and demand for its basic economic resources.

Copper has been in short supply relative to demand during the past 18 months. And I am sure there are many that would say we have only been short because of the 68-cents-a-pound copper supplied by the U.S. producers. Today's supply and demand are about in equilibrium.

It might be instructive to examine what happened. In 1971 and 1972, the free world experienced an apparent surplus of copper and prices were relatively low. Near the end of 1972, Chilean production began to fall off rapidly, Zambia experienced transportation problems due to a political dispute with a neighboring country, and in the United States, air pollution regulations began to affect smelter production. Demand turned up in late 1972 as the United States, European, and Japanese economies heated up. In 1973, demand surged at double the historic 4½-percent growth rate of copper consumption.

World prices moved up dramatically reflecting this situation. United States prices, however, were restrained by price controls. As the price disparity grew, the availability of copper in the United States was seriously affected because copper exports rose as scrap metal flowed to the higher price. In recent months, as I have said, the situation has largely corrected itself. Chilean production has improved significantly and demand for copper has receded somewhat in several areas, particularly in Japan.

This rather typical, quite short-term experience should not lead anyone to presume that any permanent shortage is imminent. Our Nation is blessed with abundant reserves despite dire forecasts one encounters from time to time. The Paley report of 1952 predicted that the United States would be out of copper in this decade. The 1971 Club of Rome study has predicted the same disaster on a worldwide scale in this century.

The fact is, the United States has been increasingly self-sufficient in copper over the year despite important growth in demand, decreasing ore grades, and higher stripping ratios. Continuing technological advances in our industry have made this possible. Given sound U.S.

Government policies, we believe the U.S. copper industry can continue this performance. My own company has proven reserves of more than 18 million tons of recoverable copper, enough to last some 40 years at current rates of extraction. This outlook does not include entirely new mining technologies such as undersea mining and in-situ mining, which we and others are studying and which offer the opportunity to tap vast additional resources.

The U.S. copper industry has announced plans to expand capacity by about 25 percent during the next 4 years and still further expansion is under consideration.

Chairman BENTSEN. What kind of return has your industry received on equity over the last 10 years?

COPPER INDUSTRY BELIEVES ITS RETURN ON EQUITY IS LOW—REASON WHY CAPACITY EXPANSION IS RETARDED

Mr. PRATT. Over the last 10 years I woud say on an average that has been about 10 percent. There are 2 of those 10 years in which we have reached a goal that we have been seeking as mentioned by Mr. Parry. We tried to achieve a 15 percent return. But it has varied down to as low as 3 percent up to 16 percent. And that generates one of the problems why we say we cannot give you the copper you need today.

My own company will be announcing shortly important expansion of its capacity to come on line later in the decade.

It is fair to pause here and address a question we face on short-term copper shortages. We are asked why, since reserves are available, we cannot maintain a standby capacity for use during these periods when demand surges or production declines for unexpected reasons. The answer deals with one of the basic problems facing the industry. We estimate that the capital cost of an annual ton of copper productive capacity is $5,000. That is, in order to expand capacity by another 50,000 tons—or have it on standby—we must spend $250 million. Obviously, we cannot afford to have that much idle investment for periods of supply imbalance.

That $5,000 figure, by the way, has risen from $3,000 just since 1971.

In terms of copper supply, this huge capital investment requirement looms as a much larger problem for the Nation than any danger of running out of mineral reserves. To illustrate, the Bureau of Mines estimates that domestic copper demand will need to be increased by 1 million tons by 1985 and 3.3 million tons by 2000. One million tons multiplied by $5,000—that's today's dollars—equals $5 billion.

COPPER INDUSTRY NEEDS $5 BILLION IN CAPITAL OVER THE NEXT 11 YEARS

Chairman BENTSEN. You are talking about capital input for the next 11 years of approximately $5 billion.

Mr. PRATT. At least. And we are told by the engineering firms that are presently making our studies for expansion that when we plan to bring this on, that we can expect a 30-percent increase in each of the next 3 years in our capital costs.

So that figure is very low.

Chairman BENTSEN. What price earnings multiples does your stock sell for?

Mr. PRATT. Let's see. Today it is about six.

Chairman BENTSEN. So you can't go to the equity market because you would have to have a return, that would get you around 30 percent before taxes, and you are not going to have that kind of return, obviously, on your investment.

Mr. PRATT. That is one of our big problems.

Chairman BENTSEN. What is your debt equity ratio?

Mr. PRATT. Looking at the industry 3 years ago we had $300 million. Today it stands at $1.7 billion. But when you look at what we have paid out to our stockholders, and also in terms of capital investment, this comes to about $8.5 million.

Chairman BENTSEN. Are you going to try to do it by cash flow?

Mr. PRATT. We have had a real cash flow problem, as you can see.

Chairman BENTSEN. Go ahead.

Mr. PRATT. One of the solutions is that the United States could rely more on imports but the consequences in terms of both the economy and the national security make that a doubtful alternative.

Greater reliance on foreign copper sources is not a necessary alternative, as I have indicated, provided Government does its part in establishing and maintaining a healthy environment for the industry.

In this context let me turn now to what I view the role of Government to be.

There need be no long-term shortage of copper and many other vital minerals if the Government would organize more effectively, and reorder and coordinate national priorities. For the Congress, this means resolution of the problems caused by designing—and sometimes enacting—legislation which singlemindedly serves one national interest at the expense of others which are equally or more important.

COPPER INDUSTRY ATTACKS ENVIRONMENTAL LEGISLATION

Congress has recognized the need for the continuing development and maintenance of a strong mineral supply in enactment of the Mining and Minerals Policy Act of 1970; unanimously approved by the Senate.

The intent of Congress was quite clear. Yet, in the 93d Congress, there has been a literal flood of legislation which is in clear conflict with the purpose of the Mining and Minerals Policy Act. Let me touch on just a few primary examples.

Recently the Senate approved the Eastern Wilderness Areas Act. The basic intent of the bill was to provide residents of the Eastern United States with recreational areas. Yet—save for amendment of the bill on the floor of the Senate—the act would also have completely repealed the provisions in the Wilderness Act which permit mining entry and location in wilderness areas until 1983. The effect would have been to bar vast Western areas to mining exploration before any measure had been taken of the minerals potential of those areas.

In June, the House considered, but fortunately rejected, a major land use planning bill reported by the House Interior and Insular Affairs Committee. Again, the effect of the bill—if passed—could have been to preclude exploration and mining in vast areas of the country without any determination of the existence, extent, or value of minerals in those areas.

Still being debated in the House is the Surface Mining and Reclamation Act. Sections of the bill call for the designation of lands as unsuitable for surface mining of coal—and of other minerals such as copper. Once again, the effect would be to effectively seal off land from mineral development—regardless of the fact that the national interest requires that we locate and evaluate all our domestic mineral resources so that we can make informed judgments as to whether these minerals should be developed.

One final example. Amendment of the Clean Air Act continues to be a live issue in Congress. The "tunnel vision" which marks current administration of the act by EPA has raised major future risks to necessary development of our mineral resources. Nebulous standards and the Agency's delay in approving state implementation plans, for example, are presenting copper smelters with a serious obstacle to planning and the commitment of investment capital essential to capacity expansion.

It is ironic that—while each of the legislative items I have cited poses major obstacles to fulfilment of the objectives set forth in the Mining and Minerals Policy Act—the intent of each piece of legislation is worthwhile and commendable.

The problem lies in the way each of these pieces of legislation has been written, in the "tunnel vision" which marks the pursuit of one important national objective at the expense of others. Each of the pieces of legislation I have mentioned serves the goal of environmental preservation and would make that goal override all other pertinent national interests. The result is a critical imbalance which only serves to generate controversy, divisiveness, and delay in achievement of important national objectives—including mineral development.

Weighing every piece of legislation in relationship to its impact on all major national objectives is a task requiring Solomon-like judgment—but that is the traditional challenge posed to the Congress, that is what Government is for. The essential elements of objectivity, patience, and breadth of vision must be applied to proposed legislation which holds the promise of major impact—both immediate and long-range—on the Nation's economy and society.

The Congress is certainly capable of such an approach, and of devising effective formulas to insure compliance with that approach. From the standpoint of adherence to the principles of the Mining and Minerals Policy Act, for example, Senator Pete Domenici has already proposed legislation (S. 3467) which would accomplish that purpose. Senator Domenici's bill would require each Federal agency and department to examine its operations to assure that they are consistent with the purposes of the Mining and Minerals Policy Act. His bill would require regular reports to the President and the Congress on the status of the domestic minerals industry so that problems could be identified and resolved. It is a thoughtful and carefully designed piece of legislation.

The principle embodied in the Domenici bill—that there should be assurance that new laws or policies do not unnecessarily or unwittingly pose obstacles to compliance with previously enacted laws—holds for all national objectives and policies. In considering any major legislation, Congress should review the entire current spectrum of vital national objectives and interests to ascertain that the proposed legislation is not contradictory.

I have referred to recent legislation which posed or poses obstacles to the development and maintenance of a healthy domestic minerals industry. Recognition and elimination of these obstacles is one necessary step toward assuring an adequate supply of minerals. But there is another vital step if Government is to follow the Minerals Policy Act's mandate to "foster and encourage" a healthy and expanding minerals industry. This is the establishment by Government of a positive economic climate.

One essential aspect of this positive economic climate is a tax structure designed to encourage expansion of domestic industrial capacity.

For the domestic minerals industry, tax laws designed to generate new capital and encourage investment are essential to the expansion of supply that is mandated by forecasts of future United States mineral demands. Let me make some specific comments on tax laws which are now being reviewed in the Congress.

Percentage depletion, as an incentive for mineral production should be retained. With the growing need for new domestic mineral productive capacity—and the increasing difficulty faced by hard-rock minerals producers in developing the necessary capital for expansion—percentage depletion represents a vital factor in attracting the additional capital.

Now, as an attachment to my presentation I have another statement that has much more detail.

Both the asset depreciation range and the investment tax credit should be continued. Each has served to encourage increases in industrial capacity, thereby generating growth in jobs and real output.

In addition, continuation of the foreign tax credit is also essential. This recommendation may seem contradictory in the light of the industry's efforts to make the United States self-sufficient but when measured against the need for the industry to remain cost-competitive, it is not. American companies need to participate in low-cost foreign sources to be fully competitive with potential overseas suppliers to the American market.

DISCUSSION OF THE RELATIVE ADVANTAGES OF THE MINIMUM TAX

Moreover, the minimum tax should be eliminated. It reflects a hedging on the judgment of Congress in regard to percentage depletion and other tax incentives and is counterproductive to the objective of those incentives.

Chairman BENTSEN. Let's talk about that one just a minute. You say we ought to do away with the minimum tax. We have a problem in this country where you will find people today living in effect off of cash flow. And then we have instances cited where you have 112 people, or whatever the number was, in 1972, who made $200.000 or more and paid no tax. I think that hurts the credibility of the tax system. I think that those people ought to pay a tax. And we have to find a way to get them to pay a tax.

I can understand the economic objectives in having incentives such as depletion, or accelerated depreciation, or investment tax credits. But to say that someone is going to take advantage of all of those and pay no tax at all is a little difficult for the layman to understand.

We ought to have some kind of a tax in the alternative where everyone who has a substantial income, it seems to me, pays some taxes.

Mr. PRATT. I would have to agree with you very definitely that we need a fair system. I think when this bill was written, it was not designed to put the minimum tax and have it apply upon another tax such as a depletion allowance.

Chairman BENTSEN. It doesn't accomplish the objective.

Mr. PRATT. That is right.

In fact, instead of having a 15-percent depletion allowance for your industry, it gives us a 13½ percent depletion allowance. So it certainly negates the intent of Congress in this regard.

Chairman BENTSEN. I still think we ought to search for a way to see that everybody in this country pays some tax, particularly if they have a large gross income and are utilizing all of these so-called incentives.

Mr. PRATT. Let me turn now to some broader suggestions, to some economic policies which, if implemented by government, would contribute to assurance of a healthy domestic minerals supply. First, there should be no continuation of economic controls in any form. Our experience during phases I through IV has given us ample evidence of the mushrooming inflationary impact of such controls and the havoc they play with traditional market forces of supply and demand. Congress has rejected extension of such controls and will, I trust continue to do so.

Second, the national interest can best be served by the enhancement of free trade—by preserving access to foreign markets for our materials and to foreign sources for minerals we need, and by assuring the free flow of capital between nations.

Third, as a corollary to an effective trade policy, U.S. private investment abroad must be protected. Failure of the Government to assure such protection can only lead to curtailment of United States investment abroad with the economic and political disadvantages such curtailment would involve.

KENNECOTT COULD MINE THE SEA FLOOR COMMERCIALLY THIS YEAR

Fourth, as we move closer to the point where recovery of minerals from the deep sea floor will become economically feasible, it is essential that we resolve very soon the legal regime question regarding international deep waters. Over the past 10 years, Kennecott has invested tens of millions of dollars in development of technology for the recovery of deep sea modules containing nickel, copper, cobalt, and manganese. Last year, we entered into an agreement with four international companies for a 5-year, $50 million research program, a study to determine whether the nodules can be mined on a commercial scale. In view of the high costs of developing the extremely complex technology needed to mine the deep ocean floor, it is imperative that private enterprise have some clear and early reading as to what legal jurisdictions will prevail.

Chairman BENTSEN. Let me ask you concerning that.

This rather exotic approach that we have been reading a lot about, and on which a lot of money is being spent, and the vast amount of minerals available on the deep sea floor, how close do you think we are to mining, in a way that is economic and feasible, some of these nodules on the floor of the ocean.

Mr. PRATT. I think it could be done this year commercially.

Chairman BENTSEN. At what depths?

Mr. PRATT. I am not sure what the depths are in the Pacific. It is very deep. From a technological standpoint the work that has to be done is significant. But I am not sure what the depth is exactly.

Chairman BENTSEN. Aren't we talking about vast new amounts of resources being available to this country through that process?

Mr. PRATT. Absolutely.

Chairman BENTSEN. This would be a great breakthrough; would it not?

Mr. PRATT. Very much so, not only to this country but to the world.

Chairman BENTSEN. All right, sir.

Mr. PRATT. These recommendations, both specific and general, relate to the longer term objective of increasing supply to keep pace with demand. They will not avoid the periodic short term shortages—or surpluses—which I described earlier, which derive from the play of elastic demand against inelastic supply.

One proposed solution to the cyclical shortage problem has been the creation of an economic stockpile. I would endorse that solution only with certain strong caveats. If the stockpile concept were employed in such a way that free market economics—especially with respect to pricing—were corrupted, then the scheme would only compound the problem. If the criteria for operation of the stockpile were to be predominantly political rather than economic, they would defeat its purpose. However, if the machinery of the stockpile could be operated objectively, with clear parameters and insulated from political pressure, it could be very helpful in traversing the crests and troughs of the market. The suggestion has been made that perhaps, in the light of the shortcomings of the stockpile concept in the past, there should be created an independent entity—perhaps a public corporation—which would administer its operations according to carefully delineated formula.

In closing, I should observe that the relatively encouraging picture I have drawn as to supply of copper is applicable, in varying degrees, to some other minerals—including molybdenum and lead. This picture is not, however, applicable to some other minerals. For example, the United States is totally dependent on foreign sources for chrome, and produces only 1 percent of the platinum it consumes.

To summarize, in regard to those minerals of which America has the resources, provided access to them is not frustrated, adequate supply is largely a matter of economics. Fundamentally, industry is responsible for responding to the economic forces at work in the marketplace. But, Government has a vital role to play. The Congress acknowledged this when it enacted the Mining and Minerals Policy Act of 1970, but there have been times when the forceful language of the Act seems to have faded in memory.

Again, I appreciate the opportunity to present those views, and would be pleased to answer any questions you might have.

Chairman BENTSEN. Thank you, Mr. Pratt.

[The prepared statement, with attachments, of Mr. Pratt follows:]

PREPARED STATEMENT OF ROBERT N. PRATT

I am Robert N. Pratt, president of Kennecott Sales Corporation which is the marketing arm of Kennecott Copper Corporation's Metal Mining Division. As you may know, Kennecott is the leading producer of copper in the United States, the number two producer of molybdenum and gold and an important source of silver, lead and zinc. Kennecott is also the largest domestic coal producer through its subsidiary, Peabody Coal Company, and a major supplier of high-quality iron and titanium slag through other interests.

Before commenting on the copper industry, I wish to say that I appreciate the opportunity to appear before the subcommittee and that I commend the subcommittee's decision to examine this area of the U.S. economic scene. Considering that primary metals alone account for some three percent of U.S. gross national product and that probably 75 percent of our GNP is affected by the minerals industries, it makes good sense for the Congress to examine from time to time the prospects for the nation's supply and demand.

Copper, like many other minerals, is a commodity produced and traded internationally. It is fungible, easily transported and tends to flow to the highest price available.

Outside the United States, copper prices are determined by a free auction system in which the London Metals Exchange plays a leading role. Here, prices for newly mined copper are established by domestic producers. These prices reflect world price considerations, but on the average have been somewhat lower than the LME price. Copper is a highly recycled metal—some 65 percent of all the copper ever produced is still in use. Thus, recycled copper plays an important role in pricing because the metal is reusable at low cost. In fact, secondary and scrap copper provides about 40 percent of total copper consumed in the United States.

I have presented this short description of our marketplace in order to make two points:

1. In discussing copper pricing it is important to realize that domestic producers do not have absolute control over their prices, and

2. In discussing demand and supply, it is important to realize that it must be considered on a worldwide basis, not on a U.S. basis alone.

Copper is a cyclical business in which relatively short-term shortages or surpluses occur due to various factors. Shortages can be caused by bursts in demand based on upswings in business activity. They can also be caused by production shortfalls. Production shortfalls can be caused by strikes, physical problems, acts of God, or political problems. Chile, for example, experienced a major falloff of production during the recent Allende regime. They can be caused, as I will relate shortly, by anti-pollution legislation.

These swings in demand and supply, as I have said, tend to be relatively short-term. Market forces correct them. But they are unavoidable.

Copper has been in short supply relative to demand during the past 18 months. Supply and demand are now about in equilibrium. It might be instructive to examine what happened. In 1971 and 1972, the free world experienced an apparent surplus of copper and prices were relatively low. Near the end of 1971 Chilean production began to fall off rapidly, Zambia experienced transportation problems due to a political dispute with a neighboring country, and in the U.S., air pollution regulations began to affect smelter production. Demand turned up in late 1972 as the U.S., European and Japanese economies heated up. In 1973, demand surged at double the historic 4½ percent growth rate of copper consumption.

World prices moved up dramatically reflecting this situation. U.S. prices, however, were restrained by price controls. As the price disparity grew, the availability of copper in the U.S. was seriously affected because copper exports rose as scrap metal flowed to the higher price. In recent months, as I have said, the situation has largely corrected itself. Chilean production has improved significantly and demand for copper has receded somewhat in several areas, particularly in Japan.

This rather typical, quite short-term experience should not lead anyone to presume that any permanent shortage is imminent. Our nation is blessed with abundant reserves despite dire forecasts one encounters from time to time. The Paley report of 1952 predicted that the U.S. would be out of copper in this decade. The 1971 Club of Rome study has predicted the same disaster on a worldwide scale in this century.

The fact is, the U.S. has been increasingly self-sufficient in copper over the years despite important growth in demand, decreasing ore grades and higher stripping ratios. Continuing technological advances in our industry have made this possible. Given sound U.S. Government policies, we believe the U.S. copper industry can continue this performance. My own company has proven reserves of more than 18 million tons of recoverable copper, enough to last some 40 years at current rates of extraction. This outlook does not include entirely new mining technologies such as undersea mining and in-situ mining which we and others are studying and which offer the opportunity to tap vast additional resources.

The U.S. copper industry has announced plans to expand capacity by about 25 percent during the next four years and still further expansion is under consideration. My own company will be announcing shortly important expansion of its capacity to come on line later in the decade.

It is fair to pause here and address a question we face on short-term copper shortages. We are asked why, since reserves are available, we cannot maintain a stand-by capacity for use during those periods when demand surges or production declines for unexpected reasons. The answer deals with one of the basic problems facing the industry. We estimate that the capital cost of an annual ton of copper productive capacity is $5,000. That is, in order to expand capacity by another 50,000 tons—or have it on stand-by—we must spend $250 million. Obviously, we cannot afford to have that much idle investment for periods of supply imbalance.

That $5,000 figure, by the way, has risen from $3,000 just since 1971.

In terms of copper supply, the huge capital investment requirement looms as a much larger problem for the nation than any danger of running out of mineral reserves. To illustrate, the Bureau of Mines estimates that domestic copper demand will increase by one million tons by 1985 and 3.3 million tons by 2000. One million multiplied by $5,000—that's today's dollars—equals $5 billion.

Our industry has produced a cash flow of $7.2 billion in the past 10 years but our total outlays—capital expenditures and dividends—were $8.5 billion. Our total long-term debt has increased 600 percent during that period—from $300 million to $1.7 billion. Thus, we have an extremely difficult capital generation and borrowing problem facing us if our country is to maintain its current level of copper self-sufficiency. The U.S. could rely more on imports but the consequences in terms of both the economy and the national security make that a doubtful alternative.

Greater reliance on foreign copper sources is not a necessary alternative, as I have indicated, provided Government does its part in establishing and maintaining a healthy environment for the industry.

Let me turn now to what I view the role of Government to be.

There need be no long-term shortage of copper and many other vital minerals if the Government would organize more effectively, and reorder and coordinate national priorities. For the Congress, this means resolution of the problems caused by designing—and sometimes enacting—legislation which singlemindedly serves one national interest at the expense of others which are equally or more important.

Congress has recognized the need for the continuing development and maintenance of a strong mineral supply in enactment of the Mining and Minerals Policy Act of 1970. Unanimously approved by the Senate, the Act declares that:

"It is the continuing policy of the Federal Government in the national interest to foster and encourage private enterprise in (1) the development of economically sound and stable domestic mining, minerals, metal and mineral reclamation industries, (2) the orderly and economic development of domestic mineral resources, reserves, and reclamation of metals and minerals to help assure satisfaction of industrial, security and environmental needs. . . ."

The intent of Congress was quite clear. Yet, in the 93d Congress, there has been a literal flood of legislation which is in clear conflict with the purpose of the Mining and Minerals Policy Act. Let me touch on just a few primary examples.

Recently the Senate approved the Eastern Wilderness Areas Act. The basic intent of the bill was to provide residents of the Eastern United States with recreational areas. Yet—save for amendment of the bill on the floor of the Senate—the Act would also have completely repealed the provisions in the Wilderness Act which permit mining entry and location in wilderness areas until 1983. The effect would have been to bar vast Western areas to mining exploration before any measure had been taken of the minerals potential of those areas.

In June, the House considered, but fortunately rejected, a major land use planning bill reported by the House Interior and Insular Affairs Committee. Again, the effect of the bill—if passed—could have been to preclude exploration and mining in vast areas of the country without any determination of the existence, extent, or value of minerals in those areas.

Still being debated in the House is the Surface Mining and Reclamation Act. Sections of the bill call for the designation of lands as unsuitable for surface mining of coal—and of other minerals such as copper. Once again, the effect would be to effectively seal off land from mineral development—regardless of the fact that the national interest requires that we locate and evaluate *all* our domestic mineral resources so that we can make informed judgments as to whether these minerals should be developed.

One final example. Amendment of the Clean Air Act continues to be a live issue in Congress. The "tunnel vision" which marks current administration of the Act by EPA has raised major future risks to necessary development of our mineral resources. Nebulous standards and the Agency's delay in approving state implementation plans, for example, are presenting copper smelters with a serious obstacle to planning and the commitment of investment capital essential to capacity expansion.

It is ironic that—while each of the legislative items I have cited poses major obstacles to fulfillment of the objectives set forth in the Mining and Minerals Policy Act—the intent of each piece of legislation is worthwhile and commendable. No one opposes improving the quality of the air we breathe. No one challenges the need to carefully plan the use of our land so that it will not be abused or wasted. No one objects to laws which will require that mined land be returned to a useful purpose after it has been mined. No one would argue against the provision of forest recreational areas for the public.

The problem lies in the way each of these pieces of legislation has been written, in the "tunnel vision" which marks the pursuit of one important national objective at the expense of others. Each of the pieces of legislation I have mentioned serves the goal of environmental preservation and would make that goal override all other pertinent national interests. The result is a critical imbalance which only serves to generate controversy, divisiveness, and delay in achievement of important national objectives—including mineral development.

Weighing every piece of legislation in relationship to its impact on *all* major national objectives is a task requiring Solomon-like judgment—but that is the traditional challenge posed to the Congress, that is what Government is for. The essential elements of objectivity, patience, and breadth of vision must be applied to proposed legislation which holds the promise of major impact—both immediate and long-range—on the nation's economy and society.

The Congress is certainly capable of such an approach, and of devising effective formulas to insure compliance with that approach. From the standpoint of adherence to the principles of the Mining and Minerals Policy Act, for example, Senator Pete Domenici has already proposed legislation (S. 3467) which would accomplish that purpose. Senator Domenici's bill would require each Federal agency and department to examine its operations to assure that they are consistent with the purposes of the Mining and Minerals Policy Act. His bill would require regular reports to the President and the Congress on the status of the domestic minerals industry so that problems could be identified and resolved. It is a thoughtful and carefully designed piece of legislation.

The principle embodied in the Domenici bill—that there should be assurance that new laws or policies do not unnecessarily or unwittingly pose obstacles to compliance with previously enacted laws—holds for *all* national objectives and policies. In considering any major legislation, Congress should review the entire current spectrum of vital national objectives and interests to ascertain that the proposed legislation is not contradictory.

I have referred to recent legislation which posed or poses obstacles to the development and maintenance of a healthy domestic minerals industry. Recognition and elimination of these obstacles is one necessary step toward assuring an adequate supply of minerals. But there is another vital step if Government is to follow the Minerals Policy Act's mandate to "foster and encourage" a healthy and expanding minerals industry. This is the establishment by Government of a positive economic climate.

One essential aspect of this positive economic climate is a tax structure designed to encourage expansion of domestic industrial capacity.

I am familiar with the testimony presented to this Subcommittee last month by Secretary of the Treasury William E. Simon and commend his direct and constructive comments on how national tax policy can be a major factor in generating the private capital essential to national economic growth.

I am in particular agreement with his comments that "we must avoid legislation and regulation that is punitive of profits honestly earned" and that more attention should be given to "new investment incentives for industry through the tax system." Since both Houses are once again reviewing the complex network of Federal tax laws, Mr. Simon's comments are particularly timely.

For the domestic minerals industry, tax laws designed to generate new capital and encourage investment are essential to the expansion of supply that is mandated by forecasts of future U.S. mineral demands. Let me make some specific comments on tax laws which are now being reviewed in the Congress.

Percentage depletion, as an incentive for mineral production, should be retained. The present rates set for copper and other hard-rock minerals should be retained if not increased. Since its first application to hard-rock minerals in 1932, percentage depletion has reflected the judgment of Congress that money which could be obtained by the public sector through taxes can better serve the public interest by remaining in the mining industry to be put to use in developing our vital raw material base. With the growing need for new domestic mineral productive capacity—and the increasing difficulty faced by hard-rock minerals producers in developing the necessary capital for expansion—percentage depletion represents a vital factor in attracting the additional capital.

Both the Asset Depreciation Range and the investment tax credit should be continued. Each has served to encourage increases in industrial capacity, thereby generating growth in jobs and real output. Repealing or limiting these measures would have a serious inflationary impact. Without them, the money market, already under intense pressure, would be confronted with still further demands for new capital which would, in turn, fuel increases in interest rates.

Continuation of the foreign tax credit is also essential. This recommendation may seem contradictory in the light of the industry's efforts to make the United States self-sufficient but when measured against the need for the industry to remain cost-competitive, it is not. American companies need to participate in low-cost foreign sources to be fully competitive with potential overseas suppliers to the American market.

The minimum tax should be eliminated. It reflects a hedging on the judgment of Congress in regard to percentage depletion and other tax incentives and is counterproductive to the objective of those incentives.

On the question of modifying capital gains tax provisions, I would support changes favoring investments which are held for longer periods. These would provide an incentive for private savings and the formation of capital which our industry needs.

Let me turn now to some broader suggestions, to some economic policies which, if implemented by Government, would contribute to assurance of a healthy domestic minerals supply.

First, there should be no continuation of economic controls in any form. Our experience during Phases I through IV has given us ample evidence of the mushrooming inflationary impact of such controls and the havoc they play with the traditional market forces of supply and demand. Congress has rejected extension of such controls and will, I trust, continue to do so.

Second, the national interest can best be served by the enhancement of free trade—by preserving access to foreign markets for *our* materials and to foreign sources for minerals we need, and by assuring the free flow of capital between nations.

Third, as a corollary to an effective trade policy, U.S. private investment abroad must be protected. Failure of the Government to assure such protection can only lead to curtailment of U.S. investment abroad with the economic and political disadvantages such curtailment would involve.

Fourth, as we move closer to the point where recovery of minerals from the deep sea floor will become economically feasible, it is essential that we resolve very soon the legal regime question regarding international deep waters. Over the past 10 years, Kennecott has invested tens of millions of dollars in development of technology for the recovery of deep sea nodules containing nickel, copper, cobalt, and manganese. Last year, we entered into an agreement with four international companies for a five-year, $50 million research program, a study to determine whether the nodules can be mined on a commercial scale. In view of the high costs of developing the extremely complex technology needed to mine the deep ocean floor, it is imperative that private enterprise have some clear and early reading as to what legal jurisdictions will prevail.

These recommendations, both specific and general, relate to the longer term objective of increasing supply to keep pace with demand. They will not avoid the periodic short-term shortages (or surpluses), which I described earlier, which derive from the play of elastic demand against inelastic supply.

One proposed solution to the cyclical shortage problem has been the creation of an economic stockpile. I would endorse that solution only with certain strong caveats. If the stockpile concept were employed in such a way that free market economics—especially with respect to pricing—were corrupted, then the scheme would only compound the problem. If the criteria for operation of the stockpile were to be predominantly political rather than economic, they would defeat its purpose. However, if the machinery of the stockpile could be operated objectively, with clear parameters and insulated from political pressure, it could be very helpful in traversing the crests and troughs of the market. The suggestion has been made that perhaps, in the light of the shortcomings of the stockpile concept in the past, there should be created an independent entity—perhaps a public corporation—which would administer its operations according to carefully delineated formulae.

In closing, I should observe that the relatively encouraging picture I have drawn as to supply of copper is applicable, in varying degrees, to some other minerals—including molybdenum and lead. This picture is not, however, applicable to some other minerals. For example, the United States is totally dependent on foreign sources for chrome, and produces only 1 percent of the platinum it consumes.

To summarize, in regard to those minerals of which America has the resources, provided access to them is not frustrated, adequate supply is largely a matter of economics. Fundamentally, industry is responsible for responding to the economic forces at work in the marketplace. But, Government has a vital role to play. The Congress acknowledged this when it enacted the Mining and Minerals Policy Act of 1970, but there have been times when the forceful language of the Act seems to have faded in memory.

Thank you for giving me the opportunity to present these views. I would be pleased to answer any questions you may have.

Attachments follow:

JUNE 7, 1974.

COPPER, PERCENTAGE DEPLETION AND THE PUBLIC INTEREST

Congress has consistently over the years recognized the significance of minerals to the security and the economy of the nation.

In the Mining and Minerals Policy Act of 1970, Congress declared:

"It is the continuing policy of the Federal Government in the national interest to foster and encourage private enterprise in (1) the development of economically sound and stable domestic mining, minerals, metal and mineral reclamation industries, (2) the orderly and economic development of domestic mineral resources, reserves, and reclamation of metals and minerals to help assure satisfaction of industrial, security and environmental needs. . . ."

The percentage depletion allowance represents the judgment of Congress that money which could be obtained by the public sector through taxes can better serve the public interest by remaining in the mining industry, where it can be put to use in helping to offset deterioration of our vital raw materials base. This tax incentive has been available to the hard rock mining industry since 1932, and has served well the purpose for which it is intended.

Percentage depletion is fully as important today to the domestic copper industry as it has been in the past, perhaps even more so. This statement has been prepared by eleven companies which account for over 98 percent of the country's primary copper production to support its retention and to explain how it works, why it is needed, and how it continues to work in the public interest.

The following companies have participated in this statement:

AMAX, Inc.
American Smelting and Refining Co.
The Anaconda Co.
Cities Service Co.
Copper Range Co.
Cyprus Mines Corp.
Duval Corp.
Inspiration Consolidated Copper Co.
Kennecott Copper Corp.
Newmont Mining Corp.
Phelps Dodge Corp.

COPPER, A SELF-SUFFICIENT RESOURCE

Copper is one of the key raw materials on which our nation's industrial and economic strength is founded. Its use is vital to the generation, transmission and use of electric power, to transportation, and to a wide range of other important industries. The United States is the world's largest producer of primary copper, and its largest user. In 1973, copper production from domestic mines accounted for 1,727,000 tons of the total free world mine production of 6,639,000 tons, and domestic consumption of refined copper, which includes some recycled scrap, accounted for 2,398,000 tons of free world consumption of 7,484,000 tons. The domestic copper mining industry has consistently been able to supply a high portion of the nation's requirements over the years, despite decreasing ore grades and increases in demand at a compound rate of about 3.5 percent per annum. The following table illustrates this, by examining three years: 1932 (when percentage depletion was first made available to copper mining), and twenty and forty years later:

UNITED STATES COPPER STATISTICS

[Thousands of short tons]

Year	Ore grade (Percent)	United States refined copper supply: From domestic ores: Tons	From domestic ores: Percent	From scrap: Tons	From scrap: Percent	From foreign ores and net refined imports: Tons	From foreign ores and net refined imports: Percent	Total: Tons	Total: Percent
1932	1.82	223	49.1	140	30.8	91	20.1	454	100
1952	.85	923	62.2	132	8.9	428	28.9	1,483	100
1972	.55	1,680	74.1	385	17.0	203	8.9	2,268	100

PERCENTAGE DEPLETION: ITS THEORY AND HOW IT WORKS

For a manufacturing company, the original cost of a productive facility, such as a machine or a factory, is a good indicator, apart from the effects of inflation, of what it will cost the company to replace that facility when its useful life has expired. The company is therefore allowed, under the tax laws, to depreciate the cost of the facility over the span of its useful life, or through accelerated depreciation (ADR) even more quickly, and so recover the funds required to purchase a replacement.

Original cost is not an adequate measure of what it may cost to find and develop a replacement for an exhausted mining property, as history indicates a clear trend of replacing exhausted mines with deposits which are more difficult to find and which—because of their lower grade or increased difficulty in handling, or both—are much more costly to operate. Percentage depletion works to provide a more realistic method of reflecting the reduction in value which occurs as a mine is exhausted, and so generate the capital necessary for replacement. Subject to certain limitations, percentage depletion permits mining companies to deduct a portion of their gross income each year while a mine is productive, thus attempting a fair approximation between the tax positions of extractive and nonextractive industries.

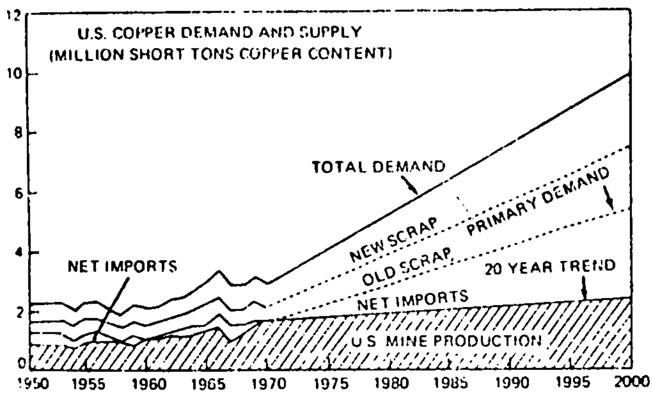
Percentage depletion for copper permits a deduction of 15 percent of the gross value of the product of each mine, but limited to a maximum of 50 percent of net income from that property. The Report of the House Committee on Ways and Means accompanying the Tax Reform Bill of 1969 noted that:

"(Y)our committee's bill provides for substantial reductions in percentage depletion rates for most items. However, some items—namely, gold, silver, oil shale, copper and iron ore—are to remain at the present 15 percent rate in the case of deposits in the United States. For these items, present depletion rates appear to provide a proper balance between the need to encourage exploration and the discovery of new reserves on the one hand and the revenue cost involved on the other hand."

Present and indicated future copper requirements make clear that this conclusion remains sound today.

THE NATION NEEDS MAJOR DEVELOPMENT OF NEW COPPER SOURCES

The following table is taken from the Final Report of the National Commission on Materials Policy (June 1973), and was prepared by the U.S. Bureau of Mines.



Net imports in 1972 and 1973 were less than predicted in the Bureau's table. The domestic copper industry's achievement in this respect must continue at an accelerated rate. The table indicates, based on historical demand and production growth rates, that very major expansion of production is required if we are not to be forced to increasingly heavy reliance on imports—domestic expansion on the order of one million tons of new productive capacity by 1985, and 3.3 million tons by the year 2000.

The alternative—to import copper in increasing proportion to our needs, up to over 55 percent of primary demand by the year 2000—is a prospect which should be avoided or at least minimized. Foreign consumption of copper is likely to increase at at least the same rate as our own, and probably more, and it is by no means clear that foreign production will be able to increase enough to handle the projected need. Secondly, the recent U.S. energy situation provides some very clear lessons on the dangers of becoming dependent on foreign countries for our vital raw materials.

The cutoff of Arab oil pointed up one of those dangers—that our dependence can be used by foreign countries to try to coerce us into reshaping our foreign policies to suit their ends. There are other drawbacks as well: our balance of payments, of course, is affected by increasing imports; radical shifts in the philosophies of foreign governments may result in sudden and unexpected interruptions of supply; price fixing and production control agreements among foreign producers could raise prices and decrease supplies available to us; and our national security can be compromised.

MINE DEVELOPMENT REQUIRES MASSIVE CAPITAL INVESTMENT

The mineral resources of this nation are among the greatest in the world. While present known reserves of copper are not nearly sufficent to accommodate an expansion of production of the magnitude indicated above, there is no reason to doubt that much additional copper can be discovered by exploration, and reliance on imports minimized. Whether or not it will be discovered and developed will depend in large measure on two things: first, on whether capital can be attracted to do the job and, second, on whether a sound government policy in support of mineral development can be established. Of these two conditions, the first should follow, if the second can be attained.

However, the capital requirements for the development of new production capacity are enormous. For example, Anamax Mining Company (a partnership between The Anaconda Company and AMAX, Inc.) is currently expanding its open pit copper mine at Twin Buttes, Arizona, to increase its annual production of copper from 75,000 tons to 130,000 tons. The cost of the expansion, a three-year project, will exceed $200 million, or over $3,650 per ton of additional annual production, before smelting and refining. Phelps Dodge Corporation is currently developing, in eastern Arizona, its new Metcalf mine, which is designed to produce 60,000 tons of copper annually. The estimated cost of Metcalf, by the time it is finished in 1975: $200 million, or $3,300 per ton of annual copper production, again before smelting and refining. (This, incidentally, represents an increase in cost of more than 50 percent in the six years since Phelps Dodge completed a similar mine at Tyrone, New Mexico.) A new Phelps Dodge smelter, being built in New Mexico to handle 100,000 tons of copper annually is also expected to cost on the order of $200 million, or $2,000 per annual ton of capacity, for smelting alone.

As recently as 1971, knowledgeable estimates placed the capital investment required to create new capacity for refined copper at around $3,000 for each annual ton of capacity. That figure is obviously much too low today, in part because of inflation and in part because of increased costs for pollution control. Because new mine development is in increasingly remote or difficult areas, or of increasingly lower grade ore, or both, costs will continue to rise. Perhaps $4,000 per annual ton of additional refined capacity would be a fair estimate today; if it is in error, it errs on the low side. Using that as a measure, the one million tons of new copper production required domestically by 1985 could require $4 billion in capital investment; the further investment to meet anticipated demand in 2000 would be $9 billion (in 1974 dollars, without escalation for inflation).

EARNINGS ARE NOT SUFFICIENT FOR NECESSARY CAPITAL DEVELOPMENT

In recent years the domestic mining industry has not had sufficient earnings or cash flow to generate internally the funds needed to meet their capital demands. Their long-term indebtedness has, as a result, increased markedly.

By way of illustration, in 1973 Phelps Dodge Corporation disbursed about $194 million for capital outlays and $45 million for dividends, or a total of $239 million. Its net income (excluding a gain on the sale of securities)—the second highest in its history—amounted to just over $100 million, or about 42 percent of those disbursements. Another $34 million was provided by depreciation and other noncash charges, leaving an amount roughly equal to its operating earnings—$100 million—which had to be borrowed. Its long-term debt has risen from zero in 1966 to $320 million in 1974, with more increases to come shortly, a trend typical of the copper industry.

Aggregating the figures for the companies participating in this paper (but excluding Cities Service Company and Duval Corporation, a wholly owned subsidiary of Pennzoil United, for lack of public information pertaining solely to their copper operations) indicates the following: their total capital expenditures (including mine development) and dividend disbursements aggregated about $5.2 billion for the five-year period 1969–1973 and $3.3 billion for the five-year period 1964–1968, compared to generated cash flow (net book income excluding extraordinary items, plus cost depletion and book depreciation) of about $4.0 billion and $3.2 billion, respectively. Thus, the shortfall in available capital for these nine copper mining companies, which had to be financed from sources other than cash earnings, aggregated $1.3 billion during the ten-year period, substantially all of it sustained over the last half of the period.

This capital shortfall was covered by increased borrowing by the copper companies. Long term debt has increased almost sixfold during the past decade, from

$.3 billion in 1964 to $1.7 billion in 1973. If this trend continues, the industry's borrowing power will be exhausted long before the enormous capital requirements for expanded production can be met.

This trend toward diminished borrowing power is aggravated by increasing competition for available capital. The demands of all U.S. industry for debt and equity capital between now and 1985 are generally expected to exceed domestic capital sources.

Equity financing is not an appropriate alternative for the copper industry. Metal mining stocks traditionally sell at low price-earnings ratios. Moreover, the composite market value of the nine copper companies' stocks for the most recent month (May, 1974) was 24 percent lower than the comparable figure for the year 1968.

It is clear that government policy to enhance domestic copper supply should increase, rather than hinder, the copper industry's ability to generate greater earnings and to attract needed additional capital. The percentage depletion allowance is a vital element of such a policy.

PERCENTAGE DEPLETION IS AN IMPORTANT HELP

Percentage depletion allowances for the companies participating in this statement (again excluding Cities Service and Duval) totaled approximately $220 million in 1972 and $290 million in 1973. Tax benefits accruing to them from these allowances were approximately $105 million in 1972 and $140 million in 1973. Tax benefits of this order of magnitude, therefore, could yield about a third of the capital funds needed for the new production that will be required by 1985.

Percentage depletion is, obviously, a very major factor in the domestic copper mining industry's ability to meet projected demand; the industry will still, however, be faced with the need to generate, or borrow, very large additional capital funds. In this regard, percentage depletion has an important secondary role: because it has the effect of increasing stockholder equity as reflected on a company's balance sheet, it also increases the amount of capital which that company will be able to borrow.

THE PERCENTAGE DEPLETION ALLOWANCE HAS BEEN PROPERLY USED IN THE COPPER INDUSTRY

The special complexities of the current oil situation, with the resulting emotionally charged public view of energy shortages, have triggered Congressional consideration of a broad range of new legislation, including elimination of percentage depletion for oil.

It is not within the scope of this paper, or indeed, within the competence of most of the participating companies, to comment on this complex matter, except that our companies:

(1) Are energy users, and as such urge that any legislative action concerning oil reflect the real need to encourage development of energy resources, including oil, and

(2) Are concerned that any legislation stemming from the oil situation should not affect the tax treatment of metal mining, which has problems and needs that are substantially different from those of oil.

The copper mining industry has not only a very real need for the funds generated through percentage depletion, but its record of its past use of capital makes clear that there has been no abuse of those funds. The major capital investments of the domestic mining companies over at least the past five years have been for either maintenance or expansion or capacity or for pollution control (the job of bringing the country's copper smelters into compliance with air quality laws will, by the time it has been completed, have incurred aggregate capital expenditures in excess of $700 million); to the extent that they have diversified operations, that diversification has been largely to add different minerals to their product mix (e.g., Phelps Dodge's uranium activities, AMAX's diversification into domestic copper, Kennecott's into coal).

Moreover, the public concern that corporations are escaping taxes and getting rich, at the public's expense, cannot properly be raised with respect to the copper mining industry. The companies participating in this statement (again omitting Cities Service and Duval) had, for example, an effective federal tax rate (both current and deferred) of 26 percent in 1973. And, as indicated earlier, the copper companies' profits during the past ten years have not been sufficient to support the level of investment needed to meet the nation's requirements for copper.

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For many reasons, the use of limited partnership arrangements, which has successfully raised much risk capital for exploration for oil, has ordinarily not been feasible for metal mining. The low ratio of success in hard rock exploration, the high cost of development, and the length of time before profit realization are among the more important distinctions. The result cuts both ways: hard rock percentage depletion has not been used as a tax shelter for wealthy individuals, but on the other hand the mining industry has not enjoyed access to that particular source of risk capital.

ANOTHER IMPORTANT CONSIDERATION

Copper is a freely traded international commodity, prices of which are determined by worldwide supply and demand. The United States produces less than 30 percent of free world copper and, because copper can be moved around the world for shipping costs which are relatively low (less than 5 percent of current prices), copper prices in this country are limited by the prices at which the other 70 percent is sold. The domestic copper industry, therefore, would be largely precluded from offsetting any loss of percentage depletion by raising prices. If foreign sources and auction markets should move during any substantial period, as they have in the past, to lower copper prices than the U.S. market would otherwise support, then even though U.S. producers have the cost-saving benefit of percentage depletion, the earnings and financial strength of U.S. copper producers and their ability to meet expanding national requirements would be even more seriously eroded.

SUMMARY AND CONCLUSIONS

1. Over the years, the United States has become virtually self-sufficient in copper production—a position which, given copper's importance to the economy as a raw material, warrants maintaining.
2. Projections of domestic copper demand indicate that, if the country is to be no more reliant on imports than it is today, domestic mine production must increase by the order of 1 million tons, or almost 60 percent, by 1985, and by 3,300,000 tons—nearly 200 percent—by 2000.
3. The capital needed for such an expansion is very great—on the order of $4 billion by 1985 and $9 billion more by 2000 (in 1974 dollars, without escalation for inflation).
4. The copper mining companies do not enjoy earnings of the magnitude needed to provide that capital internally, and their debt position has increased markedly over the past several years.
5. It is therefore important, if the nation's need for increased copper production is to be met, that the copper industry be better able to generate captial.
6. A policy which encourages capital formation in the copper industry is in the general public interest; percentage depletion is such a policy, and is an important aid to the industry, with a proven record of success.
7. Percentage depletion for copper, accordingly, should be maintained. Recommendation 4B.6 of the National Commission on Materials Policy is as valid today as when it was made in June 1973:

"We recommend that:

4B.6 . . . the Congress continue the percentage depletion provisions of our tax laws as a time-tested major incentive to discovery and development of mineral resources. These provisions should not be further reduced unless and until a better incentive system can be developed."

AMAX, INC.
AMERICAN SMELTING AND REFINING COMPANY.
THE ANACONDA COMPANY.
CITIES SERVICE COMPANY.
COPPER RANGE COMPANY.
CYPRUS MINES CORPORATION.
DUVAL CORPORATION.
INSPIRATION CONSOLIDATED COPPER COMPANY.
KENNECOTT COPPER CORPORATION.
NEWMONT MINING CORPORATION.
PHELPS DODGE CORPORATION.

STATEMENT OF MARNE A. DUBS, CHAIRMAN, COMMITTEE ON UNDERSEA MINERAL RESOURCES, AMERICAN MINING CONGRESS, WASHINGTON, D.C.

Mr. Chairman: My name is Marne A. Dubs and I am Director of the Ocean Resources Department of the Kennecott Copper Corporation. I am here as the representative of the American Mining Congress in my capacity as Chairman of the Committee on Undersea Mineral Resources. However, my statement also reflects the views of both Kennecott Copper Corporation and myself.

The American Mining Congress is a trade association, composed of U.S. companies who produce most of the nation's metals, coal and industrial and agricultural minerals. It also represents more than 220 companies who manufacture mining, milling, and processing equipment and supplies, and commercial banks and other institutions serving the mineral industry and the financial community.

The American Mining Congress very much appreciates the opportunity to testify today before the Subcommittee on Minerals, Materials and Fuels on S. 11,34, Amdt. 946, the "Deep Seabed Hard Mineral Resources Act."

Our previous testimony on the predecessor bills S. 1134 and the earlier S. 2801 stressed the importance of promoting the development of the hard mineral resources of the deep seabed, explained the merit of S. 1134 for the accomplishment of that purpose, and presented our views on the outlook for a timely and successful conclusion of the upcoming Law of the Sea Conference now scheduled this summer in Caracas.

We argued—we hope persuasively—that the United States could no longer defer taking positive action through such domestic legislation as S. 1134 in the hopes of an early satisfactory international treaty. We also maintained that, contrary to the statements of the administration, the passage of domestic legislation would not adversely affect the international negotiations but might in fact be helpful. Our views have not changed and we will not be repetitive on this subject.

The importance of promoting the development of the hard mineral resources of the deep seabed has been strongly affirmed by recent events relating to the supply of petroleum and by the obviously increasing efforts of foreign raw material suppliers of all kinds to organize themselves so as to control the availability and price of minerals to the detriment of the United States. Again it does not appear necessary to repeat our views in detail.

Except as the Committee may raise questions on these foregoing basic topics, we will confine our testimony to the provisions of S. 1134, Amdt. 946. Our point of view is to examine these provisions as to whether they in fact meet the chief purpose of the bill to promote the orderly development of the hard mineral resources of the deep seabed.

In our oral testimony we will devote our efforts to very few significant points which we believe require further consideration. We have also a number of detailed comments, including suggestions for minor changes in language, which we have incorporated in a detailed appendix to be attached to our written text. This appendix is not yet completed but will be available shortly. We request that this detailed appendix be included in the record of the hearings.

We appreciate the effort and skill which went into the amendment of S. 1134. The Committee Staff appears to have done an excellent job of solving old problems and in addition has more clearly focused our own attention on them. The resulting S. 1134, Amdt. 946 indeed seeks a middle ground between positions previously taken on the legislation and it would seem certain that it can serve as the basis for achieving a bill which will promote seabed resource development and at the same time allay some of the feas expressed by others regarding possible adverse effects on international negotiations. However, it would be a travesty if, as we believe it might well occur, the opponents of the bill would continue to unalterably oppose even such a mild conciliatory version as Amdt. 946. In fact, this opposition has continued in the testimony by the Executive Branch of yesterday. It must then be recognized that the opponents will sacrifice resource development, in spite of the demonstrated developing crises in resource availability, for the chimera of an ever receding law of the sea treaty. In that event it would appear that the final revisions to S. 1134 should more strongly emphasize resource interests and we should not be unduly swayed by those who would thwart the bill's major purpose—promoting deep seabed resource development.

There are a number of basic differences between S. 1134 and Amdt. 946 which we would like to note and comment on. These are:

1. Elimination of the subsurface block concept and a narrowing of the definition of hard mineral.
2. Elimination of the escrow fund concept.
3. Inclusion of a moratorium on commercial recovery before January 1, 1976.
4. Elimination of the reciprocating states concept.

We will discuss these points in the above order.

The elimination of the subsurface block concept and the narrowing of the definition of hard mineral is supported by us without reservation. These changes effectively make the bill read only on manganese modules, the only identified potentially exploitable resource in the deep ocean bed today. Since the bill itself is an interim arrangement, there wou'd appear to be no reason today to include all potential seabed minerals. However, the progress of science and technology is rapid and if later discoveries outpace the usual slow march of political accommodation, then it may become necessary at some future date to amend the bill to include other minerals. However, for this time a very narrow scope for the bill appears appropriate and internationally more acceptable.

The elimination of the escrow fund concept appears perfectly acceptable to us. We supported the concept in the original bill since it seemed to be indicated by the President's May 1970 policy statement on the oceans. However, we believe that its elimination does reduce possible conflicts with law of the sea negotiators.

We look upon inclusion of a moratorium on commercial recovery before January 1, 1976, with mixed views. On very pragmatic grounds we agree that actual commercial recovery of nodules from the ocean is unlikely to occur before January 1, 1976. However, such exploitation is not impossible. As I have stated at various times in the past, the Summa mining ship, now undergoing what appears to be final tests, could be successfully mining in a short time. The metallurgical processes are essentially ready and waiting. We of course do not know what is transpiring in other parts of the world and it is possible that the same potential may exist or will shortly arise elsewhere. Thus this moratorium—a moratorium very nearly as restrictive for the U.S. entrepreneur as the resisted UN moratorium—may in fact serve to hold back U.S. exploitation and not that by others. The UN moratorium resolution says in part "Declares that, pending the establishment of the aforementioned international regime: (a) States and persons, physical or juridical, are bound to refrain from all activities of exploitation of the resources of the area of the sea-bed and ocean floor, and the subsoil thereof beyond the limits of national jurisdiction;". It clearly will be a deterrent to other capable companies entering the field and they have expressed this view strongly. On balance we believe we can reluctantly accept the moratorium in a spirit of compromise and in recognition of the fears of our law of the sea negotiators. However, we would urge that you not lightly include this provision and particularly that you reexamine this issue a final time in light of both technological and political developments.

The elimination of the reciprocating state concept is a more serious matter and we strongly urge the retention of this principle. It is this principle more than any other which operates "to promote the conservation and orderly development of hard mineral resources of the deep seabed." This principle tells all nations that the United States intends to cooperate with and take into account the operations of other nations. It states that the Congress of the United States, while passing what may appear to some to be narrowly nationalistic legislation, has in fact mandated a method of easily adjusting to the needs of other nations also anxious to utilize the resources of the deep seabed. It is a principle which will serve notice that the United States will welcome working side by side with all nations in a peaceful and orderly manner in the development of seabed resources pending accomplishment of the difficult task of hammering out a universal international regime.

The reciprocating state principle makes it easy for other nations to follow our lead and adopt sensible provisions for orderly development and for protection of the marine environment. It is quite clear that other developed states are and will be proceeding with deep seabed hard mineral resource development. The United States has been a leader technologically and scientifically in seabed resource studies. Our scientists have considered the environmental questions of mining; our geologists know the character of the ore deposits; our engineers understand the requirements of the ocean mining systems. This knowledge is applied in S. 1134, Amdt. 946 and will certainly be utilized in the administration of the act. The reciprocating state concept should help ensure that sound principles are used by all who may actually carry out seabed resource development in the interim period.

It should be quite clear to all that the potential for damages which is the subject of Section 14 of the bill, "Investment Insurance," primarily rests in the acts of other developed states interested themselves in ocean mining. It is equally clear that the chances of disputes arising rests in the acts of these same states. The reciprocating state provision can thus diminish the chances of damages and disputes to a very low value and brings a stability of investment climate which should nurture most effectively the winning of the hard mineral resources of the deep seabed.

The probability of relationships—similar to those of reciprocating state concept—arising is very high even if the bill is silent on the subject. However, the time required to accept the need and then accomplish the task is apt to be prolonged unless the mandate is provided in the bill. One can easily imagine a State Department so wrapped up in their pursuit of the perfect universal international agreement that they will never find the time to do what obviously must be done with respect to this problem. During such a potentially lengthy time problems may well arise which could have been avoided by tackling the question at the very beginning.

Professor Dean Rusk said in hearings on House Resolution 216:

"We face the possibility, if I may use the phrase in these halls, of a filibuster by the developing countries which might unfortunately postpone indefinitely a generally agreed international regime with respect to the resources of international seas. I personally feel that the long-range outlook for vital resources is so serious that we should make it clear that an indefinite postponement is not acceptable. *Perhaps the dozen or more countries who are now developing the technology for such exploitation should, in that event, get together and make their own arrangements among themselves with due regard for the legitimate interests of the developing countries.*" (Emphasis Supplied) Professor Rusk clearly appreciated the probable need for a concept like reciprocating states and the need for an interim regime.

In summary we urge the reinsertion of the reciprocating state concept into S. 1134. We believe it an essential point to achieve the basic purposes of the bill.

One of the potential defects of the original S. 1134 from both the viewpoints of the guardians of the public interest and those of the resource developers was the generality and non-specificity of the regulatory provisions of that bill. This problem has been largely overcome in the redrafting which produced Amdt. 946 to the benefit of both interests cited above. However, we believe some further improvement can be made which will lessen the possibility of long bureaucratic delays, reduce the freedom of the bureaucrat to make discretionary decisions not mandated by the act, and which will at the same time preserve the greater clarity of detail in the redrafted bill.

One basic problem we see is that the Secretary appears to be empowered to make numerous discretionary decisions at the granting of each license. For example, Section 5(d) of the bill says "The Secretary is authorized to include in any license issued, or transferred, under this Act, any reasonable conditions which he finds necessary to carry out the purposes of this Act. Such conditions shall include, but need not be limited to—" The quoted portion is followed by a list of four major items. We suggest that it would be an improvement to eliminate all such discretionary open-ended powers and have such critical decisions as license conditions circumscribed by rules and regulations promulgated in advance by standard government administrative procedure as described in 5 USC 553.

We would at the same time then recommend strengthening Section 16 of the bill which provides for regulatory authority. We would suggest changing the wording of the present one-sentence paragraph in Section 16 by replacing the phrase "as he may deem necessary and appropriate" to "as may be necessary to carry out the provisions of this act." It would then be necessary to spell out the items for which the Secretary should promulgate rules and regulations. In our view these would include:

1. Eligibility of applicants for license.
2. Licensing procedures (Mechanics).
3. Procedures relating to work requirements.
4. Environmental procedures.
5. Multiple use questions.
6. Definition and handling of and reporting of data.

We are most conscious of the long delays which have been encountered in the past in the promulgation of regulations. A well-known example is the unconscionably long delay in the promulgation of regulations under the Outer Continental Shelf Lands Act for hard mineral leasing. Therefore, we suggest that a statutory reasonable time limit be imposed not to exceed ninety days.

A second problem we note with great concern is the proposed administrative procedure for each license which with the inclusion of public hearings would indicate a minimum of seven months for the issuance of each license. This is a very much longer time than we could possibly conceive of as necessary (our estimate would be less than 60 days). However, a real question is the necessity of public hearings on each license in order to meet the basic purposes of the act. We believe that the rule-making stage would in this case be completely adequate for public input and that, as long as a license application meets the promulgated in advance regulations, additional public hearings should not be required for each license application. The geography, geology, and technology of nodule deposits and mining (we must recall that the scope of this bill is now severely limited to nodules only) are such that there will be only minor differences, if any, from license to license. Thus new hearings for each license do not appear to have a sound regulatory basis.

Because of the importance of environmental matters, we note especially Item 4 in the above list, "Environmental procedures." Environmental criteria are covered in Section 7 of the bill as well as being noted in Section 5(d). We believe it is important to clearly delineate environmental criteria in the rules and regulations. However, it is our belief, based on the uniformity of manganese nodule domains and permissible mining methods, that the environmental conditions will not change from license to license. Thus rules and regulations can be promulgated in advance which will provide both necessary protections and a clear understanding of the rules the operator must follow before he undertakes any study of nodules. Obviously, the rules and regulations can be drafted so as to preclude the introduction of radically new technology such as metallurgical processing at sea—not now to my knowledge contemplated by any operator—without amendment of the rules and regulations with the attendant public hearings under 5 USC 553. It is noted that Section 7 could be interpreted in the above fashion but also could be interpreted as calling for the establishment of environmental criteria for each license. It is presumed that the former interpretation was intended.

Because of its importance we wish to comment briefly on the data provisions of the bill. We appreciate the desire of the resource managers to have data which they can use in the formulation of policy. We appreciate the need for certain specific and rather limited data to ascertain whether the licensee is meeting the license conditions as were set out on the basis of previously promulgated rules and regulations. The Committee certainly understands well the need to protect technical and financial information bearing on the ability of the licensee to compete. However, greater care will have to be taken with respect to the public availability of data. It is not only a question of the U.S. public, who will be regulated by this bill, being informed, but it is a case of the entire world being informed. This bill does not and cannot regulate the world. This bill should not be the mechanism for the free transfer of exploration data and mineral technology to the whole world. Perhaps I can illustrate by an example. Under Section 6(b)(1) the application for a license must specify the block applied for; under Section 6(c) it would appear that the location of that block must be published. This is one of the most valuable pieces of information that the United States and the licensee has. It is a passport to the rest of the world to know where to explore and where perhaps to establish rival claims while the applicant may be in an early stage of his work. The situation is of course greatly mitigated by the reciprocating state concept which should be established as early as possible. However, as things stand, there must be a clearer understanding of the need to protect such vital information. We would propose to restrict the flow of such information as much as possible.

Nevertheless we perceive the need for Congress and the public to be informed on the progress of ocean resource development. We would propose that the act contain a new provision for the Secretary to make an annual report on this subject. This report could describe in some detail what has occurred but at the same time restrict the world-wide broadcast of vital information. Particular attention could be paid in this report to environmental matters, general geographical parameters, and resource evaluation. I am sure that Congress will have additional views on the content of such a report.

Time does not permit discussion of more than these few very significant items. The appendix to this statement will cover such items as the term of the license before commercial recovery (proposes keeping 15 years), the term of the license during commercial recovery (proposes for as long as recovery continues but would limit guarantee period), the limitation in Section 10(a)(3) of the number of blocks (proposes removing this limitation), and a number of other small but important items.

Again I express our gratitude for the opportunity to make this statement regarding the provisions of S. 1134, Amdt. 946. This completely redrafted version of S. 1134 has stimulated us to examine the details of the legislation and in some cases to depart somewhat from positions we had previously advocated. We believe that the dialogue on this bill can lead us quickly toward final legislation which will serve the national interest by promoting development of the resources of the deep seabed.

We request that you seriously consider our suggestions—as you have always done—and move quickly to pass, with these slight modifications, S. 1134, Amdt. 946 into law.

Thank you, Mr. Chairman.

KENNECOTT COPPER CORP., NEWS RELEASE

McGill, Nev., July 16.—Kennecott Copper Corporation today filed a Citizen's Suit against the U.S. Environmental Protection Agency to require it to adhere to the Clean Air Act of 1970.

The Act requires the EPA to approve clean air implementation plans submitted by states or to issue substitute regulations within six months after disapproval. In May, 1972, the Agency disapproved the Nevada state plan relating to Kennecott's copper smelter here.

W. H. Winn, General Manager of the Company's Nevada Mines Division, said Kennecott representatives had met several times with EPA officials in the months following the turndown in an attempt to work out a solution.

"But, nothing was done," he said. "We are very disappointed with this latest delay in implementing a clean air plan for Nevada."

The Company filed its suit in U.S. District Court for the District of Columbia after advising the Agency on May 8 that it would take legal action if the Agency failed to act on the Nevada plan.

Kennecott also reported on May 8 that it has embarked on a $24-million construction program at the smelter that the company feels confident will enable it to meet the provisions of the Clean Air Act and the even stricter Nevada regulations.

However, Winn noted, the Company only has until mid-1976 to complete the work, including the construction of a complex acid plant to treat sulfur oxide gases. "Because we are rapidly running out of time," he said, "we must find some way to compel the EPA to set the ground rules for compliance. Hence, the suit."

The Company in June received from the EPA a one-year extension of a requirement that Kennecott meet Federal air quality standards by mid-1975. That extension was granted by an administrative law judge after a public hearing in nearby Ely, Nev., in March.

BEFORE THE ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, D.C.

(Prior Notice of Citizen Suit To Be Brought by Kennecott Copper Corporation)

Pursuant to Section 304(b) of the Clean Air Act and the EPA regulations issued pursuant thereto in 40 C.F.R. § 54, Kennecott Copper Corporation, 161 East 42nd Street, New York, New York, 10017, hereby gives notice regarding failure of the Administrator to perform acts or duties which are not discretionary under Section 110 of the Act.

This section of the Act requires that the Administrator either (1) approve a State Implementation Plan meeting certain requirements or (2) promulgate a substitute plan "within six months after the date required for submission of such plan." The Administrator has failed to perform either duty with respect to certain portions of the implementation plan of the State of Nevada applicable to the copper smelter operated by Kennecott at McGill, Nevada, The Administrator's failure has confused and delayed Kennecott's efforts to bring the McGill smelter into compliance with the Federal Ambient Air Quality Standards. In order to permit Kennecott to achieve such compliance as promptly as possible, the Administrator is requested either to (1) approve the Nevada State Implementation Plan as submitted on January 28, 1972, or (2) promulgate substitute provisions for the state regulations applicable to Kennecott's facility disapproved by the Administrator on May 31, 1972. In explanation of this notice and request, Kennecott submits the following:

1. Kennecott has submitted a plan for meeting the federal ambient air quality standards at its Nevada smelter. This plan, submitted to the State of Nevada at public hearings in 1971, provides for equipping the smelter with the best available control technology for copper smelters, which is an acid plant (and related hooding, ducting, etc.) for converting SO_2 into sulfuric acid. The plan further provides for construction of a new, taller stack and a supplementary control system to insure reduction of ambient air concentrations in the vicinity of the smelter to the levels necessary to meet both state and federal ambient air quality requirements. Control of particulate emissions to meet such standards will also be provided by means of electrostatic precipitators.

2. EPA approved this plan on May 31, 1972, as meeting primary (human health) ambient air quality standards, but (1) disapproved the plan as to secondary (public welfare) ambient air quality standards, stating that a substitute plan would be promulgated by July 1973, and (2) proposed to subject Kennecott's smelter plume to an opacity limitation. The EPA "Evaluation Report for Air Quality Implementation Plan for the State of Nevada" said (at p. 3) that "59% control [of Kennecott's smelter emissions of SO_2] is needed to achieve the primary standards and 54% control is needed to achieve the annual secondary standard [since revoked, 38 Fed. Reg. 25678 (September 14, 1973)] based on measured air quality data."[1] However, EPA diffusion modeling was said (at p. 4) to indicate a need of 98.6% control to meet the primaries and 99% control to meet the secondary three-hour standard. The report questioned these diffusion model results (at p. 4) and concluded (at p. 5):

> "* * * Since the plan provides for control equivalent to best available control technology, it is recommended that the Administrator approve Nevada's plan for attainment and maintenance of the primary sulfur oxides standards in the Nevada Intrastate Region.
>
> "Since the diffusion model indicates that considerably more control will be needed than can be achieved by the application of reasonably available control technology, it is recommended that the Administrator disapprove Nevada's plan for the attainment and maintenance of the secondary standards and that an 18-month extension be granted to allow time for the developmet of a plan to achieve the secondary standards. This extension is justified since all requirements of 40CFR51.31 are met. The extension is further justified by the inadequate data base available on which to base a control strategy for the secondary standards. EPA will use the extension period to collect air quality data in areas of maximum concentration as predicted by the model. Based on the new measured data, a plan to attain and maintain the secondary standard will be submitted by July 1973."

An attachment to the report, under the heading "Source surveillance," further recommended disapproval of a Nevada provision exempting copper smelters from visible emission limitations, saying that "Since mass emission limitations for copper smelters are part of Nevada's control strategies for sulfur oxides and particulate matter, enforcement of applicable emission limitations is necessary for detecting violations of rules and regulations." (Attachment 4, p. 2). Following this recommendation, the Administrator proposed an opacity limitation on visible emissions from Kennecott's smelter. 37 Fed. Reg. 15106 (July 27, 1972).

3. EPA held hearings in Nevada on August 31, 1972, at which Kennecott objected to the 18-month extension and the proposed opacity limitation and explained why these EPA actions were erroneous and prevented construction of the air pollution controls planned for the smelter. At the EPA hearings Kennecott presented extensive oral and written evidence demonstrating that (1) the plan

[1] Data for the 3-hour secondary standard were reported not available.

for its Nevada smelter that had been approved by the State and by the EPA for meeting the primary ambient air quality standards would in fact also meet the federal secondary ambient air quality standards, (2) the diffusion modeling that the EPA had relied on to reach a contrary conclusion was grossly erroneous when applied to the McGill smelter, and (3) the proposed opacity limitation on visible emissions was unnecessary, unworkable, unrelated to its stated purpose, and unlawful.

More importantly, Kennecott explained why the EPA's actions made it impossible for the company to proceed with construction of the needed air pollution controls for its Nevada smelter. No one could know what ultimately might be required to meet the secondary standards, in the EPA's view, at the end of 18 months' study, and no one knows how to meet the proposed opacity standard. One think was known: the next step beyond Kennecott's compliance plan that had been approved by the State and aproved by EPA for meeting the primary standards was not the expenditure of just a few more dollars but, rather, construction of a whole new smelting system—a fact recognized by the EPA which granted two-year extensions to meet the primary standards for all copper smelters in other states where measured air quality data or diffusion model results indicated that the "reasonably available control technology" of acid plants would be insufficient to meet the primary standards. (37 Fed. Reg. 15094, July 27, 1972).[2] What the EPA was telling Kennecott, then, was that if Kennecott went ahead with its compliance plan, which involved a $24 million construction program, it might all have to be scrapped because it still could not meet the secondary standards, a question to be decided some eighteen months later, and it could not meet the proposed opacity limitation.

At that point Kennecott was stymied. It had long since been determined that Kennecott's Nevada property, which had been mined for sixty years, no longer bore sufficient quantity and quality of ore to support the substantial investment that would be required to install a new smelting process. It would barely support the additional investment required for the compliance plan that had been approved by the State. These facts had been made clear to the State in its hearings and were made clear to the EPA in its hearings. The alternative to acceptance of the State Plan was to close down the operation, and Kennecott could not afford to invest $24 million in new construction under the State Plan without knowing whether, in the end, it would be wasted because EPA would decide Kennecott could not meet the secondaries or the proposed opacity limitation.

4. Informal efforts have failed to resolve the impasse. Numerous meetings with EPA officials have failed to produce any action that would permit Kennecott to know where it stands so that it can proceed with its construction program without risking loss of $24 million. The proposed opacity limitation has neither been promulgated nor withdrawn. The secondary standard question to be answered by July 1973, has not been resolved either by approval of the State Implementation Plan or promulgation of a substitute EPA plan. Meanwhile, the statutory deadline for meeting the primary standards at Kennecott's Nevada smelter is coming closer and even though a one-year extension of that deadline has been sought and hopefully will be granted, the lead time required for Kennecott's construction program requires action now if the construction is to be completed by the time the primary standards are to be met.

CONCLUSION

It is time and past for the Administrator to cut through the red tape and confusion which have surrounded the Nevada problem and prevented Kennecott from getting on with the job of cleaning up the air in the vicinity of its smelter. Accordingly the Administrator should now

1. Either withdraw the proposed opacity limitation for Kennecott's Nevada smelter (and the related disapproval of the Nevada State Implementation Plan regulation on this subject excepting copper smelters from opacity limitations) or promulgate it so that it can be appealed to the courts.

2. Either withdraw the disapproval of the Nevada State Implementation Plan for copper smelters insofar as secondary standards are concerned or promulgate a substitute plan as required by Section 110 of the Clean Air Act.

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[2] Kennecott has smelters in two states for which such extensions were granted, Arizona and Utah. In neither state was the extension requested by the Governor, but in both the compliance date for primary standards is now July 31, 1977.

Continued inaction and indecision by EPA on these matters is contrary to the law and is delaying implementation of Kennecott's program to improve the environment.

Respectfully submitted.

ALFRED V. J. PRATHER,
Attorney for Kennecott Copper Corporation.

Chairman BENTSEN. I notice in your group of taxes that you talked about you say nothing about deferment of taxes on foreign subsidiaries, corporation earnings. How do you feel about that?

Mr. PRATT. We do have a DISC corporation which we have utilized. And I would say today, in either direction Congress decided to go we would not take a strong position against. We sell a very small amount of our production overseas.

Chairman BENTSEN. It seems to me that the DISC Corp. is being abused substantially. I don't know how much it has actually increased exports and how much it is just a paper situation where some of the companies have set up a DISC corporation. With that in mind, if we are trying to encourage small and medium-sized companies to get into foreign operations, maybe what we ought to do is put a limitation on earnings of DISC corporations, and once they get above a certain limit, they lose their tax deferral. That wouldn't help you at all, I understand that.

Mr. PRATT. That would depend on the company surely. But one of the things that Congress should be doing, on the other hand, when you look at the competition that we meet on a worldwide basis [both as companies and as a Nation] and the support that foreign governments give the companies in their countries, we should be taking another look at the Webb-Pomerene Act, for instance, and doing more to support many of our companies in their export business.

BENTSEN ATTACKS U.S. SUBSIDIES OF EXPORT-IMPORT BANK LOANS

Chairman BENTSEN. It seems to me that we are giving a lot of support when we make 6- and 7-percent loans from the Export-Import Bank to companies that are moving in many instances products that are in short supply in this country, to sell them to foreign countries. And I frankly very strongly disagree with that.

When I find people in this country have to pay 12 and 12½ percent prime rates, and then to have my tax dollars, and the people's tax dollars, used to subsidize loans to send products overseas, I find that a little difficult to justify. Then I see things like the AID program that are in fact subsidizing loans for middle income Latin Americans when we are finding it very difficult for middle income U.S. citizens, to buy homes in this country, because of the escalation of prices.

Let me ask you another one on the foreign tax credit. I can understand reasons for the foreign tax credit, so you are not double taxed. But I have some concern about the foreign tax credits being utilized on the option of a country-by-country basis as opposed to pooling all of those countries together. It seems that some advantage is being taken of the Treasury in that regard.

Mr. PRATT. I think we may have prevented this. And I think, in looking at Mr. Simon's testimony before this subcommittee, that one of the most important things here is that we should have a fair tax for income that has been honestly earned.

U.S. AND WORLD COPPER PRICES ABOUT THE SAME—EFFECT OF STOCKPILE SALE ON PRICE MINOR

Chairman BENTSEN. OK, I will take that.

How about today's prices on copper in the United States, how do they compare with world prices?

Mr. PRATT. Well, as of today, they are almost identical. When you look at the transportation costs of moving an ingot of copper from foreign sources to the United States you would pay about the same price for both products.

Chairman BENTSEN. To what extent do you think the drop in copper prices has been the result of selling off the United States stockpile?

Mr. PRATT. I think it is contributative, but very minor. I think one of the things that we have seen in the cycle—we saw a great deal of interest on the London Metal Exchange from changes in the foreign currency markets which had a major impact upon the price of copper. And also, as you have looked at what has happened in gold, and the correlation between the two, and what has happened between the countries, as our country's currency has become stronger, the prices have likewise come down.

Chairman BENTSEN. In studying the price of copper as compared to the price of aluminum over a period of years we have seen it—back in 1966 it was about 1½ times the price of aluminum, and today it is about 2.6 percent?

Mr. PRATT. The gap is narrowing, yes.

Chairman BENTSEN. Are you seeing the chance of an erosion of our markets because of that kind of disparity? Isn't there some risk involved in that? Wouldn't the gentleman on the right be in on your markets?

KENNECOTT SEES NO REAL THREAT TO COPPER SALES FROM ALUMINUM

Mr. PRATT. I think in effect he would be a little concerned.

Seriously, I think that there was a great deal of substitution by aluminum for copper. Sure there are going to be other inroads in the future, but when you look at the increase in the basic needs for copper, we are still going to have a hard time meeting these basic needs.

Chairman BENTSEN. You are talking about pollution controls. It seems to me that all of us want to clean up the air and we want to clean up the waters, and we want to work at it. And I think industry has to be pushed in that regard because I don't think they are going to voluntarily do it. I can understand that. Because if you had a division head that said, look, I want to spend $20 million on pollution controls that are not required by law, and I am going to increase the cost of production, that board will probably fire that division head, or they wouldn't go along with that request, because some competitor wouldn't do it. So I can see the reasons for the laws and why they have to be tough.

So we do have to have, it seems to me, cost benefit ratios involved in any of these things that we put before us.

ENVIRONMENTAL STANDARDS CAUSE COPPER SMELTERS TO BE SHUT DOWN AND COST KENNECOTT $300 MILLION

Now, a lot of your smelters in the copper industry are old ones. Are you going to have to close some of these smelters because of the application of the environmental laws? And will you be replacing them in this country?

Mr. PRATT. The answer to your first question is, there has been one copper smelter closed in the State of Arizona. We have a smelter that, had EPA continued with the direction that they were taking, we would have undoubtedly had to close. That smelter is in the State of Nevada.

The problem that I see with the entire area is one of matching priorities, as you have indicated. This is all that we have asked for. We have recognized the law and we want to support the intent and the spirit of the law. And we want that law applied fairly and as it was written and intended by Congress. And as you may or may not know, our company challenged the EPA secondary air pollution control standard for sulfur dioxides. And we won that case in the U.S. Court of Appeals, because EPA did not have the necessary scientific data to back their position.

We are proceeding to meet all of the primary standards that have been set for the protection of health. We requested judicial review for those concerned with welfare. And we questioned whether it was necessary that you could see forever on a clear day because someone might like it, or whether it was a more necessary ingredient to the economic condition of that community to have jobs. We felt it should be the decision, many times over, of those living in these areas. But we have proceeded. Now, we are spending, as a company over $300 million for pollution controls.

Chairman BENTSEN. Over what period of time?

Mr. PRATT. Starting 2 years ago, and we will finish in about 1976, or early 1977.

Chairman BENTSEN. Do you anticipate any of your smelters being moved to foreign countries?

Mr. PRATT. Not ours; no.

Chairman BENTSEN. Because it seems to me the rising standards of demand for clean air are going to be repeated around the world. It may take a little time. But anyone that tries to run from these standards I think is going to find themselves in trouble as to where they might go.

Mr. PRATT. We have no intention to run. We intend to be good corporate citizens. But again, the only thing that we have asked is that the law be applied as intended and that we make priorities.

Now, you have indicated other areas that we compete with in copper. And you take Japan. Japan today, because of their economic conditions that they are now faced with, with high energy import requirements of oil, are starting to back away from some of their environmental standards that they set. And Germany likewise has tough standards.

But let's look at the countries where 65 percent of the world copper is produced, the CPEC countries, Africa, Chile, Peru, and the other developing areas. In these countries there is absolutely no environmental questions raised. And this is what we are competing against. But again, we have made up our minds as a company that we are going to spend $300 million and the industry $700 million to meet these standards.

Chairman BENTSEN. Thank you very much, Mr. Pratt.

Gentlemen, thank you, your testimony has been helpful. And we are appreciative of it.

We have another witness yet to be heard. Our next witness is Mr. James C. Burrows, vice president of Charles River Associates, located in Cambridge, Mass.

Mr. Burrows is involved in studies of a great number of commodities, magnesium, aluminum, tungsten, cobalt, ferrous scrap and silver, the petroleum industry, and a number of others.

We are pleased to have you, Mr. Burrows.

STATEMENT OF JAMES C. BURROWS, VICE PRESIDENT, CHARLES RIVER ASSOCIATES, CAMBRIDGE, MASS.

Mr. BURROWS. Mr. Chairman, my name is James C. Burrows, I am vice president of Charles River Associates, an economic research firm located in Cambridge, Mass.

I have prepared a very lengthy document, which I won't attempt to read.

Chairman BENTSEN. We will put it in the record, and you may summarize it.

Mr. BURROWS. I will summarize it briefly.

Several events in recent years have raised fears of a number of observers about industrial raw materials. First, as you have mentioned earlier, during the last 18 months there have been substantial increases in prices of industrial raw materials on the open market.

Second, as we all know, toward the last of the year, as a result of the Arab-Israeli war, the Arabs initiated an embargo of oil, and simultaneously increased oil prices substantially.

This has led a number of observers to question whether we may see events such as this in other raw materials, and whether the recent high prices in other materials, such as the nonferrous metals, are a permanent feature of the materials sector.

NO SEVERE PROBLEM OF THE WORLD RUNNING OUT OF INDUSTRIAL RAW MATERIALS

To summarize the testimony, according to our analyses, we do not feel that there is a severe problem of the world running out of industrial raw materials on a worldwide basis. There are some issues as to whether the United States has sufficient raw materials domestically. But on a worldwide basis we do not see any serious problems.

Chairman BENTSEN. On a worldwide basis you do not see a serious problem?

Mr. BURROWS. Right.

I will get into that in a little bit more detail later.

A second major issue of interest is the possibility of the disruptive cutoffs of industrial raw materials which we import in large quantities.

ANALYSIS OF AN EMBARGO OF COBALT TO THE UNITED STATES

Again, based on our analyses, we do not believe that there are very many commodities in which disruptive cutoffs are a significant probability. There are a few in which there may be shortrun problems at one time or another. For example, cobalt, which is supplied primarily from one country——

Chairman BENTSEN. Provided primarily from where?

Mr. BURROWS. Zaire.

And it is conceivable that if something happened to stop that supply, that would cause problems in the short run in the absence of private and Government stocks. And there are a few other commodities like that.

Chairman BENTSEN. What would be the effect in this country if we were cut off from cobalt?

Mr. BURROWS. In the short run?

Chairman BENTSEN. Yes.

Mr. BURROWS. Zaire's supply is something in the nature of 55 percent of the non-Communist supply. There would be supplies from other countries, but we would have to bid for it. Canada is a major supplier. So we would have some supplies of cobalt from normal mines.

At present the Government has a very large stockpile of colbalt which it is selling, but there is still a very large source of supply there, on the order of about 4 years U.S. consumption, I believe.

And finally, there is substitution possibility for cobalt in a number of end uses even in the short run. Nickel can be substituted for many uses. Cobalt is used in magnets, but there are many materials that can be used in magnets. And cobalt is used in super alloys but again there are many materials that can be used there. So the effect in the short run could not be catastrophic even without access to stocks. But in the long run there are substitution possibilities. And it is difficult to think of a situation in which we would be cut off from Zaire's supplies for many years at a time.

I suppose one could think of a situation where, because of a transportation cutoff, or something like that, that we might not have supplies in the short run.

The third major issue is the possibility of producer country cartels, which is a problem of concern for commodities in which we are not self-sufficient. Again, when we go down the list of commodities, we do not see very many where this is a major problem. Obviously it is a problem right now for bauxite. We have our doubts as to the long-run possibilities of a successful bauxite cartel. And I think the earlier speakers——

SUCCESSFUL LONGRUN BAUXITE CARTEL DOUBTFUL

Chairman BENTSEN. You have your doubts as to their being successful——

Mr. BURROWS. In the long run, because of the tremendous possibilities for substitution of other aluminum ores and of increasing the supply of bauxite in other countries.

Chairman BENTSEN. What do you think about the ability of the OPEC countries to continue to hold the price of oil at these levels?

Mr. BURROWS. We have not done a study of that per se. But our personal observation, and I think our general feeling, based on our other markets, is that there may be some issue as to whether OPEC can really hold the cartel together in the long run at the prices they are now getting. I read yesterday that recent bids for Kuwait oil were at the $10 or $11 per barrel range.

There is just simply an enormous number of alternative sources of supply, given enough time for development. And we are already seeing evidence of a great deal of investment activity.

EXCESS OIL SUPPLY

Chairman BENTSEN. I have heard some reports in the last couple of days that an oil glut is developing as far as supplies that are presently in storage?

Mr. BURROWS. I think the evidence is that even this year there might be, based on current expansion plans at current prices, a slight excess of supply.

Now, my supposition is that that there will not be a downward pressure on prices this year, because the OPEC countries can absorb a small quantity reduction. And certain countries would have to simply not produce as much as they say they are going to produce.

Chairman BENTSEN. But isn't there a growing resistance to the prices that they have been asking? And haven't you seen some drop in prices?

Mr. BURROWS. Yes. Initially during the embargo, prices went up as high as $20 a barrel, and then settled down to the $10 or $11 range. One of the reasons that some semblance of equilibrium has returned to the market is that consumers have cut back consumption fairly sharply already. And I think the data for 1974 indicates that for the year as a whole, world consumption will be approximately level, and will not increase over 1973. Again I should stress that I have not made a study of this, and this is just on the basis of my peripheral involvement in other studies.

Chairman BENTSEN. Let me ask you, the trend curve on the increase of production of petroleum has been at what percentage increase per year on the average over the last few years?

Do you have that number?

Mr. BURROWS. I don't have it out of the top of my head. I know it has been somewhat more rapid than growth in industrial production.

Chairman BENTSEN. Did I understand you to say that the trend curve has flattened out?

UNLIKELY THAT OPEC CAN MAINTAIN HIGH OIL PRICES IN THE LONG RUN

Mr. BURROWS. On the consumption end. My understanding is that the data show that for the year as a whole there will not be on a worldwide basis an increase of consumption of petroleum.

That is quite significant, because in general one would expect 6 or 8 percent, or something like that. I don't know the exact numbers. So there have been some cutbacks partly because of the slowdown in industrial activity, but partly because of the higher prices. I think we have observed this in the United States. I don't have the data at hand, but I think there has been some visible decline in consumption. I think the bigger issue is not too much as to whether OPEC can hold the line now, since I think they will be able to this year or next year, but what will happen 5 and 10 years down the road. Maintenance of, say, a $10 price per barrel of oil in 1974 dollars, will require substantial cutbacks of production on their part as the other sources of supply increase. And it is simply unclear how strong that cartel is, whether they can really keep the price up there. I really can't make a prediction on that.

Chairman BENTSEN. Tell me again some more of the areas where you think there is some risk of cartels being effective.

Mr. BURROWS. As I mentioned earlier in the case of bauxite, I think there the issue is not so much that one or two countries control bauxite, since there are bauxite reserves scattered across the world. There are other aluminum bearing materials, as the earlier witnesses already described. Even in this country, there are simply enormous tonnages in nonbauxite reserves.

HANDLING THE BAUXITE CARTEL

Chairman BENTSEN. Do you see a systematic shift from some of these high grade bauxite deposits in some of these foreign countries, if this cartel comes into operation, to some of the low grade domestic resources?

Mr. BURROWS. That is the point I was about to make. In the short range some of the countries, the Caribbean countries in particular, have a great deal of leverage over the aluminum companies because of the investments that are already there. A tremendous amount of infrastructure has been put into place, and it takes 5 or 10 years to really go in and replace that supply in the tonnages that are coming out of those countries. Because the price elasticity of demand is fairly low in the short run, those countries can exact a high tax for that supply of bauxite. The question is, what will happen when those high prices start inducing supplies from other countries, and even supplies from this country? My feeling is that the prices they are now charging may simply be just untenable. And that is a question as to which we really have to wait and see what happens in some instances. And I certainly feel that they could not substantially increase prices above the level they are already.

PROTECTION OF ALTERNATE INDUSTRIAL RAW MATERIAL RESOURCES

Chairman BENTSEN. Do you see much danger on the part of our domestic producers if they go to nonbauxite sources and put in their processing plants for it, do you see much danger of their being significantly underpriced by some of these foreign competitors?

Mr. BURROWS. At the end of my paper I have about a page of discussion about that. And I think there is a serious issue in cases in which the alternative technology is more expensive than the competitive prices of the material, but less expensive than the monopoly price.

For example, we have seen that in oil right now, where certain processes in this country would not have been economical at the old prices, but are economical at today's prices. And the question is, if the producers invest in those processes and then the producing countries cut the price, they might be left high and dry, holding the bag as it were.

Chairman BENTSEN. What kind of protection do you think the domestic producer should have if he is going to make a major capital investment in a new process as to new bauxite sources to work toward domestic sufficiency in this country.

Mr. BURROWS. First, I want to say that I don't advocate protection as a general policy. And I think this issue has to be examined on a case-by-case basis. I think in some cases the better part of discretion might be to wait for a little while and see what happens in some of these cases, for example, whether the bauxite tax increases really stick. If they do stick and if it is determined that the domestic alternative is cheaper than the tax-included bauxite price from the foreigners, but more expensive than the alternative, the competitive price that would prevail without a cartel, then there is a lot to be said—there are a lot of benefits to this country in investing in the alternative process and either supplying ourselves from that process or breaking the cartel.

But there is the issue that the individual companies may not be able to justify that sort of investment because of the fear that the foreign prices might fall afterward.

Chairman BENTSEN. You haven't given me an answer.

Mr. BURROWS. I am getting to it. I think in cases like that, that there is a lot to be said for some sort of protection to the producers, who are investing in those processes, that would protect themselves against a sudden drop in world prices, if the cartel does lower its prices.

I do want to express that I do not think an action such as this should be taken lightly, because in general protection of this sort is not a recommended policy. But I think this is a case in which there might be something to be said for that.

GOVERNMENT TO GOVERNMENT NEGOTIATING NOT ADVISABLE

Chairman BENTSEN. We have heard from three companies and their representatives. How would you feel about the negotiations being carried on a country-to-country basis as compared to the industries working together with the observance of the antitrust division in trying to negotiate the prices.

Mr. BURROWS. I think there is something to be said for letting the firms have some communication in the process of negotiating. There may be some danger in having the governments take over the negotiation process, in that what you might obtain is simply a block of producing countries encountering a block of consuming countries. If the consuming countries—well, it is not clear what it will come out to; it might well be that we will end up with a situation such as we have in OPEC with the producing countries simply saying that this is our price, take it or leave it. There is a lot to be said for allowing the companies to chip away by going ahead and offering separate deals. What you really want to do is induce individual countries in the cartel to break apart, and offer special arrangements in order to get the business. And the best way to achieve that might be to simply let the companies chip away at the cartel on their own. But that is a complicated issue. I am not sure in my mind what the ultimate resolution of that should be.

PASS THROUGH PRICE IMPACT OF HIGHER RAW MATERIAL PRICES

Chairman BENTSEN. You made a remark that the amount of industrial raw materials as related to our GNP is really a relatively small factor?

Mr. BURROWS. Right.

Chairman BENTSEN. That remark was also made by one of the other witnesses, I believe he used a figure of 3 percent, if I remember correctly.

Mr. BURROWS. Yes, sir.

Chairman BENTSEN. If you double the price of the raw materials coming into this country, what wil that do to the GNP deflator?

Mr. BURROWS. My feeling about that is that it would naturally at a minimum passthrough on a one-for-one basis in the consumer prices. And there would be some addons along the way. And they are carrying costs which are usually based on a percentage of the value of the commodity. But I do not feel that the ultimate effect on inflation would be substantially more than that 3 percent—it might be 4 percent—you could conceive of situations where it might be 4 percent.

Chairman BENTSEN. You don't think it would be significantly more than that 3 or 4 percent?

Mr. BURROWS. No, I do not.

Chairman BENTSEN. Isn't it true that last year 60 percent of our inflation came from the increase in the cost of commodities?

Mr. BURROWS. I think you are including in that figure agricultural commodities, which I don't think will fall within the 3 percent.

Chairman BENTSEN. So you feel that a good part of that is attributable to local commodities in agriculture?

Mr. BURROWS. A good part of that I think was; generally, I believe that is the case.

Chairman BENTSEN. Certainly oil has a significant impact on inflation?

Mr. BURROWS. Yes. I don't think the oil was included in that 3 percent—I might be wrong—I think it was more than that.

Chairman BENTSEN. So when you are talking about 3 percent you are not including oil?

Mr. BURROWS. I was using the figure, for whatever it was worth, of 3 percent, if prices go up on a dollar-for-dollar basis, the ultimate increase at the consumer level would be something more than that—is not clear to me whether it would be substantially more than that.

Chairman BENTSEN. In your prepared statement you talk about the environmental protection regulations and the uncertainties of them and the fact that they have delayed a substantial amount of capital investment.

Do you feel that these uncertainties have been weighed generally or not?

IMPACT OF ENVIRONMENTAL LEGISLATION ON CAPITAL INVESTMENT

Mr. BURROWS. I think there are still uncertainties. I have not kept up with recent legislation. I know that there is still a great deal of uncertainty about what the regulation will be in the future. I think what I was referring to was during the period of 1970 and 1971 and 1972, subsequent to the passage of the Clean Air Act in 1970, there was a tremendous amount of uncertainty about exactly how the regulations would be interpreted and enforced. Another big factor in the copper industry, and also in the aluminum industry, is that some of these interpretations have not been made, and certain decisions have been made, but there is still a great deal of uncertainty. For example, Mr. Pratt from Kennecott, Mr. Chairman, says they are now in the process of suing EPA over some of the secondary standards that—and they have won in the appeals process. But I think my understanding is that that is still in the process of litigation. So there still is a great deal of uncertainty about the environmental controls.

I do not feel that there is any substantial feeling inside or outside of industry that we should not have environmental controls, it is just that they should be intelligently designed and they should be able to have some firm expectations about what the regulations really will be.

Chairman BENTSEN. In other parts of your statement, Mr. Burrows, you said we sold from the U.S. stockpile all the copper, and all the aluminum, and much of the tin. Should we reconstitute the stockpile now?

BURROWS DOES NOT ADVOCATE AN ECONOMIC STOCKPILE

Mr. BURROWS. Again, I think this is something that you have to look at on a commodity-by-commodity basis. But in general I would not advocate building up large stockpiles of those materials.

Chairman BENTSEN. Why not?

Mr. BURROWS. Simply because it is an extremely expensive investment to make. One, the primary—let me step back for a second—the primary purpose of a stockpile I think is to alleviate shortrun difficulties in the case of supply cutoffs, or a national emergency of some kind. There are just simply not very many instances, outside of the considerations of the wartime emergency—and I do belive that there are certain substantial stockpiles for that purpose—that there have been substantial probabilities for peacetime cutoffs in supply. Even in the Jamaican bauxite situation we are not getting a cutoff in supply, they are asking for substantial price increases, but they are not refusing to sell. And it is not clear to me that a stockpile would be able to do much about a situation such as that. If you carry a stockpile, say, equivalent to 20 years supply, you certainly have a lot of bargaining leverage. But the cost of doing that would be incredible. And we do have a 4-year supply of cobalt, for example, or something close to this. And we do have a 10- or 15-year supply of tungsten.

Chairman BENTSEN. You say you have a 20-year supply?

Mr. BURROWS. It is in that ball park. I don't remember the exact numbers. It may have been declined below that, since they have been selling it—I guess I am wrong about that, I think it is more in the nature of 4 years. But it is a tremendous amount, as I recall.

Chairman BENTSEN. According to your testimony tungsten is really not a problem.

Mr. BURROWS. Since we do have a substantial stockpile, and since it is produced domestically, it is not a serious problem.

Chairman BENTSEN. Thank you, Mr. Burrows. We will place your prepared statement in the record. W appreciate your testimony.

[The prepared statement of Mr. Burrows follows:]

PREPARED STATEMENT OF JAMES C. BURROWS

My name is Dr. James C. Burrows. I am a Vice President of Charles River Associates, an economics research firm located in Cambridge, Massachusetts, with broad experience in microeconomics and econometric research in the ferrous and nonferrous metals, energy and transportation industries.

I received my Ph. D. in economics from M.I.T. and have been participating in research studies at CRA since 1967. I have completed studies of the magnesium, aluminum, tungsten, cobalt, ferrous scrap, silver and petroleum industries and have directed studies of the copper, lead, zinc, platinum, palladium, chromite, nickel, molybdenum, mercury, coal and ocean freight industries. My publications include books on regional industrial location, the U.S. oil import quota and on the cobalt, tungsten, aluminum (forthcoming), and silver (forthcoming) industries.

INTRODUCTION AND SUMMARY

During the past several years, attention has been increasingly focused on the natural resource sector of our economy. Two sets of events have been mainly responsible for this. First, open market prices of most industrial raw materials and agricultural products rose sharply during the past 18 months, although these prices have recently declined significantly. For example, the London Metals Exchange price of copper doubled from $0.51 per pound in January 1973 to $1.01 per pound in December 1973 and then increased to nearly $1.50 by May 1974, but has since fallen to about $0.85 per pound.

Second, the worldwide oil embargo and subsequent actions by OPEC to increase substantially its oil export prices resulted in a substantial decline in the supply of oil available at any price, and then in a sharp rise in the market price of oil even after these supply flows were resumed. The current uncontrolled prices of crude oil in the United States are roughly double their level of a year ago.

These events have given rise to fears about non-energy minerals—that we are running out of materials; that producer countries will band together to blackmail industrial consuming countries and to raise prices of these materials; that supplies of imported materials will be cut off entirely with devastating effects on our economy. Even if these events do not occur, there are fears that the market system no longer works in the materials sector and must somehow be restructured.

Analyzing the prospect of natural or artificially-induced scarcities of industrial raw materials requires consideration of at least three major issues—(1) the available reserves of these materials in relation to current and prospective demand on both a world and a national basis; (2) in the case of imported commodities, the risk of interruptions of supplies; and (3) the possibility of foreign cartels being formed, resulting in higher prices to the United States. Full analysis of these questions, requiring detailed analyses and forecasts of each major industrial raw material, lies beyond the scope of this paper.

Studies conducted by Charles River Associates of a number of nonferrous metals and minerals suggests, however, that there is little risk of an imminent worldwide depletion of resources. Also, the risk of an economically disruptive short-run supply cutoff is slight for most commodities. There are several commodities, such as cobalt and chromite, in which a total embargo of industrial consumers by one or two countries could cause short-term economic dislocations in the absence of industrial or government stocks, but such an embargo would not be in the economic self-interest of the producing countries.

There is some risk of successful cartelization of some industrial raw materials. This would force higher prices on consuming countries, but this risk and the economic effects of such cartelization appear to be limited. First, the supply of many commodities, such as mercury, platinum, palladium, and cobalt, is already so concentrated that the producing countries already have, and use, substantial monopoly power. Cartelization may occur in other markets, but the impact on price would be limited.

Some risk of cartelization and higher prices may exist for a few commodities. For example, in the case of chromite demand is probably very inelastic, up to a point, alternative sources of supply are not very price elastic, again up to a point, and a small number of countries account for a large share of current supply. Successful cartelization of chromite, however, would require cooperation among the Soviet Union, Turkey, Rhodesia, and South Africa.

In the remainder of this paper I will first review recent trends in the minerals markets to determine their implications for the future. I will then examine the proposition that the world and the United States are seriously depleting their minerals resources. This will be followed by a review of the general considerations relevant to producer-country cartel formation and maintenance and to the possibility of shortages of metals and minerals. Finally, I will summarize the information developed by Charles River Associates on the major nonferrous minerals and metals to evaluate the probabilities and potential costs of natural or artificially-induced scarcities of raw materials. Detailed information on these commodities is presented in an appendix to this report.

RECENT TRENDS IN MINERALS MARKETS

The recent sharp price increases in many raw materials have caused a number of observers to speculate as to whether we are seriously depleting our natural resource base or whether the metals and minerals markets somehow fail to operate properly. The underlying factors in the recent price rise in fact appear to be much less dramatic than these interpretations indicate.

The principal reason for the recent price inflation is that the world's capacity to extract and refine minerals did not keep up with the increased demand for them, for reasons quite unrelated to the adequacy of the underlying resource base or the ability of the minerals markets to function. The prices of all materials were affected, partly because of similar underlying causes and partly because of the interrelationships among these materials. That is, scarcity and high prices in one material induced consumers to substitute other materials, which in turn created pressures on the prices of the substitute.

In 1972 and 1973 demand grew much more quickly than production capacity, for several reasons. First, because of the unprecedented worldwide economic boom in all major industrial commodities, demand for all major raw materials rose sharply in the industrialized countries. While strong industrial growth in the noncommunist world was fully expected for 1972 and 1973, a few forecasters correctly anticipated the full extent of the boom. The metals producers were no different.

The 1973 growth rates in industrial production of the major industrial countries were 9 percent for the United States, 17 percent for Japan, 4 percent for Germany, 8 percent for France, 7 percent for the United Kingdom, 10 percent for

Italy, and 9 percent for Canada. The growth rates in total noncommunist demand for the nonferrous metals were even more spectacular: consumption reportedly rose 11 percent in 1972 and 16 percent in 1973 for aluminum, over 9 percent in each year for copper, and 10 percent in 1972 and 8 percent in 1973 for zinc. Consumption of some minor metals grew even more rapidly. For example, U.S. consumption of tungsten grew 19 percent in 1972 and a staggering 32 percent in 1973. It must be remembered that demand at 1972 prices was even greater because reported consumption data reflect the decline in consumption induced by high prices in 1973.

Second, the ability of the metals and minerals industries to expand their capacity in anticipation of greater demand was severely hampered by price controls, particularly in the United States. Price controls were first established in 1971, a period of particularly low prices for many metals. 1971 was a recession year, and prices of many metals had dropped to levels near the short-run variable costs of production. As a result, controlled prices were below long-run costs of production—that is, the cost of production including the normal competitive rate of return on invested capital. The copper, lead, and zinc price ceilings were all below long-run trends in real terms. These price ceilings almost certainly discouraged new investment in metals and minerals production in the United States during 1972 and 1973.

Third, uncertainties about environmental legislation and controls hindered any expansion of capacity. Firms could not predict whether new plants would violate environmental standards in two or three years, thus necessitating tremendous expenditures that might have been avoidable in the initial construction. New investment was discouraged not by the environmental controls themselves, which most people—in and out of the minerals industry—recognize as desirable, but rather by uncertainty about the exact requirements of these controls.

The decline in U.S. capacity growth in the metals industries is quite marked. At the beginning of each year Engineering and Mining Journal surveys capacity expansion projects on a worldwide basis for each major mineral and metal. According to this survey, the number of projects and expected additional production capacity for aluminum in the United States declined as follows: from 12 to 15 projects, averaging 1,333,000 tons, for the years 1968–1970; to 4 projects offering 438,000 tons in 1972; to 1 project with 120,000 tons in 1973; to 3 projects with 156,000 tons in 1974. The actual data are as follows:

	Number of projects	Total planned additions to aluminum smelting capacity [1]
Year:		
1968	15	1,364,000
1969	15	1,410,000
1970	12	1,226,000
1971	7	809,000
1972	4	438,000
1973	1	120,000
1974	3	156,000

[1] Short tons per year.

The total additions to capacity were less than these figures would indicate, since expansions take many years to complete and therefore each tends to appear in several successive years. Several projects have been repeatedly postponed, such as the Astoria, Oregon project, which was first announced in 1969, and has had a succession of different owners.

In addition to the failure of our capacity to keep pace with growing demand, U.S. prices of imported materials have increased due to declines in the exchange value of the dollar. Part of the increase in dollar prices was thus only the result of monetary adjustments.

Thus, the recent high prices and scarcity of supplies were caused by demand growing too rapidly and capacity too slowly, coupled with the effects of dollar depreciation. However, none of the factors that have caused this imbalance were in any fundamental sense related to resource depletion.

Nor is it valid to assert that the sharp increases in prices (or price fluctuations *per se*) show that the minerals markets do not function properly. The fundamental factors causing the price increases probably would not have been different under any other feasible market organization, given the conditions of the period in question. During a period of scarcity price increases are an efficient, though painful, mechanism to allocate resources to their highest-value uses.

ARE MINERAL BRESOURCES BEING SERIOUSLY DEPLETED?

There is no conclusive resolution to the debate over whether we are running out of industrial raw materials. Known reserves are by nature finite, and in a number of mineral resources the presently known reserves will be depleted in several decades. However, while the available data can lead to overly-pessimistic conclusions, an examination of the evidence from a broader perspective suggests that there is no important non-energy mineral which is in scarce supply in the foreseeable future.

First, data show that the known reserves of many materials are huge. Existing known reserves are large enough to support centuries of production at current and expected production rates of such metals as iron and steel, aluminum, magnesium, nickel, molybdenum, and cobalt. For example, the Henderson Mine in the United States could support the current U.S. production rate of molybdenum for at least 250 years; reported iron ore reserves can support the current noncommunist steel consumption rate for at least 1,500 years; and noncommunist reserves of bauxite can supply the current noncommunist aluminum production rate for at least several centuries, not including huge reserves of other aluminum-bearing ores which can be produced at somewhat higher cost; magnesium is obtained primarily from ocean water, whose supply is virtually inexhaustible; reports of the cobalt content of undersea manganese nodules are as high as 100 thousand times the recent production rate. The implications of this evidence are far-reaching. The possibilities of substitution are such that, even if the supply of a particular material becomes limited, increased production of other materials will eventually allow us to use alternative materials without significant hardship.

Second, relying on data of currently known deposits can easily give a distorted, overly-pessimistic picture of the resource potential for future production of industrial materials. In many cases the historical data on materials have always indicated that reserves are limited and equal to only several decades of production. In fact, the addition over time of new reserves of virtually all materials has more than kept up with the extraction rate.

Of course, one can say that this is merely an historical accident, a coincidence that cannot be relied upon for future planning. However, there are good reasons for the observed historical relationship between reserves and production. First, it is uneconomical to explore or measure mineral reserves which cannot be mined profitably at the current prices. Data on reserves therefore tend to be dominated by deposits which can be mined profitably at prevailing prices. The distribution of mineral deposits tends to be such that as the average quality of a deposit declines the tonnages of ore that are available increase substantially. Hence, as industries move to lower quality deposits, mineable at higher costs, sharply increasing tonnages of ore become available. Of course, the earth's crust is composed of minerals and many of these become mineable at some price. It has been observed, for example, that on the average a cubic kilometer of the earth's crust contains 200,000,000 metric tons of aluminum, 100,000,000 tons of iron, 800,000 of zinc, and 200,000 of copper.[1]

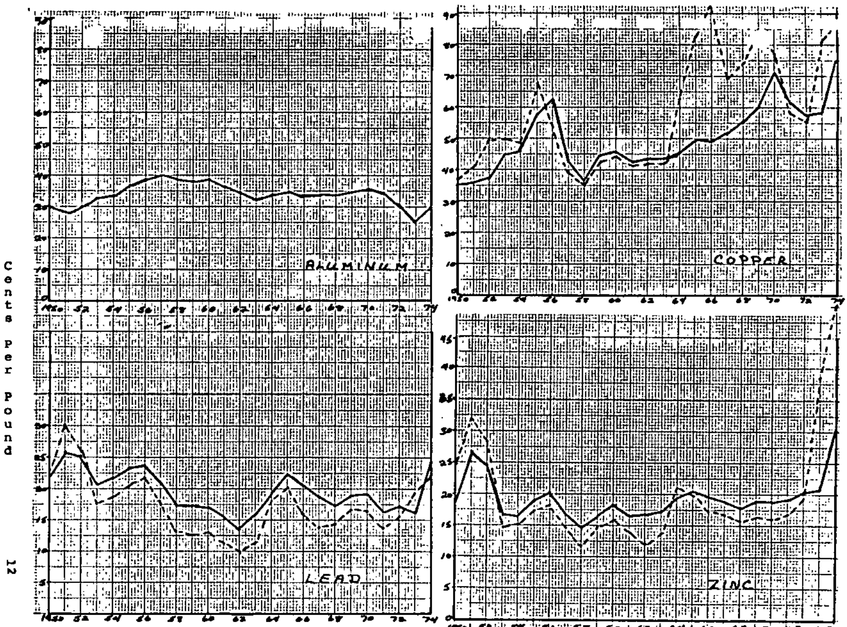
Second, once a firm is extracting ore from a given deposit, it may not pay to explore beyond the planning horizon of the firm, say 10 or 20 years. It is quite common for a mine to produce for many more years than would have been indicated by the proved reserves of the mine in its early years.

Third, the discovery of the reserves of a given quality is a price—or market-related phenomenon. Exploration is costly, and in periods of high prices more resources are devoted towards exploration, resulting in the discovery of more deposits. As a matter of historical fact, improved mining and exploration technology and the discovery of additional deposits have kept ahead of the growth in demand for minerals. As indirect evidence of this, the real prices (prices stated in dollars of cost of purchasing power) for many commodities have declined over the long term.

[1] David B. Brooks and P. W. Andrews, "Mineral Resources, Economic Growth, and World Population." *Service*, Volume 185, No. 4145, July 5, 1974, p. 13.

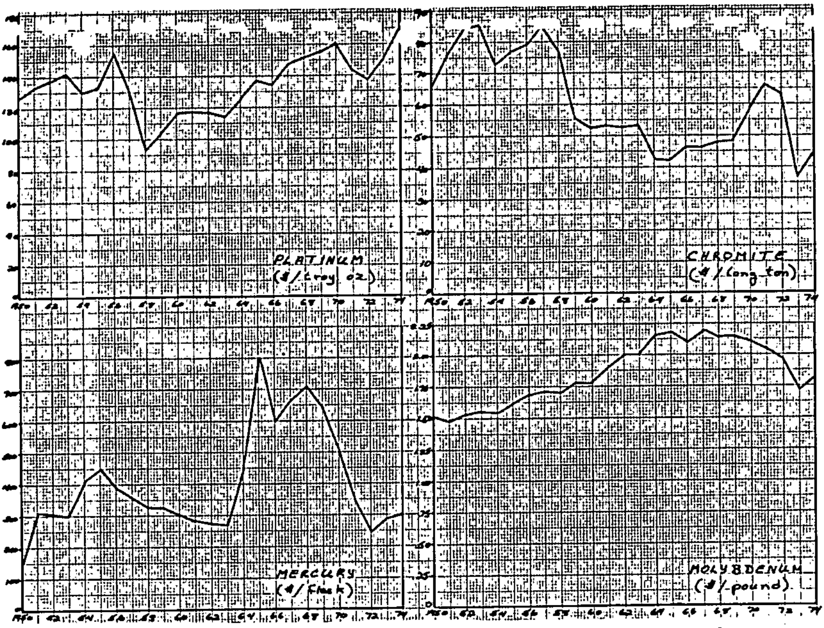
To illustrate this proposition the attached figure shows graphs of the prices expressed in 1973 dollars of the following metals and minerals: aluminum, cobalt, copper (LME price and U.S. producer price), chromite, mercury, lead (LME price and U.S. producer price), platinum, tungsten, molybdenum, and zinc (LME price and U.S. producer price).[2] The LME price of several commodities was include in cases where it was felt the published U.S. price was not completely representative of open market prices. The 1974 value chosen was the last observation available at the time of this paper.

The data do not show a pronounced trend to higher prices or, by inference, higher production costs in dollars of constant purchasing power. The data are so mixed that it is difficult to generalize, but with the exception of the last observation for the LME zinc price, there is no commodity for which recent prices would suggest that we are facing a period of significantly rising real costs of production.



Metal Prices 1950-1974 (1973 Dollars)
— U.S. Producers' Price
--- LME Price

[2] The deflator used was the U.S. Bureau of Labor Statistics wholesale price index for all commodities.



— U.S. Producers' Price

Metal Prices 1950-1974 (1973 Dollars)

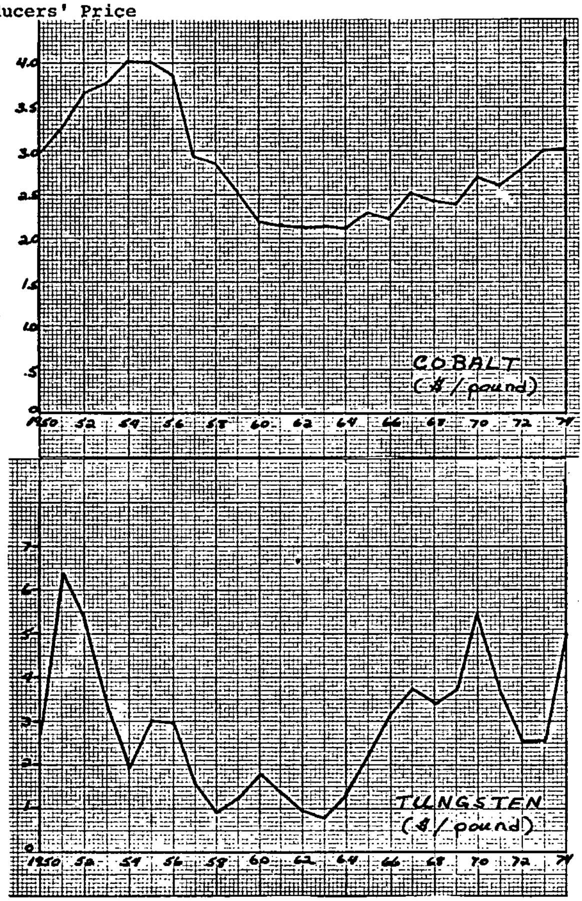
13

CHARLES RIVER ASSOCIATES INCORPORATED

Metal Prices 1950-1974

(1973 Dollars)

— U.S. Producers' Price



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Much of the increase in zinc prices has been caused by the shutdown of several inefficient U.S. smelters, accelerated in some measure by U.S. price controls and environmental standards. The undercapacity in this market is already in the process of being corrected, and zinc prices should decline substantially during the next several years. Deflated prices of copper have shown a gradual increase since 1950, but prices of lead, aluminum, chromite, and mercury are in an overall downward trend. The price histories of cobalt, tungsten, platinum, and molybdenum have no strong overall trends.

It is possible, of course, that in the future improved technology and exploration for new reserves will not keep up with increased production of certain minerals. Even if this were to happen, it would not be disastrous for the world's economy, because as the reserves for a given material become depleted, and producers have to shift to lower quality reserves at higher production costs, consumers will begin to substitute away from that material. Most materials, particularly the nonferrous materials with which I am most familiar, are very substitutable, given sufficient economic incentives and adequate time for the consuming sectors to respond.

To continue this scenario to its extreme, suppose that the resources for one or more materials were in fact being so seriously depleted that the prevailing production rate could not be maintained for any reasonable cost. Not only would there be substitution and consumption of other materials whose costs were not rising substantially, but the rising market prices of the materials in question would encourage increased secondary recovery.

There are very few industrial raw materials besides energy which are dissipated in their consumption or are used in such a manner that recovery is not feasible at any reasonable cost. Secondary recovery does tend to lag behind consumption, simply because materials do not become available for recycling until the original products in which they are used are scrapped. Because consumption of virtually all industrial raw materials has been increasing steadily at least since the Industrial Revolution, actual secondary recovery has lagged behind new mine production; in general, the more rapidly consumption of a material grows, the smaller the market share of recycled materials tends to be. The low resource costs of new mine production have prevented the market prices of recycled materials from being high enough to induce the maximum recovery of these materials, a fact which should not necessarily be deplored.

If we really did start running out of resources, several things would happen. Prices of the materials being depleted would rise and consumption would decline as a result of substitution of other materials and of reduced consumption of final products. In addition, rising prices would induce increased secondary recovery; in the extreme, price rises would halt additional growth in consumption and an equilibrium state would be reached in which the prevailing rate of consumption was supplied largely from recycled resources. Thus, even in the extreme case depletion would not require cessation of consumption of certain materials; rather, in the extreme, consumption would simply cease to grow significantly.

The overall effect of even substantially increased costs of some raw materials will therefore not be cataclysmic. We will never actually physically run out of a material but rather as a resource base becomes depleted, producers will move to higher and higher cost deposits. Other things being equal, some decline in living standards will be necessary to pay for the extra resources required to obtain raw materials, but it would require a tremendous cost increase across the board for the majority of materials for this to be a matter of critical importance to the economy as a whole.

SECURITY OF SUPPLY

A rational cartel will not cut off supplies. There is no economic reason to embargo consumers; an economically effective cartel will attempt to maximize its net revenues from the sale of the monopolized product, but it will not prevent consumers from increasing their purchases at its inflated prices. The OPEC embargo on oil was not a rational economic move, but a political ploy designed to obtain certain political ends. Supply cutoffs and cartels are related, of course, because a supply cutoff is not an effective political move unless a country or a group of countries control a significant percentage of the world supply and therefore have some monopoly power in the market.

The security of supply question is therefore primarily a question of diversity of supply, the political safety of different geographical regions, the accessibility of different regions in time of emergency, and other similar issues; the problem can be handled on these grounds.

The economic impact of a supply cutoff depends on the boycotting producers' share of the market, the short-run price elasticities of demand and supply outside of the cartel, and the extent of the market that is boycotted.[3] A short-run cutoff

[3] Price elasticity describes the responsiveness of demand or supply to price. In discrete terms, price elasticity is measured as the percentage change in quantity, resulting from a price change, divided by the percentage change in price. Hence, if the price elasticity of demand for a product is —1, a 10 percent increase in price leads to a 10 percent reduction in demand—or, alternatively, price must rise by 10 percent for consumers to willingly reduce consumption by 10 percent. The lower the price elasticity, the less responsive is demand.

will have a bigger effect on market prices, and hence will cause greater short-run economic disruption, the greater the market share of the boycotting producers, the lower the short-run price elasticities and the greater the extent of the market being boycotted.

It is in general not sufficient for one or two major supplying countries simply to embargo the United States. As long as these countries continue selling to other consumers, the overall world market would not be significantly affected. Instead, there would be a reallocation within the supply system, with the United States drawing its supplies from other countries not affected by the boycott. For example, in the case of copper, a Chilean embargo of the United States would have very little effect, either on the overall copper market or on the United States, because Chile accounts for only 12 percent of noncommunist copper supply and the United States for 32 percent of noncommunist consumption of refined copper. An embargo by Chile of all copper consuming countries would have a significant but not devastating effect on the copper market. Chile itself, of course, would have little to gain from such an embargo.

Probability and Cost of Foreign Producer-Country Cartels

The question of the impact of cartelization in commodities not already cartelized is more complex. While there is no precise answer to the probability of a cartel being formed in a particular commodity, several observations can be made.

The economic impact of a cartel can perhaps be best measured by its effect on the market price of the commodity. There is a common misapprehension that monopolization of minerals markets may cause almost unlimited price rises. In fact, price rises are frequently limited by the cartel's own economic interests. First, the supply of many mineral commodities is already controlled by a small number of producers who are already maximizing their returns from the sale of these commodities. The producers have not, historically, attempted to raise prices continuously.

Second, while a strong cartel may have the power to increase price indefinitely, it will not pay the cartel to raise prices beyond the level at which it maximizes its net returns. While there may be some ambiguity as to exactly what the cartel regards as its net returns—be it foreign exchange revenues, profits as measured in the market economy, total revenues, etc.,—the optimal price to maximize revenue will be greater the smaller the price elasticities of demand and the supply outside of the cartel. If the elasticities of demand and supply are great and if the percentage of the market controlled by the cartel is small, the cartel's optimal price may not be far from the levels actually attained during the past year or two.

There are two sets of factors which affect the probability of a cartel being formed. The first set of factors might be termed the potential gains from cartelization and is related to the optimal price and output policies that the cartel could adopt. The second set of factors involves difficulty of establishing a successful cartel even when the gains to the cartel would be substantial.

Here it is useful to point out that a cartel can successfully raise price only by restricting output. Therefore, successful cartelization requires agreement on the distribution of output reductions among the cartel members as well as effective enforcement of this agreement. Clearly, the greater the number of suppliers of a commodity, the more difficult the formation of a cartel will be. This problem becomes exceedingly complex when there are important potential producers not producing large quantities at the time of the cartel's formation. These producers must be included in the cartel for it to be successful. At the same time, there are real grounds for dispute within the cartel as to how much the expanding producers will be allowed to produce and which countries will have to reduce production as a result. Similiarly, if the production costs of the commodity differ substantially among cartel members, it may be very difficult to obtain agreement on the optimal output and distribution for the whole industry.

Another important factor is the incentive to cheat inherent in any monopolistic restriction of output. Individual members of a successful cartel have powerful incentives to increase their output to reap the rewards of the cartel's higher prices. Of course, if all members do this, the cartel will fail. Therefore, it is important that the cartel be established in such a way that cheating can be detected and stopped.

All of this suggests that the greater the number of countries included in the cartel, the greater the degree of cooperation among the countries must be. If there are substantial differences in the countries' economic structures and their political philosophies, it will be exceedingly difficult for the cartel to coordinate its policies successfully to restrict output, raise prices and maximize net returns to the countries.

The short-run considerations in most instances will be quite different from the long-run considerations. In the short run both supply and demand tend to be inelastic with respect to price—that is, a substantial price increase will induce only a small decline in consumption, and there will be only a small increase in supply from non-cartel sources because of the long period of time required to shift resources from one mode of production to another. As a result, if the members of the cartel plan to operate for only a limited number of years, in many instances they may be able to increase prices and net revenues substantially in the short run (one or two years). These high prices, however, will encourage both non-cartel sources to increase supply and consumers to substitute away from the commodity in the long run. This will eventually result in reduced net revenues to the cartel. Therefore, we easily might face a situation in which a cartel will attempt to raise prices beyond their long-run optimal level because of short-sightedness or because of misinterpretation by the cartel members of the success of the higher prices in the short run.

SURVEY OF PROSPECTS OF NATURAL OR ARTIFICIALLY-INDUCED SCARCITIES OF MINERALS AND METALS

In the attachments to this paper, I have summarized information developed by Charles River Associates for a number of commodities that would pertain to an evaluation of prospective scarcities. The list is not complete and a full study would have to examine these commodities in much greater detail to be able to draw definitive conclusions.

Our studies indicate that the long-run price elasticities of demand for most materials are quite substantial, i.e., that substitutibility in consumption is quite high. Price elasticities for many materials are greater than one, indicating that an increase in prices of 10 percent would eventually decrease consumption more than 10 percent below the rates that would otherwise be attained. The results of our studies of price elasticities of demand for selected commodities in the United States can be summarized as follows:

PRICE ELASTICITIES OF DEMAND

Material	Short-run [1]	Long-run [2]	Principle substitutes
Aluminum-Bauxite	−0.13	−0.80	Copper, steel, wood, plastics, titanium.
Chromite	0−−.2	(3)	Nickel, molybdenum, vanadium.
Cobalt	−.68	−1.71	Nickel.
Copper	−.3	(3)	Aluminum, plastics.
Lead	(4)	(3)	Rubber, copper, plastics, tile, titanium, zinc.
Mercury	(4)	−1.0	
Molybdenum	(4)	NA	Tungsten, vanadium.
Platinum-Palladium	0−−.1	−.4−.9	Gold.
Tungsten	−.15	−.3	Molybdenum.
Zinc	−.55	−.67	Aluminum, plastics.

[1] 1 yr.
[2] 3–5 yr.
[3] Elastic.
[4] Inelastic.

In general, our information suggests that for the commodities surveyed here—copper, aluminum, zinc, lead, tungsten, chromite, molybdenum, mercury, platinum, palladium, and cobalt—there is little risk of imminent worldwide depletion of resources. It also appears that in general the risk of an economically disruptive short-run supply cutoff is small for most commodities, although this of course depends on political judgments. In most cases a partial embargo of the United States by one or more countries would have little effect on the overall market in general or on the United States in particular.

For some commodities, such as chromite and cobalt, a total embargo of industrial consumers on the part of one or two countries could cause economic dislocations in the short-run in the absence of industrial or government stocks; this would however not be in the economic self-interest of the suppliers. Irrational acts cannot be ruled out, but their probability in many cases is slight.

The risk of new industrial supplier cartels and their potential economic effects are somewhat limited. The supply of many commodities, such as mercury, platinum, palladium, and cobalt, is so concentrated that the producing countries have substantial monopoly power and presumably have been exercising it. Examination of other markets suggests that a cartel's impact on price would be limited. For example, it is not clear that the optimal cartel price for copper would be much greater than the price observed in recent months, which was well over $1.00 per pound. In fact, the CIPEC countries (Chile, Peru, Zambia and Zaire) at their latest meeting reached no agreement on price and output targets, but merely stated their determination to prevent copper prices from falling to the levels of 1971 and 1972. Whether even this is possible in a situation of surplus capacity is unclear, but it does seem significant that the producer countries demanded no further price increases. The situation for zinc, platinum, and palladium may be very similar to that of copper—sufficient substitution possibilities exist in the major end uses to deter significant attempts on the part of the producers to raise prices above levels already attained.

There are two commodities for which some risk of cartelization and higher prices exist—bauxite and chromite. In the case of bauxite it is notable that in spite of the current efforts by Jamaica and other Caribbean countries to raise bauxite taxes, there has not been an explicit agreement among all bauxite producers establishing price and output goals. The long-term effectiveness of these efforts to increase prices therefore remains to be seen. There is also a ceiling on the extent to which these producers can raise prices—not only is there substantial possibility for increased bauxite production in other countries, but vast reserves of nonbauxite aluminum-bearing ores can be tapped, both in the United States and abroad, using known technology at prices not far above the current Caribbean prices.

