

ply of domestic petroleum has a great deal to do with its price and also the price others can charge us for their petroleum. We would expect that the time at which energy costs approach energy gains will in large part determine the time at which drilling for petroleum as fuel ceases to be economically profitable. A possible exception, stated explicitly in our report, is that some drillers will undoubtedly make a profit by using coal to find and pump oil for petrochemical feedstocks—or even for gasoline for those wealthy enough to afford it—even after the energy return on energy invested is negative. Unfortunately, since more than half of our nation's present energy requirements are met by domestically produced petroleum (found and produced with petroleum as the principal energy source), the driller's profits would be of little recompense for the rest of us who require these fluid hydrocarbons to sustain our present level of economic activity and material well-being.

We believe that the mechanisms Singer finds wanting are stated explicitly in our report and that our analysis negates the importance of Singer's (1) earlier observation—that oil was found at an approximately constant 35 barrels per (exploratory) foot from 1950 to the early 1970's—because in general effort was decreasing then.

One problem with Singer's apparent faith in the market is that the market may fail to give needed signals about the future, that is, if estimating future national energy supplies is at least as important as estimating future profits for drillers. In principle, economic analyses could be used to make predictions, but such analyses are improved by including physical information about the resource such as that provided by our and similar analyses (2, 3). A second problem associated with leaving all decisions to the marketplace is one of discount rates. The recent factor of 20 increase in the value of oil left in the ground was much greater than that of money drawing interest, an occurrence that was apparently unforeseen in financial circles in 1972 but one that perhaps could have been predicted from Hubbert (2). And, if the amount of oil left to be found is as limited as our and other (2, 3), analyses suggest, then the search for oil now depletes our nation's remaining reserves more rapidly and decreases the incentives to make the hard decisions as to what we should do next. The present Administration's policy of largely discounting the future (for many resources) in order to increase present-day economic activity is consistent with some free-market principles

but may do little to ensure adequate future resources.

We agree with Singer that government subsidies and taxes can distort, often undesirably, free-market resource decisions; there is at least one case (4) where net energy analysis has identified some oil fields that were pumped at a monetary gain but an energy loss due to federal price regulations. We also agree with Singer's last paragraph and add that by importing oil we can leave our own somewhat meager resources in the ground, thus giving us more flexibility to meet future contingencies.

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#### "Affordable Science":

##### Another Perspective

While I do not wish to detract from the issues raised by William D. Carey (Editorial, 1 May, p. 497) with regard to federal budget cuts affecting science funding (and in particular funding for the social sciences), these cuts may turn out to be a mixed blessing.

First, it has been pointed out that science is not unaffected by interests which to some not insignificant extent condition both the questions asked and the results produced (1). It may be the case that the disengagement from areas of research by the government will remove certain governmental prejudices and vested interests as to what "questions need and are worth studying." This disengagement could produce a more desirable effect that scientific research may become more open and free to respond to the curiosity and interests of the investigator.

Second, it appears to be the case that contemporary science is fraught with the consumer mentality of our day, namely, that "the more expensive it is, the better

it must be." Perhaps by reducing funds the government will (inadvertently, no doubt) challenge scientists to do "affordable science" and still produce the excellent research of ages past when it was somehow unnecessary to have huge grants and expensive equipment to support inquiry into natural phenomena. It may be that these budget cuts may serve to make science more accessible and less formidable an enterprise because more people would see legitimate science within their own economic means to engage in it. I remember Eckhart Hess' story about his research on space perception in chicks. He conducted this significant piece of investigation with an expenditure of less than \$3. To me, that is "affordable science."

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#### Growth in Publishing

In 1976, *Nature* published my letter (1) calling attention to the JPU, or "Just Publishable Unit," which I defined as the smallest amount of information that is normally accepted for publication as a separate item in a scientific journal. Perceptive remarks about the JPU were subsequently made by Waugh (2) and Kerr (3).

Recently, *Science* printed an article introducing essentially the same concept, named the LPU or "Least Publishable Unit" (News and Comment, 13 March, p. 1137). The article discusses the need to avoid publishing material that duplicates other observations and quotes scientists who bemoan the explosive growth in scientific publishing. I estimate that the *Science* article was 27 times longer than my letter.

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*Erratum:* In the article "A firing over formaldehyde" (News and Comment, 7 Aug., p. 630), the directors of two agencies were incorrectly identified. The head of the biology division at Oak Ridge National Laboratory is Richard Griesemer. The head of the National Institute of Environmental Health Sciences is David Rall.