

RESOURCES

Some findings and conjectures from recent research
into resource development and use



Many years ago a distinguished Frenchman, Marshal Lyautey, asked his gardener to plant a tree, and the gardener said, "Well, this won't flower for a hundred years." And the Marshal said, "In that case, plant it this afternoon."

NUMBER 47

RESOURCES FOR THE FUTURE, INC.

SEPTEMBER 1974

Assessing the Materials Threat

Adapted and excerpted from a statement by Hans H. Landsberg, Director of the RFF Energy and Minerals Program, before the Subcommittee on Foreign Economic Policy of the House Committee on Foreign Affairs, May 15, 1974.

A MAJOR CONCERN following the oil crisis precipitated by the OPEC cartel has been that other exporters might take similar action to raise the prices of nonfuel minerals. This concern has been given some substance by the recent decision of Jamaica to increase its take from bauxite exports, and some less pointed moves of other Caribbean bauxite exporters. Nonetheless, I think that there is little likelihood that materials exporters can emulate the success to date of the OPEC countries (though one should not discount the possibility altogether). There are several reasons for this view:

1. There is more geographic and political diversity among producers and exporters of nonfuel minerals than in the petroleum market. At the present time, significant amounts of major commodities are located in traditionally friendly, or at least not unfriendly countries such as Canada, Australia, and Latin America. The unifying political and perhaps cultural catalyst present in the Arab world is not as easy to find in countries producing most other materials. It is not that groupings of politically or otherwise heterogeneous nations are unimaginable, but that they would find it harder to agree on and persist in openly aggressive actions.

2. Although it is sometimes implied otherwise, the potential confrontation in materials is not between

developed and developing countries. For instance, the developed, free market countries hold more than half the world's reserves of lead, zinc, chromium, molybdenum, titanium, and potash. The centrally planned economies predominate in tungsten, vanadium, and land-based magnesium (which is also readily available from seawater).

3. Financial staying power differs widely among these countries, but is generally far inferior to that of the important oil exporters. Dependence upon a continuing flow of foreign exchange earnings, for both import procurement and budget support, is important and would militate against risking production or export interruptions. So would the role of mining activities in providing local employment.



In this respect it is worth noting, for example, that Chile and Zambia derive about 80 percent of their foreign exchange earnings from copper, Zaire about 50 percent, and Peru about 30 percent. Such differences, coupled with widely varying prospects for capacity expansion in these countries suggest that attitudes toward aggressive supply and price actions on materials would differ.

4. Many of the supplier countries are heavily involved with the importing countries in a diversified trade pattern, pointing to the potential for negotiation rather than unilateral action. Moreover, in the broad context of both environmental and foreign assistance policies it is quite feasible, and an example of a positive approach, to think of broad long-term changes in the pattern of trade and division of labor that would, as volume expands, transfer a growing share of processing to the raw materials suppliers. While at first glance one might expect this to increase the future bargaining power of the raw materials countries, I am inclined to believe that steps toward their industrialization would meet long-standing aspirations on their part, help diffuse the chances and severity of confrontation between haves and have-nots, and provide for increased interchangeability of

imported supplies as compared with ores.

5. The success of an operation patterned on that of the OPEC countries depends on control of a large share of output and on specific elasticity characteristics. These are (1) that the price elasticity of demand, and especially the cross elasticity, remain low, i.e., that price increases would not call forth substantial declines in demand or substantial shifts to consumption of a near substitute; and (2) that the price elasticity of supply for the same material produced in the rest of the world remain low. Since one of the immediate responses to materials price increases or supply shortages is substitution, cross elasticity may be so high it would preclude successful manipulation of the market.

6. In the long run, the sharp downturn in economic activity and growth predicted for OECD countries by the World Bank (from 6.6 percent in 1973 down to 1 or 2 percent in 1974) will also mean low growth rates for developing countries. Moreover, there are sharp signs that the price of materials may have crested. Thus, producers may be more interested in consolidating present gains rather than working to increase future prices.

