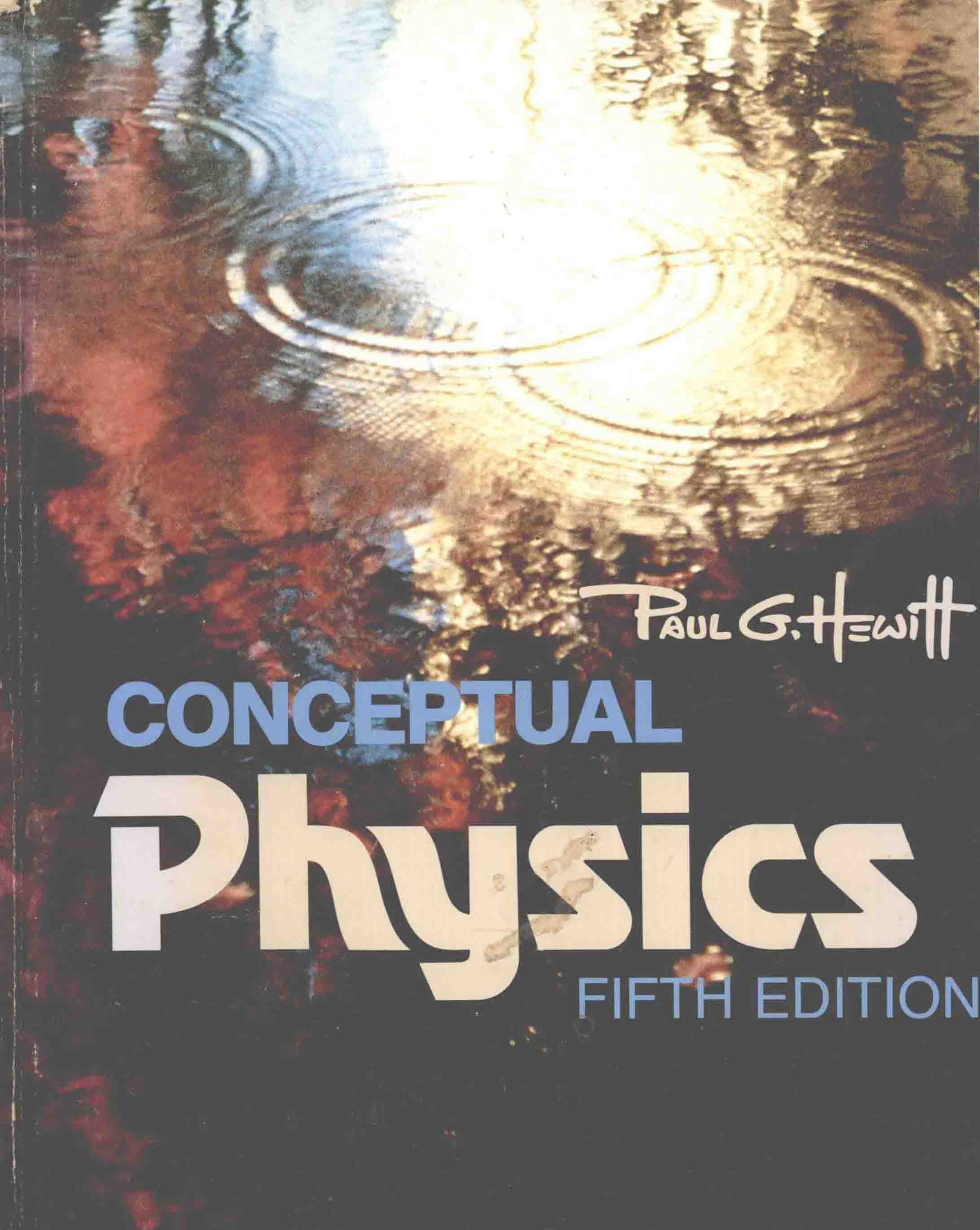
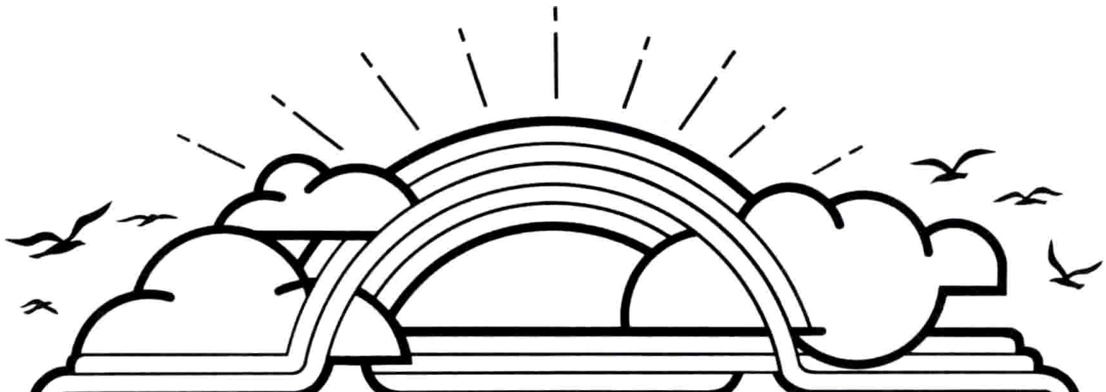


Paul G. Hewitt

CONCEPTUAL Physics

FIFTH EDITION



CONCEPTUAL Physics

FIFTH EDITION

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CONCEPTUAL
Physics

