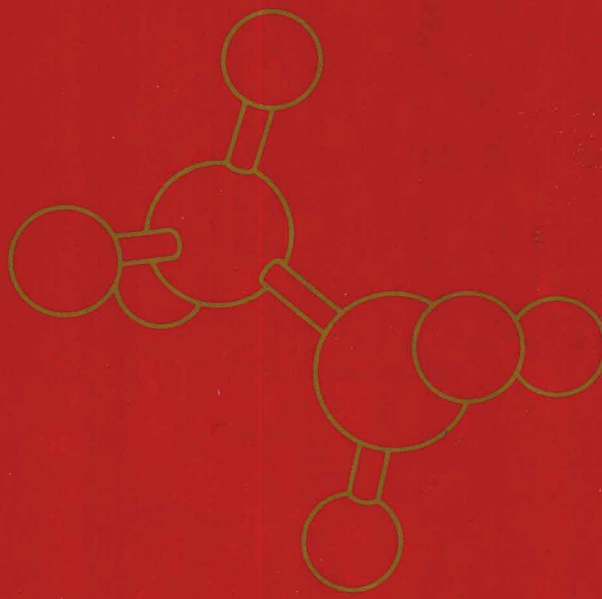
ORGANIC CHEMISTRY

STANLEY H. PINE

FIFTH EDITION



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Stanley H. Pine

Professor of Chemistry
California State University, Los Angeles

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About the Author

Stanley Pine is Professor of Chemistry at California State University, Los Angeles, an urban campus of the California State University system. He joined the faculty in 1964 after completing his doctoral work with Donald Cram at U.C.L.A., then spending a year at Harvard as a postdoctoral fellow with Robert Woodward.

Professor Pine has had a notable career combining teaching, research, and service to his profession. He has been honored as a California State University Outstanding Professor and in 1986 was the University nominee for the Chemical Manufacturers Association Catalyst award for outstanding teaching. He currently serves the American Chemical Society as a member of the Committee on Education and as the chairman of the Committee on Chemical Safety.

Pine is a "practicing chemist," for he feels that the excitement of chemistry is most obvious when faculty and students work together in the laboratory. Over 75 students have chosen to do research work with Professor Pine. He can be seen almost every day in his familiar white coat working with students on research projects or independently as he explores new areas for study. His research has spanned a broad range of topics including stereochemical studies, natural products synthesis, studies of reaction mechanisms, organometallic chemistry, and polymer chemistry. His efforts have been supported by almost one million dollars in research grants from agencies such as the National Science Foundation, the Petroleum Research Fund, and the National Institutes of Health.

Professor Pine has taken every opportunity to enhance his experiences in teaching and research by traveling widely in the United States and Europe. In addition to frequent participation in national and international chemistry meetings he has been a Fulbright visiting professor at the University of Strasbourg, France, and a visiting professor at the California Institute of Technology. In addition to employment at Union Carbide prior to joining the Cal State faculty, he spent a leave in 1981 at Occidental Research Corporation just to keep in touch with the industrial world of chemistry.

Pine's early industrial experience provided the stimulus for his activities in promoting safety in the academic laboratories as an important part of chemical education. He has been a valuable resource for high schools and colleges throughout the United States. In 1981 he was asked to be the initial chairman for the American Chemical Society Task Force on RCRA (Resource Conservation and Recovery Act) and in that capacity has worked with the EPA and other government agencies on legislative questions relative to hazardous wastes in laboratories.

In 1976 Donald Cram, George Hammond, and James Hendrickson asked Stanley Pine to join them as the new coauthor of *Organic Chemistry*. That successful fourth edition has evolved into this fifth edition of which Pine has now become the sole author.

PREFACE

The study of science is the development of ideas from experimental observations. It is not simply learning a list of facts, but rather a way of thinking. A primary goal for the student is to learn methods of problem solving and to develop the ability to apply them to any problem, scientific or nonscientific.

This text attempts to teach thinking as well as facts and theories. The facts and theories are those related to the structure and chemistry of organic compounds. Information is presented and then developed so as to guide the student through the thought processes required to solve scientific problems. Organic chemistry is one vehicle by which students can develop the important skills of problem solving.

This fifth edition of *Organic Chemistry*, like earlier editions of the textbook, presents organic chemistry by a mechanistic approach. Compounds are considered according to their common reactivity patterns. This "reaction mechanism" approach compares the similarities of a variety of different reactions. Reactivity patterns are learned without the need to memorize a multitude of specific reactions. The reaction mechanism logic relates to how a chemist thinks, how a science student should think, and how chemicals actually react as they form new compounds.