In the case of chromite, several factors seem to favor cartelization: demand is probably very inelastic, up to a point; alternative sources of supply may not be particularly price elastic, again up to a point; and a small number of countries accounts for a large share of current supply. However, successful cartelization would require successful cooperation among the Soviet Union, Turkey, Rhodesia and South Africa.

CONCLUSIONS

The recent shortages in the minerals and metals markets have stimulated debate over potential public policies to deal with such crises. Among the policies currently being considered are security stockpiles, economic stockpiles, taxes and subsidies meant to encourage exploration and development of domestic resources, trade regulations designed to discourage imports from sources considered to be insecure, government sponsored research and development in materials production and usage, and subsidies designed to encourage resource recycling. Each of these policy areas needs to be investigated in much more detail to determine the conditions under which each is justified.

A drastic change in public policy towards the minerals sector would not be warranted. The potential cost of the government simply doing nothing, even taking into account the possibility of supply cutoffs or of wasteful depletion of some resources throug hunwise public management, is probably less than the potential cost of adopting across-the-board policies towards the minerals and metals industries without thorough review and analysis. For example, the maintenance of a public stockpile may be warranted for selected commodities, but the carrying costs of maintaining stockpiles for all industrial raw materials would be staggering.

It is important to emphasize that each commodity must be examined on an individual basis, without losing sight of the interrelationships among the various materials. For example, in the case of stockpile policy there is no simple rule to determine whether there should be a stockpile of a particular commodity and, if so, how large the stockpile should be. One must consider such factors as: the total percentage of that commodity which the United States imports as well as the percentage imported from areas considered to be insecure; the share of the world market produced by areas considered to be insecure; the probability of a supply cutoff in one or more countries; the potential substitution possibilities on both the demand and supply side for that material; and the cost of the stockpile itself. The cost of the stockpile must then be compared to the potential benefits of the stockpile, measured as the expected value of the economic costs that would be incurred during supply cutoffs if the stockpile did not exist.

Another public policy issue deserves serious attention: the question of the incentives to U.S. firms to invest in domestic production processes as an alternative to dealing with foreign producer-country cartels. If the alternative domestic technology is less expensive than the cartel's high monopoly prices but greater than the costs of production of the cartel members, the cartel price may be forced to fall below the domestic production price which can be established once the domestic facilities are built. Thus, the United States as a whole may benefit from the construction of the domestic facilities while the firms who invested in these facilities will be left holding the bag. We are facing this dilemma today in the shale oil and coal industries. The appropriate policies in instances such as these are extremely difficult to determine and beyond the scope of the present study.

Appendices

Aluminum and Bauxite

Current U.S. Dependence on Imports

In general, the United States does not import substantial quantities of aluminum and aluminum mill products. However, significant quantities of alumina are imported and the bulk of both aluminum and alumina consumption depend on foreign bauxite.

In the case of aluminum, in 1972 total shipments of ingot and mill products to U.S. consumers were 11.418 billion pounds and total imports of ingot and semi-fabricated aluminum products were 1.622 billion pounds; total exports of ingot and semi-fabricated products were .694 billion pounds. Net imports of aluminum were therefore somewhat less than 10 percent of total U.S. shipments. Canada, the Common Market countries, Norway, and Ghana accounted for 92 percent of total U.S. imports, with approximately 69 percent coming from Canada.

The picture for alumina is somewhat different: in 1972 total U.S. alumina production was slightly less than seven million short tons while imports totalled 2.85 million short tons, or approximately 30 percent of total U.S. consumption. In the case of bauxite the United States is almost totally dependent on imports. In 1972 approximately 15.4 million tons of bauxite were used domestically for production of alumina in the production of aluminum; imports were 11.4 million tons, or nearly 75 percent of the total. If the contained bauxite of alumina imports is taken into consideration, approximate U.S. consumption of bauxite in 1972 is about 21.4 million tons, more than 90 percent of which is imported from abroad.

U.S. imports of bauxite have in the past come primarily from Jamaica and Surinam (60 percent and 22 percent in 1972, respectively), with the Dominican Republic a distant third at 7 percent. U.S. imports of alumina in recent years have come primarily from Australia (41 percent in 1972) and Jamaica (26 percent in 1972). In 1972 the total value of bauxite imports was $151 million, and of alumina imports was $173 million.

Factors Relevant to Cartel Formation

Both production and reserves of bauxite are geographically dispersed. Nevertheless, in recent decades a small number of countries have accounted for much of noncommunist world bauxite production. In 1972, four countries accounted for more than 60 percent of bauxite production outside of the Soviet Union and Mainland China: Australia (24 percent), Jamaica (21 percent), Surinam (11 percent) and Guyana (6 percent). In response to the increasing demand for aluminum following World War II, the search for new and high-grade bauxite deposits was intensified, especially by newcomers to the primary aluminum industry. As a result of these efforts, large deposits were found in the Caribbean, Australia and Guinea. Apart from marginal or potential resources estimated world reserves almost quadrupled from 1950 to 1965. According to data reported for 1965, total noncommunist world reserves and potential resources of bauxite were equal to 15.3 billion tons, an amount sufficient to supply noncommunist output at recent rates for several hundred years. The greatest potential for increased production lies in Australia, Guinea, and Jamaica, which account for almost three-quarters of reported noncommunist bauxite reserves. There are also large deposits in the Dominican Republic and Haiti, Brazil, Guyana, French Guyana, Surinam, Yugoslavia, Ghana, and Indonesia.

Aluminum is the most abundant structural material in the earth's crust. Aside from the rich bauxite reserves that are known to exist, the earth has a virtually inexhaustible supply of other aluminum-bearing ores. According to a recent Bureau of Mines study, known reserves of these materials in the United States are equal to over 600 billion tons with an average Al_2O_3 content of 27 percent. The reserves primarily consist of anorthosite, but significant quantities of aluminum-containing clays, kyanite, laterites, and shale exist. Aluminum extraction from by-products of shale is a good possibility should shale oil extraction become a commercial reality. The potential aluminum resources in the United States by commodities and by grade are shown in the following table.

POTENTIAL SOURCES OF ALUMINUM, BY COMMODITIES AND GRADES

[million short dry tons]

Commodity	Total quantity	Plus 50	45–50	40–45	35–40	30–35	25–30	Average percent Al_2O_3
Anorthosite	599,490					6,500	592,990	27
Bauxite	388	50	28	13	146	31	120	36
Clays:								
Ball	813					765	48	30
Bauxite	297		9	288				42
Fire	8,276	11			795	1,351	6,119	27
Kaolin	3,288				1,310	596	1,382	33
Kyanite group	23						23	27
Laterite	1,313			38		425	850	29
Shale	810					60	750	28
Total	614,698	61	37	339	2,251	9,728	602,282	27

Source: U.S. Bureau of Mines, Potential Sources of Aluminum, information circular 8335, Washington, D.C. 1967.

Several factors favor the formation of a bauxite cartel. First a small number of countries in the Caribbean (primarily Jamaica, Surinam, and Guyana) along with Australia currently provide for about two-thirds of noncommunist consumption of bauxite. Their interests may be sufficiently similar to enable them to institute an effective cartel. Second, alumina plants are geared to process specific types of buaxite from certain areas; therefore in the short run construction of new alumina plants takes many years. In addition, tremendous investments in infrastructure (port facilities, roads, etc.) must be made to develop bauxite mines in many remote areas. Once the investments in this infrastructure are made it is a sunk cost. Therefore in the short run foreign bauxite producers may have great leverage over U.S. aluminum firms.

In March 1974 the International Bauxite Association was formed. Its members (Australia, Jamaica, Surinam, Guyana, Guinea, Yugoslavit, and Sierra Leone) account for 75 percent of the world's current bauxite production. Although the IBA reached no agreement on price and output targets, shortly after the meeting Jamaica demanded increased taxes equivalent to approximately $12 per ton; such an increase would approximately double the bauxite cost of aluminum production. These taxes, however, would result in price increases of aluminum of only $.03 per pound.

Following this action, Surinam, the Dominican Republic, and Australia have been pressing for increased taxes. In addition, all of the bauxite producers are urging an acceleration of the trend towards locating alumina and aluminum plants in the bauxite producing countries.

Ways in Which the Market Could Adapt to Cartel Formation

The increased bauxite costs from cartelization could result in an increase in aluminum prices of between 5 and 20 percent of current levels, at least in the short run. Studies of aluminum demand, which is fairly elastic, indicate a long-run price elasticity of —.80 in the United States and between —.03 and 0.9 in principal foreign countries. The higher aluminum prices would induce some decline in consumption.

The most important effect, however, would be the substitution of additional bauxite sources in the production process. Bauxite reserves are fairly widely distributed and significant quantities exist in countries which are not currently major producers, such as Brazil. Reserves in Australia and Guinea are so enormous that the active support of both countries would be essential for a successful cartel. It is likely that the Caribbean countries alone cannot increase prices as much as Jamaica recently has without encouraging substantial growth in bauxite production elsewhere, although it is not at all clear that Jamaica will be able to maintain its tax increase in the long run.

The possibility of aluminum production from other ores has been actively investigated for decades and may become profitable should bauxite costs remain at the current Jamaica level. For example, Anaconda has produced alumina from Georgia kaolin, Alcoa has investigated aluminum production from anorthosite and coal waste, Reynolds has successfully run laterite ore through its alumina refinery, and Pechiney is currently building a full-size commercial plant to produce auminum from a shale-based process. Although these firms have the best information on the exact cost of these alternate processes, published information indicates that some alternatives may become fesaible if bauxite prices remain at the current Jamaican level. Certainly a substantial price increase would induce a major redirection of at least the U.S. industry towards the alternative resources.

Factors Relevant to Short Run Supply Disruptions

The possibility of a major disruption in bauxite supplies seems remote. An interruption in supply from Australia is unlikely. The Caribbean countries might halt sales briefly as a bargaining ploy or U.S. firms might not purchase bauxite at the prices requested, but a concerted refusal to sell for more than several weeks seems unlikely.

In the event of an interruption in supplies, substitution possibilities in the short run are limited. Increased bauxite production in other countries or large-scale exploitation of U.S. resources sufficient to meet demand would require five to ten years.

Trends in the Absence of Cartels

There has been a trend in recent years to locate alumina and aluminum facilities near the bauxite-producing areas (i.e., in the Caribbean and Australia). There has been very little new construction in the United States of either alumina or aluminum facilities, and we now import significant quantities of alumina. These trends will undoubtedly accelerate in the future as a result of pressure from the bauxite-producing countries. The implications for the security of U.S. supply as a result of this trend should be the subject of some concern in the future.

Until recently aluminum prices in real terms have shown very little change, although the recent fluctuations of the business cycle and the indirect effects of price controls have caused sharp fluctuations. As a result of increased demand during the 1960's, the industry overbuilt capacity, and during the recession of 1970 and 1971 there was substantial overcapacity. The list price fell from $0.29 to $0.25, while the transaction price fell as low as $0.20 in early 1972. During this period there was very little growth in capacity in the United States, and between 1971 and 1973 total noncommunist aluminum reduction capacity increased only about 12 percent.

Strong economic growth in 1972 and 1973 led to a sharp increase in demand for aluminum and reported consumption in the noncommunist world rose 11.1 percent in 1972 and 16.2 percent in 1973. As the industry approached capacity production, open market prices shot upwards. The open market price in the United

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States has reached a level of approximately $0.50 in recent months, while the aluminum list price has increased from $0.29 to $0.335 since the aluminum producers were freed from price controls.

In the long run we should expect to see aluminum prices rising from the present level at about the rate of inflation. In the next two to three years, however, there will probably be enough pressure on aluminum production capacity to maintain transaction prices of aluminum above the list price. Aluminum consumption in the noncommunist world during the foreseeable future will probably grow at a rate of about 7 percent per year from the current base.

CHROMITE

Current U.S. Dependence on Imports

Except for minor amounts released from the GSA stockpile, all chromite processed in the United States is imported. Four countries (the Soviet Union, South Africa, the Philippines and Turkey) supplied about 85 percent of 1972 imports (on a gross weight basis), while Southern Rhodesia supplied an additional 9 percent. Only a very few countries, therefore, produced almost all of U.S. imports.

In 1972, chromite imports totalled 1,061 thousand short tons, valued at $27.6 million.[1] Total consumption was 1,140 thousand short tons, the difference representing a reduction in stocks. In addition, 68 thousand short tons of low carbon ferrochromium and 73 thousand short tons of high carbon ferrochromium were also imported.

Factors Relevant to Cartel Formation

Production and reserves are highly concentrated. The Soviet Union is estimated to be the largest producer of metallurgical chromite. Of noncommunist world production, 4.1 million short tons in 1972, four countries (South Africa, Turkey, Southern Rhodesia, and the Philippines) accounted for more than 75 percent. These countries are geographically and politically disparate, except for South Africa and Southern Rhodesia, which share many political and cultural ties. These latter two countries also appear to be most able to expand output easily, as reports in the trade press indicate that extraction costs for high grade ore are rising rapidly in both Turkey and the Philippines. The major uncertainty concerns the export policy of the Soviet Union, which increased its exports of metallurgical ore substantially during the Rhodesian boycott.

Ways in Which the Market Could Adapt to Cartel Formation

Chromite deposits in the United States are of very poor quality, and would probably not be economical to develop even if the producing countries formed a cartel. Chromite deposits in the rest of the world are quite plentiful and widespread. As shown in Table A-1, world reserves, even excluding the Soviet Union and Albania, are estimated to contain 700 years' worth of production at current levels. In the event of a cartel, however, the substantial expansion of production necessary from noncooperating countries would probably require 5 to 10 years. In some cases, the poorer quality ore grades would also require changes in the consumption technologies used.

Demand, in the short run, is quite inelastic. In our previous work, we estimated elasticities for the different end uses to be between roughly 0 and —0.2. These elasticities imply that a substantial increase in price would result in much less than proportionate losses in sales.

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[1] The valuation reported to customs appear low relative to prices reported in the trade press. A better estimate of delivered value in the United States might be twice the reported figure.

TABLE A-1.—ESTIMATED RESERVES[1] AND POTENTIAL RESOURCES OF CHROMITE ORE BY TYPE AND COUNTRY, 1960[2]

[Thousands of long tons of shipping ores and concentrates]

	Thousands of long tons[3]	Percent of world supply
Country:		
Union of South Africa	2,000,000	75.6
Federation of Rhodesia and Nyasaland	600,000	22.7
Turkey	10,000	.3
United States	8,000	.3
Republic of Philippines	7,500	.3
Finland	7,500	.3
Canada	5,000	(4)
Inbia	2,000	(4)
Malagasy Republic	2,000	(4)
Cuba	1,500	(4)
Yugoslavia	1,500	(4)
Iran	1,000	(4)
Greece	750	(4)
New Caledonia	600	(4)
Japan	500	(4)
Sierra Leone	150	(4)
Brazil	150	(4)
Pakistan	100	(4)
Cyprus	100	(4)
Others	1,000	(4)
Total	2,649,350	

[1] The figures for reserves and resources are intended primarily to indicate the relative importance of the countries based on available information; upon further exploration and development some figures may be increased several times.
[2] The Soviet Union and Albania have been excluded because of lack of adequate data on the reserves of these countries.
[3] This table does not disaggregate chromite reserves by ore type.
[4] Under 0.2 percent.

Source: Chromium: A Materials Survey, U.S. Department of Commerce, BDSA, 1962, p. 8, table 3.

In the longer run, high prices could lead to considerable substitution. In metallurgical uses, different grades of stainless steel (with higher concentrations of nickel, molybdenum, vanadium and other alloying agents) can, within limits, be substituted for grades requiring large amounts of chromium. Similarly, there are a number of substitutes for stainless steel itself, although at substantially higher prices. In refractory applications, higher chromite prices might lead to a substitution of magnesite. Higher prices for chemical grade chromite would probably lead to substitution away from chromium-based pigments and chromium tanning processes.

Because chromite accounts for such a small proportion of the price of the final products, substantial increases in its price could occur before they effected demand for the product. If all of the producing countries cooperated in raising prices, it seems likely that they could at least triple current prices for chromite, implying a doubling or tripling of revenues from U.S. consumers.

Short-run Supply Disruptions

Because there are five countries supplying large amounts of chromite to the United States, the problems that would be caused by a cutoff in supply from any one in isolation would probably not be severe. The Rhodesian boycott from 1966 to 1972 is an example of such a cutoff.[1] During the boycott, prices and quantities exported to the United States of Soviet and Turkish metallurgical chromite increased considerably. Methods of using South African ores were also developed during this period in response to the unavailability of Rhodesian

[1] The Rhodesian boycott is not an entirely clear example, however, in view of the numerous rumors of leakages of Rhodesian ores.

chromite in this country. Metallurgical chromite was released from the GSA stockpiles. Although the cutoff undoubtedly created problems for U.S. firms that relied on Rhodesian ores, their ingenuity in using South African ore, coupled with an increase in Soviet exports and in stockpile sales, seems to have enabled them to weather the period without severe economic hardship or cutbacks in production.

Trends in the Absence of Cartels

In the absence of successful cartel formation, it seems probable that world prices will not rise substantially in the near future. World reserves are more than ample, and technological change is lowering the cost of using poorer grade ores. There may be short-term tightness in the market, such as the current pinch due to the increases in the price of nickel.

Another trend seems to be increased imports of ferro-chromium at the expense of imports of metallurgical chromite. A variety of factors—including relative transportation costs, relative electricity costs here and abroad, and so forth—seem to be responsible for this trend, which, however, does not affect U.S. dependence on foreign sources of supply.

COBALT

Current U.S. Dependence on Imports

The United States imports virtually all the cobalt it consumes, except for amounts released from the GSA stockpile. Because of a sharp increase in stockpile releases, imports as a percent of consumption dropped from 93 percent in 1971 to 56 percent in 1972. U.S. cobalt consumption in 1972 was reported as 14.13 million pounds, of which 6.17 million was released from the stockpile. Total value of this consumption was $34.6 million (at the 1972 price of $2.45 per pound), while total value of imported cobalt was $19.5 million.

Factors Relevant to Cartel Formation

At present, cobalt production is quite concentrated. Zaire is the dominant producer; its 1972 output of 28.75 million pounds was 65 percent of world output of 44 million pounds. The next three largest producing countries—Canada, Zambia and Morocco—produced 10.85 million pounds, an additional 25 percent of world output. These four countries thus account for about 90 percent of world cobalt production.

This degree of concentration is quite conducive to cartel formation. Because of Zaire's dominant position, however, the current price is already close to the price that a cartel would charge. Using CRA's model of the cobalt market, we estimated that a cobalt cartel would raise the price only about $0.21 per pound, or less than 10 percent of the 1972 cobalt price. World cobalt consumption would fall by about 15 percent or 7.3 million pounds at 1972 consumption levels.

In the long run, the industry is expected to become much less concentrated with increases in New Caledonian production and deep-sea mining. Canadian and French groups are planning operations in New Caledonia, and U.S., Japanese and West German interests are making preparations for ocean mining.

Ways in Which the Market Could Adapt to Cartel Formation

As indicated above, a primary response to an increase in price due to cartel formation would be a decrease in consumption. Demand for cobalt is quite responsive to price, particularly over a 3 to 5 year time span. Production from New Caledonian and ocean mining sources would probably come onstream at a faster rate as well. We next discuss the implications of a very short-term profit-maximizing strategy on the part of cooperating cobalt producers.

Short-Run Supply Disruptions

We consider two sorts of disruptions—price increases to maximize short-run profits and a cutoff in supply. Using the CRA econometric model, we estimated that the 1 year profit-maximizing price charged by a cartel would be $9.14 per pound, or an increase of 273 percent over the 1972 price.

There are compelling reasons to believe that such a large increase would in fact never occur. For example, a cartel or Zaire would probably raise prices gradually for a number of years prior to the advent of new resources coming onto the market, this would prevent them from charging a price close to the short-run maximum price in the final year. Also, releases from the GSA stockpile might be used to dampen such price increases. Finally, consumer stocks, though not massive, would be able to ride out such a price or supply disruption if it only lasted a year, as is assumed here.

In the event of a supply cutoff, there are enough domestically held stocks to prevent severe shortages in most end uses. It should be realized that, unlike fuels, cobalt is used in durable goods which are themselves inventoried and can be made to last longer under exceptional circumstances.

Over the longer term, the important end uses of cobalt can economize on its consumption if substitutes are available. The major area of concern might be the use of cobalt in superalloys for jet aircraft. But even here, there are a number of substitute alloys using varying amounts of cobalt as well as the potential of recycling cobalt from existing turbines. Other major uses—magnetic alloys and catalysts—have large potential for substitution.

Market Trends with Current Structure

New suppliers, of varying importance, will appear through the 1970's: the Philippines, New Caledonia and possibly deep-sea mines primarily from U.S. firms. The potential output from the Philippines is about 7 percent of total production; from New Caledonia about 20 percent and from deep-sea operations the potential is practically unlimited, depending largely on the price of cobalt and by-product metals (as well as political constraints).

The price of cobalt should follow the rate of worldwide inflation and exchange rate adjustments until New Caledonian and deep-sea mining become important factors, if no producer or consumer cartel is formed and there are no dramatic changes in demand or supply. However, with the possibility of major new production centers in New Caledonia and ocean mining coming onstream in the late 1970's or early 1980's the normal pricing relationships may be altered.

COPPER

Current U.S. Dependence on Imports

The United States is largely self-sufficient in copper. In 1973, net imports of copper amounted to less than 3 percent of total consumption of 3.5 million short tons.[1] Four countries—Canada, Peru, Chile and the Philippines—accounted for 80 percent of total imports of primary copper in 1973, with Canada alone accounting for 36 percent of the total.

Factors Relevant to Cartel Formation

As the largest copper producer in the noncommunist world, the United States not only is well insulated against the impact of a foreign producer-country cartel, but is a major obstacle to the successful operation of such a cartel. The United States produced 26 percent of the total noncommunist world copper mined in 1973. The next three largest producers of copper are Canada, Chile, and Zambia, each of which accounts for about 12 percent of the noncommunist world total. CIPEC, the association of copper exporting countries (Chile, Zambia, Zaire, and Peru), provided 36 percent of the total amount of copper mined in the noncommunist world.

Because CIPEC output is only 36 percent of the world copper market, it is not at all clear that CIPEC would profit from forcing the price up by cutting back on the production of its member countries. In order for CIPEC's total revenues to increase in response to a 10 percent cutback in its members' production, world prices would have to increase by more than 10 percent. Given CIPEC's share of world output, this increase could occur only if world demand was very inelastic. Specifically, the demand elasticity would have to be between 0 and —0.3. Our econometric estimates suggest that the demand elasticity in the very short run is close to —0.3. Therefore the net gains to CIPEC from a cutback are problematical. Furthermore, because copper exports are a major source of foreign exchange for several of the producing countries, price increases or production cutbacks might imply a high risk of losing substantial quantities of foreign exchange.

In the long run, CIPEC or another cartel would have a very difficult time [illegible]ing the price of copper above competitive levels. Known copper reserves in the United States, estimated to be 189 million short tons, would satisfy the 1973 domestic consumption rate of primary refined copper for the next 97 years. Of

[1] Copper is traded in a variety of forms—ores, concentrates, matte, blister, refined and scrap. In some cases, conversion of units to copper content is ambiguous, although such ambiguities do not change the main points made here.

this 189 million tons, the Bureau of Mines considers only 83 million tons to be recoverable at a copper price of $.50 per pound. Using this estimate of reserves, we find that they are adequate to supply domestic consumption of primary refined copper for the next 43 years. In addition to known copper ore reserves in countries already contributing subsantially to world supply, new large copper mines have come onstream in Bouganville, an island in the Territory of Papua and New Guinea, and West Irian, Indonesia. A huge copper ore body in Iran will probably be developed in the future. The substantial amounts of copper in the world and wide dispersion of reserves make it unlikely that the bulk of the future copper supplies will fall under common control. The extent of copper that was discovered several years ago in response to rising prices also suggests that long-run copper supplies are fairly elastic.

Many copper uses are also elastic in the long run; the best example is the use of aluminum rather than copper in electrical wires. This substitution is not limited to electrical uses. Aluminum is replacing copper in end uses for architecture, heat exchange, plumbing, and hardware. Copper also faces competition from plastics in tubing. Because of the ample possibilities of substitution between copper and aluminum, representatives of major U.S. copper producers have spoken of the value of keeping copper prices low.

Recent Market Trends

In early 1973 world copper consumption began increasing rapidly with the worldwide economic boom; in the noncommunist world, copper consumption rose 10 percent. Normally, such a rapid rise in consumption would lead to higher prices in any event, but this particular increase was aggravated by supply problems. In the middle of the summer a rash of production problems, primarily in Canada and the United States, led to output reductions, etc., by major producers. These declared reductions ranged from 10 percent, for the installation of pollution control devices at Magma, to 40 percent, caused by labor problems and expansion delays at Gaipe (Canada). Technical production problems also occurred in Zambia, and labor problems cut back production in Chile and at the Olin, Belgium copper refinery. On the other hand, speculative demand for copper was spurred by the Middle East War and the coup in Chile. The price freeze in the United States exacerbated the situation as the London Metal Exchange (LME) remained the only free copper on the market. By December of 1973, the LME price averaged $1.0108 per pound of copper, almost twice the January 1973 average on the LME market of $0.5076.

In May 1974, U.S. copper producers increased their cathode price from $0.68 to $0.80. The new price was well below the LME prices of $1.45 to $1.48 per pound. By the end of June the U.S. producer price had risen to $0.85 per pound and the LME price had fallen to $1.01042 per pound. The LME price has now fallen to the U.S. producer price level, $0.85 per pound.

LEAD

Current U.S. Dependence on Imports

The United States does not depend heavily on imports of lead. In 1972, net lead imports were 304.4 thousand short tons, about 20.5 percent of total U.S. consumption of 1,485 thousand short tons. Total lead imports were valued at $884.5 million. Sales from the GSA stockpile have also been substantial in recent years, reaching 248 thousand tons in 1973.

Imports into the United States come from a small but diverse group of countries. In 1972, 84 percent came from Canada, Peru, Australia and Mexico, with Canada accounting for 33 percent of total imports.

Factors Relevant to Cartel Formation

Production and reserves of lead are not highly concentrated. The United States was the largest producer of mined lead in 1972, with only 16 percent of the world's output. The Soviet Union was the second largest producer with 13.3 percent. The next four largest producing countries in order of output are Australia, Canada, Peru, and Yugoslavia; they produced 39 percent of world ore excluding that of Communist China. These countries are geographically diverse and, except for Australia and Canada, have few political or cultural ties. This diversity, combined with relatively unconcentrated production, make the establishment of an effective cartel unlikely.

Ways in Which the Market Could Adapt to Cartel Formation

Although cartel formation appears unlikely, the effects of a successful lead cartel on the U.S. economy could be readily mitigated. The United States is the world's largest lead producer. In the past U.S. producers have displayed independence in their pricing policies and probably would not raise their prices to higher world levels. Production costs might increase as U.S. producers increased output in response to the cartel-induced shortage.

Since lead costs usually represent only a small percentage of the final cost of the goods in which it is used, lead consumption would not change substantially nor would prices of items containing lead rise significantly in the short run. Even if the United States were unable to obtain any foreign lead, the situation would not be critical. The GSA's stockpile is over 500,000 tons in excess and its sales could buffer the effects of a cartel in the short run. In the longer run ample opportunities exist for substitution away from lead in many end uses (e.g. petroleum additives, cable covering, soundproofing material, paint).

Trends in the Absence of Cartels

World demand for lead, which is growing at a very slow pace, is expected to increase by about 100 thousand tons between 1974 and 1977, an increase of approximately 2.1 percent. U.S. demand should decrease by about 50,000 tons during that same period. World prices in real terms should remain fairly constant for the near future.

However, some problems may arise with regard to lead availability in the long term. Total world lead reserves as estimated in 1962 were about 50 million tons, of which about 39 million tons were noncommunist reserves. The 1970 *Mineral Facts and Problems* notes that present reserves would not satisfy cumulative demand through the year 2000. Smaller unmined lead deposits are not now economically feasible due to high transportation costs for the bulk ore. Mini-technologies allowing smelting and refining of the ore site may alleviate this problem. If lead prices rise, many of these smaller deposits will become economical to mine.

MERCURY

Dependence on Imports

The United States relies heavily on imports of mercury. In 1973, U.S. general imports of mercury were 46,000 flasks, valued at $13.2 million and representing 84 percent of domestic consumption. This is a substantial increase from the import rate from 1970 to 1973, which averaged 27,000 flasks and represented 49 percent of average domestic consumption. During 1973 total U.S. consumption of mercury was 54.6 thousand flasks, worth $15.6 million at 1973 prices.

Probability of Cartel Formation

Spain and Italy jointly dominate world mercury production. In 1972, (the last year for which complete data are available), Spain accounted for 31 percent of the mercury produced in the noncommunist world. Spain and Italy together produced 52 percent, and Spain, Italy, Mexico and Yugoslavia provided 72 percent of noncommunist mercury production. These four countries, together with Turkey and Algeria accounted for 89 percent.

The large percentage of supply provided by a small number of countries suggests the possibility of a cartel. In fact, Italy and Spain have openly cooperated in their production and price decisions since before World War II. There have been brief periods of disagreement between the two countries (1949–1950 is the best example) but such periods have never lasted more than three years.

The large mercury price increase between 1963 and 1966 induced a large amount of entry into the market. As a result Italy and Spain's market share has decreased significantly. The high prices of 1963 to 1966 together with the advent of pollution controls and concern in 1967 to 1970 have greatly decreased the demand for mercury. Because of the decreased demand and increased supply, the number of countries necessary for an effective cartel has grown. There were three meetings in 1973 among the major producing countries and another meeting in May 1974; in the May 1974 meeting a firm price floor, $350 per flask by the end of 1974, was agreed upon by Italy, Spain, Mexico, Algeria, Yugoslavia, and Turkey and possibly by Canada. A cartel of all of the countries mentioned above would obviously be more powerful than one comprised of Italy and Spain alone. But for such a cartel to be effective, each country must consent to exceptionally low capacity utilization ratios. The incentive for a country to cheat on the rest of the cartel is exceptionally high. In addtion, it is difficult to monitor production activities in a country such as Mexico where much of the mercury is produced in isolated mountains and then smuggled from Mexico.

Ways in Which the U.S. Market Could Adapt to the Cartel

We estimate the U.S. long-run supply curve, which is quite elastic, to be around 3; the short-run elasticity is approximately 1. Long-run demand is nearly unity elastic and short-run demand is very inelastic. The result of a large decrease in mercury supplies in the short-run would be dramatic price increases because the major end uses of mercury, batteries and chlorine production, offer few possibilities for short-run substitution. Mercury batteries are very important in space and military technology; chlorine is a fundamental industrial chemical. In the longer run there is an alternate technology for chlorine production, the diaphragm cell, which could offset the need for the mercury used in chlorine production. The United States is currently capable of producing enough mercury to fulfill its consumption in electrical uses.

Using estimates developed by the Bureau of Mines, there are reserves mineable at $350 per flask in 1972 dollars in the United States. These deposits are capable of sustaining seven years' of domestic consumption at 1973 rates.

Market Trends

In May 1972, the price of mercury reached its lowest level since 1951, when it equalled $125 per flask. The price fell so low for three reasons: (1) pollution concern and controls greatly decreased the demand for mercury; (2) industrial production and activity in aerospace and the military were at very low levels; (3) the supply of mercury had been swelled by new mines in Canada and Algeria, induced by the recent previous history of high prices. Because of worldwide production cutbacks and increasing industrial activity, the price of mercury has now risen to $350 per flask. Nevertheless, after taking account of inflation, this price is well below mercury prices observed from 1950 to 1971.

MOLYBDENUM

Current U.S. Dependence on Imports

The United States has historically been, and continues to be, a net exporter of molybdenum. Almost 40 percent of U.S. molybdenum production was exported in 1972. As the major world supplier, the United States is in no danger of supply disruptions due to the formation of a producer-country cartel abroad.

Factors Relevant to Cartel Formation

As long as suppliers in the United States do not belong to a world cartel, there is little chance of such a cartel being formed in molybdenum. Not only is the United States the major molybdenum producer with over 60 percent of world production in 1972, but it also has the capability of expanding production.

The United States has known reserves in the Henderson mine of 300 million tons of ore averaging .49 percent molybdenite (MOS_2). This deposite could supply present consumption rates for the next 250 years. In addition, there are many other operating molybdenum mines in the United States. The most noteworthy of these is the Climax mine which has sufficient reserves to continue production at its present rate for the next 30 years.

Short-Run Interruptions

The short-run demand elasticities for molybdenum are very small. During periods in which existing molybdenum mines operate at very high capacity utilization ratios, the short-run supply elasticities are also quite small. It is possible, therefore, for short-run "shortages"—or periods of dramatic price increases, such as that experienced in 1963 to 1969—to occur. Such a "shortage" period could result from a natural disaster curtailing supply or from mistaken expectations by AMAX about the future course of demand. Such shortages must be short-lived because of the very high long-run supply elasticities for molybdenum.

Special Implications of Molybdenum for the Senate Inquiry

Since the United States has such an abundance of molybdenum, the use of molybdenum as a substitute for certain other metals should be noted. In many alloying applications molybdenum is an excellent substitute for tungsten or vanadium. Thus, domestic supplies of molybdenum can be used to mitigate the impact of possible shortages of these metals.

PLATINUM AND PALLADIUM

Current U.S. Dependence on Imports

Virtually all of the platinum and palladium consumed in the United States is imported. Three countries—the Soviet Union, South Africa, and Canada—directly or indirectly account for virtually all of U.S. imports of these metals. In recent years, the Soviet Union has directly supplied more than half of U.S. consumption of palladium and about one-third of platinum group metals as a whole. The total value of palladium imports in 1972 was $35 million while the total value of platinum imports was $73 million.

The Soviet Union, South Africa and Canada also have produced virtually all of the world's platinum and palladium in recent years, with 51 percent, 39 percent and 9 percent, respectively. Precise data on production of individual metals and on noncommunist world supplies are impossible to obtain due to a lack of data on the actual breakdown of consumption by country and on Soviet exports. However, the best indications are that in 1972 total world production of platinum was about 2.2 million ounces, with South Africa producing about 60 percent, the Soviet Union about 33 percent and Canada about 8 percent. Total world palladium production in 1972 was nearly 2.0 million ounces with the Soviet Union producing about 69 percent, South Africa about 22 percent and Canada about 8 percent. The noncommunist world is therefore dependent primarily on South Africa and secondarily on the Soviet Union for its platinum supply, and primarily on the Soviet Union and secondarily on South Africa for its palladium supplies.

Factor Relevant to Cartel Formation

As indicated above, platinum and palladium are already concentrated in the hands of a very few decision makers. Because of this degree of concentration, one would expect existing producers to exploit fully their advantageous market position. It is unclear whether South Africa and Russia act independently in the market, but in any case, one would expect, and indirect evidence indicates, that the market price of both platinum and palladium approaches the level that maximizes the net revenues of the industry as a whole. Studies performed on the platinum and palladium markets by Charles River Associates have indicated that the demand for platinum and palladium in a number of end uses is highly elastic with respect to price, which implies that further price increases would lead to substantial decreases in total revenue. This conclusion is supported both by econometric analysis and by investigation of the specific substitution possibilities for the various end uses of each metal.

It is possible that explicit collusion between South Africa and the Soviet Union could result in further price rises, although the probability of this is slight. Even if such collusion occurred, it is unlikely that the increase would be substantial.

Factor Relevant to Short-Run Supply Disruptions

Because there are so few producers, the platinum and palladium markets appear to be more vulnerable than most other metals and mineral markets to an interruption in supplies. As the Soviet Union accounts or the bulk of palladium entering trade channels and South Africa supplies the bulk of platinum, an interruption in supply from either country could have severe effects in the short run. It should be noted, however, that both the U.S. government and private industry carry very large stocks of both metals. For example, in the United States at the end of 1972, total refiner, importer and dealer stocks of palladium and platinum were 405 thousand ounces and 896 thousand ounces, respectively. Current GSA stocks of platinum and palladium are 453 thousand ounces and 1,255 thousand ounces, respectively.

Furthermore, substitution possibilities between the two metals are excellent in most end uses. If supplies were interrupted by the major producers of either metal, users could be expected to shift toward the other metal. With such substitution taking place, the three-million-ounce inventory of platinum group metals, together with domestic secondary recovery, would be sufficient to replace imports for two to three years at 1972 levels of domestic use.

Ways in Which the Market Could Adapt to Cartel Formation

There is no real possibility that the United States could become self-sufficient in platinum group metals. Known U.S. reserves that are economically recoverable are small, even at prices significantly above the recent norm. Similarly, there are only modest reserves elsewhere in the world. While Columbia and Canada might be expected to increase output somewhat should the Soviet Union and South Africa raise prices greatly, their reserves are small relative to world demand. Since platinum metals are mined as co-products of other metals in Columbia and Canada, supply is probably inelastic with respect to the price of platinum.

It would be more feasible to reduce demand in the event of cartel formation. While our estimated short-run price elasticities are low (below –0.7 for platinum and –0.2 for palladium), long-run elasticities in the various end-use categories are much higher. The long-run demand elasticity for platinum ranges from –1.3 in medical and dental uses to –2.8 in electronics, and palladium from –0.4 in medical and dental uses to nearly –1.0 in electronics. The latter industry dominates the market, accounting for about half of domestic consumption.

Because of substantial substitution possibilities between the different platinum group metals the estimates of price elasticities are less certain than we would like, although in the major end uses substitutions known to be feasible reinforce the evidence of price elasticity. Petroleum refining processes which do not require platinum exist, as do catalysts which use significantly less platinum than is currently standard. In the chemical industry, both platinum-saving processes and non-platinum catalysts have been developed for nitric acid formation. Both processes reportedly are competitive at current platinum prices. Since platinum is primarily a capital good in petrochemical and chemical uses, a shift to these platinum-saving technologies would result in dramatic reductions in import demand.

In electronics the use of palladium for telephone contacts, the largest single use, is reportedly price-sensitive. Palladium contacts are being slowly phased out at a rate determined by the price of palladium. Other electrical uses of platinum group metals are less price sensitive. Because every material has its own electrical properties, substitutions may require major component redesign. However, technologies to reduce or eliminate the need for platinum are being pursued. Finally, it should be noted that platinum demand is highly sensitive to environmental quality regulations. Catalytic converters will require large amounts of platinum, especially initially, and since converters require the use of lead-free gasoline, additional platinum will be required for the refining capacity needed to maintain octane ratings at their current levels. While these demands will ultimately decline as catalysts are recycled and new technologies developed, production of catalysts may require over a half-million ounces of platinum group metals per year by the late 1970's.

Trends in the Absence of Cartels

Because of the uncertainties surrounding the use of catalytic converters, it is difficult to predict the price of platinum in the absence of cartel formation. South Africa has increased production capacity substantially in anticipation of a large catalytic converter demand. Should this market fail to develop, the price of platinum might fall substantially. In addition, current markets are distorted by inflation-hedging speculation in the precious and noble metals. While prices may rise somewhat in the near term, it does not appear likely that the real prices of platinum group metals will continue to rise at significant rates over the longer run.

TUNGSTEN

Current U.S. Dependence on Imports

U.S. production of tungsten in recent decades has generally not been sufficient to supply U.S. consumption at prevailing prices. The extent of U.S. reliance on imports is complicated by the fact that the U.S. government, through GSA sales, has been a major supplier of tungsten to the market in most years since 1966. In 1972, a year in which there were essentially no sales by GSA, U.S. imports totalled 5.7 million pounds of ore and concentrates and supplied approximately 41 percent of the total U.S. consumption of 14.1 million pounds (contained tungsten). In 1973, with GSA sales at 1.3 million pounds (some of which were for export), imports were considerably higher—9.5 million pounds, or 58 percent of the total U.S. consumption of 16.3 million pounds.

In 1972, the last year for which detailed import data are available, Canada, Thailand, Peru and Bolivia supplied 72 percent of U.S. imports of ore and concentrates; Canada the largest supplier, provided 28 percent of imports. The next four largest suppliers, in order, are Australia, South Korea, West Germany and Malaysia; they provided another 21 percent.

The 5.7 million pounds of tungsten concentrate imports in 1972 were valued at $12.1 million. In addition, ferrotungsten and tungsten carbide worth $5.7 million was imported, while $2.4 million worth of ferrotungsten and tungsten carbide was exported. The United States consumed 14.1 million pounds of tungsten which, at the average realized market price (including duty) of $2.496 per pound. was worth $35.2 million.

Factors Relevant to Cartel Formation

World production and reserves of tungsten are fairly concentrated. According to published data, the Soviet Union and China are the world's largest producers, reportedly accounting for almost 40 percent of total world production in 1972. China has over 75 percent of world reserves. Despite this, however, according to data collected by Charles River Associates, communist countries in recent years have been small net importers of tungsten from the rest of the world, with imports by eastern Europe offsetting direct exports by mainland China. In 1972 net imports by the communist world of tungsten ores and concentrates were 1.519 million pounds of tungsten content.

In 1972 the United States produced 8.150 million pounds of contained tungsten, or approximately one-sixth of the total noncommunist production of 48.753 million pounds. Of the total foreign noncommunist production of 40.603 million pounds, four countries, Canada, Bolivia, Thailand and the Republic of Korea, accounted for slightly more than 50 percent. Foreign noncommunist production is essentially concentrated in ten countries, distributed throughout North America, South America, Europe, Asia and Oceania. The principal producers are geographically and politically disparate, and no one country outside the United States has a sufficiently large and stable supply of tungsten to attempt monopolization of its own. Another important consideration is that tungsten prices, because of the nature of the market, have been highly unstable; there has been a great deal of entry and exit of tungsten firms. An extreme example of instability on the supply side is provided by Thailand, whose production grew from about 1.5 million pounds in 1969 and 1970 to 5.5 million pounds in 1971, 7.4 million pounds in 1972, and dropped to an estimated 5.3 million pounds in 1973. This production, largely from alluvial deposits, is expected to decline in the future.

Another major factor in the tungsten market has been the volatile nature of net supplies from communist countries, which grew from essentially zero in 1957 to a peak of 9.5 million pounds in 1965; they have subsequently declined to negative values since 1968. Under such circumstances it would be exceedingly difficult for a stable core of producers to band together to reach agreement on output rates and price targets. Furthermore the countries that would be involved have few interests outside of the tungsten market. In fact, a recent meeting of the principal foreign tungsten-producing nations in an UNCTAD working group failed to obtain the involvement of mainland China and failed to reach any agreements on price and output policies. The working group remains in existence.

Factors Relevant to Short-run Supply Disruption

Tungsten production is so scattered geographically and the producing countries are so politically diverse that there is little possibility of severe dislocations in the United States arising from short-run supply reduction in the near future. The largest foreign noncommunist supplier, Thailand, produced just over 20 percent of noncommunist output in 1972, but its output is expected to decline in the near future. No other single country has such a large share of the market that denial of its supplies would cause severe economic difficulties in the short run.

Over a slightly longer period of time, problems could arise if net communist supplies increase to rates equivalent to those observed in the early 1960's. This would give the communist countries a large share of the export market to noncommunist countries. However, supplies from Canada, Brazil and Bolivia are expected to increase substantially in the near future, so that the prospects for this particular problem do not appear serious.

Ways in Which the Market Could Adapt to Cartel Formation and Supply Disruptions

Reserves of tungsten in the United States are reported to contain 175 million pounds of contained tungsten at $43/short ton unit, and also 190 million pounds at $63/short ton unit. These reserves are equivalent to approximately 25 years of U.S. output at 1972 production rates. Total reported foreign noncommunist reserves have been estimated at over 500 million pounds, equivalent to slightly more than ten years total noncommunist world production at recent rates of production.

Tungsten production rates, however, have historically been quite responsive to prices. According to studies performed by Charles River Associates, the long-run (5 or more years) elasticity of supply with respect to price is between 0.5 and 1.0 (.95 in the United States and .5 for the rest of the noncommunist world); the short-run (one year) elasticity with respect to price is between 0.10 and 0.15 (.15 in the United States and .11 in the noncommunist world).

Demand in the short run is also quite inelastic in terms of price. In our previous work we have estimated short-run price elasticities for both the United States and major foreign consumers to be approximately —0.15. This implies that price would have to increase by 100 percent to encourage consumption to decline by 15 percent over a one-year period. In the long run, however, demand is more price elastic, with an estimated value of somewhat less than —4 for the noncommunist world as a whole, (—.3 for the United States and —.37 for the rest).

Analysis of the end uses of tungsten suggests the possibility for considerable substitution in a number of cases. The actual substitution in times of very scarce supplies and particularly high prices might be even greater than indicated by the econometric results. Approximately 50 percent of total tungsten consumption is in cutting tool applications in the form of high-speed steel and tungsten carbide. High-speed steels contain various combinations of tungsten and molybdenum, and in many applications it is technically feasible to substitute molybdenum-intensive high-speed steels for tungsten-intensive high-speed steels. Such substitution has recently been taking place in the Soviet Union. Titanium carbides, high-speed steels and other cutting tool materials can substitute for tungsten carbide in many applications. Tungsten is also used as an alloy constituent in stainless and heat-resistant steel alloyed steel, and super alloys, although often the properties provided by tungsten can be provided by other materials.

Because both U.S. demand and U.S. supply appear to have substantial elasticities in the long run, the optimal price for an effective cartel of principal foreign producers is probably no more than several times prices observed in recent years. As the current market price of tungsten is approximately twice its average level in 1973, it is not clear that the optimal long-run price for a cartel is significantly greater than current prices.

The short-run economic dislocations that would occur as a result of a serious disruption in supplies might be quite severe, as stated above, but it seems unlikely that there would be a short-run disruption in supplies for more than one major producing area. In the past several years the largest foreign supplier of tunggsten has been Thailand, which reached a supply peak of over 7 million pounds in 1972. Simulations of the full CRA tungsten model indicate that if a supply of tungsten of this magnitude were lost, prices would increase somewhat less than $10 per short ton unit, or approximately 10 percent of the current market price. In fact, the actual price effect might be somewhat less since the industry normally carries fairly substantial stocks of tungsten; if the shortage were known to be of short-run duration these stocks would probably be used to offset some of the supply loss. In addition, the U.S. stockpile, which is currently over 100 million pounds, would be sufficient to offset for several years the worst effects of a supply loss of this magnitude.

Probable Trends in the Tungsten Market

During most of the past eight years the U.S. government has been a significant supplier of tungsten to the world market. Forecasts of the tungsten market therefore cannot be made independently of forecasts of government policies, which are beyond the scope of this paper.

The tungsten price doubled in the first half of 1974. Other things being equal, tungsten consumption at current prices can be expected to grow more slowly than overall industrial production, because high prices will induce some substitution away from tungsten. Tungsten supply is likely to increase in the medium term (3 to 5 years), particularly from Canada, Brazil and Peru, but no relief from higher prices should be expected in the near future. Over the longer term, prices can be expected to return to more normal levels (adjusted for inflation).

ZINC

Current U.S. Dependence on Imports

The United States imported 52 percent of the zinc it consumed in 1973; imports accounted for 701,311 metric tons out of a total consumption of 1,350,300 metric tons. Valued at approximately $218.3 million in 1973, these imports would be worth $538.8 million at July 1974 prices.[1] In addition, GSA stockpile releases of 102,086 metric tons accounted for about 8 percent of U.S. consumption.

Canada, Japan, Australia and Belgium supplied 77 percent of the zinc imported in 1973, with Canada providing over one-half of the total. Three other countries provided approximately 4 percent each—Mexico, Peru and Zaire.

Factors Relevant to Cartel Formation

Zinc is mined in significant quantities on all continents. The largest producers, including communist sources, account for 50 percent of world production and are located on three continents. Canada, Australia, Peru, Japan and Mexico mine 60 percent of the noncommunist supply. The United States produces 10 percent of the noncommunist supply. Among communist producers, the Soviet Union is the largest source of zinc with a mining output considerably larger than that of the United States.

Currently, a number of foreign producers cooperatively set a price for sales to the United States. However, the geographical dispersion and divergent political views of the major suppliers make the formation of an effective worldwide cartel unlikely.

Ways in Which the Market Could Minimize the Impact of a Cartel

We estimate that a cartel, to maximize its profits, would raise prices approximately 125 percent above current prices in the short run and 70 percent above current prices in the long run.

Disruptions would be moderate, concentrated in the automobile industry and other industries which rely heavily upon galvanized steel and die cast zinc products which account for over three-fourths of U.S. slab zinc consumption. Galvanized steel users would be forced to use thinner zinc coatings or alternative coatings, such as aluminum or paint. At the expense of shortened product lives, galvanizing could be eliminated entirely in some uses, which would reduce domestic zinc consumption approximately 36 percent. Aluminum and plastics could be substitutes for zinc in die casting uses. If zinc prices rise significantly above aluminum prices, a large portion of the die cast zinc markets would be diverted to aluminum. The principal disadvantage of casting aluminum is its higher melting point, a factor which shortens mold life.

Short-run Supply Disruptions

Zinc prices in the short run would have to rise probably as much as three and one half times the present level in order to clear the market unless a four month supply of the current GSA stockpiles were drawn. Price rises and shortages would be more severe in the unlikely event of a total import cutoff. When demand and supply forces adjusted to the shortages, this price would moderate to a level of perhaps twice the current price level. The sector affected most directly would again be the automobile industry. One could expect automobile production to be substantially curtailed in the short run.

In response to these high prices domestic mining production, which has declined 15 percent since 1968, would increase at rates sufficient to prevent further price increases with expansions in the overall economy. U.S. zinc reserves are large, estimated at 25 years of U.S. consumption at current levels. U.S. reserves make up more than one-fourth of total noncommunist supply.

Worldwide potential supply increases by smaller producers would also limit the effectiveness of a cartel formed by the major mining countries. In addition to the major suppliers discussed above, ten countries each produce more than one percent of the noncommunist world total.

Trends in the Absence of Cartels

In the absence of a major supply interruption, U.S. zinc consumption can be expected to remain at about 1973 levels throughout 1974 and 1975, and then to increase by 5 percent in 1976 and 1977. On the average, growth should approxi-

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[1] Ores valued at half of the metal price. The July price used was $ .40/pound.

mate recent average annual growth rates of 2 percent. In the past the growth rate has been uneven since it depends somewhat upon automobile production, which accounts for 60 percent of die cast zinc consumption. Consumption decreases resulting from automobile size and weight reductions may be offset by the substitution of zinc for aluminum and petroleum-based plastics products which are experiencing substantial price rises.

Because domestic zinc output has decreased in recent years, there have been rapid increases in dependence on imports. Domestic mining output has declined substantially since 1951, and U.S. smelter output reached its peak in 1969. Although smelter and mine output have both declined recently, even in the past smelter output substantially exceeded mine output, requiring imports of ores and concentrates.

Transportation costs and increases in modern smelter capacity outside the United States have reduced the profitability of producing zinc from imported ores in the relatively expensive pre-World War II U.S. refineries. As a result, U.S. smelter capacity has declined by 50 percent since 1969 and is rapidly approaching equality with U.S. mine production.

Recent zinc price rises may halt further declines in domestic mine production and smelter output. Several U.S. refineries are scheduled to open in the next three years. Despite any domestic increases in output, however, the dependence on imported zinc can be expected to increase as a percentage of total U.S. zinc consumption.

Zinc price increases over the past 18 months are the result of unprecedented strains on world zinc smelting capacity caused by a surge in world zinc consumption. Artificially restrained U.S. domestic zinc prices rose only $ .02 from $ .186 to $ .206 per pound from January through November 1973. When controls were removed, domestic producer prices immediately increased $.07 in December. During the first half of 1974 domestic producer prices have risen an additional $.125, if the $.04 price rise recently introduced by one producer is followed. Prices outside the United States have also risen substantially. Uncontrolled London Metal Exchange zinc prices reflecting the capacity shortage skyrocketed in 1973 reaching a monthly peak at 700.17 £/MT in December of 1973 from a January average of 160.25 £/MT. A second monthly peak of 738.42 £/MT was reached in June of 1974. Since that time London Metal Exchange zinc prices have declined to 468 £/MT, as of July 12, 1974.

METAL PRICES, 1947–74

	Aluminum (cents per pound)		Chromite (dollars per long ton)	
	Current dollar	1973 dollar	Current dollar	1973 dollar
1947	15.00	26.56863	NA	NA
1948	15.74	25.75809	41.0	67.09541
1949	17.00	29.26938	40.0	68.86912
1950	17.69	29.30312	40.0	66.25917
1951	19.00	28.26015	51.0	75.85620
1952	19.40	29.66930	55.0	84.11400
1953	20.93	32.44868	55.0	85.26888
1954	21.78	33.68938	47.0	72.69977
1955	23.67	36.52944	50.0	77.16401
1956	26.01	38.85728	53.0	79.17861
1957	27.52	39.96742	58.0	84.23365
1958	26.89	38.51580	54.0	77.34672
1959	26.85	38.37737	39.0	55.74367
1960	27.23	38.87951	37.0	52.82929
1961	25.46	36.50614	37.0	53.05291
1962	23.88	34.13228	37.0	52.88502
1963	22.62	32.43397	37.0	53.05291
1964	23.72	33.93939	30.0	42.92503
1965	24.50	34.36594	30.0	42.08075
1966	24.50	33.23073	34.0	46.11612
1967	24.98	33.84790	34.0	46.07000
1968	25.57	33.80229	36.0	47.59024
1969	27.18	34.58113	38.0	48.34742
1970	28.72	35.24964	48.0	58.91304
1971	29.00	34.49956	55.5	66.02502
1972	26.45	30.09215	55.5	63.14232
1973	25.33	25.33000	37.0	37.00000
1974	33.50	29.15000	50.0	44.36800

Notes: 1974 price is most recent available spot obesrvation. Current prices deflated by BLS. wholesale price index for all commodities (converted to base 1973=100).

Source: Aluminum; American Metal Market, "Metal Statistics" (annual) and "Metals Week." Chromite; "Metals Week" (48 percent chromite oxide, 3:1 Turkish chromite).

COPPER PRICES, 1947-74

	U.S. producers' price (cents per pound)		L.M.E. price	
	Current dollars	1973 dollars	Pounds sterling per long ton (current dollars)	U.S. cents per pound (1973 dollars)
1947	20.958	37.12169	130.540	41.58413
1948	22.038	36.06460	134.000	39.46489
1949	19.202	33.06052	133.039	37.70422
1950	21.235	35.17534	178.782	37.02784
1951	24.200	35.99451	220.362	40.96430
1952	24.200	37.01016	259.475	49.47227
1953	28.798	44,64679	256.275	49.88954
1954	29.694	45.93079	249.349	48.36154
1955	37.491	57.85912	352.276	67.74642
1956	41.818	62.47342	329.081	61.35887
1957	29.576	42.95335	219.642	39.77655
1958	25.764	36.90298	197.846	35.54699
1959	31.182	44.56921	237.833	42.62613
1960	32.053	45.76587	246.004	44.02532
1961	29.921	42.90260	229.792	41.21863
1962	30.600	43.73734	234.100	41.94213
1963	30.600	43.87619	234.775	42.07938
1964	31.960	45.72946	352.879	62.93585
1965	35.017	49.11805	469.875	82.26557
1966	36.170	49.05941	554.471	93.77252
1967	38.226	51.79623	417.338	69.43446
1968	41.847	55.31969	523.975	74.01358
1969	47.534	60.47753	621.254	84.33871
1970	57.700	70.81839	587.902	77.17841
1971	51.443	61.19865	451.561	58.61661
1972	50.617	57.58693	434.827	55.22999
1973	58.865	58.86500	738.767	80.83562
1974	85.971	74.81740	NA	86.86190

Notes: 1974 price is most recent available spot observations. Current prices deflated by BLS wholesale price index for all commodities (converted to base 1973=100). L.M.E. prices converted to U.S. currency via United States-United Kingdom exchange rates. The BLS deflator (see above) is then applied.

Source: "Metals Week" and American Bureau of Metal Statistics, "Yearbook" (annual).

LEAD PRICES, 1947-74

	U.S. producers' price (cents per pound)		L.M.E. price	
	Current dollars	1973 dollars	Pounds sterling per long ton (current dollars)	U.S. cents per pound (1973 dollars)
1947	14.673	25.98943	85.00000	27.07715
1948	18.043	29.52689	95.50000	28.12609
1949	15.364	26.45263	103.1900	29.24495
1950	13.296	22.02455	106.4160	22.03999
1951	17.500	26.02909	162.0450	30.12344
1952	16.467	25.18373	136.7540	26.07392
1953	13.489	20.91258	91.49600	17.81170
1954	14.054	21.73878	96.44900	18.70640
1955	15.138	23.36218	105.8640	20.35877
1956	16.013	23.92240	116.3130	21.68717
1957	14.658	21.28788	96.63900	17.50105
1958	12.109	17,34429	72.78300	13.07692
1959	12.211	17.45349	70.77900	12.68552
1960	11.948	17.05958	72.14600	12.91138
1961	10.871	15.58752	64.21200	11.51794
1962	9.6310	13.76583	56.28800	10.08475
1963	11.137	15,96893	63.43800	11.37017
1964	13.596	19.45362	101.2500	18.05790
1965	16.000	22.44306	115.0900	20.13416
1966	15.115	20.50133	95.15000	16.09183
1967	14.000	18.97000	83.76300	13.93604
1968	13.212	17,46562	101,7960	14.37910
1969	14,895	18,95092	122,7000	16.65721
1970	15.619	19.17006	126.4270	16.59704
1971	13.815	16.43488	105.4560	13.68912
1972	15.029	17.09848	122.5150	15.56137
1973	16,285	16.28500	177.8589	19.46126
1974	24.500	24.32150	NA	22.47800

Notes: 1974 price is most recent available spot observation. Current prices deflated by BLS wholesale price index for all commodities (converted to base 1973=100). L.M.E. prices converted to U.S. currency via United States-United Kingdom exchange rates. The B.L.S. deflator (see above) is then applied.

Source: "Metals Week" and American Bureau of Metal Statistics, "Yearbook" (annual).

ZINC PRICES, 1947-74

	U.S. producers' price (cents per pound)		L.M.E. price	
	Current dollars	1973 dollars	Pounds sterling per long ton (current dollars)	U.S. cents per pound (1973 dollars)
1947	10.500	18.59804	70.00000	22.29883
1948	13.589	22.23804	80.02708	23.56910
1949	12.144	20.90867	87.51667	24.80299
1950	13.866	22.96874	119.2149	24.69079
1951	18.000	26.77278	171.6920	31.91677
1952	16.215	24.79834	149.4460	28.49381
1953	10.855	16.82898	75.12080	14.62391
1954	10.681	16.52141	78.21290	15.16949
1955	12.299	18.98080	90.68940	17.44054
1956	13.494	20.15917	97.76600	18.22898
1957	11.399	16.55482	81.61650	14.78052
1958	10.309	14.76606	65.90520	11.84119
1959	11.448	16.36291	82.12720	14.71942
1960	12.946	18.48454	89.31880	15.98465
1961	11.542	16.54964	77.75560	13.94730
1962	11.625	16.61590	67.45760	12.08593
1963	11.997	17.20205	76.76560	13.75891
1964	13.568	19.41356	117.3870	21.02511
1965	14.500	20.33903	112.9720	19.77910
1966	14.500	19.66717	102.0060	17.25132
1967	13.843	18.75727	100.5470	16.72847
1968	13.500	17.84634	111.1610	15.70194
1969	14.600	18.57559	121.1310	16.44421
1970	15.319	18.80185	123.1280	16.16396
1971	16.128	19.18651	128.7930	16.71847
1972	17.753	20.19758	153.4030	19.48464
1973	20.658	20.65800	352.2630	38.54449
1974	34.500	30.02410	NA	50.14460

Notes: 1974 price is most recent available spot observation.C urrent prices deflated by BLS. wholesale price index for all commodities (converted to base 1973=100). LME prices converted to U.S. currency via United States-United Kingdom exchange rates. The BLS deflator (see above) is then applied.

Sources: "Metals Week" and Mettallgesellschaft Aktiengeselshaft, "Metal Statistics" 1962-72.

METAL PRICES, 1947-74

	Cobalt (dollars per pound)		Mercury (dollars per flask)	
	Current dollars	1973 dollars	Current dollars	1973 dollars
1947	1.580	2.798562	83.740	148.3238
1948	1.650	2.700181	76.490	125.1739
1949	1.760	3.030241	79.460	136.8085
1950	1.800	2.981663	81.260	134.6055
1951	2.170	3.227607	210.13	312.5424
1952	2.400	3.670429	199.10	304.4927
1953	2.430	3.767334	193.03	299.2628
1954	2.600	4.021689	264.39	408.9594
1955	2.600	4.012528	290.35	448.0914
1956	2.580	3.854355	259.92	388.3039
1957	2.030	2.948178	246.98	358.6901
1958	2.000	2.864693	229.06	328.0933
1959	1.770	2.529905	227.48	325.1428
1960	1.540	2.198841	210.76	300.9271
1961	1.500	2.150794	197.61	283.3456
1962	1.500	2.143987	191.21	273.3012
1963	1.500	2.150794	189.45	271.6452
1964	1.500	2.146251	314.79	450.4123
1965	1.630	2.286387	570.75	800.5862
1966	1.650	2.237988	441.72	599.1297
1967	1.850	2.506750	489.36	663.0828
1968	1.850	2.445610	535.56	707.9842
1969	1.890	2.404648	505.04	642.5626
1970	2.200	2.700181	407.77	500.4786
1971	2.200	2.617208	292.41	347.8626
1972	2.450	2.787364	218.28	248.3370
1973	3.007	3.007000	286.23	286.2300
1974	3.450	3.016000	345.00	300.2408

Notes: 1974 price is most recent available spot observation. Current prices deflated by BLS wholesale price index for all commodities (converted to base 1973=100).

Sources: Cobalt: "Metals Week." Mercury: "Metals Week" and U.S. Bureau of Mines, "Minerals Yearbooks" and "Mineral Industry Surveys."

METAL PRICES, 1947–74

	Tungsten (dollars per pound)		Wholesale Price Index (all commodities) (1967=100)	United States–United Kingdom (exchange rate) (U.S. dollars per U.K. pound)
	Current dollars	1973 dollars		
1947	1.2760	2.260105	76.5	4.0286
1948	1.3610	2.227240	82.8	4.0313
1949	1.0260	1.766493	78.7	3.6872
1950	1.4580	2.415147	81.8	2.8007
1951	4.2950	6.388282	91.1	2.7996
1952	3.5140	5.374120	88.6	2.7926
1953	2.1750	3.371997	87.4	2.8127
1954	1.2550	1.941239	87.6	2.8087
1955	1.9560	3.018656	87.8	2.7913
1956	1.9740	2.949030	90.7	2.7957
1957	1.0970	1.593178	93.3	2.7932
1958	.64700	.9267283	94.6	2.8098
1959	.86600	1.237795	94.8	2.8088
1960	1.2210	1.743367	94.9	2.8076
1961	.96800	1.387979	94.5	2.8022
1962	.67400	.9633650	94.8	2.8078
1963	.55400	.7943598	94.5	2.8000
1964	.93100	1.332107	94.7	2.7921
1965	1.6460	2.308830	96.6	2.7959
1966	2.3370	3.169805	99.9	2.7930
1967	2.7670	3.749285	100.0	2.7504
1968	2.5770	3.406668	102.5	2.3935
1969	2.9270	3.724023	106.5	2.3901
1970	4.4380	5.447002	110.4	2.3959
1971	3.1220	3.714056	113.9	2.4442
1972	2.2330	2.540483	119.1	2.5008
1973	2.5400	2.540000	135.5	2.4510
1974	5.7728	5.023800	NA	2.4000

Notes: 1974 price is most recent available spot observation. Current prices deflated by BLS. wholesale price index for all commodities (converted to base 1973=100). Wholesale Price Index: The 1974 value is listed as "not available" because various monthly indexes were used, depending on the date of the most recent price data available for each metal.

Sources: Tungsten: U.N. Conference on Trade and Development, "Tungsten Statistics" and "Metals Week." Wholesale price index: U.S. Bureau of Labor Statistics. Exchange rate: Federal Reserve Board.

METAL PRICES, 1947–74

	Molybdenum (dollars per pound)		Platinum (dollars per troy ounce)	
	Current dollars	1973 dollars	Current dollars	1973 dollars
1947	0.750	1 328431	59.090	104.6627
1948	.750	1.227355	86.250	141.1458
1949	.900	1.549555	73.360	126.3060
1950	.910	1.507396	76.560	126.8200
1951	1.000	1.487377	90.000	133.8639
1952	1.000	1.529345	90.000	137.6411
1953	1.000	1.550343	91.238	141.4502
1954	1.002	1.549897	83.897	129.7722
1955	1.052	1.623531	85.978	132.6881
1956	1.128	1.685160	103.896	155.2140
1957	1.180	1.713719	89.451	129.9101
1958	1.192	1.707357	64.925	92.99511
1959	1.250	1.786656	73.250	104.6980
1960	1.250	1.784773	81.729	116.6942
1961	1.338	1.918508	82.000	117.5767
1962	1.400	2.001055	82.000	117.2046
1963	1.400	2.007407	79.755	114.3577
1964	1.512	2.163421	87.985	125.8919
1965	1.550	2.174172	97.583	136.8788
1966	1.550	2.102352	99.167	134.5058
1967	1.618	2.192390	108.509	147.0297
1968	1.620	2.141561	114.500	151.3634
1969	1.686	2.145099	121.667	154.7970
1970	1.720	2.111051	130.000	159.5562
1971	1.720	2.046181	120.524	143.3802
1972	1.720	1.956843	120.779	137.4102
1973	1.720	1.720000	150.036	150.0360
1974	2.050	1.784000	195.000	169.7013

Notes: 1974 price is most recent available spot observation. Current prices deflated by BLS wholesale price index for all commodities (converted to base 1973=100).

Sources: Molybdenum: U.S. Bureau of Mines, "Minerals Yearbooks" and "Metals Week." Platinum: "Metals Week" and American Bureau of Metal Statistics, "Yearbook."

Chairman BENTSEN. The hearing will continue tomorrow, and we will move from the subject of technology and market forces to the international negotiations and trading arrangements to try to provide more reliable raw materials prices at stable prices. And in that hearing Mr. William D. Eberle, the President's Representative for Trade Negotiations, will be here to testify before us.

We will recess until that time.

Thank you, gentlemen, for your testimony.

[Whereupon, at 12:15 p.m., the subcommittee recessed, to reconvene at 10 a.m., Tuesday, July 23, 1974.]

OUTLOOK FOR PRICES AND SUPPLIES OF INDUSTRIAL RAW MATERIALS

TUESDAY, JULY 23, 1974

CONGRESS OF THE UNITED STATES,
SUBCOMMITTEE ON ECONOMIC GROWTH OF THE
JOINT ECONOMIC COMMITTEE,
Washington, D.C.

The subcommittee met, pursuant to notice, at 10:05 a.m., in room 1202, Dirksen Senate Office Building, Hon. Lloyd M. Bentsen, Jr. (chairman of the subcommittee), presiding.

Present: Senator Bentsen.

Also present: William A. Cox and Larry Yuspeh, professional staff members; Michael J. Runde, administrative assistant; and Walter B. Laessig, minority counsel.

OPENING STATEMENT OF CHAIRMAN BENTSEN

Chairman BENTSEN. The hearing will come to order.

Over the last several years we have seen a dramatic rise in the price of raw materials critical to our economy. It can be argued that the raw materials crunch has been due to special, temporary circumstances such as the combination of worldwide boom in industrial activity, commodity speculation, and dollar devaluation. At the same time, however, we must realize that U.S. dependence on foreign raw materials suppliers will continue to increase in the years ahead. The developing countries which control access to major sources of minerals are under increasing financial pressure and political pressure to exact a higher and higher price for their scarce resources.

We have seen this in the case of bauxite that we were talking about yesterday before this committee.

We are pleased to welcome this morning Mr. William Eberle, the President's Special Representative for Trade Negotiations, and the newly appointed Executive Director of the Council of International Economic Policy, to testify before us on these problems.

Mr. Ambassador.

STATEMENT OF HON. WILLIAM D. EBERLE, SPECIAL REPRESENTATIVE FOR TRADE NEGOTIATIONS, AND EXECUTIVE DIRECTOR, COUNCIL ON INTERNATIONAL ECONOMIC POLICY

Mr. EBERLE. Mr. Chairman, it is a pleasure to be with you this morning and discuss some of these matters of mutual concern.

I would like to file for the record, if I could, my complete statement along with the attachments. The attachments themselves are rather long, but I think the papers which were used as a basis for a similar discussion by the First World Symposium on Energy and Raw Materials in Paris in June are worth looking at. I think you will find them very interesting.

Chairman BENTSEN. Thank you, Mr. Eberle, your prepared statement, and attachments, will be made a part of the hearing record at the end of your oral testimony.

Mr. EBERLE. Mr. Chairman, we have been analyzing this question from really two different points of view. The first is from the standpoint of specific commodities. I am not going to go into that aspect of the problem, because it has been studied on an interagency basis, and representatives of State and some other agencies will be testifying on that tomorrow. We have contributed to that study.

We have also been looking at this question from the broader approach of a more general need for international rules on access to supply.

Before I get into that, though, let me make a few comments without duplicating the testimony of yesterday, or of what you may hear tomorrow.

I think it is important to say that I share the skepticism of yesterday's witnesses that either natural or artificially induced scarcities are likely to arise which will seriously disrupt the U.S. economy to anywhere near the same extent as did the recent actions by the oil-producing countries. The world supply of raw materials could well become depleted over a period of time, but I think there will be gradual price adjustments which will bring new market technology and substitute materials into play which will solve this problem generally.

So, having said that, as a basic parameter, that I do not think we are likely to face major economic dislocation, it does not follow that arbitrary actions by foreign supplies will have no adverse repercussions on our economy. They will, and they may.

Even if attempts to restrict supply prove to be unsuccessful in the long run because of alternative supplies, it could take time before the alternative supplies or substitutes can actually reach the market. It is on this interim period that I think we really have to focus our attention.

Now, one of the problems that we face in such a situation is that before the alternate supplies become available, the attempt by producers to restrict the production and to raise the prices artificially, will have its intended effect; and then when the alternative supplies come onstream, you have a glut on the market. This builds instability. It builds instability into the market for two reasons.

First of all, manufacturers cannot be sure of access to the raw materials; at the same time domestic suppliers of raw materials cannot be sure of the prices that they are going to get, and therefore, they hold back investment. It is that combination of uncertainties that worries us.

I think if you look at what the market will do you will understand my concern. To illustrate, I will give you two examples which occurred in the past year: One was the situation of last year when the Japanese economy and our economy both peaked out at the same period in the cycle; this situation generated a tremendous demand for logs for the housing industry. Today, the Japanese, having purchased all those logs—and it did appear to us that they were stockpiling them—are selling them at a much lower price, which is painful to the Japanese economy and is driving the world price of logs below what the normal price would have been.

You may also see the same thing happen in the case of bauxite. The price will be driven up, and new supplies will come on stream in the United States. You can be sure that as the developing countries which had raised their prices lose their market share to a domestic supplier who will be more stable and more sure, they will reduce their price, and then those American industries will be in here asking for the U.S. Government to take action to protect their investment.

My guess is that when you look at some of the things that we propose in the new trade bill, it will be very difficult not to respond in giving that protection in order to assure that we have a stable market and that we are following a consistent policy.

I do not say that it should happen, I am saying that realistically that is the practice that we can anticipate from market forces, regardless of the politics of the situation.

Let me go on to a couple of general points in this area. When we consider that there is in the long run the ability to reduce uncertainty of supply and dependence on foreign supply by our own development of substitute materials. There will be a tendency and pressure, I think, to consider another course, that is, for the United States to try to become self-sufficient today. This, I think, would be a serious mistake. First of all, it would be extremely expensive, highly inflationary, and it would raise costs well beyond what they are today.

Chairman BENTSEN. Let me understand this, Mr. Ambassador.

Will you repeat that so that I can be sure I understand it?

Mr. EBERLE. In the short run there will be a tendency and pressures for the United States to become self-sufficient in some of these products and raw materials, on which countries attempt to apply pressures.

Now, what happens here is that we could move at a high cost to do that right away. For example, let us take the banana situation. I am not sure we could find some place where they could be raised in a hothouse. But I do not think that is the kind of thing we ought to be doing. I think we have to be very selective in what areas we want to become self-determinative of the ability to have our own domestic supplies, because we cannot afford the extra investment and the high inflationary costs of developing a total self-dependency in the United States.

Chairman BENTSEN. I would certainly agree with that.

How do you feel about energy?

Mr. EBERLE. I think energy is one field where we simply have to proceed toward this ability. I make that the ability to be self-sufficient is quite different from having total supplies. By that, I am suggesting that that ability may mean that though we may have some standby plants or standby wells that we can use so that we will not be entirely cut off, we do not have to go all the way to self-sufficiency in itself and that as we have the ability to move in that direction in the short term—and you may hear some of this tomorrow—we are at the same time trying to work toward the sharing of oil and energy, so that if another emergency comes up we will have a better chance of having a longer period for turnaround on the one side, and on the back side to have this ability to crank up energy-related resources. I do not think we are far enough along in the studies to assure you of what those, let's say, standby facilities may be. One could speculate, and I think that is all one could do at this time, but it is that ability to have the time to turn around that is important.

Chairman BENTSEN. I agree with you, Mr. Ambassador, we cannot be self-sufficient in all of these things.

It seems to me that when we are talking about energy that what we want to do is protect ourselves up to a point where we cannot be brought to our economic knees in effect by an embargo. It may be painful for us, but we can continue to move along and finally to bring into focus our own productive capacity for energy that will carry us through.

Mr. EBERLE. I think energy is one of the very few cases where that is true. And I would agree with that.

Let me move to another point that I want to make: I do not want to neglect the political dimensions of this issue, because arbitrary actions taken by one country on the supply of raw materials are clearly going to affect other countries and will in turn invite a counteraction.

Now, what happens in that case is that you start to politicize the world trading system. That is why I have the personal belief that we must focus hard to see that we have a trading system that will work, that has rules and guidelines that will keep many of these specific trade problems out of the political process. I recognize that in order to do this we have to create the political will to change the international trading system. However, the political will to change that system is quite different from the arbitrary political actions, such as in the case of oil, which countries can take. Countries know that there is a certain procedure—or a range of acceptable procedures which they are expected to follow, and if they violate them, they know the kind of actions that can be taken against them.

I am sure that with very few exceptions you would have a better chance of managing these kinds of problems under such a system than you would do when there is a trading system that has wide gaps in it and which does not allow the kind of management that I think is necessary.

NEGOTIATING AUTHORITY FOR THE SPECIAL TRADE REPRESENTATIVE

Chairman BENTSEN. Do you have the authority under this new trade bill that has been proposed to negotiate those kinds of conduct or agreement?

Mr. EBERLE. The answer is "Yes," but in saying that, there are two aspects to it, Senator.

The first one lies in the export administration bill which provides for authority for this Government to respond with export controls where other governments take export actions against us.

In the trade bill you have a different kind of situation, in which export controls may not be the proper response. Where you have unreasonable or unfair actions taken such as the ones that we are talking about, you then have the broader authority in the trade bill not only to take import restrictions, but to work out other kinds of agreements. We need both kinds of authority in order to manage the problem well.

The authority is in the two bills and with, I would hope, the addition of the Mondale-Ribicoff amendment on which I have testified before, I think our valuable improvement to the trade bill becomes more specific, and it should be added to the trade bill.

Mr. Chairman, my concerns not only cover those restrictive supply actions which countries may take in order to raise the prices they feel they can obtain, but also to recognize the actions they may take for political ends.

On the first side, countries which are faced with a sudden decline in domestic supply of a critical commodity, for instance, may need to regulate the distribution of these supplies, or a country with a price control program may need to prevent a diversion of domestic supply. But no matter how legitimate any individual country's actions may be, it does have an impact on somebody else. That is why it is necessary to look at how we should manage a situation where the action is legitimate.

Now the other side contains situations where other countries take export actions which affect us. For example, in the case of scrap steel where we had become the only country with a free market, we had to take action to protect our exports of scrap steel, because we had been the only country that had not closed off its exports. We must have this kind of ability to respond to the various kinds of actions, whether they be legitimate or illegitimate.

Now, let me start by saying that I think it is useful in looking at these possibilities to start with the GATT, because the GATT spells out existing international trade rules. It makes a distinction between export quotas and export duties as it does on the import side. Quotas are prohibited in general, but permitted under a number of exceptions which are quite broadly defined. Duties are permitted unless a country has agreed to limit the duty on a specific commodity to a specified maximum rate.

In practice it is extremely rare for a country to bind its export duties, and the prohibition on export quotas is virtually worthless.

Having said that with respect to the foundation of the rule itself, I do not think that we should say that it is totally ineffective. Although it is not an effective basis, the rule does give us the foundation on which to build and make improvements in the trading system.

I might point out here that we would foresee that the negotiations to improve these rules would follow really two separate tracks.

One involves the possible exchange of specific commitments on individual commodities of interest to different countries and the establishment of the conditions and frame-work necessary for the exchange of such commitments.

The other track would follow the line of general guidelines for actions under certain conditions.

Let me try to illustrate these two tracks to you.

The first track would make it possible for exporting countries which have strong market positions in a particular commodity to obtain trade concessions in other areas in lieu of the benefits they believe they are able to obtain by imposing export restrictions, while importing countries which feel particularly exposed on certain commodities would be able to insure themselves against artificial interruption of supply of such critical commodities.

We have not fully explored the type of specific commitments that might be exchanged, but I could give you some example of how it might work.

One approach which would most closely parallel that which has been successfully used to reduce import barriers would be to exchange a commitment by country A not to restrict, or to limit restrictions on exports which are of interest to country B for a commitment by country B not to restrict, or limit restrictions of exports which are of interest to country A.

Now, the other side of that is that a country could agree not to restrict its exports, or to put limitations on them, in exchange for a commitment from a country not to put limits on exports.

There is a whole range of possibilities here of specific commodity negotiations. We could even start out by having discussions on binding the export taxes, and then negotiating exceptions—as you already do on tariffs and nontariff barriers in the GATT—or you could reverse that: You could negotiate the exceptions and then bind all other products at zero.

In a sense, you start out with a base on the export side very similar to what you have on the import side.

Now, my associates have just completed the third meeting of the Trade Negotiations Committee of 105 countries, and they did explore orally these kinds of concepts. We have found other countries quite interested in exploring them with us.

THE NATURE OF AGREEMENTS NEGOTIATED WITH U.S. TRADING PARTNERS

Chairman BENTSEN. When you get into these agreements, will they be bilateral agreements, and will they finally work on a most-favored-nation basis?

Mr. EBERLE. The objective obviously would be to have them on a multilateral basis; however, multilateral may mean a whole series of consistent bilateral arrangements.

On the supply side, I think there has to be some exceptions to the most-favored-nation basis. These agreements should be made under some multilateral context which will allow greater flexibility, I think, than on the import restrictions side, because there is a difference here of access to markets when certain countries refuse to give you access to their markets.

If everybody opened up all of their markets, which I doubt would happen, then you could go ahead and negotiate on a most-favored-nation basis. If they do not, we must find some way to give the countries an incentive to keep their markets open as they have an incentive to do so on a most-favored-nation basis on import restrictions. But it is that kind of negotiation that we think would be well worthwhile to have discussed.

Now, these exchanges of commitments need not be restricted to measures at the borders, but could cover other policy measures governments take to affect conditions of supply of exportable raw materials. Where both the exporting and the importing countries have major stockpiles in certain commodities, both sets of countries can affect each other by their stockpiling practices.

I do not mean here that any country should control the stockpiling practices of another country, but I do think it is important to recognize that how we manage that stockpile, how we sell it on the market and acquire it, could be the subject of some generally accepted rules. There is a limited amount of raw materials on the market, and should there be a shortage, you might drive the price up by having the stockpile intervene in the market at the wrong time.

On the other hand, if you want to drive the price down, you could decide to sell from your stockpiles. In such a situation, stockpiles could be used to create just as bad a situation as a cartel could in driving prices up. There needs to be some understanding here, and, as you know, there will be discussion at the World Food Conference on whether there should be stocks of feed grains around the world, and if so, on what basis and on what commitments should countries make.

Here is a very good example of the international concept of stockpiling—and you will hear more tomorrow from representatives of other Government agencies on what the U.S. policy should be on some very specific commodities.

Chairman BENTSEN. Always in the past it was not necessary to stockpile.

Mr. EBERLE. That is right, but there are other answers to that; the responsibility of others has also to be considered.

This will give you an idea of the kind of conceptual approach that one could take in building an international framework to try to open up and keep open access to supply in conjunction with access to import markets. I would say here that this retains for countries their normal leverage where they do have advantages: If it is on the supply side, they can use the leverage to obtain import openings, and if it is on the market side, then they can use that to obtain greater access to markets. It is the kind of system that I think bodes well for the world.

Now, the second track that I referred to is designed to avoid or to facilitate the resolution of conflicts that can arise between exporting and importing countries when an exporting country finds it necessary to restrict supplies to deal with a number of exceptional circumstances. These are the kinds of cases that I referred to earlier in my testimony. This occurred in the case of logs, scrap steel and obviously soybeans, where either the normal market demand was heightened because the international cycles of all countries had hit their peak at the same moment, or a thin supply had occurred, or, because of a domestic price control system where the world price was higher than the domestic price and the product was being pulled out of the United States. When you have that kind of a situation, and it should not occur too often, there ought to be some acceptable rules of how a country should manage it.

In other words, rules should be developed on how you manage the controls; for example, do you manage them on a historical basis, or do you manage them simply on the basis of those contracts that are outstanding?

I think that countries should know that if there is ever a shortage, that there would be a fair way of managing it within acceptable international guidelines, or within a range of acceptable international guidelines. Should this happen, there is a much better chance of managing the problem so that it will have a smaller impact on not only the individual sovereign nations, but the world economy as a whole.

Now, in saying that, there are two kinds of so-called guidelines. One would be the guideline of what you do generally. We would hope that there would be some kind of consultations and procedures that a country must go through before it could make the action totally effective. Since a country is never in an emergency situation on this as it might be on some other things, and it has some time in which to solve the problem, and if countries know that there are going to be advance consultations, I think we can not only develop guidelines, but we can develop a mutual confidence, with the substantial preponderance of the world countries working together.

So between the specific negotiations and the general guidelines, I think we have a great opportunity here to improve the international trading system and improve trade in specific commodities.

Now, in saying that, let me assure you that our final positions are not drawn within this government. It is very clear that there are segments of our economy that do not believe that they need either the guidelines or commitment on specific commodities, because the United States is the largest exporter of commodities in the world, and also the largest importer.

Depending on which side of the coin your business lies, you are going to have a different perspective. But what is important here is that we need in the national interest a better international trading system that recognizes these two sides of the coin, and have them work together for the benefit of the overall United States and world economy.

Now, those are the two tracks. But there is one last subject I would like to comment on before closing, and that is cartels. I avoided referring to cartels up to this point, but there is no question in my mind that as we start to focus on the world economy in the short run, we are going to find cartel-like actions by foreign raw material producers from time to time because they are misconstruing their ability to create cartels by looking at the oil situation and saying that the same circumstances apply to us.

As I indicated, I do not believe that to be the case, but, at the same time, we do have to face the problem that this is likely to happen in certain instances.

Here, in looking at what might be done, I would like to say that we have avoided dealing directly with the subject partly because we believe it probably will not happen, and it is not a serious threat in the long run. At the same, if we are wrong on that, or if some people do take advantage of the situation, we must have the ability to respond.

These are the two cases I referred to. Both the export administration bill and the trade bill give us the kind of responsible action that this country can take.

First, we should make it very clear to these countries what the economic consequences of their actions are. And I have indicated that kind of situation. We should certainly have the kind of ability to discuss it with them.

Second, if we are unable to bring about a dialog that solves the problem, we must be in the position to respond, and it is that response that hopefully we will not have to take, but in this world I think it is important to our trading partners to understand what our position is in advance. If they understand it in advance, we have a much better chance of managing the international economic system for the world as well as for the United States.

POSSIBLE U.S. RESPONSES TO THREATENING ECONOMIC ACTIONS TAKEN BY EXPORTING NATIONS

Chairman BENTSEN. Mr. Ambassador, would you recite again some of the responses that you think this Nation should make, in the event that some very harmful restrictions are placed by some nation on raw materials, that it would be necessary to make for this country's continued welfare and growth?

What kind of economic pressure can we bring to bear?

Mr. EBERLE. First of all, let me qualify what I am going to say by putting it in the overall context, that hopefully we could agree to an improvement in the international trading system which would provide for the kind of responses that ought to be taken or could be taken within a range of possibilities so that there would be no misunderstanding by these countries.

Now, the problem in saying that is that it is going to take us some time to get there, and I think our action that we might take should always be put in that context: What is a responsible country to do? Let me give you some situations.

First, I think that when we see this happening, we certainly ought to ask for a prior consultation before any action is taken. Here I think we have to make it a point that we respect the autonomy of sovereign governments.

But second, we think, because these countries do fit into the international trading system, and because there are other products that they are interested in, that their action here is not only for the benefit of themselves, but the world in itself.

As an example, as I said, there is no question in my mind that on the bauxite side, there are going to be substitutes. We are going to be confronted, or Congress will be confronted in the not too distant future with these countries, which, because they have raised the prices, will no longer have the foreign exchange because our country has veloped a domestic course for the commodity. They will lower their price, and then probably we will have to face up to the kind of action which says that we will need protection in order to get our investment out.

Chairman BENTSEN. That is a responsibility for a private enterprise, looking for substitutes?

Mr. EBERLE. Right.

Chairman BENTSEN. What do you see in the way of governmental responsibility?

Mr. EBERLE. The point I want to make is that in this first instance we have to get across to these governments that private enterprise is going to act in the market sense, and this Government is prepared to back that enterprise if these governments act irresponsibly in relation to us. We have to make it clear in advance that we are prepared to stand up and be counted.

Now, if they do not take action, we cannot solve the problem. We have to look at the range of possibilities we have. If we have the provisions of the export administration bill, we can see whether we can move to increase the price or restrict the products that they need.

Second, we will have in the trade bill the ability to respond on the import side. And I can say that I know of no countries that have the same situation as oil. Therefore, there are products which these other countries need to market, and the United States is still the largest market in the world. So we will have that ability, which we do not have today, to respond in kind if we wish to on the import side.

Now, that is very static action. On the other hand, if we have the authority to do it and can do it, I think you have a better chance of handling the situation in the first place.

Now, I think we have another responsibility——

Chairman BENTSEN. You are talking about a general code of conduct in which other nations would participate with us in the application of these limitations?

Mr. EBERLE. That is correct. But I think we have another one, and that is, in the case of developed countries, we have the antitrust laws that can be brought to bear in these cartel-like situations.

The point I want to make clear is that whether it be on export controls, import limitations, antitrust actions, we have to first of all hopefully advise these countries in advance that we think this is wrong. We are not opposed to fair prices in the market, but we are opposed to cartel situations developing which are irresponsible in the trading system. We must try to work toward a set of guidelines. I, however, do not mean specific guidelines, but rather a range of acceptable guidelines. That is what the world is built on, that is what can be done if an irresponsible situation of this kind develops.

THE UNITED STATES WILL ALWAYS ATTEMPT TO MAKE MULTILATERAL TRADING AGREEMENTS

Chairman BENTSEN. Mr. Ambassador, you were talking earlier about bilateral contracts in effect where we might give them guarantees of access to manufactured products in return for guarantees of access to raw materials. Would that involve the multilateral approach that you have suggested we are moving toward?

Let's talk about some of the lesser developed countries, where you were trying to give preference to their manufactured products. Then among those less developed countries you might not have a quid pro quo on raw materials. They might not have the resources.

Would a bilateral contract take precedence?

Mr. EBERLE. If I understand your question, the bilateral agreements would be in the context of the multilateral negotiations, so that they would be consistent both with the generalized practices and other rules of the trading system.

Now, specifically, the point you raise, as I understand it, is that if a developing country had some product which came in under the generalized preference, but for some reason participated in a cartel on the raw materials, again, one of the possibilities that you would have under the trade bill is whether we should continue with the generalized preference for that country that took this action against the United States. So that again it is one of that range of actions that we could take if we had to.

So, A, the actions could be within the context of the multilateral trade negotiations, and B, under the specific possibility that we have, which is just another one of those actions which could be provided if we had the trade bill.

ANTITRUST ACTION—A WEAK TOOL FOR MODERATING THE IMPACT OF INTERNATIONAL RAW MATERIALS PRODUCER CARTELS

Chairman BENTSEN. You referred earlier, if I understood you correctly, to taking some antitrust action against industrialized nations which might indulge in this kind of conduct, discriminating against us. How could you take antitrust action against a foreign cartel?

Mr. EBERLE. First of all, most of the larger cartels do not operate through the private enterprises. If they operated through the market economy they would not work. That is why we need the provisions in the trade bill which provide for this kind of reaction against a nonmarketing country.

But, on the other side, you get at this through the private organization which is marketing the product in the United States. Of course, if they are going to market it here, they will be subject to the laws of the United States. It is not always a clear-cut example because there may be a dummy corporation that does the marketing.

I think the chances of the kind of cartel situation happening is not great, because if we have these tools to manage the problem, other countries will know in advance what we might do. Because in most cases; they have not just one product to deal with, but many products; they are not going to take the risk.

GOVERNMENT ROLE IN COMMODITY NEGOTIATIONS

Chairman BENTSEN. Would you agree with Mr. Kissinger that the governments ought to play a larger role in the negotiations with these foreign countries concerning the price and supply of raw materials?

Mr. EBERLE. The answer, I think, is yes; but in the context of an umbrella. I think what we do as governments is to create a climate and openness of the markets to see that you have real markets and not rigged or artificial markets. If that can be done from the government level, then I think the trading system, which is a day-to-day system, is better left to the traders of the private enterprise than to the Government. So in that context I would agree, yes.

MAJOR INDUSTRIALIZED NATIONS—BALANCE OF TRADE DEFICIT WITH OIL PRODUCING NATIONS

Chairman BENTSEN. Mr. Ambassador, when you began, I think you put a caveat in there that you did not want to get into the specifics on some of these commodities. Let me try you this way on one.

Do you see all the major industrialized nations having a balance of trade deficit with the oil-producing nations over the next decade?

Mr. EBERLE. Certainly if you add them all together, the answer probably has to be yes. But within that, again it is too easy to generalize. There are going to be a number of countries that may not, or at least they will not have deficit trade balances overall. Of course, that is what the multilateral trading system is all about.

Obviously, Germany this year is not going to have a trade deficit. Now, if you precisely said that it will have a trade deficit with the oil-producing countries, it probably does. I think as you get near the end of that decade, my guess is that these trade balances will be pretty much as they were before the oil prices for most of these countries, not all.

BALANCE OF PAYMENTS POSITION MAY IMPROVE BY 1980, BUT DISRUPTIVE IMPACT LIKELY

Chairman BENTSEN. Do I understand you to say that you think near the end of the decade that we will be reasonably in balance with the oil exporting nations?

Mr. EBERLE. The answer I give is, "Yes," with the exception of a few developed countries. If I am talking about our trading balance with the world, I would say yes; but if I am talking about the trading balance with these oil exporting countries; no. That is the distinction I want to make.

Chairman BENTSEN. Do you not see a situation developing that is going to be quite disruptive to the financial system of the world over the next 25 years with the accumulation of capital in the Middle East countries?

Mr. EBERLE. Without a commitment on the part of the oil-producing countries to work within a system, the answer is, "Yes," it could be very disruptive.

In saying that, I would add that the system for recycling the petrodollars, or whatever you want to call them, certainly can handle a very substantial part of this. I think that we have to be sure that that system works and has a backup so that there will not be a disruption.

I think that Secretary Simons' trip to explore how this might be done—we do not have a report yet, but I think is it encouraging—and our internal government studies show that the world working together can absorb this in a way that all of us will be committed to supporting the system, and I think this is very important.

I think it is interesting to note that Iran has loaned $1 billion or more to three separate countries. I think that is very good, because what this means is that they are putting their money into the present system, and therefore they will be prepared to support this system and work within it. That is what we need. That way it will not be so disruptive. But we have to watch it, and it has got to be managed; we do not have all the tools to manage it yet.

IMPACT OF EEC BEEF IMPORT CONTROLS

Chairman BENTSEN. To get to the immediate thing that has happened—and I am not sure that this is within your jurisdiction—but on the European Common Market, the ban on the importation of beef poses a rather difficult problem for us in this country, that being a conditioned market, with the problems we are having with our own markets here.

Are you involved in that? Is that part of your jurisdiction, Mr. Ambassador?

Mr. EBERLE. The answer is yes. There is no question about it; I think it is most unfortunate that the European community took this action, and we have so expressed to the European community.

Chairman BENTSEN. That means that Australia and the rest of these nations would be moving in here now and compounding our problems, does it not?

Mr. EBERLE. Well, it is harder than that.

Japan, as you know, has put certain limitations on its beef imports, and we are hopeful that it can open up its market to take more of the beef from Southeast Asia.

The real problem comes in that, as you recall, because of the sanitation problem with our friends to the south, only the beef from north of the Panama Canal can come into the United States, other than cooked and fully processed. The only markets for Brazil, Uruguay, and Argentina, really, are the third world, the African, the European community, and the Communist world. This is a very difficult situation for our friends to the south.

We have a similar situation which we are trying to work out with our neighbors to the north, where we have run into a serious problem on the use of DES, which we banned, and then the courts overturned it, and in the meantime the Canadians banned it.

But we are active on this problem, and I think this is a good example of the very kind of thing that worries us. We simply have to find a better answer to move faster. That is one of the things that we will be focusing on in these trade negotiations, to try to get the answer before the problem is on us, or a solution, instead of having all these things happen and then have the disruption. We are looking at that. I think it is too bad that the European Communities had to take this action.

CODE OF BEHAVIOR FOR MULTINATIONAL CORPORATIONS

Chairman BENTSEN. Do you feel that we might also need an international code for multinational corporations along with what you referred to earlier, so that corporations would know what to expect and have some standardized means of negotiating the differences?

Mr. EBERLE. I guess I have been on record now for 2½ years in favor of a code of good behavior on investments for both the host country and the international corporations. I think that must go together. When you are talking about a code of good behavior for the multinationals, it is not just so-called multinationals, any company that simply goes abroad——

Chairman BENTSEN. I would agree with that.

Mr. EBERLE. You must tie them together, because it is too easy to put the restrictions on one side without the assurance on the other. It must be a two-way street, and on that basis I would favor it.

SPECIAL REPRESENTATIVE FOR INTERNATIONAL INVESTMENT DISPUTES

Chairman BENTSEN. You hold a very special post in these negotiations on tariffs and nontariff barriers. Would you favor the establishment of a special representative for resolving international investment disputes?

Mr. EBERLE. I think at the moment it may not be necessary. I do not believe it is necessary. We have, I think, a mechanism that is working reasonably well.

There are two different kinds of problems here. One is the direct investment, and the other is the indirect investment. Although they have a major effect that is in common, they have a micro effect that is quite different.

What we have tried to do here is bring State and the Treasury and the Council on Economic Policy to put things together. We are examining the various issues, and I think at the moment the responsibility on the financial side can be well coordinated in a manner satisfactory to this country.

Chairman BENTSEN. Mr. Ambassador, we are appreciative of your testimony this morning. It has been helpful to us, and I appreciated your testimony before the Finance Committee. Thank you very much for your attendance, and I look forward to going into further depth in your prepared statement.

Mr. EBERLE. Thank you, Mr. Chairman.

Chairman BENTSEN. Thank you, Mr. Eberle.

[The prepared statement, with attachments, of Mr. Eberle follows:]

PREPARED STATEMENT OF HON. WILLIAM D. EBERLE

Mr. Chairman and Members of the Subcommittee: It is always a great pleasure for me to meet with the Congress on matters of mutual concern, and especially to appear before your Subcommittee to discuss the Administration's views on the development of a stable and equitable framework for international trade in raw materials.

STR has been assigned to lead a detailed interagency analysis of the supply access question, in which the Executive Branch departments and agencies responsible for the issues involved are cooperating in the effort. We are looking at these issues not only from the standpoint of specific commodity problems but also from the perspective of a more general need for international rules on access to supply. I understand that representatives of the Departments of State, Interior, and the General Services Administration will be appearing tomorrow to discuss the current internal U.S. Government study of U.S. dependence on critical imported raw materials to which members of my staff also contributed. I also understand that yesterday you heard representatives from the private sector describe their assessment of the prospects for natural or artificially induced scarcities of industrial raw materials.

I do not wish to duplicate their testimony. Let me just say briefly that I share the skepticism of yesterday's witnesses that either natural or artificially induced scarcities are likely to arise which would disrupt the U.S. economy to anywhere near the same extent as the recent actions by oil producing countries, at least as far as we can see ahead. The world's supply of some raw materials could well become depleted over time, but I would expect that gradual price adjustments will bring into the market substitute materials and new technologies. Producers of certain raw materials could seek to duplicate the recent actions by the oil producers, but our reading of market conditions suggests that producers of these materials are not likely to succeed in any attempts to reduce supplies to dangerously low levels for any significant period of time.

But while I do not think that we are likely to face major economic dislocations, it does not follow that arbitrary actions by foreign suppliers would have no adverse repercussions on economic activity in the United States. Even if attempts to restrict supply and to force up prices prove to be unsuccessful in the long run because of alternative supplies made available through the operation of market forces, it could take some time before these alternative supplies can actually reach the market. During this interim period, available supplies might fall and prices might rise. Then, once alternative supplies have been made available, removal of the restrictions imposed by the normal suppliers could, in time, create a glut and depress prices in the market until supplies were reduced once again. These attempts by producers to restrict supplies artificially could thus lead to increased market instability. Where markets are already unstable, an increase in that instability can make a qualitative difference, bringing great pressure to bear on governments to intervene in the operation of the market. In addition to to restrict supply an dto force up prices prove to be unsuccessful in the long run a policy maker, that the short-term aspects of instability will make it more difficult for governments to deal with the resulting problems.

All of this creates a new element of uncertainty for businessmen. Manufacturers can't be sure of access to the raw materials they need to run their factories, nor of the prices they will have to pay for them. At the same time, domestic suppliers of raw materials can't be sure of the prices they will receive for their goods. These uncertainties can discourage businesses from making necessary investments, or even from producing at their current capacity. Both employment and the productivity of our economy would suffer.

Attempts at restricting supplies also tend to generate a shortage mentality among consumers, resulting in speculative buying at prices which bear little or no relationship to historic trends. Such price increases are generally followed by sharp price drops as new sources of supply and shifts in demand occur. We have already begun to see such a turnaround in various commodity prices, with buyers cancelling their orders and refusing to take delivery of high-priced commodities. Some buyers are reselling at depressed prices and taking huge losses in the process, thus adding momentum to the decline in commodity prices just as the original purchases had helped push the prices higher and higher.

Of course, one way in the long run to reduce uncertainty for both domestic manufacturers and suppliers of raw materials is to reduce the country's dependence on foreign raw materials by restricting imports. I would be extremely reluctant to take this step, because it would result in a higher cost of such materials for the American consumer. Not only would inflationary pressures increase and employment decrease, but it would also imply a complete reversal of the postwar trend toward a more open world economy. It would be neither in our own interest, nor in the long-term interest of the countries that might be tempted to improve their position by restricting supplies. It is therefore extremely important that we develop an equitable framework for trade in these commodities, as you suggested, Mr. Chairman, in inviting me to testify at this hearing.

Nor do I want to neglect the political dimension of this issue. Arbitrary actions affecting another country's supply of raw materials, and the counter actions these invite, can seriously damage political and security relationships among countries. In my view, the international trading system should be adequate to resolve specific trade problems equitably, without resort to broader political pressures, and such a politicization of trade problems constitutes a partial failure of the system. When specific trade problems become too often politicized, it is a sign that the trading system needs to be improved, not only in the interests of more harmonious relations between ourselves and our trading partners, but also in the interests of a more stable world order. It will, however, take the political will to improve the trading system, which is a quite different issue than the resolution of specific trade problems. I am concerned that the U.S. must exercise strong leadership in order to insure the continuation of a stable international trading system.

My concern, however, covers not only those restrictive supply actions which countries may take in order to raise the prices they can obtain for their goods or in order to achieve various political ends. Situations can arise in which governments feel they must restrict exports temporarily to deal with domestic emergencies. Countries faced by a sudden decline in domestic supplies of a critical commodity, for instance, may need to regulate the distribution of these supplies; or countries with a price control program may need to prevent a diversion of domestic supplies to foreign markets where prices remain uncontrolled. No matter how legitimate another country's reasons for restricting its exports, such restrictions could affect our own economy by exacerbating our own short supply or inflationary problems. More likely than not, the adverse impact on our economy would come about very indirectly. For example, by reducing the amount of fertilizer shipped to third markets, the export restrictions imposed by a number of industrial countries have led to larger purchases of fertilizer in the United States, making worse our own tight supply situation. We were forced to control the export of ferrous scrap because we were the only industrial country exporting the material in any sizeable quantity. Other industrial countries had reserved their scrap steel for their domestic markets, thus intensifying pressure on the U.S. alone to satisfy increased world-wide demand for scrap steel.

Quite aside from the actual economic injury that could result from such actions, even the uncertainty created by the mere possibility that another country might act arbitrarily in such a situation could pose an increasingly serious threat to the relatively open world economy which has contributed significantly to our prosperity.

To summarize, the problem with supply restrictions that might be imposed by other governments is not that they are likely to lead to major catastrophes, but rather that on the margin they could worsen existing economic problems. I firmly believe that it is in the interests of all countries to work out rules and procedures that will prevent this result from occurring. National economies have become so interrelated that arbitrary actions on either the import or the export side by any one government can adversely affect economic activity in other countries. Such actions could tend to undermine the very foundation of our international trading system, putting in jeopardy the benefits we have realized from expanded and freer world trade. Fortunately, I have found wide recognition of these relationships both in this country and abroad, and I think we have an excellent opportunity to negotiate some useful arrangements in the course of the forthcoming multilateral trade negotiations. Mr. Chairman, I believe there is more need than ever for authorizing legislation to move these negotiations forward.

We are doing a great deal of thinking about the kinds of international understandings on short supply and export control problems which would make sense. We have had preliminary discussions with other countries to obtain their views and to give them the benefits of our own thinking. I would like to share with you some of our ideas, even though work remains to be done on their detailed implementation.

It is always useful to begin an examination of the possibilities with a review of the existing situation. The General Agreement on Tariffs and Trade (GATT), which spells out existing international trade rules, makes a distinction between export quotas and export duties, as it also does on the import side. Quotas are prohibited in general, but permitted under a number of exceptions which are quite broadly defined. Duties are permitted unless a country has agreed to limit the duty on a specific commodity to a specified maximum rate. In practice, it is extremely rare for a country to bind its export duties and the prohibition on export quotas is virtually worthless because the exceptions are so broadly defined. But while the existing rules do not give effective protection against arbitrary actions, they do constitute a useful foundation upon which to construct a tighter framework.

We foresee that negotiations on an improved framework for dealing with short supply and export control issues will follow two separate tracks. One involves the possible exchange of specific commitments on individual commodities of interest to different countries and the establishment of the conditions and framework necessary for the exchange of such commitments. The other involves the development of some general guidelines and agreed procedures for resolving conflicts of interest between consuming and producing countries. The extent of U.S. interest in making or exchanging commitments and the possible forms of such commitments are still under study in the Executive Branch and will, of course, involve consultations with the Congress.

The first track would make it possible for exporting countries which have strong market positions in particular commodities to obtain trade concessions in other areas in lieu of the benefits they believe they are able to obtain by imposing export restrictions, while importing countries which feel particularly exposed on certain commodities would be able to insure themselves against artificial interruptions of the supply of such critical commodities.

We have not fully explored the type of specific commitments which might be exchanged, but I can mention a few possibilities. One approach which could most closely parallel that which has been successfully used to reduce import barriers, would be to exchange a commitment by country A not to restrict (or to limit restrictions on) exports which are of interest to country B, for a commitment by country B not to restrict (or to limit restrictions on) exports which are of interest to country A. A variant of this approach might be for all countries to agree to bind all their export taxes at zero and then negotiate exceptions to that commitment. Such exceptions might deal with specific commodities, on which countries might be allowed to apply certain taxes, possibly within agreed ceilings, or they might deal with the circumstances in which countries would apply export taxes.

Another approach, not excluded by the first, could involve a commitment by country A not to limit exports of interest to country B in exchange for a commitment by country B not to limit *imports* of interest to country A. This approach might be of some interest to raw material exporting countries, since it could deal with one of the major reasons cited by such countries for restricting exports. These countries frequently argue that by restricting the export of the raw material, but not of its processed forms, one can induce more of the processing in the exporting country. They argue that such action is justified, since duties in the importing countries on processed materials tend to be higher than duties on the raw material. If this situation applies, therefore, it may be in the mutual interest of exporting and importing countries to exchange a commitment not to restrict (or to reduce restrictions on) access to raw material supplies for a commitment to reduce or eliminate restrictions on market access of processed goods.

Exchanges of commitments need not be restricted to measures at the border, but could cover other policy measures governments take to affect conditions of supply of exportable raw materials. Where both exporting and importing countries have major stockpiles in certain commodities, both sets of countries can affect each other by their stockpiling practices. In particular, when there is an oversupply in the world market, and prices tend to be low, large sales by a consuming country or by another exporting country which is subsidizing its sales abroad, could seriously affect the economic situation of an exporting country by depressing the price even further. On the other hand, when there is a short supply in the world market, and prices tend to be high, large purchases by a producing country could seriously injure consumers in the importing country by raising prices even further. In the case of some commodities, these circumstances could lead to a recognition by both exporting and importing countries of a mutual advantage from some form of understanding regarding "orderly" behavior. It is worth noting that this would not necessarily be a departure from present practice. The U.S. has taken into consideration the interests of producing nations in its recent releases of excess tin and natural rubber from the U.S. strategic stockpile. In this Fall's World Food Conference, we hope to discuss the issue of grain stockpiling policies with our trading partners. In addition, the problem is conceptually very similar to that faced by the reformers of the international monetary system who were looking for some rules of orderly intervention by governments in foreign exchange markets.

The second track is designed to avoid or to facilitate the resolution of conflicts that can arise between exporting and importing countries when an exporting country finds it necessary to restrict supplies to deal with a number of exceptional circumstances. Because these guidelines would cover a wide range of commodities and situations, they would be rather general. One of our principal objectives would be to keep markets open and avoid restrictive actions on the part of countries that, in turn, shift the burden to another supplying country. These guidelines would, however, be focused on the various exceptional situations that motivate governments to restrict exports, and would seek to define a balance between the legitimate interests of the exporting and the importing country.

For instance, where a country seeks to protect a domestic price control program by preventing a diversion of domestic supplies to uncontrolled foreign markets, it may be possible to agree that in controlling exports, countries will not reduce the actual level of exports. On the other hand, where a country seeks to deal with a domestic short supply situation, it may be possible to agree that the exporting country would continue to supply foreigners with a fair—if reduced—share. Other guidelines might spell out certain general principles regarding the ongoing exchange of information between producers and consumers, consultation procedures, the distribution of such exports among different importing countries (that have agreed to adhere to the guidelines themselves) equitable procedures in the administration of the controls, and so on. Any set of guidelines should not affect the right of countries to retaliate against unreasonable export actions of other countries whether or not they adhered to a code.

These are some of the ideas we are exploring. As I pointed out, they are still at a very early stage of evolution and we have not reached any final conclusions. I am convinced, though, that we are on the right track.

Before closing, I should make a final comment on cartels. My office, in conjunction with other agencies, is working on a coherent government policy for responding to cartel-like actions by foreign raw material producers. Up to now I have avoided dealing directly with this subject, partly because we believe that they are not likely to constitute a serious threat in commodity areas other than oil. Partly, because we feel that the more restricted adverse economic impact that cartels could have on the economies of other countries is best dealt with through some of the approaches I have outlined above. The possibility is there, of course, that we might be wrong—that cartels will prove more effective than our studies indicate, or that raw material suppliers will take restrictive actions before we have worked out international agreements along the lines outlined here, or that the types of agreements that I have outlined will not fully deal with the economic problem that the activities of foreign producer groups create for us and other importing countries.

If we were to be faced by such successful actions by the producers, there might be no other alternative than for us to sit down with the major producing countries, and to review areas of mutual interest, and areas of mutual dependence. We could do this by ourselves, or together with other major importers of that commodity. If we were not able to reach a mutually acceptable accommodation as a result of such discussions, we would have no choice but to seriously examine the contingencies for retaliation in other areas of our economic relationship. The actual method of retaliation could be geared to the situation and would range in severity from minor administrative measures to major trade and financial actions. Arbitrary actions by one country can only beget equally arbitrary actions by countries that are adversely affected by such actions. The international trading system is based on a fair balance of interests and mutual dependence. The system can function only as long as countries respect that balance. I am hopeful that when countries recognize this two-way relationship, we will find ways of avoiding conflict situations. Should all such efforts fail, we are prepared to defend the U.S. interest through a willingness to use more drastic measures, if necessary.

As I said earlier, however, the main thrust of our efforts is geared to the development of a better international framework for managing supply problems.

Mr. Chairman, I appreciate this opportunity to share with you some of our thinking on this critical and timely subject. I would be pleased to respond to any questions you may have.

Attachments follow:

The Economic Consequences of the Energy Crisis

(By Gerald A. Pollack)

The quadrupling of oil import prices in one year, quite apart from Arab supply cutbacks, has greatly increased the urgency and gravity of the questions that were lurking in the shadows even in the earlier, balmier days of the energy crisis.[1] No less an authority than the managing director of the International Monetary Fund (IMF) has warned that the combination of oil shortages and price increases in 1974 is likely to produce "a staggering disequilibrium in the global balance of payments . . . that will place strains on the monetary system far in excess of any that have been experienced since the war." And Treasury

[1] The views expressed in this article are solely my own and do not necessarily reflect those of Exxon Corporation or of the individuals whose assistance is acknowledged below. Important contributions were made by my colleagues Kerin D. Fenster, James W. Hanson and John F. Kyle. In addition, I have benefited from discussions with Sterle T. Beza, IMF; Samuel Pizer, Board of Governors, Federal Reserve System; and F. Lisle Widman, U.S. Treasury Department.

Secretary Shultz has stated that the recent oil price increases raised "literally unmanageable" problems for many nations.

These, then, are the questions that confront us:

Can the international monetary system sustain a transfer of wealth of such unprecedented dimensions without extensive disruption or even collapse because of intolerable balance-of-payments strains?

Will the consuming countries be able and willing to absorb the immense investments the oil-producing countries may wish to make?

Will new financial mechanisms be necessary to assure reasonable stability?

What will happen to currency values?

Will the consuming countries be able to make the necessary internal adjustments without severe dislocation and with no lasting impairment of growth?

Will the increase in oil prices further accelerate the inflationary spiral?

How severe will be the impact of higher prices on living standards?

How will the resource-poor Third World be able to cope with the oil crises, and what will be the political consequences for the industrial countries?

II

The starting point for an analysis of the monetary impact of the energy crisis is the quantum jump in import bills implied by higher oil prices. For the United States, Europe and Japan, oil imports this year may be nearly $50 billion more than in 1973. What will happen beyond this year is highly conjectural, depending on the responses of supply and demand to sharply higher prices in the consuming countries, and on the pricing and production policies of the nations that make up the Organization of Petroleum Exporting Countries (OPEC). If demand does not fall off appreciably when prices rise and if supplies remain tight, import bills will keep rising. By 1985 they might well approach $200 billion, some $150 billion more than in 1973. The OPEC investable surpluses may total nearly $100 billion by the end of 1974, and could cumulate to almost $500 billion by 1980 and more than $600 billion by 1985. These magnitudes would seem to be enough to scuttle any monetary system.

There are plenty of unknowns as we set out to forecast the outcome. But there are also a number of knowns which, if we sort them out, can help to advance the analysis.

(1) Although all importing countries will be transferring wealth to OPEC, the payments problems that may result will primarily involve financial relations among the importers.

(2) An OPEC decision to export more oil than they need to pay for imports is a decision to invest abroad.

(3) There are no limits in any financial sense on the absorptive capacity of importing countries for OPEC funds, but there may well be psychological and political problems.

These somewhat surprising conclusions will become clear if we trace through the financial flows set into motion by higher oil import bills. To the extent that the consuming countries can increase their exports of goods and services to the producing nations, higher oil imports will entail neither balance-of-payments deficits for the former, nor surpluses for the latter. But we already know that even the most rapid increases of imports by the OPEC countries must necessarily lag far behind the explosive growth of their income. And the entire excess of OPEC income over expenditure must necessarily flow back to the importing countries so as to eliminate the payments gap between themselves and OPEC. In other words, the payments flows from the importing countries as a group to OPEC must be exactly offset by reverse flows of funds for imports and investment from OPEC.

Now, how can we be so sure that what flows out will flow back? Consider this. when a U.S. company makes a payment to, say, Saudi Arabia, what happens is that title to a dollar account in a U.S. bank is shifted from a U.S. resident to a foreign government. This money actually never leaves the United States, but convention would have it that the funds flow to Saudi Arabia and then return. By simply endorsing and depositing the U.S. importer's check, Saudi Arabia increases her investment in the United States. And this foreign investment will stick to her like a burr until the Saudis spend it on imports or, to raise an unlikely possibility, give it away as grant aid to developing countries. These are the only ways their foreign investments can be drawn down. To be sure, they can switch out of dollars into deposits in other currencies. Or they can switch out of bank balances into stocks, bonds, direct investments or real estate abroad. Or they can buy World Bank bonds or lend to the International Monetary Fund (IMF). But these are all different forms of foreign investment, and shifts from one into another do not alter the total.

In this perspective, note that OPEC purchases of gold, Rembrandts, and industrial equipment, for example, count as exports, not investment. They draw down bank balances abroad and leave no claims against the industrial countries once they have been shipped to the OPEC nations. They are, of course, forms of *domestic* investment for the OPEC countries. But here we are speaking only of investment forms that involve claims on foreigners.

In the long run, domestic investment by OPEC will feed back on the balance of payments, for example, by generating locally produced goods that can displace imports or gain a foothold in foreign markets. Indeed, given their small population base, industrialization of the Gulf states would necessarily make them dependent on the export markets of their oil customers for profitable operations. This, in turn, would provide the oil-importing countries with new, possibly important, bargaining power for future negotiations with the countries concerned.

The second and third startling propositions follow from this analysis. There are only three ways OPEC could avoid investing abroad: first, to spend their entire oil export earnings on imports; second, to trim back oil exports to the level needed to pay for the imports they want; and third, to give immense gifts of money (grant aid) to their oil-poor Arab neighbors and other countries. Given the enormity of their income, the first solution would be possible only if oil prices were slashed deeply. The second solution could be difficult to implement in view of the counterpressures the importing countries might exert to safeguard their vital interests. Besides, some OPEC members at least might decide that, at present prices, oil in the ground will not long be better than money in the bank. The third solution is simply not going to occur. Even if OPEC were to provide foreign aid in amounts many times the $1 billion annual sum volunteered by the Shah of Iran on behalf of his nation, their coffers would scarcely be dented. Even more to the point, the Shah proposed to lend the money—in other words, to make foreign investments—not to make outright grants.

These conclusions carry a number of important implications. For one thing, they set to rest any concern that the OPEC nations might deny the importing countries the capital flows needed to redress imbalances. For another, they suggest that OPEC demands for investment vehicles that would safeguard them against inflation and devaluation—vehicles that do not now exist anywhere—do not have to be taken quite as seriously as they have been in some quarters. It is reasonable to suppose, however, that OPEC will take the attractiveness of investment opportunities in the industrial countries into account when deciding on how much to produce and export. In particular, special inducements might be necessary for OPEC to invest in ways conducive to international monetary stability. But the essence of the problem is OPEC's willingness to produce and export oil. There is simply no way of getting around it: above a certain level, an OPEC decision to export oil is a decision to invest abroad.

III

If foreign investment is inevitable, perhaps we should lean back and enjoy it. That there are no general absorptive problems follows from the fact that the investment initially involves no more than the transfer to foreign ownership of bank balances that already exist. Now, to be sure, there could be disturbances in the capital markets if OPEC's portfolio preferences differed greatly from preexisting patterns. This could involve significant changes in interest-rate relationships or price-earnings ratios, for example. And shifts in the location of funds from the United States to small countries like Switzerland could give rise to troublesome inflationary pressures, if the governments concerned attempted to hold their exchange rates steady, or to severe deterioration in their trade balances, if they allowed their currencies to rise.

Indeed, this latter contingency may be a psychological barrier to the willingness of some countries to absorb foreign investment. A strong mercantilist tradition still pervades our world, equating trade surpluses with virtue and deficits with sin. Higher oil prices will, by themselves, push the trade balances of most, if not all, industrial countries into deficit. To prevent simultaneous downward pressure on their currencies, they might individually accept offsetting capital inflows. But to go beyond that, to allow inflows of foreign investments that would push their exchange rates up and accentuate their trade deficits could well be unacceptable.

In some instances the limits of absorptive capacity may be set by political rather than economic considerations. The industrial countries might not be prepared to accept massive ownership of home enterprises by foreign investors, especially if those investors are not a large and diverse number of foreign individuals or companies, but a handful of governments with political fish to fry. And OPEC attempts to focus their investment interest on a limited number of securities could raise antitrust problems as well as the possibilities of disturbances in the equity markets.

Actually, the likelihood that these problems will occur has faded with the recent price increases and embargoes. Even before they declared economic war on the industrial world, the OPEC nations had a passion for anonymity in their investments. Now, they may be even more leery of having visible hostage assets abroad. Far better, from this point of view, to put funds into the Eurocurrency market, where they can circulate throughout the world without anyone being the wiser as to their origin.

IV

Now, let us return to our initial question. We began by asking whether the international monetary system could sustain the prospective immense transfer of wealth to the OPEC countries, and have concluded, so far, that the payments problems, if any, will be *among* the consuming countries, not between them and the OPEC countries. But there is less comfort in this than meets the eye. The essential question then becomes whether imbalances among the consuming countries will be so great as to tear the system apart. After all, the consuming countries, as a group, could all be in equilibrium at the same time that each of them suffered horrendous, but offsetting, imbalances. On the other hand, there would be no balance-of-payments strains for any country if it should happen that the OPEC countries placed their investable funds abroad in relation to the payments needs of each. But this is more than can be reasonably expected. Some countries are obviously more attractive than others as places to invest or as producers of the things the OPEC countries want to buy. Thus, some consuming countries stand to get more offsets, others less. How, then, are things likely to sort themselves out? Will new financial mechanisms be necessary to assure reasonable stability?

Let us see what is needed and what we can expect of existing mechanisms. The essential problem among the consuming countries, once their equilibrium is disturbed by more expensive oil imports, is to move to a new structure of trade compatible with the altered flow of international investment funds. In this process, exchange-rate movements are likely to be the main equilibrating force. They will rise for countries receiving capital inflows in amounts that exceed the increase in their oil import bills. This will make those countries less competitive internationally. Their exchange rates will continue to rise until the deterioration of their trade balances becomes large enough to offset the extra capital inflows. Countries that fail to attract sufficient capital will experience the reverse process. Thus, if market forces are allowed to work, each country's trade and capital accounts would seesaw to a new equilibrium.

This is all right as far as it goes. But it raises as many questions as it answers. For example: Just how much adjustment in trade balances might be required for individual countries, and how much change in their exchange rates? Will free market forces be permitted to operate if some countries face a severe deterioration in their trade balances and marked changes in their currencies? Would the capital flows that induced these changes in trade be stable, or would they slosh around across currency boundaries preventing trade adjustment, indeed, disrupting trade and investment?

There is certainly a danger that free market forces will not be permitted to work themselves through and that the industrial world will retreat to protectionism. We have already spoken of the pervasive mercantilist ethic that holds trade surpluses to be the essential goal of foreign commerce. Now, the industrial countries as a group cannot help being in an overall trade deficit. This would go against the grain, even if the deficit were evenly distributed among all. But that some might have to bear a disproportionately large share of the total deficit might seem wholly unacceptable. To avoid this contingency, the nations so threatened might resort to competitive devaluations or trade restrictions. The new era of floating exchange rates has heightened the danger of predatory currency practices, both by breaking the IMF rule that any country's exchange rate adjustment requires multilateral approval and by facilitating currency manipulation. At the same time, the energy crisis has increased the motivation for competitive devaluation. Before the crisis, devaluation could only aggravate the problems of over-full employment and rampant inflation confronting most countries. But now, with recessionary tendencies in evidence, devaluation may appear more attractive as a way of maintaining output in the face of shrinking demand—at the expense, of course, of other countries. This conjures up disquieting images of the 1930s.

The maintenance of a multilateral, outward-looking trade and payments system may therefore be conditional on capital flows that go quite far toward offsetting the bulk of the payments strains resulting from the energy crisis. As was said earlier, it would be possible for OPEC to prevent each and every consuming country from experiencing any balance-of-payments strain whatsoever, by the simple expedient of channeling their investments to each in accordance with its need. In practice, how close to this result is the outcome likely to be?

So far, the OPEC countries have demonstrated a preference for investing in the Eurocurrency market, rather than in national money markets or directly in securities. There, they find both anonymity—a valuable feature to governments anxious to avoid creating "hostages" abroad—and high returns on short-term deposits. The Eurocurrency market is a highly efficient mechanism for financial intermediation. The funds deposited there are quickly re-lent to commercial borrowers and to governments. Britain and Italy, through borrowings by their public authorities, have already drawn on this large pool of international liquidity to finance their balance-of-payments deficits. And on January 31 France announced intentions to borrow around $1.5 billion in the Eurocurrency market specifically for the purpose of helping to pay for the higher cost of oil imports. (Finance Minister Giscard d'Estaing reportedly expressed hope that similar actions could be taken by the Common Market to recycle Arab funds to the European nations that will need them.)

But governments need not borrow directly to use the resources of the Eurocurrency market for this end. Tight money conditions, for example, might induce their residents to borrow abroad rather than at home, thereby giving rise to the desired capital inflows. In general, since no one can know better than the deficit country concerned what its financing needs are, any institution like the Eurocurrency market that can recycle OPEC surpluses in accordance with the initiatives of the borrower should go far toward reducing payments strains.

The U.S. money markets could also perform this function if, directly or indirectly, Arab funds flowed into the U.S. money or capital markets—something that has evidently not yet occurred on a significant scale. If the OPEC countries acquired U.S. bank balances, or bought stocks, bonds, industrial property, etc., the liquidity of American financial markets would be increased. Interest rates here would tend to fall. This would attract foreign borrowers at the same time that relatively higher foreign interest rates encouraged American investors to place their funds abroad. Similar recycling mechanisms would be activated if London, Zurich, Frankfurt or any other financial center were favored by the OPEC countries. The ability of market forces to induce such intermediation has been greatly enhanced by the termination, at the end of January, of U.S. and Canadian controls on capital outflows, and by an easing of restrictions on capital inflows by a number of European countries and by Japan.

Other institutions could also help in the recycling. The IMF, for example, with its resources augmented by OPEC funds, could play a significant role in easing payments strains—a role for which it was originally designed. The World Bank and the Bank for International Settlements in Basel could help. And loans among central banks could also make a contribution.

