IV. FRIDAY MORNING PAPERS

Three papers were presented at this session, two prepared and one, by Mr. Vesterlund, as an ad lib contribution with manuscript supplied later. The thrust of Mr. Vesterlund's paper was the imperative need for global cooperation, with the developed nations shouldering more of the burden of technical assistance to those nations less developed.

The two prepared papers dealt with (a) some options for the management of a stockpile of materials for industrial use, and (b) an overview of national materials policy for the United States.

The session closed with a presentation by the Chairman of the main points developed during the conference.

STOCKPILING FOR THE FUTURE

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Introduction

The major advantage to one bringing up the rear in a week-long conference lies with having heard that which has already gone before. But then, there is both bad and good lurking in such intelligence. The bad is that by Friday, almost everything that can be said has already been said. It is highly probable that the audience, singly or in combination, one way or another, will have already covered the ground the Friday speaker comes prepared to present. I will confess at the outset that this is, to a great extent, my predicament this week.

But then the good is, as an old pro once told me, that when you have been preempted, you know what to watch out for, and you can make a speech out of summarizing what everyone else has said. In this way you keep out of arguments and get everyone to admire your magnificent perspicacity for observing the worth of their wonderful ideas.

So that is my strategy. First I will begin with a little summarizing. Then, because, luckily, a little something I came with has survived the week unscathed, I will top the summary off with a few new ideas.

What I really set out to do in this presentation was to identify "ways that a national stockpile could be socially beneficial", according to Frank Huddle's directive. As you know, "socially beneficial" covers a lot of ground. It is fortunate that a good deal of what has been said this week has dealt with social benefits. So from that background we can step out and be specific about the social benefits of stockpiling, per se.

About 10 months ago Battelle's Columbus Laboratories was pleased to have Jim Boyd ask us to review the effect of stockpiling on economic stability. It was a fascinating study, an eleventh-hour effort, that never got past the draft stage. It was never officially published, for a number of reasons, even though a few copies have gotten around in what looks like completed form. Among the more important findings in our study are two things that bear heavily on what we have been talking about this week.

The first takes off from the long standing policy of the American Government to step in and help society combat commodity scarcity whenever it occurs; notably during national emergencies, but also during other occasions as well. Stockpiling has been one, but only one of four, important tools for implementing that policy. History teaches us that none of these tools can stand alone. No one is complete in itself. In large doses any one of them alone is either too expensive, or unsuitable, or both. But, together, they seem to work well in trade-off with each other. I will elaborate on that later. The thing is, however, that for us as a nation to consider turning away from stockpiling is to consider denying ourselves the valuable use of a legitimate and effective tool for combating scarcity. It would be like a carpenter throwing away his hammer just to lighten his tool box.

The second thing is that, beyond being a defensive measure, stockpiling may provide a positive force to bear on world money problems. It may be the opening for financial innovation which we brought out in Task 11 to ease world currency scarcity, lend some support to weak currencies, and loosen constraints in foreign exchange for all nations.

Those are the two things our stockpile study disclosed that bear directly on our deliberations this week. Now, it would be presumptuous of me to promise you that stockpiling would solve all the problems of tomorrow's world of scarcity. But it doesn't have to be that good for it to be worth talking about, would it? That's why I'm here—to run through the rationales behind these points and show you how we came to these conclusions.

Conceptual Model

Our study strategy started out with stockpile history in the United States. Our aim was inductively to work back from history's lessons to underlying, hopefully, lasting principles. As a result we might find hidden truths that may more than key a better understanding of past events, but provide some measure of prescriptive capability for coping with future scarcity situations.

We started out building a conceptual framework for tying together fundamental cause-and-effect relationships evident in the history of stockpiling. With it we found what appear to be at least quasi-principles for future guidance. Coincidentally, the conceptual model integrates into one interrelated picture many of the things we have all been discussing here this week. So for the double purpose of understanding history, and summarizing some of this week, let's go through the framework and see where it takes us.

We start out by saying there are four major action recourses a nation may use to combat scarcity—Stockpiling, Standby Capacity, Substitution and Recyling. Stockpiling and Standby Capacity have a history; Substitution and Recycling, a future.

For the benefit of the conceptual framework, let us define these terms and note their principal advantages and disadvantages.

Stockpiling we define as a large inventory of critical and strategic materials available to offset prolonged periods of acute scarcities. Its major advantage is that once it gets into place the stockpile provides instant reaction capability to scarcity problems, or an infinitely short lead time to put it to use.

Its major disadvantages are its high capital cost (around $8 billion is what the DPA stockpile came to in 1962), its continuous management cost, its long lead times to build, and its potential disruptiveness in the marketplace. But, I hasten to add to the last that a properly managed stockpile need not necessarily be disruptive.

Stockpile costs for minerals and metals would be high but reasonable and somewhat self-supporting, if we were to rely 100 percent on stockpiles to combat scarcity. Fuel commodities, however, would be impossibly high cost.

Standby capacity we define as a deferrable and/or mothballed mining and/or industrial capacity capable of producing in quantity critical and strategic materials in time of scarcity. Its major advantages are it provides a quick reaction capability to scarcity problems or a relatively short lead time to put it to use.

Its major disadvantages are high capital tie-up, rapid depreciation of capital through obsolescence and deterioration of plant standing in idleness. The losses in mothba[led plants are so great that the temptation has been overwhelming to run the plants instead, and that, like a night out on the town, results in a DPA-like, stockpile hangover. In addition, the deferral of existing equipment and manpower from other less critical activity is disruptive to industry and usually requires special Government bodies set up to manage it equitably. To rely 100 percent on standby capacity to combat scarcity would incur exorbitant costs.

Substitution is the interchanging of materials able to deliver equivalent benefits to the user. Its major advantages, first, are that substitution relieves critical-material demand by replacing them with noncritical materials offering equivalent effectiveness in given uses. Second, substitution, once under way, pays for itself as it goes, except where the replacement material is inferior and requires paying an incremental cost to make up for that margin of difference.

Its major disadvantage is that substitution cannot take the economy far enough to combat broad and deep scarcity situations. Substitution technology is just not that well developed. To take the time to develop it will require long lead times. That is not to say that substitution is not done in industry. It is, but on a relatively small "nutritional" scale, so to speak; not on a sufficient scale to provide the large-scale "therapy" we would need to combat real scarcity.

Even though further technical development appears worthwhile and should take us a long way, it would be visionary to expect a 100 percent substitution to solve all scarcity problems. One can foresee at its best exorbitantly high cost, and, for technical reasons, a significant short fall of the " 100 percent" goal.

Recycling is the return of obsolete scrap to the system. Its main advantage is that it, in effect, renews nonrenewable resources. Also, it carries a pay-as-you-go feature. Moreover, recycling saves process energy per unit of production. It returns net energy to the system, where collection and scrap processing costs do not wipe out process-energy savings.

