Letters

Nuclear Power Risks

Since Robert Gillette has reported (News and Comment, 31 Jan., p. 331) on the energy policy statement signed by 34 prominent American scientists, I thought your readers would be interested in the way that statement has already been misrepresented in our state. Although I do not agree with many of the premises and evaluations which led the group to conclude that this country should rapidly develop nuclear power sources, I know that, as colleagues in science with a lifelong commitment to truth, we would all find common ground in resisting public confusion, if not deliberate misuse, of carefully reasoned statements.

At a public meeting in Baton Rouge on 20 January, the vice president of Engineering and Design of Gulf States Utilities Company, which is about to build two nuclear reactors in this area, used the statement as evidence that nuclear plants are "perfectly safe," although the statement said nothing of the kind. Rather it said that "All energy release involves risks and nuclear power is certainly no exception." While it went on to say, in a value judgment, that the risks involved are not high enough to override the benefits, it is quite possible that leading scientists would be set up for public ridicule and disrespect by such misrepresentation, since more and more citizens are coming to learn of the grave risks involved in nuclear power generation. The scientific community can ill afford to perpetuate and enhance the growing public feeling that it is merely an uncritical, perhaps even a disreputable, adjunct of business and government in the United States. If that feeling continues to be reinforced, are we not likely to find ourselves suffering under a sweeping antiscientific backlash in the near future?

A further clarification by such eminent scientists would be welcome. It might be well, for example, to address for the American people the matter of the entire nuclear fuel cycle, not merely the power plant. The brief mention of "the difficult areas of transportation and nuclear waste disposal" play down the problems by using the term "difficult." Is this not very much like the euphemisms vested interests often used to hide embarrassing problems, and is not such language likely to discredit the scientific community's reputation for willingness to look truth in the face no matter how harsh it may be? Shouldn't it be said that, so far, the waste disposal problem has frustrated all technological solution, and also that the dangers in transportation of toxic chemicals have already proved so grave that the Atomic Energy Commission recommended a national police force and "nuclear parks" as possible solutions to the problem? In care for the integrity of all scientists, shouldn't the American people be told also of the vulnerability of the highly radioactive spent fuel storage area adjacent to every plant and the high inventory of extremely "hot" spent fuel at the commercial nuclear fuel reprocessing plants that are yet to be completed? Might it not be important also to consider and discuss the absence, in calculations such as those in the "Rasmussen report," of allowance for purposeful acts like sabotage and terror? Were that allowance made, a total recalculation of risks would be required.

Finally, I would like to question the assumptions as well as the evaluations of that "energy policy" statement. It could be argued, for example, that the survival of Western civilization as we know it need not require the enormous growth of per capita consumption of energy that has been witnessed and is further projected for the country. Whether the quality of life in the United States was appreciably better in 1970 than it was 10 years earlier (during which time per capita consumption increased by 33 percent) is debatable, but surely in that 10-year period or in the period from 1970 to 1973, when it increased another 10 percent, we have not witnessed a radical change for the better; nor need we believe that a slowing or even a moratorium on per capita consumption would mean a return to the Neolithic age.

Because there is a common ground for seekers of scientific truth, Hans Bethe and his 33 colleagues should not rest content with their first public statement but should speak once again with greater clarity and comprehensiveness. And I hope that others with the knowledge and opinions our society needs to help it make intelligent choices will also speak out loudly and clearly. This and all future generations have a great stake in the course of the nuclear power technology. Public discussion and debate can only improve our chances for survival.

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Coastal Zone Management

In his description of a hoped-for national environmental policy for guiding future growth and development in this country, Luther Carter (News and Comment, 10 Jan., p. 45) has provided a brief but accurate description of an already existing federal program—the Coastal Zone Management Program, which has all the essential elements that Carter says many in Congress think are needed.

The Coastal Zone Management Act of 1972 is national in that it provides guidelines to the states, but allows development decisions to be made locally. The act requires a system of land classification in the state's coastal region (including identification of sites especially suitable for development and those areas deserving of protection) and provides for state oversight of particularly critical areas. Since each participating state is devising its own program, it cannot be said exactly what type of protection and coverage each will provide.

The program got underway only during the past year. It is winning increased recognition as a potential means of resolving conflicts among governmental entities and among private interests. The President signed on 2 January a measure authorizing additional funds this fiscal year to help states accelerate those aspects of their management programs designed to mitigate the negative landside impacts which could stem from projected additional offshore oil and gas activity.

Those of us associated with the Coastal Zone Management Program are pleased with the voluntary state response. All but one of the 30 eligible states are now participating, and all four territories are likely to take part soon.

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Recoverable Oil and Gas Resources

The recently released final report (*1*) of the Ford Foundation's Energy Policy Project (EPP) (News and Comment, 1 Nov. 1974) is a comprehensive and valuable addition to the current debate regarding this country's energy situation. However, estimates employed by EPP of the available resources of natural oil and gas appear to be overly optimistic and lead, we believe, to a complacent view of the necessity for rapidly developing alternative energy technologies and for reducing the demand for energy.

