LETTERS

Acid Precipitation

Richard A. Kerr (Research News, 12 Feb., p. 881) describes Kenneth Rahn's use of noncrustal manganese (Mn)-vanadium (V) ratios in atmospheric aerosols to ascribe source regions of acidic precipitation. On the basis of the ratio technique (*1*), Rahn concludes (*2*) that Midwest sources are responsible for sulfate pollution and acid rain at High Point, New Jersey, while local (Northeast) sources are responsible for acid precipitation at two other sites: Narragansett, Rhode Island, and Watertown, Massachusetts.

In reaching these conclusions, Rahn makes two major assumptions that are questionable. First, he assumes that the Mn/V ratio in particulate matter in Rhode Island and Massachusetts could reflect the emissions ratio from upwind sources, rather than local emission sources. Second, Rahn assumes that the source areas of Mn and V are the same as the sources of acid precipitation.

One must distinguish between primary and secondary pollutants. Primary pollutants are emitted directly from a source and, in the case of Mn and V, undergo no chemical reactions in the atmosphere. Secondary pollutants, such as sulfate (SO_4^{2-}) and nitrate (NO_3^-), which are also the principal causes of acid precipitation, are formed through the atmospheric reactions of sulfur dioxide (SO_2) and nitrogen oxides (NO_x). It takes some time for these secondary pollutants to form, so they are generally deposited downwind of their source area. Therefore, at any site where there are nearby sources, such as in Massachusetts and Rhode Island, the concentration of primary pollutants will be determined largely by local sources, while the secondary species will be determined by upwind sources. This assumes that the air is not stagnant, which it rarely is during precipitation events.

Furthermore, the New York Metropolitan Area is the largest consumer of fuel oil and, hence, the largest source of V in the Northeast. An air parcel that arrives in Watertown or Narragansett from the Midwest will travel through or near the New York Metropolitan Area. This is why the Northeast Mn/V ratio is observed at these sites even though the air traveled from the Midwest. High Point, New Jersey, on the other hand, is 50 miles west (or upwind) of the New York Metropolitan Area, and there are no major fuel-oil combustion sources between it and the Midwest. Consequently, the Midwest signature is observed at High Point.

Data obtained as part of the New York Summer Aerosol Study (*3*, *4*) shows that, on the average, 86 percent of the SO_4^{2-} in New York City was produced from emissions upwind (west) of High Point (*3*). Based on the same computational schemes employed for the SO_4^{2-}, the data (*4*) indicate that at least 78 percent of the Mn and V observed in New York City were of local origin. Therefore, the principal source areas of the sulfate and the tracer species are different, and the technique used by Rahn does not appear to be valid.

Rahn's hypothesis concerning the local contribution of sulfate aerosol is contrary to observations (*3*, *5*, *6*) and modeling results (*6*, *7*) that demonstrate the importance of long-range transport of sulfates. For example, the Brookhaven AIRSOX model (*7*) estimates that 87 percent of the sulfate in New York and New Jersey is due to transport [in excellent agreement with the 86 percent estimate for New York City in (*3*)] and that 92 percent of the sulfate in New England is due to transport. The model further predicts that only 10 percent of New England's sulfate is caused by emissions in New York and New Jersey, with the balance of the sulfate resulting from emissions further upwind.

GEORGE T. WOLFF
Environmental Science Department, General Motors Research Laboratories, Warren, Michigan 48090

References

1. K. A. Rahn, *Atmos. Environ.* **15**, 1457 (1981).
2. ———, "Elemental traces and sources of atmospheric acidity for the Northeast—a statement of new evidence" (University of Rhode Island, Kingston, 1981).
3. G. T. Wolff, P. J. Lioy, B. P. Leaderer, D. M. Bernstein, M. T. Kleinman, *Ann. N.Y. Acad. Sci.* **322**, 57 (1979).
4. P. J. Lioy, G. T. Wolff, K. A. Rahn, D. M. Bernstein, M. T. Kleinman, *ibid.*, p. 73; D. M. Bernstein and K. A. Rahn, *ibid.*, p. 87.
5. G. T. Wolff, N. A. Kelly, M. A. Ferman, *Science* **211**, 703 (1981).
6. *EPRI Sulfate Regional Experiment: Results and Implications* (Electric Power Research Institute, Palo Alto, Calif., 1981).
7. R. H. Ball *et al.*, *Matrix Methods to Analyze Long-Range Transport of Air Pollutants* (DOE/EV-0127, Department of Energy, Washington, D.C., 1981).