Its disadvantages, just as with substitution, are that the technology

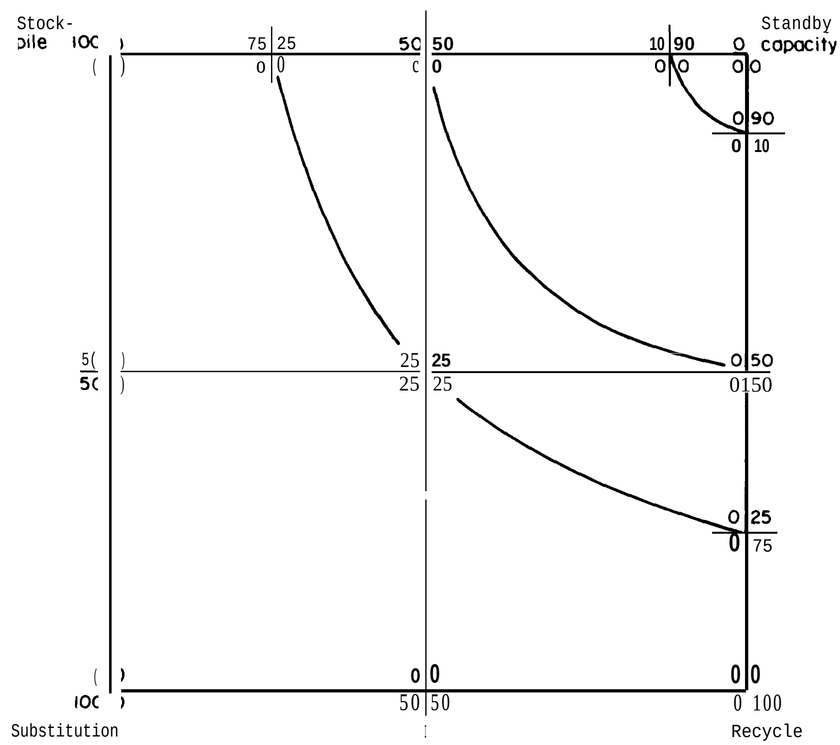

Figure 1, lsoquantic trade-offs percent dependency.

is yet to be developed to an extent required to consider it a therapeutic answer to scarcity. It will require long lead times to develop it fully, as, for example, full recycling of municipal wastes.

It is highly unlikely that we will ever have 100 percent recycling capability. To the extent we recover all materials now in the system is the extent to which we relieve the need for mining. Even at best, mining *will* always be necessary to replace material irretrievably lost in the social system as a whole, and to provide for growth.

So much for definitions. Back to the conceptual framework, we plot these four ''scarcity therapies" each on one corner of a four-dimensional isoquant—Figure 1. This is like Blum's three-dimensional isoquant, borrowed from thermodynamics. Only here we have four elements, which give us curved isoquant lines. So as not to get hung up on isoquant theory and development, let us gain familiarity with it through the application of it to our situation here.

If you were to depend entirely on Stockpile, you would plot into the chart at the upper left corner. To the extent that your "scarcity therapy" employs *some mix of all four* remedies, you fall somewhere on the face of the chart. In the middle, for example, you have an equal, or balanced mix, of all four remedies at work at once, i.e., a 25:25:25:25 percent ratio.

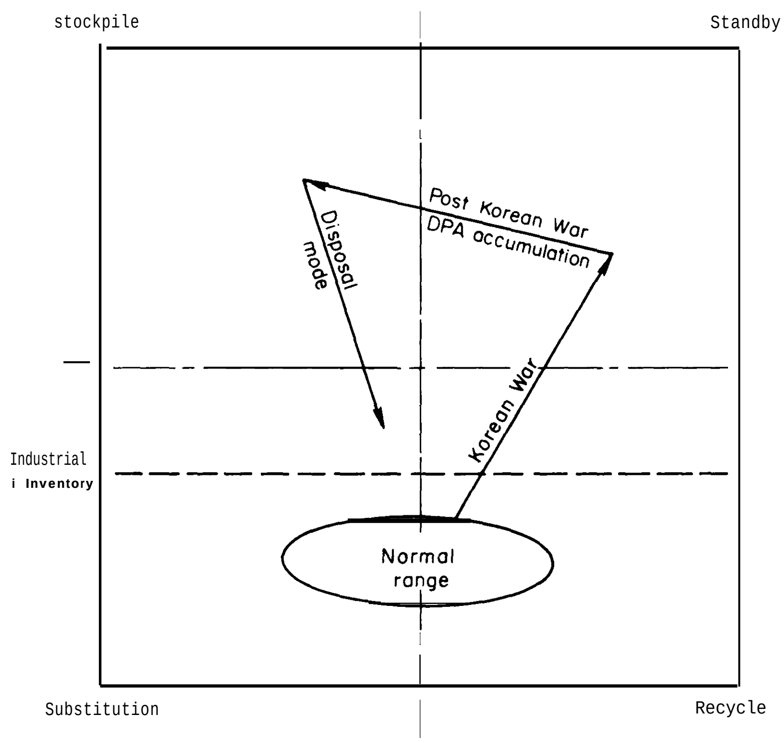

Figure 2. Stockpile history in isoquant.

With that you can plot stockpiling history on the isoquantic chart as in Figure 2. Here you have a "normal range" of mix options, where you would be in a non-scarcity situation; e.g., you use nutritional doses of inventory, excess capacity, substitution and recycling, to keep industry in an abundantly supplied economy going efficiently, say in the pre-Korean War period. Now, history documents the Korean War as taking us toward additional Standby Capacity, then into a hangover period of stockpile accumulation, and finally into a disposing mode that is taking us back toward the normal range again.

Well, what drives these changes—specifically; and why did we go in the directions taken?

What happens is that the economic system always tries to minimize the incremental cost of combatting scarcity. You are more willing to accept higher incremental costs in times of scarcity, than you are in times of abundance. When you do, you increase your options of mixes of the four remedies. Once you widen your options, then your governing

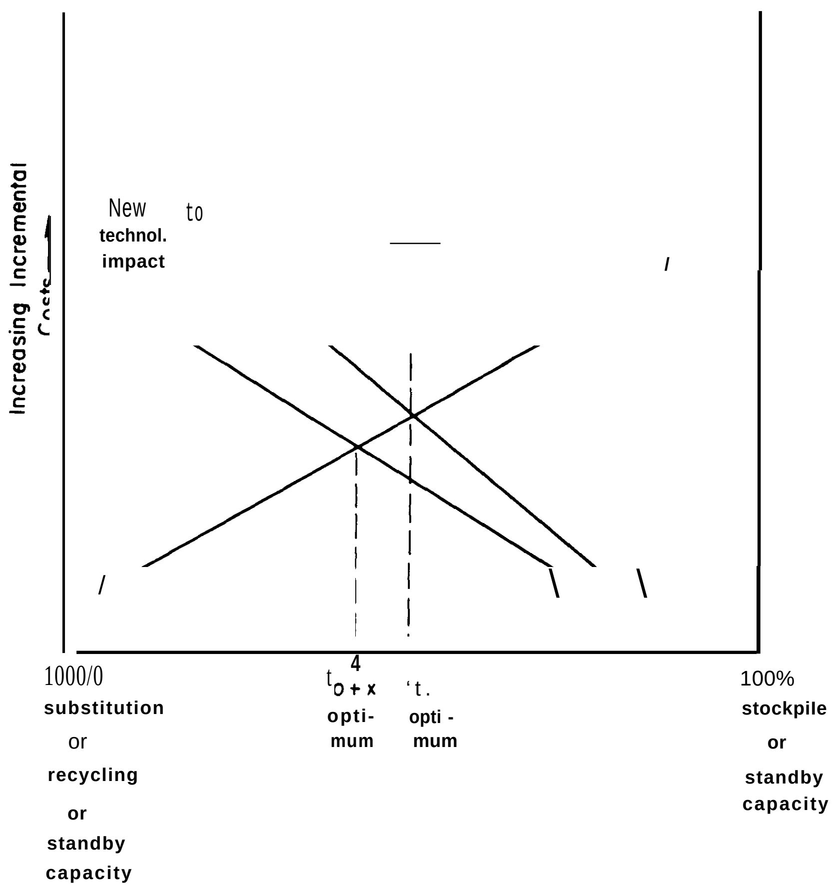

Figure 3. Stockpile trade-offs.

concern moves away from cost and toward lead time, until at the extreme, one hears, "Hang the cost, which alternative gives the fastest response ?'