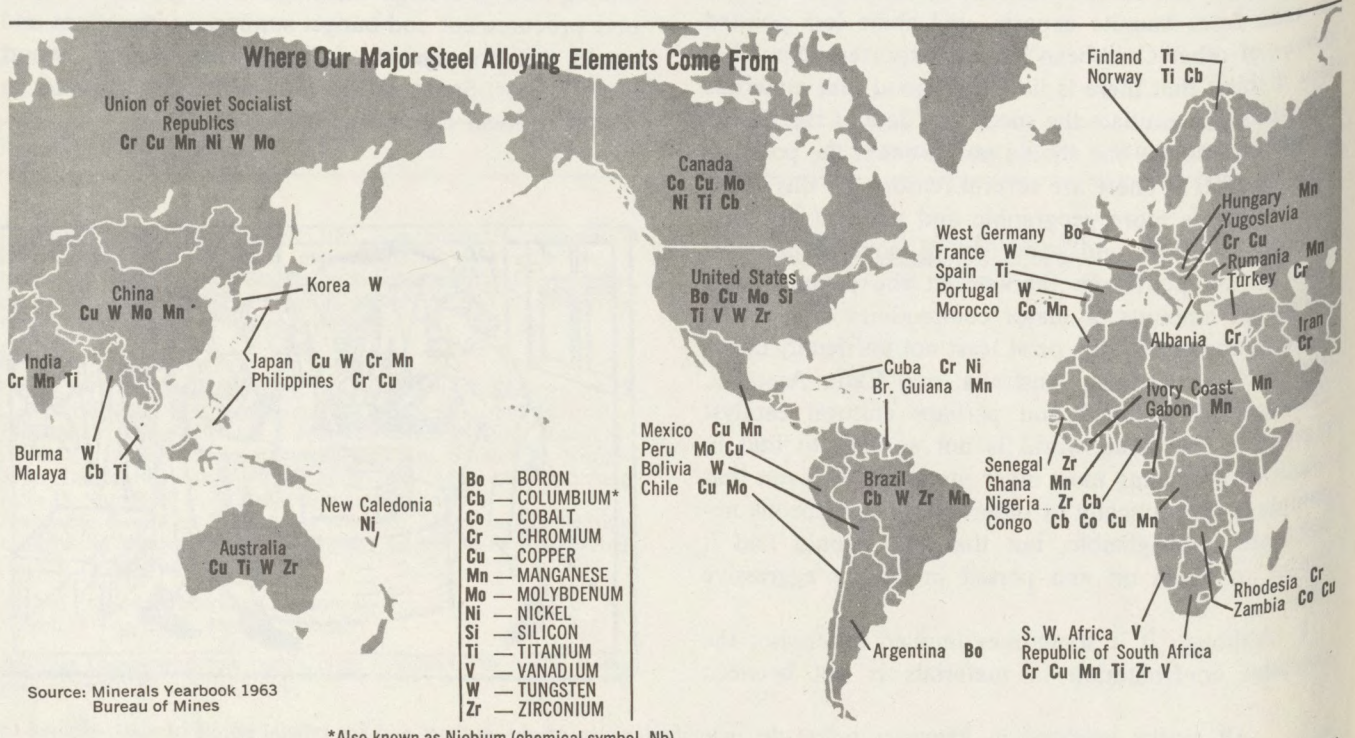
Despite the poor odds for its suc-

cess, suppose an OPEC-type action does take place. What then?

Administratively, the handling of any sudden shortages would be much easier than in the case of oil, since by and large the consumers are a moderate number of processors and converters and not, as in the case of oil, tens of millions of end-users that heat homes or drive automobiles. By the same token, most materials purchases are more readily postponable, and allocations to high-priority areas and uses more easily designed and carried out.

For the short run, a well-thought-out allocation scheme of the sort practiced in wartime, supplemented by utilizing stockpiles, is the most immediate response. Subsidized recycling activities, accompanied by adjustment of product specifications downward would come next. Wide dissemination of information on feasible substitutions would be another activity. In addition, where warranted by the impact of supply and price manipulation, political and economic pressure on the countries involved always remains an ultimate weapon.

The long-term response to materials shortages is somewhat more complicated. Revisions of design to eliminate scarce or costly materials may be possible in many cases. For instance, Chrysler has recently re-designed its automobile ignition sys-



tem to use electronic ignition, thus eliminating the need for critical and expensive alloying materials.

In situations where this is not possible, the development of a standby technology that would be ready to utilize substitute materials has been proposed. While such an approach may become necessary, its implementation poses problems of financing, degree of development, and choice of the developers.

The cost of setting up a pilot plant is not inconsiderable and even if the plant is operative, it does not necessarily mean that a commercial-sized plant will be successful. Knowing how to derive aluminum from domestic clays is a far cry from having proved it in a commercial-sized plant, and having done the latter is a far cry from having sufficient capacity ready to go into operation on short notice.

The decision to install "standby capacity" rather than rely on "standby technology" alone would be a momentous one, to be evaluated in terms of the credibility and likely impact of the threat.

IT IS IMPORTANT to recognize that the effects of price increases in materials would be considerably less disruptive than the increases in oil prices because the value of ores is heavily diluted in the end product. For example, bauxite at the price prevailing until recently of \$9 to \$15 a ton is less than 10 percent of the total cost of an aluminum ingot (over \$600/ton), even considering that it takes 4 tons of bauxite to produce 1 ton of aluminum. The cost is further diluted in the end product. Thus, even sharp increases in the price of bauxite tend to be dissipated. By comparison, a barrel of oil refinery products will typically be less than double the value of a barrel of crude. To give another example, in 1972 a 25-HP motor sold for about \$170. The 18 pounds of copper it contained were worth \$9, or a little over 5 percent of the cost of the motor. At \$1.30 per pound of copper, the cost of the motor would rise less than 10 percent. While these are simplified examples, they suffice to make the point regarding impact.

