

Hoover's position in university politics.

How to sum up the Hoover today? Scholars generally regard the library as splendid and as enjoying a comparative advantage by being well financed. The archives are looked upon as a unique resource. As a research center the Hoover is a highly heterogeneous place. Outside scholars who use the Hoover are a diverse lot and their product is equally varied.

Many observers say that Hoover policy-research publications still tend to have a hawkish tone on international affairs and a free market bias on domestic ones. At the same time, several Stanford faculty who say they disagreed with the Hoover's political orientation agreed that the Institution's publications have improved markedly in quality, and, as

one put it, "the proportion of Hoover publications below acceptable level has shrunk close to zero; it's become a respected and respectable institution." The intellectual atmosphere of the Hoover is still apparently most congenial to conservatives, but the Institution has shown a willingness to add able scholars of a politically centrist persuasion in more than token numbers.

As for the future, there are no signs that the university will seek to resolve these seeming contradictions by ending its curious kind of coexistence with this very sui generis Institution. The Hoover is expected to maintain its financial strength which is a major source of its powers of independence. Modest expansion is expected, but inflation and the Hoover conservatism which extends to

financial management will probably limit the rate of growth to well below that of the last decade.

As for its political impact, the Hoover is now being taken seriously as a source of policy analysis and advice, but the scale of the effort and the number of Hoover people circulating in the corridors of power are still too small to have made more than a modest beachhead. The 1970's were essentially a period of preparation. The 1980's will show whether the Hoover will really rival Brookings and AEI. The results of the elections in November will count significantly, but the Hoover's partisans are encouraged because they think that the changes at Hoover have come, so to speak, just when the times are Right.

—JOHN WALSH

## Phosphate: Debate over an Essential Resource

*Some see a need for a national phosphate policy, but the industry regards this as an invitation for federal meddling*

*Lakeland, Florida*—The citrus groves and cattle ranches which once, years ago, gave the landscape south of here its special character have long since largely given way to one of the most remarkable concentrations of mining, minerals processing, and chemical production activity in America. Situated some 25 miles to the east of Tampa, this is a region known for its buried treasure: the Bone Valley phosphate formation, the richest deposit of phosphate ever discovered anywhere and hence a major source of an essential feedstock for fertilizer plants in this country and abroad.

The Bone Valley phosphate mining and processing area extends over some several hundred square miles. The landscape is dominated by strip mines, plants for the beneficiation of phosphate ore and manufacture of phosphoric acid and other products, and huge "slime ponds" and gypsum piles for residues. Walking draglines, some of them big enough to rival the giant machines of the open pit coal mines of the West, dig a series of parallel cuts, each a few hundred feet wide and several thousand feet long, in removing the shallow overburden and extracting the phosphate ore.

Mining of the Bone Valley formation, which is made up of the fossilized re-

mains of marine animals laid down some 10 to 15 million years ago during the late Miocene or the Pliocene, began nearly a century ago as part of the Florida "phosphate rush" of the late 1880's and the 1890's. Production from this formation eventually became one of the dominant factors in the world market and this is still the case today. Indeed, Bone Valley phosphate has in recent years represented a third of total world production and about three-fourths of U.S. production.

But after all the years of mining, and especially the intensive mining of the last decade, the Bone Valley formation has been largely stripped of its richest ore and is expected to be exhausted within another 20 to 30 years. For some observers the coming dependence of the phosphate industry on ores that will be less rich, harder to get at, and more expensive to process signifies possible trouble ahead.

Some fear that within the next 10 to 20 years the United States will lose its position as the leading exporter of phosphate and that by sometime early in the next century it could even become a major importer, dependent on possibly unreliable foreign producers who may attempt to control the price through a new "OPEC" or Organization of Phosphate

Exporting Countries. People in the phosphate industry, on the other hand, put down such fears as nonsense and indicate that Florida alone has enough phosphate left to sustain for 500 years the current domestic production of some 50 million tons a year.