It is one thing to identify mechanisms, and another to say that they will suffice to do the job. As things stand, the Eurocurrency market has several defects for present purposes. In essence, there can be no assurance that the allocation of loans based on such commercial banking considerations as creditworthiness and relative interest rates will coincide with the requirements of balance-of-payments equilibrium. Thus, for example, the Eurocurrency market is not well suited to resource-poor or politically unstable developing countries with low credit standing. Here, a partial solution, at least, may lie in World Bank borrowing from the OPEC countries and re-lending to the Third World. Such recycling through the World Bank, for which there is already some precedent, will receive new impetus from the announced intention of the Shah of Iran to invest in World Bank bonds a portion of the $1 billion in aid funds that he pledged to make available this year. I addition, the Arab countries have already spoken of establishing a development lending bank of their own, and the Shah has proposed a new international development fund whose capital would come jointly from oil-exporting countries and the major industrial nations. But what about countries which, realistically speaking, have no prospects whatsoever of repaying a loan? Such countries—and there are quite a number—would be outside the circle of recycling funds. Their situation would be further aggravated by the likely reluctance of the industrial countries, now preoccupied with their own problems, to continue aid at existing levels, let alone contribute the added amounts the poor countries need to pay for oil.

Another problem with the Eurocurrency market is that funds placed there tend to be on short-term deposit, while the debts required to ease the payments strains of oil imports will need to be relatively long-term. This problem might be resolved through normal market processes bringing the terms desired by borrowers and lenders into closer alignment. But given the enormous speed of the Arab investment buildup, these processes might not work quickly enough.

And finally, what can be said about the danger of financial instability resulting from sudden and massive shifts of funds out of particular money markets and across currency lines? Note that this threat would not be confined to possible actions by OPEC countries. In the complicated system of intermediation sketched above, the financial boat could be rocked by any of the many borrowers, creditors, or speculators within the system, anywhere along its chain. It has often been said that OPEC's self-interest in seeing their investments prosper would deter any destructive moves on their part. The same would apply to the other actors on our stage. And yet one might wish for greater reassurance. Financial panics have occurred in the past, even though those who precipitated them lost what otherwise might have been saved.

This question of financial instability may turn out to be the biggest of the threats posed by the energy crisis. Recurring upheavals in the foreign exchange markets could trigger protectionism and bring about a severe contraction in world trade, conjuring up visions of another world depression. Accentuating the dangers here are the incredibly large OPEC surpluses that are in prospect and the extraordinary rapidity with which they will accumulate. Exising mechanisms and institutions are simply untested in handling international transfers on this order of magnitude. It is as if we asked whether, after having safely lived for nearly three months in the skylab, our astronauts could survive for another five years in outer space.

This question, moreover, puts into useful perspective any efforts at quantifying the balance-of-payments implications of various oil price and volume scenarios. In a nutshell: we could envision a cumulative OPEC surplus, including investment yields, of around $450 billion by 1980. Suppose this estimate is wrong and that it will turn out to be around $550 billion; or suppose that it is only $350 billion, or even less. Would the higher or the lower figure be materially different with respect to its implications for international financial stability? I submit that it would not, that we have taken a quantum jump into a new world that is qualitatively, not merely quantitatively, different from the old.

Recognition of the potential for instability in these extraordinary financial flows underlies the various suggestions that have been made for averting the dangers by tying up Arab funds in nonliquid form. In this connection, oil consultant Walter J. Levy has suggested buying oil now and paying part of the cost later. Also in this category is the suggestion that the IMF provide new, value-guaranteed instruments to OPEC to sop up their liquidity and then recycle it to the oil-importing countries. Secretary Shultz has suggested consideration of a new kind of multinational joint venture—a type of mutual fund, as it were—which would employ expert investment management to channel OPEC funds into a diversity of profitable investment outlets in the consuming countries. The investing nations, which would be encouraged to "commit sizable funds for extended periods," would "maintain control over some basic decisions concerning the volume and distribution of the funds." And Secretary Shultz's proposal of lower oil prices would, of course, reduce the size of the financial problem to begin with. Only time will tell whether reasonable stability can be maintained without the help of such special instruments.

But one essential point must be kept in view. The key to the viability of the international monetary system is not some stroke of inspiration in inventing a new investment vehicle with such irresistible features that it will swallow up most of OPEC's funds and neutralize them. No paper certificate or financial contract can go beyond the underlying willingness of the OPEC governments to cooperate now and in the future, changing circumstances notwithstanding. At best, such certificates provide a convenient channel for cooperation. It would no doubt be a costly channel as well, because OPEC may insist on features that no government has been willing to offer in the past—including maintenance-of-value guarantees for inflation and devaluation. Moreover, OPEC's willingness to accumulate such assets does not involve a once-and-for-all decision, but rather daily decisions because, as long as oil flows, funds flow to the producing countries. Considering also a natural desire for investment diversification, it seems likely that any special arrangements would absorb only a fraction of the funds at OPEC's disposal. Therefore, even though they can help, there is no guarantee that they would suffice to make the difference between monetary stability and instability.

Now, let us try to pull these threads together. On the positive side, the OPEC surpluses necessarily remain within the financial markets of the consuming countries, and the existing institutional framework would seem more or less capable of the intermediation necessary to channel funds to the point of need, at least within the industrial world. On the other hand, there are uncertainties as to the ability of existing institutions to cope with the immense magnitudes we envisage, the ability of the resource-poor developing countries to keep their heads above water, and the stability of a financial system so heavily dependent on international lending. No doubt, this list of problems could be expanded greatly.

The long and short of it is that no one can be sure that the financial side of the oil crisis is manageable. Perhaps the best that could be said is that, if the consuming and producing countries can cooperate in working out solutions, there is nothing about the institutional structure that would preclude a happy ending. Regrettably, the comfort inherent in this idea is somewhat marred by the history of international monetary cooperation.

V

Despite the uncertainties, what can be said about the outlook for individual currencies? Major imbalances would remain for the United States, Europe and Japan after the initial increase in oil import bills has been partially offset by oil industry profit remittances, shipping earnings and the like, and by higher exports to the OPEC countries. Unfortunately these calculations do not take us as far as we would like with respect to exchange rates because as we already know, these will be driven by the engine that recycles capital. And there is really no way to predict the ultimate destinations of OPEC funds.

It must also be remembered that, in forecasting exchange rates as in forecasting stock prices, it is not enough to be right about the underlying forces at work. One must also predict correctly the psychology of the people who make the markets. And these people—foreign exchange traders, investors, businessmen and speculators—will probably be watching the trade and current account positions of the major countries rather than the capital accounts. This is both a matter of conventional analysis and of necessity—because while trade data are released monthly, information on capital flows is fragmentary and incomplete if it is available at all.

A "first-round" look at the magnitude of the deterioration that is likely to occur in trade and current account positions reveals that all of the consuming areas are hard hit. The rapidity of the escalation in oil prices, however, has struck particularly heavily at Europe. If OPEC incomes had reached their high levels gradually, Europe, as principal supplier of OPEC's imports, would have been able to offset a substantial part of its high oil import bills with a large volume of exports. But OPEC's import spending simply cannot keep up with the explosive growth of oil income. Consequently, over the next few years at least, money that would have been spent on imports, largely in Europe, will instead flow into the capital markets.

The initial response of exchange rates to the oil crisis that erupted with the Arab-Israeli war already provides us with a frame of reference for further analysis. To be sure, the market reaction so far has been based not only on the effects of more expensive oil, but also on the possible repercussions of the disturbances caused by embargoes and cutbacks. The latter, we hope, will be shortlived. In any event, the markets reasoned that the United States was most favorably situated, with relatively low dependence on imported energy, a strong initial trade position, and favorable prospects for attracting funds. And Japan was seen at the other end of the spectrum. On fundamentals, these judgments seem realistic.

To be sure, some tempering of optimism about the dollar became evident in the foreign-exchange markets when the United States and some other nations ended their controls on capital exports and imports, respectively, at the end of January and when the oil imports of other leading countries proved to be somewhat lower than had been expected. Thus, toward the end of January, the dollar came within less than one percentage point, on a trade-weighted basis, of recovering its decline relative to Smithsonian rates. However, by the end of February, it had receded to a range roughly midway between Smithsonian levels and the nadir it reached early in July 1973.

On the other side of the coin, the major European currencies and the yen first declined substantially relative to the dollar, since last October, and then recovered about half of their losses. The pound, having risen less earlier in 1973, also fell less. And the lira, having participated in the earlier decline of other European currencies, has failed to share appreciably in their recent strength. That the pressures were great is reflected not only in the magnitude of the changes, but in France's defection on January 19 from the attempt by seven European countries to maintain fixed exchange rates among themselves while floating jointly against other currencies. France was unwilling to commit any more of her dwindling reserves to the defense of her weakening currency.

For the time being, the foreign exchange markets will probably continue their erratic search for new sustainable relationships, a process that is likely to involve abnormally large day-to-day fluctuations. This instability does not yet reflect the actual impact of Arab funds, but rather the anticipatory adjustment of positions by dealers, traders and investors who traditionally dominate these markets. It should not be surprising if, after their vigorous comeback relative to the dollar, the European currencies and the yen receded somewhat in the near term, in step with the march of monthly trade data.

The longer-term outcome will be dominated by capital flows and therefore defies prediction. The fundamentals are ambiguous. Europe will probably be the main beneficiary of the rising trend of OPEC import spending. Indeed, on the somewhat unrealistic assumptions that this trend will continue its steep ascent and that Europe will keep its high export share. OPEC's trade surplus with Europe would be falling rapidly by the late seventies and actually turning into deficits by the mid-1980s. By 1980, Britain could well have joined Norway in being self-sufficient in energy. All of this suggests that the European exchange rates should strengthen toward the end of the decade. We should also be leery of underestimating the long-term potential of the yen. The ingenuity of the Japanese, their productivity, their export orientation, the likelihood that an easing of restrictions would greatly increase the inflow of foreign investment—all of these suggest that the yen, too, may recover its luster toward the end of the decade.

On the other hand, the United States may be favored by the rising tide of capital flows, either directly or as a result of the intermediation of the Eurocurrency market. Moreover, the dollar will be reinforced to the extent that "Project Independence" bears fruit and leads to an acceleration of energy production from indigenous sources.

But this leaves the long-term outcome very much in doubt. At this point, we simply cannot forecast how trade and investment flows might sort themselves out and what exchange-rate movements would be required to do the job. However, one thing is clear: the chances of an early return to fixed exchange rates, which were bleak even before the oil crisis, are now zero. Present and prospective international reserves will simply be no match for the rapidly rising volume of international liquidity resulting from the immense outpouring of funds to oil producing countries. These funds, once mobilized by fears of loss or expectations of gain, or by political considerations, could quickly sweep over even the strongest defenses like tidal waves. Faced with this possibility, no country is likely to risk the loss of its reserve assets in an attempt to hold back pressures that, in the end, probably cannot be contained.

VI

Let us turn to the question of domestic adjustments within the economies of the consuming countries. How much dislocation and how much impairment of growth might there be? Analytically, there are two problems. The first is the transitional problem of adjusting the structure of production to reflect the changing pattern of consumption. Examples would be to shift automobile output away from gas-guzzlers toward compacts, or even to decrease automobile production and improve mass transport systems. The second problem is to maintain a full employment economy in the face of a worldwide tendency for consumption to decline and savings to increase. This is conceptually the more difficult problem to understand, although it is not necessarily more difficult to resolve than the other. The problem is, in reality, simply our old question of ability to absorb OPEC funds in a different guise. We have already concluded that, in a financial sense, there is no problem of absorption, because the funds earned by OPEC do not represent new money that must somehow be shoe-horned into the world's money and capital markets, but money already there that simply changes title. In an economic sense, however, the question is this: will the industrial countries be able to translate into productive, job-creating activities at home the financial savings of the oil-producing countries available to them? Unless they succeed, they face a lasting increase in unemployment and retardation in growth.

Let us examine the dynamics of this problem. Because crude oil prices have risen fourfold in the Gulf over January 1973 levels, consumers in the importing countries will have to spend a larger percentage of their incomes on petroleum products. If they spend a larger percentage on oil, however, they will have less to spend on other things. And, since the increased expenditures for oil accrue primarily to OPEC governments—that is, to nonresidents—total spending by residents on domestically produced goods must fall. This drop implies, in turn, a tendency for domestic employment and output to fall.

Some of this pressure toward higher unemployment will be offset by increased exports to the OPEC countries. Some of it, too, will be offset by a tendency on the part of consumers to maintain their living standards in the face of the higher oil prices by reducing savings, and by a tendency for wages to rise somewhat in response to higher prices. On balance, however, not all of the initial drop in demand for domestically produced goods is likely to be offset. Thus, the entire world will probably experience a tendency for the share of consumption to drop and for that of savings to rise, with the savings increase occurring primarily in the OPEC countries. If income and output are to be sustained in the industrial world, OPEC's extra savings will either have to be translated into investments or into spending for consumption. The latter alternative would counteract the tendency for worldwide savings to rise by offsetting OPEC's higher savings with lower savings—possibly even some outright dissaving—in the industrial countries.

Is solving this problem difficult? No, at least not in concept, because it is essentially the Keynesian problem of overcoming demand inadequacies. This has been studied and understood so thoroughly by several generations of policy-makers that success in developing future solutions could normally be assumed. All that is required, in principle, is that the governments of the consuming countries follow expansionary policies to stimulate domestic demand and offset the drop caused by the diversion of spending from domestic goods to foreign oil.

In the present situation, however, there is a new, complicating factor. When the consuming countries look at their trade balances this year, virtually all of them should find that they are running deficits. Normally, the prescription for such deficits is contractionary monetary and fiscal policies. This would tend to reduce imports and increase exports, thereby eliminating the problem.

To counteract the effect of lower demand, however, expansionary policies are needed. Thus, the instinct to safeguard the trade balance will be in conflict with the instinct to maintain full employment. The logic of the situation is that the latter instinct will prevail, but that will not necessarily happen immediately and, indeed, cannot be taken for granted even in the long run.

VII

Now, let us turn to the inflationary consequences of higher oil prices. These are no easier to fathom than the retarding effects of higher oil prices on demand and output. To be sure, one would have to be blind not to perceive the direct inflationary impact of the jump in oil prices. And it is also apparent that higher oil prices will pull up the prices of coal and other forms of energy, and spark demands for higher wages by workers attempting to keep up with inflation. For the United States, these developments will probably add about two percentage points to the GNP deflator in 1974, and a little more than three to the cost-of-living index.

Beyond these more or less immediate effects, however, lurk others that are more difficult to trace. Structural changes will be necessary within the oil-importing countries that will surely involve shifts in consumption patterns, for example, to smaller cars and better insulated homes. There may also be shifts from the production of consumption goods to investment goods as a joint result of two forces in that direction: on the supply side, an increase in world savings associated with the transfer of wealth to OPEC nations with low absorptive capacities; and on the side of demand, an urgent need in the consuming countries to step up investments in their energy industries, in particular, and, more generally, a need of some years' standing to expand industrial capacity.

Changes in relative prices provide the necessary carrot-and-stick inducements that are the traditional means for bringing about desired shifts in employment, production and investment patterns. But prices have been increasingly "sticky" on the downside, for a variety of reasons. This means that price increases will have to play a proportionately larger role in the adjustment process, and this is clearly inflationary.

In addition to these possible developments, the balance-of-payments strains resulting from higher oil prices will undoubtedly generate pressures to increase international reserves, through stepped up creation of Special Drawing Rights (SDRs), revaluation of monetary gold stocks, or other means. This, too, would tend to be inflationary.

Moreover, there is a danger that the success of OPEC in raising oil prices will inspire attempts by nations producing other essential materials to form cartels of their own. This might conceivably occur in copper, aluminum, coffee, tin, natural rubber, timber, and even such items as tea, cocoa and pepper. Some, but not much, comfort can be gleaned from the conclusions of a recent study by Bension Varon and Kenji Takeuchi published in this issue of *Foreign Affairs*. In essence, these authors found less potential for increases in the price of non-fuel minerals than existed in the case of oil, because of both market factors limiting the ability to raise prices and greater difficulties in forming an effective cartel.

Finally, currency changes will be inflationary or deflationary for individual countries, depending on whether their exchange rates move down or up. For the world as a whole, however, the effects of currency changes on inflation should be essentially neutral because the experiences of individual countries will tend to be canceled out in the process of aggregation.

As against these inflationary tendencies, only a few counterforces appear present. First, there is the deflationary impact, which we have already described, of the wealth transfer itself. In depressing consumption, it will tend to restrain price increases. Second, a shift toward more investment should, in the long run, moderate inflation. And third, after giving inflation a boost with their initial quantum jump, energy prices may subsequently slow the inflationary spiral by rising more slowly than other prices, possibly even by declining from present levels.

On balance, it would seem that the oil crisis has set in motion a number of forces that, in combination, will increase inflation not only in 1974, but also beyond.

VIII

Even if the monetary system should get through the energy crisis with its feathers unruffled, which seems unlikely, and even if there is no long-term damage to the growth and inflation prospects of the industrial world, which would take a bit of luck, I don't think that we can count on getting by with no skin off our collective backs. The transfer of wealth to oil-producing countries cannot fail to take its toll on the living standards of the industrial world, although even here some of the real burden could be shifted to future generations.

What impairment of living standards means in this context is having less of the nation's output available to its own people. And this is a different matter from employment or economic growth. An example will make this clear. Suppose that the OPEC countries were able to spend every cent of their higher incomes, and that what they wanted to buy in the United States was precisely those things which Americans could no longer afford because of higher oil prices. In that case, no one would lose his job or suffer a loss of money income, the existing structure of output would be maintained and, with it, the country's growth rate. But income in the United States would buy less, and output that would have been enjoyed by Americans would be shipped to the OPEC countries. We can estimate roughly what this would amount to in quantitative terms. If, indeed, the United States paid for the increased cost of oil imports with current output, the transfer would entail roughly the same burden as a ten percent increase in personal income taxes.

Now, consider the opposite extreme. Suppose that the OPEC countries did not wish to spend any of their money for imports, and that their entire income went into investments abroad. In this case, there need not be any change in jobs, incomes, growth or even consumption in the industrial countries. For illustrative purposes, suppose that the higher cost of imported oil were offset by tax cuts in the consuming countries. This would maintain their consumers' purchasing power. The resulting government deficits could then be financed by drawing on the capital accumulations of OPEC. The real burden of the wealth transfer would then occur in the future, not in the present.

In reality, the actual outcome will be somewhere between these two extremes. In the early years, while OPEC import spending remains low in relation to income, the current burden of the wealth transfer may be light for the industrial countries, and their future output will be mortgaged. Later, when OPEC expenditures rise to meet income, the current burden will intensify.

IX

Now, let us say a few words about the effects of the world oil crisis on the Third World. To oversimplify for this purpose, we can effectively split the globe in half, carefully cutting to include West Africa and Latin America in one semisphere, and East Africa and Asia in the other. In the western half, there is enough indigenous energy or exportable mineral wealth to leave many of the countries relatively unscathed by the rocketing energy import prices.

In the eastern half, where nearly one billion people already struggle on a per capita GNP of $100 to $200, the consequences will be acutely felt. In most cases, local energy supplies are minimal or not readily expandable. Energy imports are large relative to mineral exports or indeed total exports. There appear to be few opportunities for efficiencies or a reduction in luxury imports to counterbalance the substantial impending increase in the import bill. What oil these countries purchase will be paid for dearly in terms of imported capital equipment and therefore future growth forgone, and what oil they forgo importing will result in current GNP losses. Thus, the eastern half of the Dark Continent will become darker still and the nations of the subcontinent of Asia will no longer merit the adjective "emerging." These latter countries represent those very dominoes to which the United States has paid such profound attention during the cold war. It seems unlikely that the industrial nations or the oil-rich Arab states will be willing to provide financial support on the scale that could well be necessary to avoid political violence and anarchy in these countries.

X

This article has ranged broadly over the domestic and international implications of the recent extraordinary increases in oil import prices. Difficult internal adjustments will be necessary in the economies of oil-importing countries, but serious harm to employment, growth, inflation and living standards can probably be avoided at least in the industrial world. In many developing countries, however, the consequences will be severe, if not ruinous.

The resource-poor Third World is not the only area of particular vulnerability to the impact of the energy crisis. The Achilles' heel of the entire world economy may turn out to be the international payments system. The financial flows associated with more expensive oil are so immense as to threaten intolerable balance-of-payments strains and currency instability. While technical solutions to many, if not all, of the financial problems can be devised, it remains to be seen whether international cooperation will be up to the task of implementing them. The price of failure could be high. To fail would be to risk competitive devaluations and trade restrictions that would amplify recessionary tendencies already set in motion by the energy crisis.

Developing Countries and Nonfuel Minerals

(By Bension Varon and Kenji Takeuchi)

I

Over the past three years, a dramatic change has taken place in the world market for one key raw material, oil, whose production and reserves are heavily concentrated among the so-called developing countries of the world. Now, as part of the energy crisis, the developed countries of the world face the certain prospect of very much higher fuel costs in coming years, and the continuing threat that adequate supplies may be withheld either for political reasons or in a process of rather one-sided bargaining with the key producer countries in the now-famous OPEC grouping (the Organization of Petroleum Exporting Countries).

Inevitably, the question arises whether a similar transformation may be in store for one or more of the widely traded minerals not used for fuel. From the standpoint of the developing countries that produce substantial shares of these minerals, such a transformation represents a hope—after successive disappointments with aid flows, transfers of know-how, trade liberalization, and international commodity agreements—that they may now succeed in obtaining from advanced countries increased resources through the operation of the market in changed circumstances, and possibly through alliances emulating OPEC. Conversely, for the consuming countries, such a prospect could be alarming, raising the specter that to the already astronomical amounts they have to pay for oil will be added heavy increases for their other mineral needs, not to mention the chance of having on occasion to do without.

However viewed, the future terms of trade in nonfuel minerals can be deeply significant for individual countries, for the overall balance of economic power in the world, for the welfare of very large numbers of people. To what extent is a transformation in prospect?

It is not a question to be answered simply or with firm conviction. Each of the nine major minerals to be examined in this article—iron ore, bauxite, copper, manganese ore, lead, nickel, phosphate rock, zinc and tin—is affected by factors that cause it to differ greatly from the oil situation, and mostly also from others in the group. Moreover, as *The Economist* has wryly reminded us, recent history is sprinkled with cases where a change in price factors operated to turn prophecies of scarcity into realities of glut; even in the medium term of five to ten years, predictions of resource supplies and markets are especially affected by too many unforeseeable elements to be subject to assured linear projections. This said, only by initially making such projections, however tentatively, can one see the lay of the land and identify and assess the elements that could change what happens.

II

These nine minerals account for 85 percent of the estimated value of world production of all nonfuel minerals; they are also the nonfuel minerals of export interest to the developing countries, accounting in 1970 for 12 percent of the aggregate exports of developing countries. By comparison, oil in 1970 accounted for 31 percent of these aggregate exports.

For the period from now to 1980, current forecasts by the staff of the World Bank look for world requirements of these minerals to increase, in the aggregate, at rates approximating those experienced in the last ten to 15 years. The needs of developing countries should grow at an accelerating pace, offsetting a slowing down in the dramatic recent growth rate of Japan's import demand for raw materials. And there is the crucial overall projection—now perhaps in more doubt than it would have seemed last October—that economic activity in the OECD countries, which are of course the major consumers by far, will grow by about five percent per year in real terms over this period.[1]

Naturally, this projected growth in demand is uneven among the group. Demand for *bauxite, nickel,* and *phosphate rock* is anticipated to increase faster than economic activity generally (to have, as economists put it, an elasticity of demand greater than unity, or one). Bauxite demand is expected to expand by nine percent per year (faster than that of any mineral including petroleum), nickel by six percent, and phosphate rock (most of it used in the fertilizer in-

[1] The members of OECD (the Organization for Economic Cooperation and Development) are Australia, Canada, the United States, Japan, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and Yugoslavia.

dustry) by 5.5 percent annually (seven percent in the first half of the decade, four percent thereafter). Demand for four major minerals, *iron ore, manganese ore, copper*, and *zinc*, will expand at rates of 4–4.5 percent a year, while the growth rates for the other two minerals considered, *lead* and *tin*, are estimated to be considerably lower, namely three percent and 1.2 percent—in line with trends which have already set in for those two commodities.

It should be noted that these forecasts refer to demand for virgin ore or for primary metal only; they do not include demand for scrap—or rather assume that recovery from so-called secondary sources will account for roughly its present percentage of total supply. For the majority of these minerals, scrap is indeed a major source of supply—40–45 percent of U.S. iron, copper, and lead metal requirements come from secondary sources. While the proportion of demand met from such sources is technically augmentable, a case-by-case examination of the prospects for this, particularly the economic incentives, does not yet indicate that scrap ratios are likely to change so markedly as to inhibit the growth of demand for virgin materials significantly in the foreseeable future. For example, while according to some studies the scrap ratio in aluminum production in the United States can be increased from the current 17 percent to nearly 45 percent under an active recycling policy, there is at present little incentive to do so, since bauxite is one of the most abundant minerals. Yet the assumption of "no major changes in recycling" may turn out to be wrong even in the seventies, since interest in recycling can be fueled not simply by economics but also by environmental considerations to which public opinion may become increasingly sensitive.

The above forecasts also assume no major change in rates of substitution—this on the basis of a case-by-case examination and giving special weight also to economic considerations. This assumption, too, while justifiable at present, may prove to be fallacious, since trends in substitution are determined, among other factors, by unpredictable technological innovations in product development and processing. The development of non-silver photographic processes or of alternatives to lead in increasing the octane of gasolines, for example, may alter the demand and price outlook for these two metals significantly.

Except to the extent that one metal is simply replaced by another, unforeseen developments in both recycling and substitution would tend, of course, to slow the growth of demand for new resources. In the longer run, moreover, a third and much more powerful force may be operating to reduce the growth rate in demand for minerals. This force is the dynamics of economic growth itself, and especially the trends within the present group of developed countries. Historical experience shows, and cross-section studies confirm, that as an economy grows and matures, its requirements for most raw materials per unit of GNP (their "intensity of use") tends to decline. Nowhere is the evidence clearer and more convincing than in the case of steel, the demand for which influences the trends of a number of minerals. A recent study by the International Iron and Steel Institute (IISI) found that significant growth in "steel intensity" did not occur until income reached $300 (in 1963 prices) per head, the minimum level required before an economic takeoff can be expected. Thereafter, as rapid industrialization sets in, steel consumption is propelled upward faster than GNP; eventually, however, at an income level of around $2,500, steel intensity begins to decline, as the industry sector is extended into sophisticated spheres and the service sector expands in relative importance. Taking into account the relative size of those national markets now at the $2,500 level or above, and of those which will enter or remain at the $300–$2,500 level, one arrives at projected growth rates in demand for nonfuel minerals over the next 30 years that tend to be considerably *lower* than those just projected for the next ten years.

What then of availability and price? In terms of processing capacity, the meeting of the projected increases in demand does not appear to present serious problems, or indeed to require extraordinary investment: in the case of iron ore, nickel, and possibly one or two other minerals, existing capacity or capacity under construction is probably already sufficient for estimated 1980 requirements.

The reserve picture is more diverse. For phosphate rock, iron ore, bauxite, nickel, and manganese ore, world reserves are by any estimate ample. (Estimated proven iron ore reserves increased sevenfold in the last 25 years and are deemed sufficient to last for at least 250 years at current levels of consumption and for at least 100 years at exponentially growing demand; potential ore reserves are triple the size of proven reserves and well distributed geographically.) Copper, lead and zinc fall into an intermediate category, with proven reserves now sufficient to last for only 30 years in the case of copper, and somewhat less for the other two. However, it should be noted that copper is currently being mined at progressively lower ore content and yet at costs rising only moderately in real terms, as a result of new extractive technology. (Because of increasingly strict pollution control standards, smelting costs, in contrast, have recently increased substantially.) Among significant minerals, the only ones whose reserves are tight or critical are silver and tin. Intensified explorations have failed to uncover significant new resources. There are, however, enormous hoards of silver in private hands which can be brought into the market by higher prices. In the case of tin, demand growth has already been forced down to about one percent per annum through substitution.

Finally, as one looks to the longer term, the mineral potential of the oceans becomes relevant. It is now clear that it is enormous, specifically for the nickel, copper, manganese and cobalt contained in the so-called manganese nodules scattered over vast areas of the ocean floor. And the technology of seabed mining appears to be rapidly approaching the point of feasibility at bearable cost. The politics of developing the mineral resources of the seabed are complicated and so far unresolved.[2] But there seems little doubt that a major contribution will come from this source well within the presently calculated life of the reserves of such minerals as copper. And for the relevant materiaals the seabed potential must of necessity hang over the market, for the future if not in the short term of the next five years.

This brings us to prices. For major minerals, these have been unusually high (especially in U.S. dollar terms) in 1973. The main factors responsible for this phenomenon have been (a) currency adjustments (early 1973) including the uncertainty that preceded the adjustments; (b) the coincidence of sharp upturns in industrial activities in all major developed countries; (c) serious supply problems in several major minerals arising from pollution control problems in the nonferrous metal smelting industry. Each of these was temporary, which would suggest that the price rises are by and large of a short-run nature. On the other hand, the dramatic recent increase in oil prices, and resultant energy costs, may raise substantially the cost and price of some processed minerals—and in cases such as bauxite affect the return of countries which handle primary processing.

Nonetheless, if one looks at the prices of the raw minerals themselves, economic forces now suggest that these will be lower in real terms in the next few years than they have been in 1973. If one takes 1967–69 as a base period, then it can be estimated that only silver, zinc, and phosphate rock prices will rise faster than the rate of inflation assumed in this exercise—that the "index of the wholesale prices of internationally traded goods" will rise by 5.25 percent per year between 1967–69 and 1980. Since mineral prices are notoriously cyclical and unsynchronized (due mostly to supply factors, such as investment cycles, labor strikes, and calamities), such a forecast does not attempt to describe the shape of the price trend, only to suggest the general level of prices by the end of the period. Under this forecast, prices of bauxite, nickel and lead would hold their values in terms of 1967–69 constant dollars, while prices of copper and iron ore may decline slightly, and those of manganese ore and tin significantly.

Silver prices will register the sharpest gain in real terms, nearly 50 percent, between the late sixties and 1980, reflecting the chronic shortage of "new silver" and in order to bring out sufficient supplies from hoarded stocks to meet industrial demand. Zinc prices will follow with an increase of roughly 30 percent over the same period as a consequence of a shortage of smelting capacity (rather than ore) attributable to the problem of pollution control. In the case of the two commodities at the other end of the list, managanese and tin, real prices could decline from their 1967–69 base by about 30 percent and 20 percent respectively, reflecting sluggish demand (for tin), actual or potential overcapacity, and already-approved releases from the U.S. stockpile. The new stockpile objectives call for release of seven million tons of manganese ore, equivalent to total developing countries' output in 1971. The U.S. tin stockpile totals about

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[2] See Seyom Brown and Larry L. Fabian, "Diplomats at Sea," *Foreign Affairs*, January 1974.

250,000 tons, compared to annual world consumption of 185,000 tons in 1970–72; 43,000 tons of this, equivalent to 80 percent of average U.S. consumption per year, have already been approved for immediate release (though disposals to date have been limited), and congressional approval for the disposal of an additional 157,000 tons is being requested. Accelerated disposal of U.S. non-commercial zinc stocks, too, despite their more modest volume (equivalent to two and one-half months' world consumption) may have an impact on the market, but in this case perhaps a healthy impact, by holding prices in line with prices of substitute materials, especially aluminum and plastics.

III

On the basis of our projections of demand/supply balances and the price trends outlined above—and *without* taking into account possibly higher rates of inflation and the impact of higher energy costs—the conclusion is that developing countries' exports of these nine major minerals are likely to increase from $4.8 billion in 1967–69 to $15.2 billion in 1980 in nominal (or current) terms, rising by ten percent annually—or to $8.2 billion in constant dollar terms, rising at a rate of 4.6 percent per annum, as shown below.

ESTIMATED VALUE OF DEVELOPING COUNTRIES' EXPORTS

[In millions of dollars]

	Average 1967–69	1980 value in current dollars	1980 value in 1967–69 dollars
Copper	2,281	8,000	4,315
Iron ore	811	2,460	1,325
Tin	565	930	500
Bauxite/alumina/aluminum	450	1,475	800
Phosphate rock	220	800	430
Zinc	130	600	325
Silver	132	525	285
Lead	113	215	115
Manganese	98	195	105
Total	4,800	15,200	8,200

The picture that emerges from the trends spelled out above can be considered neither especially bullish for the developing countries nor threatening for the industrial countries. For the latter, the increased burden on the balance of payments of paying for non-fuel minerals will not be insignificant; moreover, since the United States in particular is dependent on external sources for steadily larger proportions of its mineral needs, the projected burden could rise more steeply after 1980.[3]

Nevertheless, it is important to keep the size of the trade in non-fuel minerals in perspective. For the developing countries as a group, for example, a growth in foreign exchange earnings of $10.4 billion in current dollars between 1967–69 and 1980 would be less than one-tenth of the increase now projected to arise from petroleum exports in the much shorter period from 1973 to 1980—and this without assuming that the dramatic price increases of December 1973 are maintained. While the forecast suggests that mineral prices will do generally better in the 1970s than in the past, this will serve only—for most minerals—to arrest the downward trends experienced in the 1960s. Moreover, real prices for some will continue to decline; it should be noted that for the last five to six years, the inflation adjustments obtained by many mineral-producing countries under existing contracts or through bilateral negotiations has been on the order of 2.5 percent per year—far short of the 6.2 percent yearly increase actually registered over this period in the index of wholesale price of internationally traded goods.

To repeat, the above analysis warns against the lumping of petroleum statistics and non-fuel mineral statistics—predictions that the import bill of consuming countries for "raw materials" might be X billion dollars by 1980, which are not explicit about the high ratio (currently at least 8:1) between projected oil im-

[3] One study by the U.S. government has estimated that the United States would have to pay $44 billion per year for its non-fuel, mineral imports by the year 2000. U.S. Department of the Interior, *Mining and Minerals Policy, 1973*, Second Annual Report of the Secretary of the Interior under the Mining and Minerals Policy Act of 1970. Washington, G.P.O., June 1973.

port costs and the total costs of non-fuel minerals, are grossly misleading. In addition to distorting the import picture, the lumping of statistics overlooks the fact that while roughly half of the oil revenues will accrue to five resource-surplus countries (namely, Saudi Arabia, Qatar, Abu Dhabi, Kuwait, and Libya), the projected revenue from non-fuel minerals will go to as many as 40 developing countries, nearly all of which are in great need of capital and most of which face increased oil import costs themselves.

IV

The projections presented above have been based on market forces as they currently exist, without the operation of special new pressures by the producing countries in particular. It remains to consider whether, in the light of the remarkable success achieved by the OPEC grouping since 1971 in altering the terms of trade for oil (and recently in withholding supplies), any similar success could be achieved by producers' alliances among developing countries rich in other minerals.[4]

Obviously, the political urge to form such alliances is there. A sense of disappointment at their overall treatment by the industrial countries is almost universal among developing countries. For the producers of minerals, there is moreover (as for oil) the keen sense that their minerals are non-renewable, an asset that should produce the greatest possible return and if possible have its useful life stretched out. Hence, it is only natural that producers should seek to change a situation in which, by and large, the sellers of non-fuel minerals are competing, diffuse, and unorganized in the face of relatively few and well-organized buyers on behalf of the consuming countries.

The four principal producers of copper (Zaire, Zambia, Peru, and Chile) have long worked together in CIPEC (based on its French name, *Conseil Intergouvernemental des Pays Exportateurs de Cuivre*—the Intergovernmental Council of Copper Exporting Countries), and currently there are widespread reports of intense consultation among the producers of other key minerals. The very least that can come out of the current energy crisis is that the producers of all minerals (and of key agricultural commodities as well) will be far more alert to the market situation and far more aggressive in seeking to alter it to their advantage.

But when it comes to assessing their chances of major success, the present prediction must be very cautious. Even the strongest political urge, or the most adroit management, cannot alter certain basic factors that, in our judgment, severely limit the possible accomplishments of producers' alliances in non-fuel minerals.

The key economic fact is that, while demand for most non-fuel minerals is price-inelastic in the short run (i.e., not reduced in proportion to price increases), this is not necessarily true over the long run, certainly not to the extent that holds for oil. Calculations based on historic experience for tin, aluminum and copper, for example, suggest strongly that in the long run the drop in demand more than offsets any price increase, so that the total return to the producers eventually becomes less than before the price change. Although the econometric measurement of price elasticities is a tricky process leading to differing estimates of individual cases, there is little disagreement on the broad point about short-term and long-term price elasticity.[5]

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[4] The question has received wide interest recently and several views on it have been expressed in the professional and daily press. See, on the one hand, C. Fred Bergsten. "The Threat from the Third World," *Foreign Policy*, Summer 1973; a more negative view is contained in "State Doubts Imitation on Cartel in Oil," *The Washington Post*, February 8, 1974; and Philip H. Trezise, "How Many OPEC's in Our Future?", *The New York Times*, February 10, 1974.

[5] The common arithmetical measure of elasticity is the ratio between the extent of a price change and the ensuing change in demand: thus, if a price rise of 10 percent produces a demand decrease of the same percent, the elasticity is said to be (minus) 1.0; if the same price rise produces a drop in demand of only 5.5 percent, the elasticity is (minus) 0.55 (and the producers as a group have a higher total return); at elasticities *above* unity, or one, the total return to the producers is less than before the price increase. Applying these measurements to selected minerals, one finds that while the short-run elasticity of world demand for tin has been in the neighborhood of 0.55, the long-run elasticity is estimated at about 1.25; and whereas the short-run price elasticity of U.S. demand for aluminum or copper has been about 0.20, the long-run elasticities are around 1.35 in the case of aluminum and above 2.50 in the case of copper (all figures are, of course, minus). See, for example, F. E. Banks, "An Econometric Model of the World Tin Economy: A Comment," *Econometrica*, Vol. 40, No. 4 (July 1972); Charles River Associates, Inc., *Economic Analysis of the Copper Industry* (U.S. Department of Commerce Publication, PB 189 927, March 1970); and Charles River Associates, Inc., *An Economic Analysis of the Aluminum Industry* (Cambridge, Mass., March 1971).

The reasons are threefold—stockpiles, recycling possibilities, and the use of substitutes—none of which, of course, apply to oil in anything like the same way as yet. All have already been referred to in this article, and the projections for the period to 1980 have assumed no major change in recycling or the use of substitutes.

First, the availability of stockpiles tends to mitigate the immediate impact of supply curtailment—although in times of anticipated protracted scarcity, these might not be released freely enough to improve effectively the short-term situation. Stockpiles, especially those of the United States, have long affected the price of tin, and to a lesser degree manganese and zinc. If these are maintained, the cushioning effect should continue. On the other hand, if the United States were now to dispose rapidly of its stockpiles, their hangover effect on the market would disappear, and after a period of depressed prices the result might be some tendency for prices to increase in the longer term.

The point, however, is that it is not necessary for all three factors to be at work at the same time. *Any one* of the three tends to place a ceiling on prices that would be much lower relative to current price levels than has been the case for the recent price rises of petroleum.

Thus, whereas oil is completely dissipated when consumed, recyclable metal scrap is generated continually in the major consuming countries, adding to the already vast reserves of so-called secondary sources. While recovery from some of these sources would take time, accelerated recycling is possible for a wide range of materials, including aluminum, copper and lead. The real determinants of the pace of recycling are economic, basically whether prices are such that consuming industries find it advantageous to "dig into the scrap reserve." Environmental considerations may enter in, but recent events suggest that they too may be modified in response to changed economic circumstances. As for the potential impact of the "energy crisis" on recycling, it appears to vary sharply from case to case; for aluminum, where new production is highly energy-intensive, the incentive to use scrap may increase because of the energy input already embodied in it; for steel, on the other hand, the use of scrap requires more energy to process than does "hot metal" (molten pig iron). All in all, price remains the main factor affecting the amount of recycling.

Thirdly, the possibility of substitutes represents a real threat at any time to the effective maintenance of substantially higher prices. Such substitutes can replace the basic mineral as a source for the metal, the metal itself, or the metal-containing product altogether. (For example, bauxite can be replaced by other materials in making aluminum, aluminum can be replaced by tin in making cans, and cans can be replaced by plastic or glass containers.) Current or potential substitutes are available for the majority of minerals, among them nearly all of the nonferrous metals.

While these assessments can be countered by arguments that some of the very substitutes may be in short supply or high-priced (like plastics at this time due to the oil crunch), or that their supply too may be controllable by producers' alliances, it should be borne in mind that the field of metallurgy has historically been in the vanguard of experimentation and development of substitutes in the direction of the cheapest and most abundant raw materials. In short, the infrastructure for weathering a crisis at manageable cost within tolerable time is more sophisticated in this sector than in the energy sector. While, as recent events have shown, oil was grossly underpriced vis-à-vis substitutes, in the case of almost all non-fuel minerals the price increase at which either substitution or exploitation of lower-grade sources becomes feasible is a great deal less than it is for oil, and the process involves substantially shorter time lags.

Another consideration as to the feasibility of powerful producers' alliances in non-fuel minerals is the size and distribution of global resources and the degree to which these can be controlled by certain configurations of countries. *A priori*, scarcity of a resource is not essential for the establishment of a successful cartel; what is required is *control* over present and potential supply. But the scarcity factor is important in the sense that it strenghens the hand of producing countries in imposing their terms and shaping the ultimate course of supplies, or costs. For it is crucial to the successful operation of a cartel that supply outside the membership be inelastic, i.e., that other suppliers are higher-cost producers with relatively small reserves. There are few minerals that are in fact, or are perceived to be, as potentially scarce as petroleum; and with the possible exception of copper, none is truly indispensable.

Furtherfore, the distribution of world reserves cuts across categories of economic or political interest. Developing countries are estimated to have roughly 40–45 percent of the world's major non-fuel mineral reserves, with 35 percent in developed countries and 25–30 percent in centrally planned countries.[6] Developed countries which produce and sell major non-fuel minerals in competition with developing countries include Canada, Australia, and South Africa. Consequently, in a number of minerals (copper, among others) a cartel confined to developing countries would be ineffective, since supply elasticity outside the cartel would be substantial at least in the medium term (three to four years).[7] In such situations, then, the feasibility of a cartel would depend heavily on whether individual developed countries—facing complex factors including their own broad interdependence with developed consumer countries—would participate fully in the producers' alliance.

Theoretically, the number of countries involved in a cartel effort need not be small, since the operative variable is "community of interest." But in practice, limited necessary membership is a facilitating factor also. The relationship between the amount of control by a cartel and the degree of its success cannot be stated in terms of a general formula. What is clear in the light of the wide geographic distribution of many of the minerals in question is that potential producers' alliances will have to include a wide range of heterogenous interests among their membership. Lastly, since deposits vary in grade and in the economics of exploitation and processing, price increases would continuously recast the configuration of the membership necessary to bring control to bear. Iron ore provides perhaps the best illustration of this last point, with resources distributed over four continents and among varied economic groupings. It also brings home the difficulty of neatly categorizing the producers and consumers of non-fuel minerals as groups with identifiably contrasting interests.

In addition to the above general considerations, one must return to the specific projections of the future market for individual minerals. For most non-fuel minerals the demand outlook, as noted already, is not markedly different from past experience. If decelerated economic growth is now the general result of the high cost of energy, then the predictions earlier in this article would become even less buoyant.

Finally, there is what might be called the naked bargaining position of individual producing countries at a given time. In relation to their levels of development and dependence on exports of their mineral resources for achieving developmental goals—not to mention the actual financial reserves required to play a tough bargaining game—no group of potential cartel members for a non-fuel mineral seems likely to attain as strong a position as the OPEC countries have held since 1970. The latter were dealing from a unique position of strength—in that they had no major conflicting trade interests, either domestic or within the group, enjoyed a high degree of independence from developed countries, and came to hold large financial reserves. In contrast, a producers' group for any given non-fuel mineral would be likely to include one or more large countries with basic agricultural needs or heavily dependent on the continued expansion of its export markets for manufactured goods. Moreover, whereas the OPEC states had completed the development of their oil resource base at the time of their concerted action, many developing countries that produce non-fuel minerals remain dependent on foreign capital and technology to develop, expand, transport and increase the processing of their resources.

Conceivably, some of the OPEC countries could come to the aid of a cartel in non-fuel minerals to the extent of supplying the financial resources for this kind of resource development, or to make up possible temporary shortfalls in revenues, even the "revenue foregone" by curtailment or non-development of a resource. But only the developed countires now command the technology, the wider development resources, and the markets on which many producers depend.

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[6] Among the minerals reviewed here, world reserves of phosphate, tin, and bauxite are concentrated in the developing countries, which also account for about half of the copper and nickel reserves, whereas the reserves of iron ore, manganese, zinc, lead and silver are concentrated in the developed and centrally planned countries. Higher mineral prices would not significantly alter the reserve situation in favor of the developing countries; for many minerals the opposite would be true. However, because of conceptual and measurement difficulties, reserve estimates and views such as the above must be regarded with caution.

[7] For a discussion of these factors related specifically to copper, see Kenji Takeuchi, "CIPEC and the Copper Export Earnings of Member Countries," *The Developing Economies*, Institute of Developing Economies, Tokyo, v. X, No. 1 (March 1972).

V

In sum, there are strong factors which seem to mitigate the feasibility of proliferating producers' alliances modeled on OPEC. Nonetheless, the possibilities for such alliances do exist in a few minerals. Foremost among these is bauxite, where the alliance-inducing factors seem to outweigh the obstacles, as illustrated by the preliminary consultations among Jamaica, Surinam, Guinea and other bauxite-producing countries. Moreover, in one case, Morocco, a major supplier of phosphate rock to the West European market, unilaterally raised its prices by a factor of three last fall; although the full extent of this recent price increase may not be maintained in the long run since there are large unexploited resources of the product, prices are certain to lie on a new plateau hereafter. There *is* an improved climate for group pressure or price leadership, and where the trend is toward higher mineral prices—often to pay the larger oil bills of the producing countries themselves—the new aggressive stance of producers would seem to make it irreversible.

Whether concerted pressure for higher commodity prices will be accompanied by true cartel forms of action and by attempts at supply constraints is still another question. As the above discussion makes clear, the obstacles to this kind of stronger action are especially great for the non-fuel minerals considered. Yet in a basic situation where developing countries urgently need resources for development, the chances of their resorting to such drastic measures could depend, in the last analysis, on the overall state of relations between rich and poor countries.

[Friday, June 7, 1974]

DAILY NEWSPAPER OF THE FIRST WORLD SYMPOSIUM—ENERGY AND RAW MATERIALS

OFFICIAL OPENING SESSION

(By JEAN CHENEVIER, President of Société Française des Petroles BP, President of CRC, President of the Symposium International Organization Committee)

After opening the Symposium officially and welcoming participants, Mr. Jean Chenevier summed up the basic characteristics of this event.

"Essentially, the common denominator of our seven organization is that they are private associations of company managers desirous of pooling their reflective thought on economic and social progress.

". . . The Symposium is in no way to be construed as an intergovernmental conference. It is a private event instigated by and a meeting place for top company managers. The fact that some of these companies may be government backed in no way changes the basic, private character of our discussions and of the statements made.

"By the same token, it comes as no surprise to see political figures among us here—we were hoping for their presence and are indeed pleased they could come. It is the proof, if any were needed, of the interaction between private enterprise and the society of which they are part and whose development their action influences so greatly . . .

"The second consequence stems from our awareness of the interaction linking us together. In this light, the field of energy and raw materials is, of course, a prime example. And there are a good many others—increasingly so, both in number and in size. The similarities and anxieties we share, once national, are growing more and more international and worldwide. This is why our seven organizations, some of them for a number of years now, have gotten into the habit of working in closer and closer cooperation and have taken the firm decision to develop this cooperation."

COMMON PROBLEMS

"The third consequence is due to the very nature of the factors uniting us, i.e. to our functions as company managers, far more than to the specific character of the various professional branches we represent. For this reason, our reflections are primarily devoted to problems common to all our enterprises, however wide apart they may be, problems whose similarities we hope to grasp through our differing approaches. This is, no doubt, why our attitude towards the problems of energy and raw materials facing the world today is the same. "It was not, nor could it be, our intention to organize under a single roof and at a given moment a series of meetings on specific points; what we are aiming at is to attack the problems, seemingly so varied in the most global fashion possible in an attempt to discover common bases, or at least those of general significance".

AN OPEN APPROACH

". . . Sensitive as we are to similarities, we have not overlooked differences either—the two together reflect the image of life, and it is above all our wish to be lucid observers so that we can become efficient men of action. We have therefore attempted to find the similarities between the problems involved and the diversity in approaches to them, in points of view, doctrines, and opinions concerning them. This is the very essence of the worldwide nature of the Symposium; it is also the reason for the variety of interview we obtained. Our attitude is that differences can better be overcome through a scrutiny of the essence of these differences.

BASIC REFLECTION

"To these major characteristics of our meeting should be added another which, when looked at closely, is actually rather a consequence of these characteristics. The reflection we are asking of you is by no means aimed at finding immediate solutions to the problems raised—the difficulty of such a task is obvious from present events and should be underlined in your discussions.

"What we are aiming at, through a careful examination of the basics of these problems and the many approaches that can be made to them, after exchanges of viewpoint during which we will each attempt to have a better understanding of the opinions and motivations of the others, what we are aiming at then is to uncover the concepts that could serve as bases for long range development and policies. This again has been food for reflection and research for our seven organizations. This might be the underlying reason for our deciding, in October 1972, to organize this Symposium on a subject whose importance, it must be admitted, was felt early on".

(BY WILLIAM EBERLÉ, AMERICAN AMBASSADOR, SPECIAL REPRESENTATIVES OF THE PRESIDENT OF THE UNITED STATES FOR TRADE NEGOTIATIONS)

A CRITICAL JUNCTURE

"We are at a critical juncture in the twentieth century . . . within the space of less than a year and a half prices of many goods doubled, tripled, or even quadrupled . . . inflation has reached critical proportion . . ."

In the face of such rapid and dramatic change, international economic relationship needs putting into better order. To do so, a better grasp is needed of the nature of the changes that have taken place so that we can build upon common objectives.

BASIC CONCEPTS

Three concepts are at the basis of today's economic order:

Openness, non-discrimination and multilateralism, the essential basis of the GATT,

Confidence in international negotiation to help solve disputes,

Taking special account of the needs of developing countries.

"We know from recent experience that this is no guarantee that differences can be easily resolved. Among all countries domestic requirements, vulnerabilities to supply interdiction and abilities to absorb higher import costs differ and this is reflected in differences of priorities and policies. And today a new group of nations, whose views frequently differ from those of the industrialized nations, is extremely influential.

"I believe, however, that the concepts I have outlined are still sound and generally acceptable. This does not mean that improvements or adaptations cannot or should not be made, but only that they provide a useful basis for an examination of the issues before us."

Scarcity can be the result of various phenomena:

It can be artificially caused, when a few countries desire to take advantage of their own situations. The recent oil embargoes represent such a situation.

It can be a structural and cyclical phenomenon that is eliminated by market adjustments in the near or medium term.

"While I can understand the desire to increase export earnings, attempting to do so abruptly . . . over a short period of time can involve heavy economic and social cost . . ."

"We must seek to develop an enduring international framework for coping with these problems".

WHAT IS THE ANSWER?

I should like to offer some observations as to how the problems of shortages might be handled in a manner consistent with the achievement of the objectives I outlined earlier.

"For several years now, import barriers are being progressively reduced, including in the United States . . ."

This momentum should not come to a halt because the supply problems arising at the present time are not only "problems between the north and south, or developed versus developing countries, as the United States as well as many developing countries are major suppliers of primary products".

This is why "we must also establish agreed consultation procedures and guidelines for avoiding, where possible, and for resolving where necessary, trade policy conflicts arising over the management of commodities in short supply."

A CODE OF CONDUCT

"Because there is no consensus as to what constitutes a legitimate use of export controls, a strict code of conduct will be difficult to write . . . although it would be premature to speculate on what specific form guidelines might take . . . I would like to make a few observations.

"Unilateral efforts to increase raw material prices may be a tempting approach to maximizing national economic objectives; but this may lead to repercussions which could deny countries many of the benefits they seek. For most developing countries, improved export opportunities for manufactured and processed goods—with the attendant increase in jobs, production and value added per unit of resource output—may be preferable to increasing the price of raw material exports."

THE ROAD TO BE TAKEN

"We now have the opportunity to adapt international institutions and modes of cooperation to deal with contemporary problems . . . The recent U.N. conference provided a better understanding of the various national views concerning raw materials, energy and agriculture.

"These negotiations will enable us to develop a more enduring multilateral framework for dealing with shortages.

"There are no easy answers to the questions we face . . . If we can make a beginning at this meeting we will have contributed toward a process which can produce enormous benefits for all of us."

(BY MICHEL D'ORANO, THE FRENCH MINISTER FOR INDUSTRY)

After congratulating the Symposium organizers on their initiative which created "an opportunity to pool the reflections of participants from industrial consumer countries, developing countries rich in hydrocarbons and mineral raw materials, as well as those of participants from developing countries that are pool in natural resources," Mr. Michel d'Ornano began by analyzing the consequences of the oil crisis and underlined France's devotion to an international cooperation approach.

DISRUPTIONS CONNECTED WITH THE CRISIS

Although the effects of the oil crisis are not at the present time physical in nature, the crisis continues to be felt in the financial sphere: "a question you will have to face is that of deciding whether this new international economic balance can be achieved through the massive rise in the price of oil".

Three levels of problems arise: remedy the embalance of payments, stop the inflationary process, and avoid imposing further poverty on developing countries.

THE DANGER OF CONFLICTS

"In some consumer countries, we are now witnessing the beginning of reflections tending towards self-sufficiency . . . at the same time and similarly, in producing countries, cartels of exporters of specific products are being formed to exert pressure on prices by reducing production.

These conflicting self-propagating procedures which could in many ways be considered as a form of retrogression with respect to the concept of liberalizing and expanding international economic relations."

A NEW INTERNATIONAL ECONOMIC ORDER

"The aspirations of developing countries which produce raw materials, as underlined—in particular at the last U.N. conference, are of three kinds: that of exercising a sovereign right over their natural resources, that of the constant flow of resources and, finally that of obtaining a fair price for their products.

What answers can the industrialized world give to these questions?

1. The exercise by a country of its sovereign rights "is self-evident and leaves no room for dispute".

To reconcile this principle with future development, codes of conduct could be set up to avoid the danger of conflict and to promote international cooperation;

2. As for the stabilization of raw material exchanges, the French Minister stated that "France has always been positively in favor of extending the practice of signing agreements on products, and recently proposed the creation of a world economic observatory to improve market transactions";

3. On the question of fair prices for raw materials, it is felt to be "the legitimate image of producing countries to possess suitable financial resources and ensure their growth; this question is linked with the overall problem of the redistribution of wealth on a worldwide scale and with that of providing assistance for development".

There is no doubt that economic liberalism will not provide an immediate answer to these problems and will not provide a means of guaranteeing the transfer of technical know-how and capability but it does provide a means of "finding methods for the significant and virtually automatic redistribution of a part of the world's income to the Third World as a whole, in accordance with its needs, without at the same time disrupting economic optimum".

These aims at establishing a world balance and at rational and prudent management of resources are extremely ambitious; "they require a good deal of innovation and even more willpower. As far as France is concerned, we will continue to give our full support to any proposal we feel will help international cooperation and solidarity. It was in this spirit that we proposed, at the U.N. conference, that a limited committee be formed to examine the problems involved in the exporting of energy resources so that a dialog could be got under way between producers and consumers".

For these reasons, "The Symposium will, I am certain, prove particularly fruitful for political reflection on the problems which, to a large extent, influence the entire future of our society".

(BY EMILE VAN LENNEP, SECRETARY GENERAL OF O.E.C.D.)

"The Symposium opens at a relatively timely moment for avoiding the pitfall of over dramatization resulting from short-sighted considerations. But if we look at events with a longer view, as is the purpose of this Symposium, one fact becomes evident: we have now entered into a new world system in which we will become increasingly aware of the finite character of natural resources."

THE LESSON

In making the distinction between non-recoverable and recoverable natural resources, Mr. Emile Van Leenep attempted to draw a lesson from recent years: the long period of relatively low prices limited investment and incited waste, while insufficient attention was paid to the recovery of used materials.

"Under these conditions, it is hardly surprising that during the synchronized boom the phenomena of shortage spread quickly. Care must be exercised to stabilize prices without letting them fall to a devastating level under present economic conditions. A return to prices that are too low could lead to a reduction in offer."

A NEW TYPE OF GROWTH

To answer to the challenges of today's world a new type of growth is called for. First of all, consumption must be reappraised, "the means of reappraising consumption i.e. favor consumption small amounts of natural resources over that of consumption using too great a quantity of such resources".

A considerable investment effort must also be made to economize resources and to open new sources of energy. The financing of such investments is evidently an extremely delicate point. It involves "the organization of financing circuits for channelling savings, in particular those of oil exporters which cannot be invested on site, to needy countries and in forms that will not disrupt monetary stability.

THE ROLE OF THE MARKET

"This reconversion process will begin with the market procedures . . . make no mistake, this along cannot suffice to bring about the necessary changes."

For Mr. Emile Van Lennep, this is due to the fact that the market does not take into account outside phenomena, in matters of environment in particular, which now have a strong impact.

Furthermore, the market is concerned with the short and medium terms and overlooks the long term. "In other words conscious government interventions, on the national and international levels, will play their role, along with market procedures to reach a more satisfactory balance of world economy."

PROBLEMS AND SOLUTIONS

The first problem is that of the deficit in the balance of payments of industrialized countries. "For a period of time they will have to accept these deficits, for if they try to find a remedy by imposing protectionist policies or through the artificial support of exports, they will not only transfer their difficulties to their partners but, due to a cumulative phenomenon, will cause a general fallback of international trade."

To get back on the right road, governments will have to enforce strict discipline, such as "the agreement reached last week by the members of the O.E.C.D. not to impose new restrictive trade measures for the period of one year."

As for energy and research policies, increased international cooperation is imperative if consumption is to be reduced, resources developed and waste avoided.

"I am convinced that in the coming years we will be more and more forceful in the field of economic cooperation."

ORGANIZING SOLIDARITY

"The prevalent situation up to the present time, i.e. the erratic development of exchange rates, satisfies none—neither producers; . . . nor consumers . . . Some means of organizing this solidarity must therefore be found."

"The stakes involved far outweight picky quarrels of individual interests, as the problem is one of the better management of the capital of our planet in the interest of all."

Mr. Emile Van Lennep concluded his statement by reflecting on the responsibility that falls to international organizations and to our generation as a whole.

(BY SUMITRO DJOJOHADIKUSUMO, MINISTER OF STATE FOR RESEARCH OF INDONESIA)

PRESENT AND FUTURE

The Minister first stated strongly that he did not subscribe to the guidepost of zero-growth as described by the Club of Rome. He remarked that this was his position because he was "conditioned by the experience of a developing society which is just getting started on the arduous road of development".

"There is no other way", Mr. Djojohadikusumo stated blankly, "to cope with the deterioration of our environment but to accelerate development and to utilize our resources".

Mr. Djojohadikusumo then went on to say that for environmental control in developing countries, the states were the best regulators. Although he was not against multinational companies, he had observed that, left to themselves, "in quest for profit maximization and in zealous adherence to corporate efficiency, multinational corporations are prone to extensive abuses of ecology".

The Minister of State for Research for Indonesia stressed what the Club of Rome had already underlined, that our earth was finite and its resources too.

PRICES

As for Prices, Mr. Djojohadikusumo feels that there can be no argument with the desire they should be equitable and that they should be the result of cooperation between consumers and producers. An element such as "economic rent" which until now went into the pockets of multinational companies and governments of consumer countries cannot be ignored, whereby taxes are levied on a number of imported products. "What we see happening is actually a process of re-allocation and re-distribution of oligopolistic rents . . . through the increase in the share of producing governments and the lowering of the share of consumer governments, while the prices of products are raised somewhat".

But it should be stressed that producer countries are not necessarily interested in increased prices. "Their main interest is in stable earnings in real terms, in the problem of organized trading that can in many cases best be served by long-term commodity agreements".

INTERNATIONAL TRADE AND PAYMENTS—TOWARDS A BALANCED WORLD ECONOMY

These pertinent questions, have still remained virtually unsolved. They concern the full cycle of international economic policy. "International trade and monetary issues are merely two aspects of the same problem requiring a political decision."

We are presently in the process of seeking a new equilibrium.

"The international economy has already moved away more or less permanently from a frame which itself was the result of agreements made almost thirty years ago."

This frame has undergone fundamental development. The imbalance facing us makes international cooperation an urgent necessity "to undertake a comprehensive inventory of the world's natural resources, in the realm of research, science and technology."

For developing countries, adaptive technology should be prevalent, as these are the countries that supply a good deal of the manpower involved and used in national production.

Reports of the Discussion Groups

Discussion Group No. 1

Chairman: Dr. Ing. Robert Mintrop.
Rapporteur: Dr. Wolfgang Sames.

How Is World Demand for Energy and Raw Material To Be Met?

Under the chairmanship of Dr. R. Mintrop of Germany the discussion how world demand for energy and raw materials could be met up to the end of this century presented a spread of various opinions and approaches.

In the field of energy proposals were made to arrive at a high degree of self sufficiency, especially in Western Europe—as a presented scientific extrapolation model indicates—and the United States, it was readily accepted that a similar approach on the raw material side would be practically impossible for Western Europe and Japan and in a minor degree for the United States. It was, however, stressed by all speakers that an international cooperation due to the interrelation of raw materials and energy supply was vital for a continuing stable development of the economies both in the industrialized and the third world.

Special emphasis was put on the need of not only economic and financial but also of international scientific cooperation. Various interventions made clear that although there are no shortages to be expected in the short term, the world should act far more consciously with its energy and raw material resources.

Specific prerequisites for a policy were agreed upon:

The actual consumption, especially of energy, must be reduced to a lower level of growth; the present waste of energy needs urgent reconsideration;

This cutback can be met by a far better and more effective use of existing energy and raw materials;

New technologies will play a important role in the field of energy (e.g. gassification of coal, development of oil shales, faster development of nuclear technology, advanced methods of exploration, e.g. on the outer shelves of the continents);

New technologies will be equally important in the field of raw materials (for instance, recycling of used materials, increase of the life cycle of finished materials, etc.).

Furthermore the participants underlined the continuing need of an international exchange of informations about raw material resources and the establishment of raw material inventories. In addition it would be highly desirable to make the flow of energy and raw materials more transparent.

The participants felt it to be equally important that the private sector plays a decisive role with its capital resources and its managerial and technological skills. This seems to be essential to assure a continuing and steady flow of energy and raw materials. This role can only be fulfilled by governmental understanding and support and by international cooperation especially given the fact that the private sector delivers substantial amounts of raw material and energy supplies also during the next decades. In addition private capital must be assured of a favorable investment climate throughout the world. Special attention should be given to new forms of cooperation especially with the developing countries.

There was common understanding of Commission 1 that despite the fact that shortages in raw materials and energy are unlikely to evolve during the forthcoming years, there exists a strong necessity to increase the efficiency in the use of actual resources. This can only be achieved by closest international cooperation in the political, economic and technological fields.

Discussion Group No. 2

Chairman: M. Paul Delouvrier
Rapporteur: M. Albert Robin

How May Development of Natural Sources Be Optimised?

The topic of the introductory talks was that of identifying and categorizing the various measures that could lead to a saving of energy, especially in the field of heating, energy yield of certain industrial processes, metal recycling, etc.

The question arises, however, as to whether this same effort should not be expended for the research for new modes of life which are more economical in material goods and may even be more in keeping with the deep-felt yearnings of mankind.

The statements which followed, while stressing these two aspects and adding to them, underscored the complexity of a policy for the optimum use of resources faced as we are with the upheavals of the early 1970s.

It quickly became apparent that the economizing of resources was not an end in itself: there is of course a limit beyond which no further efforts are valid. To determine this limit, a price system which gives a true picture of what is rare and one which is sufficiently stable to allow for permanent action must be set up.

The facts show that this is not at present the case. Under conditions as upset by sudden rises in price as those under which we are presently living, it is not possible to channel demand solely through price policy, first of all because the price paid by the consumer does not reflect the added cost of currency paid by the community and because the production system cannot be immediately adapted to new situations.

It was thus unanimously agreed that extremely varied measures would have to be adopted: speed limits for vehicles, heat insulation of buildings, etc. Reservations were however expressed as to the contradictory secondary effects that some such measures could involve.

In addition, all the speakers emphasized the role innovation and imagination would play in the coming decade. In this respect some recognized that the recent crisis could prove to be a stimulant. But it was recommended that a good deal of thought precede any choice and that before "*technical miracles*" be accepted a good deal of circumspection as to their economic value be exercised.

The desire for the development of international cooperation in the field of creativity was expressed more than once. The comparison of ideas across borders, whether in rich or poor countries, is undoubtedly one of the best ways of combating waste.

Furthermore, the establishment of broad markets will favor the spreading of new technologies: an example of this is a system which, although it may seem far-fetched at first glance, as in the case of heat pumps, becomes perfectly adapted to the purpose of economising energy if it is mass produced.

Finally; general anxieties were expressed: the acuteness of financial and monetary problems created due to the extent of transfers to certain oil producing countries with a small population; the need to reflect on what might be called "brainpower" which, just as in the case of material resources, deserve optimizing if mankind is to fulfill itself.

Discussion Group No. 3

Chairman: M. Stig Ramel
Rapporteur: M. Sam Nilsson

HOW ARE ECONOMIC DEVELOPMENT AND THE EXPLOITATION OF NATURAL RESOURCES TO BE RECONCILED WITH PRESERVATION AND ENHANCEMENT OF THE ENVIRONMENT?

The session began with the following invited presentations:

Mr. E. J. Stahr read the paper submitted by George Ball.

Mr. I. H. Usmani read a paper on "Sharing the Energy Crisis."

Mr. R. Ishikawa read a paper on "Economic Growth, Resources Development and Environmental Protection."

Mr. K. Oshima talked about international cooperation, its aims and its methods.

From somewhat different viewpoints all papers dealt with the new challenges facing mankind caused by: The population pressure and its consequences for the demands of energy and raw materials; the increased complexity and interdependence of nation states and business corporations; the load on the regional and global environments.

It was generally recognized, both by the speakers and by the discussants that these problems in the long term must be solved by international cooperation bilaterally, multilaterally and by involvement of industry on a large scale.

New sources of energy and methods of raw materials exploitation must be developed. The concept of "Eco-power" was suggested by one of the speakers. In essence this means that—since energy is the essential driving force of development and social change—it is necessary to devise energy technologies which make maximum use of renewable resources, allow for recirculation and conservation of limited national or regional resources, and have a minimum insult on the fragile ecosystem.

Absolute criteria for the conduct of business and society at large as to their negative effects on the eco-system are very difficult to set. For that purpose much more scientific information must be attained and synthesized. This does not mean, however, that there is time to sit back and wait for definite conclusions and recommendations. The social and economic development of all countries is a dynamic process in which politics, business, scientific research, and perhaps change of fundamental values are necessary elements.

The possible effects on the global climate by continued growth of energy output was discussed and more scientific research on this score was encouraged.

It was generally felt that although the apparent conflict between socio-economic development and the environmental constraints must first be resolved on a national level, the prospects for international business to contribute on a global scale are promising.

Cooperation and exchange of facts, ideas and experience on legal, financial and scientific matters between governmental and international bodies (like UNEP) on the one hand and business corporations on the other should be encouraged. This was felt to be a necessary requisite in the international restructuring of production and distribution mechanisms for resources, goods and services which are now emerging. In particular this concerns the resource-rich but less developed countries which now seek to deploy their resources by adoption of technologies which have mostly been developed in the rich countries. Certain but not permanent ground rules which can be regionally or internationally accepted must be established.

A spirit of realistic optimism characterized the discussions about finding such legal and economic incentives which will stimulate industry in both market economies and planned economies to develop products which will result in considerable conservation of non-renewable resources and in reduced environmental deterioration. Several examples were given from countries which indicate that there are good reasons for optimism.

The session finally devoted a great deal of attention to the new trends of public involvement on the decision-making processes regarding investments in the energy and resource sectors. However complicated this issue is, it was felt that an "opening up" of the decision process might promote the development of new technological concepts and clarify a number of technical and commercial questions from a socio-political point of view.

[Saturday, June 8, 1974]

DAILY NEWSPAPER OF THE FIRST WORLD SYMPOSIUM—ENERGY AND RAW MATERIALS

MORNING DISCUSSION GROUPS

Discussion Group 4
Chairman: Jean Rey
Rapporteur: Isaiah Frank

HOW SHOULD INTERNATIONAL TRADE BE REORGANIZED?

The problem as posed by the Chairman is two-fold: 1) can we continue to rely simply on a liberal trading system based on price mechanisms or should we design a new system based on common policies and organization of markets? 2) Are we faced with basically new relations between producers and consumers of raw materials, and if so, how may their interests best be reconciled?

With respect to the first problem, the need for a new approach to international trade policy was stressed. Developing countries which possess raw materials may be expected increasingly to process the materials locally. This will have the advantage for developing countries of employing redundant labor and earning foreign exchange. It will also reduce costs and energy in the transport of the materials since their bulk is reduced in processing.

If developing countries are to enter the stage of industrialization by processing their own materials, the developed countries will have to liberalize accesss to their markets for such processed materials. Effective tariffs on processed materials are now high in the industrial countries.

Heretofore, international trade rules and policies have been largely concerned with the question of access to markets. Except for one article. GATT is overwhelmingly concerned with import restrictions. But recent events—especially the restrictions imposed by the United States on exports of soybeans and by some Middle Eastern countries on the export of petroleum—have highlighted the critical importance of export restrictions and the urgent need for an international code of conduct with respect to them.

Export restrictions may be imposed for a variety of reasons: to counter inflation by relieving a critical shortage at home; to accomplish certain political objectives; or to bring about an increase in world market prices.

Given the worldwide inflation today, we may expect an increasing tendency to resort to export controls to relieve domestic scarcities of materials. When such actions are taken unilaterally, they can have profound effects on a country's trading partners. New international rules should be designed therefore to accomplish the following purposes: to assure international consultation in advance of the imposition of controls; to achieve equitable international sharing of products in short supply; to encourage long-term programs to cope with scarcities; and to define permissable measures for the interim.

It was recognized, however, that there is a large difference between how international trade *should be* reorganized and how it *can be* reorganized. The principal problems are political and the most difficult of these is the problem of reconciling domestic interests in each of the countries involved.

Econometric models can serve as useful instruments in anticipating changes in the pattern of international trade and investment. A description was given of such a linear programming model for the oil and gas industry. The model was developed jointly by the Energy Research Unit of Queen Mary College and the Institut Français du Pétrole. Similar models applied to other raw materials could generate valuable data and help to analyse and forecast the consequences of new developments such as national anti-pollution measures.

With respect to the second problem posed by the Chairman—relations between raw materials producers and consumers—there was general agreement that a new stage has been reached. The trend towards nationalization of raw material production and the new policies with respect to taxation and pricing of raw materials are indicative of a determination on the part of producing countries to redistribute the economic rent resulting from the production of raw materials. In the view of the producers, too much of the rent has in the past accrued to consumers in rich countries in the form of low prices, to multinational corporations in the form of high profits, and to the governments of consumer countries in the form of steep taxes on petroleum products.

Producing countries are increasingly attempting to shift the terms of trade in their favor through concerted action to increase taxes and prices. In so doing, they run the risk of taking a short-term view of their own interests, which can affect them adversely in the long run as consumers are stimulated to develop alternative sources of supply as well as substitutes.

Instead of a relationship of confrontation, consideration should be given to forms of international cooperation designed to reconcile the interests of producers and consumers in stable and equitable prices over the long run. The time may well be propitious for negotiating commodity agreements in accordance with the principles laid down in the commodity chapter of the abortive Charter of the International Trade Organization drawn up at the end of World War II. Similar consideration should be given to the Charter's draft rules regarding restrictive business practices which many developing countries believe are engaged in by multinational corporations.

In the future one of the most important forms of exchange between developed and developing countries will be the exchange of raw materials for the technology and know-how of the industrial world. Here is an important area in which the interests of producers and consumers of raw materials clearly converge. But national impediments to the international flow of science and technology should be removed.

In concluding, the Chairman noted a general consensus that producing countries and consuming countries could not solve their problems by themselves. Only through cooperation could the problems be solved, not by a return to protectionism. And finally, he expressed the hope that the conclusions from a symposium of this nature would prove of interest not only to experts but might also stimulate action on the part of political authorities.

Discussion Group 5

Chairman: Mr. Peter Parker
Rapporteur: Mr. Frank Schiff

How Are the New Financial and Monetary Trends To Be Balanced?

The group concentrated on three broad issues:

(a) What are the likely effects of energy and raw material price changes on the world monetary situation?

(b) How should the financial problems arising from these changes be dealt with?

(c) What do these developments imply for the future monetary system?

There was agreement among the speakers that the recent sudden oil price increases had created major risks of international economic and financial instability as well of a growing maldistribution of world resources.

The impact on world inflation has been severe. At the same time, it was suggested by some that the oil price increase (like a large tax increase) could lead to significant cutbacks in demand for other goods and services and lead to a widespread weakening of economic activity; others, however, doubted that this will occur.

As regards balance-of-payments relationships, the size of the emerging imbalance is dramatized by the recent estimate of the IMF that the current account surplus of the oil-producing countries in 1974 will amount to 65 billion dollars.

It was generally recognized that the corresponding deficits of the oil-importing countries considered as a group will be so large that they cannot and should not be corrected by transfers of real resources alone. Instead, the great bulk will for a number of years have to be financed by some form of borrowing from the oil-producing countries.

One major danger for international stability stems from the fact that individual countries do not like to remain in balance-of-payment deficit because of the fear that this will unduly limit their freedom of action. Hence, individual deficit countries may try to adjust by competitive exchange rate changes, trade restrictions, or other actions to shift the burden of the deficit on others. It was stressed that a high degree of international cooperation will be required to avoid such actions, which in the end are likely to work to everyone's detriment.

To resolve the financing problem, quite different issues arise in the case of the less developed countries and the industrialized countries. Most speakers agreed that the size of the problem for many non-oil producing countries in the less developed world is enormous, particularly where these countries do not produce other raw materials that are benefitting from large price increases. It was noted, for example, that India will have to use 80% of its foreign exchange earnings this year to pay for essential oil imports. For such countries, additional grants and credits on concessional terms appear essential.

Several speakers felt that over the longer term, international agreements to stabilize and in various cases raise the prices of basic commodities other than oil will be the only satisfactory way to permit the less developed countries to cope with their financing needs and to prevent a growing gap between the incomes of the world's richer and poorer countries. Suggestions were made to peg commodity prices to those of manufactured products and to set up buffer stocks of commodities financed by the IMF. There was considerable discussion as to whether such arrangements are either feasible or desirable.

For the industrial countries, the problem will not be that the *total* reflow of funds from the oil-producing countries will be insufficient to cover their deficit. Rather, it lies in the difficulty of assuring that existing markets and institutions will recycle the available funds in the form and to the places where they are needed. Problems arise in particular because the new surplus countries have so far often wanted to lend only at short-term and may not necessarily direct their loans and investments to the countries that need it the most. The large supply of short term and highly mobile funds, together with growing problems of credit quality, also adds greatly to the risks of monetary instability. It was felt that existing markets alone may not be able to handle these problems unaided. A variety of new institutional arrangements will be needed to deal with such problems on a pragmatic basis, probably involving the IMF, the BIS, and other bodies.

In this setting, international monetary reform will need to be more gradual and pragmatic than was envisaged by many not long ago. But there was considerable agreement that reforms are needed that will call for strengthened international organization and cooperation in the monetary field and that will place greater stress on rules of conduct in the exchange rate area.

Discussion Group 6

Co-Chairmen: Mr. Robert de Oliveira Campos, Mr. Julio Sosa Rodriguez
Rapporteur: Mr. Geoffrey Denton

How Is Capital Expenditure To Be Financed?

Great uncertainty surrounds the investment needs and their financing in response to the changes in the oil and raw materials markets since 1973. This was dramatically illustrated in the revisions of the estimated net current account surplus for 1974 of the oil exporting countries. In November 1973 this surplus was estimated at $13 billion; in June 1974 the revised estimate stood at $65 billion.

For the short-term, 1974 and 1975, the Commission assumed conservatively that this surplus might total $100 billion, of which it was possible that some $25 billion might be invested by oil producing countries. The remainder, $75 billion, would have to be recycled through short-term funds.

Beyond 1974, uncertainties abound on all aspects of the problem. There is uncertainty about the supply of oil from OPEC countries, but the Commission assumed the problem facing us was one of the price rather than uncertainty of supply. The price of OPEC oil, which is itself uncertain, will affect both the need for investment in alternative oil supplies and the sources of finance for such investments. Supply and price of OPEC oil may be subject to unforseeable political decisions in addition to market forces. Physical possibilities for increased production of oil in non-OPEC countries can be forecast only with wide margins of uncertainty, and the investment needs in this respect are therefore unclear. The requirements for investment in research and development of alternative non-oil sources of energy depend in turn on the outcome of the complex interrelationships of supply and price of oil from OPEC and non-OPEC sources.

Although attention has naturally concentrated on investment needs and financing in the oil sector, the importance of other sectors of the world economy for investment requirements should not be overlooked. Non-oil community prices have behaved differently from oil prices, many having fallen in the first half of 1974. They also have varying incidence on the financial situation facing different countries.

In the case of commodity exporting countries, such as Morocco, the rise in commodity prices in 1973 offset their payments burden from higher oil prices; in other cases, such as India, the higher costs of importing other commodities aggravated the burden on account of oil prices. Moreover, two-thirds of the deficits of the developing countries are derived from non-oil import requirements.

There are also substantial investment needs outside the oil sector. For example, while investments of all kinds in the oil industry have been guessed at $1000 billion over a ten year period to 1985, the world steel industry is also estimated to need $180 billion for its expansion over the same period.

In the face of all these forecasting problems, the Commission concentrated on the question of ensuring that the channels for financing investment could operate smoothly.

Many changes will become necessary in the normal perceptions and assumptions on which international trade and investment are based. Whereas underdevelopment has normally been associated with lack of capital for investment, we now have the new phenomenon of underdeveloped but capital-rich countries. Commodity agreements, seen in the industrialised countries as a form of aid to exporting countries, may now become attractive as a means of providing security of prices and supplies to commodity importers. Dual price systems may be devised to help the poor LDCs at the expense of the new rich LDCs, although many problems are involved.

There are new dangers of a slide into beggar-my-neighbour protectionism, if countries, despite pronouncements to the contrary, attempt unilaterally to correct their payments deficits.

It is essential to disinguish between the *supply* of savings likely to be generated by the new monetary flows derived from higher oil and raw material prices, and the world *demand* for investment. The new savings will be made for the most part in oil-producing countries having small populations and therefore low capacities to absorb imports: and world savings are likely to increase as a result of the transfer of income away from countries with a higher propensity to consume. However, whether investment demand will increase will depend primarily on the reaction of the industrial countries to the deflationary impulse created by their external payments' deficits. If they reflate consumption, they will merely put off the problem of paying the higher oil prices to the future, and the level of investment could even fall. *It is therefore important that the governments in the industrial countries reflate by measures that stimulate investment.*

Investment by oil-exporting countries will undoubtedly increase both in the industrialization of their own economies and in acquiring real assets in the already industrialised countries. Whether this will result in a net increase in world investment must depend on the policies of the developed countries. There will certainly be substantial lags in the oil exporting countries carrying out this investment, which will constrain their short-term contribution to total world investment.

If the re-cycling of funds derived from surplus oil revenues were left entirely to market forces, flows would be directed towards those countries in a relatively healthy economic situation, and away from those that are not credit-worthy on account of the size of their payments' deficits. Thus while the addition to world liquidity will in general make it easier for credit-worthy borrowers to obtain loans through international markets, those most in need may suffer. It may therefore be desirable to seek means of directing the flow of funds towards deficit countries in order to solve their payments and investment financing problems.

However, with this proviso, it should not matter what are the institutional channels through which the OPEC surpluses are recycled, assuming reasonably free operation of capital markets. It was suggested that the OPEC countries might attempt to maximise their economic leverage by insisting on bilateral, conditional investments. But given the existing structure of world money markets it is not easy to see how attempts to restrict the ultimate destination of recycled funds could be achieved, except in the case of direct investments.

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It is perhaps too readily assumed that debt can be piled up indefinitely, and methods should be sought of reducing the accumulated liquidity. One solution proposed was an extension of compulsory holding of stocks, which would also have the advantage of stabilizing the commodity markets.

A further suggestion considered was the monetisation of such buffer stocks. A system of separate prices for exports and for imports in terms of SDRs, periodically fixed, could regulate these stocks and stabilise the financial situation both for exporters and importers.

Investment in research and production of more durable and better quality goods could be a valuable way of reducing the demand for energy. Since the consumer has relatively little influence on decisions of manufacturers, ways must be found of inducing these energy-saving investments.

In conclusion, the Commission considered it essential to put recent events in the perspective of the long-term movement of the terms of trade between developed and developing countries. Recent changes had only reversed an earlier trend unfavourable to developing countries. Moreover, the future investment needs should not necessarily be related to an assumed objective of self-sufficiency in energy requirements for Europe and North America. The appropriate solution, and therefore the appropriate levels of investment, might be based on a more interdependent and cooperative world economic system.

AFTERNOON DISCUSSION GROUPS

Discussion Group 7

Chairman: Mr. Frederick Hall (Australia)
Rapporteur: Mr. Jack Hartshorn (Great Britain)

WHAT SORT OF NEW RELATIONSHIPS NEED TO BE ESTABLISHED BETWEEN THE PRODUCER AND CONSUMER COUNTRIES?

In effect, this session presented an example in miniature of the kind of exchange of views between the industrialized oil importing countries and OPEC that is widely being advocated at a governmental level. Mr. Abderrahmane Khene, Secretary General of OPEC, answered the views of Mr. Walter Levy, the American oil and energy consultant, M. Henri Simonet of the European Commission, and Mr. Katsuya Miyata, President, Mitsubishi Aluminium, Tokyo (who delivered a speech prepared by Mr. Hasegawa, President, Sumitomo Chemical Co. Ltd.). The spokesmen were able to agree upon the desirability of cooperation and a dialogue. But their analyses did not show much common ground in basic standpoints.

Industrialized oil importing countries, who have had an increase of several times in oil prices since 1970, are this year facing balance of payments problems that many experts consider unmanageable. The share of oil in world trade which was under 8% in 1970, reached 25% in 1973. Revenues of the exporting governments from oil have risen from about $8 billion then to probably over $100 billion in 1974.

Adjustment to this would have been difficult enough even if these exporting countries could have spent these huge revenues on current goods and services supplied by the importing countries in exchange. In fact, the total absorptive capacity of their economies, for the present, is probably well under half of that $100 billion. Hence, an enormous surplus of the order of $60 billion for the OPEC countries this year, and its mirror image—a corresponding balance of payments deficit for the oil importing countries considered together.

These problems have arisen as the first demonstration of a complete shift in power in the oil producing countries. The OPEC governments have taken complete control of export volumes (and destinations) and have begun to set the prices unilaterally. The multinational oil companies, which used to control the supply and logistics of oil, have now lost powers of decision over supply and prices. Their role as a buffer between oil exporting and importing governments has effectively disappeared.

Adjustment of all these problems involves very long time lags. The absorptive capacity of OPEC economies will rise, but over a matter of years. Similarly, development of alternative sources of energy will undoubtedly be stimulated by the far higher prices of oil. But for most importing countries, any such alternative energy development will take 10 to 15 years; and even for the lucky few countries probably at least five years. During these time-lags the monetary problems of huge surpluses, and the need to recycle these to finance the importers' oil supplies, will accumulate. And the huge accumulation of paper claims that the oil surplus countries must envisage may seem less attractive to them than simply leaving much more of their oil in the ground. Few of the forms of paper claims upon other countries that they are offered may seem to them as likely to hold their value as the oil itself.

Not all OECD countries take this problem quite as starkly as the Americans, or are as confident that oil prices can be brought down. M. Simonet, for the Common Market, did not take quite as "hard" a line as Mr. Levy; nor did Mr. Miyata. But all three were concerned to avoid any "confrontation" between the industrial importers and the OPEC countries. There was agreement on a need for a range of cooperative measures between these industrialized importers. All hoped that an eventual measure of agreement might be reached between them and OPEC on: 1. Assurances of supply on terms and conditions that the oil importing world would find economically and financially sustainable; and 2. Safeguards for the future interests of the OPEC countries whose welfare is so severely dependent upon this single, depleting natural resource.

From the point of view of OPEC, Mr. Khene felt that the rise in oil prices, belatedly, was offering its member countries their first real opportunity of fairly rapid economic development. Obviously, the situation of each oil exporting country is not identical. But for all of them, this is a vital resource which was formerly being wasted by consumers because prices were too low.

The increase in prices would encourage greater efficiency in energy use and the development of other forms of energy; a real scarcity might develop by the end of the century. He noted that industrialized countries which have or are developing large oil production, such as the UK, the Soviet Union, Canada, and Norway were clearly proposing to control the rate of depreciation of their reserves. The OPEC countries shared these same fears for the future. They have also to consider the interests of future generations as well as those of today.

Mr. Khene laid a great deal of emphasis on the fact that this was not simply a problem of OPEC and oil, but one concerning most other raw materials. He felt that the recent United Nations session devoted to this problem had begun the effective dialogue that the importers' representatives were advocating. The raw materials producing countries, which were mostly developing countries, realized that they could only develop rapidly with the cooperation and assistance of the industrialized countries.

He appreciated the problem that higher oil prices represented for the poor countries. He emphasized that assistance to the developing countries which had to import oil must still come from the rich industrialized world as well as from OPEC. He quoted the failure of the industrialized countries to reach their aid targets of 0.7% of GDP and said that OPEC countries had set itself a target 1% of their GDP in aid to poorer countries had set itself a target of 1% of their GDP in aid to poorer countries, and were already achieving this.

None of the main speakers appeared to put much hope in commodity agreeents for oil. But it appeared from the general discussion that such agreements might be far more practicable for other raw materials, particularly certain metals. Here again, most of the exporters are poor countries: decreases in price hit them as producers relatively harder than rises in price hit the much more diversified industrial importing countries. Emphasis was put on the need for these producers to organize if they were ever going to engage in a dialogue on equal terms with importers. At the same time, theese producing countries needed to define detailed legislation and terms that would enable the exporation effort—still largely carried out by private companies from the developed world—to continue on an economic basis.

The contribution that the United Nations and other international agencies could make to the industrialization of these poorer countries was stressed. Some doubt was expressed whether the magnitude of the oil problem would allow it to be handled simply by OECD and the IMF, or whether some sepcialized agency representing both exporters and importers might eventually have to be set up. But one area of immediate cooperation at the expert staff level between OECD and OPEC did not appear impossible. This would simply be work together on figures, forecasts, ranges of options, and possible scenarios for the future. Whether adequate agreement can be reached between exporting and importing countries over these questions of supply and price for oil and other raw materials can only remain to be seen. But this kind of work at the staff level can at least clear unnecessary misunderstandings.

Discussion Group 8
Chairman: Mr. Eishiro Saito
Rapporteur: Mr. Tadayoshi Yamada

WHAT MATTERS INVOLVING ENERGY AND RAW MATERIALS COME WITHIN THE SCOPE OF INTERNATIONAL COOPERATION?

The session began with the following presentations:

Mr. Juan Somavia spoke on "International section: some Problems and Proposals."

Mr. Pierre Moussa read a paper on "Practical areas for international Cooperation for Managing Natural Resources."

Following them, there were 10 participants who gave comments and observations either of their own or on some points raised by the invited speakers.

Except for one who concentrated on cooperation for utilization of seabed energy resources, they were unanimous in not looking upon the oil problem as an exclusive north—south problem and in emphasizing the need to resolving it from an overall basic raw materials point of view, taking into consideration the prices of other commodities economic conditions of resource poor developing nations, and the present international division of labor. There were some who emphasized the complex nature of oil and natural resources problems caused mainly by:

The important shifts from bipolanty to multipolarity in the management of world affairs.

Inward looking tendency within developed nations which has been caused by inflation, unemployment, slackening economic growth, etc.

Multinational corporations which have a considerable influence over the shaping of decisions taken by governments.

Rising nationalism in resources rich developing nations.

Principles regulating international economic relations which are outmoded and incapable of responding to present needs.

Reappraisal of the nature of growth in order to restore the value of man to its proper place.

The participants more or less agreed on the necessity of cooperation for establishing new firms of more rational international distribution of income and on the need for a common strategy applicable to both oil and resources producing an non-oil and resources producing developing countries vis-a-vis the prices and levels of their basic materials and commodities as well as in the way in which a new international division of labour is to be achieved.

While opinions were varied the question of getting more governmental guidance and international cooperation on energy and raw materials, there was a unanimity of opinions on cooperation with U.N. and other multinational organizations, particularly in the need of international agreements for obliging resources producing countries with assurance of adequate supply of raw materials at reasonable price and consuming countries with the assurance of continued raw materials consumption as well as the need to establish a global mechanism whereby statistical and economic research of oil and natural resources, including research for exploration, mining possibilities effective use and setting up equitable cost and price, can be carried out.

Discussion group 9
Chairman: Mr. Philip M. Klutznick
Rapporteur: Mr. Robert Toulemon

WHAT CONTRIBUTIONS CAN BE MADE TO BALANCED WORLD ECONOMIC DEVELOPMENT

The opening statement by the Chairman and the statements by most of those who took the floor during the meeting of this Discussion Group, made mention of the recent modifications in the world economic situation and of the resulting problems:

The sudden rise in the income of oil producers (the income traceable to the rise in the price of oil comes to ten times the aid given to the Third World),

The drastic reduction in the income of countries which were already lacking in oil,

The realization that the liberalist system, which is the basis for the bounding leaps of western economies, did not bring with it a general distribution of wealth nor a reduction in the inequities in income, The rise in the price of commodities as compared with that of the prices of finished products, in contradiction with earlier trends,

The appearance of a bulk of capital which should have helped in the economic and social development of the Third World,

The reappraisal of the material growth of rich countries, although no government can propose a zero-growth guideline. All economists agree that the form of growth must change. Most of them agree that some form of growth is still necessary,

Should the population explosion continue, the situation will become intolerable, in particular as relates to the dependence of a majority of mankind on a minority.

An extremely fruitful discussion got under way as to the solutions to be provided to both old and new problems. Among the recommendations of greatest interest that came out of this discussion, a distriction can be made between those concerning the short term and those concerning the long term views.

I. SHORT TERM

A threatening catastrophic situation must be avoided. This can be done through the immediate creation of an assistance fund and by setting up the material means of channelling and distributing foodstuffs by carefully avoiding waste and corruption which, unfortunately, is so frequently present.

International cooperation is needed to combat generalized inflation and to rebuild a monetary system acceptable to the major countries.

The capital bulk in oil producing countries should be recycled, which presupposes the solution of the preceding problem (possible through indexing or long term credits).

II. LONG TERM

Structural changes in poor countries which, while respecting cultural heritage, would enable investment and reduce the birth rate.

An attempt to develop models adapted to the situation in these countries rather would avoid the systematic imitation of western world as a model.

The setting up and financing of sufficient food stocks would provide the poorest peoples protection against famine and would lead to a normalization in the prices of major agricultural commodities.

The population explosion must be combatted through an awareness of the connection that exists between birth rate and cultural model; this would mean providing a guaranteed income for the aged and the childless, for example.

The possibility of a worldwide system of social security which could be financed through a tax on energy resources either at the production or the consumption level, should be given careful consideration. It is through a system of this sort that the extreme social imbalance in European countries was wiped out during the twentieth century. We are now faced with the same problem on the worldwide scale.

Aid, however, will not suffice. It must be accompanied by the creation of wealth and jobs in countries of the Third World. This involves a redistribution of industrial activities on a worldwide level. It was noted that the fear of unemployment in industrialized countries as a result of the industrialization of the Third World was highly exaggerated at a time when the western world's productive mechanism is saturated, especially in the equipment sector. But it is true that the occurrence of a new profit producing demand in the Third World will lead to deep-felt changes in industry in developed countries. This raises the extremely serious problems of adjustment and balance in regional development.

There is a possibility of considerable expansion in exploiting of renewable resources (sun, water, agriculture) and non-renewable resources in tropical countries (geological inventory is still highly incomplete) and in an expansion in the scope of research, technology and industry in western countries to provide access to the resources of tropical regions.

The countries of the Third World must be included to the greatest extent possible in the search for solutions that must not be imposed but which respect the dignity of each of these countries.

Chairman BENTSEN. Representative Rees, please proceed.

STATEMENT OF HON. THOMAS M. REES, A U.S. REPRESENTATIVE IN CONGRESS FROM THE 26TH CONGRESSIONAL DISTRICT OF THE STATE OF CALIFORNIA

Representative REES. Mr. Chairman, let me give you some material here.

Chairman BENTSEN. Representative Rees, we are gratified to have you.

Representative REES. It is a pleasure to be here, Senator.

I do not have a prepared statement, because I do not like to read them as testimony; I think it becomes rather boring.

I wish to congratulate you for the work you are doing in this field, because I think it is an issue which must be resolved within the next year.

I am chairman of a rather tongue-twisting ad hoc committee in the House. It is the Ad Hoc Committee on the Domestic and International Monetary Effect of the Energy and Other Natural Resource Pricing. I found it was the only way that I could beat the seniority system, because I am the only one that can pronounce the name of the ad hoc committee.

I am on the Banking and Currency Committee. I am on the Domestic Finance Subcommittee, the International Finance Subcommittee, and the International Trade Subcommittee.

I am an exporter by profession, having started my own business after graduating from college.

One of those documents you have, the one which begins, "Statement of the Problem," is an outline of the work being done by our special ad hoc committee.

Last winter, during the oil crisis, the oil boycott, and the arbitrary 450-percent price escalation of a barrel of imported oil, I became very concerned as to the effect on our balance of payments and on international monetary policy. I looked at some material supplied by the World Bank, and I was very disturbed to see that the pricing of oil could put at least a half a dozen countries out of business within the next 12 months. Already we have the spectacle of Italy borrowing on the short-term Eurodollar market; this is a very difficult situation, because the Eurodollar market is very short range in terms of the deposits, and the banks are trying to loan for medium and long periods, such as 5 years. There could be a definite liquidity crisis coming up within the next few months.

Let me give you a few figures.

In the OPEC countries, the total income this year, 1974, was $100 billion. Of that $40 billion is being used for goods and services, and the balance, $60 billion, is excess investment. A good part of this $60 billion is either kept in currency accounts or invested in the short-term Eurodollar market.

In 1974 the oil-exporting countries will have reserves of $70 billion, and by 1976 those reserves will have grown to $200 billion.

In the United States, assuming that the imported price of oil on the east coast port is $10 a barrel—and I think that is a relatively reasonable current and down-the-road cost in terms of the OPEC pricing mechanisms—our total imports were $3 billion in 1973; but with the price index for 1974, the projection is $21 billion, and in 1980 it will be $33 billion.

IMPLICATIONS OF THE SHIFT OF WEALTH TO THE OPEC NATIONS

Chairman BENTSEN. Congressman Rees, let's try to get these things open and in perspective if we can. Your are talking about a $200 million reserve in the Middle East countries by 1976. How would that compare among some of the other industrialized nations as against the United States, the European Common Market, or something; do you have a comparison of that so that we can judge the magnitude of it?

Representative REES. I do not have comparisons. All I have are totals in terms of what the increased oil cost will be. The increased oil cost—determined in large part by price increases in imports of oil—will run these countries into a negative position on their balance of payments.

It is my projection now that we will have at least an $8 billion balance-of-payments deficit in the United States.

Chairman BENTSEN. You mean that portion of it attributable to the importation of oil, or on an overall deficit?

Representative REES. No, I am talking about the overall deficit. We supply 75 percent of our own petroleum. The impact is far greater on Western Europe and Japan, because they are almost totally dependent on imports.

In Western Europe they will go from a $20 billion import bill in 1973 to a $55 billion import bill in 1974. Therefore, you can see the serious implications.

What the oil exporting countries do with their excess investment money is a major source of concern. I know that Secretary Simon has just visited the Middle East, and has been talking to the various countries there.

The problem in the United States is not so great. We are fortunate, both that we have a strong export market, and we produce a good part of our own oil. But the problem in the lesser developed countries is catastrophic, because people are not investing in the lesser developed countries.

If Saudi Arabia, Venezuela, or one of the other exporting countries is going to invest, the tendency is to invest in Western Europe or the United States—and it is developed countries which have the best ability to increase their export capacity.

I think what must be done, probably at the International Monetary Fund and World Bank level, is to set up some type of a recycling investment corporation to reinvest the money that the lesser developed countries are paying for oil in the account of the lesser developed countries, because the tendency in any recycling system will be for the money to come back to those countries that have the strongest economies, not those with the weakest.

I wanted to get into some problems——

Chairman BENTSEN. If I may interrupt a moment, in your projections have you taken into account—we had some testimony yesterday that the industrialized nations have leveled off in their use of petroleum, and that they have not had an increase this year as compared to the previous year, where normally they would have a substantial increase every year, that some of the tactics of conserving energy are taking effect.

Representative REES. Senator, we have two types of growth. One would be the natural growth because of population. With each unit of new population, it means that there is more demand for energy and products which depend on energy.

Then we have the growth in consumption by existing users—if you had a zero growth policy, there would still be a tendency for some increase in the use of energy.

It has been in this latter area really where most of the conservation is going. However, you might find that energy conservation is a one-shot deal: That you change your production method, you turn off so many light bulbs, or you change your heat exchanges. But that is for 1974. Hence, you will get a leveling-off period, and then the use of energy will go up, but it will not go up as fast as it has in the past.

The problem, though, with the developed countries is with their manufacturers, for these are the industries which demand energy. Production of sophisticated goods in industry—steel, for example—takes a great deal of energy; and the tendency for all the developed countries will be to attempt to increase their export market, because they must have more earnings of hard currency to pay for their oil imports.

So you can see that it feeds on itself.

CAN THE SHIFT OF WEALTH BE EQUITABLY INVESTED BY THE OPEC NATIONS

Chairman BENTSEN. When you talk about these excess amounts of reserves in relatively sparsely settled nations, nations that are often politically unstable, do you think that the financial system of the world is in a position to recycle these petroleum dollars, or do you agree with David Rockefeller that the present arrangement just cannot manage the job?

Representative REES. I tend to agree with David Rockefeller.

According to Mr. Rockefeller, there already is a great deal of stress caused within the private banking system by the recycling of just a few billion dollars worth of oil export money. I think, too, that the central banks have been having discussions as to the necessary actions if there is a liquidity crisis in the Eurodollar market.

Currently, there are about 30 major multinational banks that participate in the Eurodollar market. You could find a situation where they are lending, say, on 5-year terms—I think Chase has some 7-year money out with Italy in the Central Bank—and receiving Eurodollar deposits on a 30-, 60-, 90-day basis.

If these deposits taper off, there would be an immediate liquidity crisis within multinational banks dealing in the Eurodollar area. It might be necessary to have these central banks of the strong currency countries come in and guarantee the availability of enough liquid assets to meet the loan commitments in the Eurodollar markets.

WORLDWIDE DEPRESSION POSSIBLE

Chairman BENTSEN. You see, each of these industrialized nations tries to protect its own base against the deficit in trade dollars with the oil-producing nations, and, in trying to protect their own base, they go to a tighter monetary policy. In turn, they put up more restrictions on trade.

Do you see that triggering a depression?

Representative REES. If they put on tighter monetary policies, if they put up trade barriers, if they devalue their currency to lower the price of their goods in the export market, we will go into a worldwide depression. It is as clear as that.

Therefore, we must develop a mechanism to see that this "beggar thy neighbor" policy is not used.

The first action that Italy took was to put up import barriers in contradiction of the European Common Market policy. It will be interesting to monitor the situation of Italy, because their solution so far has just been a one-shot remedy. You can revalue your monetary gold up to the market price just once; you cannot up-value it any further. I think that we should be looking very closely at Italy, because Italy is a developed country.

Chairman BENTSEN. Do you see the international monetary authorities doing anything to try to head this kind of a problem off, the "beggar thy neighbor" policy?

NEED FOR A RECYCLING INTERNATIONAL BANK

Representative REES. Well, what they did do was form a special oil fund. I think there is around $2.5 billion in it. This money was borrowed from the oil-exporting countries, but it was borrowed at market rates. Again, what they have so far is a one-shot solution.

You can borrow money once, but if your economy continues to go down, there is no bank in the world that is going to give you a second shot at a loan. Therefore, it is absolutely imperative that the World Bank and the International Monetary Fund develop mechanisms within the International Monetary system, or we will be in a very difficult situation in 1 year.

As I have said, we have taken our first year's shots, and there are not many left.

One of the main actions I would take would be the formation of a recycling bank within the international monetary framework; this investment money would be recycled back into countries in basically the same percentage as their oil import bill. Consequently, if India spends $2 billion for oil, approximately $2 billion would go back to India in some form of investment. This could be set up like a mutual fund so that one could not say, "This is a Kuwait investment, or this is a Saudi Arabia investment;" it would be an investment through the International Monetary Fund, thereby lessening the possibility of expropriation.

I spend a lot of time in Latin America, and I did represent some businesses down there. There is always the problem of expropriation. If you look at the agreements in the Andean countries, they have a specific article for the regulation of foreign investments, requiring that 51 percent be locally owned. The best way to get past this nationalistic feeling, I think, would be to have an International Monetary Fund mechanism recycling money into that lesser-developed economy.

The United States is fortunate, but again it is hard to predict our exports.

For example, there was probably an overly large foreign purchase of foodstuffs last year. Many importers in other countries were stuck with huge stores of grains, soybeans, and other agricultural commodities. This might affect our exports this year.

Chairman BENTSEN. A lot of them are asking for delayed deliveries this year into next year?

Representative REES. Yes. Hence, we are in a situation such that the delayed deliveries will affect our exports and also our ability to receive some dollar credit.

MAJOR PROBLEMS WITH RECYCLING IDEA—SUCCESS QUESTIONABLE

Chairman BENTSEN. Let me ask you—you talked about something that was comparable to an International Monetary Fund where we would cycle petroleum dollars into countries that had deficits of trade as a result of petroleum. What kind of discipline do you finally have on that nation to try to work its way out of that continuing deficit?

You would not just continue to recycle without end those dollars back in there for investment. At some point it seems to me there has to be an end to it.

Representative REES. You are speaking of the oil-exporting countries?

Chairman BENTSEN. No, that is an oil-importing country. You are talking about having this effect where they would recycle those dollars back into that importing country that had a trade deficit resulting from the importation of petroleum. Where does that end?

Representative REES. When I start getting around to that end, I can see a lot of problems wherein the International Monetary Fund Investment Corporation, owned basically by oil exporting countries, could end up with 60 or 70 percent of the world investment.

Let me go into another facet of this.

When the oil embargo was put on by the Arab countries, I began a study of alternate sources of energy and spent a great deal of time converting to a Btu-equivalent oil shale, gasification of coal, tar sands, liquefied natural gas, atomic energy, and others. What we are doing in the ad hoc committee study is formulating a proposal, a strawman type of proposal, where we assume that we can get energy security.

I do not think there is any way that this country could ever be totally independent in terms of oil imports. I think it would be far too expensive for our economy. We would get ourselves into a very high-cost energy, let's say an equivalent of $8.50 or $9 a barrel oil in Btu equivalent. We would then be in desperate straits if the international price of oil suddenly fell down to, say, $5 a barrel.

However we are assuming some technical self-sufficiency, so if there were a boycott and we chose not to import oil because of the price, we would be able to last out for 6 months or a year.

The main purpose of this action would be to discover if we could perhaps compete against the OPEC price. If, for example, we were able to develop our storage capacity, if we were able to have more oil in places like Elk Hills, if we were able to develop shale and tar sands and other energy sources, and we did not like $10 a barrel, we could refuse to import oil for more than $5 a barrel. Then, this supply of 6 months might give us some time to attempt to beat the price down, as our oil entered into the market.

But other than action of that kind, I do not think it is very probable that the oil-exporting countries are going to lower the price. I think the price is going to be around $10. It does not look as though, in any of our studies so far, there will be a tendency to lower the price, since these oil exporting countries are all different. They run from extreme left wing governments to extreme right wing governments, but they all seem to agree on one thing, and that is the posted price in the Persian Gulf.

OPEC OIL PRICES WILL STAY HIGH

Chairman BENTSEN. You do not agree with Secretary Simon that there is a probability that there will be a lowering of the price?

We have seen some instances cited as of the present time, that there is a glut of supply of oil available in the world, and we have seen a resistance to some of the prices requested by some of the OPEC countries.

Representative REES. You will find variations in your spot price, and you might have the variation of a dollar or so a barrel. But remember, we are talking about a 450-percent increase in the price of a commodity, petroleum, so that a 5 or 10 percent plus or minus change in oil prices is not going to matter that much when compared to that 450-percent price increase.

When you are talking long term petroleum imports $10 a barrel plus or minus $1 is a reasonable price for now and for the next few years.

I think the major test for the OPEC countries will come in trying to impose production cutbacks, to try and develop their own Texas Railroad Commission, to allocate to each country a certain amount of production so the market will remain relatively tight and the price will stay up. This will be subject to a major test if there is a glut on the oil market; but I suspect, in looking at the alternatives, that they will tend to agree to some type of allocation program, because the other alternative would be an oil war, which of course would cut their revenue in half.

The work that we have been doing in oil, I think, can be translated to other products. In the material I have submitted here for the record, there is a chart entitled "United States Mineral Imports: 1973." As you can see in this chart, we are dependent on imports for nearly every strategic mineral that is used in the U.S. economy.

I understand that the Arab boycott cost the United States about 5 percent of its supply. So you can see what a relatively short cut-off did to the United States during this last winter.

Chairman BENTSEN. Yes, I have it, and without objection the material will be included in the hearing record.

ARE OTHER OPEC'S LIKELY?

Representative REES. What the material includes, Senator, is basically the outline of the work that the ad hoc committee is doing.

It is my view that if OPEC was a success for petroleum, that the OPEC concept will be a success in other areas where minerals are exported by relatively few countries. It could happen; it has happened in bauxite.

Chairman BENTSEN. Congressman, most of the witnesses we have had disagree on that, and feel that the oil cartel is unique, and that even it will have a problem holding together. They feel that on the bauxite situation that we will have substitutes.

The industry witnesses testified yesterday as to a number of alternative sources that they felt were economical to produce at the present price.

Representative REES. They have to go out and produce them. Oil shale might be a great equivalent for oil, it is costing $10 landed, but it is going to take us 6 or 7 or 8 years to develop the oil shale.

THE CASE OF JAMAICA—ALUMINUM

Chairman BENTSEN. They are talking about pretty soon on some of the aluminum processes.

Representative REES. Jamaica has substantially increased the tax on bauxite. And the tendency is, even though there is not a formal group of countries, when one country increases its price, the other countries will usually increase their prices by that amount. Canada, for example, is not a member of OPEC, but the export tax on Canadian oil to the United States at the present time more or less equalizes the price of Canadian oil with imported oil, east coast. Remember, Canada is our friend and ally, and not a member of OPEC. But I think once a country, or a series of countries, finds that they can achieve some market control, they are going to attempt to raise the price, because the success story of OPEC. OPEC was able to raise the price by 450 percent and get away with it; this example I think, has been well studied by countries exporting commodities.

What worries me when I look at this situation is the strategic stockpile program in the United States. The policy of this administration has been to sell off many materials from our strategic stockpile.

RAW MATERIALS STOCKPILES—REES CASE SHAKY

Also included here is a list of the stockpile bills passed by the 93d Congress. These are administration bills. We have not passed any stockpile/sales bills for about 8 or 9 months. But on aluminum, the objective of the policy is zero tons in storage, copper, zero tons in storage, molybdenum, zero tons in storage, opium, zero tons in storage, and zinc, down to 202,000 short tons.

Chairman BENTSEN. But we produce a very substantial amount of copper domestically. We had considerable testimony on that yesterday.

And as far as the aluminum, they tell us again that they will be on stream with some of their production domestically in very short order. You wouldn't contend that we ought to keep these substantial amounts in stockpile, would you, where we have domestic production?

Representative REES. I certainly would, because our domestic reserves of copper are going down. And, the current tendency with copper is towards more and more imports. We are dependent on copper imports. We do not import very much, but we are dependent. And our dependency will increase.

Chairman BENTSEN. We have substitutes that have moved in on copper, of course, too. And at the present time it is 2.6 times the price of aluminum, for example. And they push up too high, and we have a shortage on the small amount of importation. It seems that the substitutes move in then.

Representative REES. Substitutes can move in for copper, but copper is really the best conductor of electricity that we have, and it is absolutely necessary in that field. There is no substitute that has been developed that can touch copper when it comes to conducting electricity.

On our strategic stockpile, I feel we should have an economic stockpile as well as a military stockpile. Further, we should be stockpiling enough raw materials so that if we do face an OPEC situation, we will have some bargaining power when it comes to establishing price. By selling off all of our stockpiles, we are really making ourselves completely vulnerable when it comes to developing, let's say, a reasonable market price for imported raw materials. I think basically the administration has developed their policy because they have a cash flow problem. And they are marketing everything they can sell in order to lessen the Federal deficit. I do not think this is a prudent policy. I would in fact probably try to develop more stockpiles, with emphasis on the economic stockpile.

The strategic stockpile does not bother me much, because I do not think, if we ever get into the type of war contemplated by the strategic stockpile, that it would really mean much after the first round of pushing buttons. But it is the economic stockpile that I worry about, because we are far more vulnerable in our economy; we can be brought down far more easily there than by any World War III.

Chairman BENTSEN. You would use such a stockpile for economic purposes to regulate price? Isn't that what happens?

Representative REES. I would, if I were the czar of the stockpile, if I felt there was an arbitrary price increase with no relationship to production cost, return on investment and other costs, I would sell in the open market in an attempt to force that price down. This is on a monopoly situation. In the petro countries, if there is a monopolization, there is no opportunity to allow the market forces to work; and if we get into other monopoly situations in raw materials, I think by selling on the open market we can at least stimulate some free market play. The tendency would be for the price to go down.

When the Defense Production Act was before the Banking and Currency Committee, I put in several pages of amendments. The bill is going to be amended on the floor; it will be on the floor tomorrow.

I have the Comptroller General developing a study in consultation with various agencies of the Federal Government, and attempting nearly the same thing that the Mansfield study would do. It will probably be in conference next week. I suspect that Senator Mansfield will be interested in its progress in the conference committee, because it would be basically the same study as the Mansfield study, analyzing our dependence on imported materials and goods in order to formulate a policy for the future.

Chairman BENTSEN. Congressman, we have another witness, and I will have to ask you to summarize the rest of your testimony.

Representative REES. I think that is it, Senator. I will make available to your subcommittee the material that produced our study. I have a galley on the first part of it: An analysis of the petroleum market the last 30 years, the development of OPEC, and the rising structures within OPEC. I will make this available to your subcommittee. If we can be of any help, we have a very excellent staff and I hope that you will call on us.

Chairman BENTSEN. Thank you, Congressman Rees, I appreciate very much your consideration, and the material that you have presented will be included in the hearing record. We look forward to working with your staff.

Representative REES. Thank you, Senator.

[The material referred to follows:]

CONGRESS OF THE UNITED STATES,
HOUSE OF REPRESENTATIVES,
Washington, D.C., June 10, 1974.

DEAR COLLEAGUE: H.R. 13044, the Defense Production Act Amendments of 1973, will be before our Banking and Currency Committee this morning.

I will be offering an amendment which will provide for a study by the Office of Management and Budget, consulting with other agencies, of our current policy toward the several national strategic materiel stockpiles. The study is to be completed by March 30, 1975. The amendment would also extend the Act until June 30, 1975, instead of June 30, 1976, the date in the bill.

The purpose of the amendment is to attempt to define possible policy guidelines regarding the creation and disposition of our strategic national stockpiles. The current policy objective of the Administration is to reduce the stockpiles of many minerals to zero even though we are dependent on foreign sources of these minerals. Two prominent examples are copper and aluminum; we rely heavily on imports of both these minerals. The countries which export copper and aluminum have been meeting to explore the possibility of forming a cartel of the type which was established by the oil exporting nations and which resulted in an arbitrary petroleum price increase of 450% last year.

Given our dependence on imported critical materiels, the possibility of arbitrary price increases, and the effect of those price increases on our domestic economy, it is my feeling that our current policy must be thoroughly reassessed.

I am attaching several documents relating to the problem.

I would appreciate your support.

Sincerely,

THOMAS M. REES,
Member of Congress.

Attachments.

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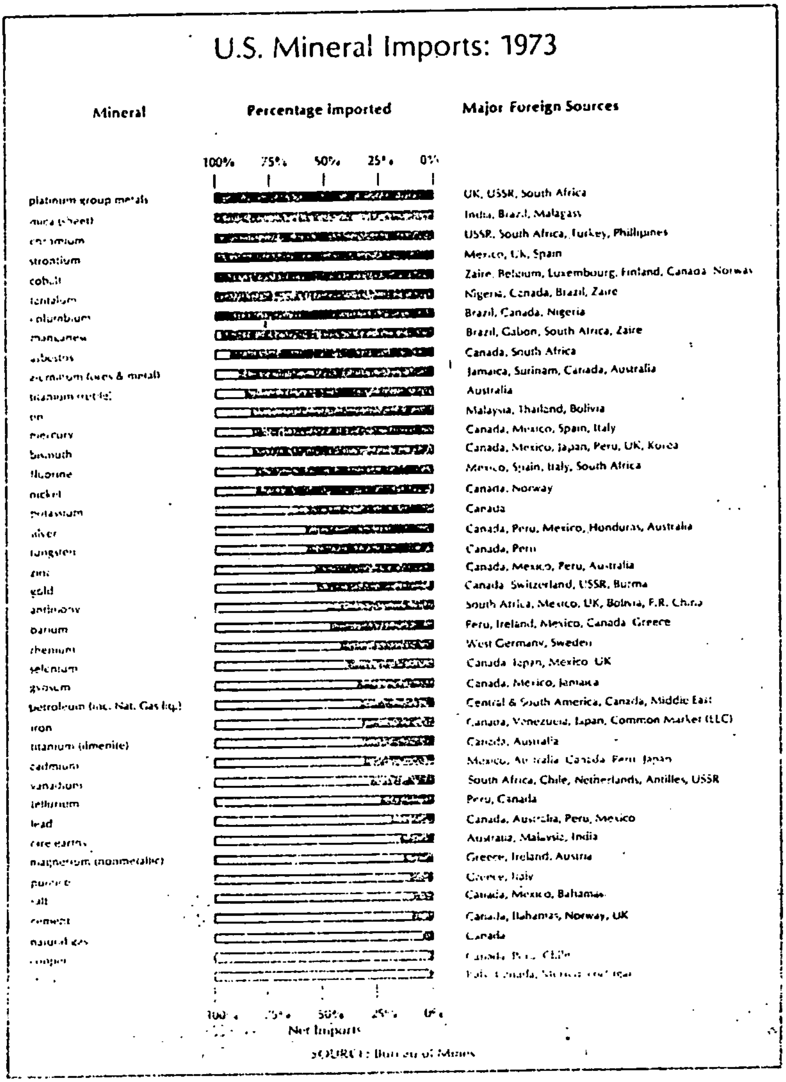

STOCKPILE BILLS PASSED BY THE 93RD CONGRESS

X 1. ALUMINUM

P.L. 93-220, approved December 28, 1973. Authorizes the disposal of 207,444 short tons of aluminum.

Objective: 0
Inventory: 66,825 short tons
Committed: 66,825 short tons
Acq. Cost: 22.7¢ per pound
Mkt Price: 31.5¢ per pound

X 2. COPPER

P.L. 93-214, approved December 28, 1973. Authorizes the disposal of 251,600 short tons of copper.

Objective: 0
Inventory: 20,000 short tons
Committed: 20,000 short tons
Acq. Cost: 26.5¢ per pound
Mkt Price: 81.5¢ per pound

X 3. MOLYBDENUM

P. L. 93-219, approved December 28, 1973. Authorizes the disposal of 36,500,000 pounds of molybdenum.

Objective: 0
Inventory: 21,219,000 pounds
Committed: 21,219,000 pounds
Acq. Cost: $1.16 per pound
Mkt Price: $1.80 per pound

4. OPIUM

P. L. 93-218, approved December 28, 1973. Authorizes the disposal of 65,700 pounds (morphine content) of opium.

Objective: 0
Inventory: 118,000 pounds
Committed: 65,700 pounds
Acq. Cost: $66.19 per pound
Mkt Price: $130.00 per pound

X 5. SILICON CARBIDE

P. L. 93-216, approved December 28, 1973. Authorizes the disposal of 196,500 short tons of silicon carbide.

Objective:	0
Inventory:	166,391 short tons
Committed:	None
Acq. Cost:	$194.00 per short ton
Mkt Price:	$250.00 per short ton

X 6. ZINC

P. L. 93-212, approved December 28, 1973. Authorizes the disposal of 357,300 short tons of zinc.

Objective:	202,700 short tons
Inventory:	538,928 short tons
Committed:	336,228 short tons
Acq. Cost:	13.9¢ per pound
Mkt Price:	34.7¢ per pound

Statement of the Problem

On the basis of prior studies the following assertions can be made:

1. For the next two or three years there will be a world-wide shortfall of petroleum and petroleum products at prices remotely approaching those of even the recent past.
2. There need be no world-wide physical shortage of petroleum and other energy after a period of adjustment (2–3 years?) until 1985–1990—and perhaps not after then—under reasonable assumptions as to population growth, economic development rates and prices.
3. The lowest cost sources of energy in the world at present, and for the foreseeable future, are in the Middle East, especially Saudi Arabia.
4. It is physically possible for the U.S. to become secure or self-sufficient (variously defined) in energy but at a very high cost.

The statements above, and elaborations of them, are represented in most of the current studies and public statements of both government agencies and private parties.

Crucial issues for the longer term are not as yet being structured and systematically attacked. This study addresses the following matters which will become critical for policy within the next year:

1. What is the long run lower bound of total cost-covering prices of petroleum at U.S. port of entry? (It is known that this price is below the U.S. current and prospective production costs—the issue is how much below.)
2. Always threatened with potential competitive energy sales at prices well below prospective U.S. energy costs, will U.S. firms undertake the investment to provide the necessary level of energy security for the period beyond the current crisis?
3. What is the least expensive (adjusted for risk) way for the U.S. to guarantee the necessary level of energy security, taking into account both consumer and taxpayer costs?

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A long run upward shift in the price of energy of an uncertain magnitude has occurred. This conclusion follows for the U.S. whether or not the petroleum exporting country cartel succeeds in holding the price greatly above its costs. The U.S. must exploit more expensive domestic energy sources, or undertake other activities, to maintain the level of security necessary for domestic and international economic and political flexibility. Hence it will be forced to pay a high price for energy, whatever happens in the rest of the world.

The long run upward shift in energy costs will have important ramifications on the domestic economy, on international financial relations and on U.S. responsibilities to and relations with other nations. The focal issues which have not yet been incisively formulated, much less seriously explored, are these:

1. What are the economic implications, and potential long run structural shifts in production and consumption required of U.S. citizens because of significantly higher energy costs?

2. What are the implications for U.S. international trade and finance of the current and prospective increases in petroleum prices?

3. What are the current and prospective effects of the increases in world prices on the economies of the less developed countries? What U.S. policies will minimize the potential harm from these price increases? What U.S. policies may be required to offset the disruptions which may occur?

Outline of the Study

Part I: Background: Where We Are and How We Got Here

A. The energy crisis as a problem in economic adjustment.

B. The development of the petroleum "squeeze" of 1973–74.

1. The market structure in the international oil industry—from an international oil company cartel to a somewhat fractured oligopoly.
2. The replacement of the international oil company cartel by the Organization of Petroleum Exporting Countries (OPEC) cartel.
3. The structure of the domestic industry in its relation to the international petroleum cartel.
4. The development of the petroleum shortage over the past three years—the factors (both domestic and international) which would have led to the energy shortfalls and price jumps of 1973–1974 even in the absence of the oil embargo.

C. From production costs to consumer prices—imported petroleum price increases, 1971–1974, and the effective range of policy action.

1. Shifts in costs and prices between 1971 and 1974—the record of the period of escalation.
   (*a*) Production costs (including exploration and development), 1971 and 1974.
   (*b*) Payments to host countries, 1971 and 1974.
   (*c*) Transport costs, 1971 and 1974.
   (*d*) Importing company margins—the difference between the U.S. price (c.i.f.) and a+b+c, 1971 and 1974.
   (*e*) Some observations on refining and distribution costs and margins, 1971 and 1974.
2. Resource costs, monopoly profits, windfall gains and cartel receipts, 1971–1974: policy implications.

D. Estimate of the long run, lower bound cost of imported petroleum to U.S. consumers.

1. Production costs abroad (including exploration, development, and necessary profits to producing companies).
2. Necessary rent and taxes (payments to host countries sufficient to cover both the social cost of production and an amount sufficient to induce them to be economically willing to produce the petroleum rather than leaving it in the ground for future use).
3. Transport and handling costs of U.S. ports.
4. Conclusion: An estimate of the minimum price under free trade that U.S. producers must be prepared to meet if they are to undertake the investment necessary to achieve U.S. energy self sufficiency.

PART II: ENERGY SECURITY: IMPLICATIONS, RISKS, COSTS AND POLICY OPTIONS

A. Estimated long run domestic costs of energy to meet various levels of self sufficiency: the extent of the potential competitive disadvantage of the U.S. energy industry in a world of free trade.

B. Alternative possible outcomes in the world petroleum market to 1985.

1. Maintenance of the petroleum exporting country cartel for economic ends—a world monopoly price.
2. Maintenance of the petroleum exporting country cartel for political ends—uncertain price, supply interruptions.
3. Breakdown of the exporting country cartel—a world competitive price (See Part I.D.).
4. Other possible outcomes.

C. Estimated costs of alternative U.S. policies to attain energy security, given A. and B. above, considering taxpayer costs, consumer costs, and effects on the cost of production of goods in international trade.

D. Concluding remarks on alternative U.S. policies to achieve self sufficiency and their relationship with other economic and social goals.

1. Impact on the U.S. economy.
2. Impact on the distribution of income in the U.S.
3. Impact on the U.S. balance of payments.
4. Impact on economic development programs in other countries.

PART III: THE IMPLICATIONS OF A POLICY OF DOMESTIC ENERGY SECURITY ON THE U.S. ECONOMY DUE TO AN INCREASE IN THE RELATIVE COST OF ENERGY

A. The reallocation of resources in production and the shifts in consumption patterns due to expected higher energy prices.

B. The impact on total production from higher energy prices (GNP effects).

C. The effect on personal income from higher energy prices.

1. Per capita income and its growth.
2. Shifts in the geographic distribution of income within the U.S.
3. Redistribution of income among different income groups and different occupations.

PART IV: IMPLICATIONS AND ANALYSIS OF WORLD OIL PRICES ON THE U.S. BALANCE OF PAYMENTS

A. Estimated dependence on foreign oil under no import restrictions and various world prices.

B. Problem of absorbing dollar earnings by the oil exporting countries and the implications for limiting the volume of trade or making alternative arrangements for payments.

C. Estimated foreign exchange burden implied by IV. (A.).

D. Alternative U.S. policies to cope with the balance of payments estimates in IV. (C.).

PART V: WORLD OIL PRICES AND LESS-DEVELOPED COUNTRIES

A. Higher oil prices and economic growth in LDC's.

B. Higher oil prices and the resulting differential competitiveness of LDC's in international trade.

C. Alternative U.S. policies to aid LDC's (perhaps in exchange for other natural resources produced within LDC's).

1. Subsidize U.S. oil exports to LDC's.
2. Encourage exploration and development of energy resources in LDC's.
3. Finance alternative energy sources in LDC's.
4. Other.