So let's look at the effect of incremental cost on mix position. Let us take any trade-off pair in Figure 3; say, Stockpile versus Substitution. 100 percent Stockpile is high cost and so is 100 percent Substitution, at the present state of their arts. As these trade off with each other we come to an optimum cost mix as shown at the bottom of the catenary curve. If and when new technology lowers the cost of

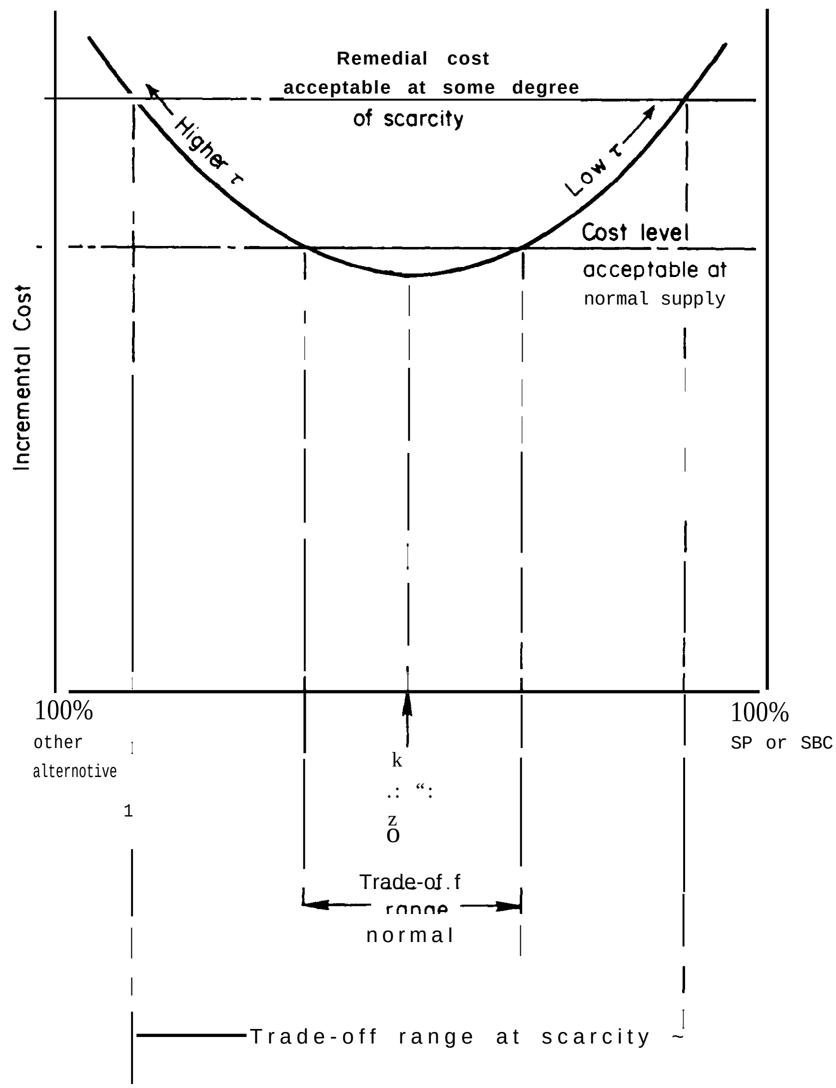

Figure 4. Trade-off-mix range as a function of supply.

Substitution, the bottom and optimum moves to the left, which raises Substitution, and lessens Stockpile in the mix.

Now, normally, your acceptable minimum cost level in a normal supply situation keeps your mix options narrowed around the optimum, Figure 4. But under "scarcity" you accept remedial costs above the normal, or raise the dotted line. This widens the intercepts and increases your trade-off range of mix options. Which option will you go for? The cheapest one, commensurate with the lead time available.

Of course, with four remedies you really have six trade-off pairs. When we combine all pairs in Figure 5, the two-dimensional catenaries

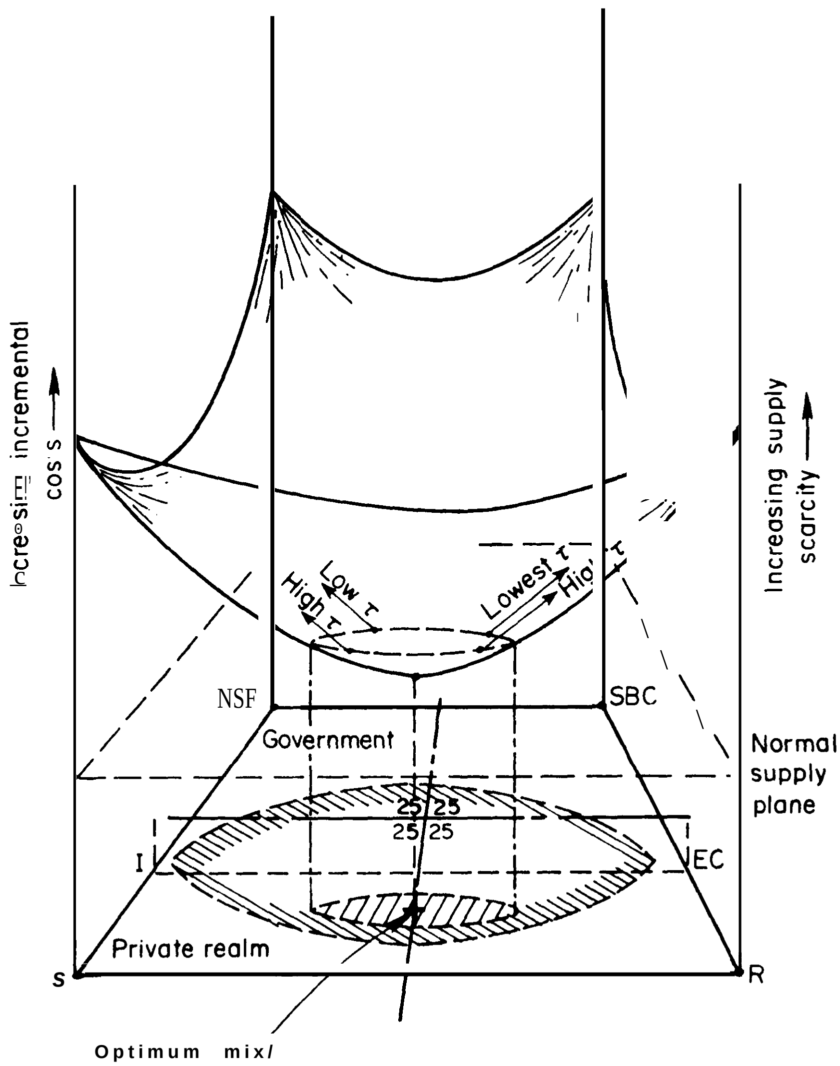

Figure 5. Integrated model.

join up to form a pendulous plane with the low point lying over the "normal" range. Under scarcity the cost-level line becomes a rising supply plane, and your mix options accordingly open out in all four directions.

These diagrams set some principles. Consider, for example, that the International Tin Council or CIPEC, or some other Agreement group gets tough. Say it puts the commodity under quota. The demand is unsatisfied. Much bidding up of price goes on by the scarcity-beset users. Now society will accept a higher remedial cost, or incremental cost to combat the scarcity, i.e., something proportional to the increased price. The dotted plane in Figure 5 rises. The intercept trace widens and the projected circle of options widen accordingly. Now you can move in four directions. What's your move?

