ment intervention in public and privately owned buildings, where building management affects ventilation or materials used indoors, or both.

We stated that "the mounting evidence of elevated indoor contaminant levels suggests that government efforts to safeguard citizens' health and safety may be justified." However, we took pains to emphasize that the issue is not just whether or not public actions are needed but also what modes of intervention are appropriate. Public agency response to unhealthful indoor air could be varied, including ignoring the problem, funding research, leaving it to personal choice (such as for saccharin and cigarettes), expanding administrative efforts on the basis of existing legislation, using moral suasion by public education efforts, defining legal liabilities, instituting fiscal incentives (such as taxes, fees, and subsidies), and promoting new rules and regulations.

We point out that, even if adequate health data existed, indoor air quality standards would be impractical and especially difficult to enforce in 82 million residences. Restricting sources, certification of "safe" concentrations, and disclosure of possible sources upon transfer of ownership may be government actions preferable to setting indoor air quality standards. As examples, the Swedish government has established "action levels" for radon in existing or new homes. It would be reasonable for the U.S. Department of Housing and Urban Development or local governments to include indoor air quality considerations as a criterion for occupancy permits, in much the same way that sanitation, structural, and electrical conditions are included.

The letter from Aaroe and Light underscores the problems faced by state health officials in dealing with indoor air quality problems. Most states lack the authority, funding, and expertise to address the issue adequately. One of us (K.S.) is director of the first, and so far only, state program devoted exclusively to investigating indoor air quality in nonindustrial environments. However, as awareness about indoor air pollution increases among scientists, engineers, regulatory officials, and environmental groups, it is likely that similar efforts will be spawned at local, state, and federal levels of government.

The comments by Roberts about adverse health consequences of indoor exposures to pentachlorophenol (PCP) are well taken. A potential health hazard in a new state office building in which interior wood had been impregnated with PCP was identified recently in Long Beach, California. The problem was noted before occupancy, and the PCP-impregnated wood was covered with a sealant to reduce emissions.

The California Department of Health Services undertook a study in this building to ensure that remedial actions were adequate to protect occupants' health (*5*). Indoor air measurements of PCP were combined with body burden monitoring (PCP in urine) to assess the relation between exposure and response for a subset of building occupants. It was established that body burden was related to measured environmental exposure.

JOHN D. SPENGLER
Department of Environmental Science and Physiology, Harvard University School of Public Health, Boston, Massachusetts 02115
KEN SEXTON
Indoor Air Quality Group, Air and Industrial Hygiene Laboratory, California Department of Health Services, Berkeley 94704

References and Notes

1. Committee on Toxicology, Board on Toxicology and Environmental Health Hazards, National Research Council, *Seven Pesticides Used for Termite Control* (National Academy Press, Washington D.C., 1982).
2. Office of Pesticides Program, *Comparative Benefit Analysis of Seven Chemicals Registered for Use Against Subterranean Termites* (Environmental Protection Agency, Washington, D.C., 1981).
3. "Minutes" (Pesticide Board Subcommittee, Department of Food and Agriculture, Commonwealth of Massachusetts, 1 March 1983); *ibid.*, 18 April 1983.
4. K. Sexton and R. Repetto, *Environ. Int.* **8**, 5 (1982).
5. J. J. Wesolowski, K. Sexton, K. Liu, P. Flessel, S. Twiss, in preparation.

Factoring

In "Factoring gets easier" (Research News, 2 Dec., p. 999), Gina Kolata conveys very clearly the sense of excitement surrounding factoring large numbers today. She also makes the significant observation that there is a common denominator to the accomplishments of Davis and Holdridge, of Wagstaff and Smith, and of Wunderlich, namely, that these researchers have capitalized on the architecture of the computers on which they work to achieve either substantial improvements in the speed of factoring or in the size of the numbers that can be factored. While this is both true and newsworthy, it is equally true that the algorithms themselves, that is, the procedures used to factor numbers, have experienced a corresponding development that has made it possible to exploit the computer architectures. For example, Kolata points out that there are two competing primary factoring algorithms: the continued fraction technique, largely due in its present form to Mike Morrison and John Brillhart, and the quadratic sieving technique discovered by Carl Pomerance as an improvement of an earlier sieving algorithm developed by Richard Schroeppel. The recent history of factoring can be viewed as much as a competition between these algorithms as a competition between the various computer architectures. The continued fraction algorithm is reasonably well adapted to being implemented on conventional computers in the CFRAC code. Consequently CFRAC was the most efficient general-purpose factoring algorithm available at the time that the Cunningham Project Table was completed. The sieving operations required to efficiently implement Pomerance's algorithm, however, while not so well matched to most computers, were ideally suited to the vector processing (operations that permit entire vectors to be processed as units) capability of the Cray computer. This explains in part the roughly 100-fold speed improvement in factoring achieved at the Sandia National Laboratory in 1983. The story doesn't end there; for while the continued fraction algorithm was reasonably well matched to conventional computer architectures, it is even better matched to the architecture of the highly parallel machines such as the DAP or the MPP (Massively Parallel Process) on which Wunderlich is currently working. Hence the expectation that the speed advantage will shift back once again to the continued fraction algorithm, with continued improvements in the algorithm itself. The final outcome cannot even be guessed at this point, but it is probably true that the lead in the machine-algorithm competition will shift back and forth several more times and perhaps to some as yet undiscovered marriage of machine organization and algorithm.

What has been achieved in factoring results from a remarkable marriage of algorithm design and machine architectures that appears to be characteristic of what is happening in the computer treatment of any number of mathematical problems that are on the edge of computational feasibility.

As a postscript: Davis and Holdridge have just broken their previous records by factoring the 67-digit hard part of the Cunningham number $11^{102} + 1$ in only 13.7 hours!

GUSTAVUS J. SIMMONS
Applied Mathematics Department, Sandia National Laboratories, Albuquerque, New Mexico 87185