feature of the corpse, but I propose an alternative hypothesis for the man's demise. My own experience is that the folded-over ear is a common consequence of having had too much to drink (substitute "state of complete inebriation" in the above quotation). Invariably, when one goes to bed in this state, he or she wakes up with a sore auricle. I thus propose that we cannot rule out the possibility that the Tyrolean man's downfall was indirectly attributable not to exhaustion, but to overconsumption of prehistoric schnapps.

George B. McManus
3175 Cumberland Road, Theodore, AL 36582

Response: McManus's hypothesis is not as improbable as it seems. His observations about the "folded-over ear" as a consequence of alcohol abuse have been described extensively (including radial nerve lesions resulting from lying in a nearly unconscious condition). However, our colleagues from the Institute for Alpine History Research at the University of Innsbruck have ascertained that no prehistoric bottle of spirits was found among the ice man's provisions. We therefore consider exhaustion to be a more likely cause of death than exposure to cold caused by intoxication.

McManus does not suggest the use of drugs, but we refer the reader to a paper by R. Pöder *et al.* (*1*) discussing pieces of two *Piptoporus betulinus*, an agaric, fastened to a leather band among the possessions of the ice man. These fungi may have been used for spiritual and medicinal purposes. They contain a pharmacologically active substance, agaricine acid, an antibiotically effective agent. To our knowledge, no hallucinogenic effects have been described for *P. betulinus*.

Horst Seidler
Institut für Humanbiologie, Universität Wein, A-1091 Wien, Austria

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EMF Research

H. Keith Florig, in his Policy Forum "Containing the costs of the EMF problem" (24 July, p. 468), addresses a segment of a broad problem that besets society today. How should one deal with fears that are not known to be justified? Florig estimates that the avoidance of weak electromagnetic fields (EMFs) now costs the United States about $1 billion annually, although there is no consensus that these fields, much small-

er than those occurring naturally in the body, can have any biological effects, let alone pose dangers.

Florig argues that more research on weak EMFs is economically justified inasmuch as that research is likely to either demonstrate that EMF dangers are real, allowing cost-effective decisions concerning mitigation, or show that the fields are harmless, thus eliminating avoidance costs. However, unless the new research differs in kind from that of the past 15 years, which I contend has created an imaginary problem where no real problem exists, one can expect only further obfuscation and higher costs to our society.

Past biological EMF research has often been misleading. Because there is no accepted model of the interactions of EMFs and the human body, experimental errors have been accepted as real effects. This is demonstrated by, and explains, the incoherence and lack of replication of the different positive reports and the almost universal lack of a dose-response relation.

Also the statistical significances of some of the biological work and many of the epidemiological reports have been seriously overstated. Such analyses are usually subjective; experience with simpler, falsifiable, physical science experiments has shown that significance levels are generally exaggerated.

There are further biases that emphasize false positives and suppress negatives. Results that are claimed to be positive are accepted for publication, while negative results are rejected as uninteresting—or as failures. And those who report positive results are more likely to have their funding renewed than those who "fail."

What should be done? Much advice, such as Florig's, is marred by conflicts of interest. Better, the National Academy of Sciences, chartered by Congress for the purpose of advising the government, should be asked to evaluate the evidence on EMF effects and to recommend appropriate action.

Robert K. Adair
Department of Physics,
Yale University, New Haven, CT 06511

Response: Adair implies that the hundreds of articles in the peer-reviewed literature reporting statistically significant observations of EMF bioeffects are the result of uncontrolled artifacts, statistical false positives, or observational bias. While such factors have undoubtedly clouded the scientific record, many credentialed observers believe that the chance that EMF hazards are real is far from negligible. A large number of biologists and epidemiologists

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contend that an equally plausible explanation of the record is that EMF bioeffects are simply more subtle than those of many other environmental agents and that, as lines of inquiry and scientific tools are sharpened through further research, uncertainties about possible EMF hazards will likely be reduced. Indeed, EMF bioeffects research funded by the Department of Energy and the Electric Power Research Institute has become much more focused over the last 5 years, reflecting knowledge gained through the previous decade.

Even if one concludes, like Adair, that the specter of EMF hazard is imaginary, there are still good reasons for expanding both the depth and breadth of EMF-related research. First, if the research record is indeed contaminated by artifact, an expanded research program that concentrates on experimental quality control and replication of existing positive studies would set the record straight. Second, public concerns and ad hoc expenditures on mitigation are driven primarily by several dozen nominally positive epidemiological studies of the relationship between EMF exposure and cancer. Further epidemiological investigation might "explain" these positive studies as arising from some non-EMF cause such as a yet-to-be-identified confounder. Third, public and private officials faced with EMF risk-management decisions are more likely to delay spending on EMF mitigation if they believe that continuing research might reduce uncertainty in their decision. Finally, accelerated research on the public's need for EMF information, on fair ways to resolve powerline siting disputes, and on low-cost means for reducing EMF exposures can reduce both contention over powerline siting and the risk of product liability suits. This would save the costs of transmission project delays and courtroom battles and would go farther toward relieving public angst than would a halt to all research.

Adair's prescription for managing the EMF issue raises another broad problem that besets society today. In a democratic society, who should decide what fears are justified? Adair would vest that power in the scientific community (or more specifically in a small elite such as a National Academy of Sciences committee). Although the public and policy-makers depend on scientists for judgments about the probability and scope of possible EMF hazards, the legitimacy of the scientist's expertise stops there. Decisions about the appropriate level of funding for EMF research or about whether to control EMF exposures require making value judgments about willingness to pay, risk aversion, and equity among other things (*1*). Such decisions require input from all stakeholders.

H. Keith Florig
Resources for the Future,
1616 P Street, NW,
Washington, DC 20036

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Brain Tumor Treatment: Significant Contributions

In our report of 12 June (p. 1550), "In vivo gene transfer with retroviral vector–producer cells for treatment of experimental brain tumors" (*1*), we cited, among others, the papers of M. P. Short *et al.* (*2*) and Z. D. Ezzeddine *et al.* (*3*), which described studies of in situ delivery of the lacZ gene into C6 gliomas and the effect of ganciclovir treatment on the growth of subcutaneously implanted tumors that bear a herpes thymidine kinase gene. We have received a complaint from X. O. Breakefield, a co-author of those reports, that our method of referencing did not give sufficient credit to their work.

It was the intent of the citations included in our manuscript to serve as an acknowledgement of the contributions of other workers reporting studies in this area of research. We regret that a more detailed description of the work contained in each of the cited papers was not possible within the space allotted by *Science* for the text of our report. The citation and terse description included were in no way intended to diminish the significance of contributions by any of the cited workers. We are pleased to again acknowledge that other investigators have suggested a similar strategy for the treatment of malignant tumors of the brain and note that none had reported the successful implementation of this strategy.

R. Michael Blaese
Kenneth W. Culver
Hiroyuki Ishii
National Cancer Institute,
National Institutes of Health,
Bethesda, MD 20892
Edward H. Oldfield
Zvi Ram
Stuart Wallbridge
National Institute of Neurological Disorders and Stroke,
National Institutes of Health

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