Closely related is the difference in effect on balance of payments. In 1972, out of a total U.S. import bill of \$56 billion, so-called crude

materials accounted for \$3.9 billion, or 7 percent (down, incidentally, from 18 percent in 1960). Of this, "ores and metal scrap" totaled \$1 billion. If we add nonferrous metals in their intermediate form, the import bill is increased by another \$1.8 billion, but even that does not make it an imposing amount. According to the Second Annual Report of the Secretary of the Interior Under the Mining and Minerals Policy Act, 1972 gross imports of raw and processed minerals broke down roughly as follows (in million dollars): nickel—\$300; copper—\$300; bauxite—\$200; alumina—\$200; aluminum—\$300; iron ore—\$400. Trade statistics reveal the composition by country of origin: of the \$1 billion of "ores and scrap," Canada shipped \$400 million; various Latin American countries \$200 million; Far Eastern countries \$40 million; with the balance scattered. Canada predominated equally among the shippers of nonferrous metal, supplying nearly half of U.S. imports, followed by Western Europe with not quite 25 percent (much probably processed from imported ores). The balance-of-payments impact would thus be

minor compared to petroleum, even if there were concerted action among the diverse suppliers to raise prices. To illustrate the contrast, the value of annual world bauxite output has in recent years run at about \$350 million; that is the equivalent of perhaps two weeks' oil production in Saudi Arabia at pre-embargo prices.

TO SUM UP, therefore, assessing the odds on the threat posed by materials exporters and its impact if enacted, is the first order of business. In addition, there is a need for a more thorough, material-by-material analysis of the situation and preparation of contingency plans, including the evaluation of need for technology, capacity, and governmental instrumentalities designed to stay abreast of developments. At the same time, it would be tragic if legitimate concern were to launch us rapidly in the direction of self-sufficiency, across the board and at all costs, to the detriment of the advantages that all who share in it can draw from increased foreign trade.



WILL HUMANITY'S LEASE EXPIRE?

Excerpted from chapter one of Sterling Brubaker's forthcoming RFF study "In Command of Tomorrow," which will be published by, and available from, The Johns Hopkins University Press.

UNTIL RECENTLY there has been no general concern about the long-term capacity of the physical world to meet our expanding wants. Now that such concern is both necessary and widespread, all of us are subjected to conflicting and often inconsistent advice on the direction to take. Mankind has no long-term strategy to guide short-term policy. It is easy to accept the idea that current policy should be consistent with a longer-term view, but this is difficult to achieve in the absence of agreement on what the longer-term options look like or which of them we wish to choose. In modern societies with representative governments, consistency between long-term objectives and short-term actions is hard to attain in any case, for governments must be responsive to short-term demands that often are in conflict with longer-term goals. Nonetheless, clearer public understanding of long-term options favors a climate in which greater reconciliation between current policy and long-term goals is possible.

With that in mind let us examine future modes of occupancy.

All civilized men are miners. Primitive hunters and gatherers were not; they depended upon and were limited by the current output of natural systems. But from the time man first domesticated goats and made bronze, he has been mining the earth's soil and rock, dispersing our materials, and degrading the environment.

However, we are not exclusively miners. We still make use of current biological output. In the case of agriculture, we have modified natural systems so as to increase greatly the earth's yield, apparently on a sustainable basis. This use, however, is not infinitely expandable; the supply of agricultural land is finite and limits to the efficiency of photosynthesis may be expected. Thus, while agriculture offers partial escape from the adverse effects of the mine, it uses exhaustible resources, meets only a limited range of needs, creates environmental problems, and is itself subject to capacity limitations.

Air and water are also complex resources which render direct amenity services to each of us and assimilate our wastes. While they are renewable in most respects, they are not so in all respects, since they can be permanently damaged.

All of these limits are aggravated by an increased scale of human activity. Because of growth in both numbers and per capita consumption the draft on resources and burden on the environment are increasing at a startling rate. The relentless logic of Malthus that, given fixed supplies of land, we could not expand food production fast enough to keep pace with population growth has not yet been verified. Still, it is impressive to observe how rapidly exponential growth threatens to exhaust finite stocks of conventional nonrenewable resources or available land, and most of us have become aware of the onerous burden of pollution that endless growth implies. These consequences loom even if technological advances extend the availability of conventional resources and the capacity to abate pollution.

While growth shortens the time to exhaustion of finite resource stocks, permanent human occupancy of the earth cannot in any case be based on the use of conventional exhaustible resources. However successful we are in finding deposits or in recovering materials from lower-grade sources, eventually we use up our supplies.

CAN THE DILEMMA posed by depletion be avoided? Essentially two paths are open to man in order to secure permanent occupancy. One is to aspire to a modest but sustainable place in the natural system by changing to a technology that is nondepleting in character. Man once held such a sustainable place when his numbers were few, wants purely biological, and technology nil. Regaining such a balance would mean reliance upon current energy flows from the sun and on the biological cycling of materials. It would not rely on the continuing net acquisition of exhaustible materials.

We might hope to manipulate the natural system through sophisticated biological methods and more efficient capture of the energy flow from, for example, sun, wind, and tides, so as to maintain numbers and a high standard of living. The more restrained our expectations with respect to population size and living standards, the more promising the outlook for this mode. Even so, it is difficult to see how this system could avoid degradation over time.



