bad enough that no honest reporting could have disguised it. The public does recognize that some problems are difficult to solve and perhaps beyond the capacity even of the best leaders. And, though the reservoir of confidence in institutions remains high, it is more vulnerable to major crisis than ever before in this century.

Any book containing the range of material to be found here would be worthy of some note. This volume, however, integrates the material with imagination and insight. It is a richly drawn general portrait of American attitudes, and it contains much information of practical interest to the leaders of American institutions as well as of general interest to the public.

WILLIAM R. KEECH
Department of Political Science, University of North Carolina, Chapel Hill 27514

Acidic Deposition in Forests

Effects of Accumulation of Air Pollutants in Forest Ecosystems. B. ULRICH and J. PANKRATH, Eds. Reidel, Boston, 1983 (distributor, Kluwer Boston, Hingham, Mass.). xviii, 389 pp., illus. $58.50. From a workshop, Göttingen, Germany, May 1982.

On the basis of available evidence concerning known and potential effects of air pollutants, ozone and heavy metals are judged to be the most important wide-area pollutants deposited in forests in the temperate latitudes. In nature, forest ecosystems may be exposed to more than one contaminant concurrently or sequentially. Interactive influences of multiple pollutants may be extremely important.

Acidic and acidifying materials resulting from a variety of human activities, particularly combustion of fossil fuels, are regional contaminants similar to ozone and heavy metals. Our history of research with acidic deposition is much shorter than that with the latter pollutants, however, and our understanding of its effects on forest ecosystems is much less complete.

This volume is useful, for it presents the perspectives of European scientists on the effects of deposition of acidic materials and, to a much lesser extent, heavy metals, on forest ecosystems. The book consists of 30 papers presented at a workshop, 28 of which are authored by Europeans (two are by Canadians). Twenty papers are by West Germans, nine of them by authors from the University of Göttingen. Bernhard Ulrich is the author or coauthor of four of the papers.

In an introductory paper, Ulrich presents a thorough discussion of his hypothesis that the wet and dry deposition and accumulation of anthropogenically produced acidic and acidifying substances from the atmosphere in forest ecosystems ultimately result in soil acidification, increased soil leaching, and aluminum or trace metal toxicity to tree roots or other elements of the soil biota. Ulrich proposes that soil is acidified beyond natural tendencies owing to disruption by air contaminants of decomposition processes and ion cycles within forest ecosystems. He proposes that cation leaching is increased owing to excess nitrate and sulfate ions in the soil as a result of atmospheric input. He proposes that the potential for aluminum-induced root or mycorrhizal toxicity is high when the ratio of calcium to aluminum in the soil drops below 1 in soils with a *p*H of less than 4.

The volume is divided into five sections, on the deposition and storage of atmospheric inputs, hydrogen ion dynamics and nutrient cycling, and the effects of atmospheric inputs on soil chemistry, soil biota, and forest trees. In large measure, most papers provide additional perspective or evidence bearing on the Ulrich hypothesis. The papers in section 1 provide quantitative data on the deposition of acidic materials and heavy metals to selected German forests (four papers) and a Swedish forest (one paper). In section 2, a paper by Nillson concludes that evidence of acidification of Swedish forest soils by atmospheric deposition is not available. In section 3, a paper by Matzner provides elemental flux rates for four German forest ecosystems. A paper by Morrison provides important lysimeter evidence of leaching of nutrient cations and trace metals. Papers by Abrahamsen and Skeffington do not support the hypothesis concerning aluminum toxicity. In section 5, several authors (Keller, Wentzel, Flühler, Athari and Kramer, Rehfuess *et al.*, Bauch) correctly stress the importance of the asymptomatic response of forest trees to air pollution stress and emphasize the importance of examining air quality impacts on tree growth rates. Tomlinson attempts to relate North American red spruce morbidity and mortality to Ulrich's hypothesis.

In summary, the view that acid deposition may enhance soil leaching in certain forest ecosystems has been strengthened by this volume, as has the view that there is not sufficient evidence to support the hypothesis that widespread soil acidification and aluminum toxicity in forest ecosystems result from atmospheric deposition. The book provides valuable clarification of and perspective on the Ulrich hypothesis.

