

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 22.3×10^{12} cubic feet to between 24.3×10^{12} and 35.9×10^{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 esti-

mates 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.

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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

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
<i>Resources required for EPP scenarios</i>		
High growth	530	2450
Technical fix	500	2300
Zero growth	480	1820

my writing as a kind of knowledge other than scientific knowledge—a knowledge that is augmentative rather than reductive, that honors and invites the aesthetic, sensuous, compassionate, and visionary possibilities of experience as well as the rational and technical. The term is not meant to exclude scientific knowledge, but to embrace it within the program Abraham Maslow called “hierarchical integration” (1). It appears that Corrington speaks for those who continue to dichotomize the spectrum of human experience, and then to reject and repress the half they consider to be “discredited.” (“Discredited” by what cultural agency, I wonder.) My position is that every such dichotomy is a symptom of disease in us: of fear, rigidity, compulsive distrust. The dichotomy is the problem, and choosing one or the other half of it is no solution, because no healthy personality, no healthy culture, no healthy science can be built on less than the full and integrated range of human mentality.

My controversy is with those (and they are many, in the behavioral as well as the natural sciences) who contend that *only* science is a valid way of “knowing” the nature of things. No matter that they are otherwise Renaissance men who allow art, poetry, flower arranging, yoga to coexist in their lives as entertainments; to hold that science monopolizes our knowledge of nature is to censor experience. If nature invites a compassionate and visionary response from us, the only intellectually honest thing to do is to give it, and trust the experience to carry us where it will. To do otherwise is to lie.

2) With Barash, I fully recognize that science begins in wonder and may well take off into towering flights of imagination—especially at its unexplored theoretical margins. It should be clear by the many examples I have offered in my writing that my argument is with *reductionist* science: science whose intention or effect is to disenchant and desacralize. Barash is being less than candid if he is not as troubled as I by how virulent, widespread, and persistent this strange vice of the scientific mind has proved to be.

Again to define the controversy: my contention is that reductionism has been a central and integral part of the scientific tradition since its inception in the 17th century; that science has provided a peculiarly fertile medium

for its proliferation; that it distorts our understanding of man, society, and nature more today than ever before; and that the scientific community remains as oddly impotent to purge the vice now as in the past. In short, I do not think reductionism is a skin blemish of science, but the blood poisoning of the profession. This is not a failing that can be offset by listing all the nonreductionist science one can think of. Of course there is plenty. I accept that as being so. But nonetheless—and even more disconcertingly—reductionism continues to command full scientific status. This, I think, will continue to be so until scientists reflect deeply upon the psychology of objectivity and its proper place in our total experience of nature.

My writing has been an effort to trace reductionism back to its historical and psychological roots, to delineate its several and changing varieties, and to diagnose the effect that the many converging strands of reductionist research have had upon our culture at large—not least of all upon the scientists’s own sense of social responsibility. My conclusion (in brief) has been that reductionism results from imposing the objective mode of consciousness upon a personality that has segregated and repressed its sensuous, visionary, and compassionate powers: the peculiar personality type produced by the Judeo-Christian religious sensibility.

This does not deny for a moment that there is a place for scientific objectivity in our psychological repertoire. The most succinct formulation I have offered of that place is perhaps on pages 374–378 of the Anchor edition of *Where the Wasteland Ends* (2). It is impossible for me to see that what I have suggested there deserves to be called “anti-scientific” or “anti-rational.” If, however, that formulation is held to be an “attack” upon science, so be it. But it is intended as a therapist’s attack upon a neurotic complex that profoundly flaws the epic grandeur and humane potentialities of science.

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References and Notes

1. A. Maslow, *Psychology of Science* (Harper & Row, New York, 1966).
 2. T. Roszak, *Where the Wasteland Ends* (Doubleday, New York, 1973).
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Clarification

I wish to correct, and to apologize for an unfortunate slip in my review (30 Aug. 1974, p. 777) of Lewis Feuer’s *Einstein and the Generations of Science* (1). The phrase regarding Engelbert Broda (p. 778), which in any case is far too strong, was of course not intended to apply to Broda personally, but to his book on Boltzmann (2), and not to the accuracy of the citations and quotations in the book, but to its characterization of fin-de-siècle physics, particularly of the battle between Boltzmann and the antiatomists.

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References

1. L. S. Feuer, *Einstein and the Generations of Science* (Basic Books, New York, 1974).
2. E. Broda, *Ludwig Boltzmann* (Deutscher Verlag der Wissenschaften, Berlin, 1957).

Accurate References

Duncan Blanchard (Letters, 20 Sept. 1974, p. 1003) clearly illustrates the danger of relying on the accuracy of references cited in papers and the necessity for checking references personally before using them. Blanchard points out that a particular paper published in *Tellus* was cited in six different papers in the 21 September 1972 issue of the *Journal of Geophysical Research*. Four of the six citations to the *Tellus* paper were incorrect in some way. Blanchard’s comments and concerns are especially relevant for the scientific community in this era of the quick copy and publication explosion. His letter struck home particularly hard in our laboratory, since three of the four erroneous citations were in papers from my group. Errors of this type are inexcusable and undoubtedly occur all too frequently. However, it is sometimes difficult to avoid them, even when one has the best of intentions. In Blanchard’s letter, he refers twice to the 21 September 1972 issue of the *Journal of Geophysical Research*. The correct date was 20 September 1972. Thurber’s moral (“There is no safety in numbers, or in anything else”), cited by Blanchard, is certainly well taken.

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