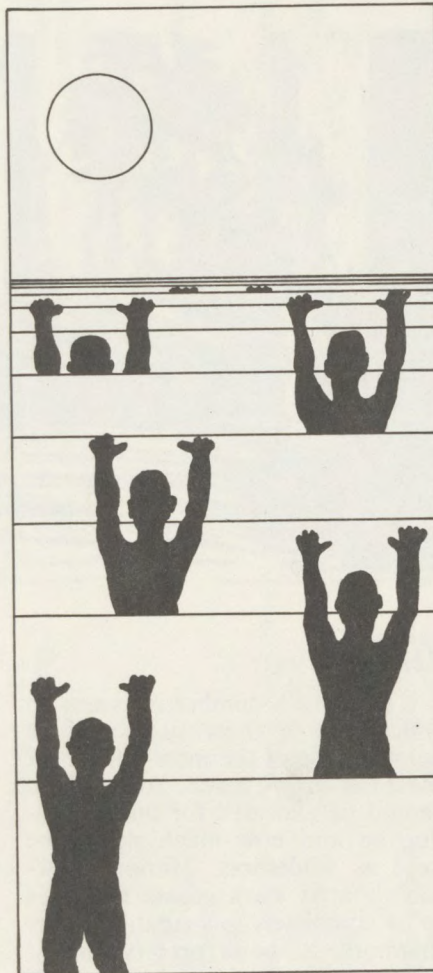
Many uses of materials are inherently dissipative, and it is hard to imagine that we could divert a current energy flow large enough to permit us to recapture that which is dispersed. As dispersion proceeded we would lose access to our initial stock of exhaustible materials, including metals. The loss of metals, hence machinery and transport, would limit our capacity to capture and utilize current energy flow. Regression in population and income would appear inevitable. Advocates of this mode might view such a result with equanimity, contending that it is still consistent with human happiness and the health of the planet. Indeed, on a sufficiently reduced scale, this mode is viable.

THE OTHER path would be a calculated effort to escape the constraints of resource exhaustion through new technologies. It differs from previous constraint-releasing advances in that it would not simply rely on enlarging the conventional supply of exhaustibles, but rather would seek to replace them with inexhaustible resources. The difference is between a temporary reprieve and a permanent solution. The second path means finding an inexhaustible source of energy as a prerequisite to other technology that would make use of more common materials. Given ample energy, we might make a direct attack on entropy, using common rock and sea water as resources, or perhaps we could reach for the alchemists' dream of elemental transmutation.

Even this approach would not be without limits on growth—dissipation of heat from the earth's atmosphere and physical space still pose limits. (Presumably we could learn to synthesize nutrients chemically, so photosynthesis and the supply of agricultural land need not limit us.) Of course, an encounter with the heat limit also could be greatly postponed by more attention to efficiency and less use of heat-using technological processes. The important point is that, while we might face limits to the magnitude of activity at any time, we could hope to escape the time limit implied by exhaustion. And, if this mode is combined with population restraint, it carries the potential for a higher standard of living for both developed and less developed countries. By contrast, when measured by cur-

rent values, the first path implies a lower standard of living. Although each path admits of many variants, the strategies suited for each path are antithetical in important respects. An interim strategy could preserve the option to choose between the two modes, but that decision cannot be indefinitely deferred.

There is no assurance that the second mode can be achieved. Is it not more risky than the first? The answer is probably negative, for if



the second path proves impassable, this does not preclude reversion to the first, although, depending on population size at the time of transition, great suffering and a dramatic reduction in numbers would be likely.

There is some risk in postponing the decision. The constraint-releasing option is perishable—we must seize it soon or forever lose it. Timing is very important. Since time is required to perfect constraint-releasing technology (if indeed it is successful), exhaustible resources should be viewed as buffer stocks to

be drawn on while the desired technology is perfected. If we continue to consume exhaustible materials without advancing to a technology able to transform or transmute plentiful materials, then we may no longer have in stock the energy or the quantities of concentrated elements needed to secure the transition. If we tarry too long or move too far down the first path, abandoning much of our technology as we go, then we forfeit the option for the second path—in effect we choose path one for our heirs, if not for ourselves.

Mankind is largely unaware of the need for choice. Instead, we mill about, increasing our appropriation of the stock for current consumption but not turning in a definitive way toward constraint-releasing technology of a sort that allows permanent occupancy. Is there still time to effect the transition before encountering resource constraints? Many doomsayers who think not are in fact expressing a preference for a romanticized version of path one. To the extent that they are also technological Luddites, there is a self-fulfilling element to their prophecy.

BUT IF PATH TWO is selected, a prudent first step would be to seek a more efficient transformation of the natural capital represented by resource stocks into the constraint-releasing technology of the future. A consumer society that uses stocks only to increase immediate gratification is inimical to the second strategy. An antitechnological bias that denies resources for the development of new technology also frustrates the second path. On the other hand, measures to conserve exhaustible resources through more efficient use, recycling, or substitution of renewables are consistent with the second strategy. Policies that restrain our rate of use of exhaustible resources, extending the time period over which the stock is used, allow a longer time for transition to occur. However, such conservationist measures need to be combined with a technical strategy if they are to contribute to the success of the second option. Thus, the conservationist, preservationist, and environmentalist biases present in much of the current discussion can be reconciled with the second strategy, but the antitechnological biases cannot.

While conservation policies permit deferral of the choice between the two paths, ultimately a choice must be made. Our society already is a heavy user of exhaustible resources and there is danger of over-staying that mode. If we opt for the second path, we must do so while resource stocks allow time, energy, and materials for possible success. Also, we must have continuity with past technical achievements. We

may be able to get there from here, but not if we wander too far away from the technological sophistication already attained. We must remember that we can always fall back on the first course, provided no cataclysmic damage has been done to the ecosystem in the process. Hence the manner in which we proceed is also of great importance to man.

