than for the radioactive fission products from reprocessing.

None of these technical-economic reasons seem very important. Our European friends and the Japanese are as concerned about nuclear proliferation as we are. It is not conceivable that they will provide plutonium-bearing fuels to countries which might extract the plutonium to make nuclear explosives. By reprocessing to recover the plutonium and burning it in their reactors they may about break even economically as they figure it. They will have converted some of their spent fuel with about 1% undesirable-for-weapons plutonium to plutonium much less desirable for weapons should it ever be reprocessed again.

If one takes a longer view, oil will really run out in 40 to 50 years, Japan and Europe do not have much coal, and fast breeders will probably become very important, as well as conservation and solar power. To demonstrate one breeder may not require a big investment of effort. To replace half of the electric generating capacity in the world by breeders in 2030 is another matter.

The United States has a lot of coal, some gas and oil, uranium, and sunshine. Our dependence on imported oil is increasing today. With a reasonable program to exploit our coal, gas, and oil reserves, and to develop solar power and nuclear power, we could become net exporters of energy rather than importers who will drive up the prices for the have-nots.

But primarily I object to our telling our friends in Europe and Asia, and elsewhere, that they should do this or that to avoid nuclear proliferation. We started it and have not done very well at containing it.

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I fully agree with Albright and Feiveson that reprocessing should not be performed to recover pure plutonium, since that can be readily used in a weapon. However, reprocessing should be performed to extract the stable fission products while the remaining very long-lived transuranics (Pu, Am, Cm, and so forth) and the long-lived fission products (^{137}Cs, ^{90}Sr, and so forth) should be recycled unseparated into fuel elements for burning and producing energy in power reactors (*1*). This avoids long-term geological-age storage of high-level waste that no one wants in their backyards, and the fissile material becomes available for power generation.

Present reprocessing plants are based on chemical processes that were primarily developed to produce pure plutonium required for making weapons. Civilian nuclear power reactor fuel needs only small concentrations (~3%) of fissile plutonium or uranium. The so-called "plutonium economy" is based on recovering and handling pure plutonium. By keeping the plutonium and uranium in dilute and unseparated form for recycling into fuel elements, the fuel material will not be prone to diversion because of its inherent radioactivity. This material will be safeguarded by virtue of its use in power reactors. Placing spent fuel elements in idle long-term storage only proliferates the stockpile of plutonium. The real fission product waste is the stable elements formed by fission and decay of short-lived isotopes. The stable fission products can be disposed of just as any other ordinary waste matter. Reprocessing for extraction and disposal of stable waste and recycling transuranics and long-lived fission products for power production should gain acceptability by the public and countries that foresee an expanding need for nuclear energy in their future.

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Response: Higinbotham and Steinberg agree with us that reprocessing and the fabrication of mixed-oxide fuels pose proliferation and diversion risks. However, Steinberg is more optimistic than we are that reconstituted fuel rods containing radioactive fission products could be used economically in commercial reactors. Higinbotham is more optimistic than we are in insisting that "It is not conceivable that [the Japanese and Europeans] will provide plutonium-bearing fuels to countries which might extract the plutonium to make nuclear explosives." It seems to us more likely that, once a substantial commercial market in separated plutonium and mixed-oxide fuels is established in Europe and Japan, it will be exceedingly difficult to prevent other countries from obtaining these materials and the facilities to produce them. Higinbotham also objects to "our" telling friends in Europe and Japan what to do. Certainly, the U.S. government should not be self-righteous in criticizing the nuclear policies of other countries. But does this mean that American analysts must forever be quiet about these policies?

None of the letters quarrel with our assessment of the near-term economics of recycling plutonium. But Spinrad argues that the costs of recycling are subject to drastic reduction in the future. Perhaps this is so (though we have not seen the evidence), but how can this possibility justify a substantial *commercial* expansion of reprocessing and recycling in the immediate future—the focal point of our Perspective? We may not have wanted to abandon the development of jet aircraft on the basis of 1939 costs, but we surely would not have wanted to encourage the construction of a commercial jet fleet at that time!

Spinrad takes comfort that, while shipment of plutonium demands a high level of security, so does shipment of diamonds. But, in fact, security of diamond shipments is far from perfect. This imperfection may be tolerable for diamonds. It would not be so for plutonium.

Spinrad also downplays the risk that reactor-grade plutonium would be used for weapons. However, since reactor-grade plutonium could—as Spinrad agrees—be used to make a bomb, it must be protected from theft and diversion as carefully as weapon-grade plutonium. Furthermore, while reactor-grade plutonium is not ideal weapons material, a country that wished to demonstrate a weapons capability rapidly might decide to use available reactor-grade plutonium initially and then later use its commercial reprocessing and plutonium fuel fabrication facilities to separate and fabricate weapon-grade plutonium.

With respect to final disposal of spent fuel and high-level waste, there remain some unresolved issues. But spent fuel and high-level waste have initially similar heat outputs per ton of original uranium and essentially identical fission product contents. The OECD study that we referred to in our Perspective concluded that "[I]n terms of repository design, the problems posed by spent fuel and highly active waste are broadly similar"; and the study attributed very little difference in cost to final disposal of the two different waste forms (*1*).

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1. Nuclear Energy Agency, *The Economics of the Nuclear Fuel Cycle* (Organization for Economic Cooperation and Development, Paris, 1985), pp. 13, 101.

Erratum: In Deborah Barnes' Research News article "Debate over potential AIDS drug" (10 July, p. 128), Douglas Brenneman was incorrectly identified as a scientist at the National Institute of Neurological and Communicative Disorders and Stroke. Brenneman works at the National Institute of Child Health and Human Development.