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Acid Rain

Acid precipitation is increasingly an important national and international issue with strong financial and emotional overtones. Abundant examples of deleterious effects have been cited, but there is wide disagreement among sincere people as to mechanisms of damage, who is responsible, and how the problem should be ameliorated.

The phenomenon of acid rain is not new. It has been active for more than a billion years. In addition to carbon dioxide, other substances contribute to acidity. About as much sulfur compounds are released worldwide to the atmosphere naturally each year as are put there by humans. In islands thousands of kilometers removed from industrial activity and presumably unaffected by it, rain with *p*H 4.7 is common. Soils having a *p*H of 3.5 are formed without human participation in the process.

What is new from a geological standpoint is large-scale burning of fossil fuels. This activity and its effects are concentrated in a relatively small area of the globe. There the anthropogenic contribution of sulfur oxides exceeds that of nature by factors of 10 to 20. Annual precipitation is often equivalent to 20 to 50 kilograms of sulfate per hectare. Nitric oxides play an important role in the conversion of sulfur dioxide into sulfuric acid and they contribute about a third of the total acidity of the rain.

The most noticeable effect from acid rain is a lowering of *p*H in thousands of lakes in Scandinavia and eastern North America. Accompanying this have been substantial increases in dissolved aluminum, which is toxic to fish. As a result, some lakes are virtually dead; others are dying. Recently an additional phenomenon has raised great concern. Substantial areas of forest in West Germany are dying. The matter has become a hot political internal issue among the various German states.

In the United States concern is growing about the health, present and future, of forests in the Northeast. Instances of pathology attributable to acid rain have been noted in the Adirondacks. Were this pathology to become more intense and widespread, the eventual damage would be great.

Some people in agriculture have spoken of acid rain as free fertilizer since it furnishes needed nutrients. Ordinarily, farmers add ground limestone ($CaCO_3$) to their soils. An application of 6 metric tons per hectare will increase the *p*H of a heavy soil from 3.5 to about 6.5. The 50 kilograms of sulfate per year from acid rain has little effect on a soil after such a treatment. Adding ground limestone to lakes has resulted in restoration of fish populations. The Swedes are now spending $40 million a year for this purpose. In North America some lakes are being treated, but those that are relatively inaccessible are neglected.

Considerable political steam has been building up, particularly in Canada, about acid rain. They export acidic gases to us, but they import far more from us. The imbalance is causing a regrettable bad feeling. In addition, people in the northeast United States take the position that coal-fired utility plants in the Midwest are a principal source of the acid in the rain that has been falling on them. In consequence of these two factors, legislation has been introduced into Congress that would require that emissions from plants in the Midwest be reduced by more than 50 percent. Annual costs for this have been estimated at $5 billion to $8 billion, which would be borne by electricity users. A large number of studies, however, have shown that the Northeast is itself responsible for a large share of its pollution. Indeed, everyone who drives an automobile is a contributor to acid rain.

If long-term damage from acid rain is to be reduced, it will not suffice to use a single scapegoat. Rather, there must be more conservation, better analysis of how to manage, and the development of technologies that effectively reduce emissions while not creating additional environmental problems.—PHILIP H. ABELSON

This editorial is based in part on material presented at the AAAS Annual Meeting in Detroit, 26 to 31 May 1983.