In sum, long-term human occu-

pancy of the earth on the present basis is not viable. The alternatives are either path two to escape resource exhaustion while retaining income aspirations or path one, based on current flows, with population and income being trimmed as necessary. In either case there are limits (though quite different ones) to the scale of human activity at any time, but no necessary limits to its endurance.



Forest Policy For The Future

Excerpted and amended from Joseph L. Fisher's paper, "A Search for Consensus," in a recent RFF Working Paper, Forest Policy for the Future. The matrix is from Marion Clawson's paper, "Conflicts, Strategies, and Possibilities for Consensus in Forest Land Use and Management," in the same volume. Marion Clawson is also the editor of the volume, which is available from The Johns Hopkins University Press.

A SEARCH FOR CONSENSUS on future forest policies would seem to be worthwhile. By consensus I mean not perfect agreement on figures or statements, but rather a shared understanding of what the issues are, the pros and cons of the solutions proposed, and the directions in which to go. With this kind of consensus the chances of reaching workable solutions—frequently they will be compromises—will be greatly increased.

There are a number of issues on which such a consensus would be helpful. One of the most difficult of these is how much forest land should be allocated for timber production and how much should be kept as wilderness. Marion Clawson's matrix shows these two uses to be completely incompatible. Furthermore, it shows preservation of wilderness to be incompatible with recreational opportunities. Both of these incompatibilities, especially the latter, require a purist concept of wilderness.

My view is that wilderness does provide opportunity for certain kinds of recreation, including backpacking, limited trail riding, nature study and photography, fishing, and even hunting for food supply. The problem is how to limit these activities so that the essential wild characteristics are preserved. The day of the absolutely trackless, unpenetrated wilderness is over. Like all other land, wilderness henceforth must be planned and managed.

In the so-called quasi-wilderness, predominantly in the East and South, carefully prescribed cutting of timber may be considered, for example, as a means toward more rapid establishment of the kind of forest thought to represent sustainable wilderness or toward reestablishment of beaver and other indigenous animals.

Wilderness preservationists justifiably fear that anything more than minimum recreational use of wilderness, and any tree cutting at all, will open the door to heavy intrusion and destroy the fragile ecosystems that are an important esthetic component of the wilderness experience. Much of the difficulty is due to a lack of confidence and trust between the antagonists. This antagonism goes back to the Hetch Hetchy controversy in California and earlier. It will not be dispelled easily. Each side has tended to portray the other as villainous, as de-

Table 1.

Degree of Compatibility among Various Forest Uses

<i>Primary use</i>	<i>Maintain attractive environment</i>	<i>Provide recreation opportunity</i>	<i>Wilderness</i>	<i>Wildlife</i>	<i>Natural watershed</i>	<i>General Conservation</i>	<i>Wood production and harvest</i>
Maintain attractive environment		Moderately compatible; may limit intensity of use	Not inimical to wilderness but does not insure	Compatible to most wildlife, less so to a few	Fully compatible	Fully compatible	Limited compatibility; often affects amount of harvest
Provide recreation opportunity	Moderately compatible unless use intensity excessive		Incompatible; would destroy wilderness character	Incompatible for some kinds; others can tolerate	Moderately compatible; depends on intensity of recreation use	Moderately compatible; incompatible if use too heavy	Limited compatibility depends on harvest timing and intensity; roads provide access
Wilderness	Fully compatible	Completely incompatible, can't tolerate heavy use		Highly compatible to much wildlife, less so to others	Fully compatible	Fully compatible	Completely incompatible, precludes all harvest
Wildlife	Generally compatible	Limited compatibility; use intensity must be limited	Mostly compatible though some wildlife require vegetative manipulation		Generally fully compatible	Generally fully compatible	Generally limits volume or conditions of harvest
Natural watershed	Fully compatible	Moderate compatibility; may require limitation on intensity	Not inimical to wilderness but does not insure	Generally compatible		Fully compatible	Moderate compatibility; restricts harvest methods but does not prevent timber harvest
General conservation	Fully compatible	Moderately compatible; if use not excessive	Not inimical to wilderness but does not insure	Generally compatible	Fully compatible		Compatible but requires modifications in methods of timber harvest
Wood production and harvest	Compatible if harvest methods strictly controlled	Moderately compatible	Completely incompatible; would destroy wilderness	Compatible if harvest methods fully controlled	Compatible if harvest methods fully controlled	Compatible if harvest methods fully controlled	

stroyers of important values. Breaking out of this frustrating and paralyzing situation will require compromise and understanding.

I think that in dealing with the issue of wilderness versus timber production and outdoor recreation, we are slowly moving in the right direction. Wilderness and semi-wilderness areas are being legislatively recognized, and should be designated according to suitable criteria and then managed so as to maintain desired standards. Kinds and degrees of use must be specified. No use in the strict sense is either unrealistic or a misnomer. Ideally, wilderness areas should be graded across a spectrum according to natural characteristics and intensity of use for approved purposes. The spread would extend from the Brooks Range in northern Alaska to a once or twice cutover Appalachian forest.

