Watch on Acid Rain: A Midterm Report

In 1979, when a small group of scientists helped draft the original plan for what became the federal government's National Acid Precipitation Assessment Program (NAPAP), the focus was on studying the causes and effects of acid rain. Even then, many scientists already knew that the problem encompassed much more than the impact of precipitation laced with sulfuric and nitric acid on lakes, streams, trees and fish.

But the focus in the public mind at that time was on damage caused by acid rain, says forest ecologist Ellis B. Cowling of North Carolina State University in Raleigh. That's how the program was sold to Congress, resulting in the passage of the 1980 Acid Precipitation Act. "In our political decision-making process, it's a lot easier to deal with one villain rather than with several villains," says Cowling. "If it had been called 'air pollution,' it probably would never have gotten funded."

Now, near the midpoint of its mandate to study and assess acid precipitation, NAPAP has amassed a great deal of information confirming the complexity of the problem. In some instances, acid rain effects have turned out to be much less serious than feared; in other cases, environmental factors seem to exacerbate the problem.

NAPAP's 1986 annual report, released last week, summarizes some of what has been learned in the program's first five years. The report contains a mixed bag of results—a blend of good news and bad. It notes, for example, that since 1975, national sulfur dioxide emissions from coal-fired power plants have decreased by 10 percent, while coal consumption has increased by 70 percent. However, sulfur dioxide emissions generated by human activities still far outweigh natural sources of sulfur dioxide. Moreover, nitrogen oxide emissions have remained roughly constant over the last decade.

Various studies, the report says, show that acid rain, in the amounts and concentrations that occur over the entire United States, appear to have no significant effect on the yield of most, if not all, agricultural crops. Acid rain also seems to have little or no effect on the foliage of seedlings. Ozone, on the other hand, may be contributing to tree damage now visible in several mountain areas. More information is needed on the effect of pollutants not only on individual trees but also on whole forests.

The NAPAP report also says acid deposition, under the right geological and soil conditions, contributes to acidifying lakes (SN: 3/22/86, p.182). Such levels of acidity can affect fish populations and other aquatic plant and animal species. A national survey of lakes shows that most potentially vulnerable lakes are in the northeastern United States. "There is currently no evidence," the report says, "that regional-scale chronic acidification has occurred in western lakes."

"My general impression is that the linkage between acid deposition and aquatic effects has become stronger," says Cowling. "And we certainly have a lot more information about emissions trends and inventories. We have an appreciable database about where acid deposition is falling. We have the ability now in a reliable way to determine changes in its distribution both geographically and in time. We're now worrying a lot more about forests than we were to start with."

However, says Gene E. Likens of the Institute of Ecosystem Studies at the New York Botanical Garden in Millbrook, "we haven't dispelled the idea that acid rain is seriously affecting natural systems. What we've really learned is that there are many components acting simultaneously. It's not just acid rain alone." The action of acid rain together with other pollutants, such as metals, ozone and various organic compounds, he says, "means that the stress on natural systems is far greater than what we perceived before."

"The acid precipitation program focuses on too narrow a perception of what the whole problem is," says Cowling. "We're talking about a whole mix of pollutants. What we now need is a more holistic program of research aimed at understanding the interactions of all major components."

Even Congress is beginning to pay attention to the complexity of the acid rain issue. Instead of strictly focusing on controlling sulfur dioxide emissions, several bills now before Congress include controls on nitrogen oxides and volatile organic compounds.

Are stricter emission controls needed? "It depends on how prudent our society wants to be," says Cowling. "If it wants to be careless, it can go on conducting business as usual." —*I. Peterson*

CH_3ips off the old genetic block

Certain traits we inherit from our father, others from our mother. But the legacies of our parents linger on at the molecular level as well, in the form of genes that may act differently depending on which parent provided them—a phenomenon called genomic imprinting, which is related to why mammals persist in requiring parents of both sexes. In a search for the imprinting mechanism, two research groups in England and Canada have independently discovered chemical differences between paternal and maternal genes that they say could help explain the mysteries of imprinting, as well as why the course of a particular genetic disease depends on which parent provided the defective gene.

Scientists at the Institute of Animal Physiology and Genetics Research in Cambridge, and at the Ludwig Institute for Cancer Research in Montreal and Mount Sinai Hospital Research Institute in Toronto, discovered that DNA inherited from the mother apparently has more methyl groups (CH_3) attached than does DNA inherited from the father. They found the telltale methyl groups after inserting easily identified foreign genes into the genetic material of mouse reproductive cells and following these so-called transgenes through several generations. The researchers measured the methylation of transgenes using standard tests for methyl groups. Although not all strains of mice tested showed sexual differences in the number of methyl groups on their DNA, some interesting patterns appeared.

Both research groups report in the July 16 NATURE that the methylation pattern is reversed when a child of the opposite sex of the parent has its own offspring. For example, a gene inherited from the father will be "undermethylated" in both his female and male offspring, but if the daughter has her own offspring, that same gene acquires more methyl groups during her egg development. The observations support the role of methylation in genomic imprinting, which by definition requires a mechanism that can switch gears depending on the parent's sex, says Carmen Sapienza of Montreal.

In addition, Wolf Reik of Cambridge says that, because methylation has been implicated in regulating the expression of genes, the relative number of methyl groups may affect the outcome of a particular gene, such as the gene for Huntington's chorea. In that disease, if the defective gene is inherited from the father, symptoms begin during adolescence; if the mother is the one passing on the gene, symptoms do not begin until middle age—a difference that may be regulated by methyl groups on the gene, says Reik. —*D.D. Edwards*