protest DOE turnoff" (News & Comment, 5 June, p. 1388). For more than 15 years, heavy ion medical studies at the Bevalac have been unmatched throughout the world in studying the impact of using heavy charged particles to treat human cancers. No other facility currently in use can provide the wide range of beams in sufficient intensities for these studies, and the National Cancer Institute (NCI) has therefore provided support for clinical trials to determine the role of these beams in cancer therapy. The human trials, by their nature, are long-term studies and are not yet finished. The program recently underwent a competitive peer review as an NCI Program Project and obtained an excellent priority score that assures funding for the next 5 years, assuming continued beam time.

If the accelerator were shut down now, the phase II and III trials using high-energy helium and neon ions on various promising tumor sites would have to be halted before adequate statistics have been accumulated, and the United States would lose its leadership in the field of heavy ion studies. More important, patients for whom this therapy is the best hope of cure would be denied access to the beams. The next available facility is now being constructed in Japan and will not provide beams before 1995.

In addition, a newly designed (NCI-funded) beam scanning system for conformal therapy has just been built and tested, and the group is ready to begin the first human cancer patient treatments in the world with this new, precise therapy system. It will be possible with the new scanner to initiate true three-dimensional treatment planning and optimization with the use of these well-localizable charged particle beams. Also in jeopardy is a successful radiosurgical program funded by the Department of Energy for treating large arteriovenous malformations in the brain.

In short, the biomedical community as well as the NASA life science and instrumentation communities stand to lose substantially if the accelerator is closed prematurely. We urge that the decision for closure be reevaluated and that a unique and vital resource for U.S. and interested researchers abroad not be lost.

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Missing Carbon Dioxide

Richard A. Kerr, in his Research News article "Fugitive carbon dioxide: It's not hiding in the ocean" (3 Apr., p. 35), wonders where about 3 to 4 billion tons of carbon emitted into the atmosphere each year are hiding, as they are unaccounted for in the current carbon budget. An article in the same issue by P. D. Quay *et al.* (p. 74) estimates the oceans are taking up about 2 billion tons of this, although Pieter Tans, as reported by Kerr, argues that it is closer to 1 billion tons a year. Research presented at a recent workshop cosponsored by the Environmental Protection Agency, Department of Energy, Edison Electric Institute, and the Umweltbundesamt (*1, 2*) concluded that a vast number of natural and managed ecosystems are sequestering excess carbon from fossil fuel and other sources in large enough amounts to readily account for the so-called "missing carbon."

What has stymied past attempts to balance the carbon budget is the unrealistic assumption that exchanges of CO_2 between terrestrial systems and the atmosphere are in steady state. That is, unless land is being converted from its natural state to a lower biomass (or carbon) system, the remainder of the landscape has a net CO_2 exchange of zero. This further implies that the whole natural landscape has not been disturbed by humans, which is, of course, unrealistic. The workshop participants concluded (*2*) that "New research, particularly from tropical forests, demonstrates that exchanges of CO_2 between the biota and the atmosphere have not been in steady state for several centuries." As these systems recover from past disturbances they can sequester substantial amounts of excess carbon from the atmosphere. Preliminary estimates of actual and potential carbon sinks in terrestrial and coastal systems were 3.7 to 9.1 billion tons of carbon a year, without consideration of CO_2 enrichment. More than 50% of these sinks are actual (in growth of temperate forests, coastal systems, soils, and some parts of the tropics); the rest are potential sinks that require new management regimes. Carbon accumulation in temperate forests has been confirmed by P. E. Kauppi *et al.* (Articles, 3 Apr., p. 70) as forests in Europe recover and accrete biomass from past disturbance.

Much of the research related to the tropics suggests that they are significant sources of atmospheric carbon. These estimates originate from models that are concerned mostly with the about 1 to 1.5% of forests that are being cleared every year; they assume that most of the other 98.5 to 99% or so of forest lands are in carbon steady state. The net flux could be considerably smaller or even act as a sink (*3*). We know that large areas of these forests are undergoing gradual reductions in carbon stocks (*4*), but other areas are recovering —even the so-called mature forests—and are increasing their carbon stocks (*3*). This carbon can accumulate for several hundred years in large trees, soil organic matter, and woody debris.

Concerning the ability of ecosystems to continue to store carbon, participants of the workshop found that "Rising CO_2 accelerates net primary productivity and probably increases carbon storage in terrestrial ecosystems" (*2*). There is still plenty of "room" for expanding carbon storages (*3*), but the landscape has to be managed with strategies that enhance net carbon storage and are compatible with the conservation of biodiversity, sustainable land use, energy conservation, and economic development.

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Malignant Hyperthermia

As David H. MacLennan and Michael S. Phillips correctly state in their article "Malignant hyperthermia" (8 May, p. 789), DNA-based testing may permit the preoperative identification of many individuals susceptible to malignant hyperthermia (MH). Contrary to a statement in Daniel E. Koshland, Jr.'s 8 May editorial (p. 717), however, knowledge of the molecular biology of MH has *not* yet reduced MH morbidity.

Current morbidity and mortality rates are unknown, but the dramatic decreases during the past decade are attributable to the efforts of (i) pharmacologists, medicinal chemists, and anesthesiologists who developed and tested dantrolene (*1*), the clinical antidote for MH; (ii) MH patient-physician organizations that educated medical personnel to recognize and treat this rarely occurring disease; and (iii) biomedical engineers who created new monitoring devices to permit the early detection of the hypermetabolic state that characterizes acute MH.

Much additional work remains to be done before the understanding of the molecular biology of MH is sufficient to permit development of improved diagnostic tests. No doubt, such tests will help reduce MH morbidity and mortality rates even further in the future.

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Chemical Weapons Disposal

The article "Piecemeal rescue for Soviet science" by David P. Hamilton (News & Comment, 27 Mar., p. 1632) mentions a suggestion by scientists from a former Soviet weapons lab to use nuclear explosives to destroy chemical weapon stockpiles. The article states that the suggestion met with a "very mixed response" from the Americans.

One could note that the U.S. government has also considered this method. The Defense Nuclear Agency completed a study in 1982 (*1*) which suggested that there were a number of advantages to be gained by using a nuclear blast to destroy chemical weapons in an underground cavity. For example, the weapons would require no preparation or disassembly, and there would be no residue requiring disposal. This idea, along with other novel concepts for the disposal of the chemical stockpile, was rejected by the Army in favor of reverse assembly–incineration.

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