PART VI: U.S. DEPENDENCE ON ESSENTIAL RAW MATERIALS—1960–1974; 1974–1990

I. Overview of current situation

II. Materials: current and projected requirements

A. Domestic consumption
B. Domestic production
C. Domestic reserves

D. Import sources
E. Pricing
F. World market
G. Technology
H. Current government programs

III. Policy Recommendations

A. Domestic policies
1. foster the expansion of domestic production
2. find substitutes or develop synthetics
3. allocate existing supplies through a priority use system
4. establish economic stockpiling
5. expand recycling
6. establish coordinative management structures
7. diversify sources of supply

B. International policies
1. develop special relations with more reliable sources
2. increase the dependence of supplying countries upon continuing U.S. goodwill
3. other

Chairman BENTSEN. Our next witness is Mr. James Theberge. We are pleased to have you sir, please proceed with your testimony.

STATEMENT OF JAMES D. THEBERGE, SENIOR INTERNATIONAL ECONOMIST AND DIRECTOR OF LATIN AMERICAN STUDIES AT THE CENTER FOR STRATEGIC AND INTERNATIONAL STUDIES, GEORGETOWN UNIVERSITY

Mr. THEBERGE. Mr. Chairman, I am here in my capacity as director of Latin American studies at the Center for Strategic and International Studies at Georgetown University. I am also director of the Latin American project of Nelson Rockefeller's Commission on Critical Choices for Americans. Over the past 6 months or so I have been examining international mineral cartels and their possible impact on the American economy.

I very much appreciate this opportunity to appear before you today to discuss the possibility that foreign exporters of certain scarce and vital nonfuel minerals may be able to acquire the power to disrupt supply and dictate prices to American consumers. To do that, of course, our suppliers must form some kind of price-fixing scheme or cartel arrangement.

Therefore, let me first say a few words about cartels. Because of its association with undue restraint of trade, the term cartel has acquired a pejorative meaning for Americans—quite rightly in my view. Perhaps it would be useful if we began our inquiry with a clear definition.

An international mineral cartel is essentially an agreement among producers domiciled in different countries—under private or government sponsorship—that aims at raising prices or reducing losses for its members, normally by restricting exports to consuming countries. Besides increasing profits, cartels have also tried to reduce the wide fluctuations in prices and incomes that have characterized the international minerals market in the past.

The possibility that international cartels might be capable of restricting essential supplies of mineral raw materials or raising their prices excessively has important implications for the economic well being—and indeed the very security of the United States. For particular minerals, imports already constitute a significant and growing proportion of domestic consumption. The impact of a sharp price increase or sudden limitation in supply could be substantial in the short run. For the long run, the scope and severity of any disruption to the U.S. economy will continue to grow as long as America's requirements are increasingly met by foreign sources.

What I am talking about so far is the potentially serious economic and security consequences for the United States of mineral-cartelization. In the time available, I hope to describe the outlines of the problem and to suggest some measures that the U.S. Government might consider to protect our interests in the uninterrupted supply of nonfuel minerals at reasonable prices. I would like to steer a course between the overly complacent and the Cassandras, and to do so by neither denying nor exaggerating the true dimensions of the problem.

The United States, and other industrial countries, have become increasingly concerned about the malfunctioning of the mineral supply system in recent years. That malfunctioning is due to a cluster of interrelated causes.

First, severe strains have been placed on our finite resources due to rapid growth of mineral usage. At the same time, the United States is increasingly dependent on mineral imports to satisfy domestic requirements and sustain industrial expansion.

Excess demand for minerals in the past few years has led to sharp price increases—largely of a short-term nature—and shortages of certain critical minerals and categories of manpower. Environmental protection legislation, no doubt necessary, has not helped matters.

MINERAL PRICE DROP SINCE APRIL 1974

Chairman BENTSEN. Let me interrupt you at that point. Have we not seen since April substancial drops in prices in some of these minerals?

Mr. THEBERGE. Yes; and minerals futures are down for most minerals. The tendency for mineral prices is downward. The projections that are being made by compentent authorities, such as the United Nations, and the World Bank, indicate that mineral prices generally, with a few exceptions, will weaken over the next year. Mineral prices have already weakened this year, and will continue to soften in 1975. After 1975–76, there should be a slower rate of growth of prices than we have observed recently. Of course, we are assuming that domestic and overseas productive capacity will continue to expand.

Added to these strains, we are witnessing a revolution in producer-foreign investor relations in the developing world, which I do not believe we can afford to ignore. This revolution has transferred control of important mineral sources to weak and unstable governments in the third world. These regimes, anxious to increase their export earnings, have intensified their efforts to form producer alliances and cartels which could limit output and set monopolistic prices.

It is quite understandable that they want to maximize their foreign exchange earnings from their present major revenue sources—primarily agricultural and mineral raw materials. Primary products, of course, constitute the bulk of the exports from the developing countries.

Now it is likely that these short and long term problems of the mineral supply system will not have the dramatic impact on the United States economy that the worldwide energy gap has registered. But we should not be complacent simply because the magnitude of the overseas mineral supply problem is not likely to be as dramatic or as disruptive as the impact of the OPEC oil cartel; it seems to me that we should not be complacent because the magnitudes of the impact are different.

Chairman BENTSEN. Will you develop that point in your statement further along?

Mr. THEBERGE. Yes, I will.

Chairman BENTSEN. All right, go ahead.

CONSEQUENCES OF MINERAL CARTELS

Mr. THEBERGE. But the consequences of mineral shortages and scarcities and interruption of supply can have harmful consequences, particularly if mineral shortages coincide with an OPEC-induced international monetary crisis, or with cyclical scarcities of other materials.

Let us examine more closely some of these disturbing trends in the mineral supply system.

Since 1970 there has been a remarkable upsurge in the prices of industrial raw materials and metals. During the two previous decades, from 1950 to 1970, nonferrous and ferrous ore prices increased about 50 percent. Yet it took only 4 years, from 1970 to 1974, for them to increase by another 50 percent.

Some of the price increases were a result of the coincidence of sharp upturns in industrial activity in the major developed countries in which demand often out-paced supply, leading to severe shortages in some cases. The rise in raw material prices were often caused by special factors such as shortages arising from pollution control problems in the nonferrous metal smelting industry; speculation in commodities as a hedge against inflation, which was quite noticeable last year and this year, and exchange rate realignments which raised import prices for the United States and other industrial countries.

CHANGES IN PATTERN OF OWNERSHIP—INTERNATIONAL ECONOMY IN FLUX

Another trend that has created uncertainties about future prices and adequacy of supply is the revolution in the pattern of ownership and control over mineral raw materials which is now underway.

I would like to stress this point, because a tremendous transformation of the international economy is now underway. Nationalization of foreign investment in the mining sector is one of the major trends in the international system. We tend to neglect it because it happens sporadically in different countries at different times.

Production of the principal mineral exports of developing countries—such as iron ore, manganese, copper, bauxite, tin, lead, and zinc—used to be almost entirely in the hands of American, British, Belgian and French firms. This is no longer the case. What we are witnessing today is the rapid liquidation by third world regimes of Western ownership and control over important mineral resources. In my view, this process could be virtually completed by 1985 or perhaps sooner.

What this means is that foreign companies can no longer operate without interference and controls by the host governments. And the mineral exporting countries are no longer willing to permit foreign companies to purchase mineral rights or to negotiate long term concession agreements. Pricing policies and foreign exchange receipts from mineral exports are placed under increasingly stringent control. Long term contracts from earlier periods are being renegotiated and, as we have observed recently, some of them are being canceled unilaterally. Special taxes are being levied on foreign mineral investments to increase the Government's share of rent from its mineral resources.

As these developing countries place the mining sector under state ownership and direction through expropriation, they require increasingly large amounts of external capital and technology to exploit their mineral resources. The displacement of the foreign firms has left a capital and technology gap that third world countries are trying to fill by seeking these productive factors from new Western sources, from the Socialist states and from Japan. Mineral exporting countries are beginning to have discussions with the Arab members of the OPEC group, because they have suddenly become such an important source of capital. Obviously they will be even more important in the future.

It is, of course, true that the increasing dependence of the United States on foreign sources of supply of mineral materials is nothing new. It is a trend that began in the 1920's, but at present the United States is completely dependent upon the import of a diverse group of ferrous and nonferrous metals. Our dependency ratio—that is, United States net imports as a percent of domestic use—has risen since 1950 for iron ore, cobalt, manganese, nickel, bauxite, platinum, titanium, and zinc.

As a result of these developments, the United States is becoming increasingly vulnerable to actions by the developing countries, particularly in view of the dwindling of the United States mineral stockpile.

IMPACT OF MINERAL PRICE INCREASES ON THE ECONOMY

Chairman BENTSEN. What percentage of our GNP would these imports be of these minerals, do you know?

Mr. THEBERGE. Offhand, I do not know.

Chairman BENTSEN. We were told yesterday that it would be 3 percent. How much of an impact does that really have on the United States?

Mr. THEBERGE. I think that is a misleading way of stating the problem.

The inflationary impact of rising mineral prices, for example, no doubt would not be great if we are talking about the spread effect through the entire economy. However, the inflationary impact on specific sectors as well as on the balance of payments can be substantial.

Some people argue that if imports only rise by $500 million as a result of a 50-percent increase in our mineral prices, there is nothing to worry about. I do not agree. I believe we must do everything we can to improve our balance of trade. Whenever possible we should do what we can to prevent or moderate rising prices of imported raw materials and other commodities. Rising mineral prices have increased United States imports of non-fuel minerals in the last few years by $300–$400 million annually, according to the World Bank and some rough calculations of my own.

In 3 years additional United States mineral imports would total over $1 billion, which in my view constitutes a significant impact on our trade balance.

So I think people who say mineral imports account for such a small share of the GNP or have such a small inflationary effect on the economy that there is nothing to be concerned about——

Chairman BENTSEN. I am trying to measure the magnitude.

Mr. THEBERGE. Right—I think, being somewhat myopic.

It seems to me that our economic difficulties require that we jealously protect our interest, and whenever we have the opportunity we must try to keep our import bill down. In the case of international mineral cartels, we should try to work out cooperative arrangements with mineral exporting countries, so that they do not unduly raise prices against us. We should make every effort to diminish the impact on our balance of trade, even if it is not a major one.

WILL MINERAL CARTELS BE EFFECTIVE?—NOT IN THE LONG RUN

Chairman BENTSEN. Let me get to the point.

Will these mineral cartels work?

I think most economists in and out of Government have argued that cartels of any kind do not and will not work—especially in the long run. That conclusion is based on economic reasoning and is shaped by experience with cartels in the interwar and postwar period. Much of this analysis remains valid. There are, however, some new aspects of the international situation that improves the chances of successful cartelization by the developing countries of a restricted list of major nonfuel minerals—such as tin, copper, and bauxite. There may be a few others.

Successful cartelization in any of these minerals could cause problems for the U.S. economy—higher prices, persistent shortages, and a larger import bill—over the short term. This favorable situation for producer alliances is, however, far from irreversible. Producer alliances have a tendency to fall apart eventually. But in the meantime, they are capable of having a substantial adverse impact on the American economy.

For example, most commodity experts expect the world economic slowdown in 1974 and 1975 to lead to some weakening of nonfuel mineral prices. But that does not give me a great deal of comfort because mineral prices have increased roughly 50 percent in the last 5 years, and the trend is upwards. Over the next 5 years, mineral prices may rise another 25 or 30 percent—some mineral prices might even increase as much as 100 percent between 1976 and 1980. That implies an additional burden on the U.S. trade balance.

I would like to return to this major factor in the international situation which tends to be neglected by policymakers here in Washington.

We are in an era of more assertive Third World nationalism, and this is radically altering producer-foreign investor relations in favor of the developing mineral producers. Nation states are seizing control of mineral supply from the foreign mining companies and have begun to consult regularly and establish producer alliances.

These are facts. The Third World is politicizing international trade, however much we may deplore it. The international trading system is under strain because countries are increasingly using trade for political ends.

I might add that the United States is not entirely innocent on that account. As you know, we have a trade embargo against Cuba.

The less developed countries want to change the foundation of the international trading system, and they hope to do it by forming cartels, by creating economic blocs, and by uniting in a Third World group which will exert pressure on the developed countries.

The South American and Caribbean mineral exporting countries—the region I am most familiar with—have been especially vigorous in promoting both economic blocs and producer organizations. They were, for example, active in the formation of Organization of Petroleum Exporting Countries (OPEC). Venezuela and Saudi Arabia were the two leaders in the formation of OPEC. Very little is heard about Venezuela's important leadership role.

In the formation of the Council of Copper Exporting States (CIPEC) Chile and Peru took a major lead. And Peru is the militant activist within the CIPEC group of copper-producing countries.

Of course, the International Bauxite Association was formed this year largely by three Caribbean countries with Jamaica and Guyana playing a key role.

Various Latin American countries are trying to transform the existing informal producer consultation into more formal OPEC-type mineral and tropical commodity cartels. These ideas are much in vogue in Latin America at present.

As a typical example, Mexican President Echevarria in Quito, Ecuador just a few days ago called for a common front of all Latin American countries to obtain better raw materials prices by creating multinational marketing organizations—which are a form of cartel—for each commodity. Ultimately President Echevarria and other Latin American leaders hope to establish a Latin American organization to coordinate the supply and price of all commodity exports from the region.

I would like to return to the——

BENTSEN—SKEPTICAL ABOUT SUCCESS OF A LATIN AMERICAN CARTEL

Chairman BENTSEN. Let me ask you, Doctor, do you take that kind of an approach or plan seriously, where you are talking about trying to get all these nations of Latin America, with all the diverse interests and objectives they have, to have a cartel affecting all of their export commodities?

I went through your list of things that are necessary in order for a cartel to work.

One of the things was that they had to have monetary reserves to withstand embargoes and that type of thing.

And second, that the material has to be a significant part of the cost of the finished product. And there are a lot of other things, in order for them to be a cohesive group, and I certainly have not seen that.

Mr. THEBERGE. I would like to comment on that for a moment. What the primary exporting countries are not talking about, I do not believe, is creating a super cartel—but setting up an organization which would coordinate cartels in specific commodities. They realize the importance of cross-cartel cooperation. Take the mineral sector—if iron ore, bauxite and copper are cartelized and the cartels coordinate their pricing policies, then the producer countries may be able to reduce the possibility of substitution of other metals for the minerals which are cartelized.

In other words, cross-cartel cooperation and price coordination increases producer bargaining strength, enhances their ability to maintain cohesive cartels, and strengthens the individual cartels.

Now this is something new. It is an emerging phenomenon with which we have little or no experience. I am not saying that this kind of cross-cartel cooperation by governments is necessarily going to work. What I am saying is that efforts are being made in this direction. It certainly is possible for OPEC, CIPEC and the Bauxite Producers Association to cooperate, with OPEC providing capital, for buffer stock schemes, and so forth. I would not rule this out.

So, returning to your original question, I do not think that President Echevarria was talking about some kind of a master cartel for all commodities. He was talking about an organization which would allow better price coordination between cartels.

Chairman BENTSEN. I suppose that is a clarification. You can talk about a Latin organization to regulate the supply and price of oil, the primary commodity exports from the region.

Mr. THEBERGE. That is what the Latin American countries ultimately would like to establish.

Chairman BENTSEN. You think it is a group of cartels put together, is that what you are talking about?

Mr. THEBERGE. Yes, a group of cartels that coordinate their policies and cooperate to create a united bargaining front.

Chairman BENTSEN. Let me clarify your statement on something else here.

You are alarmed at some of the prospects for the producer nations organizing cartels and yet in examining the individual cases for copper, bauxite, and tin, the most likely cartel candidates, you conclude that the organization of real market power will be very difficult for them.

Mr. THEBERGE. That is right, but again it depends on whether we take a short or longer term viewpoint. Jamaica has raised bauxite prices over 400 percent in the last 6 weeks. The Government of Jamaica is playing the role of a price leader in an oligopoly: It makes the first move, and the other bauxite producers follow.

Chairman BENTSEN. Let's just get to that point.

Do you think that cartel is going to work or not?

CARTELS WILL WORK IN THE SHORT RUN

Mr. THEBERGE. I think that cartel will work in the short run, yes. In the long run, success will depend on whether Alcoa, Reynolds, and the other American aluminum producers seriously move to substitute bauxite imports by developing our ores and clays, and so on. The companies claim they are going to do so, as you heard the other day, and I am heartened to hear that. But I do not think the Jamaican Government takes that prospect seriously.

If you tell that to the Jamaican Ambassador here his answer will be: "Well, that is what the companies always say." The aluminum companies simply are not taken seriously.

Chairman BENTSEN. We asked the representatives of the Jamaican Government to testify, but they are engaged otherwise.

Mr. THEBERGE. I think I should say a few more words about cross-cartel consultation and cooperation, because I do think this is a potentially important phenomenon, something not widely recognized.

There is no doubt that regular consultation exists between OPEC, CIPEC, and the Bauxite Producers Association, or at least some members of the Bauxite Producers Association. You must remember that the members of these producer alliances are third world countries, and they get together in many different forums.

Two of the OPEC countries, for example, are going to join CIPEC fairly soon, Algeria and Iran, because they are both going to become copper producers and exporters.

Increasingly, the members of the Bauxite Producers Alliance are being represented or invited to be represented at CIPEC meetings. So there is quite a lot of interaction between these producer alliances.

In addition, perhaps more important than cross-cartel cooperation and consultation is the possibility that these cartels will gain access to the surplus oil revenues of the OPEC countries. This may turn out to be extremely significant. For example, Venezuela could provide capital to the Bauxite Producers Association to hold bauxite off the market through a stockpiling scheme, or some other scheme for restricting and allocating output.

Chairman BENTSEN. I am going to have to ask you to summarize, if you will, for 5 minutes, and we will include your prepared statement for the record.

Mr. THEBERGE. Well, in conclusion, I do not foresee any major crisis in nonfuel minerals. But I fail to understand why we should not be concerned about minor dislocations and price-fixing caused by cartels that could involve substantial costs to the American economy.

It seems to me that we have no grounds for complacency. We seem to rely excessively on the old way of doing things, of reacting only when a major crisis is upon us.

I would like to say just a few words about what we might consider doing in response to this new situation.

Most important, the U.S. Government needs to formulate an action program for nonfuel minerals. This action program would aim at insuring uninterrupted supply and reasonable prices for nonfuel minerals into the future. By definition, the future is uncertain. There are considerable risks involved in idly watching our import bill for nonfuel minerals go up and hoping that everything will work out for the best, that minerals will not be successfully cartelized, that our mineral companies will be able to produce copper and aluminum from local sources, and so on.

The action program might include such items as the following: We should establish an early warning mineral information system which would provide the Congress and the administration with a continuous analysis of supplies and shortages.

The National Commission on Supplies and Shortages, which is now being considered in the House, is a first step toward institutionalizing such a system. Where that information system should eventually be lodged within the Government is another question.

The United States should also consider seriously reducing our excessive dependence on unstable foreign sources of supply of critical nonfuel minerals by limiting domestic demand and increasing supply. In the trade-off between the higher cost of relative self-sufficiency and our growing dependence on mineral imports, the United States should consider relying on imports of nonfuel minerals to the minimum extent feasible. The United States should not cut itself off from the international trade in minerals. We should, however, move in the direction of self-sufficiency or a greater degree of independence whenever it is technically feasible and the economic cost is not unreasonable.

Besides maintaining an organized strategic mineral reserve, which is under review by the National Security Council, we should consider establishing an economic stockpile to prevent unfavorable foreign price manipulation and avoid potentially costly dislocations of foreign supply.

I would also like to recommend that the U.S. Government consider influencing the development of foreign mineral supply through public sector channels. I think the Exim Bank and the Agency for International Development should be given a larger role in financing mining and mining infrastructure projects. The same is true of the international lending agencies, the World Bank group, the Asian Development Bank, and the Inter-American Development Bank; they should all be encouraged to allocate a larger share of their lending portfolios to financing mineral sector development, particularly in the poorer countries.

Chairman BENTSEN. What is to stop them from putting on all of these embargoes or limitations of cartels?

The mere fact that we have done the financing through the Export-Import Bank or World Bank, that does not preclude them from doing it, does it? They can have all the agreement they want, but still they can abrogate the agreement.

Mr. THEBERGE. That is true. Nevertheless it is in our interest to increase the supply of minerals overseas. Even though we move toward self-sufficiency, or less dependence on mineral imports, it is in America's interest to support an expansion of world production.

There are several reasons why the United States should favor an increase in foreign mineral production capacity in the developing world. The more diversified the supply, the more foreign mineral production capacity that is built, the greater the possibility of downward pressure on prices. I think that serves our interests, it serves the interests of the Japanese and the Western Europeans who are far more dependent on mineral imports than we are.

Chairman BENTSEN. But you say that they are all moving toward cartels, and we must get together on some control on prices, and at the same time you argue for self-sufficiency.

Mr. THEBERGE. I do not think there is any contradiction. There are some countries which have mineral reserves—and would like to export them but lack the capital required—that are not in the cartel groups. Take Panama, which has large copper reserves.

Chairman BENTSEN. But they are not in the cartel group.

Mr. THEBERGE. They might very well join, but the strain on the cartels would be greater if large numbers of countries had costly productive capacity that was not being utilized.

In other words, we should build toward a larger world capacity, with the expectation that the centrifugal pressure on the cartels would be greater as a result of the fact that more countries had mineral productive capacity.

I urge the creation of a new office for foreign investment negotiation as a possible innovation which might be made by the executive branch. The office could be charged with the continuous responsibility for monitoring investment problems between U.S. investors and mineral-producing countries, and, of course, other investment disputes. I think that such an office could undertake fact-finding missions at an early stage of the dispute and negotiate ad hoc bilateral settlements.

Ambassador Eberle mentioned earlier that he felt that these negotiations were being handled satisfactorily under the present system. But as you know, the settlement of the investment dispute between the Peruvian Government and some 15 or 20 American corporations which embittered our relations with Peru for the last 5 or 6 years was settled by Mr. James Green, a specially appointed envoy of the President, a banker from New York. He went to Peru over a period of a year and a half and negotiated a settlement of that set of disputes between the Peruvian Government and American companies.

Chairman BENTSEN. That was done on an ad hoc basis?

Mr. THEBERGE. Yes, sir.

Chairman BENTSEN. Was it not better to institutionalize these things, and have someone who has that role permanently, would they not start leaning more on the Government to handle the problem?

Mr. THEBERGE. Institutionalizing this function is very important. In the case of Peru, we could probably have reached a settlement earlier on the mineral and other investment disputes if there had been some institutionalized negotiating office in the executive branch which had continuous responsibility for undertaking special missions to find out what the dispute is about, analyze the facts, and negotiate over a sustained period of time in the interest of the U.S. Government.

There are a number of unsettled investment disputes between U.S. companies and foreign countries at all times—and not just in the minerals field—that could be handled by such an office. The Office of the Special Trade Negotiator in the Executive Office of the President is the kind of a model I have in mind, I believe we need it.

The experience of Mr. Green unfortunately may not be utilized again by the U.S. Government; in any event, we are not developing and utilizing valuable negotiating experience for dealing with very complicated investment disputes. If we wait for the creation of an effective international investment code to codify behavior of foreign corporations and to institute some kind of a dispute settlement mechanism, I'm afraid we are going to wait for a long time.

Investment codes have been under discussion on and off for 30 years, and it seems to me that the only effective way to settle these disputes—in fact the way that we have been settling disputes in the past—is on an ad hoc basis.

The problems between individual companies and countries are unique in many respects. I do not think you can develop a general formula to fit all cases.

Of course, I am not against the effort to find such a formula. I just do not think it is going to be very effective.

I would like to make one or two final points.

The Council of International Economic Policy, or the Domestic Council, should be strengthened to monitor nonfuel minerals information and intelligence, prepare policy options, and insure prompt implementation of policy decisions.

At present interagency policy coordination is weak, and mineral problems are dealt with on an ad hoc basis. There is no long-term planning. Decisionmaking is complex and hindered by the many Government departments, agencies, councils, and so on, having economic policy responsibility bearing on mineral availability, production, trade, and pricing.

The executive branch could be strengthened by having a small expert group within either one of these bodies charged with the task of monitoring these problems and developing policy options on a regular basis.

There is an interagency coordination group within the Domestic Council which is supposed to carry out these tasks. But a handful of people from different agencies cannot possibly monitor the whole minerals and materials problem. It is far too complex.

Finally the United States should take the appropriate steps to enhance our bargaining leverage with foreign mineral suppliers and potential cartels, but should not commit large public resources or assume aggressive postures. If possible, we ought to consult closely and coordinate our action with the other consuming countries.

However, the United States should have adequate policy instruments and decisionmaking mechanisms available to enable us to take prompt action, alone if necessary, to protect our economic well being and national security.

Thank you very much, Mr. Chairman.

Chairman BENTSEN. Thank you very much Mr. Theberge, your testimony will be helpful to us. You have come up with some special recommendations which are enlightening to us.

We appreciate your contributions. Your prepared statement will be included in the hearing record.

[The prepared statement of Mr. Theberge follows:]

PREPARED STATEMENT OF JAMES D. THEBERGE

Mr. Chairman and members of the committee, I very much appreciate this opportunity to appear before you today to discuss the possibility that foreign exporters of certain scarce and vital non-fuel minerals may be able to acquire the power to disrupt supply and dictate prices to American consumers. To do that, of course, our suppliers must form some kind of price-fixing scheme or cartel arrangement.

Let me first say a few words about cartels. Because of its association with undue restraint of trade, the term cartel has acquired a pejorative meaning for Americans—quite rightly in my view. Perhaps it would be useful if we start with a clear definition.

An international mineral cartel is essentially an agreement among producers domiciled in different countries (under private or government sponsorship) that aims at raising prices or reducing losses for its members, normally by restricting exports to consuming countries. Besides increasing profits, cartels have also tried to reduce the wide fluctuations in prices and incomes that have characterized the international minerals market in the past.

The possibility that international cartels might be capable of restricting essential supplies of mineral raw materials or raising their prices excessively has important implications for the economic well-being—and indeed the very security of the United States. For particular minerals, imports already constitute a significant and growing proportion of domestic consumption. The impact of a sharp price increase or sudden limitation in supply could be substantial in the short-run. For the long-run, the scope and severity of any disruption to the U.S. economy will continue to grow as long as America's requirements are increasingly met by foreign sources.

What I am talking about so far is the potentially serious economic and security consequences for the United States of mineral-cartelization. In the time available, I hope to describe the outlines of the problem and to suggest some measures that the U.S. Government might consider to protect our interests in the uninterrupted supply of non-fuel minerals at reasonable prices. I would like to steer a course between the overly complacent and the Cassandras, and to do so by neither denying nor exaggerating the true dimensions of the problem.

MINERAL SUPPLY SYSTEM

The United States (and other industrial countries) have become increasingly concerned about the malfunctioning of the mineral supply system in recent years. That malfunctioning is due to a cluster of inter-related causes.

First, severe strains have been placed on our finite resources due to rapid growth of mineral usage. At the same time, the United States is increasingly dependent on mineral imports to satisfy domestic requirements and sustain industrial expansion.

Excess demand for minerals in the past few years has led to sharp price increases—largely of a short-term nature—and shortages of certain critical minerals and categories of manpower. Environmental protection legislation, no doubt necessary, has not helped matters.

Added to these strains, we are witnessing a revolution in producer-foreign investor relations in the developing world. This revolution has transferred control of important mineral sources to weak and unstable governments in the Third World. These regimes, anxious to increase their export earnings, have intensified their efforts to form producer alliances and cartels which would limit output and set monopolistic prices.

Now it is likely that these short and long-term problems of the mineral supply system will *not* have the dramatic impact on the U.S. economy that the worldwide energy gap has registered. But the consequences can be harmful, particularly if mineral shortages coincide with an OPEC-induced international monetary crisis, or with cyclical scarcities of other materials.

Let us examine more closely some of these disturbing trends in the mineral supply system.

Since 1970 there has been a remarkable upsurge in the prices of industrial raw materials and metals. During the previous two decades, from 1950 to 1970, nonferrous and ferrous ore prices increased about 50 percent. Yet it took only four years, from 1970 to 1974, for them to increase by another 50 percent.

Some of the price increases were a result of the coincidence of sharp upturns in industrial activity in the major developed countries in which demand often out paced supply, sometimes leading to severe shortages. The rise in raw material prices were often caused by special factors such as shortages arising from pollution control problems in the non-ferrous metal smelting industry; speculation in commodities as a hedge against inflation; and exchange rate realignments which raised import prices for the U.S. and other industrial countries.

Another trend that has created uncertainties about future prices and adequacy of supply is the revolution in the pattern of ownership and control over mineral raw materials which is now underway. Production of the principal mineral exports of developing countries—iron ore, manganese, copper, bauxite, tin, lead, and zinc—used to be almost entirely in the hands of Americans, British, Belgian and French firms. Third World regimes are rapidly liquidating the remnant of Western ownership and control of mineral resources, and this could be virtually completed by 1985, or even sooner.

This means that foreign companies can no longer operate without interference and controls by the host governments. And the mineral exporting countries are no longer willing to permit foreign companies to purchase mineral rights or to negotiate long-term concession agreements. Pricing policies and foreign exchange receipts from mineral exports are placed under increasingly stringent control. Long-term contracts from earlier periods are being renegotiated or cancelled unilaterally. And special taxes are being levied on foreign mineral investments to increase the government's share of rent from its mineral resources.

The expropriation of foreign resources companies is occurring with increasing frequency as the developed countries strive to bring the mining sector under state ownership and direction. As the expropriation proceeds, the host countries are driven to seek the large amounts of capital and technology needed to exploit their mineral reserves from new sources. So far Japan and the socialist states seem more willing to accept the new terms and conditions than the traditional mining companies.

It is true, of course, that the increasing dependence of the United States on foreign sources of supply of mineral raw materials is nothing new. In fact, it began in the 1920's when the United States shifted from a net exporter of minerals (and forest products) to a net importer. Over the past two decades, however, the United States has begun to import a much larger share of its domestic requirements for a widening range of non-fuel minerals.

At present, for example, the United States is completely, or largely, dependent upon the import of a diverse group of ferrous and non-ferrous metals (chromium, cobalt, columbium, manganese, nickel, bauxite, platinum, tin and zinc) to satisfy domestic requirements. And the dependency ratio (net imports as a percent of domestic use) has risen since 1950 for iron ore, cobalt, manganese, nickel, bauxite, platinum, titanium, and zinc. As a result, the United States is becoming increasingly vulnerable to actions by the developing countries—particularly in view of the dwindling of the U.S. mineral stockpile.

PROSPECTS FOR MINERAL CARTELIZATION

Will mineral cartels work? Is there a real threat that Third World producer alliances will be able to exert political and economic pressures against the industrial world? Do we face an unprecedented situation, or are current fears exaggerated and unwarranted?

Most economists in and out of government have argued that cartels of any kind don't and won't work—especially in the long-run. That estimate is based on economic reasoning and is shaped by experience with cartels in the inter-war and post-war period. And much of this analysis remains valid and serves as a valuable check on the worst predictions of those who believe a major mineral crisis on the way.

Nevertheless, there is a new international situation that improves the chances of successful cartelization by the developing countries of a restricted list of major minerals—such as tin, copper and bauxite. There may be a few others. Successful cartelization in any of these minerals could cause problems for the U.S. economy—higher prices, persistent shortages, and a larger import bill—over the short-term. This favorable situation for producer alliances is, however, far from irreversible; it may not last more than a few years. The world economic slow down in 1974 and 1975 is expected to lead to some weakening of non-fuel mineral prices. And prices will tend to grow more slowly thereafter as the increase in world-wide productive capacity and the shift to substitutes in the industrial countries begins to be felt.

But before going into these new developments, it would be useful to review briefly those political and economic factors which in the past have favored the establishment of durable cartels:

Political cohesion among producer countries is an essential element for successful cartel formation.

The commodity should have no available (or potential) substitutes, it should account for a small part of the cost of the final product, and free entry of new producers into the industry should be difficult—in short, that demand and supply are price inelastic and cross elasticities are low.

Moreover, the fewer producers that control a large share of the supply, reserves and trade of the mineral the better.

It is also useful for cartel members to have large foreign exchange reserves or access to substantial financial resources. Large reserves, for example, enable a cartel to better withstand losses of revenues resulting from export restrictions and the operation of stockpile and buffer stock schemes.

Finally, consumer countries should have no means to retaliate such as by releasing mineral stockpiles.

Economists are correct to point out that most of the essential conditions for cartel-formation do not prevail for the major non-fuel minerals. And they are right to entertain strong scepticism about the long-term prospects of mineral cartels by Third World producers—despite the dramatic success of OPEC.

Nevertheless, there are some new international factors that do strengthen the chances for the cartelization of a few major minerals—at least over the short-run.

First of all, there is the recent shortage of supply of minerals—in most cases temporary—which has strengthened the bargaining power of the Third World producers *vis-a-vis* the foreign mineral companies and the consuming nations.

As noted earlier more assertive Third World nationalism is radically altering producer-foreign investor relations in favor of the developing mineral producers. Nation states are seizing control of mineral supply from the foreign mining companies and have begun to consult regularly and establish producer alliances.

The South American and Caribbean mineral exporting countries—the region I am most familiar with—have been particularly active in promoting producer organizations for petroleum (OPEC or Organization of Petroleum Exporting Countries—Venezuela), copper (CIPEC or Council of Copper Exporting States—Chile and Peru), and bauxite (IBA or International Bauxite Association—Jamaica and Guyana). Several of them are trying to transform informal producer consultation into formal OPEC-type mineral and tropical commodity cartels. These ideas are very much in vogue in Latin America at present.

As a typical example, Mexican President Echevarria in Quito, Ecuador on July 11, 1974, called for a common front of all Latin American (and Third World) countries to obtain better raw material prices by creating multinational marketing organizations (cartel combines) for each commodity. Ultimately, President Echevarria and other Latin American leaders hope to organize a Latin American organization to regulate the supply and price of all primary commodity exports from the region.

Moreover, cross-cartel consultation has already begun and cooperation will probably follow. According to the Peruvian Minister of Energy and Mines, General Jorge Fernandez Maldonado, CIPEC members have agreed to cooperate with the oil and bauxite producers. Two OPEC countries (Algeria and Iran) will soon join CIPEC in their capacity as copper producers, and three members of the bauxite producers alliance, (Jamaica, Guyana and Guinea) will be represented at the next CIPEC meeting. An effort is being made, led by Peru, to establish close price coordination between OPEC, CIPEC and the IBA and to widen their membership. OPEC is being urged to create a bank that would provide financial aid to Third World mineral producers and others. And the Shah of Iran recently promised to help developing countries that manage to set up their own cartels.

Meanwhile, in the Western Hemisphere, Venezuela could become a source of financial support for Latin American-based mineral and tropical commodity cartels. With an estimated $10 billion in oil revenues in 1974—which is more than can be profitably absorbed at home—Venezuela will have a multi-billion dollar fund that could be tapped. Costa Rica has already broached the subject of support for a new Central American coffee producers combine.

Another factor that should not be neglected is that the new cartels such as CIPEC and IBA are established by governments and therefore have a better chance of withstanding the financial strains of a declining market for their exports than private business cartels. Governments are less sensitive to changes in economic conditions and better able to withstand sustained financial losses from cartel participation without going bankrupt.

Finally, the ability of OPEC to raise oil prices fourfold in less than four years and exert political pressure on the industrial countries has made a deep impression on Third World producers of mineral and tropical commodities. It provided a powerful demonstration effect but it also harmed the Third World oil-importing countries by sharply increasing their oil import bill. In 1974 they will need an additional $10 billion to cover the balance of payments impact of the rise of oil and other commodity prices.

Therefore, primary exporting countries in the Third World have a strong incentive to raise the price of their own mineral and tropical commodity exports through some kind of producer alliance or cartel arrangement. And that precisely is what they are trying to do now.

THREE CARTEL CANDIDATES: TIN, COPPER AND BAUXITE

The most likely candidates for cartel action by Third World mineral producers are tin, copper and bauxite. Of these three minerals only the world tin market is well organized and regulated by the International Tin Council—an organization of producers and consumers and not a producers cartel. But tin is a potential candidate for Third World cartelization because reserves are concentrated and scarce. And four developing countries (Malaysia, Thailand, Indonesia, and Bolivia) control most of the world's exportable production and approximately 70 percent of world reserves. Tin can be replaced, however, by aluminum and stainless steel. At present it is not likely that the Third World tin exporters will pull out of the ITC and form a producers cartel, particularly while tin prices are very high and the ITC successfully regulates the world tin price through a buffer stock scheme.

Four copper exporting developing countries (Chile, Zaire, Peru and Zambia) formed a producers alliance in 1967 to coordinate their copper policies. So far, CIPEC has not been an effective cartel, functioning mainly as a consultative and study group. With the proper financing of a stockpiling or buffer stock scheme, CIPEC might be able to increase the export earnings of member countries by restricting supply in the short-run. In the longer-run, CIPEC, as presently constituted, is not likely to be able to control the price and supply of copper to the rest of the world.

If the developed copper-producing countries (such as Canada and Australia) joined, the potential effectiveness of CIPEC would improve. As far as the United States is concerned, we depend on copper imports for less than 10 percent of our requirements and our large reserves would enable us to rapidly become self-sufficient under the stimulus of price increases.

During the course of 1974 the major bauxite producers in the developing world set up the International Bauxite Association (IBA) with the aim of raising bauxite prices. Aluminum, the end-product of bauxite, enjoys the brightest long-term demand prospects amongst all major metals, and currently is in short supply. The IBA controls over half of the world's reserves of bauxite and the prospect for a successful producer cartel is reasonably good. The five major bauxite producers in the world—Jamaica, Guyana, Surinam, Guinea and Australia—are members of the IBA.

In June, 1974, Jamaica levied new taxes on bauxite, raising the price of exported bauxite by over 400 percent from $2.50 a ton to $11.72 and doubling the royalty payments of the American aluminum companies. The IBA appears to be following the strategy of an oligopolist, with Jamaica being the price leader. Guyana and the other bauxite exporters will likely follow Jamaica as long as no costly response is forthcoming from the American companies or the U.S. Government.

But these price increases may well prove to be self-defeating. Aluminum has physical substitutes such as steel and plastic and bauxite reources are not scarce in relation to anticipated requirements. Aluminum can also be produced from alternative materials such as clays which are abundant in the United States. At the new bauxite prices, production of aluminum from U.S. materials is now economically and technically feasible. The U.S. could achieve self-sufficiency in less than a decade by producing alumina from clays and ores available in abundant amounts in Arkansas, Georgia and other states.

WHAT SHOULD BE THE U.S. RESPONSE

This leads me to broader considerations of what the U.S. response should be to the cartelization efforts of Third World mineral producers. What should be done depends upon one's analysis of the current situation, and the nature and scope of the risks and dangers facing us. Before offering my suggestions for government and industry action, let me recapitulate the main points of my argument thus far:

The mineral supply system is not functioning well due to some short-term and longer-term factors, some of which cannot be reversed.

A new international situation has emerged recently that temporarily favors the prospects for the cartelization of a limited number of major non-fuel minerals.

Most non-fuel minerals do not lend themselves to cartelization by the developing countries because they do not control a sufficiently large share of either production or reserves.

The producer countries, even where cartelization prospects are poor, will seek to form cartels and drive prices up in order to enlarge their export earnings.

Only tin, copper and bauxite are feasible candidates for effective cartelization and tin producers are not likely to withdraw from the International Tin Council (a commodity agreement) in order to create a cartel.

Over the next few years the American economy may be confronted with some minor dislocations and monopolistic pricing from one or two of the cartel candidates. While the American economy may not be seriously threatened, the actions of mineral producers can be costly in the short-run by contributing unnecessarily to domestic inflation and balance of payments pressures.

The risks of radical action to restrict supplies for these or other non-fuel minerals are small. Producing countries have neither the power nor in most cases the motivation to do so.

Mineral producer alliances will be unable to wield the political and economic influence of the OPEC countries since no other minerals compares with oil's strategic importance in the world economy.

The prospects for effective Third World producer cartels would be enhanced if the developed countries like Australia cooperated fully.

Cross-cartel price coordination and financial support (especially between OPEC, CIPEC and IBA) is possible over the next few years, and efforts are being made toward that objective by the more nationalistic Third World countries such as Peru and Algeria.

AN ACTION PROGRAM FOR NON-FUEL MINERALS

The Federal Government should develop a Non-fuels Minerals Action Program for immediate implementation in order to insure uninterrupted supply and reasonable prices for non-fuel minerals in the future. The Action Program should coordinate the several instruments of our foreign and domestic economic policies such as: trade agreements, fiscal incentives, foreign aid, export credits and credit insurance, investment guarantees, and mutillateral lending. It should also centralize the responsibility for non-fuel minerals so that the concerted employment of these policy instruments prevent foreign price manipulation and advance our other national interests.

This Action Program should include the following—a list by no means intended to be exhaustive:

We must have an early warning mineral (and materials) information system which would provide continuous and comprehensive analysis of supplies and shortages in the American economy stemming from domestic and overseas supply problems. The establishment of a National Commission on Supplies and Shortages, which is under consideration by the Congress is a first step towards institutionalizing such a system.

The U.S. should consider reducing our excessive dependence on unstable, foreign sources of supply of critical non-fuel minerals by limiting domestic demand and increasing domestic supply. In the trade-off between the cost of relative self-sufficiency and our growing dependence on mineral imports, the U.S. Government should consider relying on imports of non-fuel minerals to the minimum extent feasible. This policy will also enhance our bargaining position with foreign mineral suppliers.

In view of the growing international competition in minerals development in the Third World and future uncertainties with respect to foreign mineral supply, the United States should rely on a mix of market forces and specific incentives to alter the composition of domestic production and imports in the direction required by the American economy and national security.

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In view of the growing international competition in minerals development in the Third World and future uncertainties with respect to foreign mineral supply, the United States should rely on a mix of market forces and specific incentives to alter the composition of domestic production and imports in the direction required by the American economy and national security.

Besides the importance of maintaining an organized strategic mineral reserve—which is now under review by the National Security Council—I believe we should consider establishing an economic stockpile which could be used to avoid costly dislocations in foreign supply and to regulate international prices of critical minerals.

The U.S. Government should consider influencing the development of foreign mineral supply through public sector channels: (i) the Export-Import Bank and AID should be given a larger role in financing mining and mining infrastructure projects; and (ii) the international lending agencies (the World Bank Group, the Asian Development Bank and the InterAmerican Development Bank) should be encouraged to allocate a larger share of their lending portfolios for financing mineral sector development, particularly in the poorer developing countries.

Consideration should be given to doing more, through a concerted use of available policy instruments, to protect U.S. investments in the mining sector abroad and to enhance U.S. bargaining leverage with the mineral exporting countries.

The possibility of creating a new Office of the Special Representative for Foreign Investment Negotiation at the highest level of the Executive branch should be examined. It would be charged with the continuous responsibility for monitoring investment problems between U.S. investors and mineral producing countries, for undertaking fact-finding missions at an early stage of a dispute, and for negotiating ad hoc bi-lateral settlements. Until an effective international investment code is adopted and enforced, such an office would be responsible for all bi-lateral negotiations concerning foreign investment problems.

A review of such devices as foreign tax credits and OPEC insurance should be undertaken by the U.S. Government to see if special investment guarantees or fiscal treatment is required to provide incentives and protection to American investment in foreign non-fuel mineral projects that are identified as critical importance to the American economy.

Consideration should also be given to strengthening the Council on International Economic Policy or the Domestic Council for monitoring of non-fuel minerals information and intelligence, preparing policy options, and insuring the prompt implemetation of policy decisions. Inter-agency policy coordination is weak and mineral problems are dealt with on an ad hoc basis. Decision-making is complex and hindered by the dozen or more Government departments, agencies, councils, offices and regulatory groups having economic policy responsibility that bears on minerals availability, production, trade and price.

The U.S. Government should take the appropriate steps to enhance our bargaining leverage with foreign mineral suppliers and mineral producer cartels but should not commit large public resources or assume aggressive postures. Close consultation and coordinated action with other consumer countries is to be preferred to independent and competitive action. Yet, the U.S. must be prepared with adequate policy instrumentalities and decision-making mechanisms to be able to take prompt action, alone if necessary, to protect its economic well-being and national security.

Finally, the U.S. Government should review the possibility of forging new kinds of exchange and consultation with the mineral exporting nations—perhaps starting here in the Western Hemisphere with a common mineral community embracing the United States and Latin American producers as suggested recently by Senator William Brock. A real interdependence and mutuality of interest between the Third World mineral exporters and the United States makes it possible to contemplate building a solid, cooperative relationship if the will is there on both sides. The United States still has a large lead in technology and remains the major world source of capital which could be exchanged on a new basis for the needed supplies of reasonably priced foreign mineral raw materials.

Chairman BENTSEN. The subcommittee will recess until 10 a.m., Thursday.

[Whereupon, at 12:07 p.m., the subcommittee recessed, to reconvene at 10 a.m., Thursday, July 25, 1974.]

OUTLOOK FOR PRICES AND SUPPLIES OF INDUSTRIAL RAW MATERIALS

THURSDAY, JULY 25, 1974

CONGRESS OF THE UNITED STATES,
SUBCOMMITTEE ON ECONOMIC GROWTH OF THE
JOINT ECONOMIC COMMITTEE,
Washington, D.C.

The subcommittee met, pursuant to notice, at 10 a.m., in room 1202, Dirksen Senate Office Building, Hon. Lloyd M. Bentsen, Jr. (chairman of the subcommittee), presiding.

Present: Senator Bentsen.

Also present: William A. Cox, Larry Yuspeh, and Carl V. Sears, professional staff members; Michael J. Runde, administrative assistant; and Walter B. Laessig, minority counsel.

OPENING STATEMENT OF CHAIRMAN BENTSEN

Chairman BENTSEN. The hearing will come to order.

Over the last few decades a gradual erosion has taken place in this country's self-sufficiency in raw materials. The United States, as a consequence, may be joining the rest of the industrial nations in mounting dependency on foreign sources for a broad range of basic minerals that are critical to our economy.

The recent shortage of key materials has stimulated debate over public policies to deal with major new economic challenges involving resource independence and the access to foreign supplies.

This administration last year announced an extensive disposal of metals and other materials in the Nation's defense stockpile as a way to fight inflation and balance the budget. But without sufficient consideration to the possibility of economically motivated embargoes.

Certainly, each of the specific commodity situations present different and complex problems but there is a heightened possibility of collective bargaining on behalf of those nations who have a sizeable potential for strategic market power in essential raw materials.

The interest of the United States would well be served by reexamining our present stockpile disposal policy and by creating a policy framework which takes adequate account of a new era of product diplomacy. While different groups may stress different objectives, the overall goals are the same for all: A healthy economy, concern for the national security, proper balance between the needs of the present and those of the future and a constructive effort to preserve and restore the human environment.

Today we will hear from three administration spokesmen who have participated in the intensive raw materials supply studies in the executive branch. We have Mr. Thomas Enders, Assistant Secretary of State for Economic Affairs, Mr. Thomas B. Falkie, Director, Bureau of Mines, Department of Interior, and General Lesie W. Bray, Jr., Director, Office of Preparedness, General Services Administration, who has the responsibility for strategic stockpile policy.

Gentlemen, we thank you for coming. Secretary Enders, would you please proceed?

STATEMENT OF HON. THOMAS O. ENDERS, ASSISTANT SECRETARY OF STATE FOR ECONOMIC AND BUSINESS AFFAIRS, ACCOMPANIED BY MICHAEL DUX, OFFICE OF INDUSTRIAL AND STRATEGIC MATERIALS, BUREAU OF ECONOMIC AND BUSINESS AFFAIRS

Mr. ENDERS. Thank you very much, Mr. Chairman.

In this opening statement, I should like to outline a general approach to the problems of high commodity price and insecure commodity supply.

One, in the past 18 months, we have seen a dramatic escalation of raw material prices.

One fundamental cause has been the conjuncture of boom conditions in all the industrial countries last year—for the first time in two decades—leading to record expansion of international trade and consequent pressure on industrial supplies. Prices of fibers, paper, natural rubber, metals and minerals surged as demand outpaced supply.

Poor weather throughout most of the world added to supply difficulties and put further upward pressure on the prices of agricultural commodities. Skyrocketing prices stimulated speculation and speculation was further spurred by currency uncertainties.

That was the first basic cause of rapid rise in prices, but there was a second basic cause.

That was the discovery by producers of what cartel and quasi-cartel action could do to raise prices and incomes, first in oil, now in bauxite, potentially in a handful more raw materials.

Two, the boom is over and prices are coming down in commodities traded in competitive markets; but prices in cartelized markets are being constrained or even increased.

In competitive markets the steam has gone out of the commodity boom. Fiber prices are down 16 percent since the beginning of the year, rubber prices are down almost 40 percent from their January peak, and nonferrous metals, more erratic in movement, are down even more sharply from their high levels in the spring. The major reason for the turnaround is the relative weakness in world industrial production. The simultaneous boom that caused prices to soar has become a simultaneous slowdown.

Other contributing factors include the high cost of borrowed money which makes speculative holding of stocks costly, the recent relative stability in currency markets which has also dampened speculative buying of commodities, and the selling off of excess stocks by major industrial users.

While capacity shortages persist in some sectors, the trend in prices is down. Commodity inflation and commodity vulnerability are reversible in competitive markets.

Three, the question is, Mr. Chairman, are they reversible in cartelized markets?

Here the key variable is investment.

If producers impose artificially high prices or artificial scarcities, consumers will protect themselves by investing: First, in alternative, more reliable, less exigent sources of supply.

Second, in substitutes—such as copper, tin, plastics for aluminum; coal, shale oil, nuclear energy for oil—and finally in economic stockpiles whose accumulation and use make consumers less vulnerable to pressure tactics by suppliers.

It is inherently difficult to fine-tune investment in cartel-type situations. When cartels assert their high prices, the first reaction of consumers is to bargain and wait, hoping to maintain short-term supply while testing to see how strong and how durable the cartel is.

But when artificially high prices persist, there is likely to come a point when suddenly investment in alternative supplies starts on a large scale as consumers conclude they can no longer count on their traditional suppliers.

Given the lead time involved, that investment may not come onstream for several years. When it does, prices may fall precipitately, and investors in the new generally higher cost alternative supplies may seek protection or subsidies.

For the producers, the trade off in this cycle is between extraordinary short term profits and the potential loss of long term markets.

For the consumer, the trade off is between lessened dependence, which can be bought only at high investment costs, and the effects of high prices.

We are at the start of cycles like this in oil and bauxite; others, but not very many others, may follow.

Four, in the case of oil, Mr. Chairman, the cartel is a testing point.

The fourfold increase in the price of oil has caused demand to drop substantially. A small surplus in supply is appearing; stocks are at record levels in all of our countries; spot prices are down; oil moving at sea is slowing down, increases in production have balanced off cuts in production in other OPEC countries. Something will have to give now, prices or production.

The emerging tactic of some oil producers is to use actual or implied threats of nationalization or of exclusion from the market to force individual oil companies to accept higher prices. The idea is to induce other producers to insist on similar high prices, and then to let the market cut producton as some portion of available supply goes unsold at the prices fixed.

Now, some oil producers argue that such further price increases are only just, because of inflation in consumer countries, and thus in the prices producing countries must pay for their imports. It is true that in the past oil was too cheap, and some margin of it was wasted.

But the overall argument does not bear analysis. Nonoil mineral raw materials have risen 115 percent, and manufactured goods exports only 40 percent in the last 3 years, as against 500 percent price increases for oil. By any calculation, the oil producers are compensating themselves many times over for the increases in prices of imports.

Moreover, exorbitant prices of oil are extraordinrily destructive of economic life. In the developing countries, they mean the sacrifice of all or nearly all of this year's growth and, if continued, of next year's and the year after. That is, I think, Mr. Chairman, a recipe for despair. In industrialized countries high oil prices are the single most important component of inflation.

We do not know whether the current attempts to put a new floor on oil prices will succeed in the short term. But we do know that companies that lock themselves into high priced deals now may find that competitors who wait may be able to obtain lower cost oil.

We know also, and I think this is important, that if companies prove ineffective in price bargaining with producer countries, consumer countries will have to consider alternative negotiating structures. We know the project independence (and its equivalent in every major consuming country) is going ahead with the express aim of lowering vulnerability to supply interruptions.

All of these factors will make long term success in sustaining prices in oil much harder to come by.

Five, some bauxite producers seek to emulate OPEC but we think they have less leverage.

The recent action by Jamaica to raise taxes and royalties on bauxite exports almost eightfold is a matter of much concern.

In taking this action, the Government of Jamaica rested its case largely on the fact that, with demand for aluminum outpacing supply, aluminum prices have increased substantially in major industrial markets, while the transfer price for Jamaican bauxite—the price which U.S. mining subsidiaries operating in Jamaica charge their parent companies—has remained practically constant.

In the near term, aluminum companies are locked in. They have little choice but to pay the higher levies because of the cost of disrupting established supply patterns during the current period of strong demand, their structural dependence on Jamaican-type bauxite, and their investments in Jamaica. The levies, if passed on, are estimated to increase the price of aluminum by nearly one-tenth.

Inspired by Jamaica's "tax leadership," two other Caribbean producers, the Dominican Republic and Guyana, have announced their intention to seek higher taxes.

We doubt, Mr. Chairman, that a Jamaican-type tax increase is sustainable over the longer term because of the abundance of bauxite worldwide. Because of the availability of close substitutes, notably the United States, the development of new technologies for the production of aluminum from clays provides an alternative.

If the tax is continued, future aluminum investment flows will shift to non-Caribbean areas. That Jamaica appears intent on voiding valid contracts with the companies containing agreed tax rates can only reinforce that shift, particularly if Jamaica refuses international arbitration. The contracts commit Jamaica to arbitration of disputes in the World Bank's International Center for the Settlement of Investment Disputes, or ICSID.

Thus, we fear that Jamaica may be putting at risk both its long term bauxite market and the fruitful United States/Jamaican investment framework, by insisting on short term profits.

Six, we may face cartel or quasi-cartel action in other commodities, but of much less serious scope than either oil or bauxite.

There are important differences between the market supply conditions for oil and the nonfuel minerals. In the case of minerals, consumers have reserves on hand in the form of recyclable scrap and lower grade sources of supply.

The time it takes to get new supply is shorter than is the case for oil, and the price increase required less. The possibilities of substitution are also greater.

Minerals are interchangeable for many uses. Producers and exporters of nonfuel minerals are more diverse geographically and politically than the OPEC members.

Thus, more than two-thirds of our imports of the major nonfuel raw materials come from Canada, Australia, and South Africa. The developing countries are also important sources, particularly for manganese, natural rubber, and tin, in addition to bauxite.

As a general matter, experience suggests that cartels are difficult to organize and more difficult to execute. They require effective control over supply and entry.

The incentive to producers to export in excess of quota can be compelling so long as some additional sales offer the immediate prospect to each of some additional earnings. Even assuming a degree of discipline and like-mindedness among producing countries that past experience suggests is unlikely, success would probably be short lived. The stimulus to production, the shift to substitutes, the encouragement to new technologies that economize on use, and consumer resistance are likely to leave producers in due course in a worse position than before, with markets irreversibly lost.

Producing countries are not insensitive to this possibility. We should not regard the formation of every association of producing countries as leading inevitably to supply shortages and exorbitant price boosts.

Seven years ago four copper exporting countries formed CIPEC. CIPEC members account for 36 percent of world copper production and more than 60 percent of the copper moving in international trade.

At a meeting 1 month ago they were unable to agree on any action to give effect to their announced desire and intention to "stabilize" copper prices and establish a floor price below which they would not sell.

Seven, Mr. Chairman, finally, what should U.S. policy be?

The first conclusion is that producers and consumers have major joint interests: Both lose if prices are set too high and result in extensive investment in high-cost alternative supplies, and in eventual loss of markets by traditional suppliers.

Because of these overlapping interests, producers and consumers can both benefit by a well-organized exchange of information, so that investment and pricing decisions become more predictable and their implications better known to all parties. Commodity consultative groups, including producers and consumers, are a useful vehicle for this sort of dialogue.

In some cases, it may also be possible to develop commodity codes, specifying rules of investor rights and obligations and assured supply and access to markets. One of the objectives of the multilateral trade negotiations will be full exploration of these possibilities.

The second conclusion is that the United States will have to sharpen and focus available instruments to direct commodity investment at home and abroad. Overseas, the main available instruments are EXIM credits and OPIC guarantees.

At home the government can play a facilitative role in legal and environmental aspects of raw material investment. Certainly at this stage subsidies and tariff protection for domestic investment do not appear desirable.

Third, we can seek to buy better protection against aggressive producer tactics by accumulating—and using—economic—as opposed to strategic—stockpiles of some materials.

However, to be effective, a number of serious problems affecting economic stockpiles will have to be worked out. One prime consideration is cost. To be effective, stockpiles need to be large enough to deal with fluctuations in demand or supply.

In the case of most commodities, the swings would dictate large stocks and this could be quite expensive. For example, in the case of tin, putting 50,000 tons on the market in the past years has not prevented a price increase in excess of 100 percent.

Another consideration affecting economic stockpiles has to do with the time of acquisition, which tends to be perverse.

Finally, there is the question of the impact of stockpiles on investment needed for expanded capacity. Stockpiles tend to deter investment, especially stockpiles maintained for price stabilization reasons.

Clearly, no one approach will suffice for all or most commodities. Some mix of each will be required.

What is needed now, Mr. Chairman, we think is to pursue the possibilities of each much more actively. A largely passive U.S. commodity policy is no longer desirable or possible.

Thank you.

Chairman BENTSEN. Thank you. What does 50,000 tons of tin mean pricewise? How much money are we talking about? Can you give me a ballpark figure to get this in perspective?

Mr. THAWLEY. About $450 million.

Chairman BENTSEN. Is that a year's consumption of tin or how much in the United States is that?

Mr. ENDERS. That is a very substantial percentage. Mr. Dux of our Office of Commodities will give you some of these statistics.

Chairman BENTSEN. I am trying to understand what this means exactly as far as impact on the market.

Mr. DUX. Mr. Chairman, the United States consumes approximately 60,000 tons of tin per year. The 50,000 figure is a combination of about 40,000 tons, which was released by GSA in the course of the past 12 months, plus a little more than 10,000 tons sold by the Buffer Stock of the International Tin Council. This is in addition to the normal figures by the tin producers.

THE LIKELIHOOD OF PREDATORY UNDERPRICING BY RAW MATERIALS EXPORTERS

Chairman BENTSEN. Now, Mr. Secretary, you say at this stage subsidies and tariff protection for domestic production do not appear to be desirable. We had other testimony, and you referred earlier in your presentation to it, to the fact it is to be requested. If you go into alternatives sources that are more expensive, it could suddenly be undermined by a price breakdown in the cartel.

Let's take an example and look at oil. If you are talking about gasification of coal, you are talking about a plant probably in the area of $500 million and if you are going to gasify coal, say you can deliver it at $1.46 NCF—something in that area—at the plant, and then the OPEC cartel, decides they are going to break that operation by dropping the price temporarily to $5 until they stop that plant, and then they put the price back up again. Now, how do you protect capital investment in this country in trying to develop self-sufficiency with other sources that may cost more?

Mr. ENDERS. Mr. Chairman, it seems to me there are two problems in the case of oil: One of them is the possibility that you allude to of a very great price fluctuation by the OPEC cartel.

Chairman BENTSEN. They are capable of it, aren't they?

Mr. ENDERS. They are probably, in my judgment, not at the degree of organization that would permit it, but one can't, of course, exclude it and one shouldn't exclude it.

Chairman BENTSEN. Well, at least the recent past shows they are capable of it. It may not hold together, but——

Mr. ENDERS. They are capable of going up. Whether they are capable of going down together is another question.

I would put a second point at perhaps a higher level of probability, and I think it is something that we have to consider in quite a different framework. That is the United States, if it were to invest heavily in higher cost sources of energy supply, including some of the ones you indicate and perhaps some others, in an effort to move to less dependency on foreign supplies, while it might be true that a country like Japan or some of the Western European countries could not do that, we could. Now, if that situation occurs, we may have the following results:

The United States moves into a higher cost energy situation on the one hand and while, because it is demanding and consuming less of the world's imported oil, the price of oil may tend to drop through normal demand and supply factors and that lower price of oil would then benefit our major industrial competitors. Now, the same kind of risk, of course, applies to the other way around as the Europeans feel that they have to move toward some greater self-sufficiency in energy.

So we perhaps have a common interest with all the consuming countries in sharing that downside risk, if you will, together.

Chairman BENTSEN. Well, let's look at that for a minute. We have talked about a shared approach, for example, to oil policy and talked to the European community of nations in that regard.

Then we became quite upset when we thought France was trying to get into a unilateral deal and then we turned around and did a unilateral deal with Saudi Arabia. How do we defend that?

U.S. RELIANCE ON SAUDI ARABIAN OIL

Mr. ENDERS. No, sir, I think there are two separate things involved here: I think what we were worried about at the Washington Energy Conference this winter was the preclusive type of industrialization for oil deals that could in effect put a corner on the oil supply in the world and——

Chairman BENTSEN. You don't think we did that with Saudi Arabia?

Mr. ENDERS. In the case of Saudi Arabia. we, as you know, receive very little of Saudi Arabian oil production. We receive maybe 800,000 barrels a day, which is about one-tenth or a little less than one-tenth of their production.

Chairman BENTSEN. We import about 7 million barrels a day, don't we?

Mr. ENDERS. But of that total, only about 800,000 is in Saudi Arabian oil and there are no provisions regulating that oil in port, which is, of course, organized by private companies, and this relates to our overall economic agreement with Saudi Arabia.

It seems to us that, Mr. Chairman, that the distinction here is between the preclusive or pre-emptive oil deal on the one hand and on the other hand measures taken in a foreign power situation and industrialization to deepen the ties between oil producing countries and the major consuming countries.

Chairman BENTSEN. You don't think that has become pre-emptive?

Mr. ENDERS. I don't think it has become pre-emptive, because it doesn't have any provision for who gets what oil and when.

UNITED STATES CANNOT DO MUCH TO STOP JAMAICA'S MOVE TO CONTROL ITS BAUXITE RESOURCES

Chairman BENTSEN. What do you do with a case like Jamaica where they have a very desperate economic situation. They have unemployment there at about 25 percent and maybe higher than that and they have seen their imports go up some $50 million to about $100 million and an increased deficit, primarily because of the cost of oil. How are you going to stop them from taking what they think is a short-term advantage, which they may feel the dire necessity for politically?

Mr. ENDERS. Mr. Chairman, we can't of course stop them from taking actions that they think are in their national interest. Jamaica is a friendly country. We have friendly relations with it. We respect their national sovereignty. We can and have and I think must point out to them what are the potential consequences of unilateral action and the impact that it will have on future investments, even in areas other than in bauxite.

Chairman BENTSEN. Did the Government play a major role in the negotiations?

U.S. ROLE IN THE JAMAICAN NEGOTIATIONS

Mr. ENDERS. The U.S. Government?

Chairman BENTSEN. Yes.

Mr. ENDERS. The negotiations were entirely between the Jamaican government and the companies at the desire of both. However, both sides——

Chairman BENTSEN. Did the Government sit in on those negotiations?

Mr. ENDERS. No, sir.

Chairman BENTSEN. Did each company work in unison in the negotiations?

Mr. ENDERS. The companies worked in unison in those negotiations insofar as they were discussing the question of taxes, which would be of course common to all. Insofar as they discussed their own individual situations with the Jamaican government, they worked separately.

If I could add one thing to that. Not only were we very closely informed of the course of this negotiation, but we did express to the Jamaican government in as clear terms as we could what we thought would be the consequences of certain actions proposed by them. We think that, in friendship, they should clearly know in advance our best judgment of the consequences, and implications of actions proposed.

Chairman BENTSEN. I thought I remembered some testimony on Monday that a Government observer sat in to be sure that there were no antitrust problems?

Mr. ENDERS. Not to my knowledge, sir. The companies, however, had a lawyer who served as their own antitrust monitor, but he had no connection with the U.S. Government.

Chairman BENTSEN. Well, we will check that one. I think I remember the testimony being that way.

If you went to an economic stockpile, what would be the three most important commodities that you would include?

BAUXITE, CHROME—PRIME CANDIDATES FOR AN ECONOMIC STOCKPILE

Mr. ENDERS. I think one of them would undoubtedly be chrome. I would certainly think that would be a potential candidate.

Certainly also I would put on the list bauxite. I would think that given the present trends in the world economy, one should look very closely at whether the present bauxite situation is satisfactory. I would think that in addition to that, the platinum metals groups should figure quite prominently on any list of that kind.

Chairman BENTSEN. Would you include more of chrome and bauxite than we now have?

Mr. ENDERS. That is a matter for study, Mr. Chairman, and a study has not been completed. You have to look, it seems to me, not only at the cost, which of course would be substantial, but in addition to that the way in which the market operates and how the manager of that economic stockpile could effectively play the reverse side of the market, which would be his role.

Now, that is a very tough job. Not very many people are consistently successful in playing the stock market and this would be a task very similar to that.

So, I would think before recommending it, we would have to have some further information as to how effectively that stockpile truly would be or would be likely to be under a single manager. That is one of the problems. Decisionmaking would be very difficult.

It seems to me also we would want to compare that with the other options in each of these fields. For example, do you want to consider certain kinds of investment incentives? What about investment overseas or in the United States? What about the cost and effects of those? The cost and effects should be compared to the economic stockpile cost and effects.

ROLE OF U.S. GOVERNMENT IN PROTECTING U.S. MULTINATIONALS FROM ABROGATION OF CONTRACTS BY HOST NATIONS

Chairman BENTSEN. You are talking about encouraging some of these investments overseas and trying to develop sources, but then you see an abrogation of contract. Do you think the U.S. Government should play a larger role than we have been playing in regard to these abrogations of contracts and instead of just leaving it to the companies? Do you think the companies are capable of a confrontation with a country?

Mr. ENDERS. Mr. Chairman, in almost every major investment dispute involving American companies overseas, there is now a substantial role for the U.S. Government.

Chairman BENTSEN. What kind of action can the Government take that is meaningful in this kind of situation, other than the powers of persuasion?

ACTIONS TO BE TAKEN BY THE U.S. GOVERNMENT TO PROTECT U.S. MULTINATIONALS IS UNCERTAIN

Mr. ENDERS. The powers of persuasion are the basic element that we have. It is also apparent that, in the case of arbitrary or aggressive actions of an illegal character affecting the interests of American companies, that this will inevitably have implications for the whole range of our relationships with the countries involved.

Now what those relationships are and how serious the effect is varies a great deal from country to country, but one of the purposes of our intervention is to point them out, to make them clear. And if necessary, one of the purposes is to take the actions that ultimately flow from it.

Chairman BENTSEN. What kind of actions?

Mr. ENDERS. You get, as you know, to the point where there are written into legislation a certain number of mandatory actions at the end of the line; the Hickenlooper amendment in particular. But the purpose of our activity——

Chairman BENTSEN. It seems to me every time we get one spelled out, the State Department tries to argue us out of it in the Congress.

Mr. ENDERS. I think there is a great question, Mr. Chairman, whether in its present form it is or is not too rigid an instrument, but certainly some such instrument is necessary in our legislative apparatus.

Chairman BENTSEN. Do you relate the Export-Import Bank to this? And do you try to have some input with the World Bank and other organizations like this?

Mr. ENDERS. Yes, those are all options open to us, in addition of course to a great deal of informal negotiating between the two parties, which you see perhaps a good example of in the settlement of the Anaconda dispute in Chile just yesterday.

Chairman BENTSEN. Are there instances where you have gone beyond just rhetoric and actually carried it out?

Mr. ENDERS. I am sure there are. Having just been sworn in yesterday, I can't give you a list of them, but I would be glad to do so.

Chairman BENTSEN. Fair enough.

[The following information was subsequently supplied for the record:]

DEPARTMENT OF STATE,
Washington, D.C., August 15, 1974.

Hon. LLOYD BENTSEN,
Chairman, Economic Growth Subcommittee, Joint Economic Committee, U.S. Senate

DEAR MR. CHAIRMAN: During my testimony on July 25 before your Committee, you requested additional information concerning the U.S. Government actions with regard to the extension of bilateral financial institutions to countries that have expropriated the property of U.S. citizens without adequate compensation.

The United States Government's policy with respect to expropriation was set out in the Presidential policy statement on economic assistance and investment security of January 19, 1972. Relevant portions are:

> "When a country expropriates a significant U.S. interest without making reasonable provision for compensation to U.S. citizens, we will presume that the U.S. will not extend new bilateral economic benefits to the expropriating country unless and until it is determined that the country is taking reasonable steps to provide adequate compensation or that there are major factors affecting U.S. interests which require continuance of all or part of these benefits.
>
> In the face of the expropriatory circumstances just described, we will presume that the USG will withhold its support from loans under consideration in multilateral development banks."

Votes in IFIs

There have been several instances where the U.S. has voted against or abstained on proposed loans to countries in which investment disputes were unresolved. Below is a record of "no" votes or "abstentions" by the U.S. in the international financial institutions, for which the reason cited was expropriation of U.S. property.

Institution	Date	Borrower	Amount (millions)	Project	Vote
IBRD	June 1971	Guyana	$5.4	Sea defense	Abstained.[1]
	do	Bolivia	23.25	Gas pipeline	Abstained.
	June 1972	Iraq	12.9	Education	No.
IDB	November 1969	Peru	9	Electric power	Abstained.
	June 1971	Bolivia	19	Gas pipeline	Abstained.
IBRD	November 1973	Peru	24	Education	Abstained.
IDA	January 1973	Iraq	40	Irrigation	Abstained.

[1] Alcan Canadian company with substantial U.S. interest was disputed claim.

Bilateral Aid

With regard to U.S. bilateral aid, the Hickenlooper Amendment has been invoked only once, on February 8, 1963 in Sri Lanka (then Ceylon). The suspension continued until July 1965 when it was determined that Ceylon had fulfilled its obligation to compensate nationalized US oil companies. Our bilateral assistance policies, however, can be affected by the expropriation of U.S. property without official invocation of the Hickenlooper Amendment. Aid has been temporarily held in abeyance on several occasions after an expropriatory act, pending clarification of the positions and intentions of those involved in the investment disputes.

The provision of U.S. assistance to Peru from October 1968 to February 1974 was carefully considered in light of the investment disputes during that period, and of the prospects of achieving a solution. Only earthquake relief loans were approved during this period. The expropriation of U.S. property in the early stages of the Allende period necessitated a similar review of aid policy towards Chile. No new development loans had been sought by the Allende government and none were offered. Disbursements on loans contracted with former governments continued until their terminal disbursement dates were reached. Grant assistance of a humanitarian and people-to-people nature was not interrupted.

OPIC Insurance

OPIC is, of course, subject to the provisions of the Hickenlooper Amendment. OPIC has respnsibility to determine where and under what conditions it will implement its programs, consistent with United States Government policy.

OPIC has been in existence since January 19, 1971 when United States Government investment incentive programs were transferred from AID. Its programs have been suspended in several participating countries for periods of time for a variety of reasons including the actions of host governments with respect to expropriation and failure to make payment of fair, adequate and effective compensation.

On September 26, 1969 a military junta seized power in Bolivia precipitating expropriation of several U.S. business interests without adequate compensation. Subsequently, OPIC ceased issuing insurance contracts in Bolivia. However, as a result of the Government of Bolivia's settlement of the Mina Matilda claim on December 11, 1972, OPIC programs were reinstated by the end of the year.

OPIC's policy toward insuring investments in Peru was affected as a result of the expropriatory practices of the Government of Peru, even though investments insured by OPIC were not directly involved. OPIC programs in Peru, which provided for inconvertibility insurance only, were terminated by mid-1969.

OPIC operations in Chile were phased out by mid-1971 as a result of uncompensated expropriations.

If I can be of further assistance, please do not hesitate to call on me.

Warm regards,

Sincerely,

THOMAS O. ENDERS,
Assistant Secretary
for Economic and Business Affairs.

INFORMATION SYSTEM OF ACTIONS OF CONSUMING AND PRODUCING NATIONS

Chairman BENTSEN. Now, you comment that the producers and consumers can both benefit by well organized exchange of information. I certainly agree with that.

Are you suggesting that some kind of a formal early warning system should be set up?

Mr. ENDERS. What I have in mind there is some kind of a grouping—perhaps it would be similar to the sorts of industrial groupings that you find in the United States or among industrialized countries—which could consider very closely the problems of that commodity area and provide, in effect, early warning of the investment decisions, the pricing decisions that are coming up and quality standards.

And of course there is a great deal of industrial work to be done in addition to that. Some of these groups already exist, but it seems to me that we should probably tend to encourage them much more actively than we have before.

I don't think its only function would be early warning. I would hope that it could play a role over a very broad surface of contact.

Chairman BENTSEN. Mr. Secretary, can you give us a report on the United Nation's Law of the Sea Conference in Caracas? Do you think they are going to make any headway or are they going to have a very pleasant social visit down there?

Mr. ENDERS. I can't give you a personal report, not having been involved in this, but I would be glad to have you provided with that estimate.

Let me say I think it is very unlikely that the governments involved would have mobilized 3 years of preparation, a vast amount of preliminary negotiations, without being quite serious on this issue. I think they are.

Chairman BENTSEN. Well, we saw this conference resulted in just a confrontation earlier this year, especially at the U.N. Assembly on raw materials and that certainly was not very pleasant.

Mr. ENDERS. I agree with that.

COMMENTS ON U.N. LAW OF THE SEA CONFERENCE

And I might add, the Law of the Sea Conference has been infinitely more carefully prepared over a much longer period of time and I think that its chances of success are, by that measure alone, much greater than that of a hastily called United Nation's General Assembly, called especially for raw materials, which appears to have been put together largely in a political spectrum.

As you know, there are some very real resource and political and legal problems involved in the Law of the Sea, which have been given profound study.

Chairman BENTSEN. Well, thank you very much, Mr. Secretary.

I would like to call on Gen. Leslie W. Bray, Jr., at this time for his testimony.

Now, General, will you please proceed.

STATEMENT OF GEN. LESLIE W. BRAY, JR., DIRECTOR, OFFICE OF PREPAREDNESS, GENERAL SERVICES ADMINISTRATION, ACCOMPANIED BY THOMAS M. THAWLEY, SPECIAL ASSISTANT TO THE ADMINISTRATOR FOR STOCKPILE DISPOSAL; AND LOUIS BROOKS, DEPUTY DIRECTOR, STOCKPILE DISPOSAL

General BRAY. Thank you.

Mr. Chairman, I wish to thank all of you, especially Chairman Patman and Chairman Bentsen, for the opportunity to appear before this subcommittee on the subject of stockpiling. My office, the Office of Preparedness within the General Services Administration [GSA], is responsible for the policy aspects of the stockpile program.

I am accompanied by Mr. Thomas M. Thawley, special assistant to the Administrator for Stockpile Disposal, and Mr. Louis Brooks, deputy director of Stockpile Disposal, GSA, who are knowledgeable about the disposal aspects of the stockpile program.

Our current stockpiling program derives its principal authority from the Strategic and Critical Material Stock Piling Act of 1946, which we usually refer to as the Stockpiling Act.

The purpose of this act has been to prevent a dangerous and costly dependence of the United States upon foreign nations for supplies of strategic and critical materials which, in the United States, are either deficient or insufficiently developed to supply the industrial, military, and naval needs of the country for common defense.

This has been accomplished by establishing stockpile objectives for individual materials under a variety of wartime scenarios and acquiring a materials inventory to meet these objectives. The stockpile objectives represent the difference between estimated supply and demand during an assumed wartime planning period.

At the present time, we plan for the first year of a conventional war fought simultaneously in Europe and Asia. This 1-year stockpile hedge should provide ample time to reduce demand by applying conservation measures, imposing austerity measures on the economy, providing for conversion to substitutes, and to expand productive capacity and supply.

Our guidance from the National Security Council regarding the determination of objectives assumes that normal supplies of materials will be available from all countries except Communist countries and countries in the war zones. Discounts for estimated transportation losses are applied to supply estimates.

An econometric model is used to project major indicators of economic activity such as gross national product and unemployment. These factors are then used to drive an input-output model of the Nation's economy.

Based upon consumption ratios provided by the Department of Commerce for civilian demand and by the Department of Defense for military requirements, we are able to calculate total demand for each strategic and critical material. We then subtract the expected supply from the expected demand for each material. If the supply exceeds the demand, then we have a stockpile objective of zero. When supply during the first year is less than demand, the shortfall becomes the stockpile objective and we maintain an inventory equal to the shortfall for the first year.

Present policy recognizes that defense needs beyond 1 year can be met by austerity, and provides the time and flexibility to more fully substitute noncritical materials for critical materials in production processes.

Materials may be acquired for the stockpile by purchase, barter, or the transfer of surpluses of materials not needed by other Government agencies. The latter method was used primarily after World War II, when large surpluses acquired for the war effort were transferred to the stockpile.

Barter arrangements have been used to acquire strategic materials in exchange for agricultural surpluses under the Agricultural Trade Development and Assistance Act of 1954. Another form of barter has been the exchange of surplus stockpile materials for materials which are needed to meet stockpile objectives. In recent years, this exchange technique has been the most common method of acquisition.

At the present time, the acquisition program is minimal, since jewel bearings are the only items on the stockpile list which are below their stockpile objectives. This deficit of jewel bearings is being met by cash procurement from a Government-owned plant located at Rolla, N. Dak.

Two other items, titanium sponge and copper, are being procured even though the stockpile objectives for both have already been met. These arrangements are considered to be in the best interest of the Government.

Titanium is being procured under a contract made with the Titanium Metals Corporation of America prior to the time that a reduction was made in the stockpile objective for titanium. The stockpile objective for titanium is now zero, and the material obtained under this contract will be resold.

Copper is being procured from the DuVal Sierrita Corp. in payment for a $83 million loan made under the Defense Production Act of 1950. Originally, this copper was being used to meet a stockpile deficit. Currently, the copper is being supplied to the Department of the Treasury for use in coinage by the Bureau of the Mint.

A part of the stockpile program includes disposal. Over $2 billion of excess materials were sold in fiscal year 1974. Aluminum, copper, and tin accounted for 60 percent of the total sales.

Careful consultation with domestic industry and foreign nations took place before and during all of the sales. Such consultation, formal and informal, is necessary under the Stockpiling Act in order to avoid disruption of the usual markets of producers, processors, and consumers.

Chairman BENTSEN. Do you feel that the sale of copper had a material effect on price or not?

General BRAY. I would like to ask Mr. Thawley to respond to that specifically, if he could?

Mr. THAWLEY. I can only relate what happened in the marketplace as we were selling copper. As you know, the Congress authorized the sale of all the copper in the stockpile and it was signed by the President, I think, December 28th of 1973.

In January, we formulated plans to conclude a sale of 85,000 tons of copper to the Mint for coinage purposes. We sold to the Department of Defense, 2,400 tons of copper for their use, and we also reserved and still have 20,000 tons of copper for sale to the Department of the Army during this fiscal year.

The balance of the 251,600 tons authorized for sale was offered to the public on a sealed bid basis in three separate sales. The first one was, I think in February, the second one late March, the third one early May.

The weighted average bid price of the copper that we sold in February was over 88 cents a pound. The weighted average bid price of the copper we sold in March was over 99 cents a pound. The weighted average of the copper we sold in May was over $1.18 a pound. Those bid prices reflect the rising international price of copper and not the domestic producer price.

The price is currently——

38,000 TONS OF COPPER SOLD IN MAY OF 1974—AFFEECTED THE MARKET PRICE

Chairman BENTSEN. Let me ask you. These numbers that you are giving me, how do they relate to the amount of copper being sold at that period of time?

Mr. THAWLEY. The total amount of the 251,600 tons we were authorized to sell represented somewhere between 3 and 4 weeks of consumption in this country. The February sale, I think we sold 45,000 tons. The March sale was 55,000 tons. Then what was the other? Was it 60,000 tons?

Mr. BROOKS. 38,000.

Mr. THAWLEY. Yes, 38,000 in May. I would point out the current quoted price of copper futures is in the order of 84 cents to 85 cents a pound.

Chairman BENTSEN. Well, do you think you had any effect on the market?

Mr. THAWLEY. Yes, sir, I think we did have an effect on the market, but not a significant one.

Chairman BENTSEN. Do you think it would have gone up more?

Mr. THAWLEY. I think because of other pressures, it probably would have gone up somewhat more. The international market reached about $1.50 per pound and——

FEASIBILITY OF ECONOMIC STOCKPILES OF RAW MATERIALS UNCERTAIN—OFFICE OF PREPAREDNESS

Chairman BENTSEN. Do you think an economic stockpile is feasible and that it could be utilized that way in addition to the strategic or military use of a stockpile?

Mr. THAWLEY. Mr. Chairman, anything is feasible, certainly, but——

Chairman BENTSEN. I don't agree with that at all.

Mr. THAWLEY. Certainly, as Secretary Enders pointed out earlier, the person who would operate that stockpile would certainly have to have the wisdom of Solomon and the touch of Midas, I think, in order to operate the thing successfully. It would be very, very difficult and complex and whether or not——

Chairman BENTSEN. Are you trying to tell me that the problems are insurmountable in trying to use an economic stockpile to influence price and protect this country as to substantial fluctuations in prices? That is what I am asking. I am not asking for perfection by the administrator. I don't know of any businessman who can bring that about. I am asking you if you think it would have an influence on the price?

Mr. THAWLEY. Oh, certainly. It would have an influence on the price. Bear in mind, please, sir, under the current legislation, as General Bray pointed out earlier, the law does not permit us to use the stockpile in an economic manner to influence economics. That would be disruptive in the marketplace. The law specifically precludes us from doing that.

General BRAY. Mr. Chairman, if I might respond to your question concerning economic stockpiling?

ECONOMIC STOCKPILES—A POSSIBLE SHORT RUN COUNTERFORCE AGAINST CARTEL ACTION

Chairman BENTSEN. Let me follow up on this first.

So we have a cartel. They decide they want to arbitrarily raise prices very substantially. Do you think that an economic stockpile could have some influence in trying to moderate that increase? Do you think it is a feasible thing for us to do and by feasible, let us say pragmatic or practical?

Mr. THAWLEY. Yes, it would have the effect that you are talking about. I can cite, for example, the commodity cobalt, which is largely produced in Africa, the country of Zaire, and controlled by a European cartel-like operation; we have been selling increased cobalt out of the stockpile at prices considerably below what the world price is, i.e., the cartel-like price has been.

As a result, we have captured a large percentage of the domestic market for cobalt and have displaced an equivalent amount of cobalt that otherwise would have been imported.

Chairman BENTSEN. All right, sir; proceed.

General BRAY. Mr. Chairman, I think I will go ahead and proceed on with the rest of my statement and come back to the question of economic stockpiles, if you want to later on.

Chairman BENTSEN. All right.

General BRAY. The needs of the Government for materials, particularly the Department of Defense, are given first consideration in all the disposal programs. Sales are expected to be less in fiscal year 1975, since only about $1.5 billion of surplus materials are currently authorized for sale. In addition, prices have started to decline for a number of materials.

We report to the Congress twice a year on all activities associated with the stockpile.

In addition to the Stockpiling Act, some authority for stockpiling is granted by the Defense Production Act of 1950. The Defense Production Act provides authorities for the establishment of priorities in performance of Government contracts, allocation of materials and facilities, and expansion of productive capacity and supply, whenever such actions are deemed by the President to be necessary or appropriate to promote the national defense, or when they will expedite performance of Government contracts for the national defense or otherwise aid the national defense. The act explicitly defines "national defense" to include stockpiling.

The earlier Strategic and Critical Materials Stock Piling Act of 1947 states:

> The natural resources of the United States in certain stretegic and critical materials being deficient or insufficiently developed to supply the industrial, military, and naval needs of the country for common defense, it is the policy of the Congress and the purpose and intent of this Act to provide for the acquisition and retention of stocks of these materials and to encourage the conservation and development of sources of these materials within the United States, and thereby decrease and prevent wherever possible a dangerous and costly dependence of the United States upon foreign nations for supplies of these materials in times of national emergency.

Together, these laws provide a basis for taking any necessary and appropriate actions to decrease and prevent dangerous and costly dependencies on foreign nations for supplies of essential materials required for the common defense.

Such actions might include stockpiling, expansion of domestic production capacity, development of substitute materials, and encouragement of alternate technologies.

Thus, stockpiling is only one of the methods available to us for preventing dangerous and costly dependence on foreign nations for supplies of essential resources to meet the needs of common defense.

That completes my oral statement, sir.

Chairman BENTSEN. Thank you.

Let's go back to this question of economic stockpiles. It seems to me that a new dimension has been added to the economic problems of this country, when we are facing cartels who arbitrarily exercise their control to escalate the prices on those raw materials which we have a dependency and which they have relatively close control. And they are particularly effective where they can act in concert, and where the raw material contributes to a final end product.

Now, do you feel that an economic stockpile is a practical thing? Do you think that an additional objective should be added?

BRAY UNWILLING TO PREDICT THE PRACTICALITY OF ECONOMIC STOCKPILES

General BRAY. Sir, I don't think really we know enough about all of the issues and the questions and the problems associated with an economic stockpile to make a judgment as to whether it is practical. Certainly it is feasible. Anything can be done and the degree of difficulty required to implement it, I am sure, is something that can be met and overcome.

If I might expand on this just for a moment, it appears to me there are possibly three reasons why we might consider an economic stockpile: One is to dampen price volatility, another might be to prevent cartel-type monopoly-type profits, the third one would be to prevent any sudden shutoff of materials available to us that we might need.

I think, as I say, that there are a lot of questions that require considerable more study before we can make a determination as to whether or not that really is a practical solution.

For example, we must find out how large a stockpile we need for various commodities. I am sure we have a good deal to find out. We need to know how much of a commodity we would need to stock in order to be able to dampen out price rises that cartels might provide at a particular time.

OFFICE OF PREPAREDNESS STUDYING THE IDEA OF ECONOMIC STOCKPILES

Chairman BENTSEN. Are you studying the idea of economic stockpiles at the present time?

General BRAY. Yes, sir; there are some studies underway I do not suggest that they are complete or will be all inclusive. I think this is a very broad area and one that is fairly new in our considerations.

With respect to our responsibility for managing and providing the policy for the strategic stockpile, our guidance has been—and the law, we think, very clearly states—that it is intended for common defense.

The purpose is not to provide for the sort of things that an economic stockpile would do.

Obviously, in the past we haven't devoted attention and priority to the sorts of questions that now need to be addressed.

Chairman BENTSEN. Let me ask you, since some commodity prices have fallen substantially in the last few months, are you considering buying back into some of those commodities or not?

General BRAY. No, sir; we are not for the strategic and critical materials stockpiles. Our stockpile objectives are being met now in all areas except one, which is jewel bearings, which I mentioned in my statement. However, we do have a continuing review of our stockpile objectives, Mr. Chairman, and we will modify those objectives when the factors have sufficiently changed so an increase in the objectives is appropriate. If that happened and we increased an objective beyond our current inventories, we would go back into the market to purchase items.

ADMINISTRATION SHAKY ON WHICH TOOLS CAN BE USED TO MODERATE RAW MATERIALS PRICES

Chairman BENTSEN. Do you have an alternative means of trying to insure not only an adequate supply, but at a reasonable cost, other than an economic stockpile?

General BRAY. I think I agree with the general statement that Secretary Enders made. There are tools available to us.

Chairman BENTSEN. Such as what?

General BRAY. Of the same type he mentioned through the financing arrangements and through our overall diplomatic arrangements with countries. Then particularly I might say with respect to those commodities that we felt represented a critical area with regard to national defense, we do have adequate legislative authorities and programs under the Defense Production Act, whereby we could provide loans, loan guarantees, and incentives to produce new manufacturing capabilities to expand productive capacity and supply.

So there are, I think, actions and alternatives to that sort of stockpiling, with regard to the strategic and critical portion. But, with regard to the economic portion, in order to insure, for example, that our full economy was operating and we had full employment to ensure full productive capacity of our Nation, well, the alternatives, I think, in the event of a cartel-type cutoff by nations, are generally those that Secretary Enders commented on.

Chairman BENTSEN. Approximately a year ago, the administration proposed a new level for stockpiling around $702 million, I recall. That is about one-tenth of what it was a year ago. Do you have some numbers for us, showing us the cost savings that we will have in caring for the stockpile and in the maintenance of the stockpile under these new objectives? How much money can we save?

General BRAY. Mr. Chairman, I could provide that for you. I don't have that figure right with me.

Chairman BENTSEN. Fine.

[The following information was subsequently supplied for the record:]

CONSOLIDATION PLANS FOR STOCKPILE DEPOTS

The volume of outshipments of strategic and critical materials during fiscal year 1974, fiscal year 1975, and early fiscal year 1976 will make it economically feasible to reduce stockpile depots from the present 29 GSA operated depots to 23 depot locations by the end of fiscal year 1976. In addition, ten other depot locations will be reduced to "open" storage space only, with the warehouse buildings at these locations being vacated through sale of the material and/or relocation of the material to another depot. Thirteen depots (warehouse buildings and open storage) will continue for long-term storage, although reductions in space will be made at these locations as stockpile material is attrited through sales and by consolidation, where possible.

STOCKPILE DEPOT SPACE REDUCTIONS PLANNED BY END OF FISCAL YEAR 1976

Location	Square feet	One-time consolidation cost	Annual [1] savings SLUC [2]
New Bedford, Mass	737,700	$183,000	$424,700
Belle Mead, N.J	735,500	871,000	1,085,600
Somerville, N.J	352,000	0	567,100
Binghamton, N.Y	822,600	1,174,000	1,376,200
Scotia, N.Y	300,000	0	315,900
Marietta, Pa	4,600	0	15,500
Curtis Bay, Md	200,000	0	381,600
Pt. Pleasant, W. Va	160,200	1,425,000	243,300
Gadsen, Ala	53,300	30,000	109,400
Marion, Ohio	1,161,000	1,454,000	812,700
Warren, Ohio	597,000	222,000	413,700
Sharonville, Ohio	18,300	0	12,700
New Haven, Ind	743,100	193,000	515,000
Terre Haute, Ind	86,400	48,000	59,900
Topeka, Kan	438,500	0	389,500
Baton Rouge, La	514,800	0	560,600
Total	6,925,000	5,600,000	7,233,400

[1] Annual savings beginning in fiscal year 1977.
[2] Savings based on SLUC charges after 13 percent reduction by OMB and 10 percent reduction by House action on fiscal year 1975 budget estimates.

PLANNED STOCKPILE POLICY CHANGES

General BRAY. I would think that, while it is not necessarily a proportional cost, as we reduce from larger stockpiles down to the lower levels there will be substantial savings in the cost of maintaining and caring for the stockpiles which we have on hand.

NO PURCHASE OF MATERIALS EXCEPT FOR STRATEGIC PURPOSES

Chairman BENTSEN. We have been talking about your objectives and what your charge is.

Have you in the past bought materials for the stockpile that weren't for strategic purposes?

General BRAY. No, sir, to my knowledge the law specifically reflects an intent to buy for the common defense and I know of no instance in the past that purchases have been made other than for strategic purposes.

Chairman BENTSEN. And you feel that when President Eisenhower chose to have the Government buy excess lead and zinc for the stockpile against the recommendation of the Tariff Commission at that time, that was for the common defense purpose?

General BRAY. Obviously, that was certainly considerably before my time. I am not sure I am fully aware of all of the implications and aspects of that action back at that time. The knowledge I do have of that action is that the purchases at that point of lead and zinc were to be done on established stockpile objectives, based on our strategic and critical needs at that time. Obviously, there is room for judgment and there are room for different opinions as to how you go about establishing stockpile objectives and the criteria that you need.

But my recollection, or, my knowledge of that incident is that these items were bought based upon a strategic requirement and to fill a valid, established stockpile objective.

SELLING OFF OF STOCKPILES DAMPENS PRICES—NOT THE MOTIVATION FOR THE SALE

Chairman BENTSEN. Well, in April of 1973, the President stated at that time that one of the weapons that had not been used was the selling off of the stockpiles and that it would strike a blow for the Nation's consumer.

Do we have a situation there where it is being used for economic purposes?

General BRAY. Well, with regard to the disposal of it, I believe his comment at that time certainly was talking about a reduction in the stockpile and the disposal of the materials. I think certainly it is true, as your question brought out, that disposal of commodities at a time when prices are rising does have a dampening effect to some degree, and therefore to the extent that it does provide an advantage and benefit to the consumers, yes, it does.

To that extent, the disposal of established stockpiles that were in being, once their justification for retention is no longer required for strategic purposes, obviously does have an economic aspect to it, when you get around to disposing of it, but——

Chairman BENTSEN. But, again, that might have been the primary objective of the disposal?

General BRAY. But again, I would say, sir, that does not indicate that you acquired that stockpile for that purpose, or that you maintain it for that purpose. It reflects that if your strategic requirements are lessened——

STOCKPILES—OK TO SELL FOR ECONOMIC PURPOSES; NOT OK TO BUY FOR THEM

Chairman BENTSEN. Are you implying that you can sell it for economic purposes, but you couldn't buy it for economic purposes?

General BRAY. Yes, sir, I think it can be disposed of for economic purposes, but it cannot be, by law, at least as we are operating under and as we read it, be acquired for economic purposes. It must be acquired to meet our common defense needs.

Mr. THAWLEY. I think, Mr. Chairman, the decision is in two parts: The first part was based on national security requirements of the stockpile, which was determined as the result of ongoing studies concluded in March, I think, of 1973.

Once those national security requirements were satisfied by what was in the stockpile, all the rest of the material then are idle government assets no longer needed for national security purposes, and it is up to the Congress to authorize the sale of the commodities, which they did do in prior years also, and again in 1973.

There is no basis for retaining surplus materials in a stockpile once they are determined to be so-called excess.

Chairman BENTSEN. After reading Snyder's book entitled, "Stockpiling Strategic Materials," he stated that during the Eisenhower administration, it was like a taffy-pulling contest going on over there and that you had the Interior Department in there fighting for the businesses and you had the Commerce Department on the other side trying to take care of the consumers and keep the prices low, and then you had the third party, the Defense Department fighting over there, trying to keep large stockpiles for defense purposes.

Is there any way to insulate this so that you don't have that kind of interplay? Are there any formulas that can be put in there?

HOW STOCKPILE POLICIES ARE DETERMINED—PRESSURES AND FORMULAS

General BRAY. Yes, sir, I think there are some things that can be done to prevent that, and again I am speaking of a period which I was not directly involved with. But in reading some of the documents and some of the books and some of the hearings, and particularly the Symington committee report in 1963, it did reflect sort of the same thing you reported.

There were conflicting pressures, conflicting pulls and tensions between the various interdepartmental agencies. At that time, there was a group designated as the Inter-departmental Materials Advisory Committee called the IMAC. The procedure, at that time, was to use the IMAC with analysis capability for determining what stockpile objectives for specific commodities should be.

Senator Symington, in his report of 1963, made the same point that you just made and recommended that the IMAC committees be abolished and that there be a single authority established for the purpose of establishing stockpile objectives as free as possible from these sorts of pressures.

In the spring of 1973, the IMAC was disbanded, and the procedures that are now in being reflect that the Office of Preparedness, which is my office, is charged with establishing stockpile objectives, based upon broad policy guidance which we receive from the National Security Council.

I feel that we are reasonably free from pressures, such as you have just mentioned, from the Department of the Interior and the Department of Commerce, to the extent that it probably existed in previous years and in the previous system.

Now, turning to the second part of your question, namely, is it possible to come up with a formula that is accepted, by which you can attempt to devise stockpile objectives, my answer is yes. I think there are formulas that you can use and I think—well, I don't say we have reache danywhere near the ultimate sophistication as to what these formulas are—I think we are improving on our capability to develop these formulas and techniques by which we can establish clearly valid, objective, stockpile objectives.

For example, at the present time we have, I think, a pretty good tie with the Department of Defense in how we come up with what we call the direct defense needs in a wartime scenario. We have to have firm guidance and understanding as to how large a conflict we need to plan on. I think we have good guidance as to where the conflict that we ought to plan for might take place.

Now from that standpoint, we need to try to calculate, first, what are the minimum essential civilian needs for those commodities at the time we are meeting defense needs, because certainly the defense requirements in practically any commodity are a relatively low proportion of the total requirement, seldom exceeding approximately 20 percent for direct defense needs.

So the problem is, as we do planning ahead, any planning job is trying to predict the future and seeing what would be the civilian consumption requirements for each of the 91 materials that we presently provide for in our strategic and critical materials stockpile list. That requires some pretty sophisticated modeling and development of techniques, to try to forecast really what the basic economy is going to be doing.

And as you know, that is a pretty tough task, even to look 6 months ahead to try to see what the economy is doing much less trying to look a couple or 3 years into the future. But, we are improving in our techniques. We are using now some sophisticated computer modeling. We are in contact with some of the more advanced model experts in the academic world and in the analysis world, to try to improve these sorts of things.

I could go into it further with you, but to answer your question, I think there is a way in which we can develop formulas for determining valid objectives, stockpile objectives.

SALE OF COBALT AT BELOW CARTEL PRICE HAD NO EFFECT ON THE CARTEL PRICE

Chairman BENTSEN. Did I understand you a while ago to say you sold cobalt below the cartel price? Did you say that?

Mr. THAWLEY. Yes, sir, just below the cartel price.

Chairman BENTSEN. Did it have any affect upon the cartel price?

Mr. THAWLEY. The cartel prices kept on going up.

Chairman BENTSEN. Did you sell it on auction or negotiated basis? How did you handle that sale?

Mr. THAWLEY. It was on a sealed bid basis.

Chairman BENTSEN. On a seal bid basis? And they bid below the cartel prices?

Mr. THAWLEY. We made the awards, based on those bids. That was for domestic consumption only.

Chairman BENTSEN. Well, thank you very much, gentlemen. We appreciate your testimony.

Mr. THAWLEY. Mr. Chairman, as I was leaving my office this morning, I noticed on my desk something which might be of interest and germane to your undertaking here, and that is that the Japanese Ministry of International Trade and Industry has announced that Japan plans to build up a stockpile of nonferrous metals to prevent economic confusion in case of an emergency situation. This was a press release.

Chairman BENTSEN. In other words, to build an economic stockpile?

Mr. THAWLEY. That is what this wire says.

Chairman BENTSEN. We have conflicting testimony on the advanages of economic stockpiles. There was some testimony the day before where they testified that they felt that the copper sale had little influence on prices.

Mr. THAWLEY. Had little?

General BRAY. Mr. Chairman, if I might respond?

Chairman BENTSEN. Yes.

General BRAY. I am sure you probably have had an opportunity to review it. The General Accounting Office did make a report this last spring of U.S. actions needed to cope with commodity shortages, which was a good report and tried to identify the nature of the problem and so on.

I thought, particularly in going through it, that the statement that was provided by Secretary Shultz, the assistant to the President at that time, after he had an opportunity to review the draft and comment on the report, which was included in the report, was particularly appropriate with regard to the broad subject of Government involvement in the matter of shortages.

In the final paragraph, and I might just read from it because it is very short, Mr. Shultz said:

> More important the basic primise of a government-managed system of resource allocation to deal with those actual and potential shortages needs to be clearly understood. Adoption of such an approach would constitute a fundamental change in the economic philosophy of this nation. It implies that an economy in which supply and demand are determined in a free competitive and open market is less desirable than one in which the government is relied upon to make the essential decisions concerning availability, allocation and prices * * *

Chairman BENTSEN. I think the problem, General, is that we are running into a situation where we don't have a free competitive market.

General BRAY. Yes.

Chairman BENTSEN. And that is what is concerning us. We've got ourselves in a situation where we are facing a cartel and all of a sudden the economic forces aren't working in a free market and they are giving us very arbitrary prices and prices far beyond what we would normally anticipate in a free market.

We are faced with the difficulty of individual consumers or corporations in this country that need those products for manufacturing purposes and are trying to negotiate with those cartels and what muscle do they have in that kind of a situation?

General BRAY. Mr. Chairman, I might say I fully support and agree that we need more illumination of this subject. We need more study of it. We need a debate on it. I think I agree completely with the problem that you have outlined. It looks like we may well face some problems of this nature.

I am just convinced we are not yet aware of the full extent of all of the problems and all of the issues and all of the ramifications and that a good public debate and a little illumination I think cannot but be helpful and useful. I certainly think that the congressional determination as to whether or not we want an economic stockpile should be a matter of formal review and formal legislation rather than an assumption or interpretation of the current legislation dealing with strategic materials for defense as though we have adequate authority to proceed already into an economic stockpile situation.

RAW MATERIAL STOCKPILES—AN UNANSWERED QUESTION

Chairman BENTSEN. I think one of the other problems you run into, General, is in trading with a totalitarian government. And when you are talking about that, you have a much different situation than trading with a democracy, because whereas we say that you can't export this or that, their situation is that you have to have an affirmative act by their government before something can be exported. There is a great deal of difference in that. We have a situation here where one of our major companies may decide it is not economical for them to be exporting this and that because they don't make a profit in selling it, but there may be 12 other companies in this country that think they can make a profit. But in a totalitarian government, when they decide, then it is cut off entirely. So you have a very disruptive trade pattern with them.

General BRAY. We need to address questions like how well would an economic stockpile function? How effective would it be? How large would it be? What are the costs? What are the factors involved in determining that? We also need to determine I think, as you just pointed out, how valid really is the need for economic stockpiling? Certainly there is a need for something. Whether or not there are other alternatives to economic stockpiling and what are the other nations doing, I think need to be answered.

I think we need a study and review.

Senator BENTSEN. Thank you, gentlemen, for your attendance today.

General BRAY. Thank you, Senator, for inviting us.

Chairman BENTSEN. Finally we have Mr. Thomas V. Falkie, Director, Bureau of Mines, Department of Interior. Sir, will you please proceed.

STATEMENT OF HON. THOMAS V. FALKIE, DIRECTOR, BUREAU OF MINES, DEPARTMENT OF THE INTERIOR, ACCOMPANIED BY JOHN D. MORGAN, JR., ASSISTANT DIRECTOR, MINERAL POSITION ANALYSIS; AND SHELDON P. WIMPFEN, ASSISTANT DIRECTOR, MINERAL SUPPLY

Mr. FALKIE. I have with me today, Mr. John D. Morgan, Jr., who is our assistant director for Mineral Position Analysis and Mr. Sheldon P. Wimpfen, who is our assistant director for Mineral Supply.

The problems associated with energy which were called to our attention most forcibly by the Arab embargo in 1973 have raised several questions concerning not only energy but also other materials, both of mineral and agricultural origin. As Director of the U.S. Bureau of Mines and as a representative of the Department of the Interior I am going to confine my discussion to matters concerning minerals, because minerals have been of prime concern to the Department of the Interior and to its various agencies for more than 100 years.

To give this subcommittee an idea of the overall role of minerals in the economy, we have prepared a series of charts to which I am going to refer. These charts are included in the record at the end of my prepared statement and I will refer to them as we proceed.

Figure 1[1] details our current use of minerals on a weight basis. Over 40,000 pounds of new mineral materials are required annually for each U.S. citizen, about equally divided between energy minerals and other minerals. The total annual use of new minerals in the United States exceeds 4 billion tons.

Figure 2[2] details the extensive usage of our transportation net by minerals. On a tonnage basis minerals account for: 90 percent of all water-borne imports, 50 percent of all water-borne exports, 85 percent of all domestic water-borne commerce, 70 percent of domestic rail traffic, and 100 percent of all pipeline traffic.

Consequently, while transportation matters are not the primary responsibility of the Department of the Interior, we nevertheless are concerned with needs for deepwater ports, improvement of our rail transportation system, and encouragement of new and improved forms of transportation, as for example, coal slurry pipelines.

If you refer to figure 3,[3] it details the role of minerals in the U.S. economy from the standpoint of value at different stages from mining through processing. Domestic mineral raw materials in 1973 were valued at approximately $35 billion. These domestic mineral raw materials were supplemented by imports valued at $7 billion. The total supply of mineral raw materials was then utilized by the mineral processing and energy generation industries to produce energy and mineral-based materials valued at $175 billion. At this stage of processing imports in 1973 supplied processed mineral materials valued at $12 billion. Exports of both raw and processed minerals in 1973 were valued at about $11 billion and old mineral scrap valued at $4 billion was reclaimed and recycled in 1973.

IMPACT OF HIGHER RAW MATERIALS PRICES ON GENERAL PRICE LEVEL UNCERTAIN—SAYS FALKIE

Chairman BENTSEN. Let me interrupt you at that point so I can get back to a question I have been trying to get resolved of several witnesses.

You say that the value of energy and raw materials, including imports, is estimated at $42 billion in 1973 or about 3.3 percent of the GNP and of this imports were only $7 billion or less than 1 percent. Now what do these small fractions indicate? If you have significant price increases, what does it actually mean in the way of the end products in this country? How much does it actually increase prices percentagewise in this country? Is it significant?

Mr. FALKIE. Obviously various minerals and materials will have different values so the effect of any one can range anywhere from a relatively small amount to a fairly significant one depending on——

Chairman BENTSEN. Of total imports, less than 1 percent of GNP you say?

Mr. FALKIE. Right. I think this is the reason why we like to discuss the value of the processed materials of mineral origin as being $175 billion, which in essence is some 15 percent of the——

[1] See fig. 1, p. 415.
[2] See fig. 2, p. 416.
[3] See fig. 3, p. 417.

Chairman BENTSEN. What does that have to do with it? Let's say you double the price of the imported materials and get up to 1.2 percent of GNP and never mind the processing—now how does that increase the end product?

Mr. FALKIE. Well of course I think it is dangerous to use average figures, Senator. I think in some particuar instances, the doubling can be significant in terms of certain commodities. This could cause perhaps dislocation in specific localities or by areas of the economy that could be significant.

Chairman BENTSEN. I understand that I am taking a rather simplistic approach to it but when such a relatively small percentage is involved—well, it is just difficult to see it translating into something of great magnitude in the way of price increase in the end product.

Mr. FALKIE. I think that what we are missing here is the realization that the mineral raw materials are basic in the same sense that agricultural raw materials are basic to our way of life, even though we are rapidly developing substitutes and developing recycling technology. I think that the general public sometimes fails to realize that minerals are basic and that just about everything in this room for example are made with or from mineral materials and——

Chairman BENTSEN. I really think that the fact that it's basic, if it is still that small a percentage, then it is difficult to see—except for one thing and here is the point I was hoping you might make that I think is material—to see this. If you still have to depend on foreign production for a percentage of it to meet the demand in this country and if that is curtailed or dramatically changed in price, then often the domestic price will rise to meet it, correct?

Mr. FALKIE. Precisely.

Chairman BENTSEN. And therefore then you get your escalation in price. Is that a fair statement?

Mr. FALKIE. In some cases that could occur.

Chairman BENTSEN. Well what if you have a shortage of supply, an excess of demand, and that small percentage that it takes to make it up, to make it equate, is escalated materially in price. Now doesn't the domestic price rise to meet it normally.

Mr. FALKIE. I would think as a general statement that could be true, Senator, yes.

Chairman BENTSEN. I bet you it does without price controls. Go ahead.

Mr. FALKIE. Figure 4 [1] details the rise in world steel production over the past two decades. Steel, as you know, is one of the major nonfuel mineral materials and many other mineral commodities are used in more or less direct proportion to steel production. Consequently, the demand for minerals is closely attuned to the tempo of steel production, which in turn is closely attuned to overall industrial activity. It is significant to note that, as shown by Figure 4,[1] steel production in most major producing areas peaked simultaneously in 1973, thus contributing to heightened worldwide demand for most mineral commodities.

[1] See fig. 4, p. 418.

While world demand was peaking in 1973 and early 1974, there was extensive speculation in raw material commodity markets and the U.S. economy was being operated under price controls. Price controls increased domestic demand and inhibited expansion of domestic sources of supply. Consequently, in 1973 and early 1974, as a combined result of high demand, high levels of speculation in mineral commodity markets, and domestic price controls, many problems developed relating to material shortages for: steel, copper, lead, zinc, aluminum, platinum group metals, fertilizers, explosives, and such things as roof bolts for coal mining, to say nothing of shortages of energy materials and derivatives thereof such as petrochemicals. However, at mid-1974 there appeared to be some easing of material shortages resulting from lower demand, apparently reduced levels of speculation, and the April 30, 1974, termination of the Economic Stabilization Act, which allowed domestic raw material commodity prices to rise, thereby reducing some of the excess demand while also stimulating supplies, and I think that is what you were referring to previously. As a result, domestic producer prices and metal exchange prices have come closer together. This situation is an indicator of more stability for raw material commodity markets and should make access to mineral commodities easier for consumers of raw materials.

Figure 5 [1] details mineral imports and exports in 1972 and 1973, along with our estimate for 1974 based on actual data through May of this year. The 1974 increase in imports of raw and processed minerals to an estimated $35 billion is attributable in large measure to increased costs of imported fuel minerals, and these import values are probably conservative in that they are based on published f.o.b. data and do not include the insurance and freight costs involved in delivery to U.S. ports. Of course, exports of agricultural and mineral commodities and manufactured goods and services, as well as floating exchange rates and capital flows help the United States to pay for needed imports of minerals. Exports of raw and processed minerals in 1974 are now estimated at $17 billion. You can see the difference between the exports and imports is projected to be some $18 billion. We understand that the overall balance of U.S. trade shows a projected surplus in 1974.

In Figure 6 [2] we detail the great increase in U.S. production and use of plastics over the past two decades. Plastics have become major substitutes or alternates in a number of applications where formerly metals were used. Our current domestic use of 12 million tons of plastics is greater than our combined use of aluminum, copper, lead, and zinc. In fact, because plastics are so much lighter than metals, on a volume basis the use of plastics in the United States is a substantial substitute or alternate material for steel itself. Plastics are made almost wholly from petrochemicals, and the recent rises in petroleum prices have made such materials more costly. The Bureau of Mines for several years has devoted research efforts not only to ways of producing more oil and gas through secondary and tertiary recovery, and to making chemicals from coal, oil shale, and tar sands, but also to ways to improve the recovery of waste plastic materials and to recycle them so as to contribute to increased plastic supplies, conservation of energy, and lessened environmental degradation.

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[1] See fig. 5, p. 419.
[2] See fig. 6, p. 420.

Figure 7 [1] details a number of key minerals commodities for which the United States is dependent upon imports for significant percentages of total supplies. Concern has arisen as to the possibilities of OPEC-like actions on the part of other raw material producing nations, although the diversity of suppliers, the needs for continuity of income to low-income producing nations, the postponability of some demands in the industrialized nations, and the possibilities of substitutions are factors which would appear to make OPEC-like actions more difficult and less serious than was the case with respect to petroleum. The potentials for problems were recognized, however, and the President, in his January 1974, State of the Union Message, said:

> It is also imperative that we review our current and prospective supplies of other basic commodities, I have therefore directed that a comprehensive report and policy analysis be made concerning this crucial matter so that government actions can properly anticipate and help avoid other damaging shortages * * *

and in his February 1974, Budget Message he said:

> The adverse impact of energy shortages on the economy could be aggravated by shortages of other raw materials. A comprehensive study on supplies of metal ores and other basic resources and our needs for them is now underway. This study will help insure that our policies properly anticipate problems.

The study directed by the President has been underway for several months under the leadership of the Office of Management and Budget. The Bureau of Mines has contributed extensively to the fundamental information on mineral commodities required as part of the study. We provided basic information on domestic production, imports and sources thereof, recycling, uses, possibilities of substitution, possibilities of domestic expansion, and domestic and world reserves. Much of the basic information supplied by the Bureau was essentially the same as that contained in the recent publication "Commodity Data Summaries—1974",[2] copies of which—the orange-color booklet are available here today for the use of this subcommittee. Because the study initially ordered by the President is now being reviewed at higher echelons of the executive branch, it would be inapproppriate for us to comment at this time as to the details thereof or to speculate what conclusions might be reached therein. Nevertheless, we understand that this subcommittee wishes some insights at this time into the current major problems affecting U.S. mineral supplies and the possibilities of increasing domestic production, and we shall endeavor to discuss this in broad outline.

By and large the United States is blessed with abundant material resources but it is important to realize to what geologists, mining engineers, and metallurgists refer when they use the broad term "resources." "Resources" are natural concentrations of raw minerals in the crust of the Earth, whether solid, liquid, or gas, or in the waters of the Earth, or in the Earth's atmosphere. There are a few materials, notably: antimony, asbestos, chromium, strategic mica, and tin, for which United States resources, based on present knowledge, are deemed to be small or insignificant. Consequently, broadly viewed, our primary concern is not with inadequacy of resources but rather that we must improve our technology to convert the raw rocks, soils, and fluids of

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[1] See fig. 7, p. 421.
[2] See "Commodity Data Summaries—1974," beginning on p. 208.

the Earth into energy and processed mineral materials useful to man, while at the same time safeguarding the environment and meeting health, safety, sociologic, aesthetic standards, and doing so economically to the extent that investment in domestic mineral industries appears attractive to venture capital.

In much of the two decades following the Korean war period many materials were available from foreign sources at prices which discouraged development of domestic mineral industries and encouraged many U.S. firms in the mining and mineral business to expand their foreign operations. Now, however, consumers of mineral materials are finding that foreign nations properly wish to reap the benefits of the value added by manufacturing. Thus, for example, foreign nations would prefer to produce alumina, rather than bauxite. If possible, and where they have access to energy sources, they will seek to produce aluminum metal rather than alumina. And once they produce aluminum metal, they will not wish to export it in pig form, but will rather seek to manufacture and ship products such as tubing, siding, girders, pots, pans, et cetera. The same trends are obvious in almost all materials. Further, it is important to remember that the U.S. population of some 212 million people is only about 6 percent of the total world population. Consequently, as the other 94 percent of the people in the world strive for higher material standards of living, mineral raw materials and manufacturers thereof increasingly will find attractive markets in many parts of the world.

Our job is to assure that, in line with the Mining and Minerals Policy Act of 1970, the Government is equipped to provide an overview of national materials needs and direction as to how those needs must be met. It must complement industry's basic responsibility and efforts to develop our natural resources to meet those needs, while at the same time assuring that other public goals such as environmental protection and national security, are served. In this activity government, industry, and educational institutions must play increasingly interactive roles, because no one of these has sufficient knowledge and authority to arrive at significant improvement alone. If these efforts are successful, improvements can be expected in the whole mineral cycle: exploration, mining, mineral beneficiation, energy generation and conversion, metallurgy and ceramic technology, making special alloys and composite materials, designing goods for longer life and ease of recycling, recycling of agricultural, urban, and industrial wastes, and reclamation of mined lands.

And as we pointed out earlier in this statement, the large volumes of mineral materials involved in our national economy require improved transportation, including: deepwater ports, harbors and transfer facilities, railroads, international waterways, and pipelines.

We can assure you that the above considerations are paramount not only in the Bureau of Mines but also in the Geological Survey, the Office of Coal Research, the Mining Enforcement and Safety Administration, and the other agencies of the Department of the Interior primarily concerned with minerals.

Chairman BENTSEN. Why don't we take the statement you have here and put it in the record and you can skip that?

Mr. FALKIE. Thank you, we will put the prepared statement in the record.

Secretary Morton concluded that he "chose to be optimistic," and we are now devoting our best efforts to solving these problems by making maximum effective use of the increased funding that the President requested and that the Congress has supplied for our mineral research and information collection and analysis activities in fiscal year 1975. We are intensively reviewing our current mineral research activities, our mineral lands utilization policies, and our mineral data collection and analysis, and we plan to propose improvements. The Department of the Interior intends to discharge effectively and efficiently its responsibilities under the Mining and Minerals Policy Act of 1970 and other pertinent mineral legislation.

[The publication referred to in Mr. Falkie's oral statement follows:]

COMMODITY DATA SUMMARIES

1974

Appendix I
to
Mining and Minerals Policy

Third Annual Report of the Secretary of the Interior under the Mining and Minerals Policy Act of 1970

This report is the earliest Government publication to furnish coordinated estimates covering 1973 mineral industry data. These data sheets contain information on the domestic industry structure, Government programs, tariffs, and salient statistics for 95 individual minerals, metals, and fuels. World resource data appearing in the statements have been provided by the Geological Survey.

Appendix I to Mining and Mineral Policy—1974 (the third annual report of the Secretary of the Interior under the Mining and Minerals Policy Act of 1970) is published in advance of the "Third Report" and in combination with the Bureau of Mines "Commodity Data Summaries" in order to present 1973 mineral data on a timely, though preliminary basis.

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ALUMINUM 1/
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: Twelve companies operated 31 primary aluminum reduction plants, three firms accounting for 66% of production. Washington, Oregon, and Montana accounted for 32% of the total production; Gulf Coast States, 25%; Northern States, 29%; and other Southern States, 14%. Output of primary metal in 1973 was valued at $2.2 billion. About 80% of the secondary recovery was from new aluminum base scrap and 20% was from old scrap. Aluminum consumption by 25,000 firms was centered in the East Central United States. Of aluminum consuming industries in 1972, building accounted for 28%; transportation 19%; electrical, 13%; packaging, 16%; and consumer durables, 10%.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Primary	3,793	3,976	3,925	4,122	4,500
Secondary	901	781	813	946	1,150
Imports for consumption	558	468	690	794	600
Exports	575	612	293	329	550
Apparent consumption	4,710	4,519	5,074	5,588	6,600
Price: Ingot, average (cents per pound)	27.2	28.7	29.0	26.3	25.2
Stocks: Aluminum industry (end of year)	1,875	2,200	2,510	2,402	2,200
Employment: Primary reduction	21,000	21,000	19,000	22,000	23,000
Secondary smelters	4,000	4,000	3,800	4,100	4,200

3. Import Sources (1969-72): Canada 76%, about 30 other countries, 24%.

4. Tariff:

	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Unwrought (in coils)	618.01	1.2¢/lb.	7¢/lb.
Unwrought (other than aluminum silicon alloys)	618.02	1.0¢/lb.	4¢/lb.
Wrought (bars, plates, sheets, strip)	618.25	2.0¢/lb.	7¢/lb.

5. Depletion Allowance: Not applicable.

e/ Estimate.
1/ See also Bauxite.
Prepared by J. W. Stamper, telephone (703) 557-0998.

6. Events, Trends, and Issues: Aluminum demand in the United States increased 18% in 1973. World demand also increased dramatically and aluminum was in tight supply in virtually all major consuming countries during most of 1973. Electric power shortages retarded production in the Pacific Northwest, however, domestic output of primary aluminum of 4.5 million tons was a new record. Sales of an estimated 815,000 tons of metal from the Government stockpile helped avert a more serious domestic supply problem.

Under price controls the domestic price for primary aluminum from large producers remained at 25 cents per pound throughout most of 1973, but on December 6, the Phase IV base price for aluminum was increased to 29 cents per pound and the domestic industry raised the price to that level. Prices in other major world markets approached 27.5 cents per pound in midyear and by September were reportedly in the 30 to 35 cents range.

Partly as a result of the strong world demand and the high world price, relative to that in the United States, exports of aluminum metal in 1973 increased about 65% while imports decreased by about 25%. However, over the long run the United States is expected to continue to be a net importer of aluminum metal.

Aluminum demand through 1980 is expected to increase at an annual rate of 6.5%. About 90% of future metal requirements could be produced at domestic plants (based largely on imported bauxite and alumina--see Bauxite). Copper can be used in place of aluminum in many electrical applications but at higher costs. Magnesium and titanium may be substituted for aluminum in many structural applications, but, again, at higher costs. Steel may be used in place of aluminum where weight savings are not important.

A 15,000 ton-per-year experimental aluminum plant was under construction that will use a new process based on electrolysis of aluminum chloride. The plant is scheduled to begin operations in 1975 utilizing 30% less electric power than current processes.

Nationalization of important non-U.S. owned bauxite mines and processing facilities in Guyana in 1971 foreshadows an increase in the domestic costs of aluminum raw materials and other possible constraints to domestic aluminum supply if other bauxite and/or alumina producing countries take similar actions.

7. Government Programs: The Bureau of Mines has research underway on extracting aluminum from domestic clays.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Aluminum	-	469	469	19	794

8. World Mine Production and Reserves:

	Production 1972	Production 1973 e/	Capacity e/
United States	4,122	4,500	4,862
Canada	1,020	1,100	1,210
France	433	370	463
Germany, West	490	600	729
Japan	1,119	1,400	1,638
Norway	604	670	809
Other Free World	2,320	2,660	3,068
Communist countries (except Yugoslavia)	1,995	2,100	2,274
World Total	12,103	13,400	15,053

9. World Resources: Long term domestic aluminum requirements cannot be met by domestic resources of bauxite, the commercial source of aluminum. However, potential resources of aluminous materials are abundant and could meet domestic aluminum requirements indefinitely. World reserves of bauxite contain about 3.6 billion tons of aluminum and are sufficient to meet forecast world demand through 2000.

January 1974

4

ANTIMONY

(Data in thousand short tons of metal, unless noted)

1. Domestic Production and Use: One company mined and recovered antimony electrolytically as a byproduct of lead-silver ores in 1972 and two small mining operations produced antimony ore and concentrate. Three companies recovered byproduct antimony from processing intermediate smelter products derived from domestically-produced lead ore. Such byproduct antimony was approximately 7% of the 1972 smelter output. Eight companies recovered antimony or antimony oxide from imported ores and concentrates (92%) and domestic sources (8%). Approximately 100 companies, centered in the industrial belt of the Eastern United States, accounted for about 90% of the total consumption of primary antimony. The major uses of antimony in 1972 were: Transportation equipment, 47%; rubber products, 7%; fire retardants, 8%; and ceramic and glass, 6%.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Mine	938	1,130	1,025	489	650
Primary plants	13,203	13,381	11,374	13,344	14,000
Secondary plants	23,840	21,424	20,917	22,428	22,700
Consumption 1/	41,683	35,361	34,624	38,652	39,500
General imports	17,032	18,654	13,595	23,743	19,000
Exports	207	543	1,023	121	500
Price: Average, cents per pound	57.57	144.19	71.18	59.00	67.00
Stocks	6,339	8,847	8,637	8,622	8,500
Employment: Plant e/	60	80	80	80	80

3. Import Sources (1969-72): Metal--Mexico 18%, People's Republic of China 16%, Japan 13%, United Kingdom 13%, Other 40%.
Ore and concentrate--Republic of South Africa 51%, Mexico 20%, Bolivia 17%, Other 12%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Statutory
Ore	601.03	Free	Free
Liquated	603.10	0.1¢/lb.	0.25¢/lb.
Metal, unwrought	632.02	1.0¢/lb.	2¢/lb.

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate.
1/ Consumption of antimony derived from both primary and secondary sources.
Prepared by C. Wyche, telephone number (703) 557-0241

6. Events, Trends, and Issues: U.S. mine production increased 33% in 1973. Production would have been higher except for a 4-month strike at a Kellogg, Idaho, producer.

Two price increases during the year encouraged mine development, and one company began engineering studies in connection with possible development of a large antimony deposit in Idaho.

Demand for antimony is expected to increase at an annual rate of about 4% through 1980. The fastest growing area for antimony was for flame retardants and promulgation of new Federal flame retardancy standards will help keep this demand growing. Since domestic output already is far below demand, antimony oxide producers will have to increase their imports of finished oxide, crude oxide, and ore. Availability of supply could be influenced by the political atmosphere of the few supplying countries.

In addition to imports, a large portion of 1973 demand was supplied by sales of about 6,000 short tons of antimony by General Services Administration. These sales exhausted that portion of stocks which Congress authorized General Services Administration to sell.

Substitution of other metals for antimony can be made in many applications. Titanium, chromium, and zirconium can displace antimony in paints, pigments, and enamels. Tin, calcium, and dispersion hardened lead are substitutes for antimony in the hardening of lead. Inorganic compounds such as titanium dioxide or iron oxide in combination with antimony oxide are accepted alternative materials in flameproofing.

Environmental problems such as gases, fumes, and dust, associated with roasting of antimony ores and reprocessing of scrap are controlled at the large plants.

