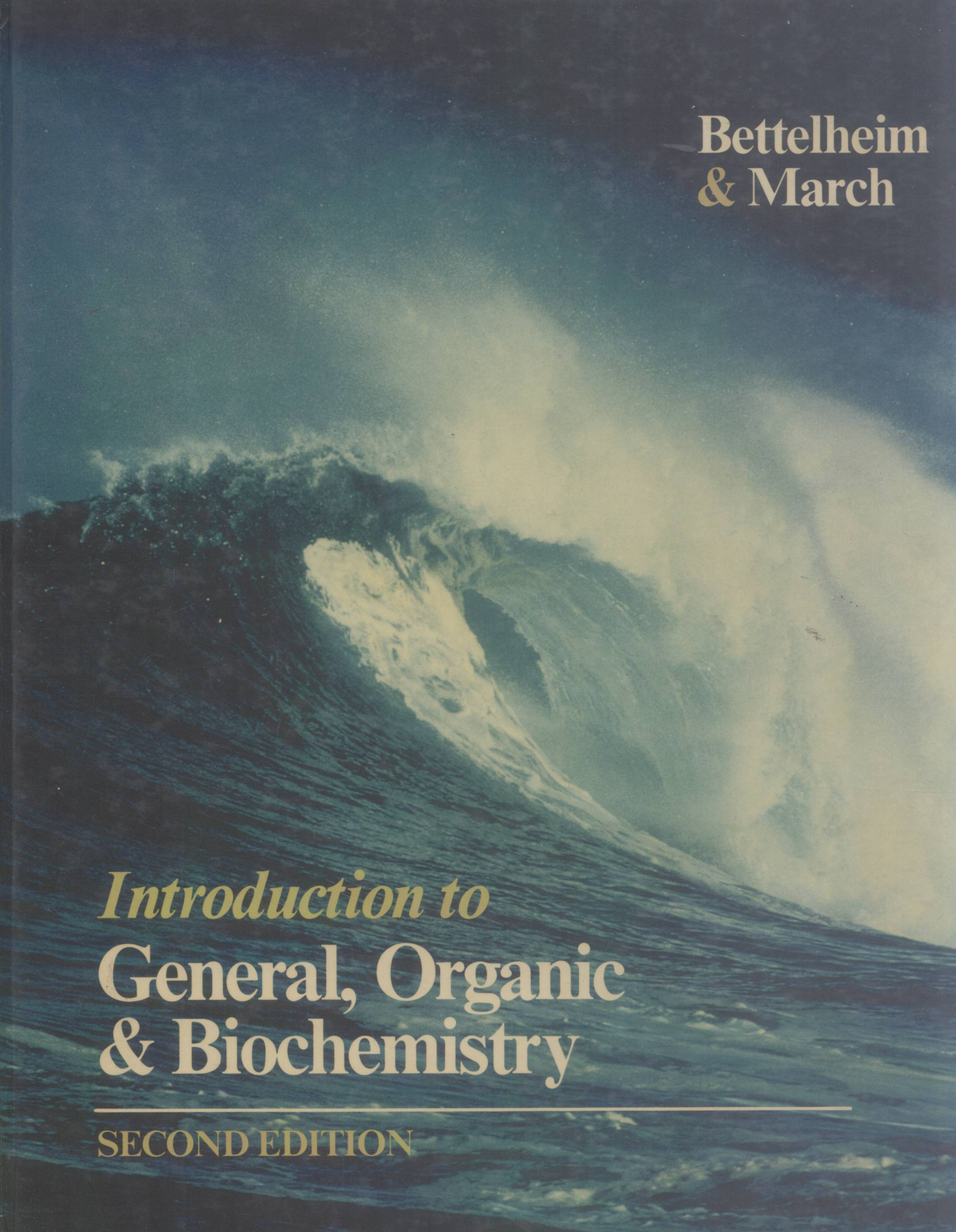

Bettelheim
& March
Introduction to
General, Organic
& Biochemistry
SECOND EDITION

INTRODUCTION TO

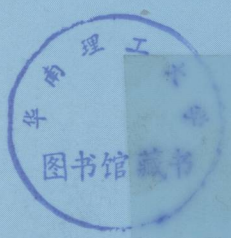
General, Organic & Biochemistry

SECOND EDITION

Frederick A. Bettelheim

Jerry March

Adelphi University



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This book is dedicated to
our mothers and wives;
Elizabeth Bettelheim, Fannie March,
Annabelle Bettelheim, and Beverly March

Preface

In preparing this second edition, our first thought is an expression of gratitude to our colleagues who, by adopting our textbook for their courses, made this second edition possible. It is our aim not only to update the first edition, but also to enlarge the scope of the book by some reorganization and by the inclusion of new material. One major improvement is the addition of full color, which enhances the readability and comprehensibility of the material.