The book suffers from lack of editorial consistency. The papers, literature citations, and reference lists are very variable in format. The printing is of only moderate quality, and there are numerous typographical errors. The book will be of interest to air pollution specialists and research scientists.

WILLIAM H. SMITH
School of Forestry and Environmental Studies, Yale University, New Haven, Connecticut 06511

Thermometry

Temperature. T. J. QUINN. Academic Press, New York, 1983. x, 416 pp., illus. $58. Monographs in Physical Measurement.

T. J. Quinn is eminently qualified to write a book intended "to give a comprehensive account of the principles of thermometry over the range 0.5 K to about 3000 K." In the opinion of this reader, Quinn has succeeded rather well in this endeavor.

The book contains chapters on the definition of temperature, temperature scales, primary and secondary thermometry, fixed points, resistance thermometry, thermocouple thermometers, radiation thermometry, and liquid-in-glass thermometers. Many chapters contain brief historical summaries that provide a useful perspective without being distracting. The physical principles used for thermometry are discussed in considerable detail, and the reader is carefully directed to the literature for the remainder. Significant advances in the past 20 years in the application of these principles are fully described. An appendix includes the text of the present international temperature scale, skeleton tables for thermocouples, and interpolation equations for industrial platinum resistors and thermocouples. A useful index completes the book.

The book offers a modern perspective on the degree of accuracy of temperature scales and the physical principles used to obtain the scales. Temperature scales are in a continuous process of evaluation and evolve gradually to greater accuracy. The reader of this book will have a firm understanding of the basis for the next temperature scale, contemplated for the late 1980's. Since the book emphasizes the physical basis of thermome-

try, it requires a background in physics and mathematics at the graduate school level.

A reader not previously exposed to a description of the status and evolution of temperature scales might find it advisable to skip chapter 2 in the first reading. The chapter is heavily laden with symbols with long subscripts, acronyms, and concepts that are only explained in later chapters. It can be heavy reading even for the aficionado. As a service to the reader, Quinn might have put a greater portion of this chapter in an appendix.

Perhaps the only topic not treated completely in the book is that of liquid-in-glass thermometers. The author argues that these thermometers are gradually being supplanted by other types treated in the book. Given that many more laboratories still use liquid-in-glass thermometers (covered in chapter 8) than use optical pyrometers (covered in chapter 7), it is hard to accept that the former are treated in 10 pages whereas the latter are treated in 83 pages.

These minor comments notwithstanding, the reader of this book can obtain an up-to-date account of the status of temperature scales as well as some historical perspective. The physical laws used in thermometry are generally very well described. The book, with its emphasis on the principles rather than the practice of thermometry, provides the background for books on thermometry that deal with its practice.

ROBERT J. SOOLEN, JR.
Temperature and Pressure Division, National Bureau of Standards, U.S. Department of Commerce, Washington, D.C. 20234

Plant Viruses

Plant Infectious Agents. Viruses, Viroids, Virusoids, and Satellites. HUGH D. ROBERTSON, STEPHEN H. HOWELL, MILTON ZAITLIN, and RUSSELL L. MALMBERG, Eds. Cold Spring Harbor Laboratory, Cold Spring Harbor, N.Y., 1983. x, 230 pp., illus. Paper, $23. Current Communications in Molecular Biology. From a conference, Feb. 1983.

Traditionally, few biochemists and molecular biologists have investigated plant viruses. The number who do has increased during the past decade, however, because of the discoveries of new and unusual viruses, unsuspected properties of well-known viruses, and viroids, which are smaller than viruses. This book of summaries of reports given at a meeting contains many ideas, some results, and a little history and methodology. The ideas and results are current, and some of them have not been published elsewhere. The emphasis is on the molecular biology of plant viruses, and most work on this aspect of the subject is included. Other aspects, such as pathology, epidemiology, and control, are not covered. There is some repetition among reports, and there are a few errors, but neither are serious drawbacks.

