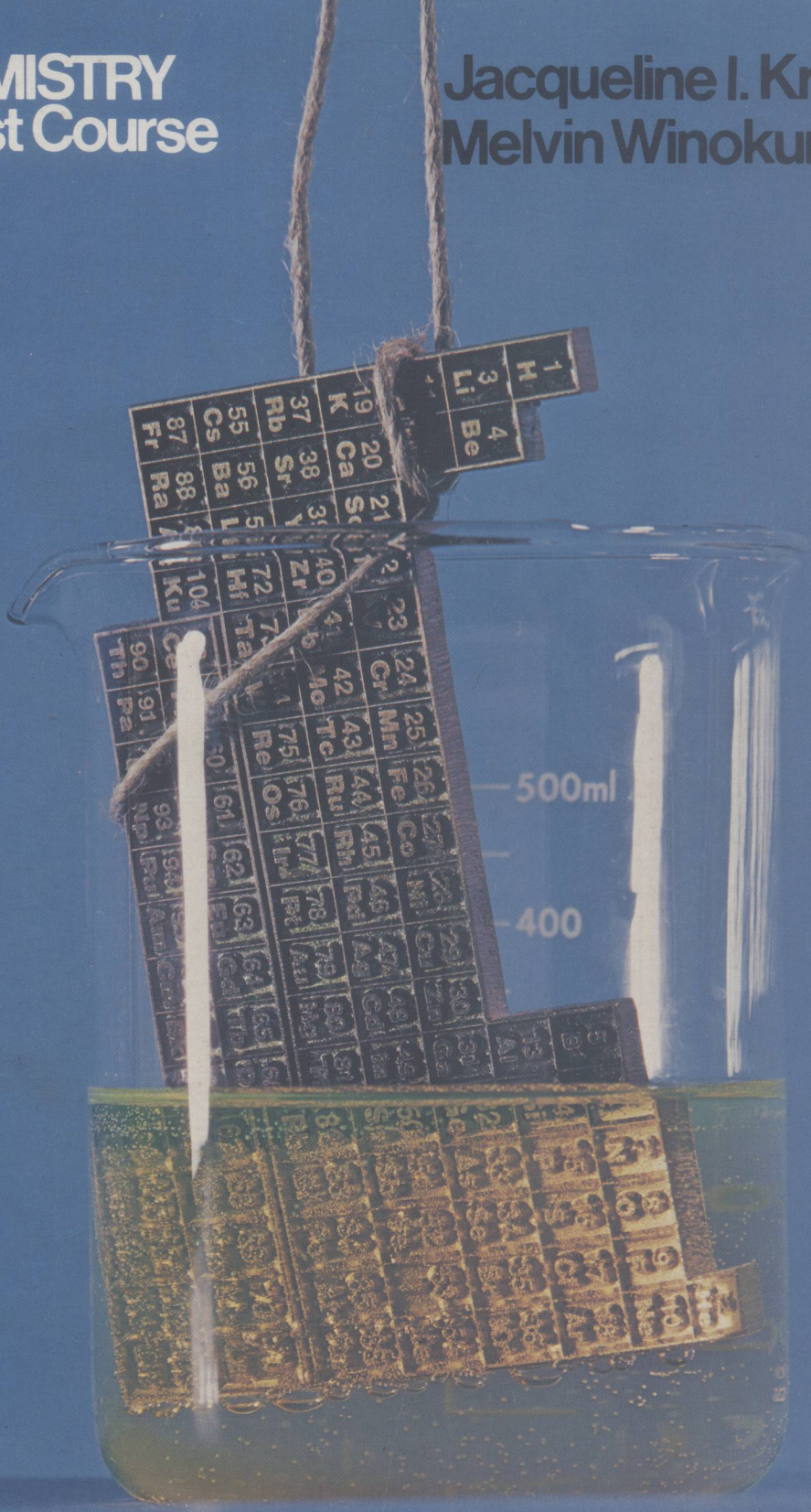
CHEMISTRY
A First Course

Jacqueline I. Kroschwitz
Melvin Winokur



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CHEMISTRY
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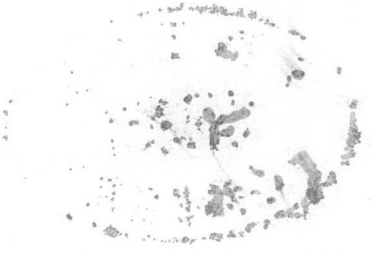

to Rose, Irene, and Jack

Preface

"To teach is to learn." In writing this book we have attempted to apply the valuable lessons which our students have generously supplied as we have tried (with some success we think) to teach them the fundamental concepts of chemistry. Perhaps the most valuable lesson we have learned is that beginning chemistry students simply do not possess certain knowledge and reasoning skills which their science instructors generally take for granted. In this text, aimed primarily at the preparatory-level chemistry course, we take nothing for granted, neither prior scientific knowledge nor prior experience in deduction.

As we approached each topic our aim was to offer complete, logical explanations which include all necessary steps in the deductive reasoning process, rather than assuming that the student already has the ability to make deductive leaps. This approach gives students the opportunity to glimpse the complete development of scientific thought, which is usually not their natural way of thinking, and to develop their own reasoning skills as they explore increasingly complex phenomena.