Well, we can strike some quasiprinciples of action depending on the foregoing advantages and disadvantages inherent to the four remedial options.

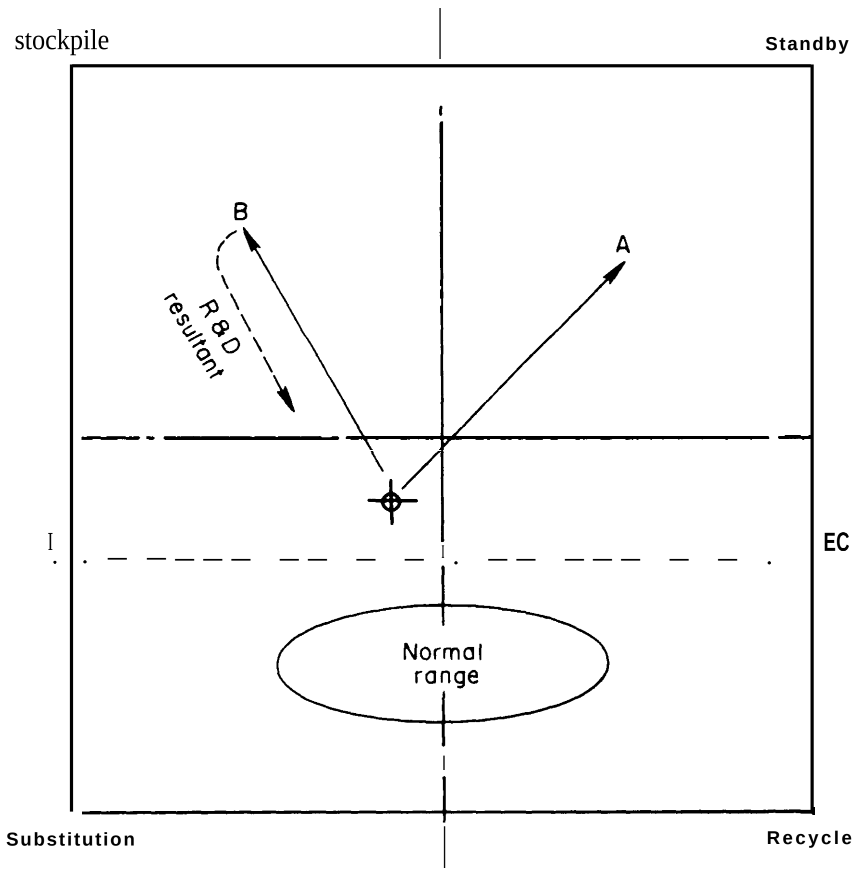

Figure 6. A strategy in isoquant.

The first principle relies on the expectation that every commodity will be different and is a separate consideration. To draw an extreme comparison, it would be absurd to stockpile municipal waste, but not copper. It would be equally absurd to build a standby copper mine and smelter, but possibly not a municipal waste separation plant. Each commodity, accordingly, is a separate consideration.

The second principle is to stay away from the SBC route (vector A, Figure 6) if at all possible. It is fast, but it gives you a hangover in the form of unwanted stockpile (such as DPA). Therefore, if you see a scarcity coming, get with other alternatives and use your lead time to advantage. But if the lead time approaches zero, you have good reason to go the SBC route—it has history and precedent, so it should not be difficult to assess realistically.

Third, go with Substitution and Recycling as far as possible, because, you will recall, these technologies, once established, have short lead times to effect, and pay for themselves as they go. But because both Substitution and Recycling need development, these remedies won't take you far enough at this moment,

Fourth, the strongest strategy at this point in time is to go with stockpile long enough to buy time for Research and Development on Substitution and Recycling; then move away from stockpiling as the latter alternatives take hold with time.

So that, in brief, is how we come to our first conclusion as given at the outset, i.e.,

(1) Stockpile, as one of four inseparable tools to remedy scarcity, is a keystone in a rational plan for the future.

(2) To turn away from stockpile is to deny ourselves of a crucial tactical option in dealing with scarcity.

Financing Defensive

If we conclude that stockpile, to some extent, and of some size, and of some specific commodity profile, is indispensable, we ought now turn our attention to ameliorating its major, but not overriding, disadvantage—high cost,

There are three ways to reduce the cost of stockpile:

(1) Physiocratic Fallacy. We already mentioned this. It is to trade-off Substitution and Recycling to eliminate Stockpile entirely, just as Germany did in World War II and the United States did in World War II and in the Korean War. As already mentioned, the fallacy of the Physiocratic Fallacy is that the state of the art of Substitution and Recycling is presently too undeveloped and hence too costly to take in large doses. It is impractical for moderate to high scarcity situations, and will remain so until such time that R&D gets costs down in both areas. It is practical only in the extreme emergency of life and death when infinite incremental cost will be borne willingly, as in the case of going all out for Substitution.

(2) Defer to Industry. Already studied are several management plans to pare stockpile costs to a minimum. First, the OEP had an objective

consultant look at transferring the DPA stockpile management to industry. He found high interest costs and storage costs so high as to make it unprofitable for private investors. Rather it appeared more economical for society as a whole to carry stockpile management under Government control within Government facilities where many fixed costs could in effect be eliminated.

Second, and now gaining renewed attention, is to authorize industries to expand regular inventories to meet stockpile objectives. By dropping the tax on "stockpile inventory", larger stocks could be accrued. Inventory tax relief is not enough. The remaining cost may be borne by a pay-as-you-go scheme in which cost passes on to the consumer in higher prices.

(3) Overlooked to date is the Coinage Principle; turn stockpile into a commodity reserve currency. Mineral and metal commodities are generally high density, slow to deteriorate, widely valued in consumer economies, difficult to purloin, etc. Minerals can to some extent be a stand-in for gold. While resting in bond in an inventory for long periods, stockpiled commodities can be **used** as a commodity reserve currency to augment gold-reserve currency. Essentially, the mineral and/or metal commodity would take its place alongside of gold to support the dollar and, accordingly, broaden the credibility base for United States currency, at least among the vast number of people in the world who stubbornly insist in having tangible things of value standing behind paper money and credit notes. The western world has its gold; Iran the crown jewels; now, make it mineral ores, and metal ingots to support any currency. Although commodity currency may not, as Friedman wrote in 1951,[1] meet the "technical efficiency of Fiat currency" on one hand, nor the "emotional appeal of gold" on the other, it may not easily in 1974 "fall between the stools", particularly since mineral commodities of any kind are looking more like "gold" to consumer nations as they enter a peacetime period of commodity scarcity.

As long as the stockpile commodities remain in escrow, so to speak, the owning nation could either print, or create de facto, credible money against the commodity value in stock. Curiously, it avoids interest charges during the escrow period, just as no interest is paid on the gold in Fort Knox. When one uses some of the commodity, however, it comes out of bond and an equivalent amount of currency or credit is retired accordingly.

During the Great Depression and Post-War years, the coinage principle was a much discussed issue among economists. But because the premises for augment are changing, perhaps it is time to revive the subject. Perhaps it might carry the seeds of financial innovation we need to deal with the special new case of scarcity in peacetime.

