Letters

The Strategic Petroleum Reserve

As reported by Eliot Marshall (News & Comment, 25 Apr., p. 441), under the Energy Policy and Conservation Act of 1975 the United States has been accumulating a strategic stockpile of crude oil in underground reservoirs in Texas and Louisiana. The strategic petroleum reserve (SPR) now stands at 500 million barrels, the original goal; the target was raised to 1 billion barrels by President Carter and later lowered to 750 million barrels. Congress wants to proceed to 750 million barrels, and the Administration wants to stop filling it—or at least slow down the rate. The debate is marked by many misconceptions, chiefly the lack of a clear distinction between dependence on imports and vulnerability. They are definitely not the same concepts.

There is no credible analysis that supports a particular target amount for the size of the SPR. The most common argument is that it should contain enough to last for 100 days at the actual rate of imports. There is concern that, as our rate of imports climbs from its present 4.5 million barrels a day (about 30% of oil consumption) to perhaps double that within the next decade, the size of the SPR must be doubled to maintain the "magic" 100-day figure. Others argue that since most of our imported oil comes from Mexico, it would not be at risk in case the Persian Gulf blows up; Japan would suffer, but not the United States.

Both arguments are incorrect. Physical vulnerability is not the problem; that would occur only if there were an actual blockade of U.S. ports, which would be considered an act of war. Vulnerability is economic and derives from the price increase that would accompany an interruption of oil output anywhere in the world. The price increase would affect *all* oil, including the oil imported from Mexico, as well as domestic oil, the price of which would rise to the world level. This price increase would hit us even if we imported only 1 barrel a day—or none at all.

By the same token, oil released from the SPR would not physically replace imported oil on a barrel-for-barrel basis—as implied by the notion of a reserve of "so many days of imports." Rather, SPR oil would simply moderate the price jump of world oil and would thus help *all* of the world's oil consumers. It is sobering to realize that our SPR benefits Europe and Japan more than it benefits us, because they have a higher rate of imports. (Of course, their smaller SPR's would benefit us to some extent.)

Now that we have an SPR, in which some $20 billion has been invested, it is important to manage it properly. A recent report (*1*) makes some sensible recommendations of limited scope to the Department of Energy: (i) monitor the quality of stored oil, (ii) provide adequate means of transporting the oil to U.S. refineries, and (iii) run realistic tests of the SPR system.

The first such test was completed only in January 1986; also tested was the administrative mechanism for selling the oil by auction. But there are no clear guidelines about what constitutes an emergency that calls for release from the SPR. Hence, there is always the nagging question of whether oil will ever be sold, as the SPR bureaucrats wait for the proverbial "rainy day" that may never come. It has been repeatedly suggested that the SPR (or at least part of it) be "privatized" by selling long-term options to refiners and others to make sure that at least some of the oil will move out of the SPR whenever the price rises to certain predetermined levels.

It is probably a good idea to buy more oil now while world prices are at about one-third the level at which most SPR oil was acquired. In the event of a supply disruption, the mere existence of a large SPR could dampen a buying panic that would bring not only price jumps but the possibility of nonmarket allocations of oil, perhaps including rationing. The lack of a clearly announced policy on disposing the oil is troubling.

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The Dilemma of the Geoscientist

In an editorial in 1978 (*1*), I stressed the unlimited opportunities enjoyed by geoscientists. My rosy picture was an understatement. Between 1980 and 1983, in the wake of soaring oil prices, companies hired anyone with a college degree in geology at highly inflated salaries. As a result the geological profession expanded as never before. Oil company staffs became bloated because of the belief that large numbers of geoscientists were needed to keep pace with ever-expanding drilling activity and rising oil prices. In years past the geological community had prided itself on its dedicated, although ill-paid, scientists, but the boom forced salaries up to a level exceeding that of other scientists and engineers, except for petroleum engineers. As a result a new breed of scientists entered the profession: those primarily interested in high salaries.

Today many thousands of geoscientists are out on the street, looking for work. With the collapse in oil prices, future uncertainties, and companies looking at next quarter's balance sheet, announcements of "workforce reductions" by petroleum companies have become almost a daily event. Those hardest hit by cutbacks are in exploration and production.

The destruction of skilled teams of geologists and geophysicists is now so rapid that years of rebuilding will be necessary. Few young graduates are entering the profession. Here lies a danger that goes beyond the geoscience community. Oil now costs less in real terms than it did in the early 1970's. The price of internationally traded coal and gas has likewise tumbled. Those who rejoice in this new era of cheap energy should remember that oil and gas are finite resources. The current apparent glut is a delusion. It is manipulated by members of the OPEC cartel. In this country, we suffer from a shortage of energy resources. If those abroad who manipulate this crisis pull the plug, we will return to square one—a situation similar to that when President Carter compared his program for energy independence to a declaration of war. If that happens the United States may be unable to rise to the challenge. Experienced geoscientists could be suffering the results of early retirement, and there will be few prospective graduates in the pipeline or young geoscientists in the ranks.

The mining industry is as depressed as the petroleum industry, and hiring freezes are the norm in government service. As the message of dwindling employment reaches students, undergraduate enrollment is dropping, which reduces employment opportunities in academic institutions. Yet real opportunities may be in store for those now entering the geoscience profession as beginning undergraduate students. When these students emerge with Master's degrees, they will have no competition and their pick of jobs. As in the stock market, it is best to avoid the stampede.

One field of geoscience is bursting at its seams: hydrogeology and the related environmental geology. Because ground-water contamination, waste disposal, and similar problems require the formulation of regulations, there is much activity in these areas today. Despite a lack of experience in this specialty, petroleum geologists are switching to hydrogeology. Even graduates in geology without graduate training are being

absorbed into this field. With the government involved in regulation, this field may become less cyclical.

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1. G. M. Friedman, *Science* **201**, 215 (1978).

Geometry Problem

We physics (failed mathematics) professors also have done no plain geometry for years. We find that the solution given by our good neighbor Jonathan Baron to the problem of constructing a line of length $A/\sqrt{2}$ which halves a triangle's area (Book Reviews, 23 May, p. 1038) is true for only one particular set of triangles—those in which the altitude A equals the base B. A solution good for any garden variety of triangle is that the base of the half-area triangle should be $B/\sqrt{2}$ (and its altitude $A/\sqrt{2}$). We have confirmed this by (i) integral calculus, (ii) Monte Carlo simulations, (iii) dimensional analysis, (iv) Runge-Kutta integration schemes, (v) drawing lots of triangles, and (vi) asking the nearest grade-school kid. (Detailed autographed solutions are available from the authors.) We suspect that this is an example of the psychology of physics and mathematics: "There's all too often another solution lurking out there waiting ta get ya." We suggest that in the future, *Science* reviewers give examples that are so imposingly complicated that we readers would never dream of solving them while reading *Science* in bed.

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