The text has been rewritten, with additions and deletions of subject matter reflecting the continuing changes in organic chemistry. Many of the problems have been changed or replaced with new ones. However, the major changes are in presentation. The writing has been modified so as to make subject materials even more interesting and understandable to students. Many of the longer chapters from the previous edition have been divided into more manageable lengths. New chapters have been added on characteristic reactions and on reaction mechanisms. The materials dealing with carbanions alpha to carbonyl groups have been brought together in one chapter. The emphasis on organic synthesis has been integrated throughout each chapter,

and is given further importance by an early chapter specifically covering nucleophilic additions and substitutions in synthesis. However, the popular chapter on organic synthesis which comes later in the text is retained as it provides a broader view of the strategy of synthesis. The topics related to the organic chemistry of biological processes and natural materials continue to be integrated throughout the text and, as separate, more extensive chapters, are also included early enough in the course so that they will not be easily skipped.

Finally, the discussion of spectroscopy has been expanded to reflect its increasing importance as a tool for the study of organic chemistry. Spectroscopy topics are concentrated in a single chapter at the end of the textbook, the appendix. This will allow instructors to introduce topics to best fit their pedagogical needs, whether these materials are used in the lecture, the laboratory, or both. Concepts are integrated, the same way that spectroscopy is used in the laboratory. Many spectroscopy problems are provided to reinforce the learning process. Spectroscopy problems are also included throughout the chapters where they relate to specific chapter topics. (Spectroscopy problems are marked with an asterisk (*).)

The material in *Organic Chemistry* is organized so that students are first reintroduced to fundamental concepts of atomic and molecular structure and their relevance to organic compounds. Following that is a necessary consideration of nomenclature, and then a review of the major types of reactions of organic compounds. This puts into perspective for the student the direction and scope of the course. It also provides a basis for understanding the variety of organic chemistry that usually is part of the accompanying organic laboratory.

Chapter topics are organized in relation to similarities of how components react, that is, by similarities in the bond-making and bond-breaking processes. The influence of molecular structure on reactivity is introduced early and built upon throughout the text.

The general characteristics of organic reactions are introduced using chemistry associated with the carbonyl group. Carbonyl groups are a component of a wide variety of organic compounds, thus the role of organic chemistry becomes obvious early in the text. In addition, carbonyl is a polar group upon which the mechanistic concepts of bond making and bond breaking are readily developed. An understanding of polar reactions of other types of compounds logically follows from the treatment of carbonyl.

Chapters 2 through 19 provide a basis for understanding and working with a majority of organic reactions. Some institutions may find materials from this portion of the text, when supplemented with examples from the latter chapters, sufficient for a short course in organic chemistry. For the more common academic year course, Chapters 20 through 27 consider topics which illustrate the role of organic chemistry in the broader areas of science and technology. Topics such as carbohydrates, amino acids and proteins, lipids, polymers, photochemistry and electrochemistry provide an opportunity for students to learn practical information and appreciate the relevance and pervasiveness of organic chemistry.

In an effort to facilitate orderly learning, each chapter begins with an outline of the contents and ends with a summary. Where appropriate, a summary of the reactions introduced in the chapter is also included. Chapters are divided into numerous sections and subsections as an aid to organization for student and instructor. A variety of examples of broad general interest are included throughout the text to pique the interest of students. Product yields, taken from the chemical literature, illustrate the experimental realities of organic chemistry. An extensive index provides ready reference to the contents of the text.

Organic chemistry is not a "spectator sport." Students learn by working with concepts. Each chapter includes a large number of in-chapter problems to guide and test the students' comprehension at each step of the learning process. End-of-chapter supplementary problems provide a more general test of knowledge attained through study of the chapters. An associated *Student Supplement to Organic Chemistry* is available with carefully worked solutions and discussions of the problems.

I am indebted to the many users of the previous editions, students, and reviewers of the present manuscript, who provided many comments, criticisms, and suggestions. Special thanks go to Donald Paulson, California State University, Los Angeles, who read and provided detailed comments on the entire manuscript and galley proofs. Joel Hawkins and Eric Ansyln, California Institute of Technology, read and critiqued the page proofs. Others who reviewed parts of the manuscript are William J. Barnhurst, Villanova University; Albert W. Burghstahler, University of Kansas; David R. Dalton, Temple University; Catherine C. Franklin, Formerly, Skidmore College; David Goldsmith, Emory University; Bruce B. Jarvis, University of Maryland; Douglas E. Johnson, North Dakota State University; Tappey H. Jones, College of William and Mary; Lawrence K. Montgomery, Indiana University; Paul Sampson, Kent State University; and James M. Wilbur, Jr., Southwest Missouri State University. Steven Tenney and Ruth Mendelsohn were particularly helpful during the editing and production stages. Yvonne Pine provided encouragement and did the tedious job of data entry. Alan S. Wingrove and Floyd A. Blankenship, Towson State University, generously provided their computer program and help in compiling the index.

Organic chemistry is a rigorous and demanding subject. I hope that you will find it as stimulating, exciting, and ultimately rewarding as I have.

Stanley H. Pine

Organic Chemistry

Contents in Brief

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