Beyond Defensive

A major lesson of the Vietnam War years was that a national stockpile is effective in preventing runaway prices to the consuming nation managing it. Earlier than that, producer buffer stocks had already demonstrated for years that they can be effectively managed to prevent witheringly low prices for producers. In none of these cases have the stockpile hoards, such as they were, ever been tied to currency support. Therefore they have either burdened their sponsors with heavy costs, or limited their effectiveness by having to stay within a budget; e.g., the ITC buffer stock, the ups and downs of which in recent years carry headlines in practically every Metals Week issue.

These experiences lead logically into a renewed interest in National and International Buffer Stocks (with the coinage principle attached?). Let's review these, briefly.

National Buffer Stocks have economic-stockpile purposes. That is, they establish accessible reserves of essential commodities, which may be administered such to obtain (1) supply continuity, (2) price stability, and (3) realistic price levels. The National Buffer Stock concept has a formal precedent in the United States. In 1940, Congress set up the Metal Reserves Company under the Reconstruction Finance Corporation. The RFC had acquisition power, administrative control, and disposal power over its stock of commodities. It was strategic oriented, set up to maintain economic stability during times of defense buying in anticipation of World War II.

Another precedent was established late in the 1960's when the DPA operated a de facto economic stockpile, built up as a hangover from the Korean War, but was never openly thought of as being anything but a strategic stockpile.

More recently the Japanese announced they are starting a National Buffer Stock, perhaps the first official buffer stock set up by a consumer nation and designed primarily to protect a consumer-nation's trading interest. Japan recently set aside $800 million for acquisition of materials deemed scarce in the Japanese economy. Japan was the first to act in this direction, but not first to think about it. Previously, England, France, West Germany, and Sweden all have publicly considered building national buffers. In all probability they are still thinking about national buffers to protect commodity price ceilings. With the Japanese precedent set, now it should not come as a surprise if these and other consuming nations follow suit.

Such national buffers or economic stockpiles were studied 40 to 50 years ago by economists as a means to stabilize economies during depressions, or in times of oversupply. The reason why buffer-stock plans were rejected in the oversupply situation of the great depression was because of the long term downward trends of commodity prices. This leaves one to expect that any commodity reserve inventory would continuously decline in value with time, and undercut the long-term viability of the buffer-stock operation. However, in scarcity situations, the prices increase with time, which turns expectations completely around. Should this not suggest new viability to the scheme in coming years of scarcity? Perhaps the pros might do well to take a new look at National Buffer Stocks as a positive new force to exercise in coming years of scarcity. I refer you to Grondona's Price Stabilization Corporation (PSC) as a start toward such a new 1ook.[2] His scheme has the unique features of operating outside government control, of management by professional guidelines, and of avoidance of partisan political influences. It allows no meddling by any government, which can only participate to the extent of managing by objective, and by monitoring progress toward such objectives as previously agreed to.

PSC has a valorizing formula to determine when to automatically buy and sell. In operation, the PSC is passive, never enters the market as a trader. It would operate only at the initiative of buyers and sellers, and then only as their court of last resort when the free market system temporarily breaks down when prices reach extremes, i.e., break through price ceilings, or price floors. Otherwise, free market operates as usual.

Administrative costs were expected to be low. Buying at price lows, selling at price highs, and profiting from a continuous price appreciation of stocks on hand provides operating funds. Its benefits are that it (1) counters inflation, (2) strengthens the currency, and (3) builds stability into the national economy.

Its operation essentially duplicates our own de facto national buffer or economic stockpile, as LBJ managed it during the Vietnam War. The PSC would be free of political pressure to move swiftly to buy and sell with dispatch. It would proceed according to an undisputable policy, or formula at buy-floor and sell-ceiling points.

Beyond these theoretical ideas are the factual signs of the times that lead us to note real and active trends toward National Buffer Stocks. These operations real and imminent are being modeled after our own DPA/GSA operations! Good or bad, these operations have set precedents that other nations plan to follow.

Although the United States de facto economic stockpile was conservatively operated with minimum political interference, one should not expect this to always be so, everywhere and at all future time. That is why Grondona's should be revisited, and his caveats reviewed with care. He may have a better idea than the one LBJ fell into by expedience. Now is the time to correct precedent, if need be; now is the time to work up an enlightened policy on a national buffer stock, or economic stockpile, or national inventory in the United States.

International Buffer

Picture, now, ten years off, the likelihood that several national buffers will be operating, most likely the United States, Japan, and common market countries.

These operations may find themselves defeating their own purposes by competing with each other by bidding up prices for open-market mineral and metal commodities, particularly if any one were to get skittish, for some reason, and over buy.

To avoid rifts in what should be a united block of consuming countries, I suggest to you Benjamin Graham and his concepts of a comprehensive International Buffer program that he calls a Commodity Reserve.[3] Because it never got past the proposal stage, it is referred to in the literature as the Commodity Reserve Proposal (CRP).

In a word, the CRP replaces the many National Buffer stocks with a single economic-stockpile, (under a Corporation comprised of several consumer countries). Again, it has a formula for goal setting, in storage commodity profiles, formulated buying and selling. It is an international buffer that operates on the foregoing principles of a national-buffer operation. It has the advantage of becoming a vehicle for international cooperation between consuming nations, and between blocks of consuming and producing nations.

Its dominant objective is to reduce the amplitude of world price fluctuations encountered in economic cycles.

Its two unique features are (1) complete automaticity of operation, leaving minimum scope for administrative decisions and partisan influences and (2) a "coinage principle", i.e., issue currency or credit on stockpile purchases; and retirement of credit on sales. Otherwise, its stabilizing benefits, international agreement characteristics, and usefulness to both the consumer's economic stability and the producer's economic stability are the same as for the National Buffer operation.

Again, the administrating agency is independent and international under a corporate structure—International Commodity Corporation. The Corporation was expected to be marginally profitable during long-term periods of declining prices without the coinage principle. It depends for its viability on profits from buying low and selling high. It might become viable with rising world commodity prices without employing the coinage principle. This is encouraging, because the coinage principle on an international scale would cause serious alterations in international monetary operations. That would not be easy.

Here again, it would be presumptuous of me to say that Grondona's PSC or Graham's International Commodity Corporation concepts would solve all the scarcity problems consumer nations imminently face. As a matter of fact, it would be surprising if the concepts would not require tailoring to adapt them to modern problems. After all, both were working in a different trade environment, i.e., commodity overabundance, not scarcity; declining world prices, not rising world prices; all commodities including food, not just minerals and metals; and a different geosocial world than today 's.

Therefore, it would seem advisable not to look to Grondona and/or Graham for perfect panaceas, but rather for strong concepts upon which to build better ideas.

I would, for example, opt for a complete overhaul. I would begin with a new term to replace the name "stockpile", with all its nationalistic and aggressive connotations from years past. It is inconsonant with the spirit of free trade and its emphasis on international cooperation, on mutual benefits for consumer and producer countries, and on a sense of relaxation of tensions.

May I suggest, instead, the terms National Trade Inventory (NTI) on the national level, and/or International Trade Inventory (ITI) on the international. Inventory carries creative connotations built upon the concepts, methods, and success of company inventories anywhere. It is agreed that company inventories, whether carried by producers or consumers, benefit both parties by supplying various goods to meet needs promptly as they arise and thus assure uninterrupted operation of the business. Similarly, the NTI or ITI might be counted on to assure uninterrupted operation of national economics. To gain such advantages for both the consumer and producer countries would be at once the objective of the Inventory, and the common objectives to underly international cooperation in a free-trade world.

Specifically, the advantages of the Inventory might include the following.

To Consumer Countries. An inventory would:

(a) Relieve the disruption of hand-to-mouth material procurement.