7. Government Programs: Exploration assistance for antimony continued under Office of Minerals Exploration and Government participation remained at 75%.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Antimony	-	40,700	40,700	-	5,816

8. World Mine Production and Reserves:

	Mine Production 1972	Mine Production 1973 e/	Ore Reserves
United States	489	650	100,000
Bolivia	14,472	15,000	400,000
Mexico	4,700	4,800	200,000
South Africa, Republic of	16,062	18,000	300,000
Yugoslavia	3,171	3,400	100,000
Other Free World	14,781	14,800	700,000
Communist countries (except Yugoslavia)	21,360	22,000	2,200,000
World Total	75,035	78,650	4,000,000

9. World Resources: United States resources are mainly in Idaho, Nevada, Alaska, and Montana; principal identified world resources, estimated at 5,600,000 short tons, are in China, Bolivia, U.S.S.R., Republic of South Africa, and Mexico. Future antimony resources may be developed from Mississippi Valley-type lead deposits and from certain base metal deposits in the Eastern United States. The possibility of future production from these sources will hinge on the ability of lead smelters to meet standards set to protect the environment and continue operations.

6

ARGON
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: In 1972 argon production increased 26% to 197 thousand short tons, all a byproduct of the oxygen produced in air-separation plants. Nitrogen is usually a coproduct of oxygen, and occasionally xenon, krypton, and neon are byproducts. Of the 117 large oxygen plants reported operating in 1972, 52 plants in 26 States produced argon. The three large industrial gas companies that dominate the oxygen market produced about 90% of the argon. Argon, in a stream tapped from an oxygen distillation column, was concentrated on the site to crude argon. It was further refined in suitable plants; some argon refining plants treated crude argon from several oxygen plants. All argon sold in 1972 was of a purity of at least 99.996%. The greater part was delivered to the consumer as a liquid in insulated tank trucks or railroad cars; smaller requirements were met by shipments of compressed gas in cylinders, i.e. on "tube trailers" (nests of tubes).

Argon, being chemically inert, was chiefly used to exclude air from various industrial processes. Thus 75% was used in gas shielded-arc welding of fabricated metal products; examples of other such uses were blanketing of corrosive uranium hexafluoride in the gaseous diffusion process for uranium refining, refining of stainless steel, and production of titanium by reduction with magnesium. Argon was also used to mix, stir, and atomize metals, and to fill electric light sources.

Helium can replace argon in many uses, but is much more expensive. Argon itself is replacing carbon dioxide in gas metal-arc welding (i.e. gas shielded-arc welding with a consumable electrode). The other inert gases, krypton, xenon, and neon, are also too expensive to replace argon, and are not available in quantity.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production	134	142	156	197	218
Imports	-	-	-	-	-
Exports	-	-	-	-	-
Consumption	134	142	156	197	218
Price: (average, dollars per short ton, cylinder (gas) and bulk (liquid))	288	276	185	168	170
Stocks	-	-	-	-	-
Employment		Not	available		

3. Import Sources (1969-72): None.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Statutory
Other physical elements in any physical form (includes argon)	415.5000	5% ad valorem	25% ad valorem

5. Depletion Allowance: None.

e/ Estimate

Prepared by W. F. Keyes, telephone number (703) 557-0495

6. Events, Trends, and Issues: In 1973 argon production was running 10 to 15% above 1972's record rate, reflecting still higher utilization of argon refining plants; these plants had been purposely built with excess capacity, compared with crude argon capacity. The ultimate limit on argon production is set, by the ratio of argon to oxygen in air, at about 6% of oxygen production; this would be over 800,000 tons a year at present, or four times present argon production. Thus even a major expansion in argon demand could be met by building refining capacity.

Demand for argon in the manufacture of heavy machinery will probably increase greatly as new nuclear and fossil fuel plants are built. Coal gasification plants will require large amounts of oxygen; byproduct argon will therefore be available in any amount needed. Argon demand through 1980 should increase at 10 to 15% a year.

7. Government Programs: None.

8. World Production and Reserves:

	Production		Reserves
	1972	1973 e/	
United States	156	197	
West Europe	105	114	
East Europe	43	50	
Japan	33	30	Unlimited
Canada	8	8	
Other	10	9	
World Total	355	408	

9. World Resources: Argon is not consumed in any of its uses, and returns to the atmosphere after use. Resources are therefore unlimited.

8

ARSENIC

(Data in short tons of white arsenic (As_2O_3), unless noted)

1. Domestic Production and Use: The entire output of arsenic is derived as a byproduct of copper refining. Production and shipments in 1973 were from one plant in Tacoma, Washington. There is no secondary arsenic industry. There are no data on consumption. Major uses were in the manufacture of agricultural chemicals (pesticides), 70%; glass and glassware, 20%; and industrial chemicals, copper and lead alloys, and in pharmaceuticals, 10%.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production (output all byproduct):					
Refinery - white arsenic	Company confidential data				
Imports for consumption:					
Metal	346	456	536	661	650
White arsenic	18,171	18,763	17,306	13,613	10,000
Exports	None				
Apparent consumption	Company confidential data				
Price: Cents per pound 1/	6.25-6.75	6.25-6.75	6.25-6.75	6.25-6.75	6.25-6.75
Stocks, yearend: Producer	Company confidential data				
Employment: Smelter	Not available				

3. Import Sources (1969-72): Sweden 43%, Mexico 40%, France 15%, Other 2%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Metal	632.04	1.2¢/lb.	6¢/lb.
White arsenic	417.62	Free	Free

5. Depletion Allowance: 14% (Domestic), 14% (Foreign).

e/ Estimate. NA Not available.
1/ Powdered, in barrels.
2/ Company confidential data.
Prepared by Gertrude N. Greenspoon, telephone number (703) 557-0224.

6. Events, Trends, and Issues: The one copper plant producing arsenic operated throughout the year. Arsenic occurs as a minor constituent of certain complex ores valued mainly for copper, gold, and lead. Thus, its production potential relates to the metallurgical processing of these ores. The technology of recovering byproduct arsenic and its marketable compounds is complicated and relatively inefficient. Conservation and processing are therefore largely dependent on production economies and market outlook.

More than half of the domestic demand is met by imports, some of which materializes in the domestic treatment of foreign base-metal ores. World availability of arsenic exceeds demand. Consumption of arsenic has been inhibited by alternate materials (synthetic organic pesticides) gaining a larger share of the growing market for pesticides, its principal use. However, worldwide expansion in agricultural production generates a growing demand for effective pest control, and some pesticidal chemicals are likely to be used for many years. Demand for arsenic is expected to increase at an annual rate of about 2.5% through 1980.

The price of refined white arsenic, 99.5% at New York docks, in barrels, small lots, has been unchanged at 6-1/4 to 6-3/4 cents per pound since July 6, 1968. This quotation held through March 8, 1973; thereafter, quotations were listed as nominal.

Owing to the byproduct relationships of arsenic, the expanding production of other metals has caused supply to exceed demand with resulting marketing problems as well as problems of storage and disposal of metallurgical segregates.

As one of the contaminants in smelter stack gases, elimination of arsenic is a component of the major problem of minimizing air pollution. The toxic properties of arsenical compounds constitute a hazard to livestock and water supplies and comprise a limiting factor in usage.

7. Government Programs: Arsenic is not a stockpile item.

8. World Production and Reserves (white arsenic):

	Mine Production		Reserves
	1972	1973 e/	
United States	(2/)	(2/)	2,500,000
France	11,000	10,000	600,000
Mexico	6,523	6,000	1,000,000
South-West Africa	4,400	4,000	NA
Sweden	17,600	17,000	NA
Other Free World	2,565	2,500	NA
Communist countries (except Yugoslavia)	7,940	8,000	NA
World Total	50,028	47,500	5,500,000

9. World Resources: World resources are equivalent to 25,300,000 short tons of white arsenic. Hypothetical resources of arsenic for the United States and the world are estimated to be 1,750,000 tons and 22,000,000 tons As_2O_3, respectively. Speculative resources of white arsenic may be about 13,000,000 tons.

January 1974

ASBESTOS
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: No one firm was the major producer as seven firms produced asbestos fiber. Production was valued at $13.4 million in 1972 and was centered in California, Vermont, Arizona, and North Carolina. Consumption of asbestos products, gaskets, and insulation by approximately 400 firms was centered in the Eastern States. Major end uses of asbestos in percent were: Construction cement products, 42; floor tile, 11; paper products, 9; transportation (brake linings and clutch facings), 10; asphalt felts, 6; packing and gaskets, 4; insulation, 2; textiles, 1; and other, 15.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production (sales): Mine	126	125	131	132	151
Imports for consumption	695	649	681	736	779
Exports	36	47	54	59	59
Apparent consumption	784	728	759	809	871
Value: Average, per short ton, f.o.b. mine	$85	$85	$93	$102	$109
Stocks: Consumer	23	22	30	46	35
Employment: Mine and mill e/	380	440	375	400	400

3. Import Sources (1969-72): Canada 96%, Republic of South Africa 3%, Other 1%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Asbestos	518.11	Free	Free

5. Depletion Allowance: 22% (Domestic), 10% (Foreign).

e/ Estimate.

Prepared by R. A. Clifton, telephone number (703) 557-0580.

6. Events, Trends, and Issues: The year 1973 was record-setting for both domestic production and consumption. The 8% increase in apparent consumption, which was aided by the continued construction boom, is not expected to last. Demand for asbestos is expected to increase at an annual rate of about 4% through 1980. The lack of acceptable substitutes is highlighted by the 1973 increase despite dust control enforcement and adverse health publicity.

Plant effluent guidelines for a portion of the asbestos products industry were promulgated by the Environmental Protection Agency. The controversial Lake Superior pollution case reached the courts in 1973.

7. Government Programs: The Government grants loans through the Office of Minerals Exploration up to 50% of approved costs for exploration of eligible asbestos deposits. Included in the data shown below is 1,578 tons nonstockpile grade chrysotile.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Chrysotile (short tons)	1,100	10,455	9,355	-	-
Crocidolite (short tons)	-	15,877	15,877	15,877	3,820
Amosite (short tons)	-	58,025	58,025	39,625	20

8. World Mine Production and Reserve:

	Production 1972	Production 1973 e/	Reserves
United States	132	151	10,000
Canada (shipments)	1,688	1,857	144,000
South Africa, Republic of	356	374	23,000
Other Free World	437	459	48,000
Communist countries (except Yugoslavia)	1,568	1,646	104,000
World Total	4,181	4,487	329,000

9. World Resources: Resources of chrysotile asbestos fiber in deposits in the United States include 6 million short tons of identified resources and another 3 million short tons of hypothetical resources. The rest of the world has another 92 million short tons of identified resources. The worldwide hypothetical resources are 50 million short tons which gives 151 million short tons as a planning figure for world asbestos resources.

BARITE
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: Approximately 30 mines in 7 States produced barite in 1972, 88% of the production coming from Alaska, Arkansas, Nevada, and Missouri. The 5 leading firms produced 80% of the total output. The producers of barite sold or used 906,000 tons valued at $14.9 million. Approximately 80% of barite produced was used as a weighting agent in oil- and gas-well drilling muds. Other uses for barite included applications in paints, glass, rubber, and in the production of barium chemicals.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Mine 1/	1,077	854	825	906	963
Imports for consumption (crude barite)	614	706	484	624	700
Exports (ground and crushed)	NA	63	24	52	83
Apparent consumption (ground and crushed)	1,605	1,410	1,355	1,477	1,525
Price: Per ton, f.o.b. mine (av.)	$14.63	$14.98	$16.35	$16.43	$15.68
Producer stocks	Not available				
Employment: Mine and mill	1,250	1,250	1,025	1,025	1,025

3. Import Sources (1969-72): Peru 24%, Ireland 24%, Mexico 20%, Canada 12%, Other 20%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Crude barite	472.10	$1.27/long ton	$4.00/long ton
Ground barite	472.12	3.25/long ton	7.50/long ton
Blanc fixe	472.14	.30¢/lb.	1.25¢/lb.

5. Depletion Allowance: 14% (Domestic), 14% (Foreign).

e/ Estimate. NA Not available.
1/ Sold or used by producers.

Prepared by Frank B. Fulkerson, telephone number (703) 557-1955.

6. Events, Trends, and Issues: Mine production of barite in Nevada was greater in 1973 than in 1972. Missouri mine production was held back by environmental constraints. In Arkansas a large mine was closed because of uneconomic operations. Imports were up despite higher ocean freight rates. The United States is the world's largest barite consumer, and while it produces about 22% of the world's output, it is still a large importer. Consumption is a direct factor of the need for weighted muds in oil- and gas-well drilling, with about 80% of the demand stemming from these activities. Resources are abundant and widely distributed. The relatively low cost and technical advantages of barite preclude the employment of other minerals as substitutes in the drilling mud market. Based on the past trend, demand for barite is expected to increase at an annual rate of about 2% through 1980. Transportation cost from domestic mines to the gulf coast, the principal consuming area; the availability of imports; and the low growth rate of barite demand are factors that have affected the development of U.S. barite resources. The principal environmental problem is the normal land disturbance generally associated with mining. Grinding plants generate dust that can be collected by air-pollution control equipment.

7. Government Programs: None.

8. World Mine Production and Reserves:

	Production		Reserves
	1972	1973 e/	
United States 1/	906	963	75,000
Canada	73	75	4,000
France	121	125	4,000
Germany, West	406	410	7,000
Greece	94	110	4,000
Ireland	220	240	3,000
Italy	200	210	5,000
Mexico	288	290	4,000
Morocco	103	110	6,000
Peru	260	250	2,000
Yugoslavia	66	70	3,000
Other Free World	653	650	50,000
Communist countries (except Yugoslavia)	870	870	33,000
World Total	4,260	4,373	200,000

9. World Resources: In the United States, identified resources of barite are estimated to be 100 million short tons, and the hypothetical resources include an additional 150 million short tons. The total of the world's barite resources in all categories is about 2 billion short tons, but only about 320 million short tons (16%) are identified resources.

BAUXITE 1/
(Data in thousand long dry tons, unless noted)

1. Domestic Production and Use: Bauxite, valued at $24 million, was mined by 9 companies at 13 operations in Arkansas, Alabama, and Georgia in 1972; Arkansas produced 91% of the quantity. Eight plants in the South Central States and one in the Virgin Islands used 93% of the total U.S. consumption of domestic and imported bauxite to make alumina, 90% of which was reduced to aluminum metal. The remainder of the bauxite and alumina was used to make refractories, abrasives, chemicals, and other products. Gallium was recovered as a byproduct from domestic bauxite at one alumina plant in Arkansas.

2. Salient Statistics--United States 2/:

	1969	1970	1971	1972	1973 e/
Production: Mine	1,843	2,082	1,988	1,812	1,850
Imports of bauxite for consumption	13,228	14,038	13,997	12,689	13,000
Imports of alumina (thousand short tons)	1,925	2,579	2,410	2,850	3,400
Exports of bauxite	5	3	34	29	10
Exports of alumina (thousand short tons)	1,163	1,265	1,261	1,154	1,100
Consumption of bauxite	15,580	15,673	15,619	15,375	15,500
Price: Nominal (f.o.b. mine) per ton	$7-10	$7-10	$5-13	$5-13	$5-13
Stocks of bauxite:					
Producers and consumers	2,956	3,229	3,664	3,555	3,500
Employment: Mine	375	350	300	300	300

3. Import Sources (1969-72): Bauxite: Jamaica 54%; Surinam 23%; Guyana 7%; Dominican Rep. 7%; Other 9%.
Alumina: Australia 50%; Jamaica 22%; Surinam 18%: Other 10%.

4. Tariff

Item	Number	Rate of Duty 1/1/74	Statutory
Bauxite	601.06	Free	$1/long ton
Bauxite, calcined	521.17	Free	$1/long ton
Alumina	417.12	Free	$10/short ton

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate.
1/ See also Aluminum.
2/ Includes Virgin Islands.
3/ Thousand long calcined tons.
Prepared by H. F. Kurtz, telephone number (703) 557-0213

BAUXITE

6. Events, Trends, and Issues: Imports of alumina, mainly from Australia and Jamaica, increased about 20% and comprised one-third of the total U.S. supply of alumina in 1973. Domestic production of alumina came èntirely from bauxite, and bauxite imports continued to provide about 85% of the supply of bauxite.

Demand for aluminum was expected to increase at an annual rate of about 6.5% through 1980. Demand for alumina in the United States should increase at nearly the same rate, but demand for bauxite was expected to increase at a much lower rate. Domestic bauxite production was not expected to change significantly.

Most of the commercial bauxite reserves are in the less industrialized areas of the world, and the availability of bauxite is sensitive to changes in the political climate in these areas. Dependence on foreign bauxite and alumina is likely to continue until the use of large domestic deposits of kaolin-type clays, anorthosite, alunite, or other aluminous materials becomes competitive. Research on processes using these materials is in progress. Large-scale use of domestic materials other than bauxite will depend partly on the cost and availability of foreign sources of bauxite and alumina.

Environmental problems include the disposal or use of residues (red mud) from alumina production. Land use conflicts as well as greater waste disposal problems could be important considerations in the use of aluminous materials other than bauxite.

7. Government Programs: Bauxite is one of the materials eligible for up to 50% exploration assistance from the Office of Minerals Exploration. The Bureau of Mines has research underway on extracting aluminum content from domestic clays.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Metal grade:					
Jamaica type	4,638	8,859	4,221	1,370	-
Surinam type	-	5,300	5,300	-	-
Refractory grade 3/	-	173	173	-	-

8. World Mine Production and Reserves:

	Mine Production 1972	Mine Production 1973 e/	Reserves Quantity	Reserves Grade % Al_2O_3
United States	1,812	1,850	40,000	50
Australia	14,205	15,800	4,700,000	50
France	3,203	3,100	60,000	58
Greece	2,398	2,600	700,000	54
Guinea	2,600	3,000	3,500,000	54
Guyana	3,668	3,600	200,000	57
Jamaica	12,345	13,900	1,000,000	50
Surinam	6,800	6,900	500,000	56
Other Free World	9,973	10,450	4,200,000	51
Communist countries (except Yugoslavia)	7,791	8,300	600,000	50
World Total	64,795	69,500	15,500,000	

9. World Resources: Domestic resources of bauxite of 250-300 million tons potential are inadequate to fulfill the long-term demand; however, the United States has virtually inexhaustible potential resources of aluminous materials other than bauxite. World bauxite resources are extensive.

BERYLLIUM

(Data in short tons of metal, unless noted)

1. Domestic Production and Use: Domestic beryl and bertrandite production remained about the same in 1973 as in 1972. One company, based in Ohio, mined bertrandite and converted it to beryllium hydroxide in Utah, and processed the hydroxide and imported beryl into the metal, its alloys, and compounds at a plant in Ohio. The only other metal-producing company in the industry, with two plants in Pennsylvania, bought imported beryl and produced beryllium alloys and fabricated both alloys and the metal. A Colorado company processed small quantities of beryl for ceramic use. There was no beryl reported as a byproduct or coproduct of other pegmatite minerals. Beryllium consumption was as follows: as the metal in nuclear reactors and aerospace applications, 47%, as an alloy in electrical equipment, 29%, in electronic components, 13%, and other, 10%. About 1% was used as the oxide.

2. Salient Statistics—United States:

	1969	1970	1971	1972	1973 e/
Production (mine shipments)	Company confidential data				
Imports for consumption	257	198	161	134	68
Consumption	339	380	415	311	312
Price (dollars)					
Domestic, metal, per lb.	60	60	60	60	60
Imported ore, per s.t.u. (20 lbs.) BeO	37	35	33	30	28
Stocks: Consumer	237	218	252	276	280
Employment:					
Mine, full time equivalent employees e/	34	34	35	35	20
Primary refineries e/	350	750	750	750	650

3. Import Sources (1969-72): Brazil 64%, Republic of South Africa 13%, Argentina 7%, Uganda 5%, Other 11%.

4. Tariff:

	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Ore and concentrate	601.09	Free	Free
Unwrought beryllium, waste and scrap 1/	628.05	8.5% ad valorem	25% ad valorem
Beryllium copper master alloy	612.20	0.6¢/lb. + 10% ad valorem	3.0¢/lb. + 25%
Beryllium oxide or carbonate	417.90	5% ad valorem	25% ad valorem

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate. W Withheld to avoid disclosing company confidential information.
1/ Duty on waste and scrap has been temporarily suspended by P.L. 93-78 until June 30, 1975.
Prepared by R. A. Whitman, telephone number (703) 557-0998.

6. Events, Trends, and Issues: One producer put beryl processing equipment on a standby basis but will buy foreign beryl to be toll processed by another company.

Use of beryllium as an alloy is increasing but overall demand is expected to increase at an annual rate of about 2% through 1980.

Imports have decreased to about 20% of consumption. It would take about 2 years to complete another mill to process any increased mine production of bertrandite.

Because of the relative high price of beryllium, the uses apparently will continue principally in applications which require its unique properties. Steel, titanium, or graphite composites may be substituted for beryllium metal, and phosphor bronze for beryllium-copper alloys, but with substantial loss of performance.

Land reclamation following open-pit mining of bertrandite does not present any insurmountable problems. Refiners and fabricators have the necessary technology to protect both workers, and the surrounding areas, from the toxicity of dusts from beryllium processing.

7. Government Programs: Cutbacks in aerospace programs have reduced the demand for beryllium metal. Participation by the Office of Minerals Exploration is not to exceed 50%.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Beryl ore (11% BeO)	-	720	720	-	-
Beryllium-copper master alloy	-	295	295	-	-
Beryllium metal	88	229	141	-	-

8. World Mine Production and Reserves:

	Mine Production 1972	Mine Production 1973 e/
United States	W	W
Argentina	e/10	8
Australia	e/8	8
Brazil	e/80	60
South Africa, Republic of	11	8
Zambia	8	4
Other Free World	19	12
Communist countries (except Yugoslavia)	60	60
World Total	196	160

Reserves

The United States has very little beryl that can be handsorted economically from pegmatites. The Spor Mountain area, Utah, contains large reserves of bertrandite, which are being mined. Domestic deposits of bertrandite ores contain about 28,000 tons of beryllium. World reserves are not delineated.

9. World Resources: No quantitative information is available for foreign resources of beryl. The resources of beryllium (reserves plus subeconomic resources) in known domestic deposits are estimated at 80,000 tons of contained metal, which can be increased by further exploration. These resources are sufficient to supply U.S. needs for many decades.

BISMUTH
(Data in thousand pounds of metal, unless noted)

1. Domestic Production and Use: All domestic production is derived from processing intermediate metallurgical products, such as lead bullion, which contain bismuth as a minor constituent. Currently, one company represents 100% of domestic production. Consumption is centered in the industrial belt of Northern and Eastern United States where about 50 companies use between 80 and 90% of the annual total. Bismuth is principally used in external and internal personal applications as pharmaceuticals, 39%; followed by manufacturing of parts for machinery, 24%; and transportation, 16%.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Refinery	Company confidential data				
Consumption	2,532	2,210	1,649	2,316	2,858
General imports	895	998	849	1,563	2,329
Exports 1/	448	910	71	264	60
Price: Average, per pound	$4.63	$6.00	$5.26	$3.63	$5.00
Stocks, yearend: Consumer and dealer 2/	598	722	1,107	717	900
Employment: Plant	60	60	60	60	50

3. Import Sources (1969-72): Peru 34%, Mexico 29%, Japan 11%, Canada 9%, Other 17%.

4. Tariff

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Metal, unwrought	632.10	Free	7.5% ad valorem
Alloys	632.66	9% ad valorem	45% ad valorem
Compounds	423.80	14% ad valorem	35% ad valorem

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate. W Withheld to avoid disclosing company confidential data.
1/ Includes bismuth, bismuth alloys, and waste and scrap.
2/ Consumer stocks only beginning with 1970.
Prepared by J. A. Rathjen, telephone number (703) 557-0242

6. Events, Trends, and Issues: U.S. production remained consistent through 1973 with the single producing plant operating at capacity and without interruption through the period. Strong demand and increased consumption were met by increased imports from traditional sources. World production and distribution were modified somewhat with the activation of the Bolivian bismuth smelter at Telemayu. Material which had formerly been treated in Peru is now being smelted in Bolivia and refined in Belgium and the United Kingdom, thus changing the pattern of world distribution. During 1973 the Bismuth Institute was incorporated in La Paz, Bolivia, with the stated objective of stimulating the consumption of bismuth in all forms. Demand for bismuth is expected to increase at an annual rate of 1.4% through 1980.

Certain compounds of bismuth are subject to substitution during periods of short supply or economic imbalance. This is particularly true in the area of pharmaceuticals and cosmetic application. Consumption and demand were strong through 1973 with the domestic price established at $4 per pound in January. Periodic increases raised the price to $5 per pound by the end of the second quarter where it remained frozen by the Cost of Living Council. Continued strong demand throughout the world pushed the price to $6.50 per pound in November. On December 6, when price restrictions were lifted, the single domestic producer announced a price change which established a firm selling price in the United States of $6.50 per pound.

Bismuth, as an individual commodity does not pose any environmental or ecologic problems, however, as a coproduct of lead smelting there may be interruptions in supply as the lead smelters adjust to meet pollution and energy requirements.

7. Government Programs: Exploration assistance for bismuth is still available through the Office of Minerals Exploration with Government participation at 75%.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Bismuth	96	2,100	2,004	-	-

8. World Mine Production and Reserves:

	Mine Production 1972	Mine Production 1973 e/	Reserves
United States	W	W	28,000
Bolivia	1,100	1,200	6,000
Canada	400	800	5,600
Japan	1,900	1,900	95,200
Republic of Korea	200	300	2,400
Mexico	1,400	1,600	25,000
Peru	1,700	1,500	20,000
Yugoslavia	200	200	1,200
Other Free World	1,000	1,300	1,200
Communist countries (except Yugoslavia)	900	900	20,000
World Total	8,800	9,700	204,600

9. World Resources: A continued supply of bismuth must come from the major producers of lead, zinc, and copper in the Western United States, with other potential sources from molybdenum and tungsten ores, ash from West Virginia coals, and oceanic manganese nodules. Bismuth is known to occur in lead deposits in the Appalachian Mountains from Virginia to Maine. Host rocks include Precambrian dolomites west of the Adirondack Mountains in New York, and Precambrian and Cambrian rocks east of the Blue Ridge in North Carolina. Pegmatite rock in southeastern Pennsylvania and in western Maine commonly carries native bismuth and bismuthinite in small amounts.

January 1974

BORON

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: Domestic production of boron minerals, primarily as sodium borates, was centered in southern California. One firm operating mainly one large open-pit mine and two large plants was by far the foremost producer; two firms each with a sizable facility using brines from Searles Lake as raw material accounted for the bulk of the remaining output; one firm recently started to work colemanite (calcium borate). Total production of boron minerals and compounds was valued at an estimated $112.9 million in 1973. Numerous firms located primarily in the North Central and Eastern States were chief consumers. Principal uses for boron minerals and compounds were in glass products, 40%; soap and detergents, 15%; vitreous enamel, 10%; and fertilizers and herbicides, 10%.

2. Salient Statistics—United States:

	1969	1970	1971	1972	1973 e/
Production (boron minerals and compounds)	1,020	1,041	1,047	1,121	1,312
Imports (boron minerals and compounds)	25	27	7	20	25
Exports (boric acid and refined borates)	234	233	202	190	200
Consumption			Not available		
Price: Per ton (granulated pentahydrate borax in bulk, f.o.b. mine)	$66.75	$75.25	$75.25	$75.25	$79.75
Stocks			Not available		
Employment 1/	1,787	1,800	1,800	1,800	1,800

3. Import Sources (1969-72): Colemanite, crude: Turkey 100%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Boric acid	416.10	0.4¢/lb.	1¢/lb.
Calcium borate, crude	418.12	Free	Free
Manganese borate	419.40	5% ad valorem	25% ad valorem
Sodium borate, crude	420.76	Free	Free
Sodium borate, other	420.78	0.06¢/lb.	0.125¢/lb.
Boron carbide	422.90	5% ad valorem	25% ad valorem
Ferroboron	607.80	5% ad valorem	25% ad valorem

5. Depletion Allowance: Borax 14% (Domestic), 14% (Foreign).

e/ Estimate. NA Not available.
1/ Includes about 200-300 in mines and 1500-1600 in plants.
2/ Turkish reserves may be expanded by factor of more than 5 if results of recent surveys are confirmed.

Prepared by K. P. Wang, telephone number (703) 557-1794.

6. Events, Trends, and Issues: Increased demand under slightly improved price conditions brought about a one-sixth rise in U.S. production. After 3 years of unchanged quotations prices went up about 6% by mid-1973. The most important gain in U.S. consumption for boron compounds was made in the area of glass wool for construction purposes. The major producers with deposits at Boron, California, that produces four-fifths of the U.S. total and exports half the output, continued to work on a known reserve that should be good for many decades. At Searles Lake, California, where reserves are regenerative, a new "soda-borax" plant is being planned. Colemanite extraction in the United States shows little promise. Most uses for boron compounds cannot be substituted.

Turkish borates are of the same magnitude as those of the United States, with production lower and reserves at least as large. The main product is calcium borate rather than sodium borate which, however, also may be extensive. Turkey's market is primarily Europe and Japan. Significant progress has been made in the exploration, beneficiation, processing, and production of borates. Thus, Turkey's relative world position should improve with time, despite uncertainties of laws related to extraction by foreigners.

7. Government Programs: No active programs in 1973. General Services Administration stocks of colemanite amounting to 67,571 long dry tons were sold in 1967 on 4-year delivery terms.

8. World Mine Production and Reserves:

(boron minerals in form of ore):	Mine Production 1972	Mine Production 1973 e/	Reserves Quantity	Reserves Grade, % B_2O_3
United States	1,121	1,312	330,000	25-45
Argentina	60	60	30,000	35
Chile	NA	NA	30,000	33
Turkey 2/	680	700	100,000	30-50
U.S.S.R.	200	200	150,000	35
Other countries	NA	NA	30,000	35

9. World Resources: Large domestic resources of borate materials are in California, chiefly in nonmarine rocks, and their contained brines, of Cenozoic age. Extensive resources also are known in Turkey. World resources are adequate to supply needs at current rates for many hundreds and possibly thousands of years.

BROMINE
(Data in thousand pounds, unless noted)

1. Domestic Production and Use: Seven companies operating ten plants produced 387 million pounds of bromine valued at $64 million in 1972. This was an increase of 9% over the 1971 production. Bromine was produced from five plants in Arkansas, four in Michigan, and one in California. Arkansas was the leading bromine-producing State. Over 94% of all bromine production was accomplished by only four of the companies. Bromine is usually produced as the sole extract from natural subterranean brine, the residue salts and water being reinjected deeply into the ground for disposal. In certain Michigan brines iodine and bromine are extracted from the same stream. Chlorine may be substituted for bromine in a few applications. Nearly three-fourths of the bromine output went into the manufacture of ethylene dibromide, a gasoline additive. About 10% was sold in elemental form to be used primarily for disinfectant and for sanitation purposes. Other significant uses occur in agricultural chemicals and flame retardants. Exports have probably increased but exact amounts are unknown.

2. Salient Statistics—United States:

	1969	1970	1971	1972	1973 e/
Production (bromine content)	335,242	349,748	355,946	386,864	421,000
Imports (bromine and bromine compounds)	50	144	14	46	50
Exports (bromine and bromine compounds)			Not available		
Consumption	NA	NA	NA	377,575	411,000
Price: (cents per pound) bulk purified bromine	19	17	17	17	17
Stocks			Not available		
Employment: Plants only	400	302	307	340	440

3. Import Sources (1969-72): West Germany 29%, United Kingdom 19%, France 16%, Belgium-Luxembourg 3%, Other 34%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Bromine	415.05	5¢/lb.	10¢/lb.
Potassium bromide	420.02	2¢/lb.	10¢/lb.
Sodium bromide	420.82	8¢/lb.	10¢/lb.
Ethylene dibromide	429.28	1.2¢/lb. + 6% ad valorem	6¢/lb. + 30% ad valorem

5. Depletion Allowance: 5% on brine wells (Domestic), 5% on brine wells (Foreign).

e/ Estimate. NA Not available.

Prepared by C. L. Klingman, telephone number (703) 557-0439.

6. Events, Trends, and Issues: The 7% per year historical growth rate of the bromine industry was exceeded for the second consecutive year in 1973 in spite of predictions that environmental restrictions on gasoline additives would depress the bromine market. The amount of bromine exported was not available but was believed to be a significant factor in the increased production. Importation of bromine comprised only a trivial fraction of the total supply. There probably was an increase in the use of bromine products in agriculture and in flame retardants. It was foreseen that bromine consumption would be reduced by about 11% per year through 1978 because of a reduction in the bromine content of gasoline and a reduction in the amount of available gasoline. From 1978 to 1980, there may be a return to a normal 7% per annum growth rate.

The current regulations of the Environmental Protection Agency require a reduction in the average lead content of gasoline to 2.00 grams per gallon by 1975; to 1.70 by 1976; to 1.50 by 1977; and to 1.25 grams per gallon by 1978. The lead scavenger, ethylene dibromide will be reduced proportionally, approximately 37% by 1978. This factor alone is predicted to reduce the overall bromine demand by about 28% over a four-year period. Other economic factors and changes in Environmental Protection Agency regulations could cause sharp revisions in this prediction.

7. Government Programs: Bromine and bromine compounds were not considered to be strategic commodities and there were no government stockpiles or incentive programs in effect in 1973. Possibility of rationing of gasoline, however, could have a direct restrictive effect on bromine production.

8. World Mine Production and Reserves:

	Mine Production		Reserves
	1972	1973 e/	
United States	386,864	421,000	Reserves in all major producing countries are large, but quantities are unknown. Sea water provides an unlimited source.
France	32,500	35,000	
Israel	30,860	33,300	
U.S.S.R.	26,000	28,100	
Japan	23,693	26,600	
United Kingdom	9,000	9,700	
West Germany	6,200	6,700	
Italy	6,000	6,500	
Other	1,395	1,500	
World Total	522,512	567,500	

9. World Resources: Resources of bromine are virtually unlimited. Sea water provides a source that is almost economic today and deep-well brines now used as a source of bromine are available in large volume. Bittern salts and interstitial brines in marine evaporite bodies have bromine concentrations similar to those in the best deep-well brines.

CADMIUM

(Data in short tons of metal, unless noted)

1. Domestic Production and Use: Cadmium was recovered as a byproduct in processing zinc concentrates, lead and zinc smelter flue dusts and refinery residues. Six companies at seven plants produced domestic primary metal and one company had a small output from secondary sources. Three companies contributed 77% of production in 1973. About 80% of refinery production was from the western States of Oklahoma, Colorado, Texas, and Idaho. Value of production in 1972 was $19 million. No record is available for the mine source of domestic cadmium but probably no more than half comes from domestic zinc or lead ores. Consumption by about 1,500 firms was centered in the industrial areas east of the Mississippi River. Consumption in metal form for electroplating parts for motor vehicles, appliances, industrial machinery and hardware used about 50% of production; compounds and salts for stabilizers in plastics and colorants in paints accounted for 35%; other uses, including nickel-cadmium and silver-cadmium batteries, used the remaining 15%. For some plating and stabilizer uses, zinc can be substituted for cadmium, but for most applications cadmium is preferred.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Refinery (includes secondary)	6,323	4,733	3,965	4,145	3,245
Imports for consumption: Metal	539	1,246	1,750	1,211	1,884
Flue Dust	557	556	556	370	50
Exports: All forms	542	187	33	508	165
Consumption, apparent	7,531	4,532	5,416	6,307	6,235
Price: Per pound, producer to consumer in 1 to 5 ton lots, average	$3.27	$3.57	$1.92	$2.56	$3.64
Stocks: Yearend, producer and distributor	716	1,918	2,149	1,611	786
Employment: Smelter and refinery	630	600	575	550	500

3. Import Sources (1969-72): Metal--Japan 23%, Canada 22%, Australia 15%, Peru 12%, Other 28%. In 1973, Japan contributed only 1%. Flue dust—Mexico 100%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Statutory
Flue dust	603.20	Free	Free
Metal	632.14	Free	15¢/lb.

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate.

Prepared by J. M. Hague, telephone number (703) 557-0213

6. Events, Trends, and Issues: World demand for cadmium is expected to increase at an annual rate of about 2.6% through 1980; U.S. demand is expected to grow at a slightly higher rate. The decline of U.S. zinc production in 1973 caused lower domestic cadmium production; the demand was satisifed by increased imports, drawdown of stocks and releases from the Government stockpile. The trend is expected to continue so that by 1985 metal imports should become about 50% of consumption of primary metal, and imports in the form of zinc concentrates should account for about 25%. An expected shift toward Mississippi Valley type ores as a source of zinc concentrates will increase intake of cadmium to domestic plants and could tend to mitigate reliance on imports.

Increased development of nickel-cadmium batteries will eventually produce a larger circulating load of secondary cadmium, but only a small percentage of total demand can come from this source. The toxic effects of cadmium in air, acid solutions and water-borne silt may restrict its use in plating establishments or as compounds in pigments or stabilizers if stricter anti-pollution standards are put into effect. Scavenging systems for industrial waste waters are available but small consumers may find the increased cost unacceptable. In industrialized nations, smelters producing cadmium byproducts will be enjoined to recover as high a percentage of cadmium input as is economically feasible in order to prevent its dispersal into the environment.

7. Government Programs: Exploration assistance for cadmium was offered under Office of Minerals Exploration with participation at 50%, but no contracts were sought. Phase IV price controls of the Cost of Living Council were applied to cadmium during part of the year but were removed on December 6.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Cadmium	2,223	4,226	2,003	1,226	380

8. World Smelter Production and Reserves:

	Smelter Production 1972	Smelter Production 1973 e/	Reserves
United States	4,145	3,245	
Australia	620	750	
Canada	970	1,100	Reserves are a
Belgium	1,250	1,250	variable function
France	640	700	of zinc reserves;
West Germany	1,090	1,200	reliable data
Italy	452	460	not available by
Japan	3,339	3,350	source country.
Zaire	287	330	
Other Free World	1,721	1,750	
Communist countries (except Yugoslavia)	3,840	4,065	
World Total	18,354	18,200	

9. World Resources: Identified world cadmium resources were estimated to be about 1.32 million tons, including measured and indicated reserves of about 460,000 tons, inferred reserves of 460,000 tons and 400,000 tons of cadmium in zinc ores not normally recovered with existing technology. About one-fourth of the identified resources are in the United States. Total world cadmium resources, both identified and undiscovered, and of economic and subeconomic grades, are estimated to exceed 20 million tons. About one-sixth of these total resources is in deposits believed to be exploitable under existing economic conditions.

January 1974

CARBON BLACK
(Data in million pounds, unless noted)

1. Domestic Production and Use: Estimated production of carbon black in 1973 was 3,430 million pounds, an increase of 7% over that of 1972. Nine companies operated 34 plants (32 furnace type and two channel type) in nine States. Six companies accounted for 92% of U.S. carbon black production. Estimated value of 1973 production was $266 million, 7% higher than the comparable 1972 value. Texas and Louisiana continued as the principal producers, accounting for 45% and 34% respectively of the Nation's output. Other producing States were West Virginia, Ohio, California, Oklahoma, Kansas, Arkansas, and Alabama. The rubber industry was the principal consumer of carbon black in 1972. Their consumption increased 10.3% to 2,954 million pounds and accounted for 93.9% of domestic sales. Other uses for carbon black included the manufacture of ink, 2.6%; the manufacture of paint, 0.7%; and miscellaneous uses including chemical, food, paper and plastics, 2.8%.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production	2,963	2,931	3,017	3,201	3,430
Imports 1/	8	6	7	7	9
Exports	196	193	163	111	160
Consumption	2,791	2,656	2,861	3,155	3,300
Price, average f.o.b. plant (¢ per lb.)	7.26	7.58	7.69	7.76	7.75
Stocks, producer	208	296	296	238	217
Employment e/	2,800	2,800	2,750	2,700	2,700

3. Import Sources (1969-1972): Canada 78%; East Germany 7%; West Germany 6%; Egypt 3%; Other 6%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Statutory
Carbon Black	473.04	Free	20% ad valorem

5. Depletion Allowance: Not applicable.

e/ Estimate.
1/ Include boneblack and lampblack.
Prepared by R. F. Zaffarano, telephone number (703) 557-0375.

6. Events, Trends, and Issues: Because of inefficiency of channel type plants and increasing costs of natural gas, feedstock for these plants, output of channel type carbon black continued to decline. Environmental constrictions contributed to the decrease in production of channel carbon black. Output of furnace blacks, the major reinforcing filler used in the tire industry, continued to increase. Outlook for the production of carbon black to 1980 is an upward trend at an average annual rate of about 4%, as compared to the annual average rate of 5% during the past 5 years. Developments in technology will probably be concentrated on improving existing grades of blacks. Most imports of carbon black have been specialty grades and constitute only about 0.2% of total supply, and no significant change in this trend is anticipated by 1980.

7. Government Programs: None

8. World Plant Production and Reserves:

	Plant Production		Reserves
	1972	1973 e/	
United States	3,201	3,430	Not applicable
Canada	196 e/	200	
France	350	350	
Germany, West	582	590	
Italy	278 e/	280	
Japan	751	800	
Netherlands	206	210	
United Kingdom	485 e/	490	
Others	1,023	1,100	
World Total	7,072	7,450	

9. World Resources: The raw materials for the production of carbon black are natural gas and liquid hydrocarbons. Resources of these materials are described in other appropriate sections.

CEMENT

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: Fifty companies operated 165 clinker producing plants in 41 States and Puerto Rico. Ten companies produced 49% of the portland cement. Fifty-one percent of the production came from six States (California, Pennsylvania, Texas, Michigan, New York, and Missouri) with nearly 12% from California alone. Portland cement accounted for 95% of the output; the remainder was masonry cement. Clinker producing capacity was 256,000 tons a day, with an apparent annual production capacity of 85.4 million tons. Mill value of 1973 cement shipments was $1.95 billion. As chief binding agent in concrete and mortars, 64% was used for ready-mixed concrete; 14% for concrete products such as blocks and pipe; 8% by highway contractors; 8% by building material dealers; and 6% by government agencies, other contractors, and for miscellaneous uses.

2. Salient Statistics--United States: 1/

	1969	1970	1971	1972	1973 e/
Production (portland, masonry and other)	76,693	74,325	78,326	82,597	85,900
Shipments from mills (includes masonry cements)	78,637	74,607	80,396	83,336	88,000
Imports for consumption	1,821	2,597	3,088	4,911	6,600
Exports	111	159	125	100	300
Apparent consumption	80,348	2/75,970	2/81,488	2/84,994	2/89,700
Average value per ton	$17.18	$17.91	$19.01	$20.69	$21.69
Stocks: Mill	7,129	7,574	6,381	7,072	7,000
Employment: Mine and mill e/	26,000	25,000	25,000	25,000	25,000

3. Import Sources (1969-72): Canada 42%, Bahamas 26%, Norway 15%, United Kingdom 5%, Mexico 4%, Other 8%.

4. Tariff: 3/

Item	Number	Rate of Duty 1/1/74	Statutory
White nonstaining portland cement	511.11	1.0¢/100 lb.	8¢/100 lb.
Other hydraulic cement and clinker	511.14	Free	6¢/100 lb.

5. Depletion Allowance: Not applicable.

e/ Estimate.
1/ Excludes Puerto Rico.
2/ Adjusted to eliminate duplication of imports shipped by domestic cement manufacturers.
3/ Rates include weight of container.

Prepared by Brinton C. Brown, telephone number (703) 557-0598.

6. Events, Trends, and Issues: Thirteen plant expansions completed in 11 States and Puerto Rico increased annual clinker production capacity 2 million tons in 1973. Three new plants and 8 plant expansions under construction will increase clinker capacity another 4.3 million tons when completed in 1974. Two new plants and 7 plant expansions with a combined annual capacity of 3.6 million tons were planned for 1975. Anticipating fuel savings of 40 to 50%, the trend of new equipment purchased is very strongly in favor of dry process kilns equipped with preheaters. Demand for cement is expected to grow as concrete requirements for construction and roadbuilding increase but production will fluctuate depending on the general economic condition of the Nation and the availability of funds for these activities. Promulgation of stringent pollution control standards caused many old kilns to be shut down. Some plants were converted to grinding facilities and as a result clinker imports were becoming increasingly important, amounting to 40% of the total 1973 cement imports. Regional shortages, particularly in the southeastern States, were alleviated by imports which increased 35%.

Environmental Protection Agency regulations impelled the cement industry to spend millions of dollars for air pollution control facilities. Proposed new effluent standards, published in the Federal Register, were estimated to cost the industry $18 million and in addition, an annual operating cost of $7 million.

7. Government Programs: The Cost of Living Council removed wage and price controls on the cement industry in return for a tentative commitment from major producers to increase production capacity. The petroleum allocation program could reduce cement production at plants using fuel oil and/or natural gas that do not have standby coal facilities.

8. World Production and Capacity:

	Production		Plant Capacities e/
	1972	1973 e/	
United States (includes Puerto Rico)	83,697	87,400	87,600
Canada (shipments)	10,010	11,000	16,000
Other North America (except Cuba)	13,668	14,600	17,000
South America	29,506	30,600	35,000
Europe, Free	215,110	230,600	247,000
Asia, Free	133,042	145,000	165,400
Africa	22,180	24,000	28,000
Oceania	6,531	6,800	8,000
Communist countries (except Yugoslavia)	188,922	205,000	235,000
World Total	702,666	755,000	839,000

9. World Resources: Raw materials for making cement are abundant in most countries but are not always located near market areas.

CESIUM

(Data in pounds of metal, unless noted)

1. Domestic Production and Use: Pollucite, the principal ore of cesium, was not mined in the United States. Using imported pollucite, one firm each in California, Colorado, New Jersey and Pennsylvania, accounted for all of the output of cesium products. Cesium, usually in the form of chemical compounds, was used mainly in research and development, including the development of magnetohydrodynamic electric power generators (MHD), thermionic energy converters, and biological research. Cesium was used commercially in electronic and medical applications, and was interchangeable with rubidium for some uses.

2. Salient Statistics—United States:

	1969	1970	1971	1972	1973 e/
Production: Pollucite			None		
Metal and compounds	Company confidential data				
Imports for consumption:					
Pollucite and metal			Not available		
Cesium compounds	3,900	3,700	3,200	8,600	2,300
Exports			Not available		
Industrial consumption:					
Pollucite	Company confidential data				
Metal and compounds			Not available		
Price (dollars):					
Pollucite, per short ton	300	300	300	300	300
Metal, per pound	100-375	100-375	100-375	100-375	100-375
Cesium compounds, principal, per pound	30-38	28-35	28-35	28-35	28-35
Stocks	Company confidential data				
Employment: Mine			None		
Plant e/	25	25	25	25	25

3. Import sources (1969-72): Pollucite—Canada and Africa; cesium compounds—West Germany 87%, the Netherlands 8%, United Kingdom 3%, Switzerland 2%.

4. Tariff:

	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Pollucite	601.66	Free	Free
Cesium	415.10	8.5% ad valorem	25% ad valorem
Cesium chloride	418.50	6% ad valorem	25% ad valorem
Other cesium compounds	418.52	5% ad valorem	25% ad valorem

5. Depletion Allowance: 14% (Domestic), 14% (Foreign).

e/ Estimate. NA Not available.
Prepared by H. F. Kurtz, telephone number (703) 557-0213.

6. Events, Trends, and Issues: Preliminary data indicated that demand for cesium in 1973 declined from an unusually high demand in 1972, when relatively large quantities were believed to have been used in research and development of MHD. No significant environmental problems have resulted from the production of cesium products because of the small scale of production.

Demand for cesium was expected to increase at an annual rate of about 8 percent through 1980 although requirements for research may cause wide fluctuations from year to year. The development of uses for cesium in electric power generation, such as its use as a seeding material in MHD, could result in a much greater demand.

World pollucite reserves, which average about 20 percent cesium, appear to be sufficient for many years provided the projected rate of growth in demand is not significantly increased. The United States currently obtains all of its cesium ore and a large part of its manufactured cesium compounds from foreign sources. Future cesium supplies will be dependent upon foreign sources unless domestic pollucite deposits are discovered or technology is developed to use other low-grade materials.

The high costs and extreme reactivity of cesium limit its applications. Rubidium can replace cesium in many of its uses, certain other elements can be substituted in light-sensing equipment, and potassium may be used instead of cesium in MHD.

7. Government Programs: None.

8. World Mine Production and Reserves (pollucite, short tons):

	Mine Production 1972	Mine Production 1973 e/	Reserves
United States	-	-	Small
Canada	-	275	350,000
Mozambique	NA	NA	NA
Southern Rhodesia	NA	NA	150,000
South-West Africa	NA	NA	50,000
Other	NA	NA	NA
World Total	NA	NA	NA

9. World Resources: Cesium forms independent minerals in pegmatites and is commonly obtained as a coproduct in the mining of tantalum, beryllium, or lithium minerals. World resources of cesium are not known, but reserves of pollucite probably could be increased substantially by intensive research.

CHROMIUM

(Data in thousand short tons of ore, unless noted)

1. Domestic Production and Use: Domestic production of chromite ceased in 1961; however, the United States continues to be one of the world's leading chromite consumers. Chromite in 1972 was consumed by seven metallurgical firms producing chromium ferroalloys and metal; ten firms producing refractories; and four firms producing chromium chemicals, most of these firms were in the Eastern United States. The metallurgical industry accounted for 64% of the total; the refractory industry consumed 20%; and the chemical industry 16%. Consumption of chromium in various end uses was as follows: Construction 22%; transportation, 17%; machinery and equipment, 15%; refractories, 13%; and all other uses, 33%.

There is no secondary industry for chromium, but purchased stainless steel scrap contributes significantly to chromium supply. Nickel, zinc, cobalt, molybdenum, vanadium, and titanium are competitive alternate materials for chromium in various end use application. However, in many of these applications cost performance and customer appeal are the determining factors in use of alternate materials.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production			None		
Imports for consumption	1,106	1,405	1,299	1,061	900
Exports and reexports	199	114	180	77	110
Consumption	1,411	1,403	1,093	1,140	1,400
Price: Dollars					
Russian - Metallurgical grade	47	57	e/70	e/60	56
South African - Chemical grade	20	23	26	26	36
Turkish - Metallurgical grade	38	48	56	56	37
Stocks: Consumer	740	733	1,019	857	500
Employment: Mine			None		

3. Import Sources (1969-72): U.S.S.R. 32%, Republic of South Africa 30%, Turkey 18%, Philippines 14%, and Other 6%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Statutory
Ore and concentrate	601.15	Free	Free
Ferrochromium (less than 3% carbon)	607.30	4% ad valorem	30% ad valorem
Ferrochromium (more than 3% carbon)	607.31	.625¢/lb. contained chromium	2.5¢/lb. contained chromium

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate.

Prepared by John L. Morning, telephone number (703) 557-0500.

6. Events, Trends, and Issues: Demand for chromite in 1973 followed that of the rising economy, returning to the level of the 1969-70 period. Although imports of chromite were at a reduced rate, supply was augmented by drawdown of industry stocks and shipments of material sold from the Government stockpiles. Imports of ferrochromium set a new record high as foreign ferrochromium production capacity continued to increase. The use of high-carbon ferrochromium in place of low-carbon ferrochromium was accelerated because of the effect of the technologic change in stainless steel manufacture. Percentage wise; both imports and domestic production of high-carbon ferrochromium were higher than that of low-carbon ferrochromium compared with 1972.

Demand for primary chromium is expected to increase at an annual rate of about 2.3% through 1985. Along with other consuming countries, the United States will continue to rely on imports of chromium but supply will be supplemented by government stockpile sales to meet demand. International relationships in the future can influence the United States supply demand position; as they have in the past. Increasing ferrochromium imports of the last few years imposes a potential threat to a viable domestic ferrochromium industry.

Environmental considerations for cleaner air imposes economic problems for some precessors. However, as cleaner air results from compliance with Environmental Protection Agency regulations, disposal of reclaimed dust and slag problems will remain.

7. Government Programs: Government financial assistance for exploration of domestic chromite deposits is available upon approval. The Office of Minerals Exploration participation is 50%.

Stockpile Status—11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Chromite:					
Metallurgical grade	445	3,408	2,964	900	40
Chemical grade	8	569	560	319	-
Refractory grade	54	971	917	571	191
Metal and alloys (content)	8	535	527	3	0.4

8. World Mine Production and Reserves:

	Mine Production 1972	Mine Production 1973 e/	Reserves (Million long tons) Quantity
United States	-	-	-
Philippines	388	400	5
Southern Rhodesia e/	400	400	550
South Africa, Republic of	1,635	1,700	1,050
Turkey	710	700	5
U.S.S.R.	2,040	2,000	21
Other	1,667	1,700	32
World Total	6,840	6,900	1,663

9. World Resources: Although world resources of chromite totaling nearly 9 billion long tons are ample for the foreseeable future, domestic resources are low grade and represent only a 4- to 5-year supply. The outlook for substantially increasing the domestic resource base, even at several times the present world price, is not favorable. The principal North American resources other than the Stillwater, Montana, complex are a similar deposit in Manitoba, Canada, and very large low grade deposits in Greenland. Most of the world resources lie in the Eastern Hemisphere primarily in the Republic of South Africa and Rhodesia.

CLAYS

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: In 1972 clays were produced in 47 States. The leading 49 firms supplied about one-half of the total output and 550 firms the remainder. Together these firms operated a total of 1,302 mines. Estimated value of all marketable clay produced in 1972 was $303 million. In 1972 major uses for specific clays, in percent, were as follows: Kaolin - (41 paper, 12 refractories, 7 rubber); Ball Clay - (26 pottery and stoneware, 20 floor and wall tile); Fire Clay - (62 firebricks, 8 foundry sands); Bentonite - (26 iron ore pelletizing, 26 foundry-sand bond, 19 drilling mud); Fuller's Earth - (68 absorbent and filtering uses, 15 insecticide dispersant).

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Mine production:					
Kaolin	4,739	4,926	4,886	5,318	5,800
Ball clay	682	710	603	675	720
Fire clay	7,261	6,459	1/3,044	1/3,581	1/3,800
Bentonite	2,640	2,533	2,666	2,767	3,100
Fuller's earth	985	982	1,014	988	1,100
Common clay	42,387	39,244	44,453	46,127	47,000
Total	58,694	54,853	56,666	59,456	61,520
Imports for consumption	82	87	64	67	55
Exports	1,574	2,076	1,973	1,847	2,000
Apparent consumption	57,202	52,864	54,757	57,676	59,575
Price:	$0.75 to $80 per short ton, depending on type and quality.				
Stocks:	Not available				
Employment: Mine	5,200	4,300	4,100	4,000	4,000
Mill	14,000	13,600	13,200	14,400	14,000

3. Import Sources (1969-72): United Kingdom 76%, West Germany 5%, Canada 4%, Other 15%.

4. Tariff:

Item	Number	Rate of Duty 2/ 1/1/74	Statutory
China clay and kaolin	521.41	$0.33	$2.50
Fuller's earth, not beneficiated	521.51	.25	1.50
Wholly or partly beneficiated	521.54	.50	3.25
Bentonite	521.61	.40	3.25
Ball clays, not beneficiated	521.71	.42	1.00
Wholly or partly beneficiated	521.74	.85	2.00
Other clays, not beneficiated	521.81	Free	1.00
Wholly or partly beneficiated	521.84	.50	2.00

5. Depletion Allowance: Kaolin, ball clay, bentonite, fuller's earth, and fire clay 14% (Domestic), 14% (Foreign); clay and shale used for making brick, tile, and lightweight aggregate 7-1/2% (Domestic), 7-1/2% (Foreign); clay used for extraction of alumina or aluminum compounds, 22% (Domestic).

e/ Estimate.
1/ Refractory uses only.
2/ Per long tons.

Prepared by S. G. Ampian, telephone number (703) 557-0567.

6. Events, Trends, and Issues: Total quantity of clays sold or used by domestic producers in 1973 was approximately 3% higher in tonnage and 12% higher in total value. Both the total tonnage and value of clays produced were alltime highs. Demand for clays is expected to increase at annual rates of between 2 and 5% through 1980. This continued growth of the energy intensive clay-based industries would be impeded severely by persistent energy problems. Domestic clay resources are more than adequate. Average prices for most clays are expected to rise slowly, reflecting higher quality requirements for the specialty clays and increasing costs associated with land acquisition, land rehabilitation, and environmental factors. Greater recovery of byproducts and coproducts should occur as processing technology improves and as problems of solid waste disposal become increasingly acute. Further enhancement of the U.S. position as a major world supplier of high-quality clays is assured by the possession of more than adequate resources of all major types of clay coupled with the clay processing technology necessary to provide large quantities of consistent-quality clays over extended periods.

7. Government Programs: None.

8. World Mine Production and Reserves: Not available.

9. World Resources: Clays are divided for commercial purposes into kaolin, ball clay, fire clay, bentonite, fuller's earth, and miscellaneous clay. Resources of these types of clay are extremely large, except for lesser resources of high-grade ball clay and high-grade colloidal bentonite.

January 1974

COAL, ANTHRACITE

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: All reported production of anthracite in the United States originates in 11 counties located in northeast Pennsylvania. In 1972, this production totaled 7.1 million short tons, a decrease of approximately 19% from that of 1971, with a value of $85.3 million f.o.b. preparation plant. Fifteen companies accounted for 67% of total production. Of the total output, 49% was obtained at strip pits, 31% from culm and silt banks, 13% at underground mines, and 7% at dredging operations. Of the total supply, 42% was used for space-heating; 22% by electric utilities; 17% was exported; 11% by the iron and steel industry; and the remainder was used at cement plants, for colliery fuel, and other uses. Distribution, based on the 1971-72 coal year, totaled: Middle Atlantic States, 71%; New England States, 1%; all other States, 12%; Canada, 5%; other countries (primarily western Europe and South America), 11%. The estimated production for 1973 is 6.5 million short tons with an estimated value of $80.0 million f.o.b. preparation plant. Output was 8.5% less than in 1972.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production	10,473	9,729	8,727	7,100	6,500
Rail shipments 1/	4,518	3,915	3,739	2,906	2,800
Truck shipments 2/	4,821	4,527	4,973	4,189	3,700
Imports			None		
Exports 3/	627	789	671	743	700
Consumption (apparent)	8,809	8,248	7,338	5,915	5,400
Price (average per ton f.o.b. preparation plant)	$9.62	$10.83	$11.86	$12.00	$12.30
Stocks:					
Electric utilities	1,297	1,099	1,123	895	1,000
At coke plants	130	121	118	84	55
Retail dealers	142	202	182	123	100
Employment (actual)	6,300	5,983	5,800	4,783	4,400
Production per man-day (tons)	7.49	7.45	6.30	6.88	6.50

3. Import Sources (1969-72): None.

4. Tariff: Not applicable.

5. Depletion allowance: 10%.

e/ Estimate.
1/ Furnished by the initiating carriers.
2/ Pennsylvania Department of Enviromental Resources, Anthracite Mine Safety Section.
3/ Does not include anthracite consigned to U.S. military forces in Europe, which amounted to approximately 973,000 tons in 1969; 789,000 tons in 1970; 718,000 tons in 1971; 448,000 tons in 1972; and an estimated 400,000 tons in 1973.

Prepared by D. R. Federoff, telephone number (703) 557-0305.

6. Events, Trends, and Issues: The high cost of mining anthracite due to complex geologic conditions and the availability, lower cost, and convenience of alternative fuels have substantially reduced the demand for anthracite. More efficient methods of recovery, increased availability of rail transportation, and new processes for utilization are needed to make anthracite more competitively attractive to energy consumers. Favorable trends are appearing in the use of anthracite as an industrial carbon, in the sintering of iron ore, and as an additive in the production of foundry coke.

The anthracite industry and region are beset by a variety of environmental problems which must be resolved: purification of streams polluted by acid mine water; reclamation of strip pits; control of fires in culm banks and coal seams; stabilization of subsiding land; and control of mine flooding.

The prolonged future need for energy in ever-increasing quantities, and the prospect of continued inadequate availability of, and increasing prices for petroleum and natural gas, may result in a deceleration or reversal of the downward trend in the demand for anthracite.

7. Government Programs: Contracts were awarded for the purchase of 0.4 million tons of anthracite by U.S. armed forces in West Germany for fiscal year 1972-73. Programs in the environmental area included underground mine and refuse or culm bank-fire control, prevention of surface subsidence, reclamation of old strip pits, and mine-water-control projects to alleviate the flooding and loss of coal reserves.

8. World Mine Production and Reserves:

	Production 1972	Production 1973 e/	Recoverable Reserves e/ (Million short tons)
United States	7,100	6,500	8,000
France	10,700	10,900	1,150
Germany, West	8,200	9,000	2,000
United Kingdom	3,700	4,000	3,000
Other Free World	26,800	28,000	10,200
Communist countries (except Yugoslavia)	139,500	142,000	85,400
World Total	196,000	200,400	109,750

9. World Resources: The estimated identified resources of anthracite and semianthracite in the conterminous United States are about 21.3 billion short tons. These resources are in beds 14 inches or more thick to a depth of 3,000 feet. This estimate as of January 1, 1972, has not changed significantly during 1973. Little data on world resources of anthracite are available as most countries, other than the United States, combine anthracite resource data with that of other rank coals. (See "Coal, Bituminous and Lignite.")

January 1974

COAL, BITUMINOUS AND LIGNITE
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: In 1972, bituminous coal and lignite production totaled 595.4 million tons, an increase of 8% from that of 1971, with a value of $4.6 billion. Coal was produced at 4,879 mines in 25 States in 1972. The principle producing States of West Virginia, Kentucky, Pennsylvania, Illinois, Ohio, and Virginia accounted for 79% of the total output. Of the total number of mines, 5.7% produced 56.5% of the total output; the next 27.5% produced 34.1%; the remaining 66.8% produced 9.4%. Coal was used in all areas of the United States except Hawaii. Approximately 67% of total domestic supply was consumed by electric utilities, 17% by coke plants, 14% by other manufacturing and mining industries, including a small portion of the transportation industries, and 2% was delivered by retail dealers. The 1973 output of 590 million tons was valued at $4.8 billion.

2. Salient Statistics--United States:

Salient Statistics--United States	1969	1970	1971	1972	1973 e/
Production	560,505	602,932	552,192	595,386	590,000
Imports (for consumption)	109	36	111	47	150
Exports	56,234	70,944	56,633	55,960	50,000
Price (value per ton) f.o.b. mines	$4.99	$6.26	$7.07	$7.66	$8.12
Production per man day (tons)	19.90	18.84	18.02	17.74	17.50
Stocks (consumers', year-end)	81,966	93,743	91,190	115,290	101,000
Consumption, total (reported)	507,275	515,619	494,862	519,776	565,000
Electric power utilities	308,461	320,461	330,000	348,612	390,000
Coke plants	92,901	95,864	85,000	87,272	93,000
Employment: Mine	124,532	140,140	145,664	149,265	155,000

3. Import Sources (1969-1973): Canada (95%); Other (5%).

4. Tariff: None.

5. Depletion Allowance: 10% (Domestic).

e/ Estimate.
1/ Recoverable reserves represent 50% of the measured and indicated resources to a depth of 1,000 feet in beds 28 inches or greater for bituminous coal and in beds 60 inches or greater for subbituminous and lignite.
2/ Includes 11.0 million tons of lignite.
3/ Includes 13.7 million tons of lignite.
4/ Reserves not identifiable.

Prepared by Leonard Westerstrom, telephone number (703) 557-1350.

6. Events, Trends, and Issues: Based primarily on the electric utility industry's planned expansion program, total bituminous coal and lignite demand (including exports) is forecasted to increase from 590 million tons in 1973 to 839 million tons in 1980, or at annual rate of about 5 percent. Annual coal demand at electric generating stations is estimated to increase from 385 million tons to 581 million tons during this period while requirements in all other consuming sectors, including exports, are expected to increase slightly or remain relatively stable.

In 1973, coal demand exceeded supply throughout the year as the coal industry at times was unable to provide coal for new customers while regular consumers drew heavily from inventories. Again, as in 1972, relatively few new large underground and strip mines were opened because of institutional and economic restraints to the development of new mining capabilities, so that the industry operated at or near full capacity. If the Nation's expanding electric energy and industrial fuel requirements are to be met, new coal production capacity will have to be developed, for which there are few incentives because of the uncertainties as to pending regulatory environmental controls, particularly air pollution standards, price constraints, nuclear potentials and the slow development of economically viable technologies for reducing air pollutants in stack gas emissions. The problems of coal supplies also are accentuated by new demands for coal caused by the cut-off of oil supplies from the Middle East.

7. Government Programs: Major emphasis in coal research was placed on the production of clean burning fuels from coal to help meet the Nation's rapidly increasing need for energy while at the same time maintaining or improving the quality of the environment. A large scale conversion of coal to pipeline-quality synthetic gas was achieved at the HYGAS pilot plant in Chicago, Illinois in 1973. The plant completed more than 100 hours of continuous operation, converting 72 to 75 tons a day of Montana lignite into sulfur-free gas of 900 to 1,000 Btu per cubic foot at pipeline pressure of 1,000 pounds per square inch. Design of a prototype plant to demonstrate the SYNTHANE coal gasification process was completed and construction of a pilot plant at the Bureau of Mines facilities in Bruceton, Pennsylvania, began in early 1973. The plant will also be capable of processing 75 tons of raw coal per day into pipeline-quality gas. The Bureau experimented successfully in proving that coal containing nearly 5 percent sulfur and 16 percent ash could be liquified with hydrogen to yield a premium fuel oil essentially ash free and containing only 0.2% sulfur.

8. World Mine Production and Reserves:

(Bituminous coal and lignite)	Production 1972	Production 1973 e/	Recoverable Reserves 1/ (Billion short tons)
United States	2/ 595,386	3/ 590,000	197
Australia	91,847	100,000	4/
Belgium	8,316	8,500	
Canada	20,949	23,000	
France	25,379	23,000	
Germany, West	226,693	215,000	
India	85,802	90,000	
Japan	30,581	25,600	
South Africa, Rep. of	62,946	63,000	
United Kingdom	128,328	110,000	
Other Free World	101,765	100,000	
Communist countries (except Yugoslavia)	1,781,900	1,830,000	
World Total	3,159,892	3,178,100	

9. World Resources: The estimated identified resources of bituminous coal and lignite in the United States total 1,560 billion short tons, according to an estimate made by the U.S. Geological Survey in 1972. Known resources of bituminous coal, lignite, and anthracite in all other countries, as published in "The World Power Conference Survey of Energy Resources in 1968," total 8,037 billion short tons.

January 1974

COBALT

(Data in short tons of metal, unless noted)

1. Domestic Production and Use: Domestic mine production ceased at the end of 1971. About 20 refiners and processors were active in the production of cobalt products. Industrial consumers totaled about 250 with the largest ones in Pennsylvania, Michigan, New York, New Jersey, Illinois, Ohio, and Indiana. Major end uses in 1972 were electrical, 31%; transportation (aircraft), 22%; machinery, 15%; paints, 12%; ceramics and glass, 10%; chemicals, 7%; and other, 3%.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Mine	W	W	W	-	-
Secondary	164	34	62	98	137
Imports for consumption	6,456	6,208	5,456	6,958	9,335
Exports (gross weight)	1,628	1,350	606	1,349	2,145
Consumption	7,804	6,684	6,250	7,065	9,382
Price (range): Metal, f.o.b. New York, Chicago, Ill., per lb.	\$1.85-\$2.20	\$2.20	\$2.20	\$2.45	\$2.45-\$3.30
Stocks: Consumer	1,096	945	706	596	806
Employment: Mine	Not available				

3. Import Sources (1969-72): Zaire 45%, Belgium-Luxembourg 29%, Norway 8%, Canada 6%, Other 12%.

4. Tariff:

	Number	Rate of duty 1/1/74	Rate of duty Statutory
Ore and concentrate	601.18	Free	Free
Unwrought metal, waste, and scrap	632.20	Free	Free
Alloys, unwrought	632.84	9% ad valorem	45% ad valorem
Oxide	418.60	0.7¢/lb.	20¢/lb.
Linoleate	490.40	3.6¢/lb.	14.5¢/lb.

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate.
W Withheld to avoid disclosing individual company confidential data.

Prepared by John D. Corrick, telephone number (703) 557-0602.

6. Events, Trends, and Issues: The producer price of cobalt increased from $2.45 per pound to a high of $3.30 per pound during the year. By the fourth quarter of 1973 the price appeared to have stabilized at $3.20 per pound. Future prices will depend more upon international monetary stability than upon cobalt's availability.

Government sales of cobalt from the national stockpile remained brisk throughout 1973. Future Government sales should moderate prices for the next 3 to 4 years.

Production resumed in March 1973, at the Kristiansand refinery in Norway which was heavily damaged by fire in 1972.

The United States continued to rely on imports of cobalt to meet demand. U.S. imports of primary cobalt as a percent of apparent consumption in 1972 were 71%.

Nickel and cobalt may be intersubstituted, depending upon the economics of the particular application.

U.S. demand for cobalt is expected to increase at an annual rate of about 1% through 1980.

The fact that cobalt is a byproduct transfers environmental considerations to the mining and processing of pyrites, iron, copper, and nickel from which it is derived. Conflicting land use, air pollution, and waste disposal have not been problems at properties that produced cobalt in the United States.

7. Government Programs: Government loans through Office of Minerals Exploration up to 50% of approved costs for exploration of eligible cobalt deposits.

Stockpile objective for cobalt changed from 19,100 tons to 5,972 tons in April 1973, by Executive Order 11051.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Cobalt	5,972	30,062	24,090	10,962	4,025

8. World Mine Production and Reserves:

	Mine Production 1972	Mine Production 1973 e/	Reserves Quantity	Reserves Grade of ore %
United States	-	-	28,000	0.06
Canada	2,076	2,500	193,000	.03-0.06
Morocco	1,261	1,300	14,000	5.0-14.0
New Caledonia and Australia e/	815	1,000	740,000	.1-5.0
Zaire	14,330	15,400	750,000	.3-2.0
Zambia	2,263	2,300	383,000	.05-0.25
Other Free World	1,400	2,000	25,000	.1
Communist countries (except Yugoslavia)	3,500	3,600	597,000	.07-.1
World Total	25,645	28,100	2,730,000	

9. World Resources: The identified cobalt resources of the United States are more than 500,000 tons chiefly in sulfide ore deposits in the Appalachian and midcontinent regions. The identified cobalt resources of the world are more than 4,500,000 tons. The world's hypothetical and speculative resources of cobalt in manganese nodules on the sea floor and lateritic iron-nickel deposits of tropical regions, probably amount to many more millions of tons.

COLUMBIUM

(Data in thousand pounds, gross weight, unless noted)

1. Domestic Production and Use: There is no domestic columbium mining industry. Metals and alloys are produced from imported concentrates, tin slags, and ferrocolumbium. Eleven companies processed imported concentrates and tin slags. End uses: Construction 38%; oil and gas industries, 20%; machinery, 20%; transportation, 18%.

2. Salient Statistics—United States:

	1969	1970	1971	1972	1973 e/
Mine production			None		
Imports for consumption: Concentrate	4,161	5,719	3,054	3,227	2,910
Consumption: Metal content of raw material consumed	2,918	3,289	2,346	2,489	2,680
Prices: Columbite 1/	\$1.00	\$1.09	\$0.90	\$0.95	\$1.28
Pyrochlore 2/	\$1.00	\$1.07	\$1.15	\$1.27	\$1.38
Stocks		Not available			
Employment: Processor and refinery e/	600	600	600	600	600

3. Import Sources (1969-72): 3/ Brazil, 62%; Canada, 16%; Nigeria, 14%; Other, 8%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Statutory
Columbium concentrate	601.21	Free	Free
Columbium metal	628.15	5% ad valorem	25% ad valorem
Ferrocolumbium	607.80	5% ad valorem	25% ad valorem

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate. NA Not available.
1/ Average price per pound of contained pentoxides for material having a Cb_2O_5 to Ta_2O_5 ratio of 10 to 1.
2/ Average contract price per pound of pentoxide.
3/ Excludes tin slags.
4/ Pounds of columbium.

Prepared by J. A. Sutton, telephone number (703) 557-0547.

6. Events, Trends, and Issues: Devaluation of the dollar caused substantial changes in the prices of columbium-mineral concentrates imported for domestic consumption. Domestic demand for columbium is expected to increase at an annual rate of about 5% through 1980. There are no commercial reserves of columbium in the United States. However, potential columbium resources do occur. These deposits contain minerals low in columbium and probably will not be recovered unless prices are attained ranging upward from $12 per pound of contained columbium. Supply needs are expected to be met by foreign mine production coupled with Government stockpile releases. Imports of primary materials as a percent of consumption of primary materials in 1972 were 74%.

Vanadium is interchangeable with columbium as an alloying agent in high-strength steel. Domestic potential resources are not large in comparison to estimated world total, and some means of employing these would tend to minimize future spot supply problems. Specifically, the practicability of extracting columbium from such resources deserve attention. Fumes, gases, and dust are generated by columbium processing plants but can be controlled by modern technology.

7. Government Programs: Office of Minerals Exploration participation is 50%. Stockpile objectives were revised downward for columbium carbide powder, ferrocolumbium, and columbium metal.

Stockpile Status 4/--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Columbium:					
Carbide Powder	16,000	21,372	5,372	1,372	-
Concentrate	-	4,376,453	4,347,705	2,596,152	1,349,237
Ferro	748,000	930,000	182,000	-	174,450
Metal	36,000	44,851	8,851	-	-
Oxide Powder	-	-	-	-	71,537

8. World Mine Production and Reserves:

	Mine Production (concentrate) 3/ 1972	1973 e/	Reserves (thousand pounds) Cb_2O_5 in Ore
United States	-	-	-
Brazil	21,382	17,100	12,876,000
Canada	8,173	6,500	2,150,000
Malaysia	50	40	5,700
Mozambique	90	70	58,600
Nigeria	2,961	2,400	930,000
Zaire	130	100	143,000
Other Free World	349	290	68,700
Free World Total	33,135	26,500	16,232,000
Communist countries (except Yugoslavia)	NA	NA	NA

9. World Resources: Most of the world's identified resources of columbium lie outside the United States and are in pyrochlore type deposits. On a worldwide basis, resources are more than adequate to supply the projected needs to the year 2000. The identified pyrochlore resources are largely in Brazil and Canada.

COPPER

(Data in thousand short tons of copper, unless noted)

1. Domestic Production and Use: In 1972 the leading 25 mines produced 93% of the domestic mine output; of these, five produced 41%. Three companies accounted for 60% of mine output. Eight companies operated 15 primary smelters and 11 companies operated 16 refineries. Principal copper-producing States were Arizona (with 55% of the total), Utah (16%), New Mexico (10%), Montana (7%), Nevada (6%), and Michigan (4%). Smelters were generally located in the principal mining States with the exception of the El Paso, Tex. and Tacoma, Wash. facilities. About half of the refinery capacity was located along the middle Atlantic coast with most of the remainder near primary smelters. Most copper is consumed as refined metal--68% by wire mills and 30% by brass mills. Old copper scrap was consumed by brass mills (42% of the total), primary and secondary smelters (54%), and foundries, chemical plants, and other (4%). Use of copper (primary and old scrap) is estimated to be 52% electrical, 18% construction, 13% industrial machinery, 9% transportation, 3% ordnance, and 5% miscellaneous. Significant quantities of byproducts and coproducts such as gold, silver, molybdenum, nickel, selenium, tellurium, arsenic, rhenium, lead, zinc, and sulfur were recovered.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Mine	1,545	1,720	1,522	1,665	1,717
Refined copper: Primary	1,743	1,765	1,592	1,873	1,830
Secondary	499	512	401	423	360
General imports: Blister	238	224	157	157	150
Other primary forms	170	166	195	247	200
Secondary	6	2	7	11	11
Exports: Refined	200	221	188	183	200
Other primary forms	6	69	37	18	40
Secondary, old (copper content)	41	63	50	45	90
Consumption: Refined	2,142	2,043	2,020	2,239	2,350
Price: Average, cents per pound	47.9	58.2	52.0	51.2	59.5
Stocks: Producer (refined)	39	130	75	57	40
Employment, mine and mill	22,800	23,500	24,000	23,300	24,000

3. Import Sources (1969-72): Canada 31%, Peru 27%, Chile 22%, Republic of South Africa 6%, Other 14%. In 1972 Canada supplied 36% of imports with Chile and Peru declining in importance.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Ore	602.30	1/0.8¢/lb.	4¢/lb.
Unwrought copper, waste and scrap	612.02-612.10	1/0.8¢/lb.	4¢/lb.

5. Depletion Allowance: 15% (Domestic), 14% (Foreign).

e/ Estimate.
1/ Temporarily suspended by Public Law 93-77, effective to June 30, 1974.
Prepared by Harold J. Schroeder, telephone number (703) 557-0226.

6. Events, Trends, and Issues: Preliminary 1973 data, on a refined copper basis, indicated that the United States experienced reduced production, net exports, near record high consumption, and a drawdown of industrial stocks. A shortage of available copper relative to demand developed in the first quarter and became a critical supply problem for some users. Salient factors causing the imbalance included: A surge in world demand; disruptions to production in Chile, Canada, and Belgium; some curtailment in domestic output to meet air quality standards; transport problems in Canada and Zambia; and the effect of U.S. economic controls coupled with a rapid escalation of world prices. Several of the supply disruptions were resolved but the continuing high demand and depleted inventories left supplies tight at yearend. The national copper stockpile objective was reduced to zero in March making available 252,000 tons of surplus copper pending congressional authorization. Domestic copper price quotations were increased by 9-1/2 cents per pound in three steps during the first quarter of 1973 to a quoted price of 60 to 60-1/4 cents per pound. Price controls prohibited any price increase between early June and December 6 after which most quotes were increased by 8 cents to 68 cents per pound. Copper-base scrap had been exempted from price controls on August 6.

Domestic copper demand is forecast to increase at an annual average growth rate of 4% through 1980. New mine projects and expansion plans are in approximate balance with the forecast consumption increases and should maintain the present high degree of self-sufficiency. Concern over emission of sulfur compounds to the atmosphere during smelting is a pressing problem facing the domestic copper industry. Uncertainties surrounding air quality standards has delayed construction of new smelter facilities and could create a problem if some older facilities were forced into early closure. New technology and large capital investments will be required to either modify existing pyrometallurgical practices or adopt new hydrometallurgical processes as a solution to the problem if the United States is to maintain a viable copper industry. The domestic copper industry also faces potentially critical conflicts on land restoration standards, waste disposal, water supply, and aesthetic values. Copper is vulnerable to substitution for many uses such as aluminum for electrical purposes, steel for shell casings, and plastics for plumbing. Use of copper cladding and improved alloys for thinner gauge sheets and tubes extend the use of copper.

7. Government Programs: Office of Minerals Exploration is authorized to grant loans for 50% of approved costs on exploration of copper. However, no loans involving copper have been awarded since 1969. In late December Congress authorized disposal of 251,600 tons of stockpile excess.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Copper	-	252	252	-	-

8. World Mine Production and Reserves:

	Mine Production 1972	Mine Production 1973 e/	Reserves
United States	1,665	1,717	83,000
Canada	801	900	33,000
Chile	799	800	58,000
Peru	248	240	23,000
Zaire	473	510	20,000
Zambia	791	800	29,000
Other Free World	1,437	1,533	82,000
Communist countries (except Yugoslavia)	1,100	1,200	42,000
World Total	7,314	7,700	370,000

9. World Resources: Identified copper resources occur principally in western North America and South America, central Africa, southeastern and central Europe, and the U.S.S.R. Hypothetical resources, located near known deposits, probably contain 400 million tons of copper. An additional speculative 320 million tons of copper is assigned to areas not yet prospected. Also, at least 380 million tons of copper are presumed to exist in subeconomic deposits, copper-nickel deposits, and deep sea nodules.

January 1974

CORUNDUM

(Data in short tons of corundum, unless noted)

1. Domestic Production and Use: Corundum was not produced in the United States, and in recent years the entire domestic supply has consisted of material imported by one firm in Massachusetts. Another firm, also in that State, accounted for one-half of the total domestic consumption. Corundum was used in grinding and polishing optical components, 45%, fabricated metal products, 40%, and other, 15%. Alternate competitive abrasives are garnet, diamond, fused aluminum oxide, and silicon carbide.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production		None			
Imports	-	-	48	-	-
Exports		Not available			
Apparent consumption		Not available			
Price: (Average value of imports per ton)	1/$21.23	1/$21.23	$54.56	1/$55.00	1/$55.00
Stocks		Normal working stocks only			
Employment: Mill	25	25	25	25	25

3. Import Sources (1969-72): Kenya 100%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Statutory
Ore and concentrate	519.17	Free	Free
Graded materials	519.37	0.4¢/lb.	1¢/lb.

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate.
1/ Estimated declared value if not embargoed.

Prepared by R. G. Clarke, telephone number (703) 557-0605.

6. Events, Trends, and Issues: The inventory of abrasive corundum crude and grain was essentially depleted in 1973. The principal user was forced to consider an alternate abrasive, reluctantly. Southern Rhodesia (now embargoed by the United Nations) was the single source of supply for abrasive corundum. The United States has abided by the embargo so that no abrasive corundum was imported from Southern Rhodesia in the period 1969 to 1973.

7. Government Programs: The Government grants loans through the Office of Minerals Exploration for up to 50% of approved costs for exploration of eligible corundum deposits. Stockpile objective for corundum has been abolished.

8. World Mine Production and Reserves:

	Mine Production		Reserves
	1972	1973 e/	
United States	-	-	No U.S. Reserves.
South Africa, Republic of	324	324	Reserves elsewhere
Southern Rhodesia	e/3,000	3,000	are large but data
Other Free World	492	500	on the quantity and
Communist countries (except Yugoslavia)	e/7,700	7,700	grade are not
World Total	11,516	11,524	available.

9. World Resources: The United States has no reserves of corundum and the resources are poorly known. Data are not available for Rhodesia, South Africa, the U.S.S.R., and other countries where deposits have been found but not evaluated.

January 1974

DIAMOND (INDUSTRIAL)

(Data in million carats, unless noted)

1. Domestic Production and Use: All industrial diamond produced domestically, the output of two firms with plants in New Jersey and Ohio, was synthetic grit in sizes suitable for use in saws and grinding wheels. About 83 firms, mostly in Northeastern and North Central States, engaged in secondary production (salvage). Percent consumption for or in major uses was: Transportation equipment 20; electrical machinery 16; other machinery and equipment 16; contract construction 11; mineral services (drilling) 8; shaping of stone, clay, and glass products and of abrasives 19; and other 10. Competitive materials are cubic boron nitride, fused aluminum oxide, and silicon carbide as manufactured abrasive materials; and, garnet, emery, and corundum as natural abrasive materials.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Manufactured diamond	13.0	13.0	13.0	15.0	17.0
Secondary	3.0	3.0	3.0	2.6	2.0
Imports	14.1	13.4	12.9	15.1	19.0
Exports, including reexports 1/	11.7	12.2	11.3	13.3	15.0
Apparent consumption	18.4	17.2	17.6	19.4	23.0
Price: Value of imports per carat	$3.75	$3.67	$3.56	$3.48	$3.55
Stocks	No accumulation of stocks by importers or users				
Employment	Not available				

3. Import Sources (1969-72): (By carat) Ireland 48%, Republic of South Africa 13%, United Kingdom 10%, Belgium-Luxembourg 10%, Other 19%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Synthetic diamond 2/	520.21	7.5% ad valorem	30% ad valorem
Miners' diamond	520.23	Free	Free
Crushing bort	520.27	Free	Free
Powder or dust	520.28	Free	Free
Other:			
Not advanced in condition or value	520.29	Free	Free
Advanced in condition or value	520.31	7.5% ad valorem	30% ad valorem

5. Depletion Allowance: 14% (Domestic), 14% (Foreign).

e/ Estimate.
1/ Excluding diamonds in manufactured abrasive products.
2/ P.L. 89-241, effective October 8, 1965, rates of duty for synthetic miners' diamond (520.19) and synthetic diamond powder or dust (520.20), Free. Rates for other synthetic diamond (520.21), as indicated.

Prepared by R. G. Clarke, telephone number (703) 557-0605

6. Events, Trends, and Issues: The demand for industrial diamond is expected to increase at an annual rate of about 4% through 1980. There are no known domestic natural industrial diamond resources, but the potential for diamond synthesis is more than adequate for the smaller sizes. Synthesis of larger industrial diamond, usable as industrial stones, is not commercial; hence the United States is dependent on imports of stones or releases from Government stockpile. Prices for the smaller sizes have decreased due to competition by domestic synthetic diamond and by imports of natural and synthetic diamond. Prices for larger sizes have increased because more than 50% of stones classified as industrial can become gem stones by laser beam treatment. Cubic boron nitride, synthesized by methods similar to those in making diamond, was used as a substitute for industrial diamond in many more applications in 1973.

7. Government Programs: The Government will grant loans through the Office of Minerals Exploration for up to 50% of approved costs for exploration of eligible industrial diamond deposits.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Crushing bort	-	39.2	29.2	15.5	2.1
Industrial stones	-	22.6	22.6	2.6	0.8

8. World Mine Production and Reserves:

	Production 1972	Production 1973 e/	Reserves
United States	-	-	
Ghana	2.4	2.0	25
Republic of South Africa	4.0	4.5	50
Other Free World	5.0	5.0	30
U.S.S.R.	7.4	8.0	25
Zaire	12.4	13.0	500
World Total	31.2	32.5	630

9. World Resources: The diamond reserves of the United States are nil and the resources are small. The potential for discovery of resources of diamond in the United States is regarded as low. Technology has been developed to synthesize diamond for industrial use worldwide in the range of sizes for bort, powder, and dust. World resources for industrial diamond in the size range of stones are unknown.

DIATOMITE
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: The domestic diatomite industry consisted of 9 firms with 11 operations engaged in both mining and processing during 1972. Four firms with 6 operations supplied the bulk of production. The value of 1972 production was $37.6 million. The major end uses in 1972 were: filter aid, 58%; insulation, 4%; and industrial fillers and other miscellaneous uses, 38%.

2. Salient Statistics—United States:

	1969	1970	1971	1972	1973 e/
Production	598	598	535	576	607
Imports		Minor quantities imported			
Exports	176	154	142	148	170
Consumption	491	444	390	430	425
Price (Average per short ton f.o.b., mine)	$60.96	$54.63	$64.25	$65.19	$65.25
Stocks e/ (Producer, dealer)	37	37	40	38	40
Employment: Mine and mill e/	650	650	500	500	500

3. Import Sources (1972): Canada, Kenya, Mexico, United Kingdom.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Crude or processed	522.11	Free	Free

5. Depletion Allowance: 14% (Domestic), 14% (Foreign)

e/ Estimate. NA Not available.

Prepared by B. Petkof, telephone number (703) 557-1955.

6. Events, Trends, and Issues: The United States is a major world producer and supplier of diatomite and can supply its own current and future domestic demand. The domestic demand for this commodity is expected to increase at an annual rate of almost 6% through 1980. The United States exports about one-fourth of its production. Diatomite is particularly important as a mineral commodity because of its filtration capability. Standardized testing techniques have not been developed for evaluating the useful properties of the mineral from a particular deposit. All production is derived from open pit operations, and as with other bulk-type commodities, the problem of reconciling any conflicting land-use problems is always present. The current energy crisis could limit domestic diatomite output if supplies of fuel are inadequate to operate processing plants.

7. Government Programs: There are currently no formal government programs involving mining and processing of diatomite. Because of the adequacy of domestic supply, diatomite has never been classified as a strategic or critical mineral.

8. World Mine Production and Reserves:

	Production		Reserves
	1972	1973 e/	
United States	576	607	Large
Costa Rica	23	25	Large
Denmark	118	120	Large
France	190	190	NA
Germany, West	64	65	Large
Iceland	22	20	Moderate
Italy	65	65	NA
Mexico	25	25	NA
Spain	22	25	NA
Other Free World	59	60	Large
Communist countries (except Yugoslavia)	420	420	NA
World Total	1,584	1,622	

9. World Resources: World resources of crude diatomite are adequate for the foreseeable future, but the need for diatomite near markets and for particular purposes encourages development of new sources for the material.

FELDSPAR
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: Four companies supplied 77% and the next three accounted for 14% of the 1972 U.S. mine production of feldspar. Taken together, North Carolina, California, Connecticut, South Carolina, and Georgia (ranked according to tonnage) provided 98% of the 1972 output, and five other States contributed smaller quantities. Total employment in feldspar mines, mills, and grinding plants was estimated at 450.

Production of lithium ores and stone yielded minor quantities of byproduct or coproduct feldspar in 1972, and feldspar processors reported coproduct recovery of mica, clays, and stone.

The end-use distribution of feldspar in 1972 was: Glass, 50%; ceramics (pottery), 44%; coating and plating (porcelain enamel), 1%; and miscellaneous applications, 5%.

Feldspar can be replaced in some of its end uses by feldspar-silica mixtures, clays, talc, pyrophyllite, spodumene, or electric furnace slag, but the most important alternative materials are domestic aplite and imported nepheline syenite.

2. Salient Statistics--United States:

Salient Statistics--United States:	1969	1970	1971	1972	1973 e/
Production: Marketable	755	726	743	732	704
Industrial demand	793	648	602	581	600
Imports for consumption: Ground	5	4	2	1	1
Exports: Ground	6	6	4	5	10
Apparent consumption 1/	792	646	600	577	591
Price, average, per short ton	$11.75	$13.28	$13.42	$14.16	$13.60
Stocks, producer (December 31)	73	149	288	435	530
Employment: Mine and preparation plant	450	585	490	450	450

3. Import Sources (1969-72): Canada, 94%; Other, 6%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Crude	522.31	Free	50¢/long ton
Ground	522.41	3.5% ad valorem	30% ad valorem

5. Depletion Allowance: 14% (Domestic), 14% (Foreign).

e/ Estimate.
1/ Industrial demand plus imports minus exports.

Prepared by J. Robert Wells, telephone number (703) 557-0566.

6. Events, Trends, and Issues: U.S. mine production of feldspar reached an alltime peak in 1969 that was 17% higher than the average of the preceding 10 years (1959-68) and has since declined to about the level recorded in 1965. The 1973 output was 7% below the peak and 1% less than the 1963-72 average. Apparent domestic consumption of feldspar also crested in 1969, reaching a point 29% above the average of the preceding decade. Since 1969 it has shown a more markedly downward trend than that of the production figures; consumption in 1973, although slightly more than in 1972, was 10% below the 1963-72 annual average. Notably, glass-grade feldspar has remained in a relatively static position in the consumption pattern since the early 1950's in spite of the conspicuous growth of the container-glass industry in the interim; that stasis appears to follow from progressively increasing utilization for that purpose of both domestic aplite and imported nepheline syenite at the expense of feldspar. Although the growing concern over environmental deterioration from throw-away glass containers may eventually develop into a significant adverse factor, no substantial restraint on that score had yet made itself felt by the end of 1973. From a balancing of considerations it is expected that the declining trend will be reversed by mid-decade and that domestic demand for feldspar will then increase at an average rate of about 5% per year through 1980.

U.S. imports of feldspar have shown a fairly consistent downward tendency since 1960, and with the closing in 1972 of the last feldspar mine in Canada, appear to be drifting toward insignificance or extinction. Feldspar exports, in contrast, rose sharply in 1973 to approximately double the 1972 figure. Some stimulus may have been provided by devaluation of the dollar, but the most obvious upward influence was the increased demand from Canada, where there is no longer any domestic production of the mineral.

Except for secondary manifestations by way of discarded container glass, in which it is an important ingredient, the environmental and ecological impact of the feldspar industry is minor and restricted to comparatively small areas.

7. Government Programs: The domestic feldspar industry was not directly affected in 1973 by Government price controls but may have been held back to some degree by some roundabout consequences of those regulations.

8. World Mine Production and Reserves:

	Production		Reserves e/
	1972	1973 e/	
United States	732	704	560,000
France	146	125	6,000
Germany, West	337	320	6,000
Italy	194	175	6,000
Japan	64	55	6,000
Norway	165	150	10,000
Sweden	35	35	4,000
U.S.S.R.	287	300	40,000
Other	675	650	282,000
World Total	2,635	2,514	920,000

9. World Resources: Identified and hypothetical resources of feldspar are more than adequate to meet anticipated world demands. Exact quantitative data on hypothetical resources of feldspar existing in granites, pegmatites, and feldspathic sands have not been compiled. There is ample geologic evidence that they are immense, but are not always readily available to centers of consumption.

January 1974

FLUORSPAR

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: In 1973, eleven companies produced a total of about 241 thousand tons of finished fluorspar worth $16.8 million from mines in 8 States. One firm with properties in Illinois and Colorado and a second firm with properties only in Illinois and Kentucky provided approximately four-fifths of the national output. Remaining output came from small operations in Arizona, Kentucky, Nebraska, Nevada, Texas, and Utah. Twenty-nine mines and 5 froth flotation plants were in operation. Two of the above flotation plants and 5 mines were closed down during 1973. Small quantities of zinc, lead, silver, and gold were recovered as byproducts from three fluorspar flotation plants in Illinois and Kentucky. Major uses of fluorspar in 1972 were: steel fluxing, 40%; industrial chemicals, 36%; aluminum, 19%; and all others, 5%.

   In 1972 about 65,000 tons of H_2SiF_6 were recovered as a byproduct from phosphoric acid plants in Florida and Mississippi. Approximately 39,000 tons of H_2SiF_6, roughly equivalent to 65,000 tons of acid grade fluorspar, were used to make Na_3AlF_6, AlF_3, and a little hydrofluoric acid (HF), predominantly for use by the aluminum industry. Recovery of H_2SiF_6 is anticipated to increase 15% or better in 1973.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Finished (all grades) 1/	183	269	272	251	241
Imports for consumption:					
Acid grade	695	676	653	711	680
Metallurgical grade	455	416	420	471	460
Exports: Ceramic and acid grades	4	15	12	3	3
Consumption: Acid grade	736	767	743	731	720
(Actual) Metallurgical and ceramic grades	621	605	602	621	630
Price: Average mine value per ton	$46	$52	$63	$69	$69
Stocks: Mine	10	12	28	15	15
Consumer	290	420	437	378	350
Employment: Mine e/	325	414	546	600	600
Mill e/	243	218	245	270	280

3. Import Sources (1969-72): Mexico 77%, Spain 12%, Italy 6%, Other 5%.

4. Tariff:

Item		Number	Rate of Duty 1/1/74	Statutory
Acid grade	(+97% CaF_2)	522.21	$2.10/long ton	$5.60/long ton
Metallurgical grade	(-97% CaF_2)	522.24	$8.40/long ton	$8.40/long ton

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate.
1/ Shipments.

Prepared by H. B. Wood, telephone number (703) 557-0439.

6. Events, Trends, and Issues: World fluorspar production is basically related to the combined demand for this mineral by the iron and steel, chemical, and aluminum industries. In 1973, world demand held firm, although prices dropped slightly in some cases. Reserves are adequate to meet current world needs. Fluorspar production in specific areas is greatly affected by transporation cost. Production may be readily expanded in most of the leading producing countries, such as Mexico, Thailand, Republic of South Africa, United Kingdom, Spain, and Italy by a moderate price increase.

U.S. output of fluorspar, which represents only about 5% of the world total, declined by approximately 4%. On the other hand, byproduct fluorine from the phosphate fertilizer industry more than made up the loss. U.S. imports of fluorspar also decreased by about 4%, but total reported consumption apparently was about the 1972 level.

U.S. consumers depend on imports for about four-fifths of their combined requirements, and if salvaging and recycling techniques and the recovery of usable fluorine compounds from the phosphate industry had not improved in 1972-73, imports probably would have been greater. No substitutes for fluorspar appear to be economically satisfactory, although some minerals are metallurgically satisfactory for limited uses.

Because of the toxic nature of excessive fluorine or fluorine compound emissions in air or water, both the fluorspar froth flotation plants and the aluminum and chemical industry plants using fluorspar or fluorine compounds have been affected economically by the Federal Environmental Protection Agency regulations.

7. Government Programs: The Government, through the Office of Minerals Exploration, grants loans of up to 50% of approved costs for exploration of eligible deposits of fluorspar. An omnibus draft bill was submitted to Congress in April 1973 recommending disposal of 890,000 short tons of acid-grade and 252,800 short tons of metallurgical-grade fluorspar. As of yearend the bill had not been passed.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Acid Grade	-	890	890	-	-
Metallurgical Grade	159	412	253	-	-

8. World Mine Production and Reserves:

	Mine Production		Reserves	
	1972	1973 e/	Quantity	Grade % CaF_2
United States	251	241	25	35
Canada	180	180	7	35
Mexico	1,149	1,200	45	35
France	410	400	15	35
Italy	306	300	10	35
People's Republic of China	280	280	13	35
Spain	537	500	12	35
Thailand	435	460	30	35
U.S.S.R.	470	450	13	35
Others	1,132	1,189	101	35
World Total	5,150	5,200	271	

9. World Resources: Fluorspar resources total 840 million tons. One-third is in identifiable resources (reserves) which at the current rate of consumption may supply the world for about two decades. U.S. resources are estimated at 70 million tons of which 25 million are identifiable resources. World identifiable resources of byproduct fluorine in phosphate rock may total 150 million tons, equivalent to over 300 million tons of fluorspar. Total world resources of fluorine in phosphate rock may be 10 times larger.

January 1974

GALLIUM

(Data in kilograms of metal, unless noted)

1. Domestic Production and Use: Two companies, one with a plant in Bauxite, Arkansas, and the other with a plant in Quapaw, Oklahoma, accounted for the total domestic production of gallium. The entire output was derived as a byproduct of zinc and alumina production. The gallium content of finished end products is very small, and no gallium is recovered from discarded products. About 60 firms used about 9[illegible]% of the gallium in producing light-emitting diodes for visual display panels in calculators, radio, television, clocks, and other instruments.

2. Salient Statistics--United States:

Salient Statistics--United States	1969	1970	1971	1972	1973 e/
Production: Refinery	Company confidential data				
Imports	1,206	1,005	2,679	6,065	12,000
Exports	Not available				
Consumption	1,100	1,100	2,289	5,076	15,000
Price: Dollars per kilogram	850	850	850	800	750
Stocks, yearend: Producers	Company confidential data				
Employment: Refinery	10	10	10	15	15

3. Import Sources (1969-72): Switzerland 72%, United Kingdom 4%, West Germany 4%, Other 20%.

4. Tariff:

Tariff	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Gallium compounds	423.00	5% ad valorem	25% ad valorem
Gallium metal	632.24	5% ad valorem	25% ad valorem

5. Depletion Allowance: Not applicable.

e/ Estimate.
Prepared by E. Chin, telephone number (703) 557-0998.

6. Events, Trends and Issues: Consumption of gallium currently exceeds the U.S. production capability. Although one producer is expanding production capacity for recovering the metal in Arkansas, U.S. imports will continue to supply the bulk of the gallium needed to meet the sharply rising increase in demand for gallium in electronic applications through 1975.

   Gallium metal and compounds are considered relatively nontoxic. There are no known environmental restrictions on the production and use of gallium.

7. Government Programs: None.

8. World Mine Production and Reserves: Data on U.S. refinery production of gallium are company confidential. Data on world refinery production of gallium are not available but total world output probably is about 15,000 kilograms.

   There are no ores with a gallium content great enough to mine for gallium alone. Based on fragmentary data, domestic reserves of gallium are 2,700,000 kilograms, 2,000,000 kilograms in bauxite reserves and 700,000 kilograms in zinc reserves. World bauxite reserves are estimated to contain 108 million kilograms, and zinc reserves, 2 million kilograms.

9. World Resources: The world's most available resources of gallium occur in deposits of bauxite (aluminum) and sphalerite (zinc) from which it can be recovered as a byproduct. The geographic distribution of both bauxite and sphalerite is worldwide. The amounts of gallium potentially recoverable from coal ash, flue dust, and stack gases generated by industrial processing are very large.

GARNET

(Data in short tons of garnet, unless noted)

1. Domestic Production and Use: Abrasive-grade garnet was supplied in 1972 by four firms, two in New York, the State leading in output, and two in Idaho. Production from one of the New York producers was a byproduct of the wollastonite operation. Uses in manufacturing, distributed as follows, in percent, accounted for the 1972 consumption of abrasive garnet: aircraft, 28; flat glass, 19; optical glass, 13; other, 22; wood furniture, 9; transportation equipment other than aircraft, 9. All other natural and manufactured abrasives are competitive with garnet.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Mine	20,458	18,837	18,984	18,916	21,000
Imports			None		
Exports			Not available		
Apparent consumption	20,458	18,837	18,984	18,916	21,000
Price: Average value per ton	$91.60	$102.78	$101.78	$103.46	$105.00
Stocks			Normal working stocks only		
Employment: Mine and mill	150	150	150	150	150

3. Import Sources (1969-72): None.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Crude	520.11	Free	Free
Grain	519.37	0.4¢/lb.	1¢/lb.

5. Depletion Allowance: 14% (Domestic), 14% (Foreign).

e/ Estimate.

Prepared by R. G. Clarke, telephone number (703) 557-0605.

6. Events, Trends, and Issues: A domestic producer in New York announced cessation of coproduct garnet as of early 1973. Demand for garnet is expected to increase between 3.7 and 7.9% annually through 1980. Domestic resources are large and domestic production is adequate for all domestic needs. Although export data are not available, the U.S. is dominant in world trade. The use of garnet is in competition in all applications with natural and manufactured abrasives such as diamond, cubic boron nitride, fused aluminum oxide and silicon carbide; hence, potential substitutability of and for other substances is a continuing issue. The environmental effects of garnet mining are minor because of the relatively small annual tonnages. The operation in New York is by quarrying; tailings are used within the quarry property for fill and road maintenance. In Idaho, the operations are at placer deposits; the land is restored after the garnet-bearing gravel is removed.

7. Government Programs: None.

8. World Mine Production and Reserves:

	Mine Production		Reserves
	1972	1973 e/	
United States	18,916	21,000	There are large deposits of garnet in many countries, but data on the reserves are not available.
Argentina	60	80	
Australia	80	90	
India	3,480	4,000	
Sri Lanka	15	25	
U.S.S.R.	500	500	
World Total	23,051	25,695	

9. World Resources: Domestic resources of garnet are concentrated in a coarsely crystalline gneiss (a metamorphic rock) in the vicinity of North Creek, New York, where the deposits are large. Large resources of garnet occur also in Idaho, New Hampshire, and North Carolina. World resources of garnet are virtually unstudied, but are undoubtedly large.

GEM STONES

(Data in million dollars for all natural and synthetic gems except industrial diamond.)

1. Domestic Production and Use: Output of gem stones was primarily from Oregon, 29% and California, 8%. Collection of gem materials was mainly by individuals for recreation. Major uses were jewelry, mineral collections, and industrial.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Mine	2.4	2.4	2.6	2.7	2.7
Imports	567	486	526	716	947
Exports, including reexports	226	197	228	296	500
Apparent consumption	343	292	301	423	450
Price	Variable, depending on size, type, and quality				
Stocks	Not available				
Employment: Mine 1/	100	100	100	110	200

3. Import Sources (1969-72): (By value) United Kingdom 30%, Belgium-Luxembourg 25%, Israel 16%, and Republic of South Africa 15%. Diamond imports were about 90% of total. Price increases for diamond in 1972 and 1973 caused higher than usual apparent consumption.

4. Tariff:

Item	Number	Rate of Duty 2/ 1/1/74	Statutory
Natural precious and semiprecious stones	520.11	Free	Free
Diamond, cut, unset, less than 1/2 carat	520.32	4.0%	10%
Diamond, cut, unset, over 1/2 carat	520.33	5%	10%
Rubies, sapphires, cut, unset	520.35	4%	10%
Marcasites, cut, unset	520.37	5%	20%
Emeralds, cut, unset	520.38	Free	10%
Other, cut, unset	520.39	2.5%	10%
Precious stones, n.p.f.e.	520.51	7.5%	30%
Rock crystal, n.p.f.e.	520.54	10.5%	50%
Other, n.p.f.e.	520.61	21%	50%
Synthetic gem stone quality materials cut, unset	520.71	4%	10%
Other synthetic gem stone quality materials	520.75	15%	30%

5. Depletion Allowance: 14% (Domestic), 14% (Foreign).

e/ Estimate.
1/ Estimate includes operators of fee site deposits.
2/ Ad valorem.
3/ Principally gem diamond except in the United States in units of 1,000 carats.

Prepared by R. G. Clarke, telephone number (703) 557-0605.

6. Events, Trends, and Issues: Practically no natural precious gems are produced in the United States and large quantities of better grade natural and synthetic semiprecious gems are imported. As a result of higher prices, 1973 activity in the mining of jade, opal, and turquoise increased in the United States. The collection of gem materials by amateurs decreased. Natural stones commanded higher prices than synthetics for jewelry applications. The production of synthetic gem materials increased for industrial applications. Diamond stones formerly classified as industrials were upgraded to gem quality by laser treatment and by reclassification; a shortage of industrial stones at industrial stone prices was claimed.

7. Government Programs: None.

8. World Mine Production and Reserves 3/:

	Mine Production		Reserves
	1972	1973 3/	
United States	3	3	Reserves of gem diamond are substantial, especially in Africa. No reserve data are available for other gem stones.
Angola	1,171	1,200	
Botswana	360	360	
Brazil	155	160	
Central African Republic	346	300	
Ghana	266	240	
Ivory Coast	131	100	
Liberia	532	550	
Sierra Leone	609	500	
Southwest Africa	1,516	2,000	
South Africa, Republic of	3,370	3,500	
Tanzania	365	350	
Zaire	980	1,000	
Other Free World	216	200	
U.S.S.R.	1,850	1,800	
World Total	11,867	12,260	

9. World Resources: Gem stones occur in most of the major geologic environments, but they do not form ore deposits in the normal sense. The resources are mostly unevaluated.

GERMANIUM

(Data in pounds of metal, unless noted)

1. Domestic Production and Use: One refinery in Miami, Oklahoma produces all the primary domestic germanium from zinc smelter residues; it also reprocesses new scrap. In addition, three other companies in Pennsylvania and New York produce germanium from imported raw materials as well as scrap. This metal is a minor byproduct of ores mined for zinc with the supply of germanium being a function of the zinc production rate. Primary production is supplemented with recycled waste or new scrap. Waste recycle returns from 65% to 80% of the metal as scrap from cutting shapes used in the manufacture of semiconductors. At present no new residues are derived from the Kansas-Missouri-Oklahoma region or from Kentucky and Illinois. A significant supply of residues has been stockpiled and most of the primary germanium is obtained from treating smelter residues resulting from roasted zinc concentrates from the above areas. No mines are operated solely for recovery of germanium. Value of domestic germanium production approximates $5 million annually. Most of the consuming firms (about 50 in number) are located in the Northeastern United States, Texas, and California. Major end uses were electrical, 55%; specialized optical glass, 43%; and other uses, 2%.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Refinery	30,000	28,000	27,000	27,000	27,000
Imports for consumption	7,851	19,553	6,698	6,200	13,000
Exports		Not available			
Consumption, apparent	45,000	40,000	40,000	40,000	40,000
Price: Average domestic, cents per gram 1/	18.5	27.1	29.3	29.3	29.3
Stocks		Not available			
Employment 2/	35	35	35	35	35

3. Import Sources (1969-72): U.S.S.R. 40%, Belgium-Luxembourg 17%, Japan 13%, Czechoslovakia 9%, Other 21%. Imports have doubled over those of last year with West Germany and U.S.S.R. supplying 70% of the imported germanium in 1973.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Germanium dioxide	423.00	5% ad valorem	25% ad valorem
Metal, unwrought, waste and scrap 3/	628.25	5% ad valorem	25% ad valorem
Metal, wrought	628.30	9% ad valorem	45% ad valorem

5. Depletion Allowance: 14% (Domestic), 14% (Foreign).

e/ Estimate.
1/ Price is shown in cents per gram in 1,000-gram lots for first reduction quality.
2/ Employment directly related to primary germanium refining is in addition to that associated with zinc smelting.
3/ Duty on waste and scrap suspended until June 30, 1975, provided by P.L. 93-78.

Prepared by H. R. Babitzke, telephone number (703) 557-0212

6. Events, Trends, and Issues: Germanium is derived as a minor byproduct of ores mined for zinc, hence the primary supply of this metal in the United States is dependent on the zinc production rate. Significant quantities accumulate in germanium-containing refinery residues. Germanium also occurs as a trace element in some coal.

Since germanium is a minor byproduct of base metal ores, its sales have little effect upon the economics of extracting and producing the primary product. Nonetheless, the available supply of germanium has been enough to occasion considerable industry inquiry into potential new uses. Also, since this commodity is produced in small quantities as a minor byproduct of zinc operations, it has little or no effect on the ecology or environment.

Use of germanium in optics is growing to where it nearly equals that used in semiconductors. Germanium catalysts are widely used in the production of polyester fibers in Europe and Japan, but such catalysts are not currently used in the United States. Silicon has been of major importance as a substitute for germanium in semiconductors. Certain tellurium, selenium, indium, and gallium bimetals may also be used; however, germanium is more reliable in some high-frequency and high power requirements.

Demand for germanium is expected to increase at an annual rate of about 2% through 1980. The forecast domestic demand for germanium by the year 2000 is expected to range between 50,000 and 100,000 pounds. Projected domestic supply of germanium as a by-product of lead-zinc operations is not adequate to meet the probable demand to 2000. Historically the U.S. has imported 50% of its requirements of germanium and it is expected to continue to rely on foreign sources.

The price of domestic zone refined (intrinsic) germanium was \$133.88 per pound and germanium dioxide was \$75.96 per pound. These prices have been in effect since June 8, 1970. If the price of germanium were to increase significantly, recovery of the metal from certain coals would be economically feasible.

7. Government Programs: None. Germanium is not stockpiled.

8. World Mine Production and Reserves:

	Mine Production		Reserves
	1972	1973 e/	
United States	27,000	27,000	Reserves associated with base metal ores are ample but data by countries are not available.
Japan	40,000	40,000	
Canada	10,000	15,000	
Zaire	50,000	50,000	
Other Free World	16,000	16,000	
Communist countries (except Yugoslavia)	17,000	17,000	
World Total	160,000	165,000	

9. World Reserves: The largest readily available resources of germanium are in zinc (sphalerite) ores and the ash of coal from many deposits throughout the world. Additional potential sources include ores of copper and tin.

GOLD

(Data in million troy ounces of metal, unless noted)

1. Domestic Production and Use: The domestic industry consists of about 200 producing firms. Approximately 41% of domestic gold is produced as a byproduct of base-metal mining operations, chiefly copper. Four leading firms supply 76% of total production. Production in 1973 centered in South Dakota, Nevada, Utah, Arizona, Colorado, and Washington, 95%. Essentially all commercial grade refined gold comes from 14 primary and secondary producers. Four of these smelt crude materials. Estimated value of 1973 production is $122 million. The estimated number of manufacturing firms is 4,000, with nearly all jewelry manufacturing centered in New York City and Providence, R.I., areas. Estimated uses in 1973: Jewelry and arts, 56%, dental, 10%, other industrial, including space and defense, 34%. Karat values and sales of karat gold jewelry generally were reported to have declined in 1973. Selective and thinner gold plating methods received added attention. Substitution for gold has been limited mainly to alternate precious metals, chiefly palladium.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Mine	1.73	1.74	1.50	1.45	1.25
Refinery: New (domestic)	1.72	1.75	1.44	1.48	1.30
Secondary (incl. toll)	2.92	2.78	2.20	2.10	2.00
General imports 1/	5.86	6.65	4.20	6.13	4.00
Exports 1/	0.34	1.07	1.34	1.47	1.80
Consumption	7.11	5.97	6.93	7.28	7.65
Price, average selling: Dollars per ounce	41.51	36.41	41.25	58.60	97.50
Stocks, yearend: Treasury 2/ (billions of dollars)	11.86	11.07	10.21	10.49	11.65
Stocks, yearend: Industry 3/	4.16	3.98	4.38	4.41	4.40
Employment: Mine and mill e/	3,800	3,700	3,600	2,800	2,400

3. Import Sources (1969-72): Canada 51%, Switzerland 24%, Burma 9%, United Kingdom 3%, Other 13%. In 1972, 9% came from the U.S.S.R.

4. Tariff: No U.S. duties imposed on imports of unrefined gold or bullion.

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Plat.-silver plated gold	605.27 - 605.28	16-20% ad valorem	65% ad valorem
Rolled-semi-mfd. gold	605.60 - 605.66	12-20% ad valorem	30-65% ad valorem
Gold compounds	418.80 & 427.28	5% ad valorem	25% ad valorem

5. Depletion Allowance: 15% (Domestic), 14% (Foreign).

e/ Estimate.
1/ Excludes coinage.
2/ Includes gold in Exchange Stabilization Fund. Stocks valued at $35 (1969-1971), $38 (1972), and $42.22 (1973) per troy ounce.
3/ Refiners, dealers, and manufacturers.
4/ Includes gold recoverable as a byproduct from base-metal ores.
Prepared by J. M. West, telephone number (703) 557-1158.

6. Events, Trends, and Issues: U.S. mine production declined 14% in 1973. Output would have been higher except for a shortage of miners at a South Dakota mine.

Gold was revalued to $42.22 per troy ounce on September 21, 1973, under Public Law 93-110. As of October 18, 1973, Treasury gold stocks were valued at $11,652 million (276 million ounces at $42.22 per ounce). Free gold price levels were about $97-$100 on the New York market on November 1, but fell sharply in mid-November to $90, after it was announced that signers of the two-tier agreement which established a free market for gold in March 1968 had terminated the agreement. This termination opened the possibility that large world supplies of gold held by governments would become available for private purchase.

These price increases have encouraged mine development, and new operations are expected in 1974-75, particularly in Nevada and Alaska. New techniques in gold extraction technology should lead to significant cost reductions within the next several years. Open-pit mining, followed by heap-leaching and carbon column extraction now permits economical treatment of some ores containing 0.05 ounce of gold per ton.

U.S. demand, about six times mine production, was expected to set a record in 1973 with increased use in sundry industrial and electronic products more than offsetting decreased use in jewelry and dentistry. In addition to imports, part of 1973 demand was met by sales of bullion from foreign country stocks held in the New York Federal Reserve Bank (1.23 million ounces in the first 9 months). Worldwide demand continues strong, with some belief that supply is falling short of industrial demands. Demand for gold is expected to increase at an annual rate of about 2% through 1980. Interchangeability with other materials and greater efficiency in use by selective applications are limited by product quality standards and, thus, will do little to lower demand.

South African gold continues to dominate world supply although output was less in 1973 because of mining lower grade ores. Also, South Africa contributed less to world supplies in 1973 because, rather than market all production, the central bank placed a significant portion in official reserves (10% to 15% of output in first 8 months). The U.S.S.R. was a rising source of free market gold, owing to its need for foreign exchange.

Environmental considerations have excluded a significant portion of U.S. gold resources from production, particularly those categorized as placer deposits, which constitute one-fourth of the total.

7. Government Programs: Suspension of U.S. Treasury conversion of dollars to gold in official exchanges began August 15, 1971. and remained in effect. Phase III economic controls briefly limited domestic gold prices in June and July 1973. Exploration assistance continues under the Office of Minerals Exploration with Government financial participation 75%.

8. World Mine Production and Reserves:

	Mine Production		
	1972	1973 c/	Ore Reserves 4/
United States	1.45	1.25	82
Australia	0.75	0.80	10
Canada	2.08	2.00	25
South Africa, Republic of	29.25	27.80	600
Other Free World	4.07	4.20	83
Communist countries (except Yugoslavia)	7.11	7.40	200
World Total	44.71	43.45	1,000

9. World Resources: U.S. gold resources are largely in the Western States. The Lead (S. Dak.) and Carlin (Nev.) mines contain the principal reserves. Copper deposits, such as Bingham Canyon (Utah) also yield gold as a byproduct. Domestic resources are sizable but deposits are generally low grade. Few deposits contain measured reserves. Most of the world's resources are in the Republic of South Africa in relatively deep but persistent deposits and in the U.S.S.R., where much of the gold is in placer deposits.

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GRAPHITE (NATURAL)

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: One firm in Texas accounted for the entire domestic production of natural graphite in 1973. There were no byproducts, coproducts, or secondary production. Consumption was by several hundred manufacturing firms, located mainly in the Northeast and Great Lakes regions. In 1972, natural graphite was used mainly in refractories, 50%; iron and steel production, 16%; lubricants, 8%; and pencils, 3%. Alternate competitive materials include manufactured graphite, calcined coke, and molybdenum disulfide.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Mine		Company confidential data			
Imports for consumption	58	66	57	64	78
Exports	10	6	6	7	8
Consumption e/	61	51	60	70	70
Price: Domestic		Company confidential data			
Imports (average per ton at foreign ports):					
Flake	107	135	143	161	199
Lumps, chips, dust	215	368	292	107	291
Amorphous	34	36	37	47	44
Stocks			Not available		
Employment: Mine, mill, and processing plant	48	48	50	54	50

3. Import Sources (1969-72): Mexico 76%, Malagasy Republic 9%, Norway 6%, Sri Lanka 5%, Other 4%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Crystalline flake (not including flake dust);			
Valued not over 5.5¢/lb.	517.21	7.5% ad valorem	1.65¢/lb.
Valued over 5.5¢/lb.	517.24	0.4¢/lb.	1.65¢/lb.
Lump and chip	517.27	2.5% ad valorem	30% ad valorem
Other	517.31	Free	10% ad valorem

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate. W Withheld to avoid disclosing company confidential data.

Prepared by David G. Willard, telephone number (703) 557-0605.

6. Events, Trends, and Issues: Political problems restricted production in Sri Lanka and the Malagasy Republic, creating a world shortage of high-grade graphite. Lower-grade graphite remained plentiful. Substitute materials cannot be relied upon to replace natural graphite in many uses, except at substantially higher cost. Demand for natural graphite is expected to increase at an annual rate of about 1.6% through 1980. Because of the limited reserves, little growth in domestic production is likely. Foreign resources are considered enormous and more than capable of supplying all future U.S. demand requirements. However, availability of this supply to the U.S. could be seriously affected by adverse foreign developments.

Environmental controls on surface mining and processing water quality may affect domestic production.

7. Government Programs: The Office of Minerals Exploration lends up to 50% of approved costs for exploration.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Sri Lanka, amorphous lump	3	5	2	-	-
Malagasy, crystalline flake	5	11	6	-	-
Malagasy, crystalline fines	3	7	4	-	-
Other than Sri Lanka and Malagasy, crystalline	-	3	3	-	-

8. World Mine Production and Reserves:

	Production 1972	Production 1973 e/	Reserves
United States	W	W	Insignificant
Austria	21	18	Small
Germany, West	14 e/	14	Insignificant
Korea, South	45	50	Insignificant
Malagasy Republic	20	18	Large
Mexico	61	62	Large
Other Free World (including United States)	26	24	Small
Communist countries (except Yugoslavia)	213	213	Small
World Total	400	399	Moderate

9. World Resources: Domestic graphite deposits contain resources in excess of 10 million tons. One deposit is being exploited in Texas, but the flake graphite deposits in Alabama, New York, and Pennsylvania are too low grade, the flake and amorphous deposits in Alaska are too remote and the vein deposits in Montana are too small to be of commercial value. The rest-of-world resources of graphite are considered to be enormous, but no overall quantitative estimates have been made. Deposits containing a total of many hundreds of millions of tons are known, and total world resources may be many times that amount.

GYPSUM

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: In 1972 five firms produced 75% of the crude gypsum, and 31 firms supplied 25%, from 65 mines in 21 States. Principal producing States were Michigan, Texas, Iowa, and Oklahoma. About two-thirds of the total requirements of crude gypsum came from domestic sources. The leading States consuming crude gypsum were Texas, California, New York, Iowa, and Georgia. Fourteen firms, operating 76 plants in 30 States, produced 12.0 million tons of calcined gypsum of which 92% was used in manufacturing prefabricated products. Other uses of calcined gypsum were for industrial and building plasters. About 5.2 million tons of domestic, imported, and byproduct gypsum were sold or used uncalcined, 76% in portland cement, 22% as agricultural gypsum, primarily in the Western States, and 2% for other uses.

2. Salient Statistics--United States

Salient Statistics--United States	1969	1970	1971	1972	1973 e/
Production: Crude	9,905	9,436	10,418	12,328	13,700
Calcined	9,324	8,449	9,526	12,005	13,300
Imports: Crude, including anhydrite	5,858	6,128	6,094	7,718	7,400
Exports: Crude, crushed or calcined	40	41	49	51	50
Consumption: Crude	15,723	15,524	16,463	19,995	21,050
Value: Average crude (f.o.b. mine) per ton	$3.88	$3.72	$3.75	$3.93	$4.00
Stocks: Producer, crude e/	3,800	4,169	3,721	4,310	4,000
Employment: Mine and calcining plant	2,600	2,421	2,430	2,900	3,200

3. Import Sources (1969-72): Canada 78%, Mexico 15%, Jamaica 5%, Dominican Republic 2%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Crude	512.21	Free	Free
Ground and calcined	512.24	59¢/long ton	$1.40/long ton

5. Depletion Allowance: 14% (Domestic), 14% (Foreign).

e/ Estimate.

Prepared by Avery H. Reed, telephone number (703) 557-0580.

6. Events, Trends, and Issues: The gypsum industry continued its rapid expansion of recent years. Output of crude gypsum expanded 11% and was 45% more than in 1970. Demand for gypsum is expected to increase at an annual rate of about 4% through 1980. The use of prefabricated wallboard has gained universal acceptance for new construction, displacing the use of plaster. Imports from nearby countries continue to account for about one-third of the total demand.

Calcining plants are complying with Environmental Protection Agency standards. There are no serious environmental problems in the industry.

7. Government Programs: None.

8. World Mine Production and Reserves:

	Production		Reserves
	1972	1973 e/	
United States	12,328	13,700	350,000
Canada	7,942	8,000	410,000
France	6,451	7,000	Reserves are large
Italy	3,860	4,000	in major producing
United Kingdom	4,590	5,000	countries but data
Other Free World	20,228	21,000	are not available.
Communist countries (except Yugoslavia)	8,146	9,000	
World Total	63,545	67,700	2,000,000

9. World Resources: Domestic resources of gypsum are adequate for centuries to come, but are unevenly distributed. They are concentrated in the eastern Great Lakes region, the central midcontinent region, the Rocky Mountain belt from Canada to Mexico, and the southern California-Nevada region.

HAFNIUM

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: Hafnium is recovered as a byproduct in the production of hafnium-free nuclear grade zirconium-base alloys. One company with a plant in Oregon and another with plants in West Virginia and New York, produce primary hafnium sponge. Three companies located in New York, Oregon, and Pennsylvania accounted for the entire hafnium crystal bar output. Most of the hafnium production was used in naval reactors for control rods. Other uses were in ceramics, refractory applications, alloys, enamels, and as foil in photo flashbulbs.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Hafnium crystal bar	28	35	32	40	40
Imports (general):					
Hafnium	(1/)	(1/)	(1/)	(1/)	1
Exports (general):					
Hafnium			None		
Apparent consumption, hafnium crystal bar	28	29	33	35	35
Price: Per pound, domestic	$85	$85	$85	$85	$85
Stocks:	5	11	10	15	15
Employment: Metal plant	(2/)	(2/)	(2/)	(2/)	(2/)

3. Import Sources (1969-72): France 65%, Japan 8%, West Germany 7%, remainder Canada, U.S.S.R., United Kingdom, Belgium-Luxembourg.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Unwrought hafnium	628.35	5% ad valorem	25% ad valorem
Wrought hafnium	628.40	9% ad valorem	45% ad valorem

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

1/ Less than 1 ton.
2/ Small portion of primary zirconium metal plant employment, see pp. 190-191.

Prepared by S. G. Ampian, telephone number (703) 557-0567.

