Acid Rain: Readable at Last

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ACID RAIN: READABLE AT LAST

Acid Rain in the Adirondacks: An Environmental History. Jerry Jenkins, Karen Roy, Charles Driscoll, and Christopher Buerkett. Cornell University Press, Ithaca, NY, 2007. 256 pp., illus. $29.95 (ISBN 9780801474248 paper).

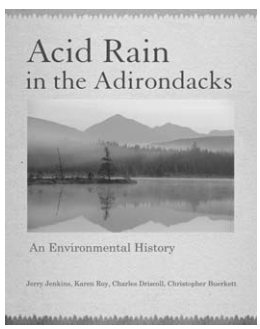
Of all the literature on acid rain that I have encountered, this book, *Acid Rain in the Adirondacks,* is the most readable. Scientific explanations are presented alongside relevant text, with remarkably well-reproduced illustrations and with appropriate formal publications easily identified and cross-referenced. Lead author Jerry Jenkins is a well-known writer with extensive botanical and ecological qualifications and with a penchant for explaining science to the public. In this work, he has been joined by Karen Roy, a research scientist in the New York State Department of Environmental Conservation; by Charles Driscoll, currently director of the Center for Environmental Systems Engineering at Syracuse University and a preeminent ecologist with strong acid deposition credentials; and by Christopher Buerkett, a past employee of the Adirondack Lakes Survey Corporation, a joint publisher with Cornell University.

A lot of effort has gone into the presentation of the scientific material. The language has been streamlined to maintain the reader's interest, yet the relevant science is conveyed in enough detail to be satisfying. As expected, however, the necessary simplification of the science results in generalizations that are sometimes difficult to accept. For example, acid deposition is defined as the deposition of sulfuric and nitric acids generated in the atmosphere by reactions involving sulfur and nitrogen oxides. For wet deposition, this may be true (at least mostly true—let's not forget sulfurous acid); it is not the case for dry deposition. It would seem better to define acid deposition as the deposition of airborne chemicals (primarily sulfur and nitrogen compounds) that cause acidification of the biosphere on which they deposit. The deposition of sulfur and nitrogen oxides per se is worthy of inclusion in the general definition, and we need to leave room for ammonia and ammonium (which both result in ecosystem acidification after they are deposited, as explained in the book). The compensatory deposition fluxes of base metals (mainly calcium) are necessarily included in any general discussion of acid rain, and indeed are treated well in *Acid Rain in the Adirondacks.*

This book concentrates on the terrestrial and aquatic ecosystems of the Adirondacks, as the title implies. However, the title promises more than is delivered. The copyright page points out that this volume is a revision of an earlier work titled *Acid Rain and the Adirondacks: A Research Summary,* presented by the Acid Lakes Survey Corporation. This pedigree is revealing, since it suggests an explanation for the rather narrow focus of this "environmental history." One would expect an environmental history to include the full breadth of the acid rain issue as it affects the Adirondacks, whereas the book addresses only the effects part of the overall picture. This shortcoming should not be viewed as too much of a problem, provided it is understood that the book relates mainly to forested watersheds, lakes, and the freshwater aquatic biosphere.

I would have liked to have seen some mention of the parallel concerns in the Laurentians, the extension of the Adirondacks on the other side of the St. Lawrence. It was observations from research in the Laurentians that sparked much of the early Canadian interest in acid rain, in the same time frame as the formative work of Gene Likens and his coworkers at Hubbard Brook. Eventually, it was the cries of horror from Canada that drove much of the US policy debate, leading to the inception of the National Acid Precipitation Assessment Program (NAPAP). In the same vein, it would be refreshing to see maps of acid deposition that extend across the US northern border into Canada; the atmosphere does not recognize political boundaries.

It is frustrating that the multiagency aspects of the research and monitoring of acid rain—its origins, fate, and effects—are not well presented in *Acid Rain in the Adirondacks.* Surprisingly, the role of NOAA (National Oceanic and Atmospheric Administration) is not mentioned at all, yet NOAA provided the leadership for the NAPAP, helped start national wet-deposition monitoring, and single-handedly initiated monitoring of dry deposition. NOAA's Atmospheric Integrated Research Monitoring Network (AIRMoN) started quantifying dry deposition well before the Environmental Protection Agency (EPA) got into the act, yet the acronyms "NOAA" and "AIRMoN" do not even appear in the book's index. NOAA's AIRMoN—mentioned in the text but attributed to the wrong agency (the EPA)—began dry-deposition monitoring in the Adirondacks with stations operating for many years at Huntington Forest and on the lower slopes of Whiteface Mountain; the resulting data, however, which are now widely available in the literature, are not considered in this book. Likewise, the central role of the Department of the Interior, under which the US Geological Survey leads the National Trends Network, is not mentioned.



The book's reliance on work conducted during the NAPAP decade is somewhat limiting. During that period, nearly two decades ago, there was an energetic debate over how best to quantify dry deposition. Ecosystem-oriented researchers favored surface sampling

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studies dominating), and atmospheric researchers relied on methods for quantifying the fluxes out of the atmosphere. Recent developments lead me to conclude that the dry deposition amounts used in some of the budget calculations included in this environmental history are substantially underestimated.

Current understanding tends to support the initial, pre-NAPAP suspicions that rates of dry and wet deposition of sulfur to a forested canopy would be about the same in the Northeast. One wonders, therefore, why the throughfall studies in the book under review yield a ratio of wet to dry deposition of about 4:1 (see the discussion on sulfur pools). I suspect that might be because throughfall methods measure primarily particle deposition to leaf surfaces, whereas the total flux from the atmosphere reported by atmospheric scientists includes trace-gas components that are deposited mostly through stomatal exchange with plant tissue. If this is correct, then we need to reconsider the budgets presented for both sulfur and nitrogen. If my suspicions are wrong, then we need to rethink a lot of the source-to-receptor modeling that has been done. But there is another wrinkle here: if deposition directly to a lake surface is important, the appropriate ratio might be much more than four. Dry deposition is determined largely by the characteristics of the surface; wet deposition isn't.

The aquatic ecosystems of the Adirondacks are addressed very well, and the ecological consequences of deposition from the atmosphere are described and explained comprehensively. The role of aluminum is explained in detail. But there is little discussion of mountaintop ecosystems, even though these were among the principal targets of NAPAP research. It is not only the aquatic ecosystems of the Adirondacks that were (and are) at risk; mountaintops are severely affected by acidic deposition because their wet deposition is augmented by the filtration of trace materials from the air as it passes across them and through the exposed canopy.

The treatment of the nitrogen cycle is especially welcome, since nitrogen and its effects on coastal ecosystems are likely to become dominant concerns as more people move toward the coasts. Likewise, the attention given to mercury is exceedingly useful. It might seem strange to have the mercury problem addressed in a treatise on acid rain, but much of the science is applicable to both problems. Moreover, the postdepositional behavior of mercury compounds is influenced considerably by the deposition of sulfur species, and hence a link between acid rain and the mercury issue is more than just scientific convenience. The explanation of how mercury is transformed biochemically is characteristically well written and is easily understood. It explains some chemical and biological behaviors that had previously seemed mysterious to this poor meteorologist.

I would have liked for *Acid Rain in the Adirondacks* to have given more attention to reduced nitrogen and to the contemporary debate about the importance of nitrogen dioxide deposition, but on the whole, to the authors I say, "Well done!"

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