Phosphate is not yet a hot issue nationally, but increasing attention is being given in Washington to the widely differing and contradictory phosphate reserve and resource estimates. There are even proposals afoot that call for a national phosphate policy looking to the development and conservation of this mineral as a vital resource.

But is such a policy in fact necessary, and, if so, what might it consist of?

Such questions have been brewing for quite a while. Even 6 years ago, the U.S. Bureau of Mines' commodity specialist for phosphate, William F. Stowasser, was concerned about what he perceived as the rapid depletion of high-grade phosphate reserves. In a memorandum to his superiors, he took strong exception to the Nixon Administration's decision—about which the Bureau of Mines was never consulted—to approve the 20-year, \$20-billion deal that Armand Hammer and his Occidental Chemical Company had struck with the Russians

for an exchange of superphosphoric acid produced by Occidental in north Florida for ammonia and potash to be produced in the Soviet Union.

The annual shipments of phosphoric acid to the U.S.S.R. were to be equivalent in amount to about 3.5 million metric tons of phosphate rock, or more than 6 percent of last year's total U.S. production. Recently, President Carter, as part of the U.S. response to the invasion of Afghanistan, imposed a ban on export of phosphate rock and fertilizers to the Soviet Union.

Bearing directly on the question of the adequacy of domestic phosphate resources is the report that was issued late last year by the U.S. General Accounting Office (GAO). Entitled "Phosphates—A Case Study of a Valuable Depleting Mineral in America," this report begins by noting that the pace at which domestic reserves are being exploited is such that more than half of all the phosphate ever produced in the United States was mined within the past 12 years. It warns that total domestic reserves are now down to 2.2 billion metric tons, or only enough for the next several decades at the present rate of production.

The report concludes by calling for: (i) a comprehensive reassessment of phosphate reserves and resources in the United States and abroad; (ii) a review of "alternatives to import dependency"; (iii) an exploration of "possible food production alternatives" to ease the demand for phosphate; and (iv) a determination as to how much environmental and land-use regulation could and should limit access to phosphate deposits. In sum, the GAO has called for a national phosphate policy.

Since 1977, the Carter Administration, with the prompting of the mining state representatives in Congress, has had under way a "nonfuel minerals policy review" which in time may lead to the adoption of a national policy looking to the conservation and development of a number of important mineral resources, phosphate included. But, so far, the visible results of this exercise have been quite modest.

One reason that little has been said or done about phosphate, however, is that compared to many other minerals, it is relatively abundant; the Administration officials who are concerned with future mineral supplies are by no means all convinced that there is an approaching problem of phosphate scarcity. The Department of Commerce, the Office of Science and Technology Policy (OSTP), and even the Department of the Interior, home of the Bureau of Mines, all show



*Clay slimes from the beneficiation of phosphate ore are pumped into this diked storage pond adjacent to an orange grove. [Photo by Sarasota Herald-Tribune]*

more than a little skepticism on this point in their comments on the GAO report.

Philip M. Smith, deputy director of OSTP, has observed, for instance, that the fact that the highest grade, most accessible phosphate rock will be gone in a few decades is in itself "not necessarily a matter of concern." He added that large additional resources exist and that, with improved technology and higher prices, they may well be exploitable by the year 2000 or thereafter.

Ever since the GAO report appeared it has been a cause of concern to phosphate industry officials. They see it as an invitation to federal intrusion and meddling in how the industry is run. The GAO's domestic reserve estimate of 2.2 billion metric tons is, they maintain, highly misleading. They insist that the GAO was much too rigid and conservative in counting only those deposits minable at a cost of \$15 per ton or less. (In 1979 the average market price was \$20.26 per ton.)

Peter O. Sandvik, geologist and a director of minerals development for the International Minerals and Chemical Corporation (IMC), the nation's largest producer of phosphate, says, "Florida alone has 8.1 billion short tons of phosphate rock recoverable by existing conventional [surface] mine and plant technology and at costs that will make them economic to mine and process at the time they will be produced."