We are all nominally for conservation and environmental protection. The question is how much conservation and environmental protection; when, where, and at what cost? Personally I want lots of it and I believe Americans want lots of it. As a matter of insurance against future risks, we in this country can afford a lot. If the people of the United States can put 5.8 percent, and rising, of their own wages and salaries into old age security, with this matched by government contribution, surely they should also be willing to put half that or so into old age security for their land, water, and air—the planetary resources on which they depend utterly.

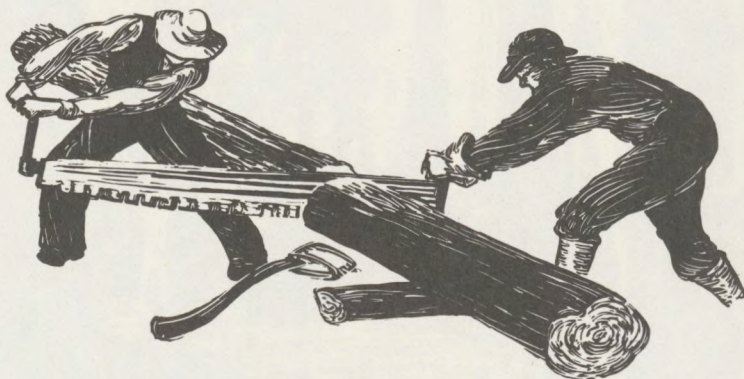
The actual funds to do this could be channeled through private or governmental programs, or both. The basic point is that the job has to be done one way or the other. My preference is for the private route, where possible, by large use of emission charges and user fees. I see much merit in pricing privately sold products and services so as to include fully the costs of protecting the environment. When this can't sensibly be done, then regulations, penalties, and taxes are available for doing the job the bureaucratic way.

At present, neither private nor public forests are being conserved and protected on a truly long-range basis, with enough flexibility built

into policies to permit response to new knowledge on conservation methods and public preferences. It should be possible to find consensus not only on long-term conservation but also on the scale of funding required to reach agreed-on objectives. The costs of an adequate program of environmental improvement do not appear to be unbearable. Two to 2½ percent annually of the gross national product (\$24 to \$30 billion a year this year), about twice what is now being spent, would enable progress to be made.

It is all too easy for professional

foresters, industry leaders, and environmentalists to become so caught up in their own work that they forget, except in a general way, that the other people in the country see the forests and forest policy from a different perspective. If it is to reflect a national consensus, forest policy in the future must also take into account the need for reasonably priced housing, cheap and attractive paper products, the effect of changes on local economic structures, and a variety of similar concerns that reflect the interests of the general population.



PETRODOLLARS AND THE WORLD MARKET

Excerpted from a preface, by Hans Landsberg, Director of RFF's Energy and Minerals Program, to a forthcoming RFF publication by Donald Wells.

PERHAPS it is just as well that the research community does not concern itself with thinking up all the potential questions to which answers may someday be needed. Some rule of relevance and timeliness does seem to order the agenda. But at times events move so rapidly that scholars are left far behind, unable to come up with good answers to burning questions. Conjecture, speculation, and the imaginative drawing of analogies then take the place of careful research.

The Arab oil embargo and the drastic increases in price associated with it are such events. They have caught the scholarly community with its cupboard bare, or at best only spottily occupied. Among the

many questions still to be answered is the degree to which the rapid and large accumulation of oil revenues will affect monetary and eventually economic stability the world over. While new jargon has quickly emerged and one talks glibly about "petrodollars" and of "recycling" the swollen treasuries of the oil-exporting countries, the knowledge on which the discussion rests is pretty thin.

An important aspect of the debate is the capacity of the Arab nations to absorb the revenues through expanding consumption by their citizens as well as their investment in productive facilities. "Absorptive capacity" is a concept long employed among students of foreign aid and development economics generally. It relates to the degree to which a country can, in an orderly manner, utilize an inflow of funds. In the case of some of the Middle Eastern oil-producing countries, the expected rise in the volume

of such funds is so steep that neither the existing literature nor the country's own experience is of much help in establishing a firm base on which to build forecasts. Even after domestic absorption, there will still be a substantial amount of cash available for use outside the exporter countries. The volume of this cash will be a critical factor in judging prospects for world economic stability.

Donald Wells has wisely chosen Saudi Arabia as the key country in this picture, given the contrast between the vast potential for expanding oil production and the modest economic stage of development. In developing his thesis that Saudi Arabia's absorptive capacity is greater than the casual observer would suspect, Wells leans heavily on an analysis of past budget appropriations and expenditure records and on evidence of unmet needs of the country's population. I use the term "needs" advisedly, since in the absence of matching income these needs have not attained the dimensions of "demands." This, however, is the transformation that Wells expects in the future, largely through government intervention via enlarged imports of consumer goods, social services, housing, and—last but not least—military hardware. In the investment area, agricultural infrastructure and oil-related industry rank high as potential outlets.



The net result of this absorption is a large but not overwhelming volume of funds seeking employment abroad. However, since one of the major factors contributing to a lower surplus is a large military buildup, it is hard to know whether or not to characterize the outlook as salutary. But that is not Wells's task. What he has done is make available a substantial volume of data and supplied ways of drawing conclusions from them. It will be up to the reader to judge their relevance as well as their usefulness for further analysis.