Watching the Watchers

Present times can be said to be the Age of Studies. Major sociotechnical reports that have implications for industrial, regulatory, and public policy decisions are turned out at a commendable but nearly overwhelming rate. Rarely are these studies subjected to the broad, serious, constructively critical review they warrant. Most such reports are reviewed by the originating institution before they are released. Directly affected groups discuss the findings. But debate over uncertainties, assumptions, social value judgments, context of controversy, and usefulness to decision-making is not often carried effectively into larger circles. The documents may not even be readily accessible. Regardless of how balanced reports may be, intellectual or political antagonists are more likely to take up the issues they address than middle-ground observers and synthesizers are.

I therefore propose that *Science* solicit in-depth essays on recently released reports that have central relevance to national decisions. These essays would amplify the reports, interpret them for a broader readership, critique their assumptions, methods, and findings, and place them in perspective relative to other studies and to public events. Such review would manifest scientific community in its original sense, provide partial answer to "Who will watch the watchers?," and offer much-needed social stewardship.

WILLIAM W. LOWRANCE
Life Sciences and Public Policy Program, Rockefeller University, New York 10021

Leprosy Research in India

Thomas H. Maugh II's article "Leprosy vaccine trials to begin soon" (Research News, 26 Feb., p. 1083) covers many facets of research on this important disorder which today afflicts about 12 million people, mostly in the developing countries. The disorder is of great interest to India, which harbors the largest number (about 4 million) of leprosy patients in the world.

Since its inception in 1952, the Cancer Research Institute in Bombay, India, has been deeply interested in leprosy research. In 1958, the late V. R. Khanolkar, who was the founder and director of the institute, cultivated a mycobacterium from human leproma using classical tissue culture techniques. The organism was named ICRC after the then name of the Institute—Indian Cancer Research Centre. The bacillus shares many antigens with *Mycobacterium leprae*, including those involved in cell mediate immunity. Of particular interest is the fact that, ICRCin, a particulate antigen prepared from ICRC, evokes skin reactions (Mitsuda type) comparable to lepromin in both leprosy patients and in normal healthy individuals. We have now pre-

R&D

in the

FY 1983 Budget: Impact and Challenge

7th Annual AAAS Colloquium on R&D Policy

23–24 June 1982

The Shoreham Hotel Washington, D.C.

Issues include:

R&D policy and the FY 1983 budget ☐ the climate for industrial R&D ☐ R&D programs of key federal agencies ☐ impacts on the scientific and engineering communities

Participants include leaders from:

OMB, OSTP, and federal agencies ☐ Congress ☐ industry ☐ the scientific and engineering communities

In addition:

Research and Development, AAAS Report VII, *by Willis H. Shapley, Albert H. Teich, and Jill P. Weinberg, will be provided in advance to Colloquium registrants. The* **Report** *covers R&D in the federal budget for FY 1983 and other topics on R&D and public policy. Registrants will also receive the published* **Proceedings** *of the conference.*

For further details, write:
R&D Colloquium
AAAS Office of Public Sector Programs
1776 Massachusetts Ave., NW
Washington, D.C. 20036

aaas *American Association for the Advancement of Science*

pared a vaccine from ICRC killed by gamma irradiation. The vaccine has been administered to more than 50 leprosy patients, most of whom have the lepromatous (LL) variety. We have specifically chosen the LL patients because they are lepromin-negative and continue to remain so in spite of prolonged treatment with drugs. In our study (*1*), lepromin conversion was observed in 50 percent of the LL patients and in 80 percent of the BB/BL (borderline) patients 4 months after vaccination. In a follow-up study (*2*), 70 percent of the vaccinated LL patients exhibited a positive lepromin (Mitsuda) reaction 8 months after vaccination. There is strong evidence that the Mitsuda reaction is an indication of the host immunity against *M. leprae*. This development therefore holds great promise, and we shall soon be conducting multicentric field trials of our vaccine.

M. G. DEO

Cancer Research Institute,
Tata Memorial Centre,
Parel, Bombay 400 012, India

References

1. M. G. Deo, C. V. Bapat, R. G. Chullawalla, W. S. Bhatki, *Indian J. Med. Res.* **74**, 164 (1981).
2. ———, in preparation.