He says, furthermore, that Florida has another 3.2 billion tons of well-defined deep phosphate deposits that will be recoverable by new mining technology already being tested in Florida and North Carolina.

The GAO report is not to be easily

brushed aside, however. It is largely based on an evaluation of the availability of Florida phosphate which was prepared for the Bureau of Mines in 1978 by two highly regarded mining consultants, Michael E. Zellars and J. M. Williams of Lakeland.

The report acknowledges the existence of reserves and resources that will be minable as prices rise and technology improves, but the total amount that is minable, at prices up to \$40 per ton, is estimated at 4150 billion short tons, or half the tonnage estimated by IMC. Moreover, recovery of this phosphate is considered by Zellars and Williams to be subject to varying levels of technical probability, which is to say that while the chance of recovering 2000 billion tons is put at 75 percent, the chance of recovering all 4000 billion is only 25 percent.

In addition, recovery of some 624 million tons is said to be subject to "extreme" environmental constraints, which means that the potential for public resistance is such that development is likely to be "severely inhibited, reduced, or delayed." Recovery of another 2150 billion tons is deemed subject to less severe, yet still significant, constraints. All told, although phosphate is indeed abundant, its recovery, as Zellars and Williams see the matter, involves considerable uncertainty.

But Zellars told *Science* that the numbers being tossed back and forth in the phosphate debate are all very large and that he is not one to cry wolf or advocate a special national policy for phosphate. As he points out, besides the phosphate in Florida, there are sizable deposits in Georgia, the Carolinas, and some western states, notably Idaho.

Yet Zellars is worried about environmental constraints on phosphate mining and about loss of phosphate-bearing land to urbanization. He says that, in Florida, it could easily be documented that more phosphate is lost to urbanization and other preemptive surface uses each year than is actually mined.

It is clear that if a strong case is made for establishing a national phosphate policy, it will rest in no small part on the need for a better reconciliation of economic, social, and environmental values. For years, environmental considerations were given short shrift, and the accumulated abuses of the past have produced a reaction which, as Zellars indicates, puts accomplishment of many industry plans in doubt.

Any visitor to the Bone Valley area can see easily enough why this reaction has come about. Until the 1970's, state and local officials put little pressure on the phosphate companies to reclaim strip-mined lands. As a consequence, only about 30,000 of the some 150,000 acres that have been mined have been reclaimed.

Slime ponds, some of them a square mile or more in extent, cover some 41,000 acres, and even when dried out they offer a surface too unstable for much more than livestock grazing. And, up until about 1972, every few years a slime pond dike would fail and allow a devastating flood of clay slimes to pour into the headwaters of the beautiful Peace River or the Alafia River, killing nearly all fish and other aquatic life for scores of miles downstream.

For a time, back in the 1950's and 1960's, fluoride emissions from phosphate chemical manufacturing plants were poisoning cattle and killing citrus trees—and helping generate the first substantial and determined effort in Tallahassee, the state capital, to bring air and water pollution under control.

The upshot of the phosphate industry's manifold abuses and of the political response to them is that over the past decade a complex, multilayered regulatory structure has taken shape and become increasingly assertive. This is an important fact of life today for the phosphate industry here in Polk County as it seeks to extend its operations beyond the Bone Valley formation to the less rich but still promising deposits in counties lying to the south and east.

The phosphate companies—of whom more than a dozen are active here, including IMC, Mobil, W. R. Grace, Agrico, and Borden—must deal with regulators at all levels of government, federal, state, and local. Some of the county gov-

ernments have themselves become increasingly tough to deal with, and efforts to win local approval of mining plans for the new frontier areas have progressed slowly. In fact, wanting to reduce at least the number of hurdles that must be jumped to get plans approved, the industry earlier this year endorsed a demanding state comprehensive mining and reclamation law proposed by Governor Bob Graham (this measure was still bogged down in committee when the legislature adjourned recently).