We hope that students might enjoy their study of chemistry despite the fact that many are captives of a science course requirement. To this end we have used a conversational tone, a few anthropomorphic explanations, and occasionally introduced humor into some illustrations. Also, we encourage student visualization of microscopic phenomena both because such imagery is a valuable scientific skill and because it is fun.

As a convenience and learning aid, and in order to reinforce concepts and encourage necessary review, we frequently refer students to previous sections needed as a foundation for understanding the topic at hand. Cross-referencing is also used to inform students of "coming attractions" in subsequent chapters. Other convenient features and learning aids are

Sample Exercises are very carefully worked out in stepwise detail using the *Unit Conversion Method* wherever possible and appropriate. Sample Exercises are supplied copiously.

Problems frequently immediately follow Sample Exercises within the chapter so that the student can test his or her understanding of the concept explained. At the end of each chapter there are *numerous problems at varying levels* so that students can reach the limits of their own capacities.

Stepwise Procedural Rules or guidelines are provided for significant manipulations; for example, see "Guidelines for writing Lewis structures" in Section 10.10.

Tables are used extensively to organize and summarize information.

Illustrations are an integral part of the explanations.

Summaries of the major points addressed conclude each chapter.

Chapter Accomplishments provide the student with the learning objectives of each chapter.

Math skills are given the status and full treatment of a chapter.

The usefulness of the *periodic table* is stressed and reiterated.

An entire chapter is devoted to the *mole concept.*

Selected answers to problems appear in Appendix 3.

Defined words are italicized in the index for ready location.

A preliminary edition of this text has been class tested and the responses of our students seem to suggest we have succeeded in writing a truly student-oriented book. Students describe the text as "self-teaching." In short, preparatory level students are able to read and understand this book and many report enjoying it in parts.

The order in which we have chosen to arrange topics is the one we have found to be most successful in teaching students with no prior experience. This scheme proceeds gradually from material which can be dealt with on a concrete reasoning level to material that demands abstract, formal thinking. Laboratory work is more easily correlated with this order of topics because nomenclature, formula and equation writing, and stoichiometry are introduced early. We have prepared an accompanying Laboratory Manual in which each experiment is related to a specific text section.

For those who prefer to introduce electronic structure and bonding at an earlier juncture than we have, there would be no problem, from the viewpoint of readability, if Chapter 9 (Electronic Structure of the Atom) were covered after Chapter 4, and Chapter 10 (Chemical Bonding) after Chapter 5. However, obviously we strongly recommend the order of topics presented. An Instructors Manual is available and provides additional comments on each chapter, suggested accompanying laboratory experiments, answers to all problems, and sample examinations for each chapter.

More material is included in this book than can be covered reasonably in one semester. The core curriculum as preparation for general chemistry would be Chapters 1-11. If time permits, the instructor then has the freedom to choose additional topics based on personal preference. Chapters 12, 13, 14, 17, and 18 stand independently of one another. Chapter 15 (Acids and Bases) relies on material in Chapter 13 (Solutions)

and Chapter 14 (Chemical Equilibrium). Chapter 16 presupposes coverage of Chapter 13.

We earnestly invite your comments and suggestions toward the improvement of this textbook as a learning device.

Acknowledgments We would like to acknowledge and thank the many individuals who helped and encouraged us as we developed this text. First of all, there are the CUNY community college students who were our original inspiration and the Chemistry 110 students (at Bloomfield College) who sustained the inspiration and who used the preliminary edition of this text thoughtfully and offered useful suggestions for improvement. To our colleagues at Kean College and Bloomfield College we offer our gratitude for their being resounding sounding boards. Thanks especially to Bryan Lees, who also shot our photographs, Alice Sayler, and George Luther. We are extremely grateful to our typists, Christina Hermann and Joyce Vogelaar, with their flying fingers and uncanny ability to decipher handwriting (especially that of one of us).

Dr. David Adams of North Shore Community College has read and reviewed the manuscript from its inception and through several revisions, giving detailed and valuable suggestions. Thanks also go to Dave for always believing in us. Jack Healy of Chabot College has been our most flattering reviewer and has prepared an excellent Study Guide as a supplement to this text. We also gratefully acknowledge the suggestions of our other chemist-reviewers, William G. Nickels, Schoolcraft College; Donald B. Fraser, Essex County College; and Vincent J. Sollimo, Burlington County College. Special thanks go to our nonchemist-reviewer and editor, Marie Hodge, who corrected us, taught us, and entertained us with her droll, marginal comments, or should it be droll comments in the margin?

We also thank the editors and other production staff at McGraw-Hill, especially Donald Jackson who initiated this project and with whom we shared some fine inspirational meals. Thanks also to James Amar who gave such careful attention to all details as the manuscript became a book.

Last, but not least, we acknowledge the indulgence of our family and friends from whom we have been reclusive of late.

Jacqueline I. Kroschwitz

Melvin Winokur

To the Student

To successfully learn chemistry you cannot just read a chemistry book. You must *interact* with your book. Answer or at least ponder the questions that are asked rhetorically. Do the problems that are there to test your understanding. Ask questions.

You must be an *active* participant in your chemical education. Think, write, and question while you read. Go to it!

Jacqueline I. Kroschwitz

Melvin Winokur

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