(b) Avoid economic damage of sudden scarcity. Bypasses a "decelerator effect". (The decelerator effect occurs when a scarcity idles consumer's manufacturing capacity requiring him to carry higher costs.)

(c) Stabilize prices, preventing them from penetrating ceilings that add to costs; i.e., idle-equipment costs, which reduce profit margins and create an increment of inflationary pressure.

(d) Introduce de facto currency support by virtue of a nation's ownership of part of the inventory, thus strengthening its currency convertibility and valuation.

(e) Introduce de facto expansion of currency via extending credit against ITI stocks, thus relaxing need for IMC to be prepared to lend money to nations faced with sudden rises in demand for foreign currency.

To Producing Countries. An inventory would

(a) Become an inventory-customer to stand in for disappearing consumer-customers in times of depressed demand and prices.

(b) Avoid economic damage of sudden high demand bypassing the "accelerator effect". (Accelerator effects occur when an increased demand pushes producer beyond his capacity, requiring him to raise his investment. A five percent increase in output, above capacity, would, as a rule, raise the investment/spending budget by perhaps 50 percent.) The Inventory would absorb the shock of a sharp discontinuity in demand, and relieve pressures on that investment/spending budget; also allow for an orderly expansion over time if demand proves to be continuous.

(c) Stabilize prices (of inelastic commodities) preventing them from penetrating floors that reduce revenues at a time when (1) idle capacity may be increasing unit costs due to lower productivity and (2) reduced revenues, and profits bear hardship on producer country.

(d) Introduced facto currency support of producer-country currency in foreign exchange. Currency convertibility increases with knowledge that valuable raw material is available in its ITI account to holders of the producing country's currency.

(e) See (e) under '*Consuming Countries".

In conclusion, I would like to raise a point described in Task II. That is, there are inherent short term conflicts in the value systems of producing countries (LDC's) and consuming countries (DC's). Inherent adversary relationships grow out of such conflicts. Thus, any negotiation toward a cooperative datum plane starts out in a hole. The Inventory can resolve two of these; evening out of supply/demand discontinuities, and price/economic stability on both sides without disrupting each one's normal way of going about its own business. It is conceivable that a knowledgeable Inventory management could smooth away the rocks in the pathways of technology transfer from developed to lesser developed countries as well.

1 hope that with an opportunistic and optimistic attitude we can contrive to pursue some of these avenues, and down the road find ways to head off some of the world tensions we see facing us.

References:

(1) *Milton Friedman, "Commodity-Reserve Currency", Journal of Political Economy, Vol. 59, June 1951.*

(2) *L. St. Clare Grondona, "Vitalizing World Abundance", George Allen and Unwin, Ltd., 1958.*

(3) Benjamin Graham, "*World Commodities and World* Currencies", *McGraw-Hill, 1944, pp 57-71.*

SOME INTERNATIONAL ASPECTS OF THE MATERIALS POLICY

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I have been asked to give some personal comments on the international aspects of materials policy. I have to confess, however, that my personal opinion in this particular matter coincides with the official Swedish view as it has been expressed in the United Nations.

The finite natural resources of the world are certainly a big problem for the future but not necessarily the most critical problem. As has been pointed out by many scientists and economists the resource scarcity problem can be resolved by proper actions undertaken by politicians and other decision makers, starting today.

But the resource scarcity problem is closely linked to another problem, which I think is even bigger; the world's economic and political structure and its failure to achieve a fair distribution of the world's wealth.

This can be illustrated by the fact that today 70% of the world's population has to exist on only 30% of the world income. An economic balance sheet that was distributed to our task force this week shows a projected growth in GNP per capita for USA from the present 6,300 dollars to 12,000 dollars in 1985 and, for the less developed countries, or developing countries, as we prefer to name them, from the present **240 dollars to** *450 dollars.* This is certainly a doubling for both categories but their relative proportions are grotesque. This is the perspective in which we have to consider the international materials policy when dealing with this particular category of countries. I think it is important to separate the poor materials-producing countries from the industrialized countries and also from the rich oil-producing countries which are now obtaining an increasingly powerful position in the world's economy.

Political independence is the first objective in order to obtain a fair distribution. Although it is a slow process, a lot of progress has been made. But we also need an economic independence which guarantees the developing countries freedom from domination and exploitation. This means that every country must be entitled to a permanent sovereign y over its natural resources. The term economic independence as explained above does not exclude an economic interdependence in which respective countries mutually benefit from an exchange of goods and services.

A central issue is the multinational corporations which in many countries are controlling the exploitation and marketing of natural resources. Even if this control is not misused, it tends to undermine the efforts of the developing countries towards economical independence. It must therefore be in the interest of the international community to bring the activities of the multinational companies in line with national and international policy objectives. Today, they are often not even accountable to any specific one of the countries in which they are operating.

It is obvious that the developing countries need a widened access to science and technology, but also financial support of research and cooperation projects in fields of trade, industry and transportation. Here we come to the issue of foreign aid which can be dealt with separately, but which also can be highly integrated with the international materials policy, whereby the developing countries in return for commodities receive cash flow, but also science, technology and educational manpower. In the case of ‘‘pure” foreign aid, Sweden is next year going to achieve the goal to give out 0,7% of the GNP. If all developed countries followed this example, it would mean that another 8-10 billion dollars a year would be put at the disposal of the developing countries.

As Dr. deAlba, my Mexican colleague, stated the other day, we must remember that the developing countries, as well as the developed countries are consumers as well as producers of commodities. We will best serve the interests of both producers and consumers if we can secure a balance between supply and demand within the framework of a sustained total growth.

I agree with task group 5B when they say that "a basic materials goal is to improve the atmosphere in which the exchange of materials' goods and services take place". This seems to me more constructive than other proposals that have been heard here this week such as the one that the United States should act out of a strong dominant position, the full meaning of which I must admit I have not really understood.

I have also found chapter 9 of the so-called Boyd report(*) to be very interesting. There is especially one paragraph (p 9-14) I would like to point out:

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* *Final Report* of the *National Commission on Materials Policy June* 1973

"These complementary interests must be realized through contractual type relationships which recognize both industrial country needs for materials as well as developing country needs for a fair return from the sale of their materials and greater control over materials exploitation. Methods of doing business that are mutually acceptable will be developed if the will is present".

The Swedish government considers that for many important commodities, international agreements are the best means to achieve stable markets and provide the producing developing countries with increased export earnings which are essential for their development.

We cannot just cynically conclude, as someone did here the other day, that it is difficult to cope with interdependence with unequals. It is my strong feeling that we must work towards an equality that may be a good base for interdependence.

MATERIALS; THE NEXT CRISIS?

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"We have become great because of the lavish use of resources and we have just reason to be proud of our growth. But the time has come for us to think seriously what will happen when our resources are gone; when the coal, the iron, the oil and the gas are exhausted, when the soil is still further impoverished and washed away in streams, polluting the rivers, denuding the fields and obstructing navigation. These questions do not relate only to the next century or the next generation . . ." These comments were made not in 1974, or even 1973, but in 1908 in a speech by President Theodore Roosevelt.

In 1974, the President of the United States was again concerned with the availability of resources. In his State of the Union Message, the President stated that ". . . it is 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 governmental actions can promptly anticipate and help avoid the damaging shortages . . . ." A few months later, William S. Paley, the chairman of the 1952 Presidential Commission on Materials Policy, expressed concern even more strongly-". . . The energy crisis can be a blessing in disguise for America. A warning has been sounded. We could be heading into stormy seas unless we heed and act now. We face a problem centering around this key question: Does the United States have an adequate supply of raw materials to feed its expanding economy and defend its security? The answer leaves no room for complacency. My experience as chairman of this Materials Policy Commission which studied the subject exhaustively along with current developments has convinced me that we have reached a watershed in our national life. For the first time we must deal with a wholly new fact . . . that the well from which our resources flow is not bottomless. . . ."