Sarasota County, which has some phosphate in its northeast corner, is regarded by the companies as so antagonistic that none of them would think of trying to mount a mining operation there. Indeed, it was David B. Lindsay, Jr., publisher of the *Sarasota Herald-Tribune*, who, shortly before Florida's Republican presidential primary in 1976, prevailed upon President Ford to have the U.S. Environmental Protection Agency prepare a sweeping environmental impact study of all of the phosphate industry's plans to expand its operations in central Florida.

Published in 1978, this study includes some recommendations for new mining operations that are viewed by the industry as burdensome, if not impossible. One is to avoid more than a year's accumulation of clay slimes in above-grade settling ponds by finding ways to use these slimes earlier in reclamation—the motivation being to reduce the number and size of settling ponds and hence the possibility of dike breaks. Another is to avoid drying the phosphate concentrates at the beneficiation plant by shipping them wet to the chemical plants, thus avoiding dust problems. A third recommendation, aimed at precluding any possibility of groundwater contamination, is to line with an impervious material the bottom of the ponds or "stacks" used for the disposal of gypsum from the chemical plants.

All three of these EPA recommendations are related in one degree or another to the fact that phosphate ore contains uranium, indeed enough uranium that it can profitably be recovered as a by-product. The residues of phosphate processing and chemical manufacture—the slimes, the dust, the impure gypsum—all contain radium-226 and other radionuclides and give off radon gas, though not nearly so much as is given off by uranium mill tailings.

The presence of the radionuclides poses a low-level radiation hazard, but how significant it is and just what should be done about it are questions that re-

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## Congress May Veto Nuclear Fuel Shipment

An effort in Congress to overturn the Carter Administration's decision to ship nuclear fuel to India is rapidly gaining adherents. Chances of a veto in the House are considered strong, although the likely outcome in the Senate remains uncertain.

Lobbying on the issue is already fierce, even though the issue will not be put to a vote until August or September. Carter announced on 19 June his intention to ship the uranium as planned, ignoring signs that Congress might object because India has flouted the requirements of United States nonproliferation law (*Science*, 6 June).

Carter accepts all of the arguments advanced by the State Department in favor of the shipment, including the consideration of cultivating India's favor as a valuable ally in an unstable region, and avoiding what Carter terms "the risk of a claim" by India that a U.S. refusal releases it from agreements not to reprocess spent nuclear fuel it has on hand. India has recently made this threat explicit. Carter says his action "in no way indicates a change in the high priority I attach to preventing the spread of nuclear explosives. On the contrary, this action reflects my judgment that nonproliferation would be set back, not advanced, by withholding these exports [because they] . . . help us to maintain a dialogue with India in which we try to narrow differences."

This stands in starkest contrast to the views of James Barnes and S. Jacob Scherr, who testified on behalf of five environmental groups during recent Senate hearings: "For over 20 years, we have heard the same arguments about the importance of maintaining U.S. leverage over the Indian nuclear program by providing them nuclear equipment, material, and technology. We have seen the State Department, time and time again, go to great lengths to avoid confrontation by relying on hair-splitting legalisms and ambiguities."

Part of the dispute centers on whether a U.S. refusal to ship the fuel violates a 1963 agreement with India. Senator Alan Cranston (D-Calif.), who opposes the sale, says it does



A dragline has stripped the phosphate ore from these parallel cuts after dumping the overburden. The cuts will later be filled in and the site regraded. [Photo by Luther J. Carter]

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main very much unresolved. In announcing on 5 May regulations for the control of hazardous wastes, EPA said that it was deferring until October the issuance of regulations applying to phosphate wastes. The agency clearly does not regard these wastes as hazardous in the usual or Love Canal sense of that term; but the volumes in which they are generated are so immense that, for the industry, the thought of *any* new regulations requiring them to be further isolated from the environment raises an alarming prospect.

In north Florida, there has been festering for years an issue that may be a classic illustration of how confused public policy can become with respect to conflicting economic and environmental values. In the mid-1960's, several companies, including Monsanto, Kerr-McGee, and the Pittsburgh and Midway Coal Company, were issued permits to explore for phosphate in the Osceola National Forest. The upshot was that some 10 years ago, the companies began applying for preference right leases to mine 52,000 acres, extending over about a third of the entire forest.