Among the pathogens of most interest to molecular biologists are the viroids, which are small infectious RNA's about 250 to 400 nucleotides long. Viroids cause serious plant diseases, such as potato spindle tuber, citrus exocortis, and cadang cadang of coconut. There are no cures, and prevention is the only known control. Similar disease agents have not yet been found in animals. Viroids apparently do not code for proteins or polypeptides. The mechanism by which they cause disease is unknown, though it has been postulated that they interfere with messenger RNA splicing or some regulatory process. Multimeric forms, possibly replicative intermediates, have been found in infected cells, and DNA polymerase II has been implicated in their replication. The demonstration by Diener and his colleagues that cloned complementary DNA dimer of potato spindle tuber viroid is infectious opens the way for studying the effect of directed base changes on their function.

Virusoids are small RNA's with a structure similar to that of viroids, but they are always associated with a larger viral RNA. Three of the four known virusoids are reported to be necessary for the replication of the larger RNA and to be a part of the virus genome. The fourth virusoid appears to be more like a satellite, that is, an extra RNA associated with a virus that is only able to replicate in cells infected by the virus. Virusoids have only been known for a few years and have been found only in Australasia. They have already been sequenced by Symons and colleagues, but information on their biological activity is incomplete.

DNA-containing plant viruses were not discovered until the late 1960's, and only a few of them have been described. Along with the Ti plasmid of *Agrobacterium tumefaciens*, they are considered as possible vectors for introducing DNA into plants. Cauliflower mosaic virus is representative of the single group with a double-stranded DNA genome. It has circular double-stranded DNA with one gap in one DNA strand and two gaps in the other. However, a supercoiled form in a minichromosome-like structure found in infected cells has no gaps and serves as the template for transcription of four RNA's. One of these RNA's is genomic-sized and may be a replicative intermediate. Cauliflower mosaic virus thus has similarities to the animal retroviruses and possibly to hepatitis in having both RNA and DNA stages in the replication of its genome. Absence of a DNA replication origin will limit its usefulness in recombinant DNA technology.

The single-stranded DNA plant viruses are the gemini viruses. They have two genomic DNA's of similar size, except those from Australia, which have only one. Perhaps the Australian tradition for unusual flora and fauna extends to viruses.

This book also contains research reports on some of the better-known plant viruses. Notable is the recent progress in the purification of template-dependent, virus-specific RNA-dependent RNA replicases from plants infected with brome mosaic and cowpea mosaic viruses, the confirmation of mutations induced in maize by barley stripe mosaic virus, and encapsidation of chloroplast RNA transcripts in pseudovirions of tobacco mosaic virus. As many as nine subgenomic RNA's of tobacco mosaic virus have been reported, but published evidence for some is scanty, and Zaitlin and coworkers suggest that six may be artifacts. These and other observations promise progress in studies of interactions of plant viruses and their hosts.

An appendix contains 15 base sequences of plant viruses, viroids, virusoids, and satellites.

This is not the book to go to for exhaustive coverage or detailed experimental protocol, but it is excellent for a concise version of recent developments in the molecular biology of plant viruses.

MYRON K. BRAKKE
Department of Plant Pathology, University of Nebraska, Lincoln 68583

Reprints of Books Previously Reviewed

Animal Architecture. Karl von Frisch, with the collaboration of Otto von Frisch. Van Nostrand Reinhold, New York, 1983. Paper, $10.25. *Reviewed* **188**, 845 (1975).

Betrayers of the Truth. William Broad and Nicholas Wade. Simon and Schuster, New York, 1983. Paper, $6.95. A Touchstone Book. *Reviewed* **219**, 1417 (1983).

La Matière Mal Condensée. Ill-Condensed Matter. Roger Balian, Roger Maynard, and Gerard Toulouse, Eds. North-Holland, Amsterdam, and World Scientific, Singapore, 1983 (U.S. distributor, Heyden, Philadelphia). Paper, $28. *Reviewed* **208**, 1025 (1980).

Risk and Culture. An Essay on the Selection of Technical and Environmental Dangers. Mary Douglas and Aaron Wildavsky. University of California Press, Berkeley, 1983. Paper, $6.95. *Reviewed* **219**, 1211 (1983).