6. Events, Trends, and Issues: Increase use of hafnium foil in photographic flashbulbs, and hafnium as an alloying agent in forming high temperature refractory metals continued in 1973. Nevertheless, most hafnium metal was still used in naval nuclear reactors. Domestic hafnium demand is expected to increase at an annual rate of about 2% through 1980. This increased hafnium demand can only be met by increasing domestic production of reactor grade zirconium. Hafnium is available at reasonable costs as long as there is a continuing demand for reactor grade zirconium. Without such demand, the cost of hafnium would become prohibitively high.

7. Government Programs: There were no national stockpile objectives for hafnium minerals.

8. World Mine Production and Reserves: World primary hafnium production statistics are unavailable, but it is a necessary component in the production of hafnium-free nuclear grade zirconium metal and alloys.

9. World Resources: The identified resources of hafnium in the United States are estimated to be 100,000 tons, available in the 10.8 million ton identified domestic resources of zircon. The world resources of hafnium are associated with those of zircon, which are described in the appropriate chapter.

January 1974

HELIUM 1/
(Data in million cubic feet of contained helium measured at 14.7 psia @ 70°F)

1. Domestic Production and Use: Helium was extracted from natural gas during 1973 by 12 plants owned by eight private companies and the Bureau of Mines (two plants). Six of these extraction plants, including one owned by the Bureau of Mines, produced high purity (99.995 purity) helium for sale. Helium not sold was injected into the Government's partially depleted Cliffside gasfield in accordance with the long-range conservation program carried out by the Department of the Interior through the Bureau of Mines. Six helium extraction plants were located in Kansas, three in Texas, two in Arizona, and one in Oklahoma. The total value of helium production for 1972 was $57,147,000 and the estimated value for 1973 output was $47,580,000. Ten States, California, Texas, Florida, Mississippi, Ohio, Tennessee, Alabama, Washington, Nevada, and New Jersey, accounted for approximately 70% of the demand for high purity helium. The requirements of Government agencies; primarily the Department of Defense, National Aeronautics and Space Administration, and the Atomic Energy Commission; and Federal contractors approximated 60% of the estimated 1973 demand. During 1972, high purity helium was used primarily for purging and pressurizing in rockets and spacecraft, 35%; research, 16%; welding, 11%; and for maintenance of controlled atmospheres, 10%.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Helium extracted from natural gas 1/	4,662	4,600	4,565	4,090	3,230
High purity helium produced for sale	760	647	577	627	700
Imports			None		
Exports 2/	e/90	e/105	130	138	150
Domestic consumption 2/	e/670	e/542	447	489	550
Employment, plant e/	850	775	770	760	700

Price: Since 1961, the price of high purity helium f.o.b. Bureau of Mines plants has been set at $35 per thousand cubic feet for the purpose of financing the Government's helium conservation program. The price of high purity helium sold by private plants averaged $21 per thousand cubic feet during 1973.

3. Import Sources: None.

4. Tariff: Free.

5. Depletion Allowance: There is no depletion allowance on helium production but a depletion allowance of 22% is applicable to the output of natural gas from which helium is extracted.

e/ Estimated. NA Not available.
1/ Includes both high purity and crude helium (helium in mixtures consisting of approximately 70% helium and 30% nitrogen).
2/ High purity helium.
3/ Helium contained in natural gas with a minimum helium content of 0.3%. Excludes helium in conservation storage.
Prepared by Gordon W. Koelling, telephone number (703) 557-0239.

6. Events, Trends, and Issues: A rising trend in domestic helium demand, which began in 1972, continued during 1973 when sales increased approximately 12%, partially in response to increased requirements for research and in breathing mixtures. Demand for helium is expected to increase at an annual rate of about 7% through 1980.

On January 26, 1971, the Department of the Interior invoked the termination of the four contracts under which it purchased helium for conservation storage under PL 86-777. Under the termination notices, the Bureau of Mines was to cease the purchase of helium on March 28, 1971. However, in compliance with a District Court order obtained by three of the contractors, the Bureau of Mines continued to purchase helium from the three firms involved pending further order of the Court. This order was affirmed on appeal on the ground that the requirements of the National Environmental Policy Act had not been complied with.

Following the release of an environmental impact statement on November 13, 1972, the Department again terminated the helium purchase contracts. An injunction against such termination was granted by the District Court on the grounds that the impact statement was unsatisfactory. This court order was reversed on appeal in October 1973 and on November 12, 1973, the Department ceased the acceptance of helium for conservation storage. However, one of the companies involved in this litigation continued to deliver helium for one month to the Bureau of Mines for storage to its own account.

A ruling made by the U.S. Court of Claims on January 4, 1972, held that the Government had materially breached its contract with the fourth contractor not involved in the above litigation. The issue of damages is pending.

Argon may be used in place of and together with helium in welding, and nitrogen is used as a pressuring medium in place of helium in liquid-fuel rockets where weight is not a problem and where nitrogen is not exposed to subliquid nitrogen temperatures. Hydrogen can be substituted as a lifting gas but at the attendant risk of fire and explosion.

Helium is a colorless, odorless, nonflammable, inert gas and its utilization has no significant ecological impact.

7. Government Programs: The U.S. Bureau of Mines produces and sells high purity helium. The Bureau also maintains helium conservation storage in the Cliffside gasfield near Amarillo, Texas. An estimated 38,200 million cubic feet of helium was held in conservation storage at the end of 1973.

8. World Production and Reserves:

	Production 1/		Reserves 1/
	1972	1973 e/	1972
United States	4,090	3,230	3/136,000
Canada e/	35	35	NA
France e/	7	7	NA
U.S.S.R. and Communist countries (except Yugoslavia)	80	90	NA
World Total e/	4,212	3,320	NA

9. World Resources: Exhaustion of the few large gas fields which now supply most U.S. helium will cause resort to natural gas containing less than 0.3% helium unless comparable deposits are found. Natural gases with little or no fuel value but appreciable amounts of helium occur in the Rocky Mountain region, but their potential for supplying helium needs of the future is not fully established.

Inasmuch as helium orginates from the decay of uranium and thorium derived from igenous rocks, accumulations are not necessarily limited to areas where oil and gas are found. Uranium mining areas and volcanic and geothermal areas of the Western United States have untested potential for helium accumulation.

Little information is available on helium resources outside the United States. Gasfields in Canada and the U.S.S.R. are the only known sources of helium in gases containing more than 0.2% helium.

January 1974

ILMENITE 1/

(Data in thousand short tons of concentrate, unless noted)

1. Domestic Production and Use: Six firms produced concentrate from seven operations in New York, Florida, Georgia, and New Jersey. Two companies produced 66% of the total. About 72% was mined in Florida and New York. Value of mine shipments in 1972 totaled $19.8 million. Major coproducts of sand deposits are zircon and rutile; at hard-rock deposits, magnetite and hematite. Ilmenite and titanium slag were consumed by 17 companies. Five titanium pigment producers used 99% of the total ilmenite and titanium slag consumed. The rest was used in alloys and carbide, welding-rod coatings, ceramics, and miscellaneous.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production	931	868	683	740	839
Imports for consumption 2/	73	233	192	317	365
Exports (includes rutile)	1	1	2	2	2
Consumption 2/	1,142	1,098	1,044	1,050	1,150
Price, average: Per long ton, 54% TiO_2 f.o.b. Atlantic seaboard	$21	$21	$21	$23	$26
Stocks: Mine, distributor, and consumer 2/	951	919	772	677	700
Employment: Mine and mill	700	650	500	800	800

3. Import Sources (1969-72) 2/: Canada 83%, Australia 16%, Other 1%.
Imports of ilmenite, less than 20,000 tons in 1972, increased to 70,000 tons in 1973, responding to strong demand. Imports of slag remained constant at just under 300,000 tons.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Titanium ore (including ilmenite and ilmenite sand)	601.5120	Free	Free
Titanium slag	603.6200	Free	Free

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate. NA Not available.
1/ See also Rutile and Titanium.
2/ Includes titanium slag from Canada.
Prepared by F. W. Wessel, telephone number (703) 557-1392.

6. Events, Trends, and Issues: Domestic mine production of ilmenite increased 13% as a result of the first full year's production of a mine in Florida, which began operations in mid-1972, and a mine in New Jersey which started up in June 1973. A further increase of 8% may be expected in 1974.

Prices during the last half of the year were steady at $32 per short ton for ilmenite, and $61 per long ton for slag. Demand for ilmenite is expected to increase at an annual rate of about 4% through 1980. Reliance on imports, now 37%, is expected to reach 47% by 1980.

There are two major problem areas: (1) land-use conflicts where black-sand deposits exist, principally along the Atlantic littoral, and (2) the potential for water pollution from the pigment-producing process which uses ilmenite - about 3.5 tons of waste per ton of product. Solutions to the latter problem include the development of an economic process for making synthetic rutile from ilmenite, and the development of methods to neutralize and control the effluents now produced.

7. Government Programs: None. There is no ilmenite in the Government stockpile.

8. World Mine Production and Reserves:

	Mine Production		Reserves	
	1972	1973 e/	Quantity	Grade, $\%TiO_2$
United States	740	839	100,000	1.8-20.0
Australia	781	700	20,000	Recoverable
Canada	2/920	950	100,000	11.0-35.0
Norway	671	700	120,000	17.0
Other Free World	533	550	130,000	NA
Communist countries (except Yugoslavia)	NA	NA	100,000	10.0-20.0
World Total (excluding Communist countries)	3,645	3,739	570,000	

9. World Resources: Ilmenite supplies 85% of the world's demand for titanium. World ilmenite resources total 1.97 billion tons of titanium dioxide. Major resource units are in the Republic of South Africa (761 million tons), Canada (397 million tons), the United States (298 million tons), India (197 million tons), Norway, Sweden, and Finland (75 million tons), the U.S.S.R. (73 million tons), and Australia and New Zealand (57 million tons).

INDIUM

(Data in thousand troy ounces of metal, unless noted)

1. Domestic Production and Use: Domestic indium production came from the treatment of flue dusts and residues collected by smelters of base metal ores, mostly from zinc concentrates. Only one company refined these residues into metal, but others produced high purity shapes, alloys and compounds from the basic ingots. Estimated uses in 1973 were: electronic components 35%, instruments 30%, and other uses 35%.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Refinery	Company confidential data				
Imports, metal	283	401	388	628	890
Imports, ore for consumption	181	52	69	-	50
Exports	Not available				
Consumption - Apparent	Company confidential data				
Price, average annual, dollars per troy ounce	$2.50	$2.50	$2.50	$2.42	$1.75
Stocks, producer	Company confidential data				
Employment	Not available				

3. Import Sources (1969-72): Canada 44%, U.S.S.R. 14%, Peru 11%, Japan 9%, Other 22%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Metal, unwrought, waste and scrap 1/	628.45	5% ad valorem	25% ad valorem
Metal, wrought	628.50	9% ad valorem	45% ad valorem
Indium compounds	423.90	5% ad valorem	25% ad valorem

5. Depletion Allowance: 14% (Domestic), 14% (Foreign).

e/ Estimate. W Withheld to avoid disclosing company confidential information.
1/ Duty on waste and scrap suspended until June 30, 1975 according to P.L. 93-78.
Prepared by J. M. Hague, telephone number (703) 557-0213

6. Events, Trends, and Issues: Production in the United States has been decreasing in recent years because of the closing of some recovery facilities and the availability of low-cost imported metal. In 1973 the main sources of supply were imports and producers stocks. The smelting industry has indium-containing residues stockpiled for future sale or use. Demand for indium is expected to increase at an annual rate of about 1.5% through 1980. No toxic effects have been reported for indium and no special treatment has been required to remove it from waste products at smelters. Recent research and development has aimed toward greater use as a connecting medium in semi-conductor devices, as a component of low-melting-point alloys and solders, in silver-cadmium-indium alloys for reactor control rods, and in compounds used for infra-red detectors.

7. Government Programs: None. Price controls were removed December 6, 1973.

8. World Smelter Production and Reserves:

	Smelter Production		Reserves
	1972	1973 e/	
United States	W	W	10,000
Canada	503	500	16,000
U.S.S.R.	300	300	7,000
Australia	198	200	4,000
Peru	141	120	4,000
Japan	122	110	1,000
Other Free World	781	700	9,000
Other Communist countries (except Yugoslavia and U.S.S.R.)	155	150	2,000
World Total	2,200	2,130	53,000

9. World Resources: Identified resources of indium that are readily available come from zinc (sphalerite) concentrate produced from ores in many parts of the world. Economic and subeconomic identified resources are estimated at 102 million ounces; presently undiscovered resources could more than double this quantity by 2000.

IODINE
(Data in thousand pounds, unless noted)

1. Domestic Production and Use: In 1973, the entire domestic output of crude iodine was produced by one company recovering iodine and other chemical products from natural brines at Midland, Michigan. About 30 plants, located mainly in New Jersey, Michigan, and Missouri reported consumption of domestically produced and imported crude iodine. Estimated uses for iodine in 1973 were: Catalysts, 20%; household and industrial disinfectants, 20%; pharmaceutical preparations, 15%; animal and fowl feed, 15%; and other uses, 30%.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production	Company confidential data				
Imports: Crude	5,705	6,043	7,275	6,207	6,300
Exports: Processed	Not available				
Consumption (actual)	4,902	5,062	4,802	5,258	NA
Price (dollars per pound):					
Crude	1.24-1.30	1.30-1.45	1.45-2.27	1.86-2.27	2.06-2.27
Resublimed	2.20-2.42	2.42-3.50	3.50-4.00	3.97-4.00	3.97-4.00
Stocks	Not available				
Employment:	See bromine				

3. Import Sources (1969-72): Chile 28%, Japan 72%. In 1972, all imports came from Japan.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Statutory
Iodine, crude	415.25	Free	Free
Iodine, resublimed	415.25	8¢/lb.	10¢/lb.
Potassium iodide	420.20	12¢/lb.	25¢/lb.

5. Depletion Allowance: 14% (Domestic), 14% (Foreign).

e/ Estimate. NA Not available. W Withheld to avoid disclosing individual company confidential data.

Prepared by K. P. Wang, telephone number (703) 557-1794.

6. Events, Trends, and Issues: U.S. iodine price remained at $2.27 per pound, whereas Japanese iodine was raised from $1.86 to $2.06 early in 1973 and Chilean iodine cut down to the Japanese price by midyear. U.S. demand remained sluggish and stocks high, but imports continued at the 1972 pace. During the first 9 months of 1973, U.S. iodine imports came entirely from Japan, with Chile failing to resume shipments.

Japan will continue to dominate the world iodine scene. Output is expected to drop slightly, because of ground subsidence problems, then return to recent levels, and finally increase significantly again by the late 1970's. Japanese efforts to produce iodine abroad are likely to bear fruit in Indonesia as a start. Chilean output may not vary a great deal, and U.S. output probably will remain small until such times that a technical breakthrough is achieved under high price conditions. Meanwhile, U.S. consumption of iodine may grow at 3-5% annually.

7. Government Programs:

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Stockpile grade	-	8,012	8,012	-	-

8. World Mine Production and Reserves:

	Mine Production 1972	Mine Production 1973 e/	Reserves e/ Iodine content	Reserves e/ Iodine (percent)
United States	W	W	NA	0.004
Chile	5,000	5,000	800,000	.04
Japan	16,480	16,000	1,000,000-3,000,000	.01
Other Countries	NA	NA	NA	NA

9. World Resources: Reserves and resources of iodine in brines and nitrate deposits currently being exploited are at least 2 million tons, of which nearly a million occur in the Chilean nitrate deposits and most of the rest in the natural gas brines of Japan. Potential resources in these deposits and other iodine-rich brines are several times as large. Potential resources in the United States probably are several hundred thousand tons.

IRON ORE 1/
(Data in million long tons of ore, unless noted)

1. Domestic Production and Use: In 1972, iron ore was produced by 35 companies operating 58 mines and 48 concentration plants. The mines included 50 open pits and eight underground mines. In addition, three companies produced byproduct ore in four plants. Byproduct ore made up less than 1% of total production. Twenty mines operated by 11 companies accounted for 84% of total production of usable ore. Open pit mines produced 94% of total output, and 92% of all ore was concentrated before shipment. About 73% of all ore was agglomerated at or near the mine sites before shipment. Pellets made up 71% of usable ore shipments (66% in 1971). Average iron content of usable ore was 61%. Mine value of ore shipments was $950 million.2/ Minnesota produced 65% of domestic output; Michigan, 15%; and the remainder was produced in 18 other States. Total consumption of iron ore and agglomerates was distributed as follows: Blast furnaces, 98.4%; steel furnaces, 1.2%; and the manufacture of cement, heavy media materials and other products, 0.4%. In 1972, 27 companies owned a total of 216 blast furnaces, of which about 70% were producing pig iron at any given time. Consumption by region was: Maryland-Pennsylvania-New York, 31%; Illinois-Indiana, 25%; Ohio-West Virginia, 21%; and most of the remainder was consumed in nine other States.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production	88.3	89.8	80.8	75.4	88.0
Imports for consumption	40.7	44.9	40.1	35.8	42.0
Exports	5.2	5.5	3.1	2.1	2.7
Consumption, total	140.2	131.6	116.2	126.9	142.8
Price (Lake Superior ores, delivered rail of vessel at lower lake ports):					
Natural ores, basis 51.5% Fe, per gross ton	$10.55-10.95	$10.80-11.20	$11.17-11.57	$11.17-11.57	$11.91-12.31
Pellets, per long ton unit of Fe	25.2¢	26.6¢	28.0¢	28.0¢	29.4¢
Stocks: Mine, dock, and consuming plant	67.1	71.5	78.8	67.4	63.0
Employment: Mine and concentrating plant	18,646	17,041	15,859	14,493	14,600

3. Import Sources (1969-72): Canada 50%, Venezuela 31%, Liberia 6%, Other 13%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Statutory
Iron Ore	601.24	Free	Free

5. Depletion Allowance: 15% (Domestic), 14% (Foreign).

e/ Estimate.
1/ See also Iron and Steel, and Iron and Steel Scrap.
2/ Excludes byproduct ore.

Prepared by F. L. Klinger, telephone number (703) 557-0621.

6. Events, Trends, and Issues: World production, trade, and consumption increased about 10% in 1973, as demand for iron and steel continued to recover from reduced levels of 1971. Devaluation of the dollar caused substantial changes in foreign iron ore prices and some shifts in competitive position among major foreign suppliers. Freight rates continued to increase, particularly in oceanborne trade. At consuming centers in Japan and the United Kingdom, new port facilities capable of receiving ore cargoes of 100,000 tons or more were completed. The first iron ore cargoes of 200,000 tons or more were shipped in 1973. Growth of production capacity for prereduced iron ore was slow.

U.S. demand for iron in ore is expected to increase at an annual rate of about 2.4% through 1980. Domestic resources of iron in ore are ample to meet forecast of primary demand by the year 2000, but owing to competition between foreign and domestic ores, and the influence of geographic location on the choice of supply sources, imported ore is expected to supply about 30% of primary demand. Specific problems impeding greater development of domestic resources include: high investment costs for plant and equipment, difficulty of economically beneficiating low-grade hematitic ores, high costs of labor and transportation, and environmental considerations. Limited availability of fuels may be a factor over the short term.

There is basically no substitute for iron ore in blast furnace burdens. Prereduced ore may be substituted for pig iron or scrap in steelmaking furnaces if economic conditions permit.

The rising trend in iron ore prices is expected to continue. The quality of iron ore, as measured by iron content and physical structure of ore traded in domestic and world markets, is expected to trend upward, reaching an average grade of 65% iron in 10 years and 80% iron in 30 years.

Environmental aspects of iron ore mining and processing mainly concern disposal of large quantities of waste rock and overburden, and elimination of dust generated in processing plants. Most waste material has little or no value and cannot be recycled, but disposal areas are being reclaimed and some waste is used to fill mined-out areas. Mineral components of iron ores and associated wastes are generally nontoxic.

7. Government Programs: Office of Minerals Exploration participation is 50%. Iron ore is not stockpiled.

8. World Mine Production and Reserves:

	Mine Production		Reserves (billion tons)	
	1972	1973 e/	Quantity	Recoverable iron (at 1972 prices) (short tons)
United States	75.4	88.0	9.0	2.0
Australia	62.8	75.0	16.0	10.0
Brazil	41.4	45.0	27.0	14.8
Canada	39.5	45.0	36.0	11.7
France	53.4	56.0	8.0	2.7
India	34.5	35.0	9.0	6.2
Liberia	24.2	26.0	0.7	0.4
Sweden	32.6	34.0	3.3	2.2
Venezuela	18.2	20.0	3.7	2.3
Other Free World	105.0	109.0	20.3	9.9
Communist countries (except Yugoslavia)	269.6	277.0	116.0	34.5
World Total	756.8	810.0	249.0	96.7

9. World Resources: The six major continents contain vast identified resources of iron ore that exceed 760 billion tons. Iron ore reserves of the United States are about 9 billion tons and the subeconomic identified resources amount to an additional 88 billion tons. These resources are mainly in the low-grade ores of the Lake Superior region that require beneficiation and agglomeration for commercial use.

January 1974

IRON AND STEEL 1/

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: In 1972, the basic steel industry was composed of approximately 90 companies producing raw steel in 150 plants. Pig iron was produced by 27 companies owning 216 blast furnaces. Pennsylvania, Ohio, Indiana, Illinois, and Michigan accounted for 70% of the total iron and steel production. The foundry industry included approximately 1,600 ferrous foundries producing gray, malleable and ductile iron castings, and steel castings. End use distribution of the domestic iron demand in 1972 was estimated as follows: Transportation, 24%; construction, 24%; and machinery, 17%. The remainder went into cans and containers, the oil and gas industries, appliances and equipment, and other unclassified consumer and military goods.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Pig iron: Production	95,003	91,293	81,382	88,866	101,000
Shipments	95,472	91,272	81,332	89,048	101,000
Imports for consumption	405	249	306	637	450
Exports	44	310	34	15	15
Consumption (actual)	94,635	90,126	81,178	89,140	101,000
Steel:					
Production of raw steel	141,262	131,514	120,443	133,241	151,000
Shipments: Steel mill products	93,877	90,798	87,038	91,805	110,000
Steel castings	1,897	1,724	1,587	1,612	1,800
Iron castings	17,105	14,797	14,721	16,411	18,500
Imports of major iron and steel products	14,528	13,860	18,844	18,158	16,000
Exports of major iron and steel products	5,788	7,657	3,526	3,546	4,000
Price (Iron Age Composite):					
Pig iron (short ton)	$57.11	$61.99	$67.95	$71.15	$77.10
Steel, finished base (cents per pound)	7.091	7.650	8.429	8.999	9.400
Stocks: Pig iron	1,723	2,082	1,779	1,660	1,500
Employment: Blast furnaces and basic steel products 2/	643,800	628,400	577,900	572,700	610,000
Iron and steel foundries 2/	235,100	228,900	217,400	220,200	234,000

3. Import Sources (1969-72): Europe 45%, Japan 40%, Canada 9%, Other 6%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Pig iron 3/	607.15	Free	$1.125/long ton
Structural steel	609.80	0.1¢/lb.	0.2¢/lb.

5. Depletion Allowance: Not applicable.

e/ Estimate.
1/ See also Iron Ore and Iron and Steel Scrap.
2/ Bureau of Labor Statistics (SIC 331, 332).
3/ May not contain more than: Chromium, 0.2%; molybdenum, 0.1%; tungsten, 0.3%; and vanadium, 0.1%.

Prepared by F. E. Brantley, telephone number (703) 557-0620.

6. Events, Trends, and Issues: Strong worldwide demand for iron and steel resulted in an estimated production increase of 12% over 1972. New records were set by the major producing countries as most steel plants were operating at or near capacity by mid-1973. The increase, particularly in electric furnace output, placed a severe strain on the world's ferrous scrap supply. U.S. iron and steel scrap prices rose to record levels and controls were placed on exports, in order to assure supplies at reasonable prices for U.S. foundries and steel mills.

The Communist countries continued at or near their planned steel expansion rates. They also increased trade with the industrialized Western World, obtaining and contracting for large quantities of iron and steel-producing machinery and equipment. The United Kingdom joined the Common Market countries in 1973, making the European Community the world's largest steelmaking group.

U.S. iron and steel demand exceeded the capacity of domestic foundries and steel mills to keep pace with orders the last half of 1973. Delivery dates on some iron and steel products, particularly energy-related goods, carried delays ranging up to several months. Devaluation of the dollar tended to slow steel imports as many former foreign suppliers diverted products to more profitable and expanding world markets. U.S. steel mills continued high expenditures for pollution control equipment to meet State and Federal standards; also for replacement of obsolete mill equipment. The results of these expenditures over the past few years were apparent in the environmental improvements of plant areas. However, there were no announced plans for expansion of present U.S. blast furnace capacity.

A decline was noted in the number of small ferrous foundries, and output from larger foundries increased. Reasons cited by the smaller foundries for closing included excessive capital needed to install pollution control equipment which would meet Government clean air standards, and high cost or unavailability of critical raw materials. Ductile iron production increased markedly during 1973, reflecting a boom in use of this material.

Alternate and lighter materials, such as aluminum and plastics, were being substituted for iron and steel to some extent in the motor vehicle industry. This resulted from efforts to reduce overall vehicle weight and compensate for loss of motor efficiency due to installation of pollution control devices and additional safety equipment. However, availability, low cost, and specific material properties of iron and steel necessary to our economy are factors that are expected to result in these metals maintaining their present use pattern essentially intact over the next decade.

U.S. demand for steel to 1980 was expected to increase at an average rate of approximately 2%, as measured from the best fit of the past trend, 1915 through 1973. Variation from the average, both up and down, is anticipated. The demand for iron in domestic foundry and steel mill products was expected to range between 165 and 255 million short tons in 2000, with foreign contribution continuing at between 10 and 20% of total market requirements.

Although technological advances exerted a downward trend on prices, increased labor and raw material costs resulted in overall upward price movements. Price increases were expected to continue, especially in light of the energy crisis. As the energy situation worsened at the close of the year, industry fuel allotments were anticipated in 1974, which would result in a decline in U.S. steel output and demand during 1974.

7. Government Programs: None.

8. World Pig Iron and Raw Steel Production:

	Pig Iron		Raw Steel	
	1972	1973 e/	1972	1973 e/
United States	88,866	101,000	133,241	151,000
France	20,499	21,000	26,515	28,000
Germany, West	34,930	39,000	48,177	54,000
Japan	79,427	99,000	106,814	131,000
United Kingdom	16,715	19,000	27,912	30,000
Other Free World	94,647	104,000	136,593	149,000
Communist countries (except Yugoslavia)	163,722	174,000	216,037	229,000
World Total	498,754	557,000	691,551	772,000

9. World Resources: Not applicable.

January 1974

IRON AND STEEL SCRAP 1/
(Data in million short tons, unless noted)

1. Domestic Production and Use: In 1972, iron and steel scrap was produced by about 3,700 companies with 40,000 employees. An estimated 90% of domestic scrap was processed by 1,300 companies and brokers. About 80% of domestic scrap production was consumed by steel mills, which used scrap together with pig iron to produce steel products for the construction, transportation, machinery and equipment, container, appliance, and other consumer industries. The foundry industry consumed about 19% of domestic production to produce a number of gray, ductile, and malleable iron products such as motor blocks, pipe, and machinery parts. Relatively small quantities were used for the precipitation of copper and by the chemical industries.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Home scrap	56.3	52.6	49.2	51.2	57.0
Purchased scrap	43.7	39.7	39.5	48.0	50.0
Imports	0.3	0.3	0.3	0.3	0.3
Exports 2/	9.3	10.9	6.7	7.7	10.0
Industrial consumption	94.8	85.6	82.8	94.3	105.0
Price per long ton: Average No. 1 Heavy Melting composite price (Pittsburgh, Philadelphia, Chicago). Iron Age	$30.87	$41.06	$34.09	$36.32	$59.00
Stocks: Consumer (Dec. 31)	6.6	7.7	8.5	8.2	8.0

3. Import Sources (1969-72): Canada 95%, Other 5%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Statutory
Iron or steel waste and scrap:			
Tin plate waste or scrap	607.10	Free	Free
Other:			
Not containing .2% Cr, .1% Mo, .3% W, or .1% V	607.11	Free	75¢/long ton 3/
Containing .2% Cr, .1% Mo, .3% W, or .1% V	607.12	18¢/long ton 3/ plus additions	75¢/long ton 3/ plus additions

5. Depletion Allowance: Not applicable.

e/ Estimate.
1/ See also Iron Ore and Iron and Steel.
2/ Includes rerolling material and ships, boats, and other vessels for scrapping.
3/ Duty temporarily suspended as provided by P.L. 93-78 extended to June 30, 1975.

Prepared by H. E. Stipp, telephone number (703) 557-0622.

6. Events, Trends, and Issues: World demand for iron and steel scrap increased sharply in 1973 corresponding to the increased world production of iron and steel; domestic consumption of ferrous scrap was up approximately 13% over 1972. U.S. prices for ferrous scrap rose to all-time highs in the latter half of the year because of increasing domestic demand combined with high exports. Shortages of quality scrap for domestic steel mill and foundry uses, even at record high prices, resulted in adoption of an export licensing system in 1973. This was administered by the U.S. Department of Commerce, and was effective in reducing exports about 50% during the last quarter of the year.

Under controls, the rising trend in iron and steel scrap prices was expected to decrease somewhat in 1974, but to remain at a high level. U.S. demand for iron and steel scrap was expected to grow at about the same average rate as that estimated for steel, or 2 to 3%. However, shortages of domestic scrap have been predicted by many observers for the future. This is expected to occur if continuous casting increases, more electric steel furnaces are installed, and exports of scrap continue. There were indications that shortages and rising prices of iron and steel scrap would encourage consumers to turn to prereduced iron ore as a substitute for ferrous scrap.

Concern for the environment encouraged legislation and research directed towards increasing the consumption of iron and steel scrap, especially that now being lost in municipal waste dumps. A railroad rate increase for transporting iron and steel scrap, proposed by the railroads for adoption in 1973, was suspended because of consideration of the possible environmental impact.

The shortage of energy that became apparent at yearend prompted industry sources to point out that it takes 74% less energy to produce 1 ton of steel, using ferrous scrap as a raw material, than it does using iron ore.

The Federal Bureau of Mines conducted research throughout the year on methods of beneficiating and utilizing low-quality scrap. A large surplus of obsolete ships was released during the year and the U.S. Department of Navy made pier facilities available for civilian use to convert the ships to scrap suitable for domestic use. This and other actions were expected to increase the supply of iron and steel scrap available, thus helping combat the shortages and rising prices.

7. Government Programs: None.

8. World Mine Production and Reserves: Not applicable.

9. World Resources: Not applicable.

KYANITE AND RELATED MINERALS

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: Three firms, each with coordinated mining and processing operations (in Virginia, Georgia, and Florida, respectively), supplied 100% of the 1972 kyanite production. The material produced in Virginia and Georgia was from hard-rock, open-pit mines; that from Florida was one of the byproducts from the extraction of titanium minerals from old beach sands; minor quantities of stone and sand were recovered as byproducts in the Virginia and Georgia operations. Synthetic mullite was produced in 1972 by eight companies at operations in Alabama, Connecticut, Georgia, Kentucky, New York, Pennsylvania, and Tennessee. It was estimated that 95% of the total 1972 domestic kyanite-mullite output was used in refractories (40% for smelting and processing ferrous metals; 36% nonferrous metals; 14% glassmaking; and 5% for boiler furnaces). When added together, all uses other than for refractories accounted for 5% of the total consumption. Specific substitutes for kyanite and related minerals are two types of synthetic mullite, fused and sintered. Bauxite, or alumina derived from bauxite, and pure silica sand are the principal raw materials for synthetic mullite production. Other materials that may be used are kaolin and other clays. Alternates are super-duty fire clays and high-alumina materials used in the making of refractories.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Mine		Company	confidential	data	
Synthetic mullite	48.6	55.5	55.1	46.4	50.0
Imports for consumption	2.1	1.2	1.3	0.1	0.1
Exports	19.7	24.0	31.6	30.0	30.0
Apparent consumption			Not available		

Price: Domestic concentrate, 35- to 325-mesh, f.o.b. Georgia, $58 to $73 per short ton; imported kyanite, no current quotation; synthetic mullite, $50 to $350 per short ton, depending upon type and grade.

	1969	1970	1971	1972	1973 e/
Stocks (producer)		Normal	working stocks	only	
Employment: Kyanite mine and plant	175	140	165	165	175

3. Import Sources (1969-72): India, 80%; Republic of South Africa, 8%; Other, 12%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Kyanite, sillimanite, andalusite, and dumortierite	523.81	Free	Free
Mullite	523.91	7.5% ad valorem	30% ad valorem

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate. NA Not available. W Withheld to avoid disclosing individual company confidential data.

Prepared by J. Robert Wells, telephone number (703) 557-0566.

6. Events, Trends, and Issues: Domestic consumption of kyanite, as estimated from production figures, was 5% more in 1973 than in 1972 and has scored significant increases in 21 of the years since the close of World War II. Synthetic mullite production, with a less consistent record of annual increases, was 8% greater in 1973 than in 1972. Domestic demand for kyanite-mullite is expected to increase at an average rate of about 6% per year through 1980. Indicative of an optimistic assessment of the demand trend, in August 1973 one of the two major U.S. kyanite producers announced the initiation of a 30,000 ton-per-year expansion of its kyanite production facilities in Georgia.

U.S. exports of kyanite-mullite have increased by a factor of at least 30 since 1953, but figures reported since 1970, now extended to include a different class of material, are misleading and preclude any direct comparison with earlier data. U.S. imports of kyanite minerals, ceasing to be an influential item of foreign trade, have diminished -- along a fairly smooth curve -- to about 1/50 of the 1953 figure.

The environmental and ecological impact of the kyanite-mullite industry is minimal.

7. Government Programs: The kyanite-mullite industry was not significantly affected in 1973 by Government price controls. The Office of Minerals Exploration offered to grant loans up to 50% of approved costs for exploration of eligible kyanite deposits, but no loans for that purpose were made in 1972 or 1973.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Kyanite, lump	-	2.8	2.8	2.8	-

8. World Mine Production and Reserves:

	Production 1972	Production 1973 e/	Reserves
United States	W	W	30,000
Australia	1	1	500
India	79	75	5,000
South Africa, Republic of	61	70	5,000
U.S.S.R.	NA	75	20,000
Other	NA	10	32,500
World Total	NA	NA	93,000

9. World Resources: Immense resources of kyanite and high-aluminum minerals known to exist in the United States should permit the increase in production that will be needed to meet the demand expected during the next 25 years. Production now comes largely from kyanite-quartz deposits in the Southeastern States. Kyanite and sillimanite are also recovered as a byproduct from Florida ilmenite sands. The quantities represented by those deposits are very large but make up no more than 5% of our total resources. The remaining 95% or more is present in deposits of micaceous schist and gneiss, mostly in the Appalachian area and in Idaho, which are not being exploited at present although profitable mining of some may eventually be possible. The situation in regard to kyanite resources in the rest of the world is believed to be similar to that in the United States.

LEAD
(Data in thousand short tons of metal, unless noted)

1. Domestic Production and Use: MINES: The domestic mining industry currently comprises about 80 mines in 14 States. Leading 25 mines produced 95% of the 1972 output, and the leading 7 mines, all in Missouri, yielded 74% of the year's total mine production, valued at $196 million. Missouri supplied 80%, Idaho 10%, Colorado 5%, and Utah 3%. Six companies accounted for 88% of the total production. Major coproducts or byproducts are: Zinc, silver, antimony, and bismuth. SMELTERS & REFINERIES: Refined primary lead production is centered in Missouri, Idaho, and Nebraska. Important secondary smelters are in New York, Philadelphia, Baltimore, Cleveland, Chicago, Baton Rouge, Dallas, Los Angeles, and San Francisco areas (140 plants). Consumption was by 600 firms in virtually all States. Transportation is the major end use of lead, 68% as batteries and gasoline additives; followed by electrical, 9%; construction, 6%; paints, 6%; ammunition, 6%. The substitution of plastics has reduced the use of lead substantially in building construction, electrical cable covering and in cans and containers. Lead also competes with other metals for use in construction, packaging, and protective coatings.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Mine	509	572	578	619	605
Refinery (primary) 1/	655	678	666	704	755
Secondary	604	597	597	617	645
General imports: Ores, concentrates and bullion	111	113	66	110	100
Pigs and bars	278	245	196	260	195
Exports	7	12	23	44	130
Consumption	1,389	1,361	1,431	1,485	1,550
Price: Average, cents per pound	14.9	15.7	13.9	15.0	16.2
Stocks: Producers and consumers 1/	143	223	170	195	130
Employment: Mine and mill 2/	8,800	8,700	8,200	6,800	6,700
Smelters and refineries	2,600	2,600	2,500	2,470	2,450

3. Import Sources (1969-72): Canada 29%, Peru 21%, Australia 21%, Mexico 12%, Other 17%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Ore	602.10	0.75 cent/lb.	1.5 cents/lb.
Bullion and metal	624.02-.03	1.0625 cents/lb.	2.125 cents/lb.
Dross	603.25	1.0625 cents/lb.	2.125 cents/lb.

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate.
1/ Refined lead plus lead content of antimonial lead.
2/ Includes all lead and/or zinc producing units.
Prepared by J. Patrick Ryan, telephone number (703) 557-0241.

6. Events, Trends, and Issues: U.S. mine production in 1973 dropped 2% below the 43-year high level of production established in 1972. Metal consumption increased about 4% to a record high.

General imports of lead concentrates and refined metal were 20% less than in 1972; imports of lead metal from Australia were temporarily suspended in September pending resolution by the U.S. Tariff Commission of dumping charges by a domestic producer. The outflow of lead materials in 1973 increased sharply to the highest level since 1939 owing to the impact of metal prices outside the United States and Canada that were substantially higher than the domestic producers' price, which was frozen by the Cost of Living Council at 16.5 cents a pound from early June to December 6. On December 10 the producers' quoted price was advanced to 18-19 cents per pound.

Domestic demand for lead is forecast to increase at an annual rate of approximately 1.6% through 1980. The domestic resource base appears more than adequate to support the domestic component of primary demand at competitive prices and reliance on imports probably will decline from the current level of about 30% of total primary metal consumption.

Environmental Protection Agency regulations reducing the lead content of gasoline by 60 to 65% over a 4-year period were scheduled to become effective on January 1, 1975, and will curtail growth in demand for lead. This potential reduction in lead consumption has stimulated research to develop new large-volume applications for lead. Implementation of the proposed Environmental Protection Agency standards limiting the sulfur content of smelter emissions may curtail production of lead.

7. Government Programs: The stockpile objective for lead was sharply reduced in 1973 and legislation was introduced to authorize disposal of an additional 464,900 tons of surplus lead.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Lead	65	838	773	308	230

8. World Mine Production and Reserves:

	Mine Production 1972	Mine Production 1973 e/	Reserves--Measured and Indicated
United States	619	605	56,000
Australia	451	430	12,000
Canada	419	385	19,000
Mexico	178	185	5,000
Peru	208	185	3,000
Other Latin America	98	150	3,000
Other Free World	920	878	21,000
Communist countries (except Yugoslavia)	956	980	25,000
World Total	3,849	3,798	144,000

9. World Resources: The reserves of lead contained in ores in known mines and districts in the world, estimated at 144 million short tons, are equivalent to a 32-year supply at the 1972 rate of consumption of primary metal or a 28-year supply at an average annual growth rate in world consumption of 1.7%. The outlook for continuing discovery of additional reserves and resources at a rate that exceeds consumption is considered to be favorable. Low-tenor lead deposits have been recognized and explored to some extent throughout the world, both on land and in the ocean basins. These potentially productive resources including lead-bearing manganese nodules are estimated to contain as much as 1.5 billion tons of lead.

January 1974

LIME 1/
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: Of the 185 lime manufacturing plants in 1972, 36 leading plants accounted for 65% of production; the next 82 plants supplied 31%; and the remaining 67 plants accounted for 4% of production. Total lime production had an estimated value of $339 million in 1972. Illinois, Michigan, Missouri, Ohio, Pennsylvania, and Texas produced 61% of the total. The principal uses were in steel-making, 36%; the manufacture of alkali compounds, 16%; the construction industry, 8%; water purification 7%; and refractories, 5%.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production	20,209	19,747	19,591	20,290	21,082
Imports for consumption	195	202	242	248	330
Exports	51	54	66	38	38
Apparent consumption	20,353	19,895	19,767	20,500	21,374
Value: Average per ton at plant	$13.89	$14.49	$15.73	$16.72	$16.60
Stocks		Not	available		
Employment: Mine and plant	8,600	8,100	6,777	7,000	7,300

3. Import Sources (1969-72): Canada 99%, other 1%.

4. Tariff: 2/

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Hydrated	512.11	Free	12¢/100 lb.
Other	512.14	Free	10¢/100 lb.

5. Depletion Allowance: Not applicable.

e/ Estimate.
1/ Data are for quicklime and hydrated lime.
2/ Rates include weight of container.

Prepared by Avery H. Reed, telephone number (703) 557-0580.

6. Events, Trends, and Issues: The lime industry was rather stable in 1973, with little change from recent years. Local shortages of hydrate for water purification caused by a strike at the largest plant were corrected before the end of the year. Demand for lime is expected to increase at an annual rate of about 3%. Foreign trade is insignificant.

The Environmental Protection Agency is formulating emission standards for the lime industry. Some plants installed dust control equipment. Several plants were closed during the past year.

7. Government Programs: None.

8. World Mine Production and Reserves:

	Production		Reserves
	1972	1973 e/	
United States	20,290	21,082	
Germany, West	12,031	12,000	Reserves are ample; data are not available.
Japan	11,166	12,000	
U.S.S.R.	24,300	24,000	
Other countries	41,660	42,000	
World Total	109,447	111,082	

9. World Resources: Domestic and world resources of stone suitable for lime manufacture are adequate.

LITHIUM

(Data in short tons contained lithium, unless noted)

1. Domestic Production and Use: Spodumene was mined and milled from pegmatites at Kings Mountain, N.C., and lithium carbonate was recovered from brines at Silver Peak, Nev. Spodumene was mined and milled from pegmatites near Bessemer City, N.C. Lithium carbonate was recovered from brines at Trona, Calif. The major consuming area of 1,400 firms was from the Central States to the Atlantic States. Major uses were primary aluminum, ceramics and glass, greases, fluxes (welding and brazing), air conditioning equipment, and metallurgy.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production		Company confidential data			
Imports for consumption	129	63	128	36	106
Consumption		Not available			
Price: Per ton, domestic		Company confidential data			
Per ton, imported ore	$48	$60	$82	$27	$63
Stocks		Company confidential data			
Employment: Mine	60	124	94	114	115

3. Import Sources (1969-72): Brazil 47%, Republic of South Africa 36%, Australia 11%, Canada 6%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Lithium mineral concentrates	523.81	Free	Free
Lithium metal	415.30	12.5% ad valorem	25% ad valorem
Lithium compounds	419.10	5% ad valorem	25% ad valorem

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate. NA Not available. W Withheld to avoid disclosing company confidential data.

Prepared by D. C. Wininger, telephone number (703) 557-0438.

6. Events, Trends, and Issues: The United States is the world's largest producer and consumer of lithium raw materials, and domestic sources, in terms of either lithium minerals or lithium recoverable from brines, are adequate to meet future demand. Demand for lithium is expected to increase at an annual rate of about 6% through 1980. Both as a metal and in the compound form, lithium is finding increased applications in the most advanced enterprises of technology. Price alone restrains a greatly increased consumption of the metal and infers a need for process improvement.

7. Government Programs: There are no special government incentive or procurement programs for lithium. The Atomic Energy Commission has a large stock of lithium hydroxide monohydrate (devoid of lithium-6 isotope). A total of 5,540 tons contained lithium in this material has been assigned to General Services Administration for disposal.

8. World Mine Production and Reserves:

	Mine Production	
	1972	1973 e/
United States	W	W
Argentina	3	3
Australia	57	60
Brazil	-	106
People's Republic of China	300	300
Portugal	24	25
Southwest Africa	166	170
Southern Rhodesia	2,010	2,000
U.S.S.R.	700	700
World Total	NA	NA

	Reserves	
Country	Measured and Indicated	Inferred
United States	1,150,000	3,000,000
Canada	130,000	200,000
Africa	94,000	-
U.S.S.R. and China	-	500,000
	1,374,000	3,700,000

9. World Resources: Lithium forms independent minerals in pegmatites. Lithium production from brines has increased so greatly in recent years that this source has captured much of the market from pegmatite minerals. Resources in regions known to contain lithium may be estimated at 10 million tons. Even these large resources could be increased with intensive search through the world.

January 1974

MAGNESIUM

(Data in thousand short tons of metal, unless noted)

1. Domestic Production and Use: Two companies accounted for the total domestic production of metal. The company in Texas used seawater as its raw material source and the company in Utah used the brines of the Great Salt Lake. A third metal producer located in Snyder, Texas, is expected to resume operations in 1974, and will use well brines as its raw material source. Reclamation of metal was in the following forms: magnesium alloys, 20%; aluminum and other alloys, 55%; anodes for cathodic protection, 20%; and other uses, 5%. Magnesite was mined by one company in Nevada, and olivine by two companies in North Carolina and Washington. Magnesium oxide and other compounds were produced from seawater by eight companies in California, Delaware, Florida, Mississippi, New Jersey, and Texas; by four companies from well brines in Michigan; and by one company from lake brines in Utah. Seven companies accounted for 92% of the nonmetal production. Approximately 40% of the total metal consumption was for aluminum-base alloys. Magnesium castings and wrought products accounted for 25% of the total consumption, followed by chemical uses, 9%, and other applications, 26%. Over 80% of the consumption of magnesium compounds was for the production of high-temperature, basic refractories. Other uses for the compounds included the production of chemicals, fertilizers, and paper.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production:					
Metal: Primary	100	112	123	121	1/125
Secondary	13	12	15	16	15
Nonmetal	1,110	1,029	879	948	975
Imports for consumption:					
Metal	4	3	4	4	4
Nonmetal	66	84	95	87	100
Exports:					
Metal	27	36	24	18	35
Nonmetal	36	56	36	37	40
Consumption:					
Metal	95	93	90	99	105
Nonmetal	1,140	1,057	938	998	1,000
Price: Cents per pound (metal)	35.35	35.25	36.25	37.25	38.25
Stocks:					
Metal (producer and consumer)	12	13	13	22	20
Nonmetal		Not available			
Employment: Metal and nonmetal plants	1,600	1,600	1,600	1,600	1,600

3. Import Sources (1969-72): Metal: Canada 67%, United Kingdom 5%, Other 28%.
Nonmetal: Greece 57%, Ireland 9%, Austria 6%, Other 28%.

4. Tariff:

	Number	Rate of Duty 11/1/74	Rate of Duty Statutory
Unwrought metal	628.55	20% ad valorem	100% ad valorem
Unwrought alloys	628.57	8¢/lb. on Mg content	40¢/lb. on Mg content
Wrought metal	628.59	6.5%/lb. on Mg content	40¢/lb. on Mg content
Crude magnesite	522.61	$2.62/ton	$10.50/ton
Caustic-calcined magnesite	522.64	$5.25/ton	$21/ton

5. Depletion Allowance: Brucite 10% (Domestic and Foreign); dolomite and magnesium carbonate 14% (Domestic and Foreign); magnesium chloride 5% (Domestic and Foreign); and olivine 22% (Domestic) and 14% (Foreign).

e/ Estimate.
1/ Production by the major producer.
Prepared by E. Chin, telephone number (703) 557-0998.

6. Events, Trends, and Issues: The Cost of Living Council exempted magnesium metal from Phase IV price restraints, effective December 6, 1973.

The United States industry capacity to produce metal and nonmetallic forms of magnesium assures consumers a large and reliable supply. The domestic magnesium industry is confronted with the basic task of expanding markets to utilize fully the available productive capability and vast resources.

Magnesium metal in bulk form does not constitute a fire hazard. However, metal in a finely divided state is easily ignited. Most magnesium compounds are considered nontoxic. In some applications aluminum is a substitute for magnesium.

7. Government Programs: No current programs.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Magnesium	-	56	56	56	34

8. World Production and Reserves (1973):

Country	Production: Metal	Production: Nonmetal	Reserves: Magnesite	Reserves: Well and lake brines and seawater
United States	125	975	9,000	The world reserves of magnesium in well and lake brines and seawater are vast.
Australia	-	4,525	90,000	
Canada	8		-	
Italy	10		-	
India	-		30,000	
Japan	12		-	
North Korea	-		492,000	
Norway	40		-	
People's Rep. of China	1		822,000	
U.S.S.R.	60		66,000	
Other	9		63,000	
World Total	265	5,500	1,572,000	

9. World Resources: Resources from which magnesium may be recovered range from large to virtually unlimited and are globally widespread. Identified world resources of magnesite total 12 billion tons, and of brucite, several million tons. Resources of dolomite, forsterite, and magnesium-bearing evaporite minerals are enormous; magnesium-bearing brines are estimated to constitute a resource in billions of tons; and magnesium contained in seawater is practically unlimited.

MANGANESE

(Data in thousand short tons of manganese ore, unless noted)

1. Domestic Production and Use: There was no production of manganese ore in 1972, except for shipment from stocks of a small quantity of Montana nodules by one company. Most of consumption was by approximately 30 firms scattered over the United States, but principally in the East. Major end use distribution was, in percent: Transportation, 17; construction, 17; machinery, 13.

2. Salient Statistics—United States:

	1969	1970	1971	1972	1973 e/
Production: Mine	6	5	-	-	-
General imports	1,960	1,735	1,914	1,620	1,600
Exports	19	20	55	25	60
Industrial consumption	2,181	2,364	2,155	2,331	1,900
Price: 46-48% Mn, metallurgical ore, per L.T.U. cont. Mn, c.i.f. U.S. ports, duty extra	\$0.59-0.49	\$0.59-0.49	\$0.63-0.56	\$0.63-0.58	\$0.81-0.58
Stocks: Total producer and consumer	1,805	1,768	2,010	1,795	1,500
Employment: Mine and mill e/	25	25	-	-	-

3. Import Sources (1969-72): Gabon 35%, Brazil 33%, Rep. of South Africa 7%, Zaire 7%, Other 18%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Ore and concentrate	601.27	0.12¢/lb. of contained Mn 1/	1¢/lb. of contained Mn
Metal	632.32	1.5¢/lb. +10% ad valorem	1.875¢/lb. +15% ad valorem
High carbon ferromanganese	607.37	0.3¢/lb. of contained Mn	1.875¢/lb. of contained Mn

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate.
1/ Duty suspended for additional 3 years as provided by P.L. 93-99, effective July 1, 1973.

Prepared by Gilbert L. DeHuff, telephone number (703) 557-0546.

6. Events, Trends, and Issues: U.S. imports of ferromanganese were at a record high level, while prices for ore, alloy, and metal increased. Mexico nationalized its principal producer of manganese ore, a company in which a large U.S. consumer held a 49% interest. The Mexican company plans construction of a ferromanganese plant for domestic utilization of the ore. This is another example of the trend for ore-producing countries to process the ore within the country.

U.S. demand for manganese is expected to increase at an annual rate of about 2% through 1980. This demand will continue to be supplied primarily by imports except as it might be supplemented by Government stockpile releases. There are no satisfactory substitutes for manganese in its principal use, and there are no U.S. reserves of manganese ore at current or even substantially higher prices. U.S. resources are sufficient to satisfy expected demand to the year 2000, but all processes and techniques investigated over many years of research fail economically to yield products from these resources that will be able to compete effectively with abundant foreign ores that are available from numerous sources at prices favorable to the consumer. There are very extensive deposits of manganese nodules on the deep ocean floors beyond the continental shelves. The possibilities for their development and exploitation are currently under intensive U.S. and foreign investigation in spite of serious legal problems as to ownership and mining rights as well as mining and metallurgical problems, the proposed solutions for which remain untested at commercial scale.

Manganese is an essential element for man and other animals. In excess, however, it can be harmful. Although manganese poisoning can be an industrial hazard, it is not ordinarily a hazard to the general population. The few recorded instances of the latter have been localized in the vicinity of a man-made source of emission under unusual circumstances with little or no pollution controls. Environmental effects of ocean mining are unknown.

7. Government Programs: Office of Minerals Exploration participation is 50%.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Battery: Natural ore	11	308	298	173	-
Synthetic dioxide	-	14	14	12	2
Chemical: Type A ore	13	147	134	112	-
Type B ore	13	100	87	65	1
Metallurgical ore	751	4,719	3,969	2,114	2,706
Ferromanganese:					
High carbon	200	890	690	290	286
Medium carbon	11	29	18	-	-
Silicomanganese	16	24	8	-	-
Electrolytic metal	5	16	11	2	5

8. World Mine Production and Reserves:

	Mine Production 1972	1973 e/	Reserves (million short tons)
United States	-	-	-
Brazil	2,127	2,000	110
Gabon	2,135	2,300	220
India	1,790	1,800	25
South Africa, Republic of	3,606	3,800	125
Other Free World	3,247	3,400	380
Communist countries (except Yugoslavia)	9,927	10,200	610
World Total	22,832	23,500	1,470

9. World Resources: Known land-based resources of manganese are very large and are very irregularly distributed throughout the world. Reserves alone are more than adequate to meet expected world demand for the balance of the century. In addition, there are very extensive deep-sea resources in the form of manganese oxide deposits over large areas of the ocean floors, particularly in the Pacific deeps.

January 1974

MERCURY
(Data in 76-pound flasks of metal, unless noted)

1. Domestic Production and Use: The producing industry is composed of about ten operations producing refined mercury at the mine site. The value of domestic mine output in 1973 totaled $634,000. California provided 58% of the mercury, Nevada 25%, and the remainder came from Alaska, New York, and Texas. Five mines accounted for 88% of domestic production. A small amount of mercury was recovered as a coproduct of gold and zinc refining. About 12 companies recovered secondary mercury from used instruments, batteries, dental amalgams, and industrial scrap and residues. Principal consumption by some 90 firms was in the Eastern United States. Main uses were in electrical apparatus, 34%; electrolytic preparation of chlorine and caustic soda, 24%; antifouling and mildew-proofing paint, 15%; and industrial and control instruments, 13%.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Mine	29,640	27,296	17,883	7,286	2,200
Secondary	13,650	8,051	16,666	12,651	9,700
General imports	30,848	21,672	29,750	29,179	44,000
Exports and reexports	615	4,703	7,232	963	300
Consumption	77,372	61,503	52,257	52,907	53,600
Price per flask: Average N.Y. (duty paid)	$505.04	$407.77	$292.41	$218.28	$288.00
London	$536.41	$411.45	$282.46	$203.01	$272.00
Stocks: Consumer and dealer	19,772	12,693	11,489	11,537	13,500
Employment: Mine and mill	740	600	350	150	80

3. Import Sources (1969-72): Canada 59%, Mexico 17%, Spain 8%, Italy 5%, Other 11%. Imports in 1973 were 58% greater than the 1969-1972 average because of the sharp reduction in domestic production. Algeria supplied about one-quarter of the imports, while Canada and Mexico supplied about one-third and one-tenth, respectively.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Metal	632.34	12.5¢/lb. ($9.50/flask)	25¢/lb. ($19.00/flask)

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate.
Prepared by V. A. Cammarota, Jr., telephone number (703) 557-1392.

6. Events, Trends, and Issues: In 1973 the Food and Drug Administration banned the use of mercury from most cosmetics. The Environmental Protection Agency promulgated its air emission standard for mercury-producing plants and included the metal and its compounds in its proposed list of toxic water pollutants.

The mercury objective for the national stockpile was reduced from 126,500 flasks to 42,700 flasks. The possible release of 157,400 flasks of surplus mercury was of prime concern to foreign producers.

With the decline in U.S. primary production, the nation will be highly dependent on foreign sources for its supply. This dependence increased from 72% of primary consumption in 1972 to almost 100% in 1973. With the price of mercury less than $300 per flask for the past several years, most of the producers have curtailed or closed operations. Air pollution standards may serve to limit U.S. production at its current level. Demand for mercury is expected to increase at an annual rate of less than 1% through 1980.

Substitutes for mercury include nickel-cadmium or other battery systems for electrical apparatus, diaphragm cells for mercury cells in the chlor-alkali industry, organotin compounds in paints, and solid state devices for industrial and control instruments.

Environmental factors will continue to dampen growth in consumption especially in paints, agriculture, pharmaceuticals, and the chlor-alkali industry. No new mercury-cell chlor-alkali plants are planned, and the existing ones are consuming less mercury through more efficient operation and recovery and reuse of mercury previously lost in effluents.

7. Government Programs: The Government, through the Office of Minerals Exploration will loan up to 75% of approved costs for exploration. Releases by the General Services Administration of surplus mercury obtained from the Atomic Energy Commission totaled about 2,600 flasks.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Mercury	42,700	200,105	157,405	-	-

8. World Mine Production and Reserves:

	Mine Production 1972	Mine Production 1973 e/	Reserves
United States	7,286	2,200	380,000
Canada	14,600	14,000	320,000
Italy	e/42,120	35,000	260,000
Mexico	22,510	28,000	370,000
Spain	e/60,500	60,000	2,600,000
Yugoslavia	16,419	15,000	460,000
Other Free World	34,273	34,000	210,000
Communist countries (except Yugoslavia)	e/81,800	82,000	700,000
World Total	279,508	270,200	5,300,000

9. World Resources: The geologic outlook for new domestic discoveries of ores rich enough to be competitive in the world market is poor, although there is some possibility in the less explored parts of southwest Alaska. Correlations between mercury occurrences and the "New Global Tectonic" framework suggest that areas of the Southwest contain undiscovered deposits. Research directed toward recovery of mercury as a byproduct from sulfide deposits and from mine and plant wastes would benefit the environment and add to the supply needed by the U.S.

January 1974

MICA (NATURAL), SCRAP AND FLAKE 1/
(Data in thousand short tons, unless noted)

1. Domestic Production and Uses: Scrap and flake mica is derived by the beneficiation of domestic pegmatites and clays primarily for the mica content. In some deposits it is produced as a coproduct with mineral commodities such as lithium and feldspar. Almost 90% of 1972 production, was obtained from deposits in the Southeastern United States. The bulk of domestic production was processed into small particle-size mica for many industrial uses such as: Construction materials (roofing and wall joint cement), 56%; paint, 21%; and rubber products, 4%. In 1972, total production was valued at almost \$4.4 million. There are 19 domestic producers of scrap and flake mica.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Mine	133	119	127	160	155
Imports (consumption)	1.5	3.0	3.6	1	3
Exports e/	5.0	2.5	3.5	5	4
Consumption	132	119	125	133	140
Price (Average): Scrap and flake	\$21.75	\$21.24	\$22.95	\$27.21	\$28.50
Ground	Dry: \$40-\$100 per ton; Wet: \$180-\$200 per ton				
Stocks: Consumer	3	3	5	28	NA
Employment: Mine	75	75	75	75	75

3. Import Sources (1969-72): Brazil 12%, India 73%, Other 15%.

4. Tariff:

Item	Number	Rate of Duty 2/ 1/1/74	Statutory
Phlogopite, untrimmed, under 2 square inches when trimmed	516.11	2 1/2%	15%
Phlogopite, waste and scrap valued under 5¢ per pound	516.21	6%	25%
Other waste and scrap, under 5¢ per pound	516.24	6%	25%

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate. NA Not available.
1/ See Mica (Natural), Sheet.
2/ All tariffs are ad valorem.

Prepared by B. Petkof, telephone number (703) 557-1955.

6. Events, Trends, and Issues: The United States is the major world producer of scrap and flake mica and has only a limited requirement for imported scrap. The United States is essentially self-sufficient in this mineral commodity. The demand for this commodity is expected to increase at an annual rate of about 4% through 1980. The increasing demand for scrap and flake mica has resulted in the development of beneficiation methods to allow the recovery of mica from schists, clays and other mica-bearing sediments and rocks. Mica has been able to withstand competition from other mineral and nonmineral commodities for almost all end uses. The current energy crisis could limit the output of domestic scrap and flake mica if fuel supplies are inadequate to operate mining equipment and processing plants.

7. Government Programs: There are no current formal Government programs relating to the mining and processing of scrap and flake mica. Due to the adequacy of domestic supply, scrap and flake mica has never been classified as a strategic or critical mineral.

8. World Mine Production and Reserves:

	Production		Reserves
	1972	1973 e/	
United States	160	155	Large
India	28	30	Very Large
Republic of South Africa	5	5	Moderate
Other Free World	15	15	Moderate
Communist countries (except Yugoslavia)	NA	NA	Large
World Total	208	205	Large

9. World Resources: Resources of scrap and flake mica are very large and can be converted to economically recoverable reserves at current prices. These resources are available in granite, pegmatite, schist and clay deposits. Resources are considered more than adequate to meet anticipated world demand in the foreseeable future.

MICA (NATURAL), SHEET 1/
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: The domestic sheet mica mining industry with only one producer produced only a small quantity of low quality material during 1973. The domestic consuming industry was dependent on imported sheet mica to meet its demand. During 1972, almost 5.4 million pounds of sheet mica was used in the manufacture of electrical equipment, 79%; electronic components, 15%; and miscellaneous electric and nonelectric uses, 6%.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Mine	W	-	0.01	0.01	0.01
Imports: (for consumption)	3.39	2.58	2.83	3.12	2.40
Exports e/	0.70	0.35	1.17	3.48	3.25
Consumption	3.29	3.26	2.74	2.73	2.80
Price: Block and Film	$1.73	$1.58	$1.73	$1.68	$1.70
Splittings	$0.43	$0.43	$0.44	$0.41	$0.40
Stocks: Consumer	1.73	1.32	1.06	1.24	1.20
Employment: Mine	5	5	5	5	5

3. Import Sources (1969-72): India 79%, Brazil 14%, Malagasy Republic 3%, Other 4%.

4. Tariff:

Item	Number	Rate of Duty 2/ 1/1/74	Statutory
Phlogopite, untrimmed	516.11	3%	15%
Split block	516.31	Free	Free
Other block	516.41	Free	4¢/lb.
Splittings	516.51	Free	Free
Film not cut/stamped	516.61	Free	Free
Film cut/stamped	516.71	11%	45%
Block cut/stamped, not perforated, indented	516.73	12.5%	40%
As above, other forms	516.74	20%	40%
As above, perforated, indented	516.76	12.5%	40%

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate. NA Not available. W Withheld to avoid disclosing individual company confidential data.
1/ See Mica (Natural), Scrap and Flake.
2/ All tariffs are ad valorem, unless noted.

Prepared by B. Petkof, telephone number (703) 557-1955.

6. Events, Trends, and Issues: The United States produces only a minor quantity of sheet mica and has been historically dependent on imports from the mica producing nations of the world to meet domestic demand. Demand for sheet mica is expected to decline at an annual rate of almost 8% through 1980. This declining forecast is expected because of increasing industrial reliance on solid state electronic components not requiring mica and the current availability of mica based and non-mica based alternate materials. It can be anticipated that additional alternate materials will be developed in the future.

7. Government Programs: Most current government programs are unlikely to have any consequential effect on domestic sheet mica mining and consumption. The Government grants loans of up to 50% of approved costs for eligible mica deposits containing strategic grades of mica. The Government, through the General Services Administration, is currently disposing of excess stockpiled mica. Current stockpile data is shown below:

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Stockpile grade					
Block: Muscovite	.80	4.69	3.89	2.10	.31
Phlogopite	0.01	0.01	-	-	-
Film: Muscovite	0.20	0.73	0.53	.05	-
Splittings:					
Muscovite	1.10	17.01	15.91	7.51	.57
Phlogopite	0.10	1.90	1.80	1.43	.25

8. World Mine Production and Reserves:

	Mine Production 1972	Mine Production 1973 e/	Reserves Quantity	Reserves Average grade
United States	0.01	.01	Small	NA
Brazil	1.90	1.90	Large	NA
India	9.26	9.50	Very large	NA
Malagasy Republic	0.44	0.40	Large	NA
Other Free World	0.94	1.00	Moderate	NA
Communist countries (except Yugoslavia)	NA	NA		
World Total	12.55	12.81	Large	NA

9. World Resources: There has been no formal evaluation of world resources of sheet mica because of the sporadic occurrence of this mineral. Large deposits of mica bearing rock are known to exist in countries such as India, Brazil and Malagasy Republic. Only limited resources of sheet mica are available in the United States. These domestic resources are currently uneconomic to recover because of the high cost of the hand labor required to mine and process the sheet mica.

MOLYBDENUM

(Data in thousand pounds of metal, unless noted)

1. Domestic Production and Use: In 1973, molybdenum concentrate valued at about $192.6 million was produced by 13 firms. Three companies accounted for 80% of domestic production. Two firms in Colorado and New Mexico mined molybdenum ore. Eleven firms in Arizona, California, Nevada, New Mexico, and Utah recovered molybdenum as a byproduct from copper, uranium, and tungsten ores. Nine plants converted molybdenum concentrate (MoS_2) to molybdic oxide (MoO_3) from which intermediate products such as ferromolybdenum, metal powder, and various chemicals were produced. Consumption of molybdenum by more than 1,200 firms was mostly in the Eastern and Midwestern States. Major end use applications were as follows: Transportation, 28%; machinery, 21%; oil and gas industry, 25%; chemicals, 9%; and other applications, 17%.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Mine	99,807	111,352	109,592	112,138	112,000
Imports for consumption, concentrate	-	25	854	385	323
Exports, molybdenite conc. and oxide	57,584	55,737	46,284	45,362	72,000
Apparent consumption	57,487	49,149	40,646	51,504	60,000
Price: (pound of molybdenum in conc.) f.o.b. Climax, Colo.	$1.72	$1.72	$1.72	$1.72	$1.72
Stocks (concentrate): Mine and plant	8,398	9,715	29,077	45,243	24,000
Employment: Mine and mill	1,806	2,039	1,430	1,751	1,800

3. Import Sources (1969-72): Canada, 12%, Chile, 71%, Peru, 14%, Philippines, 3%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Concentrate	601.33	12¢/lb. contained molybdenum	35¢/lb. contained molybdenum
Ferromolybdenum	607.40	10¢/lb. contained molybdenum + 3% ad valorem	50¢/lb. contained molybdenum + 15% ad valorem

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate.

Prepared by Andrew Kuklis, telephone number (703) 557-0500.

6. Events, Trends, and Issues: Industrial stocks, the highest on record at yearend 1972, dropped about 35% during 1973 because of increased domestic consumption and exports. The Nation exported an equivalent of over 60% of its 1973 production, principally to industrialized countries of the free world. Exports relative to domestic production dropped to 41% in 1972 from a high of 52% in 1970. Record high exports in 1973 were due to an increase in world demand, low prices on foreign markets caused by devaluation, and downward floating of the dollar.

U.S. demand of molybdenum will increase at an average annual rate of about 5% through 1980. Increasing demand is expected to be largely met by expanding domestic production. Domestic resources of molybdenum recoverable at 1973 prices are sufficient to meet the Nation's demand to the year 2000. In addition to producing sufficient molybdenum for its own requirements, the United States is a major supplier for the free world.

Continued governmental effort for pollution control may adversely affect the supply by reducing domestic roasting capacity and/or adding significantly to the production costs. Mined land restoration regulations may adversely affect mining operations and exert upward pressure on costs. Hence, future mine development will require more consideration for air and water pollution, and for increased multiple land use, which will affect the price of molybdenum.

Molybdenum is a strong carbide-forming element; much of its alloying effects in steel are imparted through the formation of carbides. There are essentially no competitive substitutes for molybdenum in its critical applications, but it can substitute for other alloying elements-notably tungsten to some extent.

7. Government Programs: Government, through Office of Minerals Exploration, will lend up to 50% of approved costs for exploration. The Bureau of Mines continued research on removal of sulfur from roaster gases.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Molybdenum disulfide	-	24,418	24,418	4,254	1,168
Molybdenum, ferro	-	5,501	5,501	-	1,500
Molybdic oxide	-	9,550	9,550	-	1,500

8. World Mine Production and Reserves:

	Mine Production 1972	Mine Production 1973 e/	Reserves
United States	112,138	112,000	6,300,000
Canada	24,844	32,500	1,000,000
Chile	13,045	10,000	1,800,000
Peru	1,712	2,000	250,000
Other Free World	2,117	2,000	60,000
Free World Total	153,856	158,500	9,400,000

9. World Resources: Identified resources amount to about 35 billion pounds of molybdenum in the United States and about 64 billion pounds in the world, and occur both as the principal metal sulfide in large low-grade porphyry and molybdenum deposits and as a subsidiary metal sulfide in low-grade porphyry copper deposits. Resources of molybdenum are adequate to supply world needs for the foreseeable future.

NATURAL GAS 1/
(Data in billion cubic feet, measured at 14.73 psia @ 60^{o}F, unless noted)

1. Domestic Production and Use: The domestic natural gas industry consists of producers, transmission companies, and utility distributors. There are approximately 1,600 establishments primarily engaged in the production of natural gas, but only 180 of these employ more than 20 people. Nearly a third of all natural gas producing companies, and 60% of the larger companies, are located in Texas and Louisiana. In addition, there are approximately 1,100 natural gas pipeline companies, about one out of eight of which are regulated by the Federal Power Commission, and there are over 500 utility distributors. The 23,009 billion cubic feet of natural gas consumed in 1972 represented a 1.5% increase over the previous year. The industrial sector (including lease and plant fuel) consumed 9,623 billion cubic feet, or 42% of the 1972 total; Texas, Louisiana, and California accounted for 48% of total industrial consumption. The residential sector consumed 5,126 billion cubic feet, and the commercial sector consumed 2,287 billion cubic feet, comprising 22% and 10% of total use, respectively; California, Illinois, and Ohio comprised 30% of the residential-commerical market. Electric utilities used 3,979 billion cubic feet, or 17% of total consumption; the electric utility companies in Texas, California, and Louisiana comprised 57% of this market. Consumption by the transporting sector (pipeline fuel) was 766 billion cubic feet, or 3% of the total. The remaining 1,228 billion cubic feet, or 6% of total consumption, was in the extraction loss and other category. Value, at the point of consumption, of total gas consumed was $14.3 billion; the residential and commercial sectors accounted for 58% of the total. Major byproducts and coproducts are natural gas liquids, helium and sulfur. Petroleum, coal and nuclear energy are alternate competitive materials.

2. Salient Statistics--United States:

Salient Statistics--United States:	1969	1970	1971	1972	1973 e/
Production (marketed)	20,698	21,921	22,493	22,532	22,900
Imports (consumed)	727	821	935	1,019	1,030
Exports	48	70	80	78	80
Transportation loss and unaccounted for	332	228	339	328	330
Domestic consumption	20,923	22,046	22,677	23,009	23,440
Value: Average @ Wellhead, (¢/Mcf)	16.7	17.1	18.2	18.6	21.3
Stocks	2,852	3,207	3,523	3,523	3,600
Employment, thousands:					
Production e/	20,000	20,000	20,000	20,000	20,000
Pipeline & Utility e/	205,000	205,000	205,000	205,000	205,000

3. Import Sources (1969-1972): Canada 97%, Mexico 3%, less than 0.5% from Algeria.

4. Tariff: None.

5. Depletion Allowance: 22% (Domestic), 22% (Foreign).

e/ Estimate.
1/ See also Petroleum,Crude and Natural Gas Liquids.
Prepared by Gordon W. Koelling, telephone number (703) 557-0239.

6. Events, Trends, and Issues: During 1973, domestic consumption increase almost 2% while proved reserves declined about 5%. Domestic production was equivalent to almost 98% of consumption, slightly less than during 1972. Barring the discovery of major new domestic reserves, the supply and consumption of natural gas are expected to increase at an average annual rate of about 2% through 1980. Such a low growth rate would contribute little to the alleviation of the current energy shortage.

Escalating gas prices are expected to enhance the economics of coal gasification, but no significant production of synthetic gas from coal is expected by 1980. The first two plants for the manufacture of synthetic natural gas for peak shaving purposes for petroleum feedstocks were completed during 1973 and several others are under construction. Research was in progress with respect to nuclear and conventional stimulation of natural gas production from tight formations. Spot deliveries of imported liquefied natural gas (LNG) from Algeria have been made to east coast ports and a proposal to import larger quantities of LNG from Algeria by 1975 or 1976 has been approved. The status of this proposal may be affected by the current Arab boycott on petroleum shipments to the United States. Other prospective sources of LNG imports include Trinidad, Venezuela, Ecuador, Nigeria, Iran, Indonesia, and the U.S.S.R.

Economics, transportation and storage facilities, technology, and environmental considerations limit short-term capability for substituting alternate fuel sources. Some industrial processes require the burning and heat characteristics provided by natural gas. Pipeline natural gas, which is virtually free of sulfur and particulates, is the cleanest burning of the fossil fuels and its use plays a vital role in air pollution abatement. In addition, the physical characteristics of natural gas are such that it does not pollute water. Natural gas transportation and distribution facilities have a minimal ecological impact since they are almost entirely underground. There is potential danger in LNG and natural gas leaks.

7. Government Programs: The Mineral Leasing Act of 1920 and other public land leasing Acts, including the Outer Continental Shelf Lands Act of 1953, permit leasing of Federal lands for exploring and developing natural gas (and crude oil) resources. The Federal Government leased 1,032,569 acres in 1973 in the Gulf of Mexico Outer Continental Shelf for bonus bids totaling $3,083 million. Government-industry cooperative research programs are being implemented with respect to the utilization of liquids, chemical explosives, and nuclear devices to fracture tight natural gas bearing sand formations to stimulate production. Contracts have been awarded by the Department of the Interior for the development of coal gasification processes. The Federal Power Commission regulates the sale, transportation, and price of gas moved in interstate commerce.

8. World Production and Reserves:

	Marketed Production		Reserves*
	1972	1973 e/	1972
United States (proved)	22,532	22,900	266,000
Canada (proved)	2,914	3,200	53,000
Netherlands	2,052	2,300	78,000
Other Free World	5,557	6,200	822,000
U.S.S.R.	7,800	8,200	658,000
Communist countries (except Yugoslavia)	1,626	1,800	20,000
World Total	42,481	44,600	1,897,000

*There is no international standard defining categories of natural gas reserves.

9. World Resources: Estimates of world resources of natural gas range from 10 to at least 15 times current proved reserves. Many unexplored sedimentary areas are more favorable for occurrence of natural gas than for oil. In the past the discoveries of gas have largely been incidental to the search for oil, and intensive exploration has been confirmed mainly to those sedimentary areas with more obvious structural features and the best prospect for oil. Large stratigraphic traps, for which little search has been made so far, are more likely to contain gas or mixed fluids than oil. In the future, vast areas of sediments that were considered unfavorable for oil or that have not been explored will be prospected for natural gas. The extent to which natural gas originally in place will be recovered will depend largely on the economic needs of the region in which they are discovered and on new developments in methods of transportation.

January 1974

NATURAL GAS LIQUIDS 1/
(Data in thousands of 42-gallon barrels, unless noted)

1. Domestic Production and Use: Estimated 1973 output of natural gas liquids from gas processing plants was 633 million barrels, a decline of 0.8% from that of 1972. However, the estimated value of output increased 9% to $1.58 billion. The number of gas processing plants decreased from 805 on January 1, 1972 to 786 on January 1, 1973. Total throughput capacity of these plants declined from 75.1 billion to 73.3 billion cubic feet per day. Texas continued to lead the Nation in production of natural gas liquids by accounting for approximately half of the output. Other leading producers by rank of output were Louisiana, Oklahoma, New Mexico, and Kansas. The 16 leading operators of natural gas processing plants accounted for 75% of natural gas liquids output in 1972. Components of the 638.2 million barrels output in 1972 were liquefied petroleum gases (LPG), 53.9%; natural gasoline and isopentane, 25.6%; ethane, 15.8%; plant condensate, 3.5%; and other products, 1.2%. Uses for ethane and LPG in 1972 were chemical (including the manufacture of synthetic rubber) 40.0%; residential and commercial, 31.9%; gasoline production, 13.8%; internal combustion engine fuel, 5.7%; industrial (including refinery fuel), 4.3%; and other uses including exports, 4.3%. Natural gas liquids are co-products of natural gas and can be substituted for natural gas in virtually all uses. Natural gas liquids can also be used as an alternate for petroleum product fuels such as gasoline and distillate heating oils.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production	580,241	605,916	617,815	638,216	633,000
Imports	12,651	21,179	38,976	63,829	90,000
Exports	12,782	9,955	9,391	11,469	12,000
Domestic demand	597,125	609,050	622,384	700,351	716,000
Value: Average @ plant ($ per bbl.)	1.90	2.10	2.24	2.28	2.49
Stocks @ plants, terminals, and refineries	60,912	69,002	94,018	84,243	79,243
Employment	Included with crude petroleum				

3. Import Sources (1969-72): Canada 93%, Venezuela 5%, Other 2%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Liquefied petroleum gases 2/	475.15	Free	Free

5. Depletion Allowance: Applies to wellhead price of natural gas.

e/ Estimate.
1/ See also Natural Gas and Petroleum.
2/ Tariffs suspended by Presidential Proclamation 3279 on April 18, 1973.
Prepared by S. O. Wood, Jr., telephone number (703) 557-0671.

6. Events, Trends, and Issues: Natural gas liquids production in the U.S. has apparently peaked and is expected to decline. Reserves have declined each year since 1967 and at the beginning of 1973 the ratio of reserves to production was 9:1. Virtually all U.S. reserve producing capacity has been exhausted. Demand for natural gas liquids is expected to increase at an annual average rate of about 4% through 1980. Supply availability is expected to be the controlling factor in the demand for natural gas liquids.

   Reliance upon imports is expected to increase from 13% of demand in 1973 to more than one-third in 1980.

   Governmental decisions resulted in a drastic shift from historic supply patterns. Other Government action created an artifically low price for natural gas, the feedstock for producing natural gas liquids, for the past two decades that discouraged the development of reserves necessary to keep abreast of spiraling demands. Changes in depletion rates and antitrust and other litigation against some major producers also discouraged investment in the industry while price controls and environmental requirements encouraged increased demands for this premium commodity.

   The Natural Gas Processors Association modified specifications for propane by changing the vapor pressure standard from 200 to 208 pounds per square inch on May 1, 1973. This modification allows an increase in the volume of ethane that may be included in propane from about 4% to 6%. The increase in vapor pressure was the maximum that satisfies container specifications set forth by the Department of Transportation.

7. Government Programs: Price controls promulgated by the Cost of Living Council under Phase III resulted in a "dual" propane pricing system that contributed to a drastic shift from historic market patterns. To alleviate adverse impacts from supply dislocations, mandatory propane (including propane-butane mixes) allocation regulations were issued in October 1973. The plan established a number of "priority" customers who use propane for: (1) residential use, (2) agricultural production, (3) food processing, (4) mass transit vehicles (5) buildings housing medical or nursing patients, (6) industrial vehicles used in enclosed facilities, (7) essential government services, (8) drilling and production operations, pipelines, and fuel for propane transportation, (9) commercial establishments not exceeding 15,000 gallons per year, and (10) peak shaving under limiting conditions.

   On April 18, 1973 a Presidential Oil Imports Proclamation suspended tariffs on imports of petroleum and petroleum products and shifted to a system whereby fees were charged for import licenses. The Proclamation excluded ethane, propane, and butanes from any allocation or license and thereby ended quota restrictions on imports of these products from the Eastern Hemisphere. Thus, an increasing portion of LPG future supplies will probably come from Middle East and African Nations.

8. World Plant Production and Reserves: Statistics on world production and reserves of natural gas liquids are not available.

9. World Resources: Raw materials for the production of natural gas liquids are natural gas and crude petroleum. Resources of these materials are discussed under the respective under the respective commodities.

NICKEL
(Data in short tons of metal, unless noted)

1. Domestic Production and Use: One Oregon firm produces nickel in ferronickel. Nickel also is produced as a byproduct of copper refining and from secondary sources. Secondary nickel is recovered from nickel bearing alloys, stainless and alloy steel, and residues at copper smelters and refiners, foundries, and steel mills. At foundries and steel mills it is normally used in the form in which it is recovered. Major industrial consumers total about 200 with the largest ones in Maryland, Michigan, New Jersey, New York, Ohio, Pennsylvania, and West Virginia. Major end uses in 1972: Transportation, 21%; chemicals, 15%; electrical equipment, 13%; and fabricated metal products, 10%.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Mine	17,056	15,933	17,036	16,864	17,000
Plant: Refined metal from domestic ore	13,096	12,649	13,073	13,226	13,000
Byproduct, copper refining	2,520	2,670	2,581	2,505	2,500
Secondary	18,775	23,159	29,657	35,926	30,000
Imports for consumption	129,332	156,252	142,183	173,870	180,000
Exports (gross weight)	34,758	31,456	26,143	21,671	20,000
Consumption, reported (excludes most secondary)	141,737	155,719	128,816	159,286	195,000
Price: Metal f.o.b. Port Colborne, Ont. (cents per lb.)	103-128	128-133	133	133-153	153
Stocks: Consumer	16,574	24,708	16,105	26,205	20,000
Employment: Mine	75	e/68	e/68	76	76
Smelter	350	266	e/265	e/265	265

3. Import Sources (1969-72): Canada 82%, Norway 8%, Other 10%. Norway's raw material is nickel-copper matte from Canada.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Statutory
Nickel ore	601.36	Free	Free
Nickel oxide	419.72	Free	Free
Ferronickel	607.25	Free	3¢/lb.
Unwrought nickel	620.03	Free	3¢/lb.
Waste and scrap	620.04	Free	3¢/lb.
Nickel powders	620.32	Free	3¢/lb.
Other	603.60	Free	Free

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate.

Prepared by Horace T. Reno, telephone number (703) 557-0602.

6. Events, Trends, and Issues: Domestic nickel consumption in 1973 reached the high level of the early 1960's after being depressed by almost 4 years of primary nickel scarcity which was followed by an industrial depression that affected the principal consumers. Ferronickel became a significant element of supply from foreign countries in 1973, and secondary nickel continued to supplement the supply to the same extent as during the 4-year shortage, although there was a large surplus of primary nickel in the country.

Domestic demand for nickel is expected to increase at an annual rate of about 3% through 1980, domestic production is expected to remain at the level set in the last 5 years, but the United States should be able to obtain all the nickel it needs from relatively secure and diversified foreign sources for a constant dollar price little changed from that which prevailed in 1973.

The world's nickel will come more from laterite deposits with attendant problems in environmental control and extractive metallurgy. As production of nickel from laterite increases, more nickel will be recovered as ferronickel and the potential supply of byproduct cobalt will be greatly expanded. Thus U.S. sources of supply will be more diversified, ferronickel will become increasingly important in U.S. supply, and cobalt may become competitive with nickel for some applications. At present, however, there is no completely satisfactory substitute for nickel in any of its many uses at competitive costs. Stainless steels made without nickel by recently developed techniques may erode nickel stainless steel markets as these steels are competitive in many use areas.

The change in supply sources will increase the environmental impact of nickel mining inasmuch as all laterite mines are relatively shallow open pits, the areas of which increase rapidly as the ore is mined. For the short term, this presents serious scarred landscape and erosion problems. Laterite mines are in areas of heavy rainfall so the scars heal with time. The one nickel smelter in the United States has achieved 98% control of stack emissions; and gases are not a problem.

7. Government Programs: Office of Minerals Exploration financial assistance in domestic exploration remained at 50%.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Nickel	-	-	-	-	-

8. World Mine Production and Reserves:

	Mine Production		Reserves (Proven, indicated, inferred)	
	1972	1973 e/	Quantity	Grade of Ore %
United States	16,864	17,000	200,000	1.5
Canada	256,467	265,000	6,300,000	1.5-3
New Caledonia	110,424	110,000	15,400,000	1-5
Other Free World	132,052	140,000	10,100,000	.2-4.0
Cuba e/	40,000	40,000	4,200,000	1.4
Other Communist countries (except Yugoslavia) e/	142,200	145,000	10,000,000	.4-4.0
World Total	698,007	717,000	46,200,000	

9. World Resources: World resources from deposits of nickel sulfides and nickel laterites are estimated to total 70 million tons of nickel in 7 billion tons of material averaging 1% nickel. An additional 7 billion tons averaging 0.2% nickel, is estimated for sulfide deposits in the United States. The 0.2-0.4% of nickel universally disseminated in peridotites and serpentinites throughout the world amounts to a figure several orders of magnitude greater than 70 million tons, as does the quantity of nickel contained in deep-sea manganese nodules, but new technological developments will be required to recover nickel successfully from these two types of occurrence. The discovery in 1949 at Thompson, Manitoba, of a major new type of nickel-sulfide deposit suggests the possibility that similar deposits may exist elsewhere in the world.

January 1974

NITROGEN (ELEMENTAL, FIXED, AND NATURAL NITRATES)
(Data in thousand short tons of nitrogen, unless noted)

1. Domestic Production and Use: Elemental nitrogen is produced as a coproduct with oxygen and argon. The largest uses are for inert atmospheres in the production of chemicals, metals and foods. Fixed nitrogen is produced as ammonia by the catalyzed reaction, at high temperature and pressure, of nitrogen and hydrogen. Ammonia is used to obtain hundreds of other fixed nitrogen compounds through other chemical reactions. A small amount, 1%, of the fixed nitrogen produced is recovered as a byproduct from coking operations. Fixed nitrogen compounds are used for fertilizers, animal food supplements, explosives, and plastics and synthetic products. No natural nitrates are produced domestically. In 1972, 61 companies operated 86 ammonia plants. Eight companies operated about 200 plants which produced elemental nitrogen. Total employment is not known.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production:					
Elemental nitrogen	4,807	5,477	6,087	7,011	7,798
Fixed nitrogen	10,664	11,516	11,673	11,901	12,416
Natural nitrates	-	-	-	-	-
Imports:					
Elemental nitrogen	-	-	-	-	-
Fixed nitrogen (ammonia)	403	398	379	317	231
Natural nitrates	36	30	41	25	13
Exports:					
Elemental nitrogen	-	-	-	-	-
Fixed nitrogen (ammonia)	920	807	407	584	583
Natural nitrates	-	-	-	-	-
Consumption:					
Elemental nitrogen	4,807	5,477	6,087	7,011	7,798
Fixed nitrogen	10,264	10,931	11,520	11,679	12,426
Natural nitrates	36	30	41	25	13
Producer stocks:					
Elemental nitrogen	-	-	-	-	-
Fixed nitrogen	1,193	1,369	1,494	1,449	1,100
Natural nitrates		Not	available		
Average price (per short ton):					
Elemental nitrogen (pipeline gas)	$9.09	$8.61	$8.16	$7.48	$7.20
Elemental nitrogen (bulk liquid)	52.92	48.25	46.80	41.85	39.00
Fixed nitrogen (ammonia)	71.00	54.50	56.00	60.00	65.00
Natural nitrates (sodium nitrate, bulk)	44.00	45.50	51.50	51.50	51.50
Employment:		Not	available		

3. Import Sources (1969-72):
Fixed nitrogen (ammonia): Canada 21%, Netherlands 2%, Trinidad and Tobago 58%, Netherlands Antilles 19%.
Natural nitrates: Chile 100%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Statutory
Fixed nitrogen (ammonia, fertilizer)	480.6540	Free	Free
Fixed nitrogen (ammonia, chemical)	417.2200	.62¢ per pound	2.5¢ per pound
Natural nitrates (sodium nitrate)	480.2500	Free	Free

5. Depletion Allowance: Not applicable.

e/ Estimate.

Prepared by Ted C. Briggs, telephone number (703) 557-0495.

6. Events, Trends, and Issues: A serious problem facing domestic producers of anhydrous ammonia is the diminishing availability of low-cost natural gas used to obtain the hydrogen required to produce ammonia and to provide plant energy requirements. Another problem with which the domestic ammonia producers have had to cope is the mandatory and unpredictable interruption of plant feedstocks due to diversions of natural gas in the interstate pipeline systems to meet demand for fuel for home heating during periods of very cold weather. The large new ammonia plants are designed for maximum efficiency and have a very close energy balance, therefore, these plants have little flexibility to adjust plant production. A significant reduction in the supply of natural gas to these plants causes a complete plant shutdown. Demand for fixed nitrogen is expected to increase at an annual rate of about 4.4% through 1980.

Liquid and gaseous elemental nitrogen is produced, as required, entirely from the air. Thus, there is no supply problem with these two forms of elemental nitrogen. Demand for elemental nitrogen is expected to increase at an annual rate of about 4% through 1980.

There is no problem of supply for the natural nitrates. Chile is the only country supplying this material but manufactured nitrates are satisfactory substitutes. The demand for natural nitrates is expected to be negligible by 1980.

Fixed nitrogen is an essential plant food and there are no substitutes for nitrogen fertilizers. Also, there are no economical substitutes for fixed nitrogen explosives and blasting agents. Plastics and synthetic fibers made from fixed nitrogen chemicals have replaced metals and natural fibers in many applications.

7. Government Programs: Because of domestic price ceilings, the devaluations of the dollar, and the strong international fertilizer market, significant amounts of United States fertilizer nitrogen moved into the export market. However, domestic price controls on fertilizers were removed in late October 1973.

8. World Production and Reserves:

	Plant Production		Reserves
	1972	1973	
Fixed nitrogen:			
United States	11,901	e/ 12,416	Unlimited
U.S.S.R. e/	7,000	7,300	"
Japan e/	3,200	3,350	"
People's Republic of China e/	1,500	1,600	"
France e/	2,000	2,100	"
United Kingdom e/	1,000	1,000	"
West Germany e/	2,200	2,000	"
Poland e/	1,600	1,700	"
Canada e/	1,000	1,200	"
Netherlands e/	1,000	1,100	"
Italy e/	1,500	1,600	"
India e/	1,300	1,300	"
Other e/	11,497	12,000	"
World Total e/	47,298	48,666	"
Elemental nitrogen:			
United States	7,011	e/ 7,798	Unlimited
Japan e/	3,000	3,200	"
West Europe e/	4,250	4,500	"
East Europe e/	5,000	5,200	"
Other e/	2,350	2,450	"
World Total e/	21,611	23,148	"
Natural nitrates:	107	100	143 million tons contained nitrogen

9. World Resources: The chief source of natural nitrogen compounds occurs in the nitrate deposits of the Atacama Desert of northern Chile and adjacent Peru. Resources of Chilean ore containing 7% (present cut-off grade) or more $NaNO_3$ are estimated to be about 2.5 billion tons. Similar deposits that contain less than 7% $NaNO_3$ constitute a subeconomic resource estimated to be about 25 billion tons. Resources for the production, from the air, of elemental and fixed nitrogen are unlimited.

January 1974

OXYGEN
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: In 1972 oxygen production, all from cryogenic air-separation plants, increased to 14.6 million short tons, or 11% over 1971; the growth rate since 1963 has been about 7.6%. Oxygen is the chief product of these plants; the major coproduct is nitrogen. In many plants argon is produced from a side stream, and in a few krypton, neon, and xenon are separated. It is characteristic of the industry that a small number of firms, which also design and manufacture the specialized equipment used, own the bulk (about 80%) of the production capacity. In 1972 there were seven of these firms, of which three were large and four small. Seven steel companies and about 100 minor producers shared the balance of the market. The industry consists of about 117 major plants in 38 States; the plants are concentrated in north central and middle Atlantic industrial areas. About 70% of the oxygen produced was consumed in the steel industry; in any one case the steel company either bought the oxygen from a plant constructed nearby for the purpose, or produced it in its own plant. Oxygen from such "on-site tonnage plants" is delivered through pipeline at the required pressure. The remaining 30% was consumed in the chemical industry and in metal production, metalworking, and aerospace. This portion, known as "merchant oxygen" is usually, but not exclusively, delivered in the liquid state, and is gasified as used in the purchaser's plant.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Marketable	13,480	13,320	13,210	14,620	15,670
Imports for consumption	-	-	-	-	-
Exports	-	-	-	-	-
Apparent consumption	13,480	13,320	13,210	14,620	15,670
Price: (dollars per short ton)					
Pipeline, gas	\$11.28	\$12.11	\$11.89	\$11.64	\$12.00
Cylinder, liquid	NA	NA	53.28	44.67	50.00
Stocks	-	-	-	-	-
Employment		Not available			

3. Import Sources (1969-72): None.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Other physical elements in any physical form (includes oxygen)	415.5000	5% ad valorem	25% ad valorem

5. Depletion Allowance: None.

e/ Estimate. NA Not available.

Prepared by W. F. Keyes, telephone number (703) 557-0495

6. Events, Trends, and Issues: Oxygen production and consumption is expected to increase at an annual rate of 5% or 6% a year through 1980. The demand for pipeline gas will parallel the growth of the steel industry, now that existing steel plants have been converted to the basic oxygen process. The manufacture of substitute natural gas from coal could use substantial quantities of pipeline oxygen in the future. Demand for merchant oxygen will grow rapidly in the near future, particularly in plants treating sewage and industrial wastes. Every major oxygen supplier is currently involved in numerous waste treatment projects.

Merchant oxygen has been in short supply in 1972 and 1973, partly because for several years, until the recent economic upswing, plant construction was at a standstill. Construction projects now underway should alleviate the shortage. These plants were formerly rather noisy, but engineering advances have virtually eliminated noise pollution. The average price of oxygen, in constant dollars, is now at the lowest point in history; it appears that strong competition in the late 1960's, together with technological advances, drove down the price. It is unlikely that it will decline further, because economies of scale are getting difficult to attain and because energy costs, which are increasing rapidly, are a major factor in both pipeline and merchant oxygen prices.

There is no substitute for oxygen.

7. Government Programs: None.

8. World Production and Reserves:

	Production		Reserves 2/
	1972	1973 e/	
United States	14,620	15,670	
Japan	10,730	11,270	
West Germany	5,450	5,720	
United Kingdom	2,200	2,300	
France	1,800	1,890	
Belgium	1,430	1,500	Unlimited
Italy	1,200	1,260	
Canada	730	770	
Other Free World	4,750	4,990	
Communist Countries (except Yugoslavia)	6,700	7,030	
World Total	49,610	52,400	

9. World Resources: Oxygen resources in the atmosphere are so large as to be virtually unlimited.

PEAT

(Data in thousand short tons, unless noted)

1. Domestic Production and Use: Peat was produced in 103 plants in 22 States in 1972. The principal producing States, in decreasing order of output, were Michigan, Illinois, Florida, New Jersey, Colorado, and California. These six States accounted for more than 75% of the total output, with Michigan producing about 36%. Of the three grades of peat produced, 56% of the total was reed-sedge peat, 24% was moss peat, and 20% was peat humus. Virtually all peat was sold for agricultural and horticultural use. Nine producing companies accounted for 53% of the domestic output.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Number of operations	128	122	120	103	100
Production	572	517	605	577	628
Commercial sales	566	526	600	607	628
Price (average value per ton)	$12.47	$11.39	$11.69	$11.72	$11.87
Imports	300	283	296	310	356
Available for consumption 1/	866	809	896	917	984
Stocks		Not	reported		
Employment	567	542	623	418	NA

3. Import Sources (1969-72): (By short ton) Canada, 96%; West Germany, 3%; Other, 1%.

4. Tariff: Except for a duty of $0.50 per long ton levied on poultry and stable grade peat from communist countries, there is no tariff on peat.

5. Depletion Allowance: 5% (Domestic).

e/ Estimate. NA Not available.
1/ Commercial sales plus imports.
2/ Reserves not delineated.

Prepared by Eugene T. Sheridan, telephone number (703) 557-1352.

6. Events, Trends, and Issues: Demand for peat in the United States is forecast to increase at an average annual rate of about 3%. With this rate of growth, probable overall demand will reach 1.4 million tons in 1985 and 2.2 million tons in 2000.

Domestic resources are large and widely distributed. However, the United States has consistently relied upon imports for a relatively large part of its supply.

Prices in terms of constant dollars are expected to increase about 10% by the end of the century. Imports at comparable prices probably will continue to supplement domestic production.

Materials such as straw, tree bark and other fibrous plant materials can be substituted for peat in some applications. Because the delivered price of these materials probably would be in the same range as peat, substantial substitutions are not expected.

Peat usually occurs in flat, marshy areas that require drainage before peat can be extracted. Generally, expended peat lands can be converted to agricultural use with relatively little reclamation.

7. Government Programs: None.

8. World Mine Production and Reserves:

	Production 1972	Production 1973 e/	Reserves 2/ (Million short tons)
United States	607	628	NA
Canada	370	381	NA
West Germany	1,753	1,805	NA
Ireland	5,770	5,940	NA
Netherlands	440	453	NA
U.S.S.R.	79,600	81,940	NA
Other	828	853	NA
World Total	89,638	92,000	NA

9. World Resources: One or more types of peat occur in all but about 8 of the 50 States and the magnitude of the identified resources is in excess of 10 billion tons. Domestic resources are estimated to comprise only about 5% of the world's resources. About 60% of the world's resources are in the U.S.S.R.

January 1974

PERLITE (CRUDE)
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: Crude perlite was produced by 12 firms at 13 mines in seven States. The leading five companies supplied 93% of production. New Mexico supplied 87% of total crude ore mined in 1972. Perlite was expanded by 39 companies at 84 plants in 30 States. Value of domestic crude production sold or used in 1972 was a record $6.2 million. In 1972 the major uses were: Insulation board and plaster and concrete aggregate, 65%; filter aid, 16%; low temperature insulation, 4%; and horticultural aggregates, 3%. Long-established competitive commodities include exfoliated vermiculite, pumice, slag, expanded clay and shale, and diatomite.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Mine	613	607	495	649	650
Imports			None of record		
Exports			Not available		
Consumption	471	456	432	545	548
Price (sold to expanders):					
Per ton, f.o.b. mine	$10.19	$11.68	$11.78	$11.34	$11.68
Stocks			Not available		
Employment: Mine and mill	104	95	90	100	100

3. Import Sources (1969-72): None.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Crude or ground	523.18	Free	Free

5. Depletion Allowance: 10% (Domestic), 10% (Foreign).

e/ Estimate. NA Not available.

Prepared by A.C. Meisinger, telephone number (703) 557-1955.

6. Events, Trends, and Issues: Demand for perlite is expected to increase at an annual rate of about 3% through 1980. The domestic supply of perlite that is available from estimated reserves is expected to adequately meet the 1972-2000 cumulative demand of approximately 25 million tons. Perlite mining has the normal associated problems of judicious disposal of overburden and consideration of the ultimate condition of the abandoned mine site, but in its totality results in a relatively small area of disturbed surface and generally occurs in remote areas. Consequently, the environmental problem is not too severe. Alternate materials can be substituted for all uses of perlite if necessary.

7. Government Programs: None.

8. World Mine Production and Reserves:

	Production		Reserves
	1972	1973 e/	
United States	649	650	Large
Greece	201	NA	Large
Other Free World	300	NA	NA
Communist Countries (except Yugoslavia)	800	NA	Large
World Total	1,950	NA	NA

9. World Resources: The total domestic resources of perlite can be estimated conservatively at about 650 million tons. Total world resources are much larger, but much of this resource is undeveloped or largely unevaluated, if identified.

January 1974

PETROLEUM, CRUDE 1/

(Data in millions of 42-gallon barrels, unless noted)

1. Domestic Production and Use: Crude oil having a wellhead value of $12.3 billion was produced from approximately 502,000 wells in 30 States. Approximately 70% of these wells produce 10 barrels or less per day. Of the estimated 7,000 operators which produce crude oil (including lease condensate) the top 30 accounted for approximately 60% of total output. Major producing States were Texas (39%), Louisiana (24%), and California (10%). Proved reserves, nearly equal to those in Texas, have been found in Alaska. Principal end uses of refined petroleum products and their percentages of total consumption were: Fuel, 89.9%; petrochemical feedstocks, 5.0%; asphalt and road oil, 2.9%; and miscellaneous uses including lubricants and losses, 2.2%. Because of the shortage of natural gas supplies, residual fuel oil used at electric power utilities increased substantially. Consuming sectors in 1972 were transportation, 53.4%; household and commercial, 16.8%; industrial and chemical, 15.8%; electric utilities, 8.3%; and miscellaneous, 5.7%. Petroleum supplied 45.6% of total domestic energy consumption in 1972 and an estimated 46.3% in 1973.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production	3,372	3,517	3,454	3,455	3,356
Imports	514	483	613	811	1,164
Exports	1	5	1	-	-
Domestic demand	3,892	3,984	4,087	4,282	4,545
Value: Average @ wellhead ($ per bbl.)	3.09	3.18	3.39	3.39	3.66
Stocks	265	276	260	260	235
Employment, exploration and production 2/	279,900	270,100	262,400	261,900	265,400

3. Import Sources (1969-72): Canada 42%, Venezuela 17%, Nigeria 7%, Indonesia 7%, Saudi Arabia 6%. Imports in 1973 were 92% higher than the 1969-72 average.

4. Tariff: Duties on imported petroleum were suspended effective May 1, 1973 and were replaced by a new license-fee system as a means for providing incentives to increase domestic exploration and drilling and to expand domestic refining facilities. The new license-fee schedule is as follows, in cents per barrel:

	May 1 1973	Nov. 1 1973	May 1 1973	Nov. 1 1973	May 1 1973	Nov. 1 1973
Crude oil	10.5	13.0	15.5	18.0	21.0	21.0
Motor gasoline 3/	52.0	54.5	57.0	59.5	63.0	63.0
All other finished products and unfinished oils 3/ 4/	15.0	20.0	30.0	42.0	52.0	63.0

5. Depletion Allowance: 22% (Domestic), 22% (Foreign).

6. Events, Trends, and Issues: The Nation experienced significant petroleum shortages during 1973. This was created by declining domestic production and a growing worldwide shortage, and was aggravated by the October embargo placed on crude oil exports to the United States by Arab petroleum exporting nations. Although the shortfall was slight at first, shortages of refined petroleum products in early 1974 were expected to reach about 15% of domestic demand, the weather being an important variable.

Effective May 1, volume restrictions on oil imports were discontinued and refinery construction encouraged. By September many companies had announced plans for major refinery construction projects. During the previous year refinery capacity increased only 3%, whereas demand increased 8% and at the beginning of 1973 plans called for a less than 1% capacity increase in 1973.

e/ Estimate.
1/ See also Natural Gas and Natural Gas Liquids.
2/ Includes employment in natural gas and natural gas liquids production.
3/ Excludes motor gasoline from Canada for which a separate schedule was provided.
4/ Excludes ethane, propane, butanes and asphalt which are exempt.
Prepared by D. A. Carleton, telephone number (703) 557-0217.

In November the President signed a law which removed legal barriers to the construction of the Alaska pipeline from Prudhoe Bay to Valdez. The remaining barrier was a possible constitutional review of the provision exempting the project from further judicial examination.

Domestic crude oil wellhead values experienced their largest average annual increase since 1957. This was the result of a general $0.25 to $0.35 per-barrel increase during the spring and, following price controls established on May 15, a partial decontrol of prices later in the year. The two-tier pricing system established in September and broadened in November released from price controls oil produced from new wells or reservoirs (new oil), some oil from established wells (released oil), and all oil produced from stripper wells, i.e. those which produced 10 barrels per day or less. In December the Cost of Living Council permitted a 23% or about $1.00 per barrel increase in the price of crude oil under control (old oil). By yearend spot prices for controlled oil were about $1.60 higher than those in January, and crude oil exempted from price controls was about $4.00 more than controlled oil.

7. Government Programs: Prior to the embargo of Arab exports to the United States, the Federal Government established programs for the allocation of propane and distillate fuel oil. Anticipated wintertime shortages because of stock drawdown and supply dislocations necessitated these programs. Shortages were intensified by the embargo and new Federal and State legislation were promulgated to reduce petroleum demand. Included were lower highway speed limits, crude oil and refined products allocations, a ban on powerplant conversions from coal to oil. Furthermore, controls over refinery production schedules were initiated in December and certain Federal and State air quality standards were relaxed through variances to permit the burning of low quality fuels. The Federal Government leased about 1.0 million acres in the Gulf of Mexico OCS for bonus bids totaling $3.1 billion. The moratorium on drilling in California's offshore Santa Barbara Channel under State control was partially lifted in December. Motor gasoline rationing and export licensing were definite possibilities for 1974. Field tests by the Bureau of Mines on methods for producing heavy oils indicate that injection of solvents alone or in combination with fracturing the formation may permit oil recovery from currently nonproductive reservoirs.

8. World Production and Reserves:

	1972	1973 e/	Reserves
United States	3,455	3,356	36,300
Algeria	385	400	7,600
Canada	561	640	8,000
Iran	1,844	2,130	60,000
Kuwait	1,201	1,100	64,000
Libya	820	828	25,500
Saudi Arabia	2,202	2,770	132,000
U.S.S.R.	1,178	3,070	80,000
Venezuela	2,896	1,230	14,000
Other Free World	3,701	4,406	174,800
Other communist countries (except Yugoslavia)	355	370	23,000
World Total	18,598	20,300	625,200

9. World Resources: Total crude petroleum resources have not been determined with much precision; vast potential areas are unexplored. Recent estimates of potentially recoverable crude petroleum (including heavy oil) resources vary from 2.0 to 4.5 trillion barrels.

PHOSPHATE ROCK
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: Twenty-five firms and the Tennessee Valley Authority produced phosphate rock, with several firms producing from more than one mine. The distribution of marketable phosphate rock production by percent was Florida and North Carolina, 81; Idaho, Missouri, Montana, Utah, and Wyoming, 13; and Tennessee, 6. The value of this production was $234 million. The principal consuming classifications were agriculture 84%, food products 10%, soaps and detergents 5%, and 1% was consumed in miscellaneous applications. Over 5,000 firms processed end products for agricultural purposes. There was not a dominant segment in the industry.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Marketable	37,725	38,739	38,886	40,831	42,600
Imports for consumption	140	136	84	55	75
Exports	11,336	11,738	12,587	14,275	14,300
Apparent consumption	25,534	27,163	27,788	29,535	31,500
Value: Average per short ton, f.o.b. plant 1/	$5.57	$5.26	$5.26	$5.10	$5.50
Stocks (Florida and North Carolina producers)	13,697	14,566	12,617	10,513	8,500
Employment: Mine, washer, and beneficiation plant	4,557	4,300	4,300	4,173	4,300

3. Import Sources (1969-72): Netherlands Antilles 77%, Mexico 23%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Phosphates, crude and apatite	480.45	Free	Free

5. Depletion Allowance: 14% (Domestic), 14% (Foreign).

e/ Estimate.
1/ Published prices do not represent actual selling prices, comparable export price was $8.68 per short ton, f.o.b. mine, in 1973.
2/ Marketable phosphate rock.
3/ Million short tons.
4/ Recoverable at present prices and technology.

Prepared by W. F. Stowasser, telephone number (703) 557-0470

6. Events, Trends, and Issues: During 1973, the U.S. as well as world demand for marketable phosphate rock again exceeded production. Domestic and world reserves are large, however, emphasis on new reserves will shift production patterns by 2000 or sooner.

Demand for phosphate rock is expected to increase at an annual rate of about 4% through 1980 and exports of phosphate rock will decline as more rock is diverted into the domestic fertilizer industry.

Phosphate rock export prices increased significantly reflecting the change from oversupply to a shortage of phosphatic fertilizers. Demand is expected to exceed supply through 1975 and domestic prices will rise to more profitable levels.

New fertilizer plant capacity planned for 1974-75 will increase the demand for phosphate rock by at least 7 million tons in the United States. Within the next 2 years Morocco and Spanish Sahara are scheduled to increase their production to 18 and 3 million tons per year, respectively.

Because phosphorus ranks as one of the six most important elements necessary for life (it is needed for the transfer of chemical energy within protoplasm, whether this energy is used for activity or growth) and it does not have a substitute, efficient utilization as well as conservation of this element will become increasingly important. To assure adequate supplies in the next century, present recovery of phosphorus from ores could be significantly improved and the application of phosphatic fertilizers regulated to avoid unnecessarily high and wasteful levels. Agronomists indicate a 2 to 1 ratio of nitrogen to P_2O_5 will optimize crop yields.

Industry and Government supported programs will emphasize mined land restoration programs and waste slime dewatering systems that will permit disposal of all mining and beneficiating wastes without the need to impound the colloidal clays behind earthen dams.

The principal impediments to developing this mineral's potential are moratoriums on mining permits and refusal to rezone agricultural classified land for mining in Florida counties. Although preference right lease applications have been made to mine phosphate ores from the Los Padres National Forest in California and the Osceola National Forest in Florida, strong opposition by groups and individuals concerned about the effects of strip mining and processing plants on the environment has delayed issuing mining permits for the past several years.

7. Government Programs: Price controls on phosphate and fertilizers were lifted October 30, 1973.

8. World Mine Production and Reserves 2/:

	Production 1972	Production 1973 e/	Reserves 3/ 4/
United States	40,831	42,600	2,016
Morocco	16,503	17,600	500
Senegal	1,561	1,900	50
Spanish Sahara	-	1,500	400
Togo	2,125	2,700	50
Tunisia	3,734	3,400	300
Other Free World	10,392	11,800	874
Communist countries (except Yugoslavia)	28,720	27,200	935
World Total	103,866	108,700	5,125

9. World Resources: Most of the United States and world resources are in widely distributed marine phosphorite deposits. Identified resources of the world are measured in billions of tons of contained phosphorus and hypothetical resources are probably many times as great. Phosphate rock contains fluorine and potentially economically recoverable amounts of vanadium, uranium and rare earths.

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PLATINUM-GROUP METALS
(Data in thousand troy ounces, unless noted)

1. Domestic Production and Use: One company mined platinum metals from placer deposits in Alaska. Virtually all the remaining domestic primary metals were obtained as byproducts of copper refining by four firms, three of which are on the east coast. Refining of secondary metal was done by one of these, and by at least 33 other plants, mostly in the East and Midwest. The platinum-group metals sold in 1973 were distributed by at least 90 processors and retailers, largely in the Northeast. The major uses were estimated as: Electrical, 36%; chemical, 34%; petroleum, 8%; glass, 5%; dental and medical, 5%; jewelry and decorative, 3%. Potential substitutes are: Gold and silver in electrical uses; transition metal catalysts in petroleum refining and chemical uses.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Mine	22	17	18	17	17
Refinery: New	18	20	21	15	15
Secondary	372	350	278	256	241
Imports for consumption	1,299	1,532	1,388	1,892	2,655
Exports	501	414	405	539	645
Consumption	1,358	1,389	1,376	1,560	1,693
Price: (Dollars per oz.) 1/					
Platinum (average)	124	133	123	121	150
Palladium (average)	42	38	37	42	78
Stocks (refiner, importer & dealer)	1,078	765	857	897	920
Employment: Mine	Company confidential data				
Refinery e/	340	360	360	360	360

3. Import Sources (1969-72): United Kingdom 39%, U.S.S.R. 32%, Republic of South Africa 12%, Other 17%. The U.S. imported nearly twice as much platinum-group metals from the U.S.S.R. in 1972 as in 1971.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Ore	601.39	Free	Free
Unwrought metals	605.02	Free	Free
Unwrought alloys	605.03	20% ad valorem	65% ad valorem
Semimanufactured:			
Gold plated	605.05	25% ad valorem	65% ad valorem
Silver plated	605.06	12% ad valorem	65% ad valorem

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate.
1/ Producers allocated price.
Prepared by W. C. Butterman, telephone number (703) 557-1159.

6. Events, Trends, and Issues: World production of the platinum-group metals rose more than 10% in 1973 as demand increased, especially in Japan and the United States. Most of the increment came from South African producers, who were gearing up for anticipated high demand in the U.S. for platinum and palladium in automobile emissions control catalysts, beginning in 1974. In the U.S., which imports about 99% of its requirements of primary platinum-group metals, mine production remained at about 17,000 troy ounces; it is unlikely that domestic production, which is largely a byproduct of copper mining, will ever satisfy much of the domestic demand. The environmental constraints on much of the domestic platinum production are those on the associated copper and gold production; the constraints on placer mining on the coast of Alaska are not as yet severe.

Imports rose by 40% in 1973. The U.S.S.R., the United Kingdom, and the Republic of South Africa remained the most important sources, but imports from Japan, the fourth major source, increased sharply. For a time, in the second and third quarters of the year, U.S. prices of the platinum-group metals were below world levels, owing to price controls.

Demand for the platinum-group metals in the U.S. for existing uses is expected to increase at less than 2% per year through 1980. However, beginning in 1974, use as automobile emissions control catalysts is expected to increase U.S. demand significantly for several years in mid-1970's; depending on the rate of development of alternate means of emissions control, consumption for this use should peak about 1980 or possibly in the late 1970's.

Because of their unique catalytic and physicochemical properties, the platinum-metals can be substituted for only at a considerable penalty in efficiency and operating costs.

7. Government Programs: The Government, through the Office of Minerals Exploration, U.S. Geological Survey, grants financial assistance up to 75% of approved costs for the exploration of eligible platinum-group metal deposits.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Platinum	188	453	265	-	-
Palladium	329	1,255	926	-	-
Iridium	2	17	15	0.2	-

8. World Mine Production and Reserves:

	Mine Production 1972	Mine Production 1973 e/	Reserves
United States	17	17	3,000
Canada	399	420	16,000
Colombia	26	26	5,000
South Africa, Republic of	1,803	2,200	400,000
Other Free World	18	18	---
U.S.S.R.	2,350	2,500	200,000
World Total	4,613	5,181	624,000

9. World Resources: Present estimates of world resources of the platinum-group metals range from about 1,200 to 1,900 million troy ounces, that is, 2 to 3 times the estimated reserves, and 5 to 8 times the estimated consumption in the period 1972-2000. Total U.S. resources are estimated at about 200 million troy ounces.

January 1974

POTASH

(Data in thousand short tons K_2O equivalent, unless noted)

1. Domestic Production and Use: In 1972 potash production was centered in eastern New Mexico, where seven mines produced 86% of the total by conventional mining of bedded deposits. One mine in Utah recovered potash by dissolving it underground. Two plants in Utah and one in California recovered potash from salt lake brines. Ten companies comprise the domestic industry; nine had one operation each, and one had both a mine in New Mexico and the plant in California. No one company was dominant. The value of production in 1972 was $107 million. In addition to potash, borax, sodium carbonate, lithium phosphate, and bromine were recovered as coproducts from brines in California, and sodium sulfate, sodium chloride and magnesium chloride from brines in Utah. Most potash is produced as the chloride, KCl, but is generally reported in terms of the oxide, K_2O. Some 94% of the total output was used directly in the fertilizer industry; almost all was the chloride, but certain crops are harmed by the chloride and potassium sulfate was produced for this market. Over 5,000 plants produce fertilizers; they are located in all States, but are concentrated in north central farming areas. There is no alternative to the use of potash in fertilizer.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Marketable	2,804	2,729	2,587	2,659	2,595
Imports for consumption	2,332	2,605	2,766	2,961	3,394
Exports	700	544	564	764	805
Apparent consumption 1/	4,701	4,730	4,794	4,815	5,442
Price: Cents per short ton unit of K_2O, standard 60% muriate f.o.b. Carlsbad (average, quoted)	25	33	34	34	36
Stocks, producer, at end of year	392	454	428	469	300
Employment: Mine, daily average	1,429	1,347	1,200	1,183	1,100

3. Import Sources (1969-72): Canada 94%, Israel 2%, Other 4%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Potassium chloride or muriate of potash	480.50	Free	Free
Potassium nitrate or saltpeter, crude	480.60	Free	Free
Potassium sulfate	480.55	Free	Free
Potassic fertilizers and fertilizer materials	480.75	Free	Free

5. Depletion Allowance: 14% (Domestic), 14% (Foreign).

e/ Estimate.
1/ Measured by sold plus imports minus exports.
2/ Million short tons at present price levels, using current technology.

Prepared by W. F. Keyes, telephone number (703) 557-0495

6. Events, Trends, and Issues: Domestic demand for potash is expected to increase at an annual rate of 4% through 1980. There is a current worldwide oversupply resulting from Canadian expansion in the past decade; Canadian reserves and potential production are the largest in the world. The U.S. industry has declined 20% since its peak in 1966, and dependence on imports is consequently growing. U.S. imports as percentage of consumption have increased from between 10% and 15% in the 1950's to 61% in 1972. However, given the existence of the Canadian industry, no future supply problems are foreseen. U.S. production is higher cost than that of the richer Canadian deposits and significant expansion to recapture lost markets is not economically feasible under present conditions, even if desirable from the standpoint of such considerations as employment and the trade balance. Chief recent and projected production expansion is in recovery of potash from salt lake brines; this is counterbalanced by the closure of one New Mexico mine in June 1973, reportedly for refitting. Solution mining is often mentioned as a way to develop large lower-grade deposits not currently minable, but it is problematical whether, with Canadian mines so close, much money will be spent on new solution mines; conversion of a conventional mine to solution mining in 1972 was undertaken to protect the existing investment. For the long term, the U.S. Bureau of Mines and other organizations could conduct a sustained low-level research program on obtaining potash from sea water, the ultimate source.

Potash mining produces large amounts of waste salts, principally sodium chloride. The mines are fortunately in arid areas, but some environmental damage could be caused to streams and ground water if care were not taken to protect waste dumps.

7. Government Programs: The U.S. Bureau of Mines is studying methods for recovering potash from high-clay slime ore in New Mexico. The Bureau of Land Management has a leasing program for potash on public lands. Potash is not a stockpile item.

8. World Mine Production and Reserves:

	Production 1972	Production 1973 e/	Reserves 2/
United States	2,659	2,595	120
Canada	4,130	4,160	12,000
France	1,930	2,100	60
Germany, West	3,136	3,200	3,000
Italy	238	250	35
Spain	678	680	60
Israel and Jordan (Dead Sea)	618	600	280
Other Free World	336	350	225
Communist countries (except Yugoslavia)	8,740	8,800	9,100
World Total	22,465	22,735	24,880

9. World Resources: Domestic potash resources available in crystalline deposits and brines are sufficiently large to last at least 100 years at currently anticipated rates of production. About one-half of the world's resources are in Canada. World resources of potassium compounds are enormous. Estimates of quantities in known deposits exceed 100 billion tons of K_2O.

January 1974

PUMICE AND VOLCANIC CINDER
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: Output of pumice and volcanic cinder in 1972 was produced by 101 firms, individuals and Governmental agencies from 220 operations in 16 States. Combined output of Arizona, California, and Oregon accounted for two-thirds of the national total. California led all producing States with 95 active operations. Value of 1972 production was $6.5 million. The major uses were for road construction, 52%; concrete admixtures and aggregates, 31%; and railroad ballast, 11%. Alternate competitive materials include crushed stone and gravel, expanded shale and clay, and diatomite.

2. Salient Statistics--United States:

Salient Statistics--United States:	1969	1970	1971	1972	1973 e/
Production: Mine	3,609	3,036	3,391	3,813	3,605
Imports for consumption	384	365	400	600	325
Exports (short tons)	533	304	357	256	3,100
Apparent consumption	3,992	3,401	3,791	4,413	3,927
Price: Per ton, f.o.b. mine or mill (av.)	$1.40	$1.54	$1.54	$1.71	$1.77
Stocks			Not available		
Employment: Mine and mill	562	485	511	525	500

3. Import Sources (1969-72): Greece 52%, Italy 48%. Pumice imported for consumption in 1972, set a record in both quantity and value due to the increased demand for pumice used in the manufacture of concrete masonry products.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Statutory
Used in the manufacture of concrete masonry products such as building blocks, bricks, tiles, and similar forms	519.05	Free	Free
Crude or crushed:			
Valued not over $15 per ton	519.11	0.02¢/lb.	0.1¢/lb.
Valued over $15 per ton	519.14	.04¢/lb.	.25¢/lb.
In grains or ground, pulverized or refined	519.31	.17¢/lb.	.75¢/lb.
Millstones, abrasive wheels, and abrasive articles, n.s.p.f.	519.93	7% ad valorem	35% ad valorem
Articles, n.s.p.f.	523.61	7% ad valorem	35% ad valorem

5. Depletion Allowance: 5% (Domestic), 5% (Foreign).

e/ Estimate. NA Not available.

Prepared by A.C. Meisinger, telephone number (703) 557-1955.

6. Events, Trends, and Issues: Demand for pumice and volcanic cinder is expected to increase at an annual rate of about 4% through 1980. Domestic pumice resources are expected to adequately supply the probable cumulative domestic demand of around 215 million tons during the period 1972-2000. Transportation cost determines the maximum distance that pumice and volcanic cinder can be shipped and remain competitive with alternate materials. Changing geographic demand patterns coupled with the transportation cost make the lack of detailed reserve information a problem in selecting new production locations.

7. Government Programs: None.

8. World Mine Production and Reserves:

	Production		Reserves
	1972	1973 e/	
United States	3,813	3,605	Large
France	692	700	NA
Germany, West	5,400	5,500	Large
Greece	1,140	1,200	NA
Italy	5,950	6,000	Large
Other Free World	656	700	Large
Communist countries (except Yugoslavia)	NA	NA	NA
World Total	17,651	17,705	NA

9. World Resources: The domestic identified resources of pumice and pumicite are estimated to be at least 25 million tons. The identified and undiscovered resources in the Western and Great Plains States are in the range of 250 million to 450 million tons. The domestic identified resources of volcanic cinders, including scoria, can be estimated at about 1 billion tons (plus or minus 25%). Undiscovered domestic resources are about 10 billion tons.

QUARTZ CRYSTAL-ELECTRONIC GRADE
(Data in thousand pounds, unless noted)

1. Domestic Production and Use: Natural quartz crystal suitable for electronic applications, is not produced in the United States. The consuming industry has been dependent on imports. However, natural quartz is being rapidly supplemented by manufactured (artificially cultured) quartz produced by 6 domestic firms. Domestic manufactured quartz crystal production capacity is estimated to be in excess of 130,000 pounds per year. Twenty-eight crystal cutting firms consumed 189,000 pounds in 1972. Quartz crystal manufactures consisted primarily of oscillator plates, with the remainder consisting of filter, resinator and transducer plates.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Mine			None		
Imports for consumption	237	94	35	65	100
Exports: Natural	NA	231	113	90	200
Consumption: Natural	104	98	62	87	100
Price: Natural	$2.50 to $50 per pound varying with crystal size and quality				
Manufactured			$18 to $30 per pound		
Stocks	104	93	90	74	70
Employment: Mine			None		

3. Import Sources (1969-72): Brazil 95%, Other 5%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Statutory
Raw quartz	521.21	Free	Free

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate. NA Not available.

Prepared by B. Petkof, telephone number (703) 557-1955.

6. Events, Trends, and Issues: Manufactured quartz continued to replace natural quartz crystal for the manufacture of finished crystal units. The demand for natural quartz can be expected to decline annually between now and 1980 and perhaps phase out almost completely by 1985. The development and commercial acceptance of manufactured quartz has made the U.S. crystal cutting industry independent of foreign supplies of quartz crystal.

7. Government Programs: The Government through the Office of Minerals Exploration will grant loans of up to 50% of approved costs for exploration of eligible quartz crystal deposits. The Government has, through the General Services Administration, stockpiled quartz crystal but is currently offering surplus stockpiled quartz for sale. Current stockpile data are shown below.

Stockpile Status—11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Quartz Crystal	209	4,009	3,800	3,689	310

8. World Mine Production and Reserves:

	Mine Production 1972	Mine Production 1973 e/	Reserves Quantity	Reserves Average grade
United States	-	-	-	-
Brazil (exports)	e/390	390	Large	NA
Other Free World	Negligible		-	-
Communist countries (except Yugoslavia)	NA	NA	NA	NA
World Total	390	390		

9. World Resources: Only limited resources of natural quartz crystal, suitable for electronic use, are available throughout the world. World dependence on these resources will decline because of increasing acceptance of manufactured quartz crystal as an alternate material.

