relative impunity. However, the argument does not consider that such a deployment should also be perceived as a basis for arms reduction: It would (i) limit damage if deterrence fails and (ii) ensure the survival of retaliatory forces in the event of a disarming first-strike attempt against those forces. In the first instance, damage limitation as an incentive for a preemptive first strike is removed. The second supplies an incentive for strategic offensive force levels below first-strike requirements, as a force with guaranteed survivability need only be large enough for a retaliatory attack.

In any event, I applaud the efforts of *Science* to keep the discussion going.

E. R. HEIBERG III
Department of the Army, Washington, D.C. 20310

Major General Heiberg has left the Navy out of his analysis of U.S. retaliatory needs and strategic vulnerabilities. It is true that penetration aids are of little value if the missiles that use them are destroyed in a preemptive attack. This explains why one of the key penetration technologies—the maneuvering warhead—was developed for use with the Navy's survivable force of submarine-launched ballistic missiles. No one questions that such missiles would retaliate effectively "in the event of a disarming first-strike attempt."

Heiberg also states that the BMD system deployed around Moscow has a "considerable level of effectiveness" against a half-hearted attack. It seems doubtful, however, that the United States would ever attack Moscow half-heartedly.

Finally, Heiberg suggests that, because the Soviets have an edge in ballistic missile throw-weight, they could easily overwhelm a U.S. BMD simply by using more warheads. If this is true, how will deployment of such a system significantly "limit damage [to U.S. forces] if deterrence fails," as Heiberg asserts?

—R. JEFFREY SMITH

Health Effects of Power Lines

Eliot Marshall, in his article on Project ELF (News and Comment, 12 Aug., p. 630), refers to pertinent work on health hazards from power-line fields and states that "in one of the most frequently cited studies, the investigators . . . never troubled to measure the intensity of the supposed cancer-causing electromagnetic fields they were interested in."

As the authors of that study (*1*), we would like to point out that we made extensive measurements of the power-line magnetic fields that were our concern (*1*, *2*). But it was not possible to measure the particular fields experienced by our subjects while they were developing cancer, as that was up to 30 years before our work began.

Measuring fields today at addresses previously occupied by our subjects would be one way to estimate exposures retroactively [this method has recently been used, with results that support ours (*3*)]. However, magnetic fields from power lines (unlike the corresponding electric fields) vary with power consumption, so there are wide hourly, seasonal, and long-term changes in those magnetic fields. Even getting an accurate profile of present-day exposure is a laborious task; extrapolating into the past is unavoidably uncertain.

We therefore chose to estimate the historical exposures by identifying wiring configurations indicating high magnetic field exposure (that is, large-diame-

ter wires near the residence, and so forth). We made numerous measurements to verify that those configurations were in fact associated with especially high magnetic fields. We found such configurations unusually often at the homes that cancer patients had occupied.

NANCY WERTHEIMER
Department of Preventive Medicine and Biometrics, University of Colorado Health Sciences Center, Denver 80262

ED LEEPER
Salina Star Route, Boulder, Colorado 80302

References

1. N. Wertheimer and E. Leeper, *Am. J. Epidemiol.* **109**, 273 (1979).
2. ———, *Int. J. Epidemiol.* **11**, 345 (1981).
3. L. Tomenius, L. Hellstrom, B. Enander, paper presented at the International Symposium on Occupational Health and Safety in Mining and Tunnelling, Prague, 1982.

Mass Mortalities of Coral Reef Organisms

Corals and sea urchins are dying in large numbers in the Pacific Ocean and in the Caribbean Sea, respectively. In the Gulf of Chiriqui, on the Pacific side of Panama, we first noticed extensive bleaching (loss of zooxanthellae) and coral mortality in March 1983 (*1*). This occurred to a depth of 12 meters and on some reefs reduced coral cover to 10 percent of its previous levels. This disturbance also occurred in the Gulf of Panama in June, in Costa Rica in May (*2*), in Colombia in June (*3*), and in the Galápagos Islands in April (*4*). Massive coral death has also occurred in Moorea (*5*) and the Tokelau Islands (*6*) in the central Pacific and in Indonesia (*7*) and the Ryukyu Islands (*8*) in the western Pacific. Smaller scale bleaching and death of corals and other coelenterates, to a depth of 20 meters, has also been occurring in the Caribbean since June 1983. Affected areas include Panama, Costa Rica (*9*), Colombia (*10*), and Venezuela (*11*).