AN EXCHANGE OF VIEWS

August 27, 1974

Editor:

The address by Allen Kneese (excerpted in June, 1974, "Resources") was an excellent conceptual and historical assessment of the phenomena that induce serious pollution problems. Basically his argument is that "common property resources," primarily water and air, are left unpriced (and "unowned") so that there is every inducement to utilize these resources in detrimental, as well as, harmless ways. Other institutional inducements, such as depletion allowances and direct subsidies encourage the use of large amounts of materials. Unpriced water and air induces material waste although private production and distribution costs induce efficient use of product materials prior to disposal. I agree that some degree of coalition and cooperation is required to reduce pollution (and

waste) levels. I also agree that a persistent source of the pollution and waste problem is the system of incentives promoted by tax and subsidy plans at all levels of government.

I disagree with Kneese when he goes on to say that pollution is a result of market failure and that federal laws taxing effluents and effluent-creating inputs should be enacted to somehow remove or equalize incentives for pollution and waste treatment. This proposal is like wielding an axe on the head of another axe rather than its handle. An alternative proposal readily follows from his insightful analysis.

First it must be recognized that increased pollution and waste is not an example of market failure. The inducements to exploit greater quantities of resources and to "freely" dump wastes and residuals into the air, land, and water come from government policy intervention into the market system. It is unlawful to own most waterways and airways and thus there is no private incentive to keep them clean. As owners and controllers of property, governments have been most lax. Yet governments are quick to enact laws and propose policies regarding the activity of the private sector. Most of these policies lead to "special interest" legislation. The proliferation of special interest laws and regulations has served to abrogate the efficiency of market allocation of privately owned resources. Whatever the original intent of these laws the effect has been to close markets, increase prices, increase pollution and waste, and reduce output and labor employment. To characterize present environmental (and economic) problems as market failures is to pervert the notion of the operation of free markets unencumbered by plans and restrictions.

Second, in his policy proposal Kneese determines the appropriate level of coalition to handle pollution problems. He calls for taxation at, presumably, both state and national levels. By and large the impact of pollution from stationary sources is confined to localities such as urban or extended urban areas. Since areas differ in air and water quality it is not unexpected that urban policy makers would devise different tax policies than state or national governments.

Third, Kneese points out that "common property resources" are only imperfectly reduced to and defined as private property parcels. This, of course, is supposition and denies the important function of a market which is to rearrange and adjust ownership patterns (once some initial allocation is determined) in order to gain in private welfare. That some owners of land, air, and water would allow greater amounts of pollution and waste on their property is a likely result of market allocation. Yet pollution would cost in the private market and its harmful effects would be fully compensated. What would result is a new set of prices on polluters, pollutants, and resources which would improve efficiency in waste disposal. Furthermore, the size of decision units (ownership) would emerge from efficient market processes in a similar way that economies of scale are discovered and exploited.

The proposal I would make would be to open up government held or controlled property—air, land, and water—to private ownership claims and private control and to remove existing tax and subsidy incentives already on the law books. Only then will the market system function at its best resulting in, I suspect, greater output, less pollution, lower prices, and greater general welfare than the present situation even with the imposition of Kneese's new taxes. Market failure is generally what people posit as the source of many adverse events having large externalities. Externalities, however, can be priced away (internalized) at various levels of coalition. A free market, unlike the existing U.S. market system, induces coalition and cooperation to improve the private (and social) welfare. The freeing of markets and the extension of markets to new areas is the key policy to be proposed. It is the force of government, which is incompatible with free enterprise, that has failed in the pollution case and will continue to fail as long as government policy makers impede the functioning of the market.

Sincerely,
William K. MacReynolds
 Research Associate
 Center for Environmental
 Quality Management
 Cornell University,
 Ithaca, New York 14850

September 5, 1974

Dear Mr. MacReynolds:

I am pleased that you found part of my address to the Canadian Royal Society meeting insightful. I fear, however, we must continue to disagree on the policy implications of my analysis of the sources of pollution problems. I do not feel that private ownership of the air and water resources would produce desirable results.

Imagine private ownership of the New York—New Jersey Metropolitan air-shed. To avoid the continuing existence of large scale externalities ownership would have to be in a single unit. Let us say that ownership implied the privilege of charging a fee for residuals discharge (and on breathing?). Since from what we know about the probable response of dischargers to such a fee, very high fees or very low fees would yield the most revenue, so the monopolist, being a revenue maximizer, would almost certainly set the price at an inappropriate level.

One could claim, of course, that breathers of the air would band together to bribe the owner to set the fee higher (if he has set it too low) but then we encounter the well known problem of the "transactions costs" involved in setting up a market.

I do not think the problem of establishing a positive and creative environmental policy can be met so easily as you suggest.

Sincerely,
Allen V. Kneese
 Department of Economics
 University of New Mexico,
 Albuquerque, N.M. 87131



IN MEMORIAM

RFF announces the publication of the selected works of Orris C. Herfindahl, 1918-1972.

RESOURCE ECONOMICS
 Selected Works of
 Orris C. Herfindahl
 edited by David B. Brooks



Orris Herfindahl was among the first modern economists to go beyond a descriptive survey of natural resources and to view mineral resources as economic goods. Using traditional (neoclassic) theoretical and empirical economic analysis, he threw new light on resource supply and demand relationships.

