

AIR POLLUTION

EDITED BY

ARTHUR C. STERN

VOLUME I

AIR POLLUTION

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ARTHUR C. STERN

*United States Public Health Service
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VOLUME I

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PREFACE

This book is concerned with the cause, effect, transport, measurement, and control of air pollution. It is intended for professionals. However, by professionals are meant those trained in as wide a variety of callings as are represented among its authors: engineers, chemists, physicists, physicians, meteorologists, lawyers, agronomists, and toxicologists.

Since this is a two-volume work, it may be helpful to the reader who does not find the subject of his interest in Volume I to outline briefly the contents of Volume II. It covers four major areas: the emissions to the atmosphere from the principal air pollution sources; the control techniques and equipment used to minimize these emissions; the applicable laws, regulations and standards; and the administrative and organizational procedures used to administer these laws, regulations, and standards. The concluding chapter of Volume II discusses air pollution literature resources and gives guidance in locating information not to be found in either volume. Volumes I and II were prepared simultaneously and the total work divided into two volumes to make it easier for the reader to use.

Altogether, the two volumes represent the work of forty-five separate authors. It was my responsibility, as planner and editor of the book, to define the subject area to be covered by each author. Therefore, gaps in the coverage of the over-all subject of air pollution are my fault, not that of the authors. Some of the gaps are intentional. For instance, during the time this book was being written, there has been intensive development of instrumental methods of chemical analysis. Because it was felt that discussion of these developments was in the domain of analytical chemistry rather than air pollution, it was omitted from the book. We also debated the desirability of including detailed lists of air pollutant levels in a number of cities. These, too, were intentionally omitted because of their rapid obsolescence. Appendix I of Volume II lists industrial processes capable of causing emission of pollutants. It is admittedly an incomplete list. Since it was obviously impracticable to cover all such processes, only a few were selected for detailed discussion in Volume II.

Two very common shortcomings of multi-authored books are repetition of the same material in several chapters and unevenness of treatment of the subject matter among the several chapters. I have attempted to control repetition by initially requiring detailed chapter outlines from each author and then eliminating like material from all but one chapter outline.

To maintain uniformity of technical level among the chapters, the authors were asked to write for a scientifically advanced reader and to assume that any further mathematical or other scientific background information that might be required by a reader could be obtained from other sources.

Authors were initially assigned chapter lengths. It is interesting to note that most authors felt that to achieve the desired level of sophistication, they required more space than was originally assigned them, some exceeding their initial quota by a considerable margin. In each case where a longer-than-intended chapter was allowed to remain, it was because I believed that severely cutting it would deprive the reader of valuable information. My reluctance to cut these chapters back to their preconceived length has resulted in expanding a book originally planned as a one volume work of 500 pages to the present two volume work of 1,200 pages.

The principal problem of the editor of a work of this nature is the race between the time it takes the slowest author to complete his chapter and obsolescence that has accumulated in all the previously completed chapters. The authors of all chapters were given the opportunity of last minute updating of their material. Despite this, the astute reader will spot some differences in the relative amounts of very recent material included in the various chapters.

The subject index for both volumes was prepared by Esther E. Norton and Marion G. Curry.

As editor of a multi-author book, I thank each author for both his contribution and his patience. For each author, there is also a family to be thanked for their forbearance and a secretary for her help in preparation of the manuscript. In my particular case, as not only editor but also chapter author, I acknowledge to my family and thank my secretary, Celia G. Barlow, who carried forty-five times the burden of all the other authors' secretaries combined. In this task, Carolyn S. Froelich helped her carry the load. Special thanks are due my superiors in the Public Health Service for permitting the participation of myself and so many of my Public Health Service colleagues.

ARTHUR C. STERN

Cincinnati, Ohio
November, 1961

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PART I

Air Pollution and
Its Dispersion

CHAPTER 1

Classification and Extent of Air Pollution Problems

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I. Historical Perspective

A. AIR POLLUTION PRIOR TO THE INDUSTRIAL REVOLUTION

The quality of the atmosphere, on which all terrestrial forms of life are dependent, has been recognized as an important variable in the environment only during the past few decades. It may be supposed that smoke and fumes from forest fires, volcanoes, and crude "domestic" heating and cooking arrangements were troublesome or lethal in discrete localities even before our human ancestors became organized in fixed communities, and that the odors of decaying animal and vegetable refuse, attested to by existing residues of prehistoric garbage dumps in and near Stone Age dwellings, were cause for protesting comment in such language as may have been available to the temporary residents.

However, it is unlikely that such circumstances can have been regarded as more than incidental to devastating natural cataclysms, or as

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