Traditionally, the forest has been managed for timber production, public recreation, and protection of the watershed of several rivers, including the famous and treasured Suwannee. Florida officials have therefore viewed any prospect of massive strip mining in the Osceola as a terrible and totally unacceptable incongruity. The U.S. Forest Service is also opposed to the proposed mining because the mined areas could not be returned to their present condition and uses.

Yet the companies involved, having gone to the expense of an exploration effort sanctioned by federal permit, claim a vested right to the mining leases. A com-

promise solution now being explored would have the companies abandon their claims in the Osceola in return for leases on federal coal lands in Wyoming. Such an outcome would put the Osceola phosphate lands off limits to exploitation in the foreseeable future, but the phosphate—some 120 million tons of it—would still be there as a modest strategic reserve if it should eventually be needed.

Federal, state, and local agencies are increasingly being faced with the question of whether to allow phosphate mining in sensitive areas such as national forests and freshwater wetlands. According to some EPA people now engaged in environmental review and permitting procedures, the decision-makers need policy guidance to help them weigh the nation's interest in assuring phosphate production at various levels against its interest in avoiding or mitigating environmental impacts.

One thing seems clear: Even if U.S. phosphate production falls below domestic demand sometime in the next century, the sky is not going to fall. Indeed, if Morocco, the "Saudi Arabia" of phosphate with about two-thirds of the world's identified reserves, should ever produce phosphate rock more cheaply than the American companies and claim a part of the U.S. market, this could lead to some easing of the pressures driving fertilizer and food prices upward.

Nonetheless, there is no question but that it is in the national interest for the United States to continue to have a strong, competitive phosphate industry. To this end, development of a national phosphate policy might be useful in a number of ways. Besides helping public officials better to resolve the kind of economic and environmental questions referred to earlier, such a policy could:

- Encourage land use planning and controls aimed at zoning phosphate

lands so that, while some areas may be designated "unsuitable for mining," others will be designated as "reserved for mining." Such zoning is called for in the National Academy of Sciences (NAS) 1979 report *Surface Mining of Non-Coal Minerals*.

- Encourage the phosphate industry to do more and better research, both with respect to recovering more phosphate from the ore, or "matrix" as it is called, and to achieving better land reclamation and management of clay slimes and other residues. Up to 35 percent or more of the phosphate in the original matrix is lost in processing. Some companies, such as IMC, are active in research, but, as the 1977 *World Food and Nutrition Study* of the NAS pointed out, they are the exception and not the rule.

- Promote better control of soil erosion. Along with the alarming loss of top soil from erosion, there are enormous losses of phosphorus and other soil nutrients.

- Encourage the development and adoption of farming practices to increase the efficiency of use of phosphate fertilizer and of the phosphorus that naturally occurs in most soils and that exists in organic materials. Some experts on plant nutrition believe that the gains in efficiency could reduce the demand for phosphate fertilizer substantially, perhaps by as much as 50 percent.

To judge from its comments on the GAO report, the Department of the Interior's attitude toward development of a national phosphate policy is quite reserved. In a letter to a Florida congressman, Secretary Cecil D. Andrus said some of the report's recommendations appear "based on the assumption that the market system is no longer capable of planning and providing for the mineral needs of this country and that overall government planning should be put in place.

"We find no reason for a reorientation of the respective roles of government and the private sector," Andrus said. But Interior is, at a minimum, committed to the kind of major reassessment of domestic and world phosphate reserves on which a national phosphate policy could be based.

Also, two consultants to the President's Council on Environmental Quality (CEQ), Eric Rifkin and David Sheridan, are preparing a report which will envision a policy that may embrace some or all of the goals cited above. Certainly, CEQ, along with EPA and the Department of Agriculture (home of the Forest Service), has reason to favor such a policy.—LUTHER J. CARTER