AIR POLLUTION

THIRD EDITION

VOLUME II

The Effects of Air Pollution

Edited by

Arthur C. Stern

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Preface

This third edition is addressed to the same audience as the previous ones: engineers, chemists, physicists, physicians, meteorologists, lawyers, economists, sociologists, agronomists, and toxicologists. It is concerned, as were the first two editions, with the cause, effect, transport, measurement, and control of air pollution.

So much new material has become available since the completion of the three-volume second edition, that it has been necessary to use five volumes for this one. Volumes I through V were prepared simultaneously, and the total work was divided into five volumes to make it easier for the reader to use. Individual volumes can be used independently of the other volumes as a text or reference on the aspects of the subject covered therein.

Volume I covers two major areas: the nature of air pollution and the mechanism of its dispersal by meteorological factors and from stacks. Volume II covers the effect of air pollution upon plants, animals, humans, materials, and the atmosphere. Volume III covers the sampling, analysis, measurement, and monitoring of air pollution. Volume IV covers two major areas: the emissions to the atmosphere from the principal air pollution sources and the control techniques and equipment used to minimize these emissions. Volume V covers the applicable laws, regulations, and standards; the administrative and organizational strategies and procedures used to administer them; and the energy and economic ramifications of air pollution control. The concluding chapter of Volume II discusses air pollution literature sources and gives guidance in locating information not to be found in these volumes.

To improve subject area coverage, the number of chapters was increased from the 54 of the second edition (and 42 of the first edition) to 72. The scope of some of the chapters, whose subject areas were carried over from the second edition, has been changed. Every contributor to

the second edition was offered the opportunity to prepare for this edition either a revision of his chapter in the second edition or a new chapter if the scope of his work had changed. Since 8 authors declined this offer and one was deceased, this edition includes 53 of the contributors to the second edition and 48 new ones.

The new chapters in this edition are concerned chiefly with aspects of air quality management, such as, data handling, emission inventory, mathematical modeling and control strategy analysis; global pollution and its monitoring; and more detailed attention to pollution from automobiles and incinerators. The second edition chapter on Air Pollution Standards has been split into separate chapters on Air Quality Standards, Emission Standards for Stationary Sources, and Emission Standards for Mobile Sources. Even with the inclusion in this edition of the air pollution problems of additional industrial processes, many are still not covered in detail. It is hoped that the general principles discussed in Volume IV will help the reader faced with problems in industries not specifically covered.

Because I planned and edited these volumes, the gap areas and instances of repetition are my responsibility and not the authors'. As in the two previous editions, the contributors were asked to write for a scientifically advanced reader, and all were given the opportunity of last minute updating of their material.

As the editor of a multiauthor treatise, I thank each author for both his contribution and his patience, and each author's family, including my own, for their forbearance and help. Special thanks are due my secretary, Susan Bigham, and her predecessors, who carried a hundred and one times the burden of the other authors' secretaries combined, and Eleanor G. Rollins for preparing the subject index for this volume. I should also like to thank the University of North Carolina for permitting my participation.

Arthur C. Stern

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1

Effects on the Physical Properties of the Atmosphere

Elmer Robinson

I. Introduction

Pollutants in the atmosphere can bring about changes in atmospheric properties from the obvious observation of heavy smoke to subtle effects on urban temperature or regional precipitation. These active air pollutants may be either gases or particles. It is only with an understanding of