ary regress of microorganisms swallowing ever smaller microorganisms.

JERRY COYNE
Department of Ecology and Evolution, University of Chicago, 1101 East 57th Street, Chicago, IL 60637

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Learning from the Acid Rain Program

The News & Comment account by Leslie Roberts of the National Acid Precipitation Assessment Program (NAPAP) (15 Mar., p. 1302) identifies the difficulties that this program has encountered in the course of its 10-year odyssey. But these difficulties hardly add up to explaining the chief charge—that NAPAP contributed little to the national debate over acid rain policy. The fundamental reasons for this outcome, I believe, were (i) a legislative charter that simply passed to the Executive Branch responsibility for direction of the program and coordination of agencies having different missions and different objectives, and (ii) lack of initiative and leadership at the White House level. The result was that the science and policy of acid rain were placed in separate compartments and kept there for 10 years.

The NAPAP experience provides a lesson for the global change program. Up to now, government discussions about global change policy have floated silently between the State Department and the President's staff, with little visible exposure or regular contact with the Global Change Research Progam. It is not too late to do something about this. It should be feasible to link policy and science within a single recognized component of the Executive Office of the President. This would help scientists become aware of and sensitive to critical policy questions and would help policymakers understand the scientific and factual bases for the issues they must face. By keeping science and policy in separate compartments the Administration sharpens the suspicion that it is stalling to avoid effective actions (*1*).

ROBERT G. FLEAGLE
Department of Atmospheric Sciences, University of Washington, Seattle, WA 98195

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With respect to the lessons learned from the acid rain program for research on global change, action is already under way to ensure a proper balance of science, assessment, and policy. A statement from the Second World Climate Conference (*1*, p. vi) specifically calls for

> a special initiative [that] would create a network of regional interdisciplinary research centres, located primarily in developing countries, and focusing on all the natural science, social science, and engineering disciplines required to support fully integrated studies of global change and its impacts and policy responses . . . and [to] study the interaction of regional and global policies.

A proposal is already before the world scientific community, international organizations, and national governments to estab-

lish a global system of regional research networks to "ensure communications between the scientists and private and public sector decision makers" (*1*). This is in addition to research, training, data management, and synthesis modeling.

Envisioned is the assessment of issues related to global environmental change, in order to provide timely and responsible scientific information for regional and national needs within the region."

THOMAS F. MALONE*
Department of Marine, Earth and Atmospheric Sciences, Box 8208, North Carolina State University, Raleigh, NC 27695–8208

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*Member, Oversight Review Board, National Acid Precipitation Assessment Program

Roberts' article "Learning from acid rain" missed a key lesson. NAPAP strived to focus research on developing the information needed for assessments. There was inevitable tension between curiosity-driven science and the required policy-driven research. The challenge was conducting relevant assessments with sufficient scientific credibility for such a politically charged issue.

The NAPA program could have been in sync with the legislative process if the 1985 interim assessment had been released as planned. Instead, the momentum developed during the first 5 years was lost when leadership and consensus-building were replaced with autocratic management. The resulting lack of participation in the assessment process eroded NAPAP's technical and political credibility.

The remaining years of the program had to be spent regaining legitimacy by reinstating the laborious but necessary consensus-building and review activities. The clear lesson is that for assessment programs, well-defined processes for consensus-building and broad scientific review are essential for ensuring credibility. Unfortunately, learning that lesson made NAPAP's results too late to be of full value. The true payoff now is in applying the relevant lessons to global climate change.

CHRIS BERNABO
Science and Policy Associates, Inc., 1333 H Street, West Tower, Suite 400, Washington, DC 20005

Leslie Roberts describes "what went wrong with NAPAP," but there was also much that went right. Since its inception, NAPAP has provided a unique interagency mechanism for the long-term critical examination of an important environmental issue, acid rain, where views have differed widely. Through the free exchange and open discussion of ideas and the scientifically rigorous testing of hypotheses, NAPAP advanced environmental science. That such discussions were often spirited and controversial is an indication of the scientific health of the program.

NAPAP also pioneered a framework for the administration of scientific research, monitoring, and assessment. Through interagency coordination, research gaps and redundancies were minimized. Through regular interagency peer reviews of program plans and projects in progress, high quality was assured. Much of the science initiated under NAPAP will contribute to the evaluation of other environmental concerns.

During its first 10 years, NAPAP produced numerous public reports and findings updates, hundreds of articles in refereed journals, and generally informed the debate on acid rain issues. The program provided a credible source of information for all sides, allowing the congressional debate to focus on policy issues.

As NAPAP begins its second decade, it will address new goals set forth by the Clean Air Act Amendments of 1990, capitalizing on its successes, learning from its errors, and meeting the challenges of the future.

PATRICIA M. IRVING
Director, National Acid Precipitation Assessment Program, 722 Jackson Place, NW, Washington, DC 20503

For a short period of time, I was active in a key element of NAPAP, the National Surface Water Survey. We collected samples from several hundred lakes, performed some analysis, and processed the remaining portions for further analysis. My role was that of a field laboratory manager.

I agree with the observation that "NACP became obsessed by the need to have the best science." This obsession was practiced at the expense of common sense. In the selection and development of analytical procedures, the approach was to consult a few "experts" in the field. However, once the procedures were proposed, they were not subject to peer review. During the training program, I identified several biases or systematic errors in procedures.

When we started fieldwork, it became apparent that these and other procedures required adjustment. When too many lakes on the sample list had to be rejected because of size, depth, or stratification criteria, the "statisticians in Corvalis" changed the criteria. The entire program was designed without a single lake being prescreened before sampling.

After 10 years and hundreds of millions of dollars, it is appropriate to ask whether NAPAP was a wise investment. Although Roberts' article focused on the political aspects of NAPAP, I believe the scientific aspects should also be reviewed: specifically, the basic assumptions and procedures used in the name of "good science."

THOMAS E. BARNARD
Colorado School of Mines, Golden, CO 80401–1887

Where Zagreb Is

We were interested to see a reference to our observation of the 17.2–kiloelectron volt neutrino in the Research News article, "Is there a massive neutrino?" (22 Mar., p. 1426). The article attributes the work to the "Ruder Bošković Institute in Zagreb, Czechoslovakia."

The work is actually a Rudjer Bošković Institute–University of Ottawa collaboration. Zagreb is in Croatia, Yugoslavia, a country that has a common border with Italy, Austria, Hungary, Romania, Bulgaria, Greece, and Albania, but not with Czechoslovakia. Ottawa is the capital of Canada, a country to the north of most of the United States.

A. LJUBIČIĆ
Rudjer Bošković Institute, Bijenička ceska 54, Post Office Box 1016, 41001 Zagreb, Croatia, Yugoslavia
B. A. LOGAN
Department of Physics, University of Ottawa, Ottawa, Ontario K1N 6N5, Canada

Sununu Diplomacy?

A Briefing of 5 April (p. 35) plaintively asks, "Was John Sununu joking?" in reference to Leon Lederman's well-publicized survey of science funding. Apparently Sununu said, "I don't know who Leon Lederman is." Perhaps he was just being diplomatic, and so refrained from observing that a survey that implicitly asks people, "Do you need more money" is likely to produce the response, "Yes, lots more."

SAUNDERS MAC LANE
Department of Mathematics, University of Chicago, 5734 University Avenue, Chicago IL 60637