In the three energy scenarios discussed in the EPP report, domestic oil production is expected to rise from the current annual level of 3.79 billion barrels to between 5.17 and 6.89 billion barrels in the year 2000, and domestic gas production similarly is expected to increase from the current annual 22.3 $\times 10^{12}$ cubic feet to between 24.3 $\times 10^{12}$ and 35.9 $\times 10^{12}$ cubic feet.

We have investigated the compatibility of these production rates with various published estimates of the ultimately recoverable resources of oil and gas in the United States (including Alaska and the outer continental shelf). Since it is reasonable to assume that the curve of production of a resource as a function of time is roughly symmetrical about a peak, and since the EPP production rate estimates for oil and gas increase to the year 2000 in all cases but one, minimal values of the ultimately recoverable reserves required to achieve the EPP production rates were obtained by assuming that peak production occurs in the year 2000, integrating the production curve up to this peak, and doubling the result. (In the "zero growth" scenario, the gas production rate in 1985 is the same as the rate in 2000, and so the peak was assumed to occur in 1993.)

The results of this computation and the estimates of the ultimately recoverable resources made by M. King Hubbert (*2*), the National Petroleum Council (NPC) (*3*), and the U.S. Geological Survey (News and Comment, 12 July 1974, p. 127) are presented in Table 1. It is clear that the smallest oil resource bases consistent with the EPP production figures are considerably larger than the estimates of Hubbert and the NPC and only barely within the limits of the Geological Survey estimates. The same is true for gas in the "high growth" and "technical fix" scenarios of EPP. Only the "zero growth" gas figures are consistent with the resources estimated by the Geological Survey and NPC, but even in this case they exceed the Hubbert estimates by 65 percent.

In reviewing the energy supply situation, the EPP report (*1*, p. 332) concludes:

> Our judgement is that the oil and gas resource base in this country is far from exhausted and can supply over half the U.S. energy supply in the Technical Fix scenario for the remainder of the century. Limitations on oil and gas availability are likely to stem from a combination of environmental, social, and political constraints on rates of development rather than from a physical limit on the quantities in the ground that could in theory be available.

In a literal sense, this statement may possibly be true as long as one's outlook is strictly limited to the time period before the year 2000. However, the above analysis suggests that, from a longer perspective, such a view may be incautiously optimistic.

In assessing energy policies, the wisest approach would appear to be to employ reasonably conservative estimates of resource availability to ensure that one does not fail to develop alternative energy technologies before it is too late. A continued reliance on conventional oil and gas to supply the bulk of our energy needs is appealing since, on the whole, these energy sources are less environmentally damaging, require less capital investment, and are cheaper for the consumer than alternatives. However, postponing the development of alternative energy sources and the adoption of concerted efforts to reduce the demand for energy in the hopes that current estimates of oil and gas resources are low appears to us to be a shaky foundation for a responsible energy policy.

Table 1. Estimates of ultimately recoverable oil and gas resources. The figures for oil include estimates for natural gas liquids. The National Petroleum Council's (NPC) estimate for oil assumes a 40 percent recovery efficiency (current efficiency is estimated by NPC to be 31 percent).

Source	Oil (10^9 barrels)	Gas (10^{12} cubic feet)
Hubbert	253	1100
USGS	340 to 540	1600 to 2600
NPC	320	1860
Resources required for EPP scenarios		
High growth	530	2450
Technical fix	500	2300
Zero growth	480	1820

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References

1. *A Time to Choose: America's Energy Future* (Ballinger, Cambridge, Mass., 1974).
2. M. K. Hubbert, *U.S. Energy Resources: A Review as of 1972* (Government Printing Office, Washington, D.C., 1974).
3. *U.S. Energy Outlook* (National Petroleum Council, Washington, D.C., 1972).

Gnosis and Reductionism

Before the letters from John W. Corrington and David P. Barash (13 Dec., p. 976) confuse things hopelessly, please let me make two corrections regarding my criticism of science.

1) My use of the word "gnosis" (especially in the summer 1974 issue of *Daedalus*) in no way implies that I am a proponent of Gnosticism. That old and recurrent Christian heresy boasts an immense internal diversity; I would be hard put to say which of its many variations Corrington has in mind, and which I might care to endorse or reject. Granted my views may overlap some aspects of Gnosticism (along with many other traditions). But that is purely coincidental to my main purpose. Indeed, I have taken special care never to use the adjectival form "gnostic," precisely to avoid the confusion Corrington introduces. The word "gnosis" has a fully independent existence within Western philosophy; neither the term nor the concept is any more the monopoly of the Gnostics than truth (as he quaintly suggests) is the monopoly of Judeo-Christian culture.

I have carefully defined "gnosis" in