RADIUM

(Data in curies 1/, unless noted)

1. Domestic Production and Use: No U.S. primary radium production was recorded after 1950. Domestic demand was met by secondary recovery, sales of radium salts from stocks, and insignificant imports. A long half-life and high prices made recovery of radium from secondary sources economically feasible. Three firms were involved in transactions with radium and its secondary recovery. Principal uses of radium were in radium therapy for cancer (about 80%), luminous materials, and radium-beryllium neutron sources. About 1,600 curies of radium were in use throughout the United States during 1973.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production			None		
Exports: Metal and alloy 2/			Not available		
Imports: Radium and radium salts 2/			Not available		
Industrial consumption			Not available		
Prices, per milligram; $24, less than 100 milligrams; $20, 200-499 milligrams; $18, 500 milligrams; $17, over 5 grams.					
Stocks			Not available		
Employment			Not available		

3. Import Sources (1969-72): 3/ Radium, radioisotopes, and compounds - Canada 78%, United Kingdom 9%, Other 13%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Radium, radioactive isotopes, and compounds (excludes cobalt-60)	494.5040	Free	Free

5. Depletion Allowance: 14% (Domestic), 14% (Foreign).

e/ Estimate.
1/ One curie is equivalent to the radioactivity of one gram of pure radium or 37 billion disintegrations per second.
2/ Tariff schedules for imports and exports include radium with all radioactive isotopes.
3/ Percent of radioacitvity value (curies).
Prepared by R. V. Sondermayer, telephone number (703) 557-0291.

6. Events, Trends and Issues: Imports from Canada and the United Kingdom were the principal sources for new radium during 1973. According to incomplete data, up to 40 curies are added to the radium in use in the United States every year. U.S. demand for radium is expected to decrease slowly in the future. Substitution by other radioisotopes continued. Man-made radioisotopes which are produced at relatively lower costs and are safer than radium are becoming increasingly available. Most are better suited than radium for similar application. Prices for radium remained high, approximately at the 1972 level. No significant changes in prices are expected in the near future.

   Ecological problems of using radium result from its radioactive properties. Gamma emission of radium, if uncontrolled, may be lethal or cause genetic changes. Heavy shielding and special handling are required in all operations. Furthermore, a half-life of over 1,600 years makes disposal of radium difficult and expensive.

7. Government Programs: During 1973 there were no specific Federal programs related to radium. However, the Atomic Energy Commission, National Institutes of Health, and National Bureau of Standards provided safety regulations in use of radium.

8. World Mine Production and Reserves: There are no known reserves in the world. In the past, most radium was produced from high-grade carnotite and pitchblende uranium deposits. Uranium reserves containing radium in a ratio of 1 part radium to 3 million parts of uranium are not presently a source of radium but could provide additional radium in case of increased demand.

9. World Resources: World resources for radium are abundant but there are no quantitative data available.

January 1974

RARE-EARTH METALS

(Data in short tons of rare-earth oxide (REO), unless noted)

1. Domestic Production and Use: Rare-earth minerals were produced domestically by three companies in three States - bastnaesite in California and monazite in Georgia and Florida. Bastnaesite is mined exclusively for itself whereas, monazite is a byproduct in placer mining for titanium minerals and zircon. Thorium and yttrium are coproducts in processing monazite. The United States remained the world's principal producer and consumer of rare earths and was a net exporter of rare-earth concentrate, compounds, and metals in 1973. Rare-earth compounds, metals and alloys were produced mainly by ten companies, located primarily in the East and Midwest. Industrial consumption was estimated as follows: iron and steel (including pyrophoric alloys), 45%; petroleum (catalyst), 33%; ceramic and glass, 17%; electrical, 4%; and miscellaneous, 1%. Small quantities of expensive, high purity europium and gadolinium compounds were used in electronics and in cathode tube phosphors.

2. Salient Statistics -- United States:

	1969	1970	1971	1972	1973 e/
Production of rare-earth concentrates	Company	confidential			data
Imports for consumption: Monazite e/	2,310	1,900	1,860	492	980
Metal, alloys, and compounds 1/ e/	363	580	786	1,019	820
Exports: Bastnaesite e/	3,000	2,250	2,500	2,500	4,000
Ferrocerium and pyrophoric alloys	49	37	30	101	100
Industrial consumption (apparent)	11,000	11,500	10,200	13,400	13,700

Prices: Monasite concentrate $180-$200 per long ton; bastnaesite concentrate, $0.30-$0.40 per pound REO. Average prices for the processed rare earths, per pound: Mixed compounds, $0.29 (chloride) to $0.90 (fluoride); high-purity oxides, $1.90 (cerium) to $2,300 (lutetium); metal, $21 (cerium) to $6,500 (lutetium).

	1969	1970	1971	1972	1973 e/
Stocks	7,619	6,435	6,184	4,405	5,000
Employment		Not	available		

3. Import Sources (1969-72): Monazite -- Australia 53%, Malaysia 44%, Other 3%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Ore and concentrate	601.12, 601.45	Free	Free
Cerium chloride, oxide	418.40, 418.42	15% ad valorem	35% ad valorem
Alloys, incl. mischmetal	632.78	50¢/lb.	$2/lb.
Ferrocerium and other pyrophoric alloys	755.35	50¢/lb. + 6% ad valorem	$2/lb. + 25% ad valorem

5. Depletion Allowance: Monazite 22% (Domestic), 14% (Foreign). Other rare-earth minerals, 14%.

e/ Estimate. W Withheld to avoid disclosing individual company confidential data.
1/ Mainly rare-earth chloride from Brazil and India.
Prepared by J. H. Jolly, telephone number (703) 557-0291.

6. Events, Trends, and Issues: The strong upsurge in world demand for rare earths that began in mid-1972 continued throughout 1973. U.S. mine production of rare-earth minerals exceeded all previous production levels, increasing about 60% (as expressed in REO) over the previous year. The major advance was made in bastnaesite production which increased about 75%. Bastnaesite mine capacity was expanded in 1973 and represents about 62% of the total world REO mine capacity. Monazite production also increased due mainly to the first full year's production at the newly commissioned placer operation in Florida.

U.S. demand for rare earths set a record in 1973 as consumption increased in all major uses, especially in the iron and steel industry. The growth rate will probably decrease in 1974 because of slower economic growth and energy deficiencies, but overall consumption is expected to rise owing to increased demand for pipeline steel, nodular iron, and petroleum catalysts. Demand for rare earths is expected to increase at an annual rate of 3 to 4 percent through 1980.

The rare-earth elements are in abundant domestic and world supply, and no shortages are anticipated. Various minerals contain rare-earth elements in different combinations and concentrations; therefore, when processed, large surpluses may develop in those elements for which there is little demand. The demand pattern is expected to continue the shift toward individual compounds and metals and special mixtures. Improved knowledge of rare-earth properties will lead to new industrial applications.

7. Government Programs: Office of Minerals Exploration participation is 50% of approved costs for exploration of rare-earth deposits.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available for Disposal	Sales, 11 Months
REO	-	10,207	10,207	10,207	1,608

8. World Mine Production and Reserves:

	Mine Production 1972	Mine Production 1973 e/	Reserves
United States	W	W	5,045,000
Australia	3,045	3,200	400,000
Brazil	1,349	1,400	350,000
Canada	-	-	250,000
India	2,585	2,700	1,000,000
Malaysia	1,060	1,100	30,000
U.S.S.R.	e/2,000	2,000	450,000
Other	640	640	180,000
World Total	10,679	11,040	7,705,000

9. World Resources: Some members of the rare-earth group of metals are relatively abundant in the earth's crust, but minable concentrations are uncommon. Bastnaesite, a rare-earth fluocarbonate, and monazite, a rare-earth phosphate, are the two major ore minerals. Bastnaesite is mined extensively from carbonatite in California, and monazite is recovered largely from placer deposits in various parts of the world. The rare earths also occur in many other minerals. Apatite is a source of rare earths as a byproduct of fertilizer manufacture in Europe. The large reserves of bastnaesite in California make the United States self-sufficient in the rare-earth elements. Total world reserves and resources of rare-earths are estimated to be between 20 and 25 million tons.

January 1974

RHENIUM
(Data in pounds of metal, unless noted)

1. Domestic Production and Use: Rhenium was recovered as a byproduct from flue dusts and gases from roasting of byproduct molybdenite obtained from southwestern porphyry copper ores. There was only one major domestic rhenium producer. Four other firms also produced rhenium during the year. The principal rhenium application was in bimetallic platinum-rhenium catalysts used in the petroleum industry, 81%; other applications (includes X-ray tubes, vacuum tube and flashbulb filaments, coatings, filler rod alloys for welding molybdenum and tungsten, electrical contacts, and high temperature nickel-base and refractory metal-base alloys) 12%; and instruments (includes thermocouples, temperature controls, and electronic devices) 7%.

2. Salient Statistics--United States:

	1970	1971	1972	1973
Production e/	5,900	7,250	6,100	6,500
Imports e/	1,067	3,924	2,351	4,500
Exports	Negligible			
Consumption e/	5,100	7,600	4,300	4,500
Price: (Average, per pound)				
Metal powder, 99.99% pure	$1,050	$1,200	$1,000	$900
Perrhenic acid	800	1,000	875	775
Stocks: Consumer and producer e/	6,400	9,900	13,000	17,500
Employment	Small			

3. Import Sources (1969-72): West Germany 71%, Sweden 22%, U.S.S.R. 2%, United Kingdom 2%, Other 3%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Unwrought, waste and scrap 1/	628.90	5% ad valorem	25% ad valorem
Wrought	628.95	9% ad valorem	45% ad valorem

5. Depletion Allowance: 14% (Domestic), 14% (Foreign).

e/ Estimate.
1/ Duty on waste and scrap suspended until June 30, 1975.

Prepared by Larry J. Alverson, telephone number (703) 557-0500.

6. Events, Trends, and Issues: Potential rhenium supply is limited to about 16,000 to 21,000 pounds annually from domestic porphyry copper ores, but half of the molybdic oxide plants make no attempt at rhenium recovery. U.S. demand for rhenium is expected to increase at an annual rate of about 5% through 1980. Production should keep pace with demand in the short run but may be hard pressed to continue if the effects of demand from new petroleum refineries are felt in about 1975-76. Increased reliance on imports in the short run may be necessary if this increased demand is substantial. In the long run, however, imports should not represent the major portion of future U.S. supply, totaling about 20% to 40%.

   Further research on the properties and applications of rhenium in catalytic and high-temperature alloy uses may alter future potential supply-demand patterns. Continued development and application of less expensive rhenium-platinum catalysts to replace platinum in petroleum refining operations are expected to create greater demands for this commodity. However, the future of rhenium as a catalyst in petroleum refining is uncertain past 2000; by that time, its use in high-temperature alloys may be the dominant end use. Iridium was being used as an alternative metal in platinum petroleum reforming catalysts, but limited reserves should prevent it from becoming a major threat to platinum-rhenium catalysts.

   The main problem areas to full development of rhenium's potential are: Poor overall recovery of rhenium from porphyry copper ores; questionable economic return to molybdic oxide processors on initial or additional rhenium recovery equipment due to uncertain future demand and limited production potential; increased usage of substitute materials in petroleum refining catalysts; and environmental strictures imposed on the copper and molybdenum industry, from which rhenium is derived as a byproduct.

7. Government Programs: The Bureau of Mines is continuing its research into more efficient ways of recovering rhenium from molybdenite concentrate. The electrooxidation technique has been successfully applied to recovery of molybdenum and rhenium from sulfide ores and concentrate. This process eliminates the use of conventional roasting techniques, which contribute to the SO_2 pollution of the atmosphere.

8. World Mine Production and Reserves: World production of rhenium in 1973 totaled an estimated 11,000 pounds and came from four countries (United States, Chile, U.S.S.R., and Zaire). United States measured, indicated, and inferred reserves of rhenium from porphyry copper ores are estimated to total 1,200 tons. At 60% to 80% recovery, about 8 to 10 tons of rhenium could be produced annually if all presently recovered U.S. byproduct molybdenite were treated for its rhenium content. An additional reserve of about 60 tons of rhenium may be obtainable from other molybdenum, uranium, tungsten, vanadium, zirconium, columbium-tantalum, and gadolinium ores. The world reserve of rhenium from molybdenite is estimated at about 1,900 tons.

9. World Resources: Rhenium is obtained from molybdenite that is recovered as a byproduct of copper production, and the supply of rhenium, as well as the world resources of rhenium, are therefore closely related to resources of molybdenum in porphyry copper deposits.

   Identified U.S. resources of rhenium are estimated to be about 4,000 short tons, and world resources on the order of 8,000 short tons. Although other sources may exist, they are not known to be significant.

January 1974

RUBIDIUM

(Data in pounds of metal, unless noted)

1. Domestic Production and Use: Most rubidium was produced from stocks of a byproduct recovered from the residues of previous lithium production. One company produced most of the rubidium products and a few other companies have produced intermittently. Rubidium, usually in the form of chemical compounds, is used mainly in research and development. It also is used commercially in electronic and medical applications.

2. Salient Statistics--United States:
   Production: Rubidium raw materials--None; metal and compounds--company confidential data.
   Imports for consumption: Raw materials and rubidium compounds--NA; rubidium metal--negligible.
   Exports: Not available.
   Industrial consumption: Rubidium raw materials--company confidential data; metals and compounds NA but largely for research and development.
   Price: Per pound. Metal, 99.5+%, lots of 1-4 pounds--$300; standard grades of most rubidium compounds--$44 to $51.
   Stocks: Company confidential data.
   Employment: Mines--None. Plant--e/25.

3. Import Sources (1969-72): Rubidium imports were negligible.

4. Tariff:

	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Rubidium	415.40	5% ad valorem	25% ad valorem
Rubidium compounds	423.00	5% ad valorem	25% ad valorem

5. Depletion Allowance: 14% (Domestic), 14% (Foreign).

e/ Estimate. NA Not available.
Prepared by H. F. Kurtz, telephone number (703) 557-0213.

6. Events, Trends, and Issues: Rubidium was more a subject of laboratory study rather than one of significant commercial concern. Demand remained at only a few hundred pounds. Rubidium and cesium have similar properties, and the more electropositive cesium was usually used when this property was desired. Because of the small scale of production of rubidium products, no significant environmental problems have been noted.

   Demand for rubidium is expected to increase at an average annual rate of about 4% through 1980. Inventories of the raw material from which most rubidium products have been produced in the United States are likely to be exhausted in about 5 years. This material, generated as a residue in a process formerly used to recover lithium compounds, is expected to be replaced as a source of rubidium by pollucite.

   Pollucite is currently obtained entirely from imported sources. Future rubidium supplies are likely to be dependent upon foreign sources unless domestic pollucite deposits are discovered or methods to utilize potential rubidium sources, such as brines, are developed.

7. Government Programs: None.

8. World Mine Production and Reserves: No known mine production for rubidium. Rubidium was contained in minerals mined for purposes other than rubidium production. Rubidium comprises about 1% of the pollucite reserves. (See Cesium.)

9. World Resources: Rubidium forms no known independent minerals but occurs chiefly as a substitute for potassium, especially in minerals formed late in the crystallization of pegmatites. Meaningful estimates of the rubidium resources cannot be made.

RUTILE 1/

(Data in thousand short tons of concentrate, unless noted)

1. Domestic Production and Use: Rutile was produced at one Florida mine. Major coproducts are ilmenite and zircon. Of 37 consuming firms located mainly in the Eastern United States, eight companies used 86% of the rutile consumed to make titanium dioxide pigment. Welding-rod coatings consumed 5%; miscellaneous applications, which include metal and glass fibers, over 8%; and alloys, carbide, and ceramics, less than 1%.

2. Salient Statistics--United States:

Salient Statistics--United States:	1969	1970	1971	1972	1973 e/
Production	-	-	-	W	W
Imports for consumption	205	243	215	2/204	2/212
Exports (includes ilmenite)	1	1	2	2	2
Consumption	185	189	225	243	250
Price: Per short ton, f.o.b. Atlantic and Great Lakes ports, last quarter	$160	$185	$185	$175	$180
Stocks: Mine, distributor, and consumer	194	238	237	157	135
Employment: Mine and mill	-	-	-	10	10

3. Import Sources (1969-72): Australia 92%, Sierra Leone 8%. No imports came from Sierra Leone in 1972 and 1973.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Titanium ore (including rutile and rutile sand)	601.5140	Free	Free

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate. NA Not available. W Withheld to avoid disclosing company confidential data.
1/ See also Ilmenite and Titanium.
2/ Includes rutile substitutes.
Prepared by F. W. Wessel, telephone number (703) 557-1392.

6. Events, Trends, and Issues: Production in Australia, which has for years been the source of about 90% of the world's rutile, gained 2% over that of 1972. U.S. imports from Australia, however, were estimated at 183,000 tons, a 6% decline.

Demand for rutile is expected to increase at an annual rate of slightly over 4% through 1980. Dependence on foreign sources is more than 95%. A new and significant factor in the supply-demand relationship is synthetic rutile, not domestically produced, but imported from Japan, Australia, and India. In 1972, 9,200 tons was imported; an estimated 28,600 tons came in during 1973.

The major impediment to more extensive use of rutile is the limited supply. On the East Coast of Australia 9 million tons of rutile is present, but, because of environmental pressures, only about 5 million tons can be mined. Exploitation of the deposits in Sierra Leone presents major engineering problems which may take some time to solve.

It is environmentally much cleaner to make pigment from rutile, using the chloride process, than to make pigment from ilmenite, using the sulfate process. Wastes are on the order of 0.3 ton per ton of product, and in addition are less toxic to the environment.

7. Government Programs: The Office of Minerals Exploration will supply 75% of approved costs for exploration of rutile deposits.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Rutile	-	43	43	4	14

8. World Mine Production and Reserves:

	Mine Production 1972	Mine Production 1973 e/	Reserves
United States	W	W	500
Australia	350	357	5,000
Sierra Leone	-	-	3,000
Other Free World	7	8	900
Communist countries (except Yugoslavia)	NA	NA	300
World Total (excluding Communist countries)	357	365	9,700

9. World Resources: Total world resources of rutile are estimated at a minimum of 19.4 million short tons. Resources in Australia are 7.9 million tons, including both east and west coasts. An area in Oaxaca, Mexico, contains at least 5 million tons. Several mineral areas in the United States contain a total of 2.7 million tons. Deposits in Sierra Leone contain at least 3.0 million tons, and possibly much more. Two known areas in Brazil contain a total of 0.8 million tons; in addition, a newly-discovered deposit in Minas Gerais, not yet accurately measured, may have as much as 16 million tons.

SALT
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: In 1973 salt was produced by 96 plants in 16 States by 54 companies. Overall production was slightly lower in 1973 than that of 1972. Salt imports amounted to about 7% of the apparent consumption and exports amounted to 1%. The States of Louisiana and Texas continued to lead in salt production with 54% of the national output. Ohio, New York, and Michigan contributed another 34%. Eleven companies each with a production of more than a million tons of salt per year, produced over 84% of the national production. The usual distribution pattern between types of salt was observed: 56% to brine; 31% to rock salt; and 13% to evaporated salt. As to the usage pattern, the making of chlorine and caustic soda continued to be the largest consumer of salt followed by the making of soda ash. These two uses alone amount to over 58% of the consumption. After the salt required for making chemicals, the use of rock salt for deicing claimed an additional 18%. Total food uses amounted to 6%.

2. Salient Statistics—United States:

	1969	1970	1971	1972	1973 e/
Production	44,245	45,896	44,077	45,022	43,860
Imports for consumption	3,302	3,536	3,855	3,463	3,300
Exports	716	423	670	869	500
Apparent consumption	46,831	49,009	47,262	47,616	46,660
Prices: Quoted, carlots, f.o.b. New York, in 100 pound bags, dollars per ton			$19.40 to $30.80		
Average sales price f.o.b. mine, dry (including bulk and pressed but excluding brine), dollars per ton	$9.99	$10.60	$11.03	$10.62	$10.50
Stocks			Not available		
Employment: Mine and plant	3,100	5,242	5,240	5,070	4,950

3. Import Sources (1969-72): Canada 34%, Mexico 28%, Bahamas 22%, Chile 9%, Other 7%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
In brine	420.92	5% ad valorem	20% ad valorem
In bulk	420.94	0.8¢/100 lbs.	7¢/100 lbs.
Other	420.96	Free	11¢/100 lbs.

5. Depletion Allowance: 10% (Domestic), 10% (Foreign).

e/ Estimate.

Prepared by C. L. Klingman, telephone number (703) 557-0439.

6. Events, Trends, and Issues: The mild winters of 1971-72 and 1972-73 caused a buildup of large stockpiles of deicing salt which was not needed for highway application. These large inventories of rock salt had a depressing effect on production of this type of salt. The shortage of fuel and electric power in 1973 caused some limitation in production and is expected to reduce salt production to a much greater extent in 1974 and 1975. There may also be salt shortages caused by transportation difficulties. In 1973 there was less salt used in the manufacture of soda ash by the Solvay process, but this was offset by a greater use of salt in the making of chlorine and caustic soda.

The excessive use of deicing salt on highways has been attacked from an environmental standpoint. It may kill vegetation along the right-of-way and will hasten deterioration of steel structures and of automobile bodies. Moderation in the use of deicing salt is likely to be the result of this confrontation.

7. Government Programs: There are no programs of governmental control of salt production and distribution, and there are no government-controlled stockpiles of this commodity.

8. World Mine Production and Reserves:

	Mine Production		Reserves	
	1972	1973 e/	Quantity	Grade
United States	45,022	43,860	Large	95-98% NaCl
Canada	5,535	5,800		
China	19,800	20,900		
France	5,739	6,000		
Germany, West	10,120	10,700		
India	7,165	7,500		
Italy	4,497	4,700		
Mexico	4,850	5,000		
Netherlands	3,530	3,700		
Poland	3,318	3,500		
United Kingdom	9,739	10,300		
U.S.S.R.	13,200	13,900		
Other countries	30,046	32,000		
World Total	162,561	167,860		

Reserves are large in principal salt-producing countries but grade is unknown. The oceans comprise an inexhaustible supply of salt.

9. World Resources: World resources of salt are virtually unlimited. Domestic resources include those in huge bedrock deposits in the Northern, Southeastern, and Central Western States. Salt lakes and solar evaporated sea salt facilities are close to populated areas of the West Coast States.

SAND AND GRAVEL
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: In 1972 production from 6,716 commercial and noncommercial operations was valued at $1.20 billion. About 49% of the total was produced by 698 commercial operations. California produced 13%; Michigan, 7%; Ohio, 5%; Illinois, Minnesota, Wisconsin and Texas, each 4% of the total tonnage. Consumption by thousands of firms was concentrated near metropolitan areas. About 95% was used in the construction industry with 55% used for highway and street construction and 37% used in general building and other heavy construction. The remaining 8% was used for abrasive products, glass sand, molding sand, railroad ballast, and miscellaneous industrial uses.

2. Salient Statistics—United States:

	1969	1970	1971	1972	1973 e/
Production	937,169	943,941	919,593	913,375	914,483
Imports	897	879	715	761	753
Exports	2,106	1,210	1,728	1,821	1,585
Apparent consumption	935,960	943,610	918,580	912,315	930,418
Price (dollars per ton)	1.14	1.18	1.25	1.31	1.35
Stocks			Not available		
Employment: Mine	50,100	45,500	44,000	50,000	50,000

3. Import Sources (1969-72): Canada 92%, Other 8%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
95% or more silica and not more than 0.6% iron oxide	513.11	25¢/long ton	$2.00/long ton
Other	513.14	Free	Free

5. Depletion Allowance: (Domestic and Foreign)
Sand or Gravel; common varieties 5%, quartz sand or pebbles 14%.

e/ Estimate.

Prepared by Walter Pajalich, telephone number (703) 557-1955.

6. Events, Trends, and Issues: Sand and gravel prices should begin to rise slowly as higher production costs are caused by rising land values, anti-pollution and restoration requirements, and local zoning regulations which will increase the distance to markets.

Environmental problems will become more critical in the future as more and more sand and gravel operations are overrun by urban expansion. Use of crushed stone is increasing as a substitute for sand and gravel.

Demand for sand and gravel is expected to increase at an annual rate of about 4% through 1980.

7. Government Programs: None.

8. World Mine Production and Reserves:

	Production 1972	Production 1973 e/	Reserves
United States	913,375	914,483	Reserves ample except for local shortages.
Other countries	6,945,000	7,020,000	
World Total	7,858,375	7,934,483	

9. World Resources: The total sand and gravel resources of the United States and the world are literally inexhaustible. However, their geographic distribution and quality often do not match market patterns or requirements.

The most important commercial sources of sand and gravel are river channels and glacial terrain. As these sources become depleted, deposits in marine and lake environments could become important.

Silica sand formations and quartz sandstones, from which much of silica sand is derived, are abundantly distributed through the United States and the world.

SCANDIUM

(Data in kilograms of metal, unless noted)

1. Domestic Production and Uses: Definable mine production of scandium from domestic sources apparently was nil in 1973. Small refinery production (one refinery) was based on imported raw materials or on materials held in stocks by the producing company. About 14 companies purchased or sold scandium. Scandium was mostly used in investigations by research laboratories. It has only two established commercial uses -- as a tracer in petroleum production (a radioistope Sc-46) and in special high-intensity lamps. Demand for scandium was small and was expressed in kilograms. Scandium was a byproduct of uranium and tungsten processing.

2. Salient Statistics -- United States:

	1969	1970	1971	1972	1973 e/
Production (mine)	16	-	-	-	-
Exports: Metal and alloy			Not available		
Imports: Scandium contained in concentrates metal, alloys, and compounds	1	3	28	-	3
Industrial consumption: e/	10	16	14	10	11
Price:					
Ingot, dollars per gram 2/	4.40	6.00	6.00	8.00	8.00
Distilled, dollars per gram 2/	15.00	15.00	15.00	15.00	15.00
Employment			Not available		

3. Import Sources e/ (1969-72): 1/ Australia 55%, Canada 40%, Other 5%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Metal	632.38	5% ad valorem	25% ad valorem

5. Depletion Allowance: Not applicable.

e/ Estimate.
1/ Imports and exports of scandium are reported together with minor commodities.
2/ In lots of 100-453 grams.
Prepared by R. V. Sondermayer, telephone number (703) 557-0291.

6. Events, Trends, and Issues: The small domestic demand for scandium was apparently satisfied from existing stocks in 1973. Large scandium resources are available from domestic uranium, tungsten, and phosphate resources if demand should increase. Demand for scandium is expected to increase at an annual rate of 4 to 5 percent through 1980.

Production of scandium oxide and metal is complex and costly. Scandium is vulnerable to substitution by other, less expensive metals such as the rare earths and yttrium. Demand for scandium in a special high-intensity mercury vapor lamp, a relatively new application, may be affected adversely by current energy conservation practices. Continuing research and development may lead to development of new industrial applications. The ecological impact of scandium use or production is minimal.

7. Government Programs: None.

8. World Mine Production and Reserves: Canada and the U.S.S.R. were the largest producers of scandium in 1973. Small production and demand make data on scandium scarce and unreliable. Uranium reserves contain sufficient scandium to meet future requirements.

9. World Resources: World resources are abundant. Scandium is a highly dispersed element that occurs chiefly in trace amounts in the ferromagnesian minerals of igneous rock. Scandium may be concentrated above normal amounts in pegmatites, some of which have been mined for thortveitite, one of the few scandium minerals. Scandium may also be present in some phosphate deposits, uranium and tungsten ores.

January 1974

SELENIUM

(Data in thousand pounds of metal, unless noted)

1. Domestic Production and Use: Selenium production during 1973 decreased 29,000 pounds from 1972 to 740,000 pounds, imports increased 50,000 pounds, and producers' stocks decreased 31,000 pounds. All reported primary selenium production was recovered as a byproduct during the processing of electrolytic copper refinery sludges to recover their gold and silver contents. Tellurium is also recovered from these sludges by additional processing. Other selenium sources that can be utilized are smelter flue dusts, electrolytic lead refining sludges, and sulfur burning residues. Secondary selenium, aside from considerable quantities recovered from intracompany scrap, constituted an estimated 3% of the domestic supply. Market value of the selenium produced in 1973 was $8 million. Four copper companies, with refineries in Maryland (1), New Jersey (2), and Utah (1), accounted for all of the domestic production of selenium. Sludges from copper refineries owned by other companies are shipped to these plants for recovery of gold, silver, selenium, and tellurium. More than 200 firms in widely scattered locations are domestic consumers. Major uses were in electronic components, 45%; ceramics and glass, 34%; chemicals, 13%; and other, 8%. Domestic consumption increased moderately with most of the increase occurring in electronic applications.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Refinery	1,247	1,005	657	769	740
Imports for consumption:					
Metal and compounds	546	454	395	430	480
Exports		Not available			
Apparent consumption	1,975	1,510	1,058	1,221	1,250
Price: Average, per pound,					
100-pound lots, commercial grade	$7.00	$9.00	$9.00	$9.00	$9.30
Stocks, yearend: Producer	240	189	182	161	130
Employment:					
Primary and secondary refinery	250	250	200	200	200

3. Import Sources (1969-72): Canada 92%, Japan 3%, Mexico 3%, Other 2%. Imports provided about 38% of the selenium consumed in 1973.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Selenium	632.40	Free	Free

5. Depletion Allowance: 14% (Domestic), 14% (Foreign).

e/ Estimate. NA Not available.
Prepared by Lyman Moore, telephone number (703) 557-7539.

6. Events, Trends, and Issues: Continuing progress in techniques for manufacturing electronic devices using miniaturization and thinner selenium film resulted in less selenium consumption per manufactured unit although total consumption for electronic uses increased. Selenium was proposed as an additive for chicken, turkey, and swine feed by the Food and Drug Administration on April 27. Dietary selenium is necessary for normal physical development. The fuel and energy shortage resulting from curtailed petroleum supplies stimulated interest in photogalvanic cells which convert light energy to electrical energy and in selenium-tinted window glass which has a lower heat conductivity than conventional glass. Domestic demand for selenium is expected to increase at an annual rate of about 1.9% through 1980, and world demand at a 1.2% rate. Materials, in abundant supply, can be substituted for selenium in many applications with only moderate reduction in product quality. These include silicon in rectifiers, manganese in glass decolorizing, lead in free-machining steel, copper in ruby-colored glass, and sulfur in wear-resistant rubber and in blasting caps. Adequate supplies of selenium are expected to continue to be available as a byproduct of copper production. However, possible future changes in copper metallurgical practice, to reduce air pollution from smelting, might require changes in selenium recovery methods.

Domestic producers priced selenium at $9 and $10 per pound for commercial grade and at $11.50 and $12.50 per pound for high-purity metal from January until June. A price ceiling at these amounts was imposed in early June by the Cost of Living Council and continued until December 6. The price of commercial-grade metal, following price decontrol, was increased $1 per pound by some producers and $3 per pound by others to $11 and $12 per pound. The price of high-purity selenium was increased $1.50 per pound to $14. Merchant prices in the United States and Europe varied from under $9 to over $18 per pound for commercial-grade metal.

7. Government Programs: Office of Minerals Exploration assistance for selenium continues at 50%. However, no selenium exploration has been financed under this program because the abundance of byproduct metal has kept prices low, for a rare element.

Stockpile Status—11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Metal	-	194	194	194	265

8. World Production and Reserves:

	Plant Production 1972	Plant Production 1973 e/	Reserves
United States	769	740	54,000
Australia	7	8	5,200
Belgium-Luxembourg	147	160	-
Canada	655	760	21,400
Finland	16	20	1,000
Japan	738	820	1,500
Mexico	97	110	5,900
Peru	18	20	15,000
Sweden	140	160	1,400
Yugoslavia	55	60	4,600
Other Free World	NA	NA	101,400
Communist countries (except Yugoslavia)	NA	NA	29,100
World Total	NA	NA	240,500

9. World Resources: In addition to the above large reserves of byproduct selenium which is contained in identified copper deposits of economic grade, an estimated three times this quantity of byproduct metal is believed to exist in other metal deposits, and in copper or other metal deposits that are undeveloped, of uneconomic grade, or as yet undiscovered. Coal contains an average of 1.5 parts per million of selenium and the total selenium content of coal deposits is about 100 times the content of identified economic copper deposits.

SILICON

(Data in thousand short tons of metal, unless noted)

1. Domestic Production and Use: Ferrosilicon was produced by 13 companies in 19 plants, with four companies producing about 70% of the total. Metallurgical-grade silicon was produced by six companies in eight plants with production about equally distributed among them. Most of the production plants are east of the Mississippi River. The plants of end users of ferrosilicon, are also in the Eastern United States, while the plants of the end users of metallurgical-grade silicon are well distributed geographically throughout the country. Major end uses of silicon in percent were: Transportation, 27%; construction, 22%; machinery, 19%; electrical equipment, 8%; oil and gas industries, 4%; appliances and equipment, 4%; chemical, 5%; and other, 11%.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production	471	530	448	535	550
Imports for consumption	17	10	13	30	56
Exports	4	22	13	7	17
Apparent consumption	477	531	451	561	568
Price: Average f.o.b. plant, carload lots (cents per lb.)					
Ferrosilicon	14.1	15.2	16.0	15.0	17.2
Metal. gr. silicon	21.6	23.2	24.6	25.4	27.2
Stocks: Consumer and producer	76	66	63	60	68
Employment: Mine and plant e/	10,000	10,000	10,000	10,000	10,000

3. Import Sources (1969-72): Canada 22%, France 15%, Norway 17%, Sweden 8%, Other 38%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Statutory
Ferrosilicon, 8-60% silicon	607.5000	Free	2¢/lb.
Ferrosilicon, 60-80% silicon	607.5100	0.5¢/lb.	3¢/lb.
Ferrosilicon, 80-90% silicon	607.5200	1¢/lb.	4¢/lb.
Ferrosilicon, over 90% silicon	607.5300	2¢/lb.	8¢/lb.
Silicon, +97.7% silicon	632.4300	5% ad valorem	25¢ ad valorem

5. Depletion Allowance: None, except on quartzite sand.

e/ Estimate.

Prepared by E. Shekarchi, telephone number (703) 557-0601

6. Events, Trends, and Issues: Silicon is a relatively low priced commodity, influenced by cost and availability of energy and transportation. Production capacity for silicon is governed by and related to requirements of the steel and aluminum industries.

Domestic supplies of ferrosilicon and metallurgical-grade silicon are ample to meet the forecast primary demand, which ranges between 830,000 and 1.5 million short tons by the year 2000. Significant changes in the demand is not anticipated in the near future and demand for silicon is expected to increase at an annual rate of about 2.1% through 1980.

The price of silicon in domestic and foreign markets began to rise in 1966 after trending downward for several years. Competition between foreign and domestic labor, the availability of cheap energy in exporting countries and devaluation of the dollar abroad, caused substantial import increases of silicon in recent years.

Silicon producing companies faced with Federal and local air and water pollution control requirements are weighing the cost of compliance against moving their plants to foreign countries with cheaper energy. Or, to compensate for the costs of pollution control devices and the rising costs of energy in this country, domestic producers show a tendency toward more specialization, dropping production of marginal silicon products.

Silicon's low-cost, limitless resources, and inertness make it a likely subject for research to develop new uses or substitute for more expensive material.

7. Government Programs: None.

8. World Production and Reserves:

	Production		Reserves
	1972	1973 e/	
United States	535	550	Reserves in major producing countries are large in relation to demand. Quantitative estimates are not available.
Canada	65	66	
France	95	95	
Italy	64	64	
India	20	21	
Japan	129	130	
Norway	196	196	
Sweden	38	40	
West Germany	68	68	
Other Free World	85	87	
Communist countries (except Yugoslavia)	550	560	
World Total	1,845	1,877	

9. World Resources: Identified resources of silica sand are virtually inexhaustible. Known deposits can satisfy world demand at reasonable cost for centuries.

SILVER

(Data in million troy ounces of metal, unless noted)

1. Domestic Production and Use: There are more than 300 domestic producers. About 75% of primary supply is a byproduct of base metal mining operations. The leading six firms supply 63% of total production. There are 24 principal refiners of commercial grade silver, of which five are primary smelters and one a Government refiner, the U.S. Assay Office in New York City. Secondary silver is treated by all refiners. Production in 1973 was centered in Idaho, 36%; Arizona, Montana, Colorado, and Utah, 51%. Estimated value of production in 1973 is \$93.2 million. Number of manufacturing firms estimated at 5,000 - photographic industry largely centered in New York (State); most other silver manufacturing facilities are in Connecticut, New York, Rhode Island, and New Jersey. Estimated major uses in 1973: Sterling and electroplated ware, 31%; photographic materials, 25%; and electrical and electronic products, 24%. An important demand factor in 1972-73 was the rapidly expanding market in pure and sterling silver collectors items - medallions, coins, and small embossed bars. U.S. demand, about five times domestic production, and the highest since 1967-68, accounted for 35%-40% of world demand, which continued to outrun newly mined supply by a large margin - 150-200 million ounces in 1973. Deficits were made up from secondary metal, from stocks, and through trading.

2. Salient Statistics--United States:

Salient Statistics--United States	1969	1970	1971	1972	1973 e/
Production: Mine	41.9	45.0	41.6	37.2	37.4
Refinery: New	83.5	81.4	68.7	77.5	77.4
Secondary (old scrap)	79.8	56.0	30.1	31.1	33.7
General imports 1/	71.9	62.3	58.0	65.4	105.0
Exports 1/	88.9	27.6	12.2	29.7	14.6
Consumption: Industrial	141.5	128.4	129.1	151.1	185.0
Coinage	19.4	0.7	2.5	2.3	2.0
Price, average New York: Cents per ounce	179.0	177.1	154.2	168.5	252.0
Stocks, yearend: Treasury 2/	70.2	25.1	48.0	45.8	44.3
Stocks, yearend: Industry, COMEX, C.B.T. 3/	198.8	210.2	185.3	152.5	125.0
Employment: Mine and mill e/	1,450	1,500	1,500	1,200	1,050

3. Import Sources (1969-72): Canada 58%, Peru 20%, Mexico 8%, Honduras 5%, Other 9%.

4. Tariff: No duties imposed on imports of unrefined silver or bullion.

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Plat.-gold plated silver	605.46 - 605.47	16-25% ad valorem	65% ad valorem
Rolled-semimanufactured silver	605.60 - 605.66	12-20% ad valorem	30-65% ad valorem
Silver compounds	427.28 & 420.60	5% ad valorem	25% ad valorem

5. Depletion Allowance: 15% (Domestic), 14% (Foreign).

e/ Estimate
1/ Excludes coinage.
2/ Balance in Mint only.
3/ Industry: Refiner, fabricator, and dealer. COMEX: New York Commodity Exchange. C.B.T.: Chicago Board of Trade.

Prepared by J. R. Welch, telephone number (703) 557-1158.

6. Events, Trends, and Issues: U.S. mine production of silver was slightly higher than that in 1972; most other major producing nations showed increased outputs. A nearly 6% drop in Idaho production resulted from a strike at the major mine. World silver output was estimated 4% higher in 1973.

Silver prices rose sharply from $2.03 per troy ounce at yearend 1972 to a midyear peak and alltime record of nearly $3, then declined somewhat. The 1973 average was about 84 cents above that for 1972. The price rise accompanied declining stocks and rising first half silver consumption. In the second half of 1973, consumption began to fall and stocks were partly replenished by a large rise in imports, mainly bullion, from Mexico. During 1973, total visible domestic stocks declined an estimated 28 million ounces and consumption rose 34 million ounces, while net imports rose an estimated 55-60 million ounces.

Price increases have encouraged increased secondary recovery, with a significant part of this coming from photographic wastes, electroplating residues, and about 10%-15% from military scrap. Processes have been improved by the Bureau of Mines for separating silver from electronic scrap. Coin melting remains a large potential source of silver. Research on deep metal mining practices and new metallurgical practices reducing extraction costs at the mine or millsite promise to lower marginal ore grades (cutoff limits).

Demand for silver is expected to rise at an annual rate of 3%-4% through 1980, with resulting increased U.S. reliance on imports and stock withdrawals. New photographic products require less silver per unit picture area; however, greater sales more than offset lowered unit consumption. Intensive research has failed to provide any acceptable substitute in photography, Thinner plating and greater recovery of secondary silver results in economies of use.

Impending closure and limited operation of several major base metal smelters because of sulfur emission controls have increased producers problems in securing access to smelting facilities. Land withdrawals, prospecting regulations, and waste controls have made mine location and development more costly. Control of waste plating solutions containing silver has been an environmental problem to the manufacturing industry. A recent study has indicated some 5-6 million ounces of silver annually may be released to the atmosphere from open-hearth furnaces in the iron and steel industry. This poses both a pollution problem and potential opportunity for secondary recovery.

7. Government Programs: Silver is eligible for exploration assistance up to 75% of approved costs under the Office of Minerals Exploration program.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Silver	21.7	139.5	117.8	-	-

8. World Mine Production and Reserves:

	Mine Production 1972	Mine Production 1973 e/	Reserves*
United States	37.2	37.4	1,300**
Canada	47.0	51.0	640
Mexico	37.5	39.0	730
Peru	40.2	42.0	530
Other Free World	78.2	80.0	300
Communist countries (except Yugoslavia)	48.8	50.0	1,980
World Total	288.9	299.4	5,480

* Measured & Indicated--Includes silver recoverable as a byproduct of base-metal ores.
** In currently operating mines.

9. World Resources: Resources of silver that would become available at higher prices are chiefly in low grade copper and low grade silver deposits. Resources are such that a doubled silver price will about triple the quantity of silver reserves. Approximately, 50% of the world's silver reserves and resources are on the North American continent.

January 1974

SODIUM CARBONATE
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: Soda ash comes from a natural product derived primarily from the mineral trona and from a manufactured product utilizing salt and limestone as raw materials. Four companies operated 5 plants in 2 States to produce 3,928,000 tons of natural soda ash. Three of the plants produce over 87% of the nation's natural soda ash. There are no significant byproducts from the trona processing plants, but when soda ash is extracted from brine there are many other salts such as borax, sodium sulfate, and potassium chloride which are extracted concurrently. Soda ash may be interchanged with caustic soda, NaOH, in certain applications. Nearly half of the soda ash production, 47%, was consumed in making glass; 23% went to the manufacture of chemicals such as sodium bicarbonate; 7% went to the pulp and paper industry; 6% to cleaning agents; 3% to water treatment; and the remaining 12% to minor miscellaneous uses.

2. Salient Statistics—United States:

	1969	1970	1971	1972	1973 e/
Production: Mine	2,495	2,678	2,878	3,218	3,928
Manufactured	4,540	4,414	4,275	4,301	3,785
Imports (calcined)		Negligible		0	4
Exports (mostly refined)	324	336	437	480	321
Apparent consumption	6,711	6,756	6,716	7,039	7,396
Prices: Quoted (soda ash 58 percent Na_2O) in carlots, at works, dollars per ton			$33.00-$35.50		
Average sales price (natural source), f.o.b. mine or plant, dollars per ton	$20.26	$20.96	$21.12	$22.27	$23.95
Stocks			Not available		
Employment: Mine and mill	1,000	901	1,042	1,070	1,100

3. Import Sources (1969-72): France 53%, United Kingdom 23%, Other 24%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Statutory
Calcined (Soda ash)	420.84	0.12¢/lb.	0.25¢/lb.
Hydrated and Sesquicarbonate	420.86	0.24¢/lb.	0.25¢/lb.

5. Depletion Allowance: 14% (Domestic), 14% (Foreign).

e/ Estimate.

Prepared by C. L. Klingman, telephone number (703) 557-0439.

6. Events, Trends, and Issues: The heralded increase in natural soda ash production capacity began its impact in 1973 with a 22% increase over the natural soda ash production of 1972. Four major companies have announced plans for large increases in production of natural soda ash and a fifth has announced plans for the opening of a new mine and processing plant. For the first time in history there was more soda ash made from natural sources than was manufactured by the Solvay process. There was a sharp decrease in synthetic soda ash production probably due to governmental restrictions intended to prevent pollution of the waterways. Because of very high domestic demand for soda ash, exports were reduced by a third; and for the first time, there was a significant amount of soda ash imported from Europe. Demand for soda ash is expected to increase at an annual rate of about 7% through 1980 and supply will be hard pressed to meet this requirement for at least another year. It is expected, however, that there will be ample soda ash from natural sources by 1976. The only restrictions foreseen at this time are a possible lack of processing fuel, a lack of skilled labor, and a lack of railroad shipping capacity. The production of natural soda ash has only minor ecological effects, but the synthetic (Solvay) plants discharge large amounts of salt and calcium chloride into natural watercourses. Governmental restrictions on such discharges have caused the closing of two Solvay plants and others may follow.

7. Government Programs: There are no programs of governmental control of soda ash, and there are no government controlled stockpiles of this commodity.

8. World Mine Production and Reserves:

(Natural sources):	Mine Production 1972	1973 e/	Reserves Quantity	Grade
United States	3,218	3,928	Very large	53-63%
Kenya	178	165	Unknown	
Chad	7	7		
World Total	3,403	4,100		

9. World Resources: The world and domestic resources of sodium carbonate are immense. Not only are there nearly inexhaustible supplies of salt and limestone from which sodium carbonate could be manufactured by the Solvay process, but the trona deposits in the Green River Formation of Eocene age in southwestern Wyoming that are now in production would supply the nation's needs for more than 3,000 years at the present rate of consumption. An additional 32 billion tons of sodium carbonate is estimated to be available in the subeconomic resources of nahcolite in the Green River Formation in the Piceance Creek Basin, Colorado.

SODIUM SULFATE
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: Sodium sulfate, or salt cake, was extracted from natural brine or was manufactured as a byproduct from the rayon, cellophane, hydrochloric acid, sodium bicarbonate, phenol, and boric acid industries. Natural sodium sulfate was produced by 6 plants in California, Utah, and Texas. About 74% of the natural sodium sulfate was produced by 3 plants in California. The byproduct salt cake was produced by 35 plants in 17 States. About 63% of the sodium sulfate production was used in the manufacture of pulp and kraft paper, and another 18% went to the compounding of various detergents. The remaining 19% was used in a variety of products such as glass, stockfeeds, dyes, textiles and medicines. When sodium sulfate was extracted from natural brines there were often coproducts such as borax, soda ash, and potassium chloride. To a limited extent, other sodium salts may be substituted for sodium sulfate in certain applications.

2. Salient Statistics—United States:

	1969	1970	1971	1972	1973 e/
Production: Natural	672	598	688	701	696
Imports for consumption	286	269	268	299	238
Exports	91	55	66	29	36
Apparent consumption (natural and manufactured)	1,670	1,576	1,558	1,627	1,642
Price: Quoted (salt cake - 100 percent Na_2SO_4), in carlots, bags, bulk at works, dollars per ton	28	28	28	28	28
Average sales price (natural source), f.o.b. mine or plant, dollars per ton	19.88	18.15	17.99	16.26	15.45
Stocks	Not available				
Employment: Mine	50	79	92	105	132

3. Import Sources (1969-72): Belgium and Luxembourg 47%, Canada 42%, W. Germany, 5%. Other 6%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Crude (salt cake)	421.42	Free	Free
Anhydrous	421.44	25¢/ton	$3/ton
Crystallized	421.46	50¢/ton	$1/ton

5. Depletion Allowance: 14% (Domestic), 14% (Foreign).

e/ Estimate.

Prepared by C. L. Klingman, telephone number (703) 557-0439.

6. Events, Trends, and Issues: During the early part of 1973, the demand and price for sodium sulfate was low; and consequently, a great deal of raw glauber salts were stockpiled in anticipation of a better market. The shortage of soda ash and caustic soda, however, caused the sodium sulfate to be called for as a substitute material, so by the end of the year, production seemed to be about normal. Technological changes in the pulping of wood for paper caused less sodium sulfate to be used for this purpose than was required in the past. There was a 6% increase in production of byproduct sodium sulfate and a 1% decrease in the salt cake derived from natural brine. Imports of sodium sulfate were off 20% dropping from 18% to 14% of the apparent consumption. It is anticipated that total production of sodium sulfate will increase approximately 4% per year through the year 1980. There are no significant ecological aspects to the extraction of sodium sulfate.

7. Government Programs: The sodium sulfate market is not regulated in any way by the government. There is no government stockpile of this commodity.

8. World Mine Production and Reserves:

(Natural sources):	Mine Production 1972	Mine Production 1973 e/	Reserves Quantity	Reserves Reserves
United States	701	696	Large	About 60%
Canada	703	740	Do	Do
Argentina	39	40	Unknown	
Chile	20	21	Do	
Turkey	18	19	Do	
World Total	1,481	1,516		

9. World Resources: World and domestic resources of sodium sulfate are large. Searles Lake, Calif., alone is estimated to contain 400 million tons, a 600-year supply at present rates of consumption in the United States. Great Salt Lake contains about 30 million tons and both solid and brine deposits are known in 10 other States.

STONE

(Data in million short tons, unless noted)

1. Domestic Production and Use: CRUSHED STONE: Crushed stone was produced from 4,627 quarries; total value of output was $1.6 billion in 1972. Seventy-seven companies operating 743 quarries accounted for 50% of production. Pennsylvania, Illinois, Ohio, Texas, Florida, Missouri, Michigan, California, New York, and Virginia were the leading producing States, supplying 53% of the total quantity. Limestone and dolomite accounted for 73%; granite, 12%; traprock, 9%; and other kinds of stone, the remainder. Seventy-one percent of crushed stone was used for construction and maintenance purposes, 15% for cement and lime manufacture, 3% for agricultural purposes, and 3% for flux stone. Clays, lithium and gypsum are the principal byproducts. DIMENSION STONE: In 1972, 476 quarries produced dimension stone. Of these, 30% produced sandstone, 28% granite, and 18% limestone. Value of total shipments was $91 million. The Appalachian district, extending from Maine to Alabama, produced most of the granite, marble and slate; the Bedford-Bloomington, Indiana district led in production of dimension limestone; Ohio, Pennsylvania and New York were the most important sandstone producing States. About 58% was used in construction, 24% for monuments, 15% for curbing and flagging, and 3% for other uses.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production	863	869	876	920	1,000
Imports for consumption (value, thousands)	$30,548	$35,674	$33,643	$43,472	$45,000
Exports (value, thousands)	$10,223	$10,396	$11,489	$11,107	$11,000
Consumption	Virtually the same as production				
Average price (dollars per ton)					
Dimension stone	52.78	60.80	57.26	60.91	59.76
Crushed stone	1.54	1.58	1.72	1.72	1.77
Stocks	Not available				
Employment: Quarry and mill	63,800	58,600	63,600	64,000	64,000

3. Import Sources (1969-72): Dimension Stone: Italy 69%, Canada 11%, Portugal 8%, Other 12%. Crushed Stone: Canada 92%, Other 8%.

4. Tariff:

Number	Rate of Duty 1/1/74	Statutory
513.21-515.64	Dimension stone tariffs vary according to type, size, value and degree of preparation. Crushed stone rates vary according to type of stone and use.	

5. Depletion Allowance: (Domestic and Foreign) 14% except 5% if used for riprap, ballast, road material, rubble, concrete aggregate, or similar purposes.

e/ Estimate. NA Not available.

Prepared by H. J. Drake, telephone number (703) 557-0510.

6. Events, Trends, and Issues: The stone industry was marked by increased use of computers, mobile plants, and larger transportation vehicles. Competition from alternative materials such as steel, plastics, wood, glass, and, in the case of dimension stone, concrete, is strong. U.S. demand for dimension stone is expected to decline at an annual rate of 4% through 1980. The share of the U.S. market for dimension stone supplied by domestic producers (73% in 1972) continued to decline. Demand for crushed stone is expected to increase at an annual rate of 5% through 1980. International trade in crushed stone, minor in past years, began to rise in 1972.

Demands to protect the environment have had minor but growing impacts on the industry as a whole. Dust emission standards for stone operations are being developed by the Environmental Protection Agency.

7. Government Programs: None.

8. World Mine Production and Reserves:

	Production		Reserves
	1972	1973 e/	
United States	920	1,000	Adequate except for certain special types and local shortages.
Australia	187	188	
France	125	126	
Germany, West	129	131	
United Kingdom	99	100	
Other Free World	NA	NA	
Communist countries (except Yugoslavia)	NA	NA	
World Total	4,992	5,360	

9. World Resources: Limestone and dolomite are at or near the earth's surface over at least 10% of the continental areas, and resources are extremely large. However, high-purity stone suitable for chemical and metallurgical use is restricted in extent, but its resources also are large. For uses in which the chemical properties are important, substitutes are few, generally scarce, and more costly. The largest resources of high-purity limestone and dolomite in the United States are in the central and eastern parts of the country, but details of the distribution of such stone are incompletely known. Domestic resources of stone for construction, both crushed and dimension stone, are adequate. However, resource problems exist in localities of urbanization and industrial development, and will increase, unless careful plans are made to reserve favorable areas for quarrying.

STRONTIUM

(Data in short tons contained strontium, unless noted)

1. Domestic Production and Uses: Consumers of strontium minerals continued to depend on imports for their supply. The domestic strontium-mining industry has been inactive since 1959. Imports by chemical firms in California, Georgia, New Jersey, and Ohio were used in the manufacture of the following: color television picture tubes, 47%; pyrotechnics and signals, 22%; ferrite permanent magnets, 14%; ceramics, 4%; zinc refining, 4%; and other, 9%.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Strontium minerals			None		
Imports: Strontium minerals	12,595	16,876	20,169	13,536	12,000
Exports			Not available		
Consumption (apparent)	15,825	19,125	19,980	14,745	15,500
Price: Average value of mineral imports at port of exportation, per ton of ore	$21.00	$22.00	$24.50	$27.06	$24.35
Stocks			Not available		
Employment: Mine			None		

3. Import Sources (1969-72): Mexico 81%, United Kingdom 12%, Spain 7%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Strontium (celestite)	421.82	Free	Free

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate.

Prepared by D. C. Wininger, telephone number (703) 557-0439.

6. Events, Trends, and Issues: The United States consumed about 34% of the world's production of strontium in 1973 but produced none. Domestic resources are substantial but of a grade that precludes competition with imported material. Nothing is foreseen that will alter the pattern. Demand for strontium is expected to increase at an annual rate of about 3% through 1980.

7. Government Programs: None.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Celestite	-	18,460	18,460	18,460	8,057

8. World Mine Production and Reserves:

	Mine Production 1972	Mine Production 1973 e/	Reserves
United States	-	-	Domestic: 1.13 million tons of strontium
Argentina	1,050	1,000	
Canada	18,600	18,500	
Guatemala	-	35	Foreign: Large reserves available Detailed data lacking
Italy	356	350	
Mexico	12,200	10,000	
Pakistan	166	160	
Spain	5,000	5,000	
United Kingdom	4,170	4,000	
U.S.S.R.	1,000	1,000	
World Total	42,542	40,045	

9. World Resources: Resources in the United States have been estimated at 3.5 million tons of rock containing 85% or more strontium sulfate. World resources, although unevaluated, are probably many times larger.

January 1974

SULFUR

(Data in thousand long tons of sulfur, unless noted)

1. Domestic Production and Use: In 1972 sulfur was produced at 152 operations in 30 States for a total shipment value of $194 million. Texas and Louisiana accounted for 83%. Ten companies with 54 operations accounted for 82%. Frasch sulfur was produced in Texas and Louisiana by 5 companies, operating 13 mines, with the 5 largest mines accounting for 52% of the total domestic production in all forms. Recovered elemental sulfur was produced as a coproduct at refinery and natural gas operations in 25 States by 51 companies with 115 individual plants. Coproduct sulfur was also produced in the form of sulfuric acid, pyrites, hydrogen sulfide, and sulfur dioxide in 13 States by 15 companies with 24 operations. Sulfur for domestic consumption was obtained mainly from domestic sources: Frasch 59%; recovered 19%; and combined coproduct sulfuric acid, pyrites, hydrogen sulfide, and sulfur dioxide 10%. The remaining 12% of the sulfur was obtained by substantial imports of Frasch and recovered sulfur and by minor imports of pyrites. Distribution of consumption was: Southern States, 69%; North-Central States, 11%; Western States, 12%; and Northeastern States, 8%. Ninety percent was converted to sulfuric acid prior to end use. Agricultural chemicals (fertilizers) accounted for 53% of demand. Together, plastic and synthetic products, paper products, paints, nonferrous metals production, and explosives accounted for an additional 20% of demand. Other uses were very widespread, as most products produced by industry required sulfur in one form or another during some stage of their manufacture. Sulfur is an indispensable mineral commodity for which there is no substitute at present or anticipated price levels.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Frasch	7,146	7,082	7,025	7,290	7,535
Recovered	1,422	1,457	1,595	1,928	2,315
Other forms	977	1,018	960	978	1,135
Total	9,545	9,557	9,580	10,196	10,985
Imports: Frasch, recovered and pyrites	1,795	1,667	1,429	1,188	1,145
Exports: Frasch and recovered	1,551	1,433	1,536	1,852	1,605
Apparent consumption: All forms	9,169	9,227	9,173	9,833	10,430
Price (reported): Average value per long ton of elemental sulfur f.o.b. mine/plant	$27.05	$23.14	$17.47	$17.04	$18.26
Stocks: Producer	3,338	3,829	4,120	3,794	3,890
Employment: Mines and processing plants	4,600	4,200	4,000	4,000	4,100

3. Import Sources (1969-72): Canada 67.0%, Mexico 32.9%, Other 0.1%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Sulfur (crude)	415.45	Free	Free

Imports from Canada and Mexico are subject to special duties under provisions of the Antidumping Act.

5. Depletion Allowance: 22% (Domestic), 22% (Foreign).

e/ Estimate. XX Not applicable.
1/ Million long tons at present price levels, using current technology.

Prepared by Roland W. Merwin, telephone number (703) 557-0495.

6. Events, Trends, and Issues: Domestic demand is forecast to increase at an annual rate of 4.1% through 1980. A current oversupply, both domestic and worldwide, is expected to continue over the short and long range periods. Causes are tremendous increases in Canadian production from sour natural gas, increased Polish production, and projected increases from environmental-related sources. Prices were at distress levels for the Frasch industry despite a moderate improvement in prices as a result of a sharp increase in the demand for fertilizer manufacturing. Domestic reserves of Frasch sulfur are limited at current price levels but would be ample at a price level of $28 per long ton.

If anticipated environmental-related production materializes, it could become the major source of supply or even create an oversupply in itself. Fundamentally, this will be brought about by the absolute necessity for the removal of sulfur from solid, liquid and gaseous effluents, or wastes for the protection of the environment. The nonsulfur industries affected by environmental necessities require the development of technologies that will permit them to cover the capital and operating costs of coproduct sulfur recovery at cost levels that will be competitive with other sources. If such technology is not available, they may be forced to absorb at least a portion of the cost of coproduct sulfur production into the production cost of their prime product. This added cost will be passed on to the consumers of their basic products in the form of higher prices. Additionally, the projected nondiscretionary oversupply, even with no threat from substitute materials and a high consumption efficiency in present uses, will require the development of new end uses.

Investigations by the U.S. Department of the Treasury and the U.S. Tariff Commission led to conclusions that industry in the United States was likely to be injured by imports of elemental sulfur from Canada at less than fair value. As a result, elemental sulfur from Canada sold at less than fair value became subject to special dumping duties similar to those previously applied to imports of sulfur from Mexico. Imports of elemental sulfur from Canada and Mexico amounted to only 11% of domestic demand and were less than equivalent exports. Most of the imports were into regions where imports were competitive with domestic sources by reason of transportation costs.

7. Government Programs: The U.S. Bureau of Mines has a research program aimed at developing new uses for sulfur that would alleviate the oversupply problem. The U.S. Bureau of Mines is conducting research on removal of sulfur from smelter gases and industrial stack gases. The U.S. Bureau of Mines and Office of Coal Research are doing research on gasification and liquefaction of coal. Sulfur recovery potential would be very great from this process if commercialized. The Office of Minerals Exploration lends up to 50% of approved costs for exploration. The Bureau of Land Management has a leasing program for native sulfur on public lands. Sulfur is not a stockpile item.

8. World Mine Production and Reserves:

	Production - All Forms		Apparent Reserves 1/
	1972	1973 e/	
United States	10,196	10,985	75
Canada	7,454	7,915	385
France	2,200	2,400	20
Japan	3,000	3,500	40
Mexico	1,050	1,100	15
Spain	1,100	1,100	10
Other Free World	6,000	6,500	105
Near East	XX	XX	465
Communist countries (except Yugoslavia)	12,000	12,500	85
World Total	43,000	46,000	1,200

9. World Resources: The world's total resources of sulfur are vast, but only a fraction is minable or recoverable at present price levels, using current technology. Resources of elemental sulfur in evaporite and volcanic deposits and sulfur associated with natural gas, petroleum, tar sands, gypsum and metal sulfides amount to about 25 billion tons. Approximately 220 billion tons is contained in coal and 380 billion tons in oil shale and shale rich in organic matter. Domestic resources are about one-fifth of the world total.

January 1974

TALC, SOAPSTONE, AND PYROPHYLLITE
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: There were 32 producing companies in 1972, the 10 largest of which supplied 83% of the total output. New York, Texas, Vermont, California, and Montana leading in that order among the 14 States where talc was produced, accounted jointly for 86% of the yearly total. Most of the crude material was processed for sale or use in about 40 grinding mills in 12 States, with New York, California, and Vermont leading in tonnage.

   Talc-group minerals were used primarily in the making of ceramics, 35%; paints, 18%; toilet preparations, 14%; insecticides, 7%; paper 6%; refractories, rubber products, and construction materials, 4% each; with numerous minor applications making up the other 8%.

   Talc, soapstone, and pyrophyllite are subject to competition from each other, from kaolin, fuller's earth, limestone, and other nonmetallic fillers, and from feldspar for ceramics as determined partly by price and partly by performance. Phosphate-bonded talc is a thoroughly acceptable substitute for block steatite talc; potential alternative materials are magnesium oxychloride-bonded talc, phosphate-bonded synthetic mica and hot-pressed synthetic mica.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Mine	1,029	1,028	1,037	1,107	1,209
Sold by producers	985	948	979	1,084	1,150
Imports for consumption	20	30	17	29	25
Exports	69	105	136	171	185
Apparent consumption 1/	936	873	860	942	990
Price: $5 to $250 per ton (crude or ground) depending upon grade and degree of preparation.					
Stocks, producer (December 31)	200	205	144	167	225
Employment: Mine and mill	950	900	950	950	950

3. Import Sources (1969-72): Italy, 43%; Canada, 31%; France, 18%; Other, 8%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Crude, not ground	523.31	0.02¢/lb.	0/25¢/lb.
Ground, washed, powdered	523.33	6% ad valorem	35% ad valorem
Cut or sawed	523.35	0.2¢/lb.	1¢/lb.
Other, n.s.p.f.	523.37	12% ad valorem	35% ad valorem

5. Depletion Allowance: Block steatite talc -- 22% (Domestic), 14% (Foreign)
   All other -- 14% (Domestic), 14% (Foreign).

e/ Estimate.
1/ Sold by producers plus imports minus exports.

Prepared by J. Robert Wells, telephone number (703) 557-0566.

6. Events, Trends, and Issues: U.S. mine production of talc-group minerals, with a record of 16 annual increases since 1954, has almost doubled in tonnage during those two decades and in the same period has advanced in total value by almost 250%. Apparent consumption of talc minerals in the United States, although expanding less consistently than production, reached a level in 1973 that was higher by two-thirds than that of 1954. Domestic demand for talc and related materials is expected to increase at an average annual rate of about 4% through 1980.

U.S. imports of talc for consumption have remained comparatively stable and have shown no evident trend, either upward or downward, for many years. In contrast, U.S. exports of talc minerals have grown notably in recent decades; the tonnage exported in 1973 was approximately 6 times more than in 1954, and the corresponding total value was nearly 9 times greater.

Adverse effects following from publicity given to the close genetic relationship between talc and members of the asbestos group, some of which have been implicated as becoming carcinogenic under conditions of long-continued inhalation, continued to vex the industry in 1973, and utilization of talc in certain applications may have been inhibited to some degree because of that possible -- but unproven -- health hazard. In other respects, the environmental and ecological impact of the mining and processing of talc-group minerals is minor, although some milling operations may give rise to quite localized atmospheric contamination with silicate dust.

7. Government Programs: Under terms of a regulatory ruling proposed by the Food and Drug Administration, Department of Health, Education, and Welfare (Federal Register, V. 38, No. 188, September 28, 1973, pp. 27076-27081) any talc to be approved for use in the manufacturing or processing of drugs or in the preparation or packaging of foods must be shown by a proposed analytical method, validation pending, to be as nearly free of asbestos fibers as is attainable.

The Government, through the Office of Minerals Exploration, offered to grant loans up to 50% of approved costs for exploration of eligible deposits of block steatite talc, but no loans for that purpose were made in 1972 or 1973.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Block and lump steatite talc	-	1.2	1.2	1.0	0.001

8. World Mine Production and Reserves:

	Mine Production 1972	Mine Production 1973 e/	Reserves e/
United States	1,107	1,209	150,000
Finland	100	100	10,000
France	280	250	10,000
Italy	164	150	10,000
Japan	1,661	1,500	60,000
U.S.S.R.	430	450	20,000
Other	1,510	1,500	101,000
World Total	5,252	5,159	361,000

9. World Resources: The United States is self-sufficient in most grades of talc, soapstone, and pyrophyllite. Domestic and world resources have been estimated to approximate 5 times the quantity of reserves. However, quality and geographic location factors are often unfavorable to convenient utilization.

TANTALUM

(Data in thousand pounds gross weight, unless noted)

1. Domestic Production and Use: There is no domestic tantalum mining industry. Metals and alloys are produced from imported concentrates and tin slags. If supply of tantalum raw materials is curtailed or the price increased substantially aluminum, titanium, stainless steel, zirconium, columbium, platinum, tungsten, rhenium and glass could be used as alternate competitive materials for certain uses. Ten companies processed imported concentrates and tin slags. End uses: Electronic components, 54%; machinery, 25%; transportation, 17%; nuclear reactors, 4%.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Mine production			None		
Imports for consumption: Concentrates	975	1,046	1,180	1,229	895
Consumption: Metal content of raw material consumed	928	1,733	1,116	1,280	1,320
Price: Tantalite 1/	$6.81	$7.13	$6.88	$6.00	$6.88
Stocks		Not available			
Employment: Processor and refinery e/	500	500	500	500	500

3. Import Sources (1969-72): 2/ Canada, 30%; Brazil, 22%; Zaire, 14%; Other, 34%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Tantalum concentrate	601.42	Free	Free
Tantalum metal	629.05	5% ad valorem	25% ad valorem

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate. NA Not available.
1/ Average price per pound of tantalum pentoxide, 60% basis.
2/ Excludes tin slags.
3/ Pounds of tantalum.

Prepared by J. A. Sutton, telephone number (703) 557-0547.

6. Events, Trends, and Issues: Too rapid a release of tantalum from the Government stockpile at prices below mining cost might result in the closure of some of the world's tantalum mines. Domestic demand for tantalum is expected to increase at an annual rate of about 3% through 1980. There are no commercial reserves of tantalum in the United States. However, potential tantalum resources do occur. These deposits contain minerals low in tantalum and probably will not be recovered commercially unless prices are attained ranging upward from $33 per pound of contained tantalum. Supply needs are expected to be met primarily by foreign production. Imports of primary material as a percent of consumption of primary material in 1972 were 90%.

Columbium is interchangeable with tantalum as an alloying agent in high-strength steel. Aluminum could be substituted for tantalum in capacitor applications, but only with major design changes and resultant performance sacrifices. New tantalum deposits need to be discovered and new or improved methods for extracting tantalum from submarginal mineral materials and tin slags need to be developed so that anticipated future demand requirements can be satisfied more economically.

There are no known health hazards connected with production or fabrication of tantalum metals and compounds. Fumes, gases, and dust generated by extraction plants can be easily controlled by modern technology.

7. Government Programs: Office of Minerals Exploration participation is 75%. Stockpile objectives were revised downward for tantalum minerals, tantalum carbide powder, and tantalum metal.

Stockpile Status 3/--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Carbide powder	2,900	28,688	25,788	-	-
Metal	45,000	201,133	156,133	-	-
Minerals	312,000	3,342,213	3,030,213	525,426	204,810

8. World Mine Production and Reserves:

	Mine Production (concentrate) 2/ 1972	1973 e/	Reserves (Thousand pounds) Ta_2O_5 in ore
United States	-	-	-
Brazil	640	460	22,000
Canada	609	438	8,000
Malaysia	10	7	2,000
Mozambique	137	100	6,000
Nigeria	2	2	12,000
Zaire	135	98	49,000
Other Free World	285	185	11,000
Free World Total	1,818	1,290	110,000
Communist countries (except Yugoslavia)	NA	NA	NA

9. World Resources: Most of the world's total resources of tantalum lie outside the United States. On a worldwide basis, identified resources of tantalum are barely adequate to meet projected needs to the year 2000. These resources are largely located in Zaire, Nigeria, Canada, Brazil, and southeast Asian tin deposits.

TELLURIUM

(Data in thousand pounds of metal, unless noted)

1. Domestic Production and Use: Production decreased 37,000 pounds from 1972 to 220,000 pounds. All reported tellurium production was recovered as a byproduct of the electrolytic refining of copper. Secondary output is negligible. Three copper companies with refineries in Maryland, New Jersey, and New York accounted for the total domestic output. The number of consumers is unknown; the major users are producers of free-machining steel and copper, most of whom are located in the Middle Atlantic States. The market value of 1973 production is estimated at $1.4 million. Apparent consumption of 290,000 pounds was less than the unusually high 1972 figure which probably included quantities of metal that were exported or added to merchants and consumers inventories. Consumption by major use is estimated as follows: Iron and steel products, 62%; nonferrous metal products, 19%; rubber products, 11%; chemicals, 6%; and other, 2%.

2. Salient Statistics—United States:

	1969	1970	1971	1972	1973 e/
Production	234	158	164	257	220
Imports for consumption	112	64	30	146	70
Exports		Not	available		
Apparent consumption	326	271	206	417	290
Price: Average, per pound	$6.00	$6.00	$6.00	$6.00	$6.05
Stocks: Producer	177	128	116	102	100
Employment: Refinery	50	40	40	50	50

3. Import Sources (1969-72): Peru 65%, Canada 34%, Other 1%. Disregarding an unusual import from Peru in 1972, average imports, would be: Peru 52%, Canada 46%, Other 2%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Metal	632.48	4.0% ad valorem	25% ad valorem
Compounds	421.90–427.12	5% ad valorem	25% ad valorem

5. Depletion Allowance: 14% (Domestic), 14% (Foreign).

e/ Estimate. NA Not available.
Prepared by Lyman Moore, telephone number (703) 557-7539.

6. Events, Trends, and Issues: Only minor changes occurred in production and consumption patterns. The supply of tellurium sludge from electrolytic lead refining was exhausted and copper refineries provided all tellurium refining feed material. Plans were announced for future byproduct tellurium production from gold telluride deposits in which development has been resumed following the rapid increase in the price of gold.

Domestic demand for tellurium is expected to increase to 1980 at an annual rate of only 0.2% and world demand, which is now relatively low, at a 2.7% rate. Large increases in consumption are not expected because substitute materials can be used for all large quantity applications and any shortage severe enough to result in high prices, would be met by substitution. Lead is an acceptable tellurium replacement in free-machining steel and copper, and sulfur in wear-resistant rubber. Tellurium has some unique properties that could possibly cause a large future demand such as the ability to convert heat directly to electricity and to cool directly with electricity, and also the ability to control the chill rate and porosity of iron castings.

Present byproduct sources of tellurium are adequate to meet expected demand well beyond 2000, assuring tellurium supplies if present copper production methods continue to be widely used. A change to low-pollution copper furnaces that capture a much greater proportion of effluents would increase the quantity of byproduct tellurium available, while a change to hydrometallurgical methods for treating ores and concentrates would make tellurium recovery difficult and necessitate development of new recovery processes. However, it is believed that enough copper will continue to be produced by smelting and subsequent electrolytic refining of anodes to provide an adequate source of tellurium.

The producer price of tellurium was maintained at $6 per pound for commercial-grade metal and $10 to $32 per pound for high-purity grades until December 10 when a principal producer increased the price of commercial-grade metal $1 per pound.

7. Government Programs: Office of Minerals Exploration assistance for tellurium continues at 50%. No tellurium exploration has been financed under this program because the abundance of byproduct metal has kept prices low. Tellurium is not a stockpile item.

8. World Production and Reserves:

	Plant Production		Reserves
	1972	1973 e/	
United States	257	220	16,600
Canada	48	55	6,600
Japan	77	90	400
Peru	40	45	4,600
Other Free World	NA	NA	35,900
Communist countries (except Yugoslavia)	NA	NA	9,900
World Total	NA	NA	74,000

9. World Resources: In addition to the above large reserve of byproduct tellurium contained in identified copper deposits of economic grade several other sources of byproduct metal exist. Reserves of economic lead ore contain about one-fourth the quantity of tellurium occurring in economic copper deposits, however, at present very little lead is refined by the electrolytic method which allows tellurium recovery. Relatively small quantities of tellurium can be recovered from gold telluride ores. Copper and other metal resources which are undeveloped, of uneconomic grade, or as yet undiscovered, contain an estimated four times the quantity of tellurium in identified economic copper deposits. Coal deposits contain an estimated average of 0.015 parts per million tellurium or a total content about four times that of economic copper deposits. Oceanic manganiferous nodules are believed to contain very large quantities of tellurium.

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THALLIUM
(Data in pounds of metal, unless noted)

1. Domestic Production and Use: Thallium and thallium compounds are limited as to both size of market and number of uses. One plant in Colorado was the only domestic producer of thallium and thallium compounds. Thallium is a minor byproduct of ores mined for zinc and supply is derived wholly from processing selected smelter flue dusts and residues. There is no secondary industry. Distribution of thallium consumption was about 75% for electrical, 7% for agriculture, 3% for pharmaceuticals and other uses about 15%.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Refinery	Company confidential data				
Imports for consumption 1/	5,020	2,892	2,131	2,200	924
Exports	Not available				
Consumption - Apparent	5,600	5,000	3,150	2,000	2,000
Price, dollars per pound	7.50	7.50	7.50	7.50	7.50
Stocks	Company confidential data				
Employment e/2/	15	15	15	15	15

3. Import Sources (1969-72): West Germany 56%, Belgium-Luxembourg 25%, France 13%, Other 6%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Thallium, unwrought and waste and scrap 3/	632.5000	5% ad valorem	25% ad valorem
Thallium compounds	422.0000	5% ad valorem	25% ad valorem

5. Depletion Allowance: 14% (Domestic), 14% (Foreign).

e/ Estimate. NA Not available. W Withheld to avoid disclosing company confidential information.
1/ Includes thallium contained in compounds.
2/ Employment directly related to thallium refining is in addition to that associated with zinc smelting.
3/ Duty of waste and scrap suspended until June 30, 1975, provided by P.L. 93-78.
Prepared by H. R. Babitzke, telephone number (703) 557-0212

6. Events, Trends, and Issues: Present technology limits thallium supply to quantities present in base-metal ores, notably zinc, and only a fraction of total contained thallium is currently recovered. Dispersal of thallium into various smelter products not amenable to economic separation limits the improvement in recovery capability. Current generation of thallium containing residues is larger than requirements, and the unprocessed portion has been stockpiled to be available for future needs.

Curtailment of thallium used as a rodenticide by Government action is continuing with increasing controls because of the issuance of Executive Order 11643 which offers environmental safeguards on activities for animal damage control on Federal lands. Alternate materials are available for most uses of thallium. As a rodenticide, thallium was replaced by warfarin ($C_{19}H_{16}O_4$).

Demand for thallium is forecast to increase at an annual rate of about 2% through 1980. The market is smaller than that of the other zinc byproduct metals.

Since this commodity is produced in small quantities as a minor byproduct of the zinc operations, it has little or no effect on the ecology or environment.

7. Government Programs: None. Thallium is not stockpiled.

8. World Mine Production and Reserves:

	Mine Production		Ore Reserves
	1972	1973 e/	
United States	W	W	150,000
Rest of the World	NA	NA	490,000
World Total	NA	NA	640,000

9. World Resources: World identified resources from zinc, lead, and iron sulfides are estimated at 1,390 tons and those in coal ash are 715,000 tons. Identified manganese nodules occurring on the sea floors are estimated to contain 9.9 million tons of thallium.

THORIUM
(Data in short tons of ThO_2, unless noted)

1. Domestic Production and Use: U.S. production of thorium was derived from monazite, a by-product of titanium in heavy mineral beach sands. Domestic monazite, recovered principally for rare earths and yttrium, was produced in operations near Folkston, Georgia, and Green Cove Springs in Florida. Domestic output met about one-third of the demand in 1973. Two facilities, one in Chattanooga, Tennessee and the other in North Chicago, Illinois recovered thorium from domestic and imported monazite. In addition, nine companies processed or fabricated thorium, including nuclear reactor fuels. Thorium, mostly in forms of metal, oxide, nitrate and chloride was used in energy and nonenergy applications. In the energy field, thorium was used as a fertile material in commercial and experimental nuclear reactors to produce fissionable U-233. Nonenergy uses were: gas mantle manufacture, 59 percent; aerosapce (high temperature alloys), 16 percent; refractories, 21 percent; and minor applications, including chemcial, electronic, and metallurgical, 4 percent.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production, mine	Company	confidential			data
Imports: Monazite e/	252	207	202	54	90
Metal, alloys and compounds 1/2/	4,778	4,367	9,708	11,290	14,000
Exports: Ores and concentrates (ThO_2 content) 1/	1,544	81	-	-	-
Industrial consumption e/	120	130	125	152	150
Prices (dollars per pound):					
Nitrate (mantle grade)	2.75	2.50	2.50	2.50	2.50
Oxide (average)	8.00	8.00	8.00	8.00	8.00
Metal (in pellets)	15.00	15.00	15.00	15.00	15.00
Stocks, industrial e/	659	589	713	437	500
Employment		Not available			

3. Import Sources (1969-72): Monazite - Australia 53%, Malaysia 44%, Other 3%. During 1972 Malaysia was the principal supplier, replacing Australia which was not among the sellers of monazite to the United States.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Ore including monazite sand	601.45	Free	Free
Nitrate and other compounds	422.10 & 422.14	17.5% ad valorem	35% ad valorem
Metal	632.52	6% ad valorem	25% ad valorem
Alloys	632.68	7.5% ad valorem	25% ad valorem

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate. NA Not available. W Withheld to avoid disclosing individual company confidential data.
1/ Pounds of material indicated
2/ Includes estimated ThO_2 content in imported gas mantles.
Prepared by R. V. Sondermayer, telephone number (703) 557-0291.

6. Events, Trends and Issues: Thorium-fueled, high-temperature, gas-cooled reactors (HTGR) were ordered in the United States and abroad. Two companies concluded financial arrangements for joint development of a thorium-uranium fueled reactor. Research was started on utilization of the HTGR as a source of heat for coal gasification, steel production, and hydrogen generation. While these events indicate increasing future demand for thorium in nuclear fuels, future expansion of the thorium market for fuels is contingent on satisfactory performance of large HTGR units. Low current demand and nuclear research oriented toward uranium were impediments to full development of thorium potential.

Since 1970 domestic and foreign supply has declined because thorium is a byproduct of rare-earth production from monazite, which has been partially supplanted by other rare-earths sources.

Based on projected HTGR development, demand for thorium is expected to increase at an annual rate of 12.5 percent through 1980. Prices for thorium and compounds have been stable in the past.

The chief environmental concern in thorium mining from monazite placers along beaches and rivers is the possible conflict with urban and recreational facilities. Land reclamation has been practiced successfully at operations in Georgia and Florida.

As a nuclear fuel, thorium poses environmental problems similar to those of uranium. In addition, in the Th-232-U-233 fuel cycle, a side product U-232, decays to heavy gamma-emitting isotopes requiring greater safeguards in shielding, remote control handling, and disposal. The HTGR, being gas-cooled, reduces thermal water pollution, a problem in the more common water-cooled reactors.

Except in magnesium-thorium alloys, where titanium may be used instead of thorium, no major substitution of thorium is foreseen. The energy crisis is likely to reduce consumption of thorium in gas mantles.

7. Government Programs: Office of Minerals Exploration assistance is available for up to 50% of approved costs.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Thorium nitrate (ThO_2 equivalent)	-	1,768	1,768	1,768	27

8. World Mine Production and Reserves:

	Mine Production 1972	Mine Production 1973 e/	Reserves
United States	W	W	105,000
Australia	390	400	40,000
Brazil	160	170	20,000
Canada	-	-	60,000
India	400	420	150,000
Malaysia	160	170	10,000
Other Free World	150	160	10,000
Communist countries	NA	NA	NA
World Total	1,260	1,320	395,000

9. World Resources: Large deposits are found in beach and fluviatile placers, veins, sedimentary rocks, alkalic igneous rock, and carbonatites. Most of the thorium resources are in Canada, India, Greenland, the United States, Brazil and Australia.

January 1974

Tin
(Data in long tons of metal, unless noted)

1. Domestic Production and Use: In 1973 small quantities of tin concentrates were produced as a byproduct of molybdenum mining in Colorado and as a coproduct of placer gold mining operations in Alaska. Three companies accounted for 100% of domestic production. The only tin smelter in the Nation, at Texas City, Texas, treated 4,000 tons (tin content) of Bolivian concentrates. Twenty-one percent of the tin consumed in the United States was derived from secondary material at 11 detinning plants and 160 secondary nonferrous metal processing plants, located principally in the East. About 200 men were employed in mining and primary smelting. Approximately 250 firms consumed the majority of the tin metal and alloys in the United States. The major uses were in cans and containers, 35%; electrical, 18%; construction, 14%; transportation, 13%; machinery, 11%; and chemicals, 7%.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Mine	Company confidential data				
Smelter	345	NA	4,000	4,000	4,000
Secondary	22,775	20,001	20,096	20,180	21,100
Imports for consumption: Metal	54,950	50,554	46,940	52,451	41,400
Ore (tin content)	-	4,667	3,060	4,216	4,000
Exports: Ingots, pigs, and bars	2,903	4,452	2,262	1,134	2,100
Consumption: Primary	57,730	52,957	51,980	53,506	56,400
Secondary	23,060	20,880	17,970	15,527	15,000
Price: Average annual, cents per pound					
New York	164.435	174.135	167.344	177.469	220.000
London	155.496	166.552	158.610	170.956	215.000
Penang	153.409	162.885	154.782	166.765	210.000
Stocks: Consumer and dealer	30,596	26,310	24,837	25,361	23,000

3. Import Sources (1969-72): Malaysia 64%, Thailand 27%, Other 9%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Ore and concentrate	601.48	Free	Free
Metal	622.02	Free	Free
Waste and scrap	622.10	Free	Free

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate. NA Not available. W Withheld to avoid disclosing company confidential data.
Prepared by K. L. Harris, telephone number (703) 557-1393.

6. Events, Trends, and Issues: Consumption of primary tin was up 5% and consumption of secondary tin was down 3% from the 1972 levels. Demand for tin is expected to increase at an annual rate of about 2.2% through 1980. Substitution of aluminum, glass, paper, plastic, or tin-free steel for tin in cans and containers; epoxy resins for solder; and aluminum-, copper-, and lead-based bearing alloys or plastics for tin-containing babbitt metal would lower the projected rate of growth.

Imports of metal declined 21% from the 1972 level because sales of surplus stockpile tin lessened U.S. reliance upon foreign sources for primary tin. Imports of metal and concentrate accounted for only 80% of primary consumption for 1973 compared to 106% in 1972.

The International Tin Council, in an effort to bring world production and consumption into balance, placed member producing nations under export control from January 19 through September 30. In December, Consolidated Tin Smelters, Ltd. closed its Williams, Harvey smelter located in the United Kingdom.

Tin is mined and smelted in such small quantities in the United States that any adverse environmental effect is almost nonexistent. In any secondary detinning operation, tin-containing muds are generated as waste material. Waste water from the rinsing of detinned steel may contain small amounts of caustic, sodium nitrate and tin. Drosses and dusts from industrial centers eventually become sources of secondary tin.

7. Government Programs: The Office of Emergency Preparedness announced a revised stockpile objective of 40,500 tons, down from the previous level of 232,000 tons. On June 7, the General Services Administration commenced commercial sales of surplus tin previously authorized for disposal. A long term sales program, with interim sales starting September 10, established the General Services Administration as a major supplier of tin for U.S. consumers. From inception until the end of 1972, disposals of surplus tin from the national stockpile totaled 97,972 tons. The Government grants loans through the Office of Minerals Exploration up to 75% of approved costs for exploration.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Pig tin	40,500	235,492	194,992	34,866	15,071

8. World Mine Production and Reserves:

	Mine Production 1972	Mine Production 1973 e/	Reserves
United States	W	W	5,000
Australia	11,765	11,000	81,000
Bolivia	31,056	32,000	325,000
Indonesia	20,992	22,000	550,000
Malaysia	75,617	73,000	600,000
Nigeria	6,625	6,000	86,000
Thailand	21,717	22,000	1,400,000
Zaire	e/6,400	6,400	140,000
Other Free World	16,273	19,000	278,000
Communist countries (except Yugoslavia)	e/49,157	49,000	715,000
World Total	239,602	240,400	4,180,000

9. World Resources: U.S. tin resources, located primarily in Alaska, are insignificant compared to those of the rest of the world. World resources, all within established tin-producing countries, are located principally in southeastern Asia, Brazil, the People's Republic of China, Bolivia, and Zaire. Sufficient resources are available to sustain present production rates well into the next century.

January 1974

TITANIUM 1/
(Data in short tons of metal, unless noted)

1. Domestic Production and Use: Sponge metal was produced by two firms in plants in Ohio and Nevada with more than 60% of the production in Nevada. Ingot was made by the two sponge makers and by seven other firms located in California, Michigan, Nevada, North Carolina, Oregon and Pennsylvania. Twenty-nine companies produced titanium mill products with 19 of them being located in the east-central region and the others in California, Oregon, and Nevada. In 1972, about 84% of the titanium metal was used in jet engines, airframes, and space and missile applications. The remainder was used in the chemical processing industry and in marine and ordnance applications.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production	Company confidential data				
Imports for consumption	5,745	5,931	2,802	4,078	6,700
Exports (mainly scrap)	2,802	2,902	1,711	3,510	3,000
Consumption	20,124	16,414	12,145	13,068	19,300
Price: Per pound	$1.32	$1.32	$1.32	$1.32	$1.42
Stocks: Industry	1,908	2,516	2,724	1,816	2,250
Employment: Reduction plant	1,000	900	900	850	950

3. Import Sources (1969-72): Japan 73%, U.S.S.R. 19%, United Kingdom 8%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Unwrought, waste and scrap 2/	629.15	18% ad valorem	25% ad valorem
Wrought	629.20	18% ad valorem	45% ad valorem

5. Depletion Allowance: Not applicable.

e/ Estimate. NA Not available. W Withheld to avoid disclosing individual company confidential data.
1/ See also Ilmenite and Rutile.
2/ The suspension of duty on waste and scrap was extended until June 30, 1975, provided by P.L. 93-78.
Prepared by F. W. Wessel, telephone number (703) 557-1392.

6. Events, Trends, and Issues: Production of titanium sponge increased by more than 40% over that of 1972, but much of the increase was for delivery to the national stockpile. Production for industrial use showed a modest increase. Demand for titanium sponge is expected to increase at an annual rate of about 8% through 1980. Industrial uses, as contrasted with aerospace uses, are increasing their share of titanium consumption, although at a slow rate.

The demise of the supersonic transport program in 1971 was a setback for future titanium consumption. In mid-1972, the decline in sponge production was reversed with the award of Federal stockpile contracts to achieve the stockpile objective and to maintain the domestic productive base. A viable domestic melting and fabricating industry is a necessity for fulfilling demand in aircraft construction, corrosion-resistant equipment, and in a possible space shuttle program by the National Aeronautics and Space Administration.

7. Government Programs: In June 1972 the General Services Administration signed contracts with two producers for 3,250 tons of sponge from each, deliverable over a 2-year period. The titanium objective for the national stockpile was reduced on April 12, 1973, from 33,500 tons to zero.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Specification sponge	-	27,708	27,708	11,480	-
Off-grade sponge	-	6,982	6,982	6,982	1,532

8. Sponge Metal Production and Capacity:

	Production 1972	Production 1973 e/	Capacity e/
United States	W	W	25,000
Japan	5,133	6,100	16,000
Other Free World	e/2,500	2,500	4,000
Communist countries (except Yugoslavia)	NA	NA	15,000

9. World Resources: The source of titanium for sponge production is Australian rutile (See Rutile).

January 1974

TUNGSTEN

(Data in thousand short tons of metal, unless noted)

1. Domestic Production and Use: In 1973, over 90% of the major domestic tungsten production continued to come from two mines, one in California and the other in Colorado. Both of these mining operations also recovered metal values other than tungsten. An operation in North Carolina which shutdown in August 1971 remained on "standby" status during 1973. Estimated production, as measured by domestic mine shipments, decreased about 1% during the year. Consumption, which increased 10%, (by 15 steel producers and 22 processing firms producing metal powder and tungsten carbides) was primarily in the area between New York and Chicago. Major uses of tungsten, in percent, included metalworking and construction machinery 74, transportation 11, lamps and lighting 7, electrical 4, chemicals 3, and other 1.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production (mine shipments)	3,955	4,656	3,430	3,523	3,500
General imports (in concentrate)	767	649	288	2,949	4,320
Exports (in concentrate) e/	3,575	9,735	1,003	48	53
Industrial consumption	6,526	8,350	5,811	7,053	7,750
Price: Average c.i.f. U.S. ports, duty paid, per stu of WO_3 1/	\$52.71	\$75.97	\$55.43	\$39.59	\$43.75
Stocks: Producer and consumer	799	1,072	1,760	2,097	1,750
Employment: Mine and mill	570	605	490	510	535

3. Import Sources (1969-72): Canada 61%, Peru 9%, Australia and Mexico 5% each, Other 20%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Ore and concentrate	601.54	25¢/lb. W cont.	50¢/lb. W cont.
Ferrotungsten	607.65	21¢/lb. W + 6% ad valorem	60¢/lb. W + 25% ad valorem
Metal, carbide, combinations in lump, grains or powder	629.28	21¢/lb. W + 12.5% ad valorem	60¢/lb. W + 50% ad valorem
Ingots and shot of metal and carbides	629.29	10.5% ad valorem	50% ad valorem
Other material in chief value tungsten	603.45	21¢/lb. W + 10% ad valorem	60¢/lb. W + 40% ad valorem

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate. NA Not available.
1/ A short ton unit (stu) of tungsten trioxide (WO_3) contains 15.862 pounds of tungsten.

Prepared by Richard F. Stevens, Jr., telephone number (703) 557-0500.

6. Events, Trends, and Issues: World production and consumption of tungsten in concentrate increased about 5% in 1973 as demand for tungsten carbide in machining, earthmoving and wear resistant applications recovered from the recessional period in 1971-72. Devaluation of the dollar early in 1973 did not cause substantial changes in foreign tungsten concentrate prices or significant shifts in the major foreign suppliers.

U.S. demand for tungsten in concentrate is expected to increase at an annual rate of about 7% through 1980. Because presently known domestic resources of tungsten are insufficient to meet forecast primary demand by the year 2000 the shortfall in future supply is expected to be met by imports and Government stockpile releases. Specific problems restricting full development of domestic resources include: Difficulty of economically beneficiating and recovering tungsten from low-grade ores, limited availability of fuels, environmental restraints, high labor costs, and high investment costs for plant and equipment.

The development of technology to economically recover extremely low-grade tungsten resources could provide the supply required to meet forecast demand. Unless these low-grade sources are developed, the use of tungsten will have to be replaced by more expensive and less satisfactory substitutes such as molybdenum in specialty steels and titanium carbide in wear resistant applications.

7. Government Programs: There is no Office of Minerals Exploration participation for tungsten. After reviewing the tungsten market, the General Services Administration initiated monthly sealed-bid disposals in September at a rate not to exceed 3,000 tons per year.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 months
Tungsten ore and concentrate					
(stockpile grade)	2,117	39,768	37,651	29,005	497
(non-stockpile grade)	-	20,594	20,594	20,594	252
Metal and carbide	-	3,094	3,094	1,273	-

8. World Mine Production and Reserves:

	Mine Production		Reserves		
	1972	1973 e/	Predominant type	Quantity	Grade $\%WO_3$
United States (mine shipments)	3,523	3,500	Scheelite	87,500	0.3-1.0
Australia	1,686	1,600	Scheelite	12,500	.5
Bolivia	2,462	2,500	Wolframite	43,500	1.5
Canada	1,966	1,925	Scheelite	12,000	1.3
Portugal	1,525	1,500	Wolframite	11,000	.4-1.0
Republic of Korea (South)	2,239	2,240	Scheelite	50,500	1.5
Thailand	3,685	2,800	Scheelite	5,000	NA
Other Free World	7,257	8,135	NA	87,000	NA
Communist countries (except Yugoslavia)	18,020	20,300	NA	1,066,000	NA
	42,363	44,500		1,375,000	

9. World Resources: More than 90% of the world's estimated tungsten resources are located outside the United States, with 60% in southeastern China. Other areas with significant resources are in Canada, U.S.S.R., North Korea, South Korea, and South America. The U.S. resources are conservatively estimated to contain two to three times the reserves.

January 1974

URANIUM

(Data in short tons U_3O_8, unless noted)

1. Domestic Production and Uses: Domestic mine production in 1972 involved 178 mining operations producing 6.4 million tons of ore containing an average of 0.21% U_3O_8. These ores were mined in eight States, of which New Mexico (42%) and Wyoming (33%) were the leaders. Three companies accounted for 56% of total output; six companies provided 71%. U_3O_8 concentrate (yellowcake) was produced at 20 mills, located in and near the principal mining districts. Four mills were closed during 1972-73, owing to the continuing soft uranium market and termination of U_3O_8 sales contracts. Uranium enrichment services remained an exclusively Government (Atomic Energy Commission) operation, although there was considerable private commercial interest in developing additional enrichment capacity. Nuclear fuels, fuels-reprocessing, and radioactive waste management industries were gradually emerging. Uranium demand for nuclear fuels was an estimated 11,600 tons in 1972; non-nuclear uses totaled about 500 tons for ballast, counterweights, and balancing in aircraft, radiation shielding, alloys, refractories, catalysts and glass colorant.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Mine production: Content of ore	12,281	12,768	12,907	13,667	14,000
Recoverable e/	11,870	12,190	12,260	12,880	13,300
Mill production	11,609	12,905	12,273	12,900	13,000
Imports (general): Concentrate	1,504	665	942	2,284	5,000
Other compounds	639	1,341	3,983	5,366	5,500
Exports (U_3O_8, other compounds, alloys)	53	2,046	3,088	3,441	2,000
Consumption e/ 1/	6,200	9,300	12,800	11,600	12,000
Price (per pound U_3O_8) 2/	$5.85	$6.30	$6.20	$6.30	$6.50
Stocks (producers and consumers, yearend)	10,000	11,356	11,363	18,841	19,000
Employment (mine and mill, yearend)	9,059	8,165	7,373	6,403	6,500

3. Import Sources (1969-72): Concentrate - Canada 50%, Republic of South Africa 44%, Other 6%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Ore and concentrates	601.57	Free	Free
Oxides and other compounds	422.50 & 422.52	Free	Free
Metal	629.50	12.5% ad valorem	45% ad valorem

5. Depletion Allowance: 22% (Domestic), 22% (Foreign).

e/ Estimate. NA Not available.
1/ Private sales for nuclear fuel use.
2/ Atomic Energy Commission purchase price, 1969; estimated average commercial price, 1970-73.
3/ Includes Territory of South-West Africa.
Prepared by W. C. Woodmansee, telephone number (703) 557-0290.

6. Events, Trends, and Issues: Domestic U_3O_8 production is gradually expanding to meet growing uranium fuel demand for commercial power reactors, which are expected to assume an increased share of the domestic energy market. Demand for uranium is expected to increase at an average annual rate of about 18% through 1980. Nuclear power development, delayed by environmental opposition and other causes, is expected to be expedited because of the energy crisis.

Because a uranium surplus and weak market have existed for several years, industry has been reluctant to invest in exploration and mine and mill development, needed to maintain an adequate uranium resource base. The breeder reactor, which presumably would provide a continuing supply of nuclear fuel materials (plutonium), would ease demand for uranium later in the century. In 1973, plans for the Nation's first demonstration breeder reactor were completed by the Atomic Energy Commission, the Tennessee Valley Authority, and industry participants.

Ventilation in underground uranium mines is closely monitored and must meet Government standards to prevent excessive accumulations of radon gas. Tailings and effluents from uranium mills must be stabilized to prevent low-level radioactive products from entering surface and ground water systems. The potential threat of a radiation incident, thermal pollution, and radioactive wastes pose problems in nuclear power development. Stringent requirements of the National Environmental Policy Act must be met before power reactor construction or operating licenses are granted by the Atomic Energy Commission.

7. Government Programs: Pursuant to the Atomic Energy Act of 1954, as amended, the Atomic Energy Commission has administered the domestic uranium program. One section of this Act states that foreign uranium cannot be imported for domestic consumption but, in 1973, the Atomic Energy Commission proposed an amendment which, would provide for relaxation of the embargo starting in 1977. Office of Minerals Exploration offers exploration assistance for up to 50% of approved costs. Atomic Energy Commission stockpile - 50,000 tons.

8. World Mine Production and Reserves:

	Production		Reserves
	1972	1973 e/	($10 per lb.)
United States	13,667	14,000	337,000
Canada	4,898	5,100	241,000
France	1,566	1,500	47,000
Gabon	577	550	26,000
Niger	956	950	52,000
South Africa, Republic of	5,589	5,400	3/263,000
Other Free World	436	400	161,000
Communist countries (except Yugoslavia)	NA	NA	Moderate
World Total	27,689	27,900	1,127,000

9. World Resources: In the United States, large exploitable deposits are found chiefly in sandstones and associated rocks. In addition to domestic reserves at costs of $10 per pound U_3O_8, the Atomic Energy Commission estimates reserves at $8 per pound U_3O_8 (273,000 tons) and $15 per pound U_3O_8 (520,000 tons). The lower cost reserves are considered sufficient until the early 1980's and, with anticipated price increases, the higher cost resources would extend domestic supplies an additional 10 years or more.

Low-grade, high-cost, domestic uranium resources in black shales and granitic rocks are very large, but production from these sources would require the mining and processing of vast quantities of rock, disrupting large land areas. Byproduct uranium from phosphate mining for phosphoric acid and fertilizers is potentially viable.

The largest foreign deposits are mainly in quartz-pebble conglomerates and veins. Major foreign resources are available in Australia, Canada, France, Niger, Republic of South Africa, and the Territory of South-West Africa.

January 1974

VANADIUM

(Data in thousand pounds of contained vanadium, unless noted)

1. Domestic Production and Use: Three firms produced vanadium pentoxide in 1972 as a co-product from uranium-vanadium ores or from impure ferrophosphorus. The value of vanadium pentoxide produced in 1972 was $31 million. Production was primarily in the Colorado Plateau area and Arkansas. Vanadium was consumed by approximately 285 firms throughout the United States. Major end uses, in percent: Transportation, 31; construction, 20; metal-working machinery and tools, 14; construction machinery and equipment, 12; chemicals, 6.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production (recoverable basis)	11,154	10,638	10,504	9,774	W
General imports (ores, slags and residues)	4,500	4,000	4,000	2,800	3,400
Exports (oxides and vanadates)	516	1,946	520	352	500
Industrial consumption (intermediate products—reported)	12,308	10,268	9,604	10,454	12,000
Price (per pound):					
Vanadium pentoxide, dealer export	$1.80-0.95	$2.60-1.75	$2.00-1.50	$1.50-1.50	$1.50-1.50
Stocks: Consumer	3,014	2,048	1,290	1,576	2,100
Employment		See uranium			

3. Import Sources (1969-72): South Africa, 55%; Chile, 35%; U.S.S.R., 7%; Other, 3%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Ore and concentrate	601.60	Free	Free
Metal	632.58	5% ad valorem	25% ad valorem
Ferrovanadium	607.70	6% ad valorem	25% ad valorem

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate. NA Not available. W Withheld to avoid disclosing individual company confidential data.

Prepared by H. A. Taylor, Jr., telephone number (703) 557-0548.

6. Events, Trends, and Issues: The General Services Administration sold all of the 1,200 short tons (vanadium content) of ferrovanadium that remained in the national stockpile. The world's largest producer of vanadium (in South Africa) announced plans to increase its production of vanadium-bearing slag by 25%.

The mining and recovery of vanadium has resulted in ecological problems of radon daughter exposure in underground uranium-vanadium mines, disposal of wastes as ponded liquids and fine tailings, and toxicity of certain vanadium materials. Extensive adoption of the Flexicoking process could result in the future recovery of large quantities of vanadium from crude residua in oil refineries as requirements for low-polluting desulfurized demetallized petroleum products increase. The semicommercial Flexicoking unit being built in Texas and the three additional commercial units being designed elsewhere should help bring this possibility closer to reality.

U.S. demand for vanadium is expected to increase at an annual rate of about 5% through 1980. Although domestic reserves are large enough to meet expected demand, cheaper foreign material will probably meet about 25% of demand. Inefficient and costly current vanadium recovery technology impedes development of domestic reserves. Columbium and some other alloying elements are interchangeable with vanadium for certain uses.

7. Government Programs: In April 1973, the Office of Emergency Preparedness abolished the remaining vanadium stockpile objective, which was for vanadium pentoxide.

Stockpile Status—11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Vanadium pentoxide	-	1,080	1,080	-	-
Ferrovanadium	-	-	-	-	2,400

8. World Mine Production and Reserves:

	Mine Production		Reserves
	1972	1973 e/	
United States	9,774	W	230,000
South Africa, Republic of	16,460	18,400	4,000,000
Other Free World	7,864	7,900	4,000,000
Communist countries (except Yugoslavia)	NA	NA	12,000,000
Free World Total	34,098	W	8,230,000

9. World Resources: Large resources of vanadium occur in the United States and other countries in known, but unproductive, deposits, including those in carbonaceous shale, and those associated with both titaniferous and non-titaniferous magnetite. Vanadium also might be recovered from other iron ores, phosphate rock, petroliferous materials, and other byproduct sources. In spite of the large resources of vanadium, supplies are not automatically available because much of the vanadium can only be recovered as a byproduct.

VERMICULITE (CRUDE)
(Data in thousand short tons, unless noted)

1. Domestic Production and Use: One company operating two mines in Montana and South Carolina produced virtually the entire output of vermiculite in 1972. Value of production was $8.1 million. Most of the crude vermiculite was shipped to 50 exfoliating plants in 31 States. A small quantity was exported to Canadian processing plants. The major uses for exfoliated vermiculite were lightweight concrete aggregate, 32%; loose fill insulation, 30%; agriculture, 21%; and miscellaneous and unspecified, 17%. Substitutes such as expanded clays, shales, and slags, pumice, expanded perlite, mineral wool, and synthetic soil conditioners are available to replace vermiculite in its various uses.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Mine	310	285	301	337	340
Imports: Crude	6	12	10	18	22
Exports			Not available		
Consumption: Exfoliated	250	221	209	247	270
Prices: Average per ton, f.o.b. mine	$21.95	$22.81	$23.91	$24.01	$24.10
Producer stocks			Not available		
Employment: Mine and mill	225	225	225	225	225

3. Import Sources (1969-72): Republic of South Africa 100%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Crude or processed	523.81	Free	Free

5. Depletion Allowance: 14% (Domestic), 14% (Foreign).

e/ Estimate. NA Not available.

Prepared by Frank B. Fulkerson, telephone number (703) 557-1955.

6. Events, Trends, and Issues: Construction of a $7 million, 1,000-ton-per day wet-processing plant near Libby, Montana was completed. The new facility was equipped to process finer-sized ores. Demand for vermiculite is expected to increase at an annual rate of about 3.5% through 1980. Vermiculite faces competition from lower cost products including pumice and expanded clays, shales, slags, and perlite. Transportation costs from the source to exfoliation plants, near the point of end use, limit the size of marketing areas as well as the competitive position with regard to other commodities. Improvement in practices that would minimize the treatment losses in fine fractions or provide a market for fine-sized vermiculite would improve the competitive position of vermiculite. The number of operating quarries is small, and the industry poses no severe environmental problems.

7. Government Programs: None.

8. World Mine Production and Reserves:

	Production		Reserves
	1972	1973 e/	
United States	337	340	Large
Argentina	5	5	NA
South Africa, Republic of	163	170	Large
Other Free World	7	7	NA
Communist countries (except Yugoslavia)	NA	NA	
World Total	512	522	

9. World Resources: Descriptions of currently mined vermiculite deposits in Montana and South Carolina indicate the availability of adequate reserves. Subeconomic resources of vermiculite in North Carolina, Texas, Wyoming, Colorado and Nevada are estimated to be 2 to 3 million tons. Undiscovered domestic resources are estimated to be 25 to 100 million tons. In South Africa, the Loolekop deposit in Transvaal Province is believed to contain significant reserves. Other world resources are mostly undiscovered, but probably are large.

YTTRIUM

(Data in short tons of yttrium metal, unless noted)

1. Domestic Production and Uses: Yttrium is processed by companies dealing in the rare-earths. Although the element is produced domestically as a constituent in rare-earth minerals by three mining companies, most purified yttrium produced in the U.S. is derived from imported monazite, xenotime, and uranium residues. Six companies in 10 States produce yttrium compounds and/or high-purity oxide and metal. Three companies account for more than 90% of domestic production. The largest producer is in Colorado. Consumption of purified yttrium compounds and metal by major uses is estimated as follows: Color television phosphors, 60%; electronic 25%; other (alloys, refractories, ceramics, nuclear, and research), 15%. Yttrium is often not separated from the rare-earth elements and being chemically similar, functions as they do in many applications. In most uses, especially phosphors, yttrium cannot be substituted for by other elements but in some minor applications where cost is a factor some substitution occurs.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production of yttrium concentrates	Company confidential data				
Imports for consumption:					
Monazite/xenotime e/	50	40	41	11	25
Uranium residues e/	25	30	25	26	30
Yttrium metal, alloys and compounds	Not available				
Exports: Yttrium	2	1	1	1	1
Consumption, apparent	85	88	84	91	92
Prices: Monazite concentrate \$180–\$200 per long ton or \$9 per pound contained yttrium; xenotime (minimum 25% Y_2O_3) \$3-\$5 per pound contained yttrium oxide; yttrium oxide \$33-\$375 per pound depending on purity; yttrium metal \$150 per pound.					
Stocks	20	79	125	95	97
Employment	Not available				

3. Import Sources (1969-72): Monazite--Australia 53%, Malaysia 44%, Other 3%. Uranium residue--Canada 100%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Ore and concentrate	601.12 & 601.45	Free	Free
Metal	632.38	5% ad valorem	25% ad valorem

5. Depletion Allowance: Monazite 22% (Domestic), 15% (Foreign). Other yttrium minerals 14% (Domestic and Foreign).

e/ Estimate. W Withheld to avoid disclosing individual company confidential data.
Prepared by J. H. Jolly, telephone number (703) 557-0291.

6. Events, Trends and Issues: The demand for yttrium, mostly as high-purity oxide for use in color television phosphors, continued strong during the year. U.S. mine production of yttrium increased about 56% in 1973, however, this is attributed to the strong demand for the coproduct rare-earth elements. Because of relatively large surplus stocks held by rare-earth processors domestic production of yttrium compounds and metal continued to be less than 50% of estimated capacity. World capacity also far exceeds production and demand.

Recovery of yttrium-rich uranium residues in Canada was resumed in 1973 after three years suspension owing to oversupply conditions. The major U.S. processor, a company in Colorado, produced yttrium from stockpiled residues and recently negotiated a new contract to obtain additional supplies of residue through March 1976.

No problems in supply or production capacity are anticipated even though demand is expected to increase at an annual rate of 7 to 8 percent to 1980. Yttrium is produced with relatively small-scale equipment because of limited demand, but costs are high. Large scale solvent extraction and ion exchange equipment could readily be adapted to produce yttrium should demand warrant it. Lower production cost and improved understanding of the element's properties would lead to new applications and increased consumption.

The environmental impact in the production and use of yttrium is generally minimal, however, a major producer of yttrium and rare-earths in Illinois is closing at the end of 1973 because production processes cannot be economically adapted to meet water pollution standards. Environmental considerations also exclude certain yttrium placer resources (largely monazite and xenotime) from production.

7. Government Programs: Office of Minerals Exploration assistance is available for up to 50% of approved exploration costs for rare-earths, including yttrium.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available for Disposal	Sales, 11 Months
Yttrium Oxide	-	237 pounds	237 pounds	237 pounds	-

8. World Mine Production and Reserves:

	Mine Production 1972	Mine Production 1973 e/	Reserves
United States	W	W	900
Australia	66	69	6,000
Brazil	29	30	2,600
Canada	-	30	2,400
India	56	58	20,000
Malaysia	23	24	600
U.S.S.R.	e/40	40	1,600
Other	6	6	2,340
World Total	220	257	36,440

9. World Resources: Large resources of yttrium are available as a byproduct of processing monazite deposits. Additional large subeconomic resources of yttrium occur in other monazite-bearing deposits, apatite-magnetite rocks and sedimentary phosphate deposits, in deposits of niobium-tantalum minerals, and in the residues of certain uranium mills, especially those of the Blind River district, Canada. From the knowledge of the occurrence of yttrium, it is probable that the world's undiscovered resources are very large.

ZINC

(Data in thousand short tons of metal, unless noted)

1. Domestic Production and Use: The 25 leading mines accounted for 89% of the domestic recoverable mine production in 1972; of these, 5 produced 32% and 10 produced 56%. Tennessee was the leading producing State with 21% of the Nation's total followed in order by Colorado 13%, Missouri 13%, New York 13%, Idaho 8%, and New Jersey 8%. Value of mine production in 1972 was $170 million. Pennsylvania, Texas, Oklahoma, Idaho, and Montana accounted for all the smelter production and the three leading firms supplied 62% of the slab zinc. Two primary and four secondary smelters produced 73,718 tons of slab zinc from scrap. Consumption was by approximately 600 firms. In decreasing order, Ohio, Illinois, Pennsylvania, Michigan, and Indiana consumed 61% of the zinc. Distribution of zinc consumption was: Construction materials, 35%; transportation equipment, 26%; electrical equipment, 11%; machinery and chemicals, 12%; and other 16%. Major coproducts and byproducts of zinc are lead, cadmium, germanium, indium, thallium, silver, and copper.

2. Salient Statistic--United States:

	1969	1970	1971	1972	1973 e/
Production: Mine	553	534	503	478	477
Primary slab zinc	1,041	878	766	633	500
Secondary redistilled slab zinc	71	77	81	74	76
General imports: Ores and concentrates	602	526	343	255	200
Slab zinc	325	270	320	523	600
Exports: Slab zinc	9	-	13	4	7
Consumption: Slab zinc	1,385	1,187	1,254	1,418	1,520
Price (weighted): Zinc metal, all grades, cents per pound	14.7	15.3	16.1	18.3	21.1
Stocks, yearend: Producer and consumer	168	191	133	147	150
Employment: Mine and mill 1/	8,800	8,700	8,200	6,800	6,700
Smelter	7,000	5,900	5,400	4,500	4,500

3. Import Sources (1969-72): Ores and concentrates--Canada 60%, Mexico 24%, Peru 8%, Other 8%. Metal--Canada 48%, Australia 10%, Japan 9%, Peru 8%, Other 25%.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Rate of Duty Statutory
Ores and concentrates	602.20	2/0.67 cent/lb	2/1.67 cents/lb
Fume	603.50	do	do
Metal	626.02	.7 cent/lb	1.75 cents/lb

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate
1/ Includes all lead and/or zinc producing units.
2/ Zinc content less certain allowable deductions.
Prepared by H. R. Babitzke, telephone number (703) 557-0212

6. Events, Trends, and Issues: Mine production in 1973 remained at the same level as in 1972 while smelter production decreased 21%. Development work continued in central Tennessee and a new zinc mine in Maine reached full production. An electrolytic plant was reactivated which replaced a smelter that was phased out by yearend.

With the decline in smelter capacity over the last three years, reliance on imports of slab zinc increased while imports of ores and concentrates declined. U.S. dependence on imports for primary supply approximates 50%. Demand for zinc was 1.5 million tons and is expected to increase at 3% annually through 1980.

The price of domestically-produced zinc was controlled by the Cost of Living Council and from April 19, 1973 until December 6, 1973, Prime Western zinc was sold at 20.25 and 21 cents per pound. Both European producer and London Metal Exchange prices were higher than U.S. prices and increased during the year with resulting prices of 32.5 and 93.5 cents per pound, respectively.

Demand for zinc covers a wide spectrum of industrial applications and while aluminum, plastics, and improved steels pose threats to some of these markets, it seems likely that inroads by substitute materials will be offset by advances in zinc application technology which will maintain the upward trend in total demand.

Zinc is mined by underground methods and while tailings and mine water do present disposal problems, they do not seem to represent major obstacles. In many instances the mine tailings are sold as crushed rock and agricultural limestone. Several old zinc smelters have been closed and a number of operating smelters are currently under pressure to comply with emission requirements. During the year one company received an extension permit from the Texas Air Control Board to continue to operate its retort smelter until May 31, 1975.

7. Government Programs: Legislation signed by the President December 31, 1973, authorized disposal of an additional 357,300 tons of zinc from the stockpile. As a result, at the end of 1973, 412,385 tons of stockpile metal was available for disposal by the General Services Administration.

Stockpile Status--11-30-73

Material	Objective	Total Inventory	Total Excess	Available For Disposal	Sales, 11 Months
Zinc	203	643	440	83	262

8. World Mine Production and Reserves:

	Mine Production 1972	Mine Production 1973 e/	Reserves--Measured and Indicated
United States	478	477	30,000
Canada	1,410	1,504	34,000
Mexico	300	295	4,000
Australia	554	456	9,000
Peru	394	384	Included with
Japan	310	282	other Free World
Other Free World	1,381	1,380	34,000
Communist countries (except Yugoslavia)	1,331	1,330	20,000
World Total	6,158	6,108	131,000

9. World Resources: Total world zinc resources, both identified and undiscovered, are estimated at more than 5 billion short tons. Of these, 131 million short tons are reserves, identified to be economic, and an estimated 507 million tons will probably be found to be of current economic grade when they are discovered.

January 1974

ZIRCONIUM

(Data in short tons, unless noted)

1. Domestic Production and Use: Coproduct zircon is extracted from deposits, along with ilmenite and rutile, by 3 firms with operations in Florida and Georgia. One company with a plant in Oregon and another with plants in West Virginia and New York produce primary zirconium sponge and coproduct hafnium sponge. These firms and two others, one in California and another in Massachusetts, convert zirconium sponge to ingot. Most zircon was used in the Northeastern States. Fifty-five percent was used in foundry sands, 15% in refractories, 18% in ceramics, and the rest in making zirconium metal, used in alloys for nuclear and refractory applications and in chemical processing equipment.

2. Salient Statistics--United States:

	1969	1970	1971	1972	1973 e/
Production: Zircon concentrate	Company confidential data				
Zirconium metal	Company confidential data				
Imports (general):					
Zircon concentrate 1/	95,414	94,759	96,387	67,537	108,000
Zirconium metal	250	150	154	207	300
Exports: Zircon concentrate	5,395	4,335	9,429	17,360	20,500
Zirconium, alloys, and scrap	200	300	562	659	550
Apparent consumption, zircon	160,000	145,000	166,000	168,000	190,000
Price: Zircon concentrates, domestic	$56-57	$56-57	$54-55	$54-55	$60
Stocks: Zircon, consumer and dealer 2/	46,000	46,000	36,000	39,780	42,000
Employment: Mine	75	75	75	75	75
Metal plant	1,000	1,000	1,000	1,000	1,000

3. Import Sources (1969-72): Australia 96%, remainder Canada and the Republic of South Africa.

4. Tariff:

Item	Number	Rate of Duty 1/1/74	Statutory
Zirconium ore & concentrate	601.63	Free	Free
Unwrought zirconium	629.60	6% ad valorem	25% ad valorem
Unwrought zirconium alloys	629.62	7.5% ad valorem	25% ad valorem
Wrought zirconium	629.65	9% ad valorem	45% ad valorem

5. Depletion Allowance: 22% (Domestic), 14% (Foreign).

e/ Estimate. W Withheld to avoid disclosing individual company confidential data.
1/ Includes baddeleyite: 1969-383 tons; 1970-355 tons; 1971-871 tons; 1972-385 tons; 1973-600 tons.
2/ Excludes foundries.

Prepared by S. G. Ampian, telephone number (703) 557-0567.

6. Events, Trends, and Issues: Domestic zircon output increased 20% in both quantity and value in 1973. Increased zircon production, both foreign and domestic, was prompted by a worldwide tight zircon supply during 1972. Zircon imports, mostly from Australia, were estimated at 108,000 short tons or nearly 60% above the 1972 quantity. Zircon exports increased in 1973 from approximately 17,000 tons in 1972 to nearly 20,500 tons. Demand for zirconium, nonmetal and metal, is expected to increase at annual rates between 3% and 5% through 1980. Domestic zircon resources are large and increases in demand will probably be met by increased domestic production. The major growth areas for the mineral zircon are in refractories and chemicals, and for zirconium metal are in material for constructing nuclear reactors, in refractory alloys, and in chemical processing plants.

7. Government Programs: There is no stockpile objective for zirconium minerals. The national stockpile sold 15,999 tons of baddeleyite containing 10,878 tons of zirconium dioxide, with none remaining on hand.

8. World Mine Production and Reserves:

	Mine Production		Zircon Reserves
	1972	1973 e/	(1,000 short tons)
United States	W	W	10,500
Australia	400,000	450,000	13,200
Other Free World	20,000	25,000	8,000
Communist countries (except Yugoslavia)	large	large	large

9. World Resources: Identified resources of zircon in the United States are about 10.8 million short tons containing about 5 million tons of zirconium. About 80 percent of these resources are in the States along the Atlantic Coast. Identified world resources of zircon exceed 34 million tons, about half of which is zirconium. Undiscovered resources similar to those already identified undoubtedly occur throughout the world. Phosphate and sand and gravel deposits especially may yield substantial amounts of zircon as a byproduct in the future.

January 1974

Units of Measure

1 barrel (bbl) =	42 U.S. gallons
Btu =	British thermal unit
1 carat (diamond) =	200 milligrams
1 flask (fl) =	76 pounds, avoirdupois
1 karat (gold) =	one twenty-fourth part
1 kilogram (kg) =	2.2046 pounds, avoirdupois
1 long ton (lt) =	2,240 pounds, avoirdupois
1 long ton unit (ltu) =	1% of 1 long ton or 22.4 pounds
long calcined ton (lct) -	excludes water of hydration
long dry ton (ldt) -	excludes excess free moisture
Mcf =	1,000 cubic feet
1 metric ton (mt) =	2,204.6 pounds, avoirdupois
1 short ton (st) =	2,000 pounds, avoirdupois
1 short ton unit (stu) =	1% of 1 short ton or 20 pounds
1 troy ounce (tr oz) =	1.09714 avoirdupois ounces

Energy Equivalents

anthracite	-	25,400,000 Btu per short ton
bituminous coal and lignite (consumption average)	-	23,750,000 Btu per short ton
crude oil	-	5,598,100 Btu per barrel
kilowatt hour		3,412 Btu
natural gas (dry)	-	1,031 Btu per cubic foot
natural gas liquids	-	4,050,000 Btu per barrel

Resource Terms

A newly developed mineral resource/reserve classification system has been adopted by the Geological Survey and Bureau of Mines. The terminology used in the Commodity Data Summaries conforms with this system. The definitions follow:

Resource - A concentration of naturally occurring solid, liquid, or gaseous materials in or on the earth's crust in such form that economic extraction of a commodity is currently or potentially feasible.

Total resources - Materials that have present or future value and comprise identified or known materials plus those not yet identified, but which on the basis of geologic evidence are presumed to exist.

Identified resources - Specific bodies of mineral-bearing material whose location, quality, and quantity are known from geologic evidence supported by engineering measurements with respect to the demonstrated category.

Undiscovered resources - Unspecified bodies of mineral-bearing material surmised to exist on the basis of broad geologic knowledge and theory.

Reserve - That portion of the identified resource from which a usable mineral and energy commodity can be economically and legally extracted at the time of determination. The term ore is used for reserves of some minerals.

Other Publications

Additional statistical, economic, and technologic data on mineral commodities are available in other publications of the Bureau of Mines and Geological Survey.

Bureau of Mines

Minerals Yearbook - An annual publication which reviews the mineral industry of the United States and foreign countries. Contains statistical data on metals, minerals, mineral fuels and their products and includes information on economic and technical trends and developments. The Yearbook is published in three volumes: Volume I, Metals, Minerals, and Fuels; Volume II, Area Reports, Domestic; and Volume III, Area Reports, International.

Mineral Industry Surveys - Periodic statistical and economic reports designed to provide timely statistical data on production, distribution, stocks, and consumption of significant mineral and mineral fuel commodities. The surveys are issued monthly, quarterly, or at other regular intervals, depending on the need for current data.

Bulletins - Reports which describe major Bureau investigations or studies that are considered to have permanent value.

Information Circulars - Reports which primarily compile, review, abstract, and discuss various activities and developments in the mineral industries.

Reports of Investigations - Describe the principal features and results of minor investigations or phases of major investigations, to keep the mineral industries and the public informed on progress in original Bureau research.

These and other Bureau reports are described in the monthly release "New Publications--Bureau of Mines," which is available free upon request from the Publications Distribution Branch, Bureau of Mines, 4800 Forbes Avenue, Pittsburgh, Pa. 15213.

Geological Survey

Professional Papers - Comprehensive reports on the results of resource studies and of topographic, hydrologic, paleontologic, and geologic investigations, including longer contributions to the literature on scientific and engineering subjects.

Bulletins - Either final or progress reports on the results of resource studies and of topographic and geologic investigations; shorter contributions to economic and general geology; and descriptions of Survey instruments and techniques.

Circulars - Timely scientifically sound and accurate reports for which a simpler and less permanent format is deemed adequate. In general, the treatment of the subject is less comprehensive and final, or the report is of relative local or restricted interest, or of relatively temporary usefulness.

Maps and Charts - Numerous maps and charts pertaining to mineral resource investigations are published. These include: Oil and Gas Investigations Maps and Charts; Coal Investigations Maps; Mineral Investigations Field Studies Maps; and Mineral Investigations Resource Maps.

These Geological Survey publications are described in the monthly release "New Publications of the Geological Survey," which is available free upon request from the Branch of Distribution, Geological Survey, 1200 South Eads Street, Arlington, Va. 22202.

INT.-BU.OF MINES,PGH.,PA. 19200

Mr. FALKIE. I could of course, Senator, take quite a bit of time to talk about the extensive research efforts. For example, we are working in the area of aluminum in conjunction with the industry to evaluate the possibilities of various substitutes such as aluminous clays, alunite, and other domestic raw materials in a pilot plant effort that is jointly funded by the Government and the industry and——

Chairman BENTSEN. That is in Nevada?

Mr. FALKIE. Right.

ALUMINUM INDUSTRY MAKES SMALL CONTRIBUTIONS TO BOM ALUMINOUS CLAY RESEARCH

Chairman BENTSEN. Let me ask you about that. I am told that a large share of the resources you have are being used in this project going into the technology for using aluminous clays. Now if that is the case, Monday we heard testimony from industry spokesmen that private power projects using anorthosite, alunite and culm were completed and the construction of large commercial scale plants will begin soon. If that is the case, doesn't that indicate the Bureau of Mines is behind in this situation and spending some money on something that industry has already moved out beyond you?

Mr. FALKIE. Six companies have signed cooperative agreements so far and two others have indicated that they will do the same very shortly and each has agreed to put in $50,000 each year for 3 years as the agreements are written. We are studying several possible methods of making alumina from a variety of domestic materials.

Chairman BENTSEN. Weren't seven companies involved?

Mr. FALKIE. Six of the major aluminum companies and two more to come. Six have already signed agreements. We have invited a total of 12 aluminum companies to participate.

Chairman BENTSEN. About $300,000 a year for 3 years?