While these three quotations appear to express like apprehensions about serious problems for the continued availability of materials resources, the nearly three-quarters of a century between the two presidential statements was a period that seemed to prove that the Malthusian warning of 1908 was misplaced. Over that period, both the United States population and its national wealth grew with associated increases in the consumption of materials and energy. In the face of these increases and despite the need to move to leaner and leaner ores as the richer mineral deposits became worked out, the "reserves" of the major industrial materials remained stable or increased over the same period and the material cost (in constant dollars) declined continuously. This contra-trend was due in large part to the ability to provide continual improvements in the technological efficiency of extracting and processing these basic materials. This experience of long-term downward trends in the constant dollar cost of materials was in large part responsible for the rise of the "Cornucopia School" of resource economics, which assumes that necessary technological advances will continue likewise into the future.

However, the two statements made in 1974 point to a relatively recent change in attitude towards materials resources which involves concerns both for shortages in the near-term and for the finiteness of the earth's supply of materials. Both these latter concerns—frequently jumbled together in a confusing way—have led to a great deal of current public debate in newspapers, television and technical journals. This revival of neo-malthusian thought was stimulated sharply by the Club of Rome's study "Limits to Growth". Since the onset of the energy crisis in 1973, there have been numerous Congressional Hearings on materials shortages. Indeed, at this moment a bill proposing a National Commission on Supplies and Shortages, supported by both the Majority and the Minority leadership and by the Executive Office is being considered in the Congress. The United Nations held a Special Session of the General Assembly in April of this year on "Raw Materials and Development". In Paris, in June, the Council for Economic Development conducted the "first World Symposium on Energy and Raw Materials".

These various events and activities are all directed to the question that is the topic of this talk. The important point at issue is whether these recent concerns for materials really correspond to a materials "crisis', in the sense that the word crisis means a pivotal decision point or a turning point. In trying to answer the question it is useful to consider in turn, for both the United States and the world at large, the problems of the near term and those of the period beyond the rest of this century.

Concern with the supply of materials over the near-term future, i.e. the period of the next 10 to 20 years, appears to have arisen directly from the events triggering the recent oil crisis, when a small group of oil producing and exporting countries were able to withhold oil supply both to force a four-fold increase in price and to influence a political issue—the Arab-Israeli conflict. The United Nations Conference mentioned above was initiated to bring together energy and other raw materials exporting countries to demand an improved trading position with respect to the principal raw materials importing countries. Although the United States is a major producer of both energy and raw materials, she has become increasingly dependent on imports from other countries to supply her large and expanding needs. As a result, the country has become vulnerable to supply cutoff or price increase, particularly for several key industrial materials. In 1970, the United States, with only one-twentieth of the world population, consumed approximately one-third of the world's raw material supply. For twenty non-fuel minerals, including the important industrial metals—platinum, chromium, aluminum, nickel, and zinc, the United States imports more than half its supply from abroad. For seven of these non-fuel minerals (platinum group metals, chromium, strontium, cobalt, tantalum, aluminum ore and metal, manganese) the imports for each amount to 95 percent or more of the U.S. annual consumption.

This dependence on imports has arisen either because such supplies are cheaper than using indigenous U.S. sources (as is the case for the ore for aluminum, bauxite) or the material is not indigenous to the United States, but has performance characteristics uniquely suited to specific and desired technological needs (e.g., palladium for telephone contacts, platinum for the catalysis of chemical reactions, chromium for resistance to corrosion and oxidation), Almost all the other industrialized nations are more dependent on importing raw materials than is the United States and hence have an even more vulnerable position. It is the concern with the price and reliability of supply of such imports over the next several decade that is really the major issue in most current discussions on materials "shortages". In addition, there is an immediate and serious problem of the present actual shortages in many processed materials such as steel, aluminum, copper, etc. These particular shortages appear to be due principally to the undercapacity of the United States and world materials producing industries, resulting from a long period of underinvestment in new capacity and the unprecedented period of high rate of economic growth that has occurred simultaneously in most of the developed countries. The resulting higher prices for materials, also driven up by energy price increases, is stimulating some cautious expansion in production capacity and some improved efficiency of materials use or substitution in the materials and manufacturing industries. Such changes can be expected to alleviate this particular source of shortages but will not resolve the questions of vulnerability to imported raw materials.

Is there indeed a "Materials OPEC" threat and what can be done if it occurs? To the first part of the question there is no certain answer, only best judgments, as to its component uncertainties of the odds of collusion and the odds of successful collusion. However, it is helpful to consider the likely effects of any such success. In general, price multiplication of raw materials should affect product prices much less than has been the case for energy. Thus, bauxite has been close to $12 per ton, whereas the price of aluminum ingot is some $600 per ton. Even allowing for the fact that it takes about 4 tons of bauxite to produce 1 ton of aluminum, it is clear that the doubling of the bauxite price should not influence the final metal price as strongly as the changes in crude oil prices increased the resulting prices for energy fuels. However, while the impact of such price increases should accordingly not be as traumatic as was the case for energy, there is evidence that along with price increases for raw materials, the producing countries will press for setting up industries for materials processing and fabrication rather than simply exporting raw materials. Such changes in industrial structure could not only result in significant changes in the rate of economic development, but could also, depending on the future level of world demand for materials, influence the structure of the U.S. materials industry. Correspondingly, at the present time the prospect of "a Materials OPEC" is the subject of strong examination both inside and outside the Federal Government. Such considerations have led already to changes in the character of discussions in international trade relations from the focus of the past several decades on "access to markets" towards one of "access to supply". The statement by Ambassador William Eberle (Special Representative for Trade Negotiation) at the recent Hearings on Materials Shortages before the Joint Economics Committee of Congress pointed to such an Administration view on the development of a stable and equitable framework for international trade in raw materials.

The second part of the question, addressing what might be done if the threat becomes reality, involves science and technology issues more strongly. Both increases in price and uncertainty of supply are likely to stimulate the following technical responses:

a. Materials substitution (i.e., the use of a different material, to perform the same function, such as copper or aluminum in conductors).

b. Process substitution (i.e., the use of a different raw material, such as alumina clays in place of bauxite).

c. System modification or substitution (i.e., reduce or avoid the need for a specific material by changing the engineering system, such as the use of a magnetic circuit breaker in a car ignition system in place of the conventional electrical circuit breaker).

d. Stockpiling either of materials or of technology.

The implementation of the first three of these responses is known from experience to require relatively long lead times to effect the technical change involved. For example, the substantial substitution of natural fibers by synthetic fibers has taken some 40 years. More recently, the replacement of open hearth steelmaking technology by the basic-oxygen process has taken some 10 years. In general, historical experience indicates that the substitution of a material or a new process for another takes on the order of 20 years. Usually, exceptions to this time scale occur only when little or no capital investment or write-off of existing plant is required. Such conditions were met in the case of the introduction of hybrid corn, which took only 2 or 3 years for almost full substitution to occur. Crash programs can also effect unusually rapid change as was the case for the development of the atomic bomb or in the program to place a man on the moon, but the investments of resources required are extremely large.