In the Caribbean Sea, populations of the ubiquitous and ecologically important (*12*) sea urchin species *Diadema antillarum* have also suffered mass mortalities. The first outbreak was noted near the Panama Canal in January 1983 (*13*); mortalities were observed in the San Blas Archipelago in April and at the Panama-Colombia border in June. They extended to Jamaica (*14*), the Cayman Islands (*15*), and Costa Rica (*16*) by July. In late July they occurred in the Florida Keys (*17*), in mid-August in Santa Marta Bay, Colombia (*18*), and in late August in the Bahamas (*19*). In September they reached Bermuda (*20*). Populations of *D. antillarum* have been reduced to 2 percent of their past levels, but other species of sea urchins have remained unaffected. *Diadema mexicanum* in the eastern Pacific have been similarly unaffected.

At this point we do not know whether the bleaching of the coelenterates in both oceans and the mortality of *Diadema* in the Caribbean are related and whether they are direct or indirect consequences of the climatic changes associated with the 1982–1983 El Niño event (Research News, 2 Sept., p. 940). Important clues about the causes of this widespread mortality can be gained from knowledge of the geographical extent and timing of the outbreaks. We ask scientists in Caribbean and Pacific laboratories who may have noticed similar phenomena elsewhere to communicate with us.

H. A. LESSIOS
P. W. GLYNN
D. R. ROBERTSON
Smithsonian Tropical Research Institute, Box 2072, Balboa, Panama

References

1. P. W. Glynn, *Envir. Conserv.* **10**, 149 (1983).
2. J. Cortes, Universidad de Costa Rica, personal communication.
3. H. von Prahl, Universidad del Valle, personal communication.
4. G. Robinson, Charles Darwin Research Station, Santa Cruz, Galàpagos, personal communication.
5. B. Salvat, Laboratoire de Biologie Marine et Malacologie, Paris, personal communication.
6. G. H. Balazs, National Marine Fisheries Service, Honolulu, personal communication.
7. R. E. Cook, Bessindo pt agung, Jakarta, personal communication.
8. M. Yamaguchi, University of Ryukyu, personal communication.
9. A. Morales and J. Cortes, Universidad de Costa Rica, personal communication.
10. F. Duque and C. Gomez, Instituto Nacional de los Recursos Naturales Renovables y del Ambiente, Cartagena, personal communication.
11. T. Knipe, the Cousteau Society, personal communication.
12. P. W. Sammarco, *J. Exp. Mar. Biol. Ecol.* **65**, 83 (1982); C. W. Stearn and T. P. Scoffin, *Proc. 3rd Int. Cor. Reef Symp.* **2**, 471 (1977).
13. J. Burgett, Smithsonian Tropical Research Institute, Panama, personal communication.
14. J. Woodley and B. Keller, Discovery Bay Marine Laboratory, personal communication.
15. K. S. Gomez and J. Parsons, Cayman Department of Agriculture, Lands, and Natural Resources, personal communication.
16. M. Murillo, Universidad de Costa Rica, personal communication.
17. J. C. Halas and B. Cosey, Department of Natural Resources, State of Florida, Key Largo and Looe Key, personal communications.
18. A. A. Acero and S. Zea, Instituto de Investigaciones Marinas, Santa Marta, Colombia, personal communication.
19. G. B. Smith, Food and Agriculture Organization, United Nations, Nassau, personal communication; B. Blonder, Forfar Field Station, Andros Island, personal communication.
20. B. E. Luckhurst, Division of Fisheries, Bermuda, personal communication.

Erratum: In the letter by Peter S. Ashton *et al.* (28 Oct., p. 366), reference 2 was incorrect. It should have read, "E. Marshall, *Science* **221**, 242 (1983)."