Best known for his work in minerals supply and completion in the minerals industry, Herfindahl advanced the now widely accepted view that ore deposits are better treated as capital than as "land." In his later work, Herfindahl addressed the larger issue of the quality of the environment. From 1957 until his death, Herfindahl was a senior research associate with Resources for the Future.

David Brooks, a colleague of Herfindahl's, has compiled a convenient text of balanced and representative samplings of Herfindahl's writings on the nature and scope of source economics, natural resource supply and conservation, the economics of the minerals industry, the supply of natural resource information, and the quality of the natural environment. The editor provides an introduction which sets the thematic framework and a full bibliography of Herfindahl's work.



New RFF Books

The following titles may be ordered from The Johns Hopkins University Press, Baltimore, Maryland 21218.

West African Marine Fisheries: Alternatives for Management. James A. Crutchfield and Rowena Lawson. RFF Program of International Studies of Fishery Arrangements Paper 3. 64 pp. Summer 1974. Paper, \$3.00.

Organizational Arrangements to Facilitate Global Management of Fisheries. Edward Miles. RFF Program of International Studies of Fishery Arrangements Paper 4. 23 pp. Summer 1974. Paper, \$1.00.

Fisheries of the Indian Ocean: Issues of International Management and Law of the Sea. Arlon R. Tussing and Robin Ann Hiebert, with Jon G. Sutinen. RFF Program of International Studies of Fishery Arrangements Paper 5. 55 pp. Summer 1974. Paper, \$3.00.

Tuna: Status, Trends, and Alternative Management Arrangements. Saul Saila and Virgil Norton. RFF Program of International Studies of Fishery Arrangements Paper 6. 59 pp. Summer 1974. Paper, \$3.00.

Resource Economics: Selected Works of Orris C. Herfindahl. David B. Brooks, ed. 339 pp. September 1974. Cloth, \$16.00.

Minerals and Men: An Exploration of the World of Minerals, revised and enlarged edition. James F. McDivitt and Gerald Manners, 192 pp. October 1974. Cloth, \$7.50.

Technical Change, Relative Prices, and Environmental Resource Evaluation. V. Kerry Smith. 116 pp. September 1974. Cloth, \$8.00.

Interbasin Water Transfers: A Case Study in Mexico, Ronald G. Cummings. 144 pp. October 1974. Cloth, \$7.00.

Waterfowl and Wetlands: Toward Bioeconomic Analysis. Judd Hammack and Gardner Mallard Brown, Jr. 103 pp. September 1974. Cloth, \$7.00.

Working Papers

Energy and the Social Sciences—An Examination of Research Needs. Hans H. Landsberg et al. RFF. October 1974. \$7.50.

Forest Policy for the Future: Conflict, Compromise, Consensus. Marion Clawson, ed. 360 pp. Summer 1974. Paper, \$5.00.



Note

Out of print issues of *Resources* are now available in microform from Xerox University Microfilms, 300 North Zeeb Road, Ann Arbor, Michigan 48106. For further information, please write to that address.



RFF Reprint Series

The following reprints of staff material have been added to the RFF Reprint Series. Single copies are available free on request to Resources for the Future. Additional copies are priced as listed.

114. *A Linear Programming Model of Residuals Management for Integrated Iron and Steel Production.* Clifford S. Russell and William J. Vaughan. From *Journal of Environmental Economics and Management*. July 1974. More than one copy 25 cents each.

115. *Disparate Fisheries: Problems for the Law of the Sea Conference and Beyond.* Francis T. Christy, Jr. From *Ocean Development and International Law Journal*. Summer 1974. More than one copy 25 cents each.

116. *Limiting the Demand for Energy: Possible? Probable?* Joel Darmstadter. From *Environmental Affairs*. July 1974. More than one copy 25 cents each.

PUBLISHED THREE TIMES A YEAR.

REPLICATION WITH CREDIT IS PERMITTED

RESOURCES FOR THE FUTURE, INC. is a nonprofit corporation for research and education, established in 1952 with the cooperation of the Ford Foundation to advance the development, conservation, and use of natural resources, and the improvement of the quality of the environment.

Board of Directors:

Erwin D. Canham, *Chairman*, Harrison Brown, Roberto de O. Campos, Edward J. Cleary, Joseph L. Fisher, Luther H. Foster, F. Kenneth Hare, Charles J. Hitch, Charles F. Luce, Laurence I. Moss, Frank Pace, Jr., Emanuel R. Piore, Stanley H. Ruttenberg, Lauren K. Soth, Janez Stanovnik, Maurice F. Strong, Julia D. Stuart, P. F. Watzek, Gilbert F. White

Honorary Directors: Horace M. Albright, Hugh L. Keenleyside, Edward S. Mason, William S. Paley, Laurance S. Rockefeller, John W. Vanderwilt

Acting President: Marion Clawson
Secretary-Treasurer: John E. Herbert

Address correspondence concerning *Resources* to Mark Reinsberg, director of publications.

RESOURCES FOR THE FUTURE, INC.

1755 Massachusetts Avenue, N.W.
Washington, D.C. 20036