Mr. FALKIE. $50,000 a year from each firm for 3 years.

Chairman BENTSEN. But $300,000 a year? And is that a $7 million or $8 million project?

Mr. FALKIE. The Bureau of Mines in the current program for this coming year has $970,000 in aluminum research including $600,000 at Boulder City and in the miniplant project; $100,000 in alunite and engineering support work for the miniplant at Salt Lake City; $200,000 at the Albany metallurgy center for clay investigations; and some work at cost estimates and economics at our College Park Metallurgy Center. So our share this year is $970,000.

But to answer your question specifically, Senator we are planning on looking at three separate processes for clay and other materials, involving nitric, hydrochloric, and sulfuric acid.

And since I come from the anthracite region and the coal regions I am familiar with the interest in using coal wastes. We are keeping our eye on this and we feel that the basic technology developed here will be transferrable——

Chairman BENTSEN. What do you mean by "keeping your eye on it?" Do you have a financial commitment involved that is substantial?

Mr. FALKIE. Well we are spending $1 million this year in the whole area of alumina from domestic materials, Senator.

Chairman BENTSEN. No, you are talking about coal wastes. You said you were keeping your eye on that. What does that mean?

Mr. FALKIE. That means that we are in touch with the industry relating to the possibility of using coal wastes as the source of aluminum.

BOM NOT INVESTING IN COAL WASTES AS A SOURCE OF ALUMINA

Chairman BENTSEN. But this does not mean that you are spending anything on it?

Mr. FALKIE. Not at present time. But what I was getting at is that we feel that the technology that will be transferrable will be transferrable in a general way. Also it is technology that is developed in this miniplant program and——

Chairman BENTSEN. Your technology or theirs?

Mr. FALKIE. It is a combination of both. That is why we have the industry involved with the Government.

Chairman BENTSEN. You state that the Bureau of Mines' mission is an overview of national material needs and direction as to how those needs must be met. You compliment the industry on what they are doing in maintaining the goals of environmental protection and national security in your statement.

But you don't list the specific programs that the bureau has implemented that will help bring about those expected improvements. Could we have some now. We are talking about exploration and mining?

BUREAU OF MINES INVESTMENT IN R. & D.

Mr. FALKIE. In fiscal year 1974, the Bureau of Mines' Budget was approximately $106 million and in 1975 that budget will be, assuming that the Interior Appropriations Committee acts favorably, approximately $215 million and much of it is an increase on the energy side.

Our research activities are divided into three general areas: Developing and bringing along new mining technology for both the fuel and the nonfuel minerals; developing metallurgy and ceramic technology, which in a broad sense includes mineral processing techniques, uses of materials, and recycling; and energy, where we are accelerating our work in gasification and liquefication of coal, in the extraction of petroleum—and I think should be of interest to you, Senator—by secondary and tertiary recovery methods, and in the oil shale area——

Chairman BENTSEN. You are doing things beyond what the industry itself is doing?

BOM R. & D.—JOINT COST SHARING WITH INDUSTRY

Mr. FALKIE. We are doing things in cooperation with the industry in the petroleum area. In fact the whole theme of the research and development program in minerals and in energy is to have joint cost-sharing programs with the industry and——

Chairman BENTSEN. How is the Government connected in that kind of situation where you are developing new processes?

Mr. FALKIE. The technology is available to the public and anything developed under the research program itself is available to the public.

The previous technology, whatever was done previously by private industry belongs to the private company involved.

RAW MATERIAL PRICES IMPACT RESERVE FIGURES

Chairman BENTSEN. Let me ask you this. We have had estimates that the known recoverable resources for example, of oil, for an area could be 34 million barrels. Those numbers were given to us when the price of oil was substantially less than it is today for new oil. If the price of new oil is in the area of $10, what does this mean in the way of now proven recoverable reserves? Because we know the economic factors very much are based on that.

Mr. FALKIE. Very definitely.

Chairman BENTSEN. And we have doubled our known recoverable reserves by this?

Mr. FALKIE. Have we done what?

Chairman BENTSEN. Have we doubled them by this?

Mr. FALKIE. I don't know if we have doubled them but I would think it is safe to assume they have increased and I don't have the numbers at the tip of my fingers.

Chairman BENTSEN. Isn't it important in trying to arrive at decisions in the Congress as to what we do in a resolution of the energy problems of this country that we get some new numbers?

Mr. FALKIE. Very definitely.

NEW RESERVE FIGURES NECESSARY

Chairman BENTSEN. Shouldn't we have some new numbers based on current economic factors as to what the now known recoverable resources are to see how much time we have to get over to gasification of coal and some of these other sources of energy we are going to have to go to?

Mr. FALKIE. Very definitely, sir, and we are doing this. The Geological Survey and the Bureau of Mines work closely to define "resources" and "reserves" because reserves are a dynamic thing. They are changing every day with conditions, which is the point that you are bringing out about the prices having an effect thereon. Improvements in secondary and tertiary recovery should change the reserve picture. So we are constantly reevaluating our reserves. Not only for oil but other minerals.

SOURCES OF INFORMATION FOR THE BUREAU OF MINES

Chairman BENTSEN. In addition to that let me ask you this question. What access do you have to the information that the major oil companies have concerning their reserves so that you can come up with some figures that are meaningful?

Mr. MORGAN. Are you speaking about petroleum or minerals?

Chairman BENTSEN. I am talking about coal and oil on a domestic basis.

Mr. MORGAN. We do not get reserve figures from coal by corporations. We develop these ourselves in collaboration with The Geological Survey on the basis of the geologic information on the extent of the seams and their thickness, and the methods of mining and the normal rate of extraction and the——

Chairman BENTSEN. How do you obtain all of the geological information that is necessary on these coal mines? What access do you have to private corporations or public corporations?

Mr. MORGAN. Mr. Chairman, we get varying degrees of information from mining companies. They do not all give us the same information and with the same degree of detail, but there are about 6,000 operating coal mines and my recollection is we got coverage of 56 percent of the production in a land utilization canvass, which covered much of this information because it was relatable to other known factors. In other words, once we know how much land they use a year both for surface and underground mines, and how thick the coal seam is, we can relate these things to the tonnage per acre-foot, and then by a knowledge of geology, we can project such data and determine for a county or district, without respect to land ownership, what the reserves are on a legal subdivision basis, but not on a corporate basis.

This is information that we should be developing in more detail but——

Chairman BENTSEN. Do you also have it in the oil companies? How can you really decide what we have to do as far as our long term energy needs without knowing what the oil reserves are of this country?

Mr. FALKIE. Senator, the Federal Energy Administration has been instructed to develop an independent analysis of oil reserves. This is part of the act establishing the Federal Energy Administration. We are working with them in trying to develop methodology for making this independent assessment.

Chairman BENTSEN. Are you getting cooperation from the oil companies concerning their reserves?

Mr. FALKIE. I am going to get back to our original reserve list and ask Mr. Wimpfen to comment on how our oil reserves are established at the present time.

Mr. WIMPFEN. Mr. Chairman, we don't ourselves in the Bureau of Mines try to establish our oil reserves in a general sense with respect to corporate holdings.

However, we take the information derived by the American Petroleum Institute which in its reserve committee has some one hundred and seventy of the most expert petroleum geologists in the country and that is the data that we have used.

With respect to what might be done in terms of specific studies of selected fields in some 25 States we have done a lot of work on determining what might be recovered from the areas by the application of secondary and tertiary methods. I think we must understand here in the terminology that the oil industry uses, Senator, that on an average only about 30 percent of the oil in place is recoverable and this will vary from a range of about 13 to 52 percent depending upon the quality of the crude.

Chairman BENTSEN. We are getting back again to what past prices were I assume because you are going to be able to recover substantially more now?

Mr. WIMPFEN. Precisely.

Mr. FALKIE. It also entices you to do more research and development in the secondary and tertiary recovery.

Mr. WIMPFEN. Now you ask if doubling the price of oil say from $5 to $10, would double the reserves.

I don't think we could be certain of this but we could be certain that far greater efforts would be directed towards improving recovery at existing operations and going back into old ones with secondary methods.

Chairman BENTSEN. Let me ask you this on the API figures. Is it correct that the figures submitted on known recoverable reserves went down somewhat in 1974 over 1973? Didn't they show a minor decrease in the known recoverable reserves?

Mr. WIMPFEN. I don't remember the figures exactly.

Chairman BENTSEN. But would you think that was realistic if that was the case?

Mr. WIMPFEN. Pardon.

Chairman BENTSEN. Would you think that would be realistic if that is the case?

If their stated known recoverable reserves that they compiled were shown to decrease in 1974 as related to 1973 would that be realistic?

CLARIFICATION OF RESERVE FIGURES

Mr. FALKIE. Senator, I would want to examine the basis for the recovery figures because that study if I am not mistaken, may have been made before that rapid increase on the prices. I would want to check that and submit something to you on how that particular reserve estimate was obtained.

[The following information was subsequently supplied for the record:]

EXTRACT OF PREPARED STATEMENT OF JOHN E. HODGES, DIRECTOR OF STATISTICS, AMERICAN PETROLEUM INSTITUTE, BEFORE THE SUBCOMMITTEE ON PRIORITIES AND ECONOMY IN GOVERNMENT OF THE JOINT ECONOMIC COMMITTEE, JANUARY 21, 1974 [1]

RESERVES DATA

The first organized effort by the API to develop an estimate of the country's over-all reserves of oil (as far as I have been able to determine) was made in 1935 by a Subcommittee on Known Reserves of the API's Special Committee on Production and Supply. This Committee's finding was that, as of January 1, 1935, domestic proved oil reserves were 12.17 billion barrels. Since that initial effort, the name of the committee has been revised several times to reflect the nature of its work more accurately, and its workload has been greatly expanded.

In 1965, a study entitled *Petroleum Statistics Report* was prepared by the Petroleum Statistics Study Group at the request of the Bureau of the Budget. (This group was comprised of members of the various agencies of the federal government including Commerce, Interior, Justice, the Council of Economic Advisers, Office of Emergency Planning, and the Federal Power Commission. Hereafter, the study prepared by this group will be referred to as the "Krueger Report.") The Krueger Report called for a substantial amount of additional information pertaining to crude oil reserves in the United States. Late in 1965 the Director of the Office of Oil & Gas was given focal responsibility for coordinating federal government requirements for petroleum statistics. Observers from the Office of Oil & Gas were present at meetings of the API Committee on Reserves & Productive Capacity where various reserves definitions and informational requirements were discussed. As a result of these efforts, the API reserves report was expanded from approximately thirty pages to approximately two hundred and fifty pages. Since 1966, the Director of the Office of Oil & Gas has been serving as an observer on the API Committee on Reserves & Productive Capacity, and qualified government observers have been attending some of the subcommittee meetings for several years.

The API publishes annual estimates of proved reserves and productive capacity of crude oil, and collaborates with the American Gas Association in the preparation of estimates of proved reserves of natural gas liquids.

At this point it may be helpful to define the meaning of proved reserves as developed by the API Committee on Reserves and Productive Capacity.

Proved reserves as of any given date are the estimated quantities of all liquids statistically defined as crude oil, which geological and engineering data demonstrate with reasonable certainty to be recoverable in future years from known reservoirs under existing economic and operating conditions (including technology at the time the estimate is made).

Reservoirs are considered proved if economic producibility is supported by either actual production or conclusive formation tests. The area of an oil reservoir considered proved includes: (1) that portion delineated by drilling

[1] The Bureau of Mines is presently collecting some inventory statistics for a selected number of independent terminal operators on the East Coast. This is, however, not a complete accounting. In addition, the Federal Power Commission collects statistics on one very important category of secondary stocks, i.e., those held by electric power companies. Their latest report contains data as of December 1972.

and defined by gas-oil or oil-water contacts, if any; and (2) the immediately adjoining portions not yet drilled but which can be reasonably judged as economically productive on the basis of available geological and engineering data. In the absence of information on fluid contacts, the lowest known structural occurrence of hydrocarbons controls the lower proved limit of the reservoir.

Reserves of crude oil which can be produced economically through application of improved recovery techniques (such as fluid injection) are included in the "proved" classification when successful testing by a pilot project, or the operation of an installed program in the reservoir, provides support for the engineering analysis on which the project or program was based.

Estimates of proved crude oil reserves do not include the following: (1) oil that may become available from known reservoirs but is reported separately as "indicated additional reserves"; (2) natural gas liquids (including condensate); (3) oil the recovery of which is subject to reasonable doubt because of uncertainty as to geology, reservoir characteristics, or economic factors; (4) oil that may occur in untested prospects; and (5) oil that may be recovered from oil shales, coal, gilsonite and other such sources.

The API has not developed a definition of "potential future reserves." However, it appears that this phrase is used in referring to the estimated volume of a resource in the ground that has not yet been discovered. Potential future reserves are sometimes designated as probable, possible, and speculative. Whether estimates so characterized will ever be discovered, and what the volumes will actually be, will depend upon the interplay of *future* economic, political, and technological factors. Such factors do not fall within the scope of the API reserves program.

For purposes of developing estimates of reserves, the United States is divided into fourteen geograpaic districts. A subcommittee is appointed for each district and charged with responsibility for the determination of reserves and productive capacity estimates in that district. The district subcommittees are made up of qualified technical personnel (professional engineers and geologists) from API member companies, having knowledge of the fields and reservoirs in their areas of responsibility.

Annual reports for each district are submitted by the subcommittee chairmen to the member of the main Committee on Reserves & Productive Capacity that has responsibility for the district. District totals are submitted to the Division of Statistics about March 1 of each year for tabulation by the API staff. About the middle of March the main committee meets for the purpose of reviewing year-end estimates prepared by the district subcommittees.

There is a common misconception that API reserves data are based on reports submitted by individual companies. In fact, estimates published by the API are prepared by highly qualified, professional personnel who prepare individual and independent estimates as to what proved reserves may be in the various areas.

An estimate prepared by an individual serving on a subcommittee may very well differ from the reserves data carried on the books of his company. Among other things, such differences may reflect the use of definitions by the various companies that differ from those used by the reserves committee and applied uniformly in all districts. Such differences may also occur because of different interpretations that may be placed upon complex geologic and reservoir data by qualified engineers.

The complexity of the physical behavior of oil, gas, and water within the producing reservoirs means that the preparation of estimates of reserves requires detailed study of changing reservoir performance by experts with very specialized training in engineering and geology. The estimates involve judgment as well as interpretation of available data, with the result that some variations can exist in the numbers calculated by different qualified experts.

Reserves estimates made in the early stages of development of a field may differ substantially from estimates made after further development has been completed.

[News release, American Petroleum Institute, Mar. 28, 1974, Washington, D.C.]

U.S. Proved Reserves of Crude Oil Drop 1.0 Billion Barrels in Past Year

Washington, D.C., March 29—The nation's proved recoverable reserves of crude oil as of December 31, 1973, were estimated to be 35.3 billion barrels (including the North Slope of Alaska) according to the American Petroleum Institute Committee on Reserves and Productive Capacity.

The December 31, 1973, estimate represents a decrease of 1.0 billion barrels in 1973 as compared to a decrease of 1.7 billion barrels in 1972.

According to information developed jointly by the American Petroleum Institute and the American Gas Association, proved reserves of natural gas liquids were 6.4 billion barrels, reflecting a decrease of 0.3 billion barrels from 1972.

The combined total of proved liquid hydrocarbon reserves (crude oil and natural gas liquids) at the end of 1973 was estimated to be 41.7 billion barrels, which represented a decrease of 1.3 billion barrels or 3.2 per cent below 1972.

Proved reserves of crude oil and natural gas liquids are those which geologic and engineering data demonstrate with reasonable certainty to be recoverable from known reservoirs under economic and operating conditions as of December 31, 1973. They do not include oil in unproved portions of partly developed fields.

Price increases in 1973 had little impact on the Committee's estimates of proved reserves since they occurred late in the year and their effect was clouded by the threat of a rollback.

An increase in the price of domestic crude oil serves to extend the producing life of reservoirs beyond their economic limit at lower prices, and thereby increases known reserves. However, any significant additions to proved reserves depend primarily upon increased exploration and development drilling activities, increased reservoir stimulation, increased secondary or tertiary recovery applications, etc. Such increased activities could not be accomplished in the short period of higher prices which prevailed in late 1973.

The API also announced that the total estimated productive capacity of crude oil in the United States (which could be available within 90 days from December 31, 1973) was 9.7 million barrels per day, a decrease of 600,000 barrels per day from 1972. (No significant productive capacity was credited to the North Slope of Alaska.) This was the sixth consecutive decrease since the API began to estimate productive capacity in 1967 .

Productive capacity as defined by the API committee is the estimated amount of crude oil that can be produced on leases within 90 days from December 31, 1973, with existing wells and surface equipment, with adjustments for (1) changes in production facilities that could be made within that period with available service capabilities and personnel; and (2) declining productivity resulting from capacity operation. This estimate does not reflect changes that might result from (1) additional exploratory drilling; (2) the completion of development wells after the 90 day period; or (3) restrictions on production resulting from the lack of storage or transportation facilities beyond the lease.

The difference between the new estimate of the productive capacity of crude oil (9.7 million barrels as of March 31, 1974) and the estimated production of crude oil in December, 1973 (8.7 million barrels) amounts to 1,000,000 barrels per day of incremental capacity.

The Committee emphasized that the daily productive capacity figure is one that may be achieved within 90 days from December 31, 1973, under conditions of an extreme national emergency. Most of the difference between the estimate of productive capacity and estimated production in December, 1973, is located in 14 fields. Three of these fields make up 80 per cent of the total difference.

In one of these fields which is producing at the maximum achievable legal rate, the utilization of its incremental capacity would probably create equity problems concerning mineral rights. In addition, there would be considerable wastage of natural gas because of gas production exceeding gas processing capacity. Under overriding considerations of national interest in time of extreme emergency, it is assumed that these problems would be resolved in 90 days.

In the case of the second field, which is also producing at the maximum achievable legal rate, the utilization of its incremental capacity would probably create equity problems concerning mineral rights. Under considerations of extreme emergency, it is assumed that these problems would be resolved in 90 days.

The third field (Elk Hills) is a Naval Petroleum Reserve where production potential is subject to federal control.

API estimates of reserves and productive capacity are based on the work of 24 committees composed of some 170 geologists and engineers from various segments of the producing industry. These individuals have broad experience and expertise in the estimation of reserves and productive capacity. Committee members work on a voluntary basis throughout the year, gathering and analyzing data on all fields in the United States.

TABLE I.—ESTIMATED RESERVES OF CRUDE OIL IN THE UNITED STATES

[Thousands of barrels of 42 U.S. gallons]

State	Proved reserves as of Dec. 31, 1972	Changes in proved reserves during 1973: Revisions: Plus	Changes in proved reserves during 1973: Revisions: Minus	Changes in proved reserves during 1973: Extensions	Changes in proved reserves during 1973: New field discoveries	Changes in proved reserves during 1973: New reservoir discoveries in old fields	Changes in proved reserves during 1973: Producton [1]	Proved reserves as of Dec. 31, 1973	Net changes in proved reserves during 1973	Indicated additional reserves from known reservoirs [2]
(1)	(2)	(3a)	(3b)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Alabama	56,734	2,221	1,568	5,400	1,776		10,960	53,603	(3,131)	22,041
Alaska	10,096,282	85,754			1,500	1,000	72,323	10,112,213	15,931	36,000
Arkansas	113,100	12,401	6,502	3,540	60	75	17,121	105,552	(7,548)	21,444
California [3]	3,553,735	300,198	82,632	16,740	30,000	5,800	335,741	3,488,100	(65,635)	1,560,150
Coastal Region	513,322	148,204	68,080	14,050		5,550	76,762	536,284	22,962	202,750
Los Angeles Basin	1,282,048	53,081	5,047				132,214	1,197,868	(84,180)	418,000
San Joaquin Basin	1,758,365	98,913	9,505	2,690	30,000	250	126,765	1,753,948	(4,417)	939,400
Colorado	326,411	10,613	6,139	7,174	3,496	99	36,864	304,790	(21,621)	93,790
Florida	208,149	6,093	3,644	5,697	160		32,596	183,859	(24,290)	161,203
Illinois	174,883	11,084	7,387	1,375	1,257	238	29,107	152,343	(22,540)	6,500
Indiana	29,383	2,142	938	625	292	516	5,398	26,622	(2,761)	2,800
Kansas	453,394	27,113	20,859	5,565	2,459	5	66,588	401,089	(52,305)	1,500
Kentucky	48,193	1,364	1,370	325	15	275	8,822	39,980	(8,213)	3,000
Louisiaua [3]	5,028,478	163,460	100,254	118,853	31,900	54,112	719,723	4,576.826	(451.652)	233,877
North	281,451	9,392	3,115	620	103		36,063	252,388	(29,063)	31,645
South	4,747,027	154,068	97,139	118,233	31,797	54,112	683,660	4,324,438	(422,589)	202,232
Michigan	62,002	7,612	483	10,000	7,035		13,722	72,444	10,442	7,500
Mississippi	312,458	32,604	6,569	3,235	2,422	410	53,511	291,049	(21,409)	22,952
Montana	241,248	18,176	7,145	650	930		34,516	219,343	(21,905)	51,420
Nebraska	30,553	5,333	1,513	1,068	61		7,337	28,166	(2,387)	4,145
New Mexico	582,593	191,767	38,915	2,687	322	754	96,214	642,994	60,401	319,510
Northwest	24,246	4,923	207		36		5,138	23,860	(386)	4,025
Southeast	558,347	186,844	38,708	2,687	286	754	91,076	619,134	60,787	315,485

New York	9,246						958	8,288	(958)	2,000
North Dakota	166,033	28,493	3,739	8,470	5		19,742	179,520	13,487	14,670
Ohio	127,385			6,275		44	8,793	124,911	(2,474)	
Oklahoma	1,303,004	153,522	22,818	15,584	1,251		179,579	1,270,964	(32,040)	261,000
Pennsylvania	37,345	5,550					3,282	39,613	2,268	54,770
Texas[3]	12,144,057	1,042,727	319,278	106,682	17,825	22,904	1,258,304	11,756,613	(387,444)	2,083,344
District 1	147,324	15,616	1,740	2,966	253	100	20,730	144,149	(3,175)	36,702
District 2	636,768	153,082	44,923	1,519	763	4,226	74,310	677,125	40,357	5,720
District 3	1,536,426	206,594	102,290	12,777	1,907	3,878	169,864	1,489,428	(46,998)	31,928
District 4	343,752	37,083	39,922	6,073	95	8,921	51,580	304,422	(39,330)	36,865
District 5	98,963	51,070	3,290		300	2	20,583	126,462	27,499	36,000
District 6	2,208,438	5,777	5,602	3,554	220	101	163,240	2,049,248	(159,190)	199,055
District 7-B	235,962	21,718	3,268	13,724	2,513	720	35,499	235,870	(92)	10,500
District 7-C	239,270	13,091	35,112	16,317	5,017	161	33,748	204,996	(34,274)	9,028
District 8	3,402,358	102,706	55,192	30,060	940	1,449	276,783	3,205,538	(196,820)	1,016,630
District 8-A	2,793,503	341,161	17,988	9,579	2,804	2,056	345,807	2,785,308	(8,195)	686,861
District 9	324,018	80,775	8,147	9,333	2,655	1,045	45,971	363,708	39,690	10,555
District 10	177,275	14,054	1,804	780	358	245	20,539	170,359	(6,916)	3,500
Utah	244,397	14,660	9,566	47,000	60	65	32,104	264,512	20,115	44,100
West Virginia	34,040			530		15	2,459	32,126	(1,914)	5,000
Wyoming	949,779	89,219	20,578	22,501	12,646	1,404	138,208	916,763	(33,016)	131,644
Miscellaneous[4]	6,526	1,779	210	165	625	100	1,429	7,556	1,030	
Total, United States	36,339,408	2,213,885	662,108	390,141	116,097	87,816	3,185,400	35,299,839	(1,039,569)	5,144,360
Gulf of Mexico[5]	2,565,862	103,353	52,249	68,337	31,780	20,145	389,703	2,347,525	(218,337)	40,532

[1] Preliminary estimate.
[2] Additional reserves include additional recoveries in known reservoirs (in excess of the proved reserves) which engineering knowledge and judgment indicate will be economically available by application of fluid injection, whether or not such program is currently installed.
[3] Includes offshore reserves.
[4] Includes Arizona, Missouri, Nevada, South Dakota, Tennessee, and Virginia.
[5] Included with Texas and Louisiana.

Note: Figures in parenthese denote negative volume.

Chairman BENTSEN. It is my understanding that study was made in the first 3 months of this year and if that is the case, I can't see how you can accept such a report because there is no question but that you have substantially increased the known recoverable reserves by what you can do in secondary and tertiary recoveries, and what you can do in dealing with the marginal wells with the new process is increased.

The problem of the ownership of mineral rights in the West is another consideration. We know the ownership is extremely fragmented and sometimes difficult to ascertain. Until you get those rights clarified and consolidated, it is going to be rather difficult to develop some of those deposits economically.

Is the Department of the Interior doing anything to try to get a clarification of the extent of federally owned rights and developing more accessible records of who owns what?

Mr. FALKIE. Yes, this comes under the purview of the Bureau of Land Management and there are several things going on with regard to minerals and the public lands.

There have been several changes proposed in legislation dealing with the Bureau of Land Management and an organic act therefor. There have been some legal decisions with regard to ownership of oil shale including old oil shale claims, and there is underway an extensive study of the coal leasing policy for leasing of coal on the Federal lands. This covers a pretty broad range of the three things just mentioned, and it covers a fairly broad range of all minerals on public lands. So these types of activities are underway, yes.

Chairman BENTSEN. Do you favor the thought that unless someone develops the mineral rights within a specific period of time, their lease terminates?

Mr. FALKIE. I think that we need to distinguish between locatable minerals and broadly based minerals. Our policies must recognize that minerals are where nature put them and minerals like coal and oil shale are contained in sedimentary deposits which cover relatively large areas, while deposits of many copper and zinc and other metals are located on a spot basis.

So that the policy needs to recognize this and——

Chairman BENTSEN. Well I don't think I follow that one. If someone has tied up a piece of property with a claim, don't you think they have to develop it within a certain period of time or lose it?

Mr. FALKIE. Certainly, there should be some encouragement to develop——

Chairman BENTSEN. It would have to be heavy encouragement, don't you think?

Mr. FALKIE. To entice them to produce within a reasonable amount of time?

Chairman BENTSEN. Well are you in favor of that?

Mr. FALKIE. They should be encouraged to develop.

Chairman BENTSEN. Now insofar as undersea mining, we are seeing private industry spending a lot of money at the present time seeing if it would be feasible or practical to develop under the sea minerals. Are you participating in that kind of a study?

BUREAU OF MINES ON UNDERSEA MINING

Mr. FALKIE. I am going to call on Mr. Morgan to answer that, because there were some activities and since I just arrived at the Bureau of Mines, there were some transfers of functions over the past several years as to who is involved in undersea mining activities.

Mr. MORGAN. Sir, a number of years ago the Bureau of Mines was concerned with undersea mining. It had a station on the west coast at Tiburon, Calif. Then Congress in its wisdom established the National Oceanic and Atmospheric Administration or NOAA.

When NOAA was established, ocean going activities at the Bureau of Mines was transferred to NOAA, and the Pacific coast station was shut down.

Therefore up to this time we have not been able to move into this area directly, though in our metallurgy laboratories we are doing some research on materials recovered from the sea bottom because apparently they are much more complex metallurgically and not readily amendable to treatment by conventional metallurgical processes.

So through our laboratories we are doing some metallurgical research on sea bed minerals but we are not actively engaged in undersea mining at the present time.

Chairman BENTSEN. In your communications with these people do you have any feel for what we are looking to in the way of the time frame?

By 1985 would a significant amount of our minerals used in this country will come from undersea mining?

Mr. MORGAN. Personally, sir, I am not too optimistic that great quantities of nonfuel minerals will come from the sea, the reason being that there are still very large quantities of reasonable quality materials on the surface of the land and there are real difficulties in operating in the ocean hundreds of miles from the shore and in waters 2 to 3 miles in depth.

And I don't think all of these difficulties have been overcome.

Another thing is that many of these calculations of possible profit from undersea mining; look at the particular article—let's say it is a nodule and it contains manganese and nickel and cobalt and copper and so on—and it ascribe to each one of these constituents the value that presently sells for.

Normally in mining operations if you can see your way clear to make a profit on one constituent, then that is a pretty good business.

If one trys to count on the values of all of the byproducts or coproducts one is likely to be in danger on the success of the operation.

I hope something comes of it. We are anxious to see something come of it but until it is a demonstrated technology, I personally would be not too optimistic that it is going to solve many problems in the near future. I think the solution will come at a later date.

Chairman BENTSEN. Well thank you very much. Thank you gentlemen for your testimony.

[The prepared statement of Mr. Falkie follows:]

PREPARED STATEMENT OF HON. THOMAS V. FALKIE

The problems associated with energy which were called to our attention most forcibly by the Arab embargo in 1973 have raised several questions concerning not only energy but also other materials, both of mineral and agricultural origin. As Director of the U.S. Bureau of Mines and as a representative of the Department of the Interior I am going to confine my discussion to matters concerning minerals, because minerals have been of prime concern to the Department of the Interior and to its various agencies for more than 100 years.

To give this Committee an idea of the overall role of minerals in the economy, we have prepared a series of charts to which I am going to refer. Figures 1 through 7 are appended at the end of this statement.

Figure 1 details our current use of minerals on a weight basis. Over 40,000 pounds of new mineral materials are required annually for each U.S. citizen, about equally divided between energy minerals and other minerals. The total annual use of new minerals in the United States exceeds 4,000,000,000 tons.

Figure 2 details are extensive usage of our transportation net by minerals. On a tonnage basis minerals account for: 90% of all water-borne imports, 50% of all water-borne exports, 85% of all domestic water-borne commerce, 70% of domestic rail traffic, and 100% of all pipeline traffic. Consequently, while transportation matters are not the primary responsibility of the Department of the Interior, we nevertheless are concerned with needs for deepwater ports, improvement of our rail transportation system, and encouragement of new and improved forms of transportation, as for example, coal slurry pipelines.

Referring to figure 3, it details the role of minerals in the U.S. economy from the standpoint of value at different stages from mining through processing. Domestic mineral raw materials in 1973 were valued at approximately $35 billion. These domestic mineral raw materials were supplemented by imports valued at $7 billion. The total supply of mineral raw materials was then utilized by the mineral processing and energy generation industries to produce energy and mineral based materials valued at $175 billion. At this stage of processing imports in 1973 supplied processed mineral materials valued at $12 billion. Exports of both raw and processed minerals in 1973 were valued at about $11 billion, and old mineral scrap valued at $4 billion was reclaimed and recycled in 1973.

Figure 4 details the rise in world steel production over the past two decades. And steel as you know is one of the major nonfuel mineral materials and many other mineral commodities are used in more or less direct proportion to steel production. Consequently, the demand for minerals is closely attuned to the tempo of steel production, which in turn is closely attuned to overall industrial activity. It is significant to note that, as shown by Figure 4, steel production in most major producing areas peaked simultaneously in 1973, thus contributing to heightened worldwide demand for most mineral commodities.

While world demand was peaking in 1973 and early 1974, there was extensive speculation in raw material commodity markets and the U.S. economy was being operated under price controls. Price controls increased domestic demand and inhibited expansion of domestic sources of supply. Consequently, in 1973 and early 1974, as a combined result of high demand, high levels of speculation in mineral commodity markets, and domestic price controls, many problems developed relating to material shortages for: steel, copper, lead, zinc, aluminum, platinum group metals, fertilizers, explosives, and such things as roof bolts for coal mining; to say nothing of shortages of energy materials and derivatives thereof such as petrochemicals. However, at mid-1974 there appeared to be some easing of material shortages resulting from lower demand, apparently reduced levels of speculation, and the April 30, 1974, termination of the Economic Stabilization Act, which allowed domestic raw material commodity prices to rise, thereby reducing some of the excess demand while also stimulating supplies and I think this is what you were referring to. As a result, domestic producer prices and metal exchange prices have come closer together. This situation is an indicator of more stability for raw material commodity markets and should make access to mineral commodities easier for consumers of raw materials.

Figure 5 details mineral imports and exports in 1972 and 1973, along with our estimate for 1974 based on actual data through May of this year. The 1974 increase in imports of raw and processed minerals to an estimated $35 billion is attributable in large measure to increased costs of imported fuel minerals, and these import values are probably conservative in that they are based on published f.o.b. data and do not include the insurance and freight costs involved in delivery to U.S. ports. Of course, exports of agricultural and mineral commodities and manufactured goods and services, as well as floating exchange rates and capital flows help the United States to pay for needed imports of minerals. Exports of raw and processed minerals in 1974 are now estimated at $17 billion. We understand that the overall balance of U.S. trade shows a projected surplus in 1974.

Figure 6 details the great increase in U.S. production and use of plastics over the past two decades. Plastics have become major substitutes or alternates in a number of applications where formerly metals were used. Our current domestic use of 12,000,000 tons of plastics is greater than our combined use of aluminum, copper, lead, and zinc. In fact, because plastics are so much lighter than metals, on a volume basis the use of plastics in the United States is a substantial substitute or alternate material for steel itself. Plastics are made almost wholly from petrochemicals, and the recent rises in petroleum prices have made such materials more costly. The Bureau of Mines for several years has devoted research efforts not only to ways of producing more oil and gas, both in the secondary and tertiary; and to making chemicals from coal, oil shale, and tar sands, but also to ways to improve the recovery of waste plastic materials and to recycle them so as to contribute to increased plastic supplies, conservation of energy, and lessened environmental degradation.

Figure 7 details a number of key mineral commodities for which the United States is dependent upon imports for significant percentages of total supplies. Concern has arisen as to the possibilities of OPEC-like actions on the part of other raw material producing nations, although the diversity of suppliers, the needs for continuity of income to low-income producing nations, the postponability of some demands in the industrialized nations, and the possibilities of substitutions are factors which would appear to make OPEC-like actions more difficult and less serious than was the case with respect to petroleum. The potentials for problems were recognized, however, and the President, in his January, 1974, State of the Union Message, said:

"It is also imperative that we review our current and prospective supplies of other basic commodities, I have therefore directed that a comprehensive report and policy analysis be made concerning this crucial matter so that government actions can properly anticipate and help avoid other damaging shortages . . ."

In his February, 1974, Budget Message he said:

"The adverse impact of energy shortages on the economy could be aggravated by shortages of other raw materials. A comprehensive study on supplies of metal ores and other basic resources and our needs for them is now underway. This study will help insure that our policies properly anticipate problems."

The study directed by the President has been underway for several months under the leadership of the Office of Management and Budget. The Bureau of Mines has contributed extensively to the fundamental information on mineral commodities required as part of the study. We provided basic information on domestic production, imports and sources thereof, recycling, uses, possibilities of substitution, possibilities of domestic expansion, and domestic and world reserves. Much of the basic information supplied by the Bureau was essentially the same as that contained in the recent publication of the "Commodity Data Summaries—1974," copies of which are available here today for the use of this Committee. Because the study initially ordered by the President is now being reviewed at higher echelons of the Executive Branch, it would be inappropriate for us to comment at this time as to the details thereof or to speculate what conclusions might be reached therein. Nevertheless, we understand that this Committee wishes some insights at this time into the current major problems affecting United States mineral supplies and the possibilities of increasing domestic production, and we shall endeavor to discuss this in a broad outline.

By and large the United States is blessed with abundant mineral resources but it is important to realize to what geologists, mining engineers, and metallurgists refer when they use the broad term "resources." "Resources" are natural concentrations of raw minerals in the crust of the earth, whether solid, liquid, or gas, or in the waters of the earth, or in the earth's atmosphere. There are a few materials, notably: antimony, asbestos, chromium, strategic mica, and tin, for which U.S. resources, based on present knowledge, are deemed to be small or insignificant. Consequently, broadly viewed, our primary concern is not with inadequacy of resources but rather that we must improve our technology to convert the raw rocks, soils, and fluids of the earth into energy and processed mineral materials useful to man, while at the same time safeguarding the environment and meeting health, safety, sociologic, and aesthetic standards, and doing so economically to the extent that investment in domestic mineral industries appears attractive to venture capital.

In much of the two decades following the Korean War period many materials were available from foreign sources at prices which discouraged development of domestic mineral industries and encouraged many U.S. firms in the mining and mineral business to expand their foreign operations. Now, however, consumers of mineral materials are finding that foreign nations properly wish to reap the benefits of the value added by manufacturing. Thus, for example, foreign nations would prefer to produce alumina, rather than bauxite. If possible, and they have access to energy sources, they will seek to produce aluminum metal rather than alumina. And once they produce aluminum metal, they will not wish to export it in pig form, but will rather seek to manufacture and ship products such as tubing, siding, girders, pots, pans, etc. The same trends are obvious in almost all materials. Further, it is important to remember that the U.S. population of some 212,000,000 people is only about 6 percent of the total world population. Consequently, as the other 94 percent of the people in the world strive for higher material standards of living, mineral raw materials and manufacturers thereof increasingly will find attractive markets in many parts of the world.

Our job is to assure that, in line with the Mining and Minerals Policy Act of 1970, the Government is equipped to provide an overview of national materials needs and direction as to how those needs must be met. It must complement industry's basic responsibility and efforts to develop our natural resources to meet those needs, while at the same time assuring that other public goals such as environmental protection and national security, are served. In this activity Government, industry, and educational institutions must play increasingly interactive roles, because no one of these has sufficient knowledge and authority to arrive at significant improvement alone. If these efforts are successful, improvements can be expected in the whole mineral cycle: exploration, mining, mineral beneficiation, energy generation and conversion, metallurgy and ceramic technology, making special alloys and composite materials, designing goods for longer life and ease of recycling, recycling of agricultural, urban, and industrial wastes, and reclamation of mined lands.

And, as we pointed out earlier in this statement, the large volumes of mineral materials involved in our national economy require improved transportation, including: deepwater ports, harbors and transfer facilities, railroads, international waterways, and pipelines.

We can assure you that the above considerations are paramount not only in the Bureau of Mines but also in the Geological Survey, the Office of Coal Research, the Mining Enforcement and Safety Administration, and the other agencies of the Department of the Interior primarily concerned with minerals. Just a few days ago, Secretary of the Interior Rogers C. B. Morton, himself, said on July 12, 1974:

"If we are to meet the challenge of providing minerals for the Second America, we must begin a massive revitalization and rededication of mineral science and technology.

"If new resources are to be discovered—as they must—we shall need something better than yesterday's techniques. And yesterday's methods of mining and processing will have to be examined critically in order to develop new technologies that will permit more effective exploitation of the mineral resources now being mined.

"Moreover, all these things must be done with due regard to health and safety, environmental protection and land use.

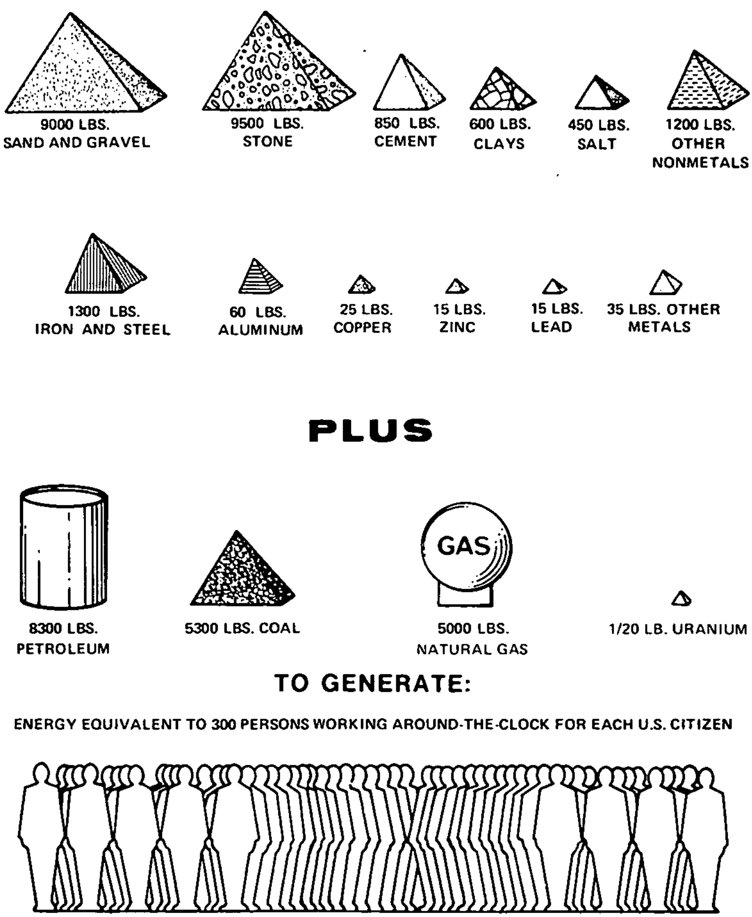
"Downstream, our technology with respect to reuse of mineral commodities—their recycling into productive channels—must be improved and the application of new methods accelerated.

"The job to be done is immense. Can we solve these problems? The answer will depend upon the sense of commitment, of involvement, of cooperation that we can muster."

Secretary Morton concluded that he "chose to be optimistic," and we are now devoting our best efforts to solving these problems by making maximum effective use of the increased funding that the President requested and that the Congress has supplied for our mineral research and information collection and analysis activities in fiscal year 1975. We are intensively reviewing our current mineral research activities, our mineral lands utilization polices, and our mineral data collection and analysis, and we plan to propose improvements. The Department of the Interior intends to discharge effectively and efficiently its responsibilities under the Mining and Minerals Policy Act of 1970 and other pertinent mineral legislation.

Figure 1

ABOUT 40,000 POUNDS OF NEW MINERAL MATERIALS ARE REQUIRED ANNUALLY FOR EACH U.S. CITIZEN



U. S. TOTAL USE OF NEW MINERAL SUPPLIES IN 1973 EXCEEDED

4 BILLION TONS !

42-305 O - 75 - 27

Figure 2

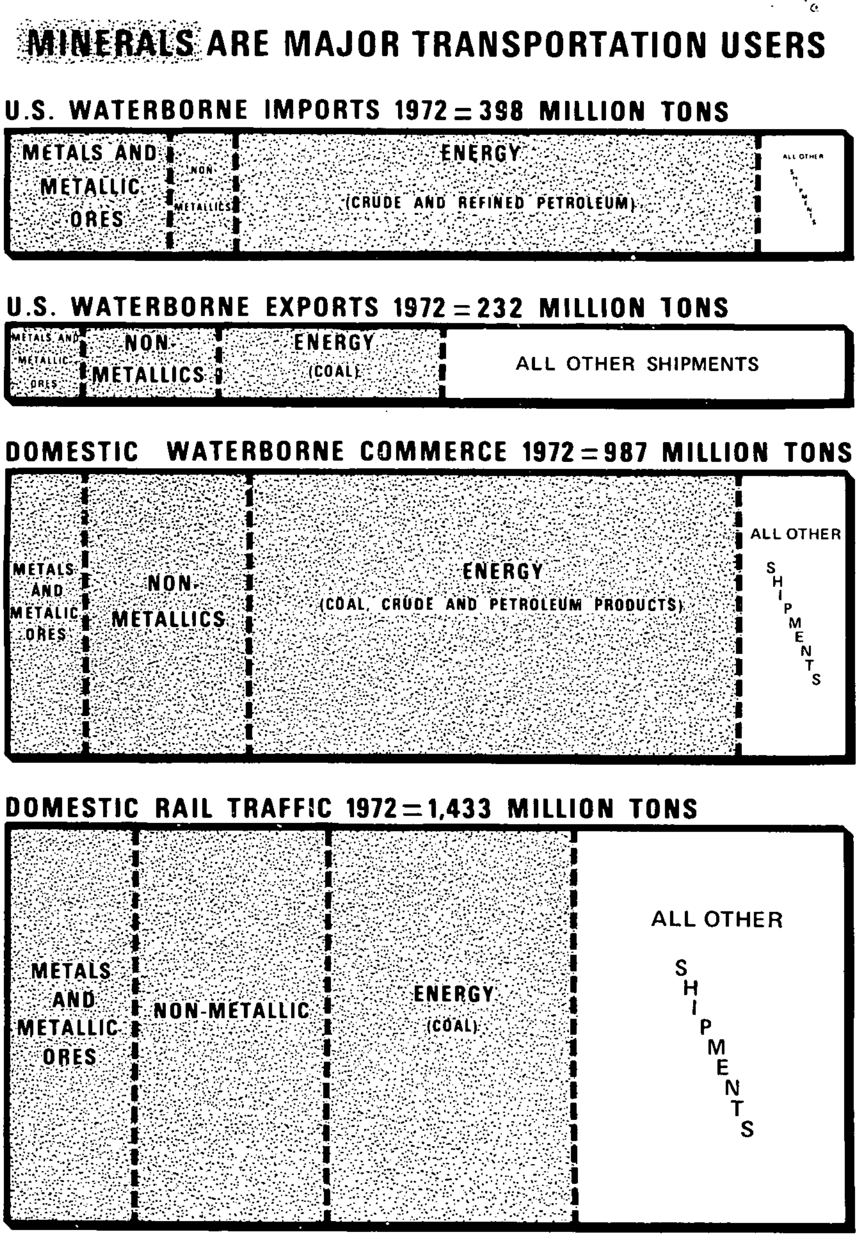

MINERALS ARE MAJOR TRANSPORTATION USERS
U.S. WATERBORNE IMPORTS 1972 = 398 MILLION TONS
METALS AND METALLIC ORES
NON METALLICS
ENERGY
(CRUDE AND REFINED PETROLEUM)
U.S. WATERBORNE EXPORTS 1972 = 232 MILLION TONS
METALS AND METALLIC ORES
NON METALLICS
ENERGY
(COAL)
ALL OTHER SHIPMENTS
DOMESTIC WATERBORNE COMMERCE 1972 = 987 MILLION TONS
METALS AND METALIC ORES
NON-METALLICS
ENERGY
(COAL, CRUDE AND PETROLEUM PRODUCTS)
ALL OTHER SHIPMENTS
DOMESTIC RAIL TRAFFIC 1972 = 1,433 MILLION TONS
METALS AND METALLIC ORES
NON-METALLIC
ENERGY
(COAL)
ALL OTHER SHIPMENTS

Figure 3

THE ROLE OF MINERALS IN THE U.S. ECONOMY

(ESTIMATED VALUES FOR 1973)

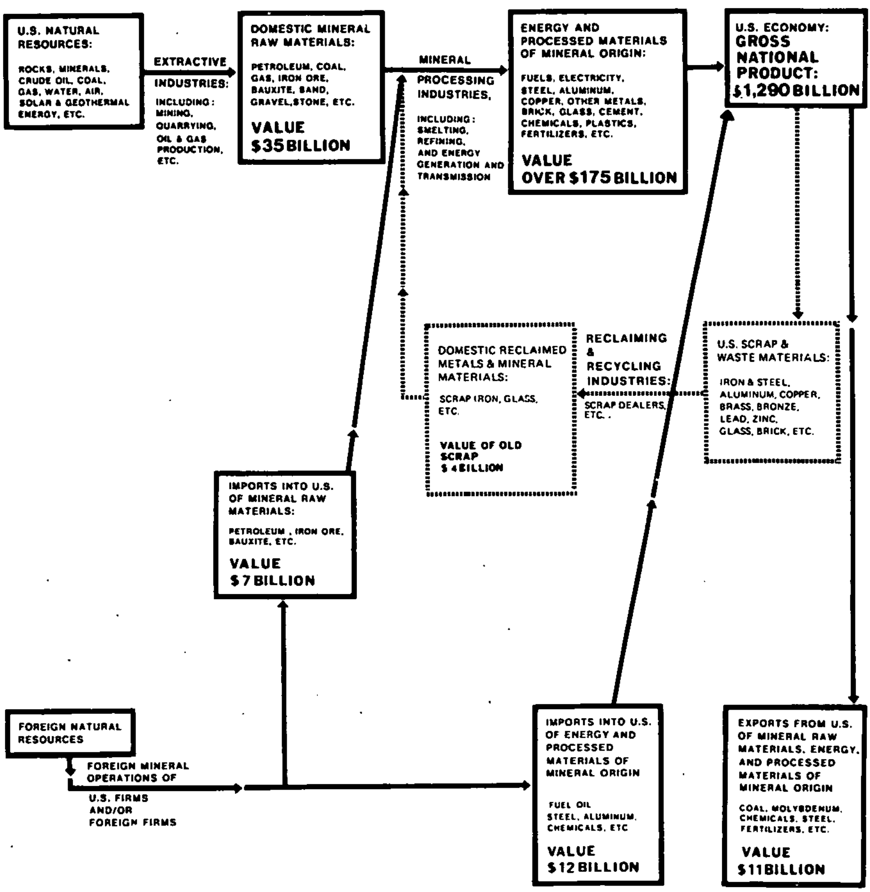


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Figure 4

THE U.S.A. NOW PRODUCES ONLY ABOUT ONE-FIFTH OF THE WORLD'S STEEL

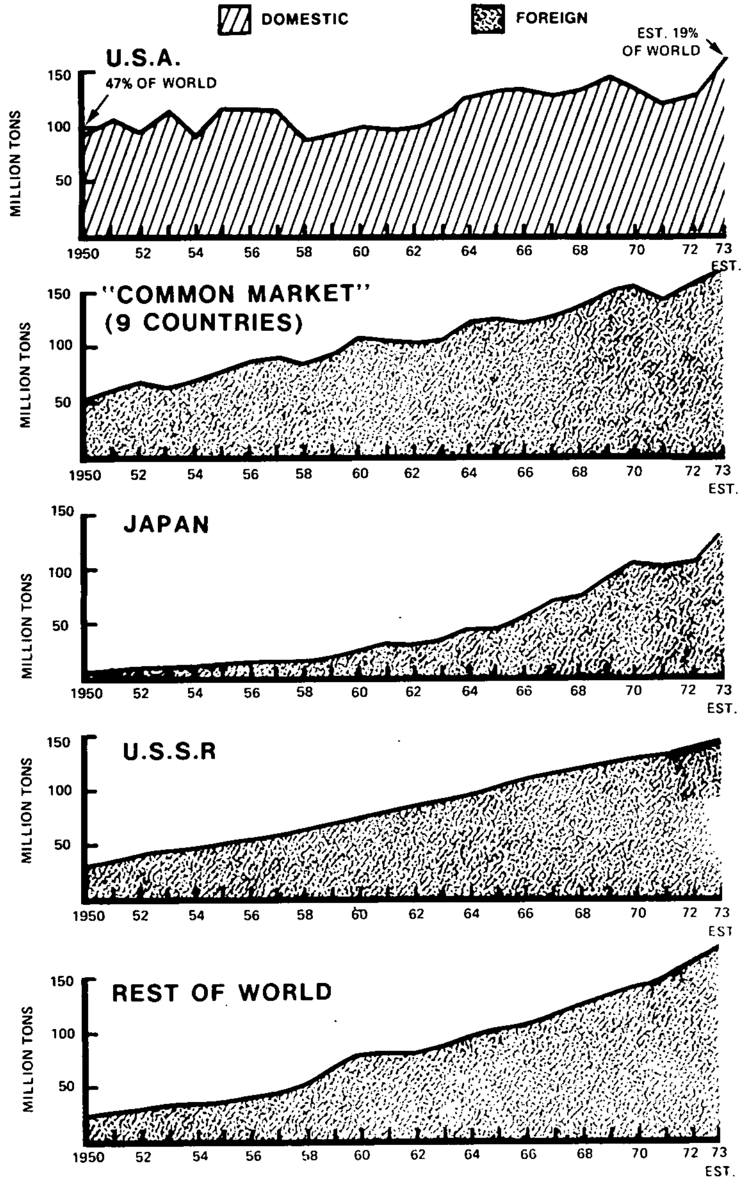
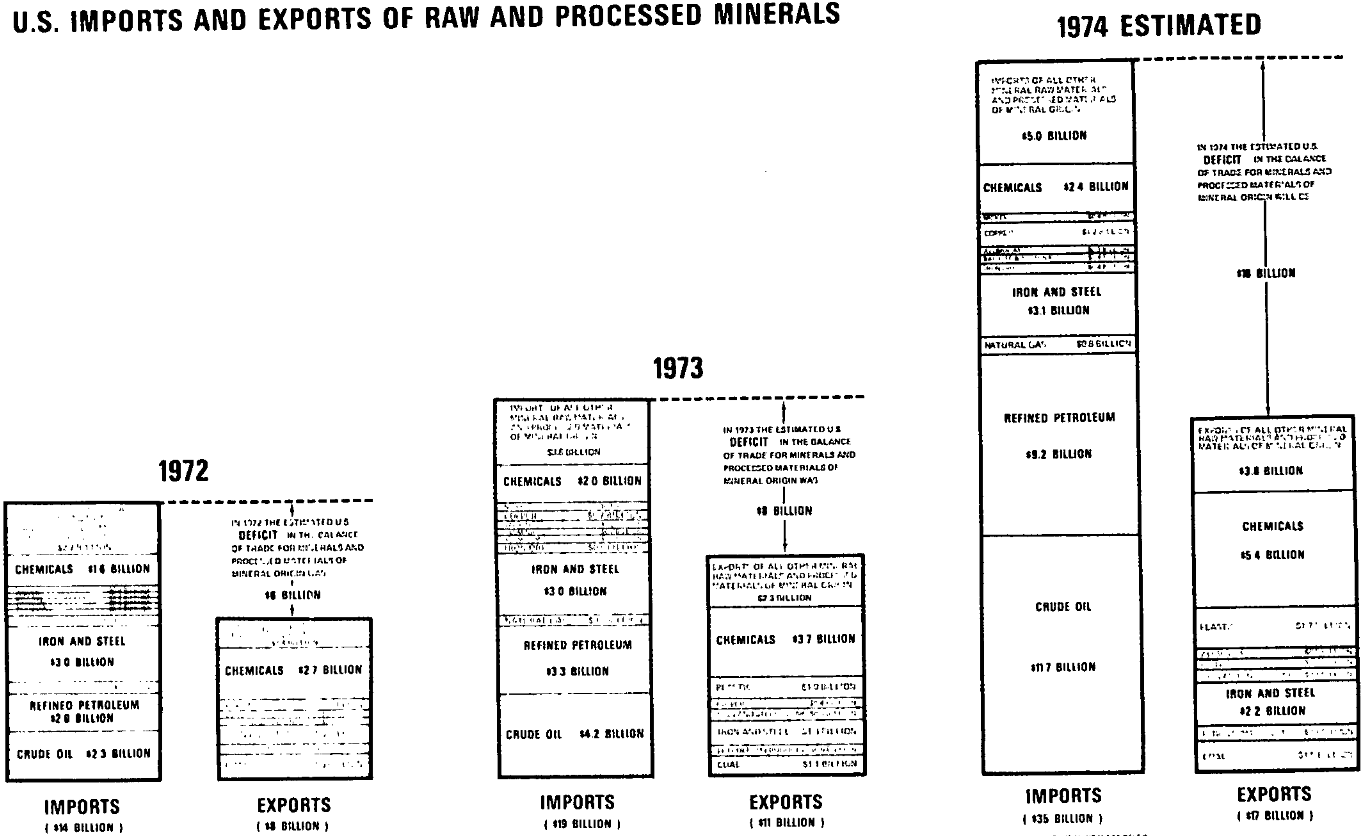


Figure 5

U.S. IMPORTS AND EXPORTS OF RAW AND PROCESSED MINERALS



1974 ESTIMATE BY BUREAU OF MINES BASED ON JANUARY THRU MAY DATA

SOURCE: U.S. DEPARTMENT OF COMMERCE, BUREAU OF CENSUS AND U.S. BUREAU OF MINES (F.O.B. VALUES)

Figure 6

U.S. SUPPLIES AND USES OF PLASTICS

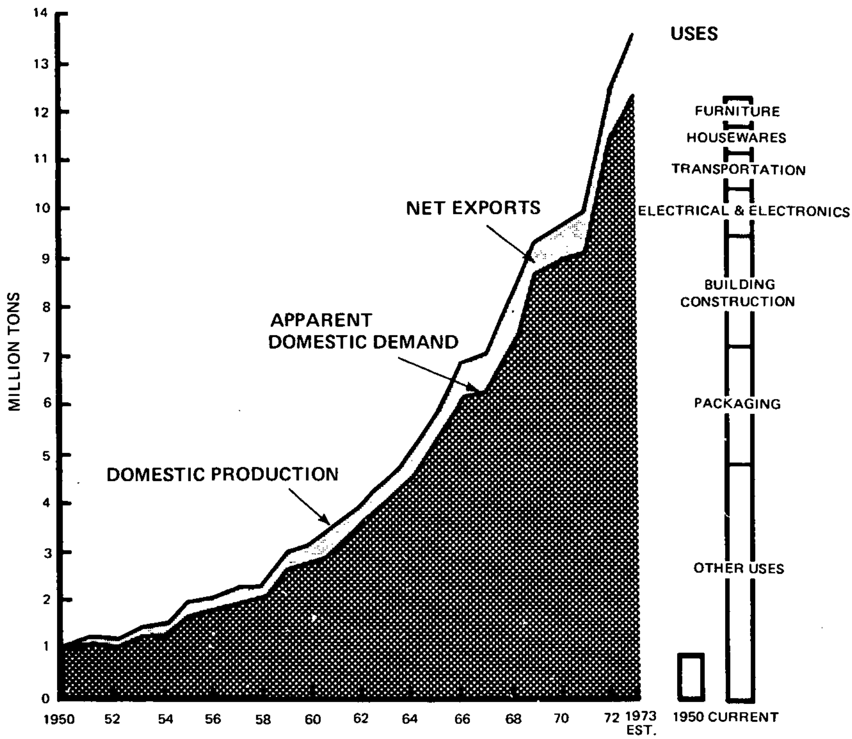
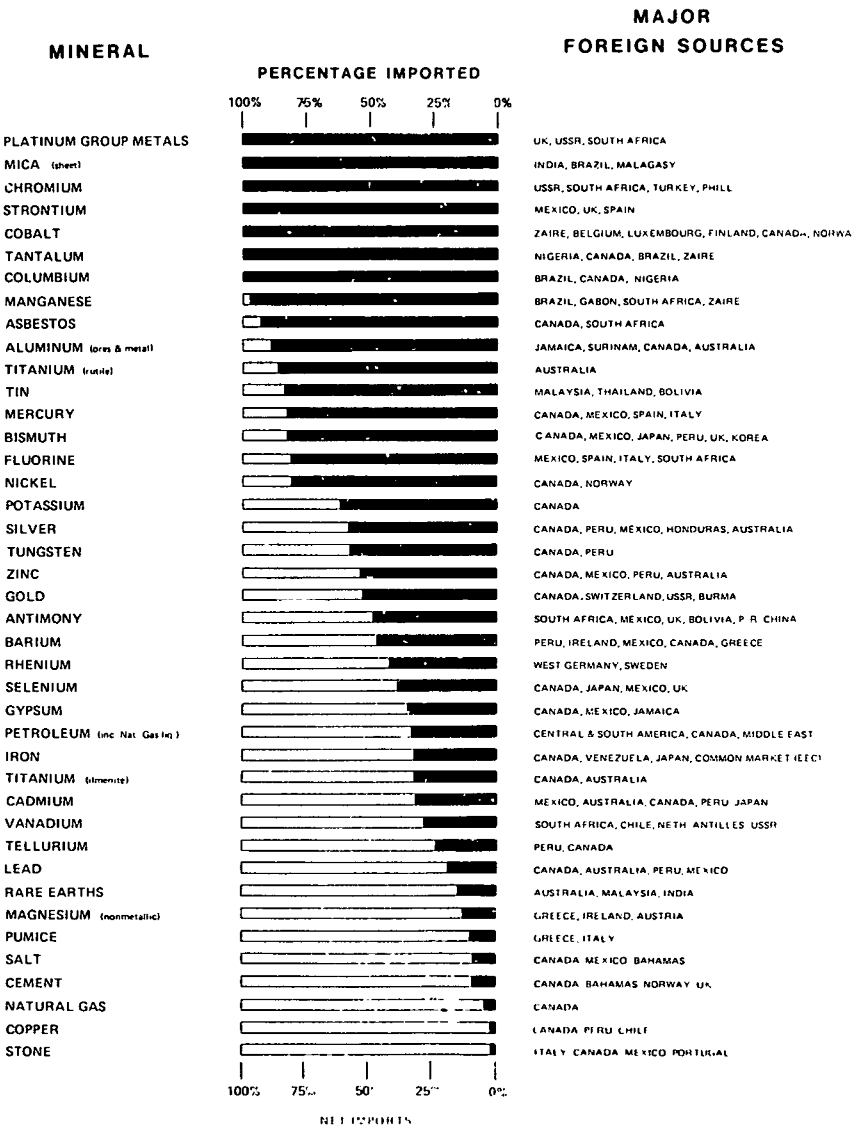


Figure 7

IMPORTS SUPPLIED SIGNIFICANT PERCENTAGES OF TOTAL U.S. DEMAND IN 1973



Chairman BENTSEN. We will adjourn our hearings now, and probably not to meet again until in September.

[Whereupon, at 12:30 p.m., the subcommittee adjourned, subject to the call of the Chair.]

APPENDIX

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ALTERNATIVES TO IMPORTED BAUXITE: DOMESTIC POTENTIAL SOURCES OF ALUMINUM

By
Stephen M. Phillips
Analyst in Environmental Policy
Environmental Policy Division

August 9, 1974

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SUMMARY

The recent imposition of a six-fold increase in the taxes and royalties on Jamaican bauxite imported by U. S. companies, indications of similar action in the Dominican Republic and possibly Surinam, and Guyana's plans to nationalize bauxite operations in that country have instigated an intensified investigation of domestic alternatives to bauxite to meet the Nation's aluminum needs. The U. S. Bureau of Mines and the U. S. aluminum industry have for some time studied the various raw aluminous materials available in the United States, but have heretofore found that they were not economically competitive with bauxite.

Because of its own limited bauxite resources, the United States is dependent on imported bauxite and alumina, the intermediate product in aluminum production. Less than ten percent of the Nation's aluminum output emanates from domestic sources. Now that the price of imported bauxite from Jamaica, which supplies over fifty percent of total bauxite imports, has risen dramatically, production of alumina from domestic sources may be economically feasible. Reliable cost information is not available since, with the exception of the Soviet Union, no country has used anything other than bauxite as a commercial source of alumina except for a short period during World War II, and the aluminum companies do not disclose much in the way of cost information. Although the technology to process domestic aluminous materials for alumina production is known, it has not been refined nor tested in anything other than pilot plant operations.

Domestic sources of alumina are numerous and some are in abundance. The commonly cited domestic alternatives to bauxite are high-alumina clay,

anorthosite, alunite, dawsonite, aluminous shales, coal wastes, copper leach solutions, low-grade bauxite, aluminous phosphate rock, and saprolite. Of these, high-alumina clays, anorthosite and alunite are generally considered the leading potential commercial sources of alumina. High-alumina clay of the kaolin-type found in Georgia has been the subject of considerable Government and industry research, and might well be the domestic source that the industry would turn to if a decision to convert to a domestic material were to be made immediately.

The National Materials Advisory Board, an affiliate of the National Academy of Sciences, conducted a study of the processes for extracting alumina from nonbauxite ores in 1970 and recommended that nitric acid and hydrochloric acid processing of clay be tested in pilot plants since these two processes were "the most promising for the economic production of alumina from materials other than commercial bauxite." At present, high-alumina clays are probably the most feasible alternative to bauxite imports as an economical raw material for aluminum. Although there has been no large-scale profitable production of aluminum from clays under competitive economic conditions, aluminous clays were tested in pilot plants by the Bureau of Mines during World War II and the Anaconda Company in conjunction with Kaiser Aluminum did pilot plant processing of kaolin clay with hydrochloric acid in 1962-63. Reynolds Aluminum is also known to have conducted considerable research in kaolin clays. Although ample supplies of clay with an alumina content of 30-35 percent are available, the most accessible highgrade clay is already being utilized by industry for use in paper filler, refractory products and ceramics.

The Aluminum Company of America (Alcoa) has been working to develop anorthosite, an igneous rock of which there is a huge supply in the United States, as a commercial source of alumina. The company purchased 8,000 acres of anorthosite-bearing property near Laramie, Wyoming, in 1972, and has been operating a pilot anorthosite-to-alumina plant in East St. Louis, Illinois, for the past six to eight months. An announcement by Alcoa in the next three or four months that it will construct a commercial-size anorthosite processing facility is likely, according to a company representative. The lime-soda sinter process of extracting alumina from anorthosite has been extensively tested and is considered the most favorable at this time. As is the case with clay, anorthosite processing is a more energy-intensive process than obtaining alumina from bauxite, which is energy-intensive itself.

A relatively new alternative to bauxite, alunite, may be the first domestic source to be used commercially if the plans of the National-Southwire Corporation are realized. Having operated a pilot plant since January 1971, in Golden, Colorado, the National-Southwire Corp., the principal owner of the Nation's known alunite supply, plans to complete its plant operations by the end of the year. With the aid of Soviet technology which the company recently purchased, National-Southwire plans to have a $230 million commercial facility on stream by 1978. Because the alunite reduction process generates large tonnages of fertilizer products (520,000 tons of triple super phosphate, diamonium phosphate, or monophosphate per 500,000 tons of alumina) in addition to potassium sulfate and alumina, company officials believe alumina production from alunite will be economical even if the trend towards higher imported bauxite prices changes downward.

Of the remaining domestic alternatives to bauxite, dawsonite is the most prominently mentioned as a potential alumina source. Because it is associated with western oil shales from which oil and nahcolite would also be recovered, the National Materials Advisory Board in its 1970 report stated that alumina extraction from dawsonite had economic potential and deserved a high priority for continued research. The companies that are developing western oil shales are currently studying the feasibility of recovering dawsonite. Although the aluminum industry does not rate dawsonite highly as an alumina source, oil shale companies indicate they may be producing alumina from dawsonite as part of an integrated minerals processing industry by 1980.

Coal wastes, coal ashes, copper leach solutions, low-grade bauxite, aluminous phosphate rocks and saprolite have all received some attention as domestic sources of alumina, but high processing costs. inadequate quantities or insufficient concentration of the aluminous material reduce the likelihood of any of these materials becoming a major commercial source of alumina.

The Bureau of Mines is now in the second year of a four-year, $2.8 million mini-plant program to test four aluminous materials, clay, anorthosite, alunite and dawsonite. Originally planned in 1973 as a $2.4 million, six-year program, the mini-plant program recently became a cooperative effort when the Bureau obtained $50,000 per year for three years from eight aluminum producers. This additional $400,000 per year for three years will allow for completion of the project in 1977 rather than 1979, studies on additional clays and shales, more thorough sulfurous acid processing of clay, and more thorough study of dawsonite processing alternatives. The program is being conducted in six overlapping phases. In chronological order, they are: processing clay with nitric acid, a phase which began in July 1973 and is now nearing completion, hydrochloric acid leaching of clay, lime-soda sinter processing of anorthosite, sulfurous acid leaching of clay, alunite processing and dawsonite processing. The particular processing techniques for winning alumina from alunite and dawsonite have not yet been determined. An additional $100,000 will be expended by the Bureau of Mines for supportive engineering and cost estimating work.

Although the aluminum industry is accelerating its efforts to find an economically viable alternative to bauxite in response to the outlook of higher prices and less reliable supplies of imported bauxite, these efforts are probably no less intense than the industry's work to locate reliable foreign bauxite sources. Bauxite, with an alumina content exceeding 50 percent, compared to nonbauxite sources which have alumina contents only half as great, remains the logical source of aluminum and is in adequate supply worldwide. Furthermore, the industry has a tremendous investment in the Bayer process of converting bauxite to alumina. For the short term at least then, continued dependence on higher-priced foreign sources of bauxite and a concomitant rise in aluminum prices can be expected.

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INTRODUCTION

The search for a commercial domestic raw material source for aluminum has been underway for many years, but has taken on new significance and received greater attention in recent months. Bauxite, the heterogeneous earthy material from which all U.S. aluminum is derived, is the most logical raw material source, since it contains over 50 percent alumina, the intermediate product in the aluminum production cycle. Although bauxite is in adequate supply worldwide, domestic supplies of commercial-grade bauxite, amounting to about 40 million tons, are inadequate to meet the U.S. demand for aluminum. Thus, the United States, the world's leading aluminum producer, is largely dependent on foreign sources to supply the necessary raw materials. Less than ten percent of primary aluminum production in the U.S. currently emanates from domestic sources and the trend is toward increasing dependency on foreign ores.

The United States' reliance on bauxite and alumina imports to satisfy its aluminum needs has not been a matter of absolute necessity, but dictated by economic factors. With its high alumina content and amenity to relatively inexpensive mining techniques, foreign bauxite has been the most economic source of alumina. A processing method, the Bayer process, has been developed and refined for extracting alumina from bauxite and large sums have been invested in processing plants geared to this technology. Numerous domestic sources of aluminous raw materials, some of which represent potentially huge supplies of alumina, are available and the technology to utilize them is well-known. However, these domestic

SOURCES OF NEW U.S. ALUMINUM SUPPLY 1/

(data in thousand short tons aluminum content) 2/

	1972 (percent)	1973 (percent)
Aluminum Produced in the U.S.	4,994 (86.2)	5,666 (89.8)
Primary Production	4,744 (81.9)	5,306 (85.6)
From Domestic Bauxite	467 (8.0)	477 (7.7)
From Imported Bauxite	2,792 (48.2)	3,057 (49.3)
Jamaica	1,558 (26.9)	1,525 (24.6)
Surinam	700 (12.1)	749 (12.1)
Dominican Republic	191 (3.3)	226 (3.6)
Guyana	178 (3.1)	350 (5.6)
Australia	64 (1.1)	116 (1.9)
Others	101 (1.7)	91 (1.5)
From Imported Alumina	1,485 (25.6)	1,772 (28.6)
Australia	609 (10.5)	1,019 (16.4)
Jamaica	390 (6.7)	457 (7.4)
Surinam	297 (5.1)	213 (3.4)
Others	189 (3.2)	83 (1.3)
Secondary Production - Old Scrap 3/	250 (4.3)	260 (4.2)
Aluminum Metal Imports	794 (13.7)	629 (10.2)
Canada	558 (9.6)	481 (7.8)
Norway	64 (1.1)	17 (.3)
Others	172 (3.0)	131 (2.1)
TOTAL New Aluminum in U.S.	5,788 (100)	6,195 (100)

1/ By definition, this table does not include the contribution of the U.S. government stockpile and industry reserves to the total U.S. supply of aluminum. In 1972, 165 thousand short tons aluminum content were released from the government stockpile, leaving a balance of 5,319, and industry stocks dropped from 4,195 to 4,021. In 1973, another 995 thousand short tons aluminum content were released from the government stockpile, leaving 4,324, and industry stocks dropped from 4,022 to 3,822.

2/ Aluminum content of U.S. bauxite assumed to be 23 percent; South America bauxite, 24 percent. Aluminum content of alumina was assumed to be 52.1 percent.

3/ This figure is for old scrap, i.e., post-consumer scrap. In addition to this secondary source, runaround (home) scrap and new (prompt industrial) scrap is used in aluminum production. Since the availability of these types of scrap is a direct function of current primary production, they are not generally considered as independent sources of the aluminum supply. However, to the extent that new or runaround scrap is not recovered and must be replaced by primary sources, it can be considered a supply factor.

Source: U.S. Bureau of Mines.

DISTRIBUTION OF U.S. ALUMINUM SUPPLY 1/

(data in thousand short tons)

	1972 (percent)	1973 (percent)
U.S. Industrial Demand	5,333 (100)	6,297 (100)
Aluminum Metal	4,719 (88.4)	5,650 (89.8)
Construction	1,310 (24.5)	1,550 (24.6)
Transportation	915 (17.1)	1,095 (17.4)
Automobiles(40%)	366 (6.8)	
Aircraft (20%)	193 (3.6)	
Electrical	630 (11.8)	750 (11.9)
Cans & Containers	750 (14.1)	900 (14.3)
Appliances & Equipment	457 (8.5)	545 (8.7)
Machinery	304 (5.7)	360 (5.7)
Other	353 (6.6)	450 (7.1)
Nonmetal Aluminum	614 (11.5)	645 (10.2)
Refractories	174 (3.2)	189 (3.0)
Chemicals	347 (6.5)	359 (5.7)
Abrasives	93 (1.7)	97 (1.5)
EXPORTS	794 (100)	1,095 (100)
Alumina & Bauxite	465 (58.5)	573 (52.3)
Aluminum Metal	329 (41.4)	522 (47.7)

1/ In 1972 and 1973, there were no additions to either the U.S. government stockpile or industry stocks. In 1972, 165 thousand short tons aluminum content were released from the U.S. government stockpile and industry stocks declined from 4,195 to 4,021 during the course of the year. In 1973, 995 thousand short tons aluminum content was released from the government stockpile and industry stocks declined from 4,022 to 3,822 during the year.

Source: U.S. Bureau of Mines data

alumina-bearing ores have not been used commercially to date because they are not considered economic vis-a-vis imported bauxite.

INCREASED COST OF BAUXITE IMPORTS

Recent developments in the bauxite-producing countries, resulting in substantially higher bauxite costs and creating some doubt as to the dependability of future supplies, have prompted serious questions as to whether foreign bauxite is still or will be in the future the most economic raw material for U.S. aluminum. The immediate catalyst for this reexamination of the viability of bauxite imports as the principal commercial source of aluminum was a sharp increase in bauxite taxes and royalties imposed in June 1974 by Jamaica, from whom the U.S. aluminum industry obtains half of its bauxite supply. Faced with a mounting balance of payments deficit caused primarily by the world increase in petroleum prices, the government of Jamaica took action that is designed to increase revenues from the six North American aluminum firms operating in the country from about $25 million per year to about $220 million, after rejecting industry offers that would have generated $80 million annually. The royalty rate on Jamaican bauxite was raised from $2.25 to $11.12 per ton (Jamaican dollars) and income tax payments were made dependent on the price of aluminum ingots in the United States. A minimum production level for tax purposes was also established in the Jamaican legislation.

Following quickly on the heels of Jamaica's six-fold increase in taxes and royalties were events in other Caribbean bauxite-exporting countries. Negotiations between the Dominican Republic and the Aluminum Company of

America (Alcoa), the only aluminum company with bauxite mines in that country, were discontinued on July 8, 1974, and unilateral action similar to that taken by Jamaica is a possibility. Although a tax bill has passed the lower house of the Dominican legislature, it may not pass the Senate or be signed by President Joaquin Balaguer, who has fostered economic growth by attracting foreign investment. The government of Surinam, the second largest supplier of bauxite to the United States, is reportedly also seeking an increased royalty on its bauxite exports.

Having nationalized the much larger Alcan Aluminum operations in July 1971, the government of Guyana, on July 14, 1974, announced its intention to nationalize Reynolds Aluminum's bauxite mines by the end of the calendar year. Guyana had previously announced its intention to follow Jamaica's lead in raising taxes on exported bauxite through a formula based on the price of refined aluminum in the United States.

The actions taken by Jamaica, Guyana and the Dominican Republic within the last two months can probably best be read as part of a comprehensive plan to gain greater benefits from and exert greater control over their natural resource supplies. The under-developed exporting countries seek to secure a direct financial interest in the foreign subsidiaries of U.S. firms, and nationalization should be considered a future possibility. Jamaica has already indicated its interest in regaining the bauxite deposits on lands now owned by foreign aluminum producers.

Recognizing the greater revenues to be earned, the bauxite producing countries are also pressing for more local processing. Unlike some minerals whose mining costs are a large share of total costs, bauxite ore delivered to an alumina plant represents only about 15 percent of the cost of the finished product, while processing costs, from bauxite to alumina and from alumina to aluminum account for 18 and 67 percent respectively. In some cases, aluminum itself will be produced in the bauxite producing country while in other cases bauxite will be processed into alumina and then transported. Unless there is a shift toward utilization of nonbauxite domestic ores, the proportion of aluminum and alumina imports is likely to increase relative to the much lower-valued bauxite, thus exacerbating the U.S. balance of payments problems. In an effort to reduce their dependence on foreign aluminum companies, Jamaica, Guyana and Trinidad in June 1974 announced plans for building and operating jointly two aluminum smelters, each with a production capacity of 200,000 tons of aluminum per year.

In a related development that has contributed to the intensified look at the domestic sources of alumina, the principal bauxite exporting countries--Jamaica, Guinea, Australia, Guyana, Surinam, Sierra Leone and Yugoslavia--have recently banded together to form the International Bauxite Association. With the success of the Organization of Petroleum Exporting Countries as the background, some observers fear that I.B.A. members will cut back bauxite production or further raise prices jointly in order to maximize the benefits from their strategic bauxite resources. However, the chances of a successful bauxite cartel along the lines of OPEC's Fall 1973 action are not considered too great because of the exporting countries' lack of monetary reserves and the substitutability of other materials for aluminum and other raw materials for bauxite.

In the face of more expensive and perhaps uncertain bauxite supplies, the United States is expected to meet an increasing demand for aluminum, already the world's fastest-growing nonferrous metal (annual growth rate for 1950 to 1970 of 9.9 percent). An average annual growth rate of 6.5 percent is predicted for 1970-2000, with a 7.2 percent growth rate in the United States expected until 1985.

DOMESTIC ALUMINOUS RESOURCES

The net impact of these recent developments is to make the recovery of alumina from domestic aluminous raw materials more attractive in relation to continued reliance on higher-priced imports. Until the imposition of the new Jamaican tax, the domestic alternatives were not considered economically competitive with producing alumina from imported bauxite. Now, numerous industry and Government officials state that the price of producing a ton of alumina from imported bauxite is approaching, if not equal to, the cost of recovering a ton of alumina from one of the more promising domestic alternatives, such as high-alumina kaolin clay. As the price of bauxite imports has increased, the technology to win alumina from domestic sources has been further developed, closing the processing-costs gap. Specific cost information is not available since, with the exception of the Soviet Union, no country has used anything other than bauxite as a commercial source of alumina, and the aluminum companies are not inclined to release much data resulting from their laboratory and pilot plant work on nonbauxite domestic alumina sources. Although the aluminum producers will not release a specific figure, industry observers indicate that the cost of producing alumina

MAJOR POTENTIAL DOMESTIC SOURCES OF ALUMINUM

(data in million short tons)

SOURCE	QUANTITY	ALUMINA CONTENT QUANTITY	ALUMINA CONTENT PERCENT
Alunite	800	120	15 1/
Anorthosite	599,490	158,342	27
Clays			
Ball	813	243	30
Bauxitic	297	125	42
Fire	8,276	2,275	27
Kaolin	3,288	1,076	33
Dawsonite	27,000	9,500	35 2/
Laterite	1,313	384	29
Aluminum Phosphate Rock	800	164	13
Aluminous Shale	810	229	28
Saprolite			25

1/ Deposits contain 40 percent alunite which is 37 percent alumina.

2/ Deposits contain 12 percent dawsonite which is 35 percent acid-extractable alumina.

Source: U.S. Bureau of Mines data.

from either Jamaican bauxite or domestic kaolin clay is probably about $90 per ton today.

High-alumina clay, anorthosite, alunite, dawsonite, aluminous shales, coal wastes and ashes, mineral waste solutions, low-grade bauxite, aluminous phosphate rocks, and saprolite are the commonly cited domestic alternatives to bauxite. Varying in grade, alumina content, concentration and quantity, these aluminous materials have been subjected to various degrees of examination to determine their economic feasibility as commercial sources of alumina. High-alumina clays, anorthosite and alunite are generally considered the leading potential commercial sources of alumina. Each is readily available in the United States and none present serious technological problems.

The Soviet Union, which recovers alumina from alunite and from the igneous rock, nepheline syenite, is the only country currently using a non-bauxitic ore for alumina production. Mexico and Poland reportedly have facilities under construction to produce alumina from alunite and clay respectively. During World War II, a number of countries turned to nonbauxitic indigenous sources to obtain aluminum, but in the absence of wartime conditions, bauxite returned as the most economic aluminum source. Threatened with a possible cut-off of bauxite shipments from the Caribbean, the United States operated four experimental plants to extract alumina from domestic nonbauxitic sources. Two plants, one in Harleyville, South Carolina, and the other in Salem, Oregon, processed clay into alumina. Anorthosite was tested at a facility in Laramie, Wyoming, and alunite was processed at Salt

Lake City, Utah. Germany recovered alumina from clay and Japan used alunite, clay, and aluminous shales for alumina production during the War.

High Alumina Clays

High-alumina clays have for some time been considered as the leading domestic alternative to bauxite as a source of alumina. The U.S. Geological Survey, the Bureau of Mines and private industry have all engaged in work evaluating the Nation's clay resources and the feasibility of winning alumina from clay. At the present time, it is generally agreed that clay offers the most favorable economics as an alternative to bauxite and may now be competitive with Jamaican bauxite. There are, however, no known immediate plans to build a commercial plant to recover alumina from clay in the United States.

After studying the potential of various aluminous materials, the National Materials Advisory Board (NMAB), in a 1970 study, concluded that an acid process treatment of clay was the most promising domestic alternative to bauxite for the economic production of alumina. The Board found that there were sufficient data to assert that the acid processes for treating high-alumina clays were more economical than alkaline techniques and were more competitive with the Bayer process of treating bauxite than any other method. The NMAB report recommended that the Bureau of Mines, with financial help and cooperation from domestic aluminum producers, build and operate two pilot plants, each capable of producing one to five tons of alumina daily. One plant would use a hydrochloric acid process of extracting alumina from

POTENTIAL CLAY SOURCES OF ALUMINUM IN THE UNITED STATES

(data in million short tons)

Type	State	Crude	Alumina	Alumina Content (percent)
BALL CLAY		813	243	30
	Kentucky	630	189	30
	Tennessee	135	41	30
	Texas	48	13	27
BAUXITIC CLAY		297	125	42
	Arkansas	270	113	42
	Georgia	27	12	44
FIRE CLAY		8,276	2,275	27
	Ohio	4,150	1,038	25
	W. Virginia	1,500	390	26
	Missouri	565	198	35
	New Jersey	540	189	35
	Illinois	331	106	32
	Kentucky	280	95	34
	California	320	90	28
	Pennsylvania	272	87	32
	Others	318	82	
KAOLIN		3,288	1,076	33
	Georgia	1,025	400	39
	Arkansas	545	169	31
	Oregon	518	145	28
	Texas	212	70	33
	Oklahoma	300	75	25
	South Carolina	150	51	34
	Others	538	166	32
TOTAL CLAYS		12,674	3,719	

Source: Potential Sources of Aluminum, U.S. Bureau of Mines Information Circular 8335, 1967.

clay while the other would employ a nitric acid process. While many different techniques have been investigated, nitric and hydrochloric acid extraction processes are considered the most attractive techniques to recover alumina from clay resources. This recommendation has largely been accepted by the Bureau, which is currently operating a miniplant testing these and other methods of producing alumina from clay and other domestic sources. (See page 48 for discussion of U.S. Bureau of Mines Miniplant Program.)

The U.S. Bureau of Mines has been engaged in research to find an economical means to use clay for alumina for a number of years. As indicated previously, when imports of high-grade Caribbean bauxite were threatened by enemy submarines, the Bureau operated two pilot plants utilizing clay as a raw material source for aluminum. In the past 15 years, the Bureau has investigated producing alumina from clay by a number of different processes. While the technical feasibility of these processes has been demonstrated on a small scale, it has not yet been determined if economies of scale and technological improvements will permit the economic production of alumina from clay.

Industry has also been active in research to evaluate the domestic alternatives to bauxite and has rated high-alumina clays favorably. Although industry officials generally share the view that high-alumina clays are the most economical domestic source at present and may now be competitive with Jamaican-taxed bauxite, there is still a less than firm conviction that clay is the best domestic source to develop and no indication that the industry is now prepared to make the large capital investments necessary to produce alumina commercially from clay in the near future.

The designation of clay as the leading domestic alternative to bauxite is due to its high-alumina content relative to other domestic aluminous materials, availability and relatively low mining and processing costs. The Bureau of Mines surveyed the four principal types of aluminous clays and in 1967 reported that there were approximately 12.7 billion short tons of aluminous clays in the United States, with an estimated alumina content of 3.7 billion tons. Most of these were fire clays (8.3 billion tons, with an average alumina content of 27 percent), followed by 3.3 billion tons of kaolin clay with an average alumina content of 33 percent, 813 million tons of ball clay with a 30 percent alumina content, and 297 million tons of bauxitic clay with a 42 percent alumina content. The total quantities of aluminous clay in the United States are higher than these figures indicate, as the Bureau of Mines survey was limited to aluminous deposits having at least 3 million tons contained alumina and whose alumina content was at least 25 percent.

The classification of "high-alumina" clays usually is meant in an economic sense--clays that can be considered as an economic source of alumina. The most significant factor is the percentage of alumina contained in the clay, with a 30 percent alumina content the usual cut-off. Some clays with an alumina content of over 30 percent will not be included due to other factors such as an abnormally high silicate content or occurrence at an excessive depth. High-alumina clays occur in many parts of the United States, and are difficult to appraise definitively because few deposits have been investigated sufficiently. Not all high-alumina clay occurs in places where it can be mined cheaply. Low and moderate grade clay (20-30 percent alumina content) is in abundant supply, but the low alumina content reduces its value as a potential aluminum source.

Although there are considerable deposits of high-alumina clay in the United States, many of the larger and easily mined clay deposits are owned by companies using high alumina clays for paper coater, paper filler, ceramics, and refractories. Since the value that can be obtained for high-alumina clay going for these purposes often exceeds their value as a source of alumina for aluminum production, these clay deposits can not really be considered as potential raw material sources for aluminum. Other factors affecting the availability of clay as a substitute for bauxite include the concentration of deposits and their location in relation to transportation facilities.

Kaolin clay, located in many parts of the country, is the material most likely to be utilized as a substitute for bauxite in aluminum production. Approximately 1.3 billion tons of the higher-grade kaolin is located in Georgia and South Carolina and has been investigated by industry as a possible alumina source. The Anaconda Aluminum company owns kaolin clay deposits in Georgia having an alumina content ranging from 33 to 38 percent. In a joint program conducted with Kaiser Aluminum in the 1960's, Anaconda tested kaolin clay in a five-ton-per-day pilot plant in Anaconda, Montana, utilizing a hydrochloric acid processing technique. Anaconda also owns clay deposits in Latah County, Idaho, but these do not offer as favorable economics since the alumina content is only 20-24 percent and iron content is high. Reynolds Aluminum, the third largest producer in the United States, has also done considerable research and testing with kaolin clays.

The kaolin clay found in Georgia has the most potential for use in aluminum metal production, and is estimated to contain 1 billion tons with an average aluminum content of 39 percent. Most of the kaolin clays are recoverable by relatively inexpensive mining techniques as their overburden is not very deep.

The most extensive clay resource meeting the Bureau of Mines survey criteria, fire clay, is by definition clay generally used for refractories. Usually found underlying coal seams, it may be kaolin clay, ball clay or shale. The principal supplies of fire clay are in Ohio where 4.15 billion tons of fire clay with 1 billion tons of alumina (average alumina content 25 percent) cover an area of more than 17,000 square miles. Missouri has 565 million tons of fire clay with a 35 percent average alumina content in the east-central area of the State. West Virginia has 1.5 billion tons averaging 26 percent alumina, but most deposits are deeply buried. There are also sizeable deposits of high-alumina fire clay in New Jersey, but most of these are not available for mining.

Bauxitic clays are associated with the bauxite deposits in Georgia and Arkansas where 90 percent of the country's commercial bauxite is mined. Although not relatively extensive in quantity, the 297 million short tons of bauxitic clay surveyed by the Bureau of Mines were important in that their alumina content averaged in the 42-44 percent range. In many cases, bauxitic clay has a higher alumina content than the lower-grade ferruginous and lateritic bauxites found in other parts of the country.

The Bureau of Mines found 813 million short tons of ball clay containing 243 million tons of alumina (30 percent average alumina content) in its 1967 survey. Most of these depostis were located in the southwestern corner of Kentucky, but additional ball clay meeting survey requirements was located in Texas and Tennessee. Ball clay is currently mined for whiteware, floor and wall tile, and refractories. Although ball clays consist primarily of kaolinite, they have a higher silica-to-alumina ratio and larger quantities of mineral impurities than those found in kaolin clay.

The National Materials Advisory Board in its 1970 report listed the operating cost of producing a ton of alumina from bauxite by the Bayer process at $47; the costs of using the nitric and hydrochloric acid processes for winning alumina from clay were put at $58 and $63 per ton respectively. Since these figures were calculated, the costs of all these processes has increased, but technological refinements in the clay processing techniques have caused a narrowing of the gap. Three steps are involved in the acid processing of winning alumina from clay: (1) separation of dissolved iron and aluminum salts; (2) recovery of the acid; and (3) crystallization of an aluminum salt of sufficient purity to yield reduction-grade alumina.

A novel approach to recovery of alumina from kaolin clay is being developed by Charles Toth, a former Chrysler Corporation engineer who originated his clay-to-alumina technique in his garage. Patented in 1967 (US 3,615,359), the Toth process is based on the chlorination of kaolin clay, followed by a reduction of the resultant aluminum trichloride by manganese metal. The process offers a number of potential significant advantages over the present process of producing alumina by the Bayer method and producing aluminum through the Hall technique, in that it is said to reduce the energy requirements of the energy-intensive Bayer-Hall process by 90 percent and

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alleviate the red-mud pollution problems associated with the traditional process. Furthermore, according to the New Orleans-based Totn Aluminum Corporation, the Toth process cuts production costs in half and reduces the capital expenditures for constructing an aluminum plant by as much as 75 percent.

At present, the Toth process is still in the research development stage. The company plans to spend $4 to $5 million extending over a 1 1/2-2-year period for research purposes, and then build a pilot plant. Expected to be completed sometime around January 1977, the pilot plant is estimated to cost $22-24 million (in 1972 dollars) to build and operate for six months. Having concurrently worked on the design of a commercial plant, the company hopes to have a commercial plant built in two to three years after pilot plant operations are completed and begin commercial operation after a three-month start-up period. All told, if operations go according to plan, Toth Aluminum expects to have a commercial plant using clay as the raw material source within six to eight years.

The Toth Corporation's plans are based on building a commercial plant in the United States, but the company has indicated that its inability to date to secure necessary financing in the United States, coupled with the receptiveness of foreign governments, may prompt the company to go overseas. Mr. Toth at first attempted to sell his technology to American aluminum producers, but was unable to find a buyer. Industry reaction to the Toth process ranges from those who do not doubt the basic chemistry of the process but question its commercial application, to those who consider it nonsense. Skeptics point to a number of substantial changes in the Toth process since the patent was obtained as evidence of its impracticability. At a press conference in London in July 1973, the Company announced plans to build a $25 million, 100 tpd semi-commercial Toth plant in Europe which would be in operation by the spring of 1975. The Hungarian, East German, and Austrian governments were reportedly interested in having the plant built within their countries and a plant site was to be selected within 60 to 90 days, but this plan has not materialized.

Anorthosite

In terms of quantity, anorthosite, a soda-lime feldspar igneous rock, represents the principal domestic source of alumina. Anorthosite deposits were estimated to comprise nearly 599.5 billion short tons of total potential aluminum resources of 615 billion tons, according to the 1967 Bureau of Mines survey of domestic aluminous materials. Its uniform composition and abundance make anorthosite a leading domestic alternative to bauxite for alumina recovery.

The Aluminum Company of America (Alcoa), the world's largest producer of aluminum, has led the industry in attempting to develop anorthosite as an alumina source. In 1972 Alcoa purchased 8,000 acres of Wyoming land containing large anorthosite deposits, at a cost exceeding $1 million. The Company has engaged in laboratory work and conducted pilot plant operations using anorthosite for the past six to eight months in East St. Louis, Illinois. In light of the bauxite import situation, Alcoa's anorthosite work is likely to be accelerated and an announcement in the near future that a commercial anorthosite processing facility will be constructed would not be unlikely.

A lime-soda sinter process of extracting alumina has been extensively tested andis considered the most feasible technique to recover alumina from anorthosite. Although the lime-soda technique was found preferable to other more expensive or less productive methods, the 1970 National Materials Advisory Board report said that high processing costs associated with the present technology made anorthosite an economically infeasible source of alumina at that time. Because it is a hard rock, anorthosite would be relatively expensive to mine and process. Production of alumina from anorthosite utilizing the lime-soda treatment is more costly and energy-intensive than the extraction of alumina from high-alumina clays, which is itself an energy-intensive process. The Defense Plant Corporation began construction of a 50-ton-per-day facility near Laramie, Wyoming in 1945 to recover alumina from anorthosite. With the termination of World War II and the availability of Caribbean bauxite, the original plans for this plant were abandoned, but the Bureau of Mines did operate the plant for a short period in the early 1950's, using the lime-soda sinter process.

In addition to the deposits in the Laramie Range, Wyoming, vast quantities of anorthosite are present over 1,200 square miles in the Adirondack Mountain region of northeastern New York and along 82 square miles in the central part of the San Gabriel Mountains in Los Angeles County, California. The alumina content of anorthosite averages 27 percent, according to the 1967 Bureau of Mines report. It can be considered a virtually inexhaustible source of alumina.

POTENTIAL ANORTHOSITE SOURCES OF ALUMINUM IN THE UNITED STATES

(data in million short tons)

STATE	REGION	CRUDE	ALUMINA	ALUMINA CONTENT (percent)
NEW YORK	Adirondack Mountains	392,260	102,000	26
WYOMING	Laramie Range	153,800	41,520	27
CALIFORNIA	San Gabriel Mountains	35,000	9,450	27
IDAHO	Shoshone, Clearwater Ctys	8,700	2,520	29
MONTANA	Stillwater Complex	6,200	1,860	30
OKLAHOMA	Wichita Mountains	3,000	840	28
MINNESOTA	Lake, Cook Counties	300	90	30
PENNSYLVANIA	Chester County	230	62	27
	TOTAL:	599,490	158,342	27

Source: Potential Sources of Aluminum, U.S. Bureau of Mines, Information Circular 8335, 1967

Alunite

Although it has been the most recent domestic alternative to bauxite to be considered seriously, alunite may well be the first nonbauxitic raw material to be used for the commercial production of aluminum. In a joint venture, Earth Sciences, Inc., the National Steel Corporation and its aluminum affiliate, Southwire Company, have been operating a $1 million alunite reduction pilot plant in Golden City, Colorado and anticipate having a commercial plant on stream by 1978.

For many years, alunite was not considered an economically feasible domestic source of alumina. The 1970 National Materials Advisory Board report states that "alunite has little potential for being a major raw material of aluminum in this country because all known deposits are either small and scattered or have the mineral disseminated through volcanic rock." An experimental plant had been constructed by the Defense Plant Corporation at Salt Lake City during World War II and about 37,000 tons of alunite were mined for testing purposes, but the project was terminated shortly after the War. The Soviet Union has been producing alumina from alunite at a plant in Kirovabad in the Azerbaijan Republic since the mid-1960's, and Mexico is reportedly building a commercial plant at Salamanca, Mexico, using a process developed at the University of Guanajuato, Mexico.

The catalyst for American development of alunite was the discovery of large alunite deposits near Cedar City, Utah, in 1970 by Earth Sciences, Inc., geologists, primarily Colorado School of Mines graduates. The principal deposits owned by Earth Sciences and its partner, National-Southwire

Aluminum Co., are estimated at 680 million tons of alunite-bearing rock containing 100 million tons of alumina. These deposits contain 40 percent alunite which has a 37 percent alumina content. The group also controls a number of other alunite-bearing properties and is investigating others.

The Earth Sciences/National-Southwire group began pilot plant operations in January 1974 and has encountered no major technological problems, according to a company representative. Although the Company has worked toward developing its own technology, National-Southwire has also negotiated an agreement with the Soviet Union to purchase Soviet alunite processing technology. In addition to receiving Soviet technical data, National-Southwire Co. personnel are to study the alunite reduction process at the Kirovabad plant and at the Soviet Union's National Aluminum and Magnesium Institute. Three Soviet representatives are to work with National-Southwire in the United States, beginning in two to three months. Pilot plant operations and a feasibility study of operating a commercial plant are to be completed by the end of 1974 with construction of a $230 million commercial plant begun shortly thereafter.

National-Southwire officials feel that alumina can be produced from alunite "at a very competitive price," regardless of the new Jamaican bauxite tax because of potential byproduct recovery. For each 500,000 tons of alumina produced, 250,000 tons of potassium sulfate and 520,000 tons of either triple superphosphate (TSP) fertilizer, diammonium phosphate (DAP), or monophosphate will be generated. The proposed commercial plant will be built near Cedar City, Utah. The Earth Sciences/National-Southwire group plans to either build its own aluminum smelter near there or ship the alumina to another aluminum firm's smelter in the Pacific Northwest in exchange for alumina available in the Southwest. National-Southwire currently owns and operates a 180,000-ton-per-year aluminum smelter in Hawesville, Kentucky.

The key to whether alunite will be utilized successfully as a commercial source of alumina may well hinge on the marketability of the byproducts recovered. At present, fertilizer products are in short supply, but fertilizer demand may not be as strong by the time large quantities of either TAP or DAP are generated through alunite processing.

Dawsonite

Dawsonite, a colorless or white acid-soluble mineral, has been prominently mentioned as a potential commercial source of alumina because of its occurrence among the sodium mineral deposits associated with Colorado, Utah and Wyoming oil shales. Since shale oil and nahcolite could be recovered concurrently, alumina recovery from dawsonite is said to have promising economic potential. The National Materials Advisory Board singled out dawsonite as a potential economic source of alumina in its 1970 evaluation of processes for extracting alumina from nonbauxite ores, and recommended that the Bureau of Mines expand its research to determine the feasibility of utilizing dawsonite for alumina production.

Potentially large deposits of sodium minerals, including dawsonite, have been discovered in association with deep oil shales of the Green River formation in the western United States, principally in the Piceance Creek Basin of northwestern Colorado. A Department of the Interior survey of 150,000 acres of the sodium-minerals-rich oil shales portion of the Piceance Creek Basin showed approximately 27 billion tons of dawsonite with an alumina content of 9.5 billion tons and 30 billion tons of nahcolite, which could be used as soda ash or in flue-gas treatment for control of stack gas emissions. The oil recovery from these shales is estimated at 30-35 gallons per ton. The typical composition of a dawsonite-bearing rock has been estimated in terms of average weight as follows: dawsonite--12 percent; nahcolite--20 percent; oil shale kerogen--15 percent; potash feldspar--12 percent; dolomite--14 percent; calcite--3 percent; silica--24 percent. The dawsonite content may range from 0-20 percent, the nahcolite content from 0-90 per cent and oil shale kerogen content from 10-30 percent. It is possible to select certain mineable zones to obtain a desired content mix since these minerals are more concentrated there.

The development of dawsonite as a commercial substitute for bauxite is dependent upon the development of an oil shale industry in the United States. If western oil shales are not developed as an energy source, dawsonite definitely could not be considered as an economical source of alumina. Also, if oil shale is retorted in situ, using fracturing techniques, such as through nuclear detonation, dawsonite would probably not be recovered since much of the alumina values inherent in the oil shale would be lost.

Most of the dawsonite-bearing area is held by the Federal Government and has been withdrawn from minerals disposition for the time being. However, dawsonite deposits of commercial significance are located on property owned by the Superior Oil Company and on one tract, known as C-b, which has been leased to a consortium of oil companies (Arco, Tosco, Ashland and Shell) through the Department of the Interior's prototype land-leasing program. Commercial development of dawsonite as an alumina source is being seriously considered as a byproduct of shale oil recovery by these companies. At the present time, both companies are conducting evaluations to determine the optimum manner to develop their shale properties. Since the dawsonite on the Superior Oil Company property occurs in part in an outcrop where it could be more easily mined, there is probably at least an even chance that Superior will attempt to recover alumina from dawsonite commercially. The likelihood of the Tosco consortium's recovery of alumina from dawsonite is probably somewhat less than 50/50, according to an expert who has been following development of the Piceance Creek oil shales. If the decision is made to produce alumina from dawsonite concurrent with recovery of oil from shale, the oil shale companies believe they can do so within five to seven years.

Whether it is profitable to recover dawsonite and in some areas nahcolite from oil shale will largely be a question of the quantity and depth of these minerals in the shale. The availability of the substantial water resources needed for processing, and the market value of the recovered products when commerical plants would be operating, are very important factors to be considered in determining the economic feasibility of mining dawsonite and nahcolite. Where the alumina and sodium content offer sufficient economic incentive, dawsonite and nahcolite recovery will be attempted.

Because the ores that will be mined do not contain sufficient quantities of dawsonite and nahcolite to justify their recovery, most of the early oil shale plants will be limited to oil production. The TOSCO consortium which is one of the most advanced in terms of oil shale processing technology, for example, is likely to recover shale oil from the upper or "mahogany" zone in its oil shale tract without recovering dawsonite which is predominantly located in a lower zone. If the company should decide to attempt dawsonite recovery, it would probably do so at a later date.

The oil shale concerns that are considering dawsonite recovery have engaged in laboratory and bench-scale pilot plant work with respect to recovering alumina from dawsonite, but have not attempted a full-scale pilot plant operation to date. The major aluminum producers have given some attention to dawsonite as an alumina source, but do not rate it favorably relative to such bauxite substitutes as kaolin clay or anorthosite. Likewise, U.S. Bureau of Mines and Geological Survey officials who have considered the various domestic sources of alumina, do not feel that dawsonite is a leading alternative to bauxite imports. In contrast to the oil shale companies which envision commercial production of alumina from dawsonite about 1980, these officials do not foresee full-scale commercial plants for another 15 to 20 years, if at all.

Aluminous Phosphate Rock

Although it does offer potential byproduct recovery, aluminous phosphate rock, containing a number of desirable minerals, is not considered an economical source of alumina at present. Extending over several hundred miles in a belt stretching from west-central peninsular Florida northward into southern Georgia, aluminum phosphate rock is estimated to total 800 million tons with an alumina content ranging from four to twenty percent. Part of this domestic resource has been lost in mining phosphate ore. The largest and best known aluminum phosphate deposits are located in a region east of Tampa Bay, Florida.

The aluminous phosphate materials are found in a leached or transitional zone between the surface and phosphate ore deposits. Along with the surface layer, the aluminous materials in the leached zone are now discarded when the underlying calcium phosphate is strip-mined. In order for alumina recovery from the aluminous phosphate rocks to have any economic potential, both phosphate and alumina would have to be recovered from the leached zone. Even with concurrent recovery of phosphate and alumina, the National Materials Advisory Board reported that extraction of alumina from phosphate rock would not be feasible.

Aluminum phosphate rock would be a more economic source of alumina if, in addition to alumina and phosphate, the small quantities of uranium and cement ingredients also found in the leached zone could be profitably recovered. The technology to recover alumina, phosphate, uranium and other materials occurring in the phosphate rock is not well developed since interest in their recovery waned in the late 1940's and early 1950's when the discovery of richer uranium ores caused uranium prices to decline. Consequently, even though the aluminum phosphate rock deposits are easily mined, no commercial extraction of alumina, phosphate or uranium has yet been attempted.

Aluminous Shales

Aluminous shales, typically a hardened laminated clay or mixture of silt and clay, represent an immense domestic source of alumina. Aluminous shales occur throughout the United States, but their alumina content, generally 20-24 percent, is usually considered insufficient to permit the economic recovery of alumina. The 1967 Bureau of Mines survey of potential aluminous sources found vast supplies of aluminous shale in many States, but only Missouri and Washington were found to have shale with an alumina content averaging over 25 percent.

Although shales are not used as a commercial source of alumina today, Japan recovered alumina from shale during World War II. In the United States, the North American Coal Corporation built and operated a pilot plant at Powhatan Point, Ohio, in 1962-63 to recover alumina from shale, but alumina recovery was unprofitable and the project was discontinued. The material used in the pilot plant was shaly roof stone above the Pittsburgh coal bed and was believed to have an alumina content of 20-22 percent. Since aluminous shales are also abundant in Canada, the Canada Department of Mines and Technical Surveys has also engaged in some work to evaluate the possibility of developing shales as a commercial source of alumina.

The National Materials Advisory Board felt that most shales would be too low in alumina content to allow profitable extraction of alumina, but indicated that some shales might offer real potential and deserve more attention as an aluminum source. The aluminous shales found in the United States and Canada vary in content according to geography. Exploration may reveal shale resources with a sufficiently high alumina content to make this source one of the more attractive alternatives to bauxite. At the present time, aluminous shales would be a fairly cheap raw material to obtain, as large tonnages are removed in the surface mining of coal and clay. In addition, the U. S. Geological Survey has reported that large shale deposits are favorably located with respect to transportation facilities, power and markets--a factor which tends to improve the economic feasibility of recovering alumina from shale.

Low-Grade Bauxite

Low-grade bauxite refers to those bauxite ores whose content is such that alumina cannot be profitably extracted from them. A low alumina content, inclusion of materials deleterious to alumina extraction or high mining costs are the usual reasons for the "low-grade" classification. With the recent increase in the cost of imported bauxite, it may now be economically feasible to utilize some domestic resources of low-grade bauxite in aluminum production. The processing of low-grade bauxite, also known as laterite, is usually identical to that used for commercial-scale bauxite, except that more raw materials are needed and larger quantities of residue are generated in the production of a given amount of alumina.

The U. S. Geological Survey estimates the total supply of low-grade bauxite in the United States at 300 million long tons with an alumina content averaging about 35 percent. These resources are located principally in three areas: (1) near the Arkansas commercial-grade deposits; (2) along an 80-mile stretch of border between Oregon and Washington; and (3) on the islands of Kauai, Maui, and Hawaii, in the State of Hawaii. Additional low-grade bauxite deposits are located in Georgia and Alabama. Arkansas low-grade bauxite either occurs in beds that are too thin or too deeply buried to be profitably mined, or is excessively high in iron and silica content. The ferruginous bauxite found in Washington, Oregon and Hawaii is high in iron and titanium. Some of these aluminous resources can not really be considered as sources of alumina because the lands on which the deposits are located are being utilized for more highly valued purposes. The alumina contained in the Nation's supply of low-grade bauxite is probably about 100 million tons.

Reynolds Metals Company, the second largest U. S. aluminum producer, has mined 50,000 tons of Washington and Oregon laterite ores and demonstrated on a small scale the feasibility of using this material as an aluminum source. Reynolds is now developing a modification of the Bayer process to use these ores commercially. While low-grade bauxite may now be an economic source of alumina, the domestic supply of low-grade bauxite is not sufficient to be a long-term source of aluminum that could satisfy continuously rising demand.

Coal Ash and Coal Wastes

The 50 million tons of coal ashes generated annually in the United States from the burning of coal have received increased attention in recent years as a possible aluminum source. A study of 373 coal ash samples, reported by the National Materials Advisory Board, showed alumina content ranging from 8 to 41.6 percent. Ashes from bituminous coal, the principal coal burnt in the U.S., have an alumina content of 25-35 percent, but lower-grade lignite ashes were found to have only an 18-19 percent alumina content.

A lack of sufficient quantities of coal ashes produced at one locality has been cited as the primary obstacle to the economic utilization of coal ashes as a source of alumina. Specific data showing the location and quantities of alumina-bearing coal ash is not available, making an economic evaluation of this source difficult. As the Nation requires greater amounts of coal and turns more toward low-sulfur western coal to meet energy and environmental quality requirements, more alumina-bearing coal ashes will be produced, so the economics of alumina recovery from this source may improve. American Metals Climax, one of the Nation's largest mining companies, has been examining ways to extract aluminum from coal ashes.

The Aluminum Company of America has done substantial work investigating coal waste piles, called culm, as a source of alumina. In a February 1974 interview, Alcoa President W.H. Krome George was quoted as saying that "the very preliminary figures from coal waste look very attractive as opposed to new bauxite." The Company has engaged in complete bench-scale processing of culm, with a 25-28 percent alumuna content, and plans to begin pilot plant operations using this alumina source in the near future. While Alcoa is currently further advanced in its research and development of anorthosite as a commercial substitute for bauxite, the Company may also develop coal waste as a commercial alumina source. Alumina production from culm might reasonably be expected within six to eight years.

A factor working against the economic recovery of alumina from coal waste is the presence of sulfates which complicate processing and reduce alumina yield.

Copper Leach Solutions

Copper has long been recovered from waste dumps and other low-grade ores through an acid-leaching process. In recent years, the possibility of also recovering alumina and other materials from copper leach solutions and perhaps other mineral processing waste solutions has received some attention.

A 1968 Bureau of Mines research project indicated that significant tonnages of alumina were available in mineral processing wastes and were a good potential source of alumina. Approximately 2,000 tons of alumina have been estimated to be available per day at 14 U.S. copper mines, and several mines may be able to produce 300 to 1,000 tpd, according to Bureau research. The technology to recover alumina from copper leach solutions is readily available, since most of the chemistry is identical to the treatment methods used to win alumina from clay. The National Materials Advisory Board reported in 1970 that "apparently, the extraction of aluminum from copper-leach solutions is an established fact, and the aluminum content of these solutions could be removed by several methods that have been studied in other contests." The Kennecott Copper Company has been active in this area, having obtained two processing patents and operated a pilot plant to determine the rate of recovery of various materials from copper waste leaching solutions.

Because the technology exists to recover alumina from this source and front-end operating costs (e.g., mining, crushing, calcining, grinding, leaching, filtration and evaporating) and the capital expenditures associated with these operations would be eliminated, researchers felt that recovery of alumina from copper waste solutions might be economically competitive with producing alumina from bauxite through the Bayer process, before the recent round of bauxite price increases. The economics could be further improved through the recovery of such byproducts as uranium, yttrium and a number of rare-earth elements. While the recovery of alumina and other materials from copper waste processing solutions may prove economic, the National Materials Advisory Board pointed out that this alumina source does not represent a potentially large source of supply.

Saprolite

Despite its relatively high alumina content, ample supply and susceptivity to strip mining, saprolite is not considered a promising economic domestic alternative to bauxite. The fine-grained texture and heterogeneous composition of saprolite, a soft, weathered rock, make processing inordinately costly.

Some saprolite samples examined by the U.S. Geological Survey showed an alumina content of 25-36 percent, but this figure is considered high for most saprolite deposits. Saprolite occurs in large quantities in a number of places in the United States, with the major deposits in the Piedmont region of the southeastern States. Subsidiary companies of Alcoa and Reynolds

Aluminum investigated some Piedmont saprolite deposits in the late 1950's, but evidently did not find saprolite an attractive source of alumina as no further efforts were initiated to develop saprolite as a domestic alumina source. A small company, Gibbsite Company of America, was formed in 1970 and leased large acreages of saprolite-bearing property, ostensibly to recover alumina, but the company has apparently not taken any steps to recover saprolite.

Aluminum Scrap

Although aluminum scrap does not have the potential to be a major source of new aluminum, increased recycling of aluminum scrap could ease the demand for raw aluminous materials and result in substantial energy savings. Production of aluminum from alumina is an extremely energy-intensive process, consuming some 15,000-17,000 kilowatt hours per ton of aluminum. The principal operation in recycling scrap is melting which requires less than five percent of the energy needed in the electrolytic reduction of alumina to aluminum.

The extent to which aluminum scrap is recycled is a matter of economics. Unlike some secondary materials, aluminum scrap is in many circumstances a more economic source of supply than virgin ore. The investment costs, power requirements, and transportation costs associated with producing aluminum from alumina are greater than for processing aluminum scrap into new aluminum. Secondary aluminum smelters, for instance, can be installed for considerably less per ton of annual capacity than primary smelters and, not requiring a cheap and abundant source of power, can be located near scrap generation and aluminum consumption centers. The favorable economics of aluminum scrap recycling has led to a steady expansion in the number of secondary smelters from 25 plants in 1941 to 90 in 1972.

The most comprehensive study of aluminum recycling was conducted by the Battelle Memorial Institute and Columbus Laboratories in 1972 as part of an Environmental Protection Agency grant. Although this study examined aluminum scrap data for 1969, its findings are indicative of the scrap situation today. The Battelle/Columbus study indicated that 2.2 million tons of old and new aluminum scrap were available in 1969 and that about 1 million tons or 48 percent of this available aluminum scrap were recycled. About 18.6 percent of the new aluminum produced in 1969 was derived from aluminum scrap, according to the study. The Bureau of Mines reported that 1.14 million short tons, or about 16 percent of the 6.97 million tons of new aluminum produced in 1973 were derived from secondary sources. New scrap accounted for 893,000 tons of secondary recovery, while some 251,000 tons of old scrap were recycled in 1973, according to the Bureau.

About eighty percent of the aluminum recycled annually is classified as new scrap. Also commonly referred to as prompt or industrial scrap, new scrap is generated in internal primary aluminum production and the fabrication of aluminum products. Because it is a clean and uncontaminated material with a known relatively homogeneous metallic content, new aluminum scrap is economical to recover and is recovered to the fullest extent possible (a recycling rate of over 90 percent) as a normal industry practice. The actual quantity of new scrap recovered annually is highe than what is reported, since only purchased scrap is counted in aluminum scrap statistics. There are no figures kept indicating the amount of home or runaround scrap that is recycled each year, i.e., scrap transferred from one operation to another within a particular company.

The potential for increased recycling of aluminum scrap lies in old scrap, also known as obsolete or post-consumer scrap. The sources of old scrap are as varied as the end products which utilize aluminum in their composition, ranging from such items as obsolete aircraft and buildings to aluminum beverage containers and other discarded household products. Of the 1,334,000 tons of old scrap estimated to be available for recycling in 1969, about 175,000 tons or 13.1 percent were recovered, according to the Battelle/Columbus study. The recycling rate for old aluminum scrap is generally believed to be about 15 percent today.

There are a number of reasons for the low recycling rate of old aluminum scrap, but the primary impediment to increased recycling is the need for separate collection or segregation of aluminum scrap from other waste materials and the isolation of specific aluminum alloys. Also, old scrap is normally generated in relatively small quantities and in widely scattered locations. Not designed with recycling in mind, most aluminum products are made of many different materials of which aluminum may represent only a small component. The aluminum itself will usually appear in a composite form as part of a particular aluminum alloy and often will be covered with paper, vinyl, paint or other coatings. The necessity of removing these coatings and separating aluminum composites makes the recycling of aluminum less economical. There is a need to develop improved, economic refining of old aluminum scrap to solve this technical barrier to increased recycling. If products were designed with recycling in mind, the technical barriers to recycling might well be lowered.

Because of its heterogeneous nature, almost all of the recycled old scrap has traditionally been channeled to secondary smelters where it is used for casting alloys. Specifications for casting alloys are generally not as demanding as for the wrought alloys produced by primary producers and aluminum fabricators. Primary producers and aluminum fabricators need "pedigreed" scrap--scrap with a known specific alloy which meets rigid specifications. Since old scrap does not meet these criteria, its market is currently limited to re-use in casting alloys. Even if greater tonnages of old scrap became more readily available, the limited market for secondary alloys could preclude their recovery unless the scrap could be segregated by alloy-type.

The recycling of aluminum soft drink and beer cans by the primary aluminum producers is a recent, small, but growing exception to the restricted usage of old aluminum scrap for casting alloys and represents one method of solving the separation problem and increasing the recycling rate. After a false start in Miami in 1967, trying to induce people to bring aluminum cans to gasoline stations in exchange for oil and gas coupons, Reynolds Aluminum Company established the prototype for the current industry reclamation program in Los Angeles in 1969, inviting individuals and organizations to bring aluminum cans and other aluminum scrap to reclamation centers where they would receive ten cents per pound of aluminum. By establishing a program to recover primarily one type of aluminum scrap, the industry is able to supply itself with scrap containing a particular, known alloy that can be easily recycled.

While the original impetus for the reclamation program may have been to ward off restrictive packaging legislation, its steady growth indicates the economic feasibility of re-using old scrap for its original purpose when the scrap is segregated by alloy type. Since Reynolds initiated the program, Kaiser Aluminum, Alcoa, Coors Brewing Co. and others have established aluminum beverage container reclamation centers. The recovery rate for aluminum beverage containers has increased from 5 percent in 1970, to 11.6 percent in 1971, to 14 percent in 1972, to 15 percent in 1973. In 1973, according to recent congressional testimony, about 1.6 billion aluminum cans (1.1 billion of which were collected and recycled by Reynolds) were recovered at 1,200 reclamation centers in 45 States, for which industry paid $6.8 million. Nearly 70 million tons of aluminum can scrap were recycled through this reclamation program. Industry's willingness to pay for relatively homogeneous old aluminum scrap was demonstrated by the May 1974 decision to increase from 10 to 15 cents per pound the price it would pay for aluminum scrap brought to reclamation centers. Reynolds has estimated that the proportion of aluminum beverage containers brought to reclamation centers may ultimately be as high as 30 percent of the aluminum cans reaching the market.

Of the six principle sources of old aluminum scrap (see table on page 44), the Battelle/Columbus study singled out containers and packaging as the most promising source from which greater amounts of old aluminum scrap could be recycled. In 1969, only 2,000 tons or 0.4 percent of the

OLD ALUMINUM SCRAP RECYCLING, 1969

Scrap Source	Estimated Aluminum Becoming Obsolete, Tons	Estimated Old Aluminum Recycled, Tons	Estimated Percent Recycled	Estimated Aluminum Not Recycled, Tons
Building and Construction	71,000	9,000	13.0	62,000
Transportation	329,000	100,000	30.0	229,000
Consumer Durables	197,000	25,000	13.0	172,000
Electrical	7,000	6,500	93.0	500
Machinery and Equipment	61,000	15,000	25.0	46,000
Containers and Packaging	486,000	2,000	0.4	484,000
Other	183,000	17,500	9.2	5,500
Totals	1,334,000	175,000*	13.1	1,159,000

* Imports are ignored because it is believed that the old scrap component of imports is not significant.

Source: Battelle Memorial Institute, Columbus Laboratories.

<u>A Study to Identify Opportunities for Increased Solid Waste Utilization</u>, Volume II: Aluminum Report, 1972.

484,000 tons of aluminum scrap eminating from containers and packaging were recycled. Furthermore, this widely disseminated scrap source has experienced the fastest growth rate, averaging nearly 16 percent per year between 1960 and 1970, of the aluminum scrap sources, is becoming a larger component of municipal solid waste and is also highly visible in litter. In addition to continuing the can reclamation programs, the Battelle/Columbus study recommended that segregation of aluminum before it becomes part of mixed municipal refuse be promoted by law or other incentives and that existing local refuse collection systems be utilized to obtain aluminum scrap.

Two other promising potential sources of recyclable old scrap cited by the Battelle/Columbus study were transportation equipment and consumer durables, from which 30 and 13 percent, respectively, of the available scrap was recycled in 1969. To recycle more of the estimated 229,000 tons of old aluminum scrap available annually from abandoned automobiles and obsolete aircraft, trucks, trailers and other transportation sources, improved collection of abandoned automobiles, better utilization of the aluminum contained in auto shredder scrap and additional research to increase recycling of other transportation scrap were recommended. The consumer durables which are currently being recycled are cooking utensils and lawn furniture. The Battelle/Columbus study recommended that more research be undertaken to learn how to recycle economically the small amounts of aluminum that are found in old refrigerators, washing machines, air conditioners and similar items.

At present, aluminum scrap is not recovered, once it becomes a component of mixed municipal waste. In its March 1974 report to Congress on

Resource Recovery, the Environmental Protection Agency stated that 800,000 tons, amounting to only 0.6 percent of the 125 million tons of post-consumer municipal waste generated in 1971, was old aluminum scrap. The sources of this aluminum scrap are primarily containers and packing and consumer durables. EPA estimated that 80,000 tons of the post-consumer aluminum scrap that would normally have entered municipal solid waste collections were recycled in 1971. Most of this recycled scrap material consisted of discarded beverage containers recovered through the industry reclamation program.

There are a number of resource recovery systems in various stages of development which will provide for aluminum recovery from mixed municipal refuse. Demonstration projects funded by the Environmental Protection Agency in Franklin, Ohio, Wilmington, Delaware, and San Diego, California, will include separation and recovery of aluminum from municipal waste. Another EPA-funded demonstration project in Lowell, Massachusetts, includes the recovery of aluminum from incinerator residue, using a technology developed by the Bureau of Mines. Additional resource recovery facilities planned for New Orleans and Ames, Iowa, will include aluminum recovery. As metropolitan centers shift from solid waste disposal to installation of resource recovery systems, aluminum will begin to be recovered from mixed municipal waste. Aluminum will not be recovered in all such systems, though, because in some localities--St. Louis is a current example--the aluminum portion of the municipal refuse will not be deemed sufficient to make recovery economical. Several practical methods of extracting aluminum from mixed municipal wastes are currently being examined to determine the most feasible technology. The techniques under consideration utilize gravity separation, electric or magnetic field separation, or chemical/thermal separation techniques. However, none of these will segregate aluminum by alloy types.

BUREAU OF MINES MINI-PLANT PROGRAM

The U.S. Bureau of Mines is now in the second year of a four-year, \$2.8 million mini-plant program to evaluate and improve the processes to recover alumina from four domestic sources--high-alumina clay, anorthosite, alunite and dawsonite. Initiated in July 1973 as a six-year, \$2.4 million effort, the program has within the past year been made a joint Government-industry project, by arrangement with eight aluminum producers who will each provide \$50,000 per year for three years. The eight aluminum producers expected to participate in the cooperative program are Alcoa, Alcan, Reynolds Metals, Kaiser Aluminum and Chemical, Anaconda Aluminum, Consolidated Aluminum, American Metals Climax and Martin Marietta. They are expected to form a joint steering committee which would review progress of the program, recommend changes and offer technical guidance.

The additional \$400,000 per year received from the aluminum industry will allow for completion of the project in 1977 rather than 1979, studies on additional clays and shales, more thorough sulfurous acid processing of clay and more thorough study of dawsonite processing alternatives. An additional \$100,000 will be expended by the Bureau of Mines for supportive engineering and cost estimating work at its College Park, Maryland, and Salt Lake City Metallurgy Research Centers.

The mini-plant operation is being conducted in six overlapping phases at the Bureau's Boulder City, Nevada, Metallurgy Research Laboratory. The plant is designed to produce 25 pounds of alumina per hour and to allow for easy switchover from one processing system to another. With industry support, the Bureau of Mines will spend $1.35 million to investigate the three leading processes to extract alumina from clay, $600,000 for anorthosite processing, $400,000 for alunite processing, and $450,000 for dawsonite processing.

The first phase of the mini-plant operation, begun in July 1973, was nitric acid processing of clay. The Bureau completed its initial clay runs in June 1974, will make additional clay runs beginning in August 1974, and will issue a report by December 1974. The second phase, hydrochloric acid processing of clay, began in July 1974 and will continue for one year. Between October 1974 and June 1976, anorthosite will be evaluated as an alumina source, using a lime-soda sinter process. The principal objective of this third phase of the mini-plant program is to eliminate the formation of a gel in the leaching circuit, which causes processing difficulties and low alumina recovery.

In the fourth phase of the program, the recovery of alumina from clay utilizing a sulfurous acid treatment will be examined. This phase is scheduled to begin in July 1975 and be completed in June 1976. The fifth phase, the recovery of alumina from alunite, will be conducted in two distinct stages. Between July and September 1974, the Bureau of Mines will study various techniques to recover alumina from alunite. The best technique will be tested at the Boulder City pilot plant between April 1976 and June 1977. Dawsonite is scheduled as the last aluminous material to be investigated, to allow more time to study processing alternatives and to gather data needed to design the mini-plant. Laboratory work is to be conducted between July and November 1976, with mini-plant operations planned for March 1976 through June 1977.

At the conclusion of the mini-plant program, the Bureau expects to have enough data to select the most economical process or processes to employ in a full-scale demonstration plant or plants. At the present time, Bureau officials envision two demonstration plants, one for processing clay and the other for recovering alumina from anorthosite. Each plant will cost about $11 million to build and $5 million to operate for two and a half years.

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