Soot-Catalyzed Reactions

A recent letter by Herbert Rosenkranz (23 Apr., p. 360) discusses some of the potential health effects associated with increasing soot emissions from diesel vehicles. We would like to point out another potential problem associated with soot particles in the atmosphere, namely, the catalytic activity of such particles for certain atmospheric chemical reactions, including the oxidation of sulfur dioxide (SO_2) to sulfate.

Conversion of SO_2 to sulfate is widely recognized as a major source of acidity in clouds and rain water. The conversion is generally assumed to occur in the gas phase, with subsequent condensation or solution, or both, of the product sulfate. Gas phase conversion of SO_2 to sulfate implies that reduction of SO_2 emissions should result in roughly proportional reductions in sulfate and acidity. However, reductions in SO_2, when actually accomplished, have not resulted in corresponding reductions in sulfate (*1–2*). This is the well-known "urban sulfate anomaly," which has provoked considerable debate (*1, 3*).

A possible explanation for this anomaly is that a significant component of atmospheric sulfate may be generated by heterogeneous (multiphase) reactions rather than gas phase reactions (*3*). Heterogeneous conversion of SO_2 to sulfate on soot particles was demonstrated in laboratory studies by T. Novakov and co-workers in 1974 (*4*). Subsequent laboratory investigations by these and other investigators have confirmed and extended this finding (*5–7*). For example, water (liquid or vapor) has been found to enhance carbon-catalyzed sulfate formation and, in fact, to effectively prevent saturation of the reaction (*6, 7*). Furthermore, carbon has been shown to catalyze oxidation of SO_2 by the trace oxidant NO_2 as well as by O_2 (*6–8*). The range of other atmospherically important reactions that may also be catalyzed by carbon is not known.

Serious consideration of heterogeneous reactions in the atmosphere is a relatively recent phenomenon, and much more research will have to be done before the importance of soot-catalyzed reactions is fully established. Nevertheless, in view of existing laboratory results it seems advisable to consider the catalytic properties of soot when assessing the potential impact of increasing diesel emissions.

DAVID R. SCHRYER
ROBERT S. ROGOWSKI

Laser Systems and Measurements Branch, Flight Electronics Division, Langley Research Center, National Aeronautics and Space Administration, Hampton, Virginia 23665

WESLEY R. COFER, III

Environmental Chemistry Branch, Marine and Applications Technology Division, Langley Research Center

References

1. A. P. Altshuller, *J. Air Pollut. Control Assoc.* **26**, 318 (1976).
2. R. E. Meyers and E. N. Ziegler, *Environ. Sci. Technol.* **12**, 302 (1978).
3. D. R. Schryer, R. S. Rogowski, W. R. Cofer, III, in *Environmental and Climatic Impact of Coal Utilization*, J. J. Singh and A. Deepak, Eds. (Academic Press, New York, 1980), pp. 275–292.
4. T. Novakov, S. G. Chang, A. B. Harker, *Science* **186**, 259 (1974).
5. S. G. Chang and T. Novakov, in *Man's Impact on the Troposphere*, J. S. Levine and D. R. Schryer, Eds. (NASA RP-1022, National Aeronautics and Space Administration, Washington, D.C., 1978), pp. 349–369.
6. W. R. Cofer, III, D. R. Schryer, R. S. Rogowski, *Atmos. Environ.* **14**, 571 (1980).
7. R. S. Rogowski, D. R. Schryer, W. R. Cofer, III, R. A. Edahl, Jr., S. Munavalli, *NASA TP-2014* (National Aeronautics and Space Administration, Washington, D.C., 1982).
8. L. G. Britton and A. G. Clarke, *Atmos. Environ.* **14**, 829 (1980).

Erratum. In the report "Bronchoconstrictor effects of leukotriene C in humans" by J. W. Weiss *et al.* (9 Apr., p. 196), the second sentence of the abstract should have read: "Leukotriene C was 600 to 9500 times more potent than histamine on a molar basis in producing an equivalent decrement in the maximum expiratory flow rate at 30 percent of vital capacity above residual volume."

Erratum. Howard A. Meyerhoff, former AAAS official, died in Tulsa, Oklahoma, *not* Tucson, Arizona, as stated in AAAS News (7 May, p. 613).