In the case of stockpiling materials, the U.S. experience to date has been primarily with ensuring supplies in the event of war. There still remain serious questions as to the effectiveness of materials stockpiles for the purpose of economic security, and as to whether they should be privately or publicly funded and managed. Furthermore, it is uncertain whether economic security is better met by international stockpiles analogous, for example, to the producer-consumer managed stockpile involved in International Tin Agreement rather than by national ones. The latter clearly are required if military security is the question. The stockpiling of technology can occur either as standby production plants or excess plant capacity, or by subsidizing the operation of higher cost production processes that permit the use of non-vulnerable resources. Compared with maintaining stocks of materials themselves, the costs incurred in stockpiling technology are very large and it appears doubtful if the insurance provided would be worth it. Since we are really trying to insure against finite dislocations in materials supply and /or price, stockpiling of materials appears to be the least expensive solution and the one that can be implemented most rapidly. A major relevant issue of science and technology policy is whether the Federal Government should underwrite research and development for alternative technologies, substitute materials or raw material supplies. However, such an issue is really more concerned with long term impact than the needs of the short term.

These various considerations lead to the conclusion that, for the short term, materials is not the next crisis for the United States or indeed, the world at large. Undoubtedly, there will be price changes, supply perturbations and alterations in industry structure, but in economic terms none of these developments appear likely to result in a crisis situation, i.e., one comparable to the world energy crisis of the recent past and the world food crisis that appears possible in the near-term future.

Let us turn now to the long-term questions, that is, the ones of the world of the year 2000 and beyond. Recently, we have seen a rekindling of the conflict of view between the resource optimists and the resource pessimists. The former correspond to the cornucopia school of resource economics, where it is assumed from past history that technology will provide an answer to the gradual decline in quality and quantity of the resource base. In sharp contrast, the resource pessimists, corresponding to the theory advanced by Malthus in 1798 of the inevitability of conflict of arithmetic growth in food supply with geometric growth of population, are concerned with the potential impasse between the finiteness of physical resources* and the limits

**To no small degree, sharp differences in some of the public debates as to the seriousness and immediacy of the problem of the adequacy of resources for materials are associated with the frequent failure to distinguish between reserves (i. e., identified sources that are economically exploitable with current technology) and resources.*

perceived to technology. While the strong resurgence of these ideas has been associated with the ''Limits to Growth" study, already during the 1960's public attention had been drawn to the worldwide pervasiveness of the hazards of nuclear explosions in the atmosphere and of the increasing pollution of water and air from the wastes generated by industry and private individuals. Thus, the dramatization of the resources situation by the Club of Rome study found a receptive public and rapidly generated wide concern for the finiteness of "Spaceship Earth" and its resources, and raised serious questions as to the wisdom of continued economic growth. For many, the current demographic projections of the doubling of the world population for the year 2000 with corresponding pressure on resources has reinforced the import of this analysis.

Like the question "will there be a materials OPEC?", the optimist/pessimist question cannot be resolved with certainty. Moreover, it appears likely that this may not be the right question to ask because the issue is going to be really one of choosing among alternatives, all involving some restrictions of present choices, rather than ''continue as before" versus "catastrophe".

How finite are the world's resources? In the sense that the entire globe is composed of minerals, the answer is a number so large that it is essentially infinite in comparison with the likely world demand; in particular when account is taken, in evaluating such demand, of the evidence for a saturation of the level of the per capita consumption of materials in advanced countries and the fact that problems other than materials are likely to force a solution to the increasing pressure on all resources from population growth long before world population reaches "standing room only" levels. Similar considerations apply to the world supply of "renewable resources" of plants, trees and animals, in contrast to the minerals or non-renewable resources. In this very long term sense, the question whether or not materials resources are finite becomes academic. Much more practical is the question of the costs likely to be incurred, as opposed to the benefits, by continuing high rates of materials production and consumption and how can they be reduced. How can the pain of the transition period be modified? What is the role of science and technology?

The economic and social factors to be taken into account in seeking an optimum solution to this question of balancing costs and benefits in providing and using materials in the economy are principally the integrity of the environment, human health and safety, energy consumption (in particular, associated with the need to use progressively lower grade ores), competing uses for land, water and capital, and the stability of international relations. Science and technology can assist beneficially in this process of optimization through activities that offer options for both the supply of materials and reducing demand for new supply. Thus, increases in supply can be developed through:

1. Advances in the understanding of mineral formation and the techniques for exploration, and of plant biochemistry
2. Creation of new materials or processes that open up new resources

(e.g., synthetic polymers, new mining techniques for minerals on land and in the oceans)

3. Improving the physical efficiency of the extraction of minum and steelmaking, or wood products)

4. Develop lower cost alternatives for existing materials (i.e., substitution of materials or systems to provide the same performance or function), including the possibilities for greater use of the more abundant materials, such as magnesium and silicon, or of renewable materials, including current organic wastes such as lignin.

Opportunities for reducing demand for new supply lie in:

1. Better integration of materials selection with component design to develop manufacturing processes that reduce materials loss during manufacturing

2. New or improved materials to permit engineering designs that reduce the amounts of material required to perform a given function (e.g., miniaturization, as in solid-state devices, or improved reliability)

3. Conservation in use through improved materials performance that provides increased service life (e.g., reduction in rates of deterioration by corrosion and wear)

4. Improved recovery or direct reuse of materials during processing, manufacturing and after completion of the useful life of capital or consumer goods.

At the present time, there is increasing recognition that market forces alone may not move the United States and other developed countries rapidly enough towards ensuring that these science and technology activities develop timely contributions to the solution of meeting needs for materials in the future, Involved in this recognition are such issues as "the problem of the commons" and the internalization of external costs that have not yet been incorporated adequately into economic theory. Thus, a major question is how, where and to what extent should the Federal Government become involved so as to encourage effective use of resources and technology, and to anticipate the materials requirements of the future. A variety of deliberations and activities in the Congress and the Executive Branch, in the Organization for Economic Cooperation and Development, and in the United Nations are focusing on different aspects of these issues. Some movement is apparent towards addressing the most difficult question, that of the feasibility and wisdom of developing a more comprehensive approach to the management of materials resources.

From the above discussion, it appears that, while the reasons differ from those for the short-run case considered earlier, the longer term likewise does not threaten a materials "crisis". In particular, it is improbable that the world will "run out of materials" before other potentially critical issues intervene. However, the conclusion that no real crisis is likely for materials does not mean that, in the absence of appropriate attention, serious problems may not arise in their supply and use. Public choices in both developed and developing countries will have to be made between the costs and benefits involved, especially over the immediate future when expanding new production will continue to be the principal means of meeting consumption requirements.

Recently, two wide-ranging and complementary studies have examined the principal questions involved in such matters. The studies point to the close inter-relationships between materials, energy and the environment that, together with the concept of the total materials cycle, are central to adequate management of materials resources. The report of the National Commission on Materials Policy in June, 1973, entitled "Materials Needs and the Environment Today and Tomorrow", examines the characteristics of current and future supply and demand for materials in the United States and the world, and the policy issues to be faced. The National Academy of Sciences report in January, 1974, entitled "Materials and Man's Needs: Materials Science and Engineering", focuses on the science and technology of materials themselves. In addition, it examines the institutions in industry, government and university that conduct research, education and manufacturing to develop understanding and control of materials properties and performance, and to provide materials for individual and national purposes. Together, these reports offer an excellent starting point and framework for larger public examination of the needs for materials and the opportunities for meeting them. A variety of technical and organizational opportunities are available and given adequate and timely consideration followed by action, alleviation of short-term materials problems in addition to those perceivable as likely over the longer term can be expected.