Audience

As was the first edition, this book is intended for nonchemistry majors, mainly those entering health science and related fields (such as nursing, medical technology, and nutrition). In its entirety it can be used for a one-year (two-semester or three-quarter) course in chemistry, or parts of the book can be used in a one-term chemistry course.

We assume that the students using the book have little or no chemistry background. Therefore, we introduce the basic concepts slowly at the beginning, although the tempo and the level of sophistication increase as we go on. We progress from the basic tenets of general chemistry to organic chemistry, and finally to biochemistry. We consider this progression an ascent in terms of both practical importance and sophistication. While this progression goes on we always keep a unified view of chemistry. We do not consider the general chemistry sections to be the exclusive domain of inorganic compounds, but frequently use organic and biological substances to illustrate general principles (for example, acid–base reactions).

While it is our aim, through this ascent, to teach the chemistry of the human body as the ultimate goal, we try to show that each subsection of chemistry is important in its own right, besides being required for future understanding.

T cell lymphocytes atacking a cancer cell.

Boxes (Medical Applications of Chemical Principles)

An important feature of this book is the large number of boxes, most of which contain medical and biological applications of the principles discussed in the text. In the second edition we have added 17 new boxes and discarded some of the less relevant ones from the first edition. There is now a total of 158 boxes. The new boxes have been written along the same lines

Chernobyl after the nuclear accident. (V. Zufarov, Fotokhronica Tass)

as those in the first edition. They are relevant illustrations of the topics discussed, and they provide interesting and up-to-date information. For example, some of the new boxes describe the Chernobyl nuclear disaster, the role of anabolic steroids in sports physiology, and the use of self-absorbing staples in closing surgical wounds.

The presence of these boxes allows a considerable degree of flexibility. The instructor can assign only the main text, in which case the boxes will not interrupt the continuity and all the essential (core) material will be covered. However, most instructors will probably wish to assign at least some of the boxes, since they enhance the core material. Few courses will have time for all the boxes, but such a large number allows each instructor to choose those that best fit the particular needs of the course and of the students. As an additional aid to instructors and students, problems have been provided for nearly all of the boxes.

Relevance of the Material

Students, especially those already embarked on a career, often ask, "Why do I have to learn this?" Our aim is to answer this question, and we do so in three ways: (1) The previously mentioned boxes. For each topic in the main text, the associated boxes demonstrate the relevance of that topic to the student. (2) Each topic is presented in the context of a larger experience to show how it fits in with the entire discipline of chemistry. (3) We make constant references to past and future sections of the book, where related topics have been (or will be) discussed, in order to emphasize the importance of general and organic chemistry in understanding the working of the body (biochemistry).

Organization

Nine chapters deal with general chemistry, six with organic chemistry, and eleven with biochemistry. Although the organization of the material is largely traditional, there are some noteworthy features. In the organic chemistry chapters, we concentrate on the structure, nomenclature, physical properties, and only the most important reactions of each class of compounds. Except for one box (Box 11D), we have nothing at all on organic reaction mechanisms. We feel that in the relatively brief portion of the course devoted to organic chemistry, students do not have the time to learn a large number of reactions or anything at all about mechanisms. The reactions we do discuss are mostly those that have biological applications. In order to help students learn the reactions, we include summaries of reactions at the ends of the chapters. We also discuss many individual compounds that have physiological activity of one sort or another. In the second edition we have added a new section on inorganic nomenclature.

Metabolism; Color Code

The biological functions of chemical compounds are explained in each of the biochemistry chapters. The emphasis is on chemistry rather than physiology. We have received much positive feedback regarding the way in

which we organized the topic of metabolism (Chapters 20, 21, and 22). We have maintained the structure of these three chapters, but now that we have full color, we have introduced a color code into the equations and illustrations. We hope that the color code will make these complex processes more comprehensible to the student. We continue to introduce first the common catabolic pathway through which all food will be utilized (citric acid cycle; oxidative phosphorylation), and only after that do we discuss the specific pathways leading to the common pathway. This is better pedagogically, and it also enables us to sum up the caloric values of each type of food because their utilization through the common pathway has already been learned. Finally, we separate the catabolic pathways from the anabolic pathways by treating them in different chapters, emphasizing the different ways the body breaks down and builds up molecules.

New Chapter

In the second edition we have added one new chapter, Chapter 26, on nutrition and digestion. Although many instructors may not have the time to teach this topic, it can always be used as reference material. We have also enlarged the coverage of the two most rapidly developing biochemical fields: nucleic acids and protein synthesis (Chapter 23) and chemical communications: neurotransmitters, hormones, and immunoglobulins (Chapter 24). We present the modern view in discussing neurotransmitters, hormones, and immunoglobulins in one chapter. This emphasizes their function as message-carriers and their chemical mode of action: interacting with receptors.

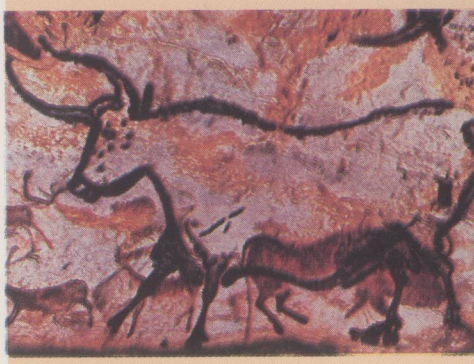
Features

As mentioned earlier, one of the main features of the book is the number of applications of chemistry presented in the boxes. Another important (and unusual) feature is a glossary-index. The definition of each term is given along with the index entry and the page numbers. In this second edition we have added a list of key terms at the end of each chapter, with a notation of the section number in which the term is introduced. Many students will find these lists to be helpful study guides.

Problems

The second edition also has a larger number of difficult (starred) problems at the ends of the chapters. The total number of problems in each chapter has also been increased.

The end-of-chapter problems are strictly arranged in order of topic coverage, except that at the end of each problem set there are additional problems, not arranged in order of topic coverage. These are included to be more challenging, since it is not immediately apparent where the topic is discussed. Answers to all of the in-text problems and to the odd-numbered end-of-chapter problems are given at the end of the book. Answers to the even-numbered problems are included in the Instructor's Manual and the Study Guide. Other features are the summaries at the end of each chapter



Prehistoric cave painting from Lascaux, Dordogne, France.

(including summaries of organic reactions in Chapters 11 to 15) and the substantial number of marginal notes.

Style

In the first edition and even more so in the second, we have taken special care to ease the absorption and understanding of the difficult concepts. Our writing style addresses the students directly in simple and clear phrasing, illuminating some concepts from more than one angle in order to make the picture complete. Our most important aim was clear and concise writing. We have tried to avoid oversimplifications; wherever space limitations permit, we show the ramifications of each topic, in most instances with pertinent examples from health care and related fields.

Ancillaries

This textbook is accompanied by a number of ancillary publications:

1. Laboratory Manual to Accompany *Introduction to General, Organic & Biochemistry,* by J. Lee and F. A. Bettelheim.
2. Study Guide by W. Scovell.
3. Instructor's Manual to Accompany *Introduction to General, Organic & Biochemistry* by Frederick A. Bettelheim and Jerry March.
4. Instructor's Manual to Accompany *Laboratory Manual for Introduction to General, Organic & Biochemistry* by J. Lee and F. A. Bettelheim.
5. Approximately 100 overhead transparencies in both two and four colors.

Acknowledgments

The publication of a book such as this requires the efforts of many more people than merely the authors. A number of reviewers have read all or significant portions of the manuscript at various stages. We thank the following for their constructive criticisms and helfpul suggestions:

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Many of our reviewers pointed out inadvertent errors or certain weaknesses in the first edition. We have attempted to correct these, and thus we hope that the second edition will prove even more useful than the first.

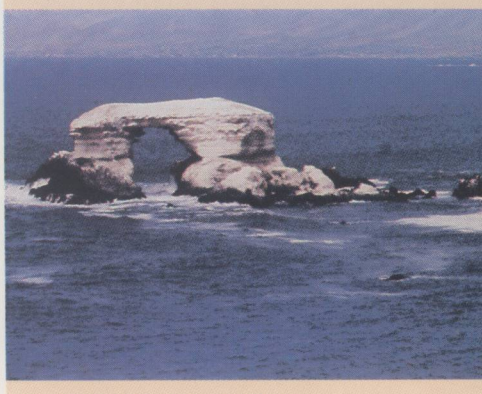
We also wish to thank several of our colleagues at Adelphi University for their useful advice. These include Donald Davis, Stephen Goldberg, Joseph Landesberg, Sung Moon, Donald Opalecky, Reuben Rudman, Anthony Sisti, Madelyn Todd, and Stanley Windwer. We are also grateful for the guidance of John Vondeling, Associate Publisher. We thank Carol Bleistine, Tim Frelick, and Sally Kusch for supervising the art, production and editing of the book you see before you. J & R Technical Services, Inc., transformed our crude drawings into pieces of art. We especially want to thank Beverly March and Charles D. Winters for their many excellent photographs.

F. A. Bettelheim and Jerry March
Adelphi University

INTRODUCTION TO

General, Organic & Biochemistry

Contents Overview

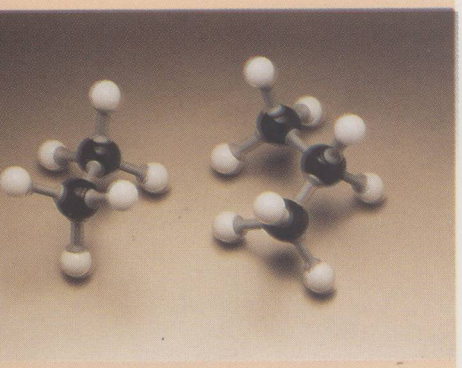


Rock formation in the Strait of Magellan.

Contents

A. L. Lavoisier and wife by David. (Metropolitan Museum of Art)

Chapter 3
Chemical Bonds 53



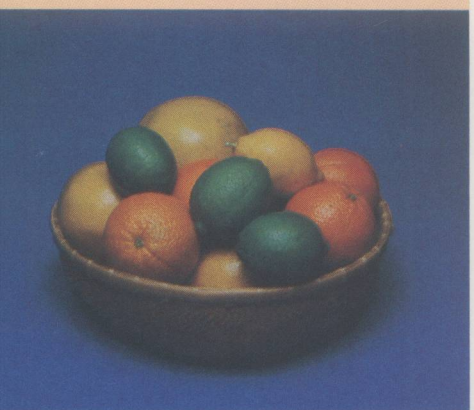
Molecular models of ethane and propane. (Charles D. Winters)

Chapter 4
Chemical Reactions 82

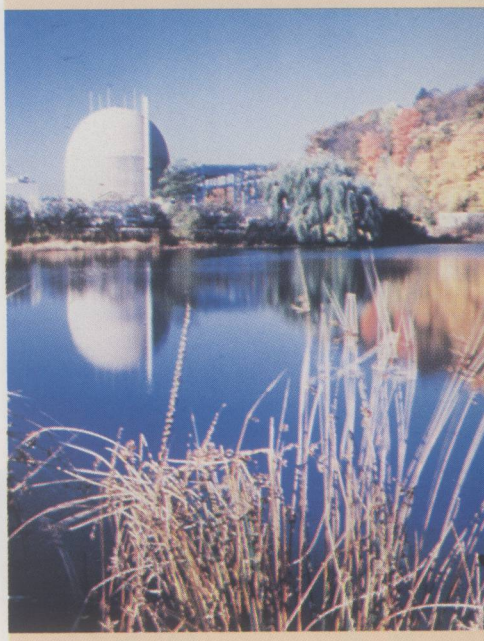
Chapter 5
Gases, Liquids, and Solids 107

Chapter 6
Solutions and Colloids 136

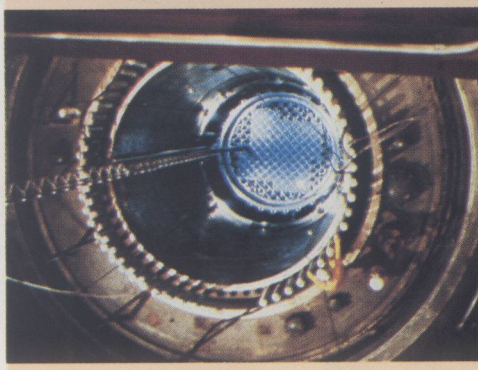
Hot-air balloon flown by Montgolfier brothers in 1783 at Versailles. (Musée Carnavalet, Paris)



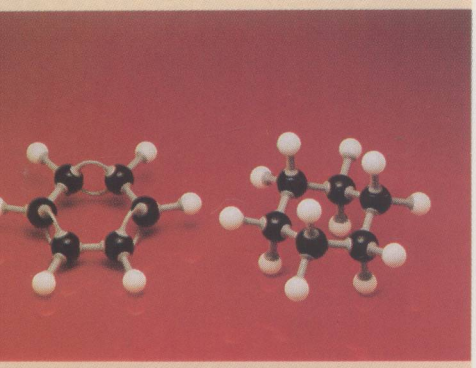
Citrus fruit contains acids. (Beverly March)



Haddam Neck nuclear reactor. (Atomic Industrial Forum)



Core of a nuclear reactor. (Atomic Industrial Forum)



Molecular models of benzene and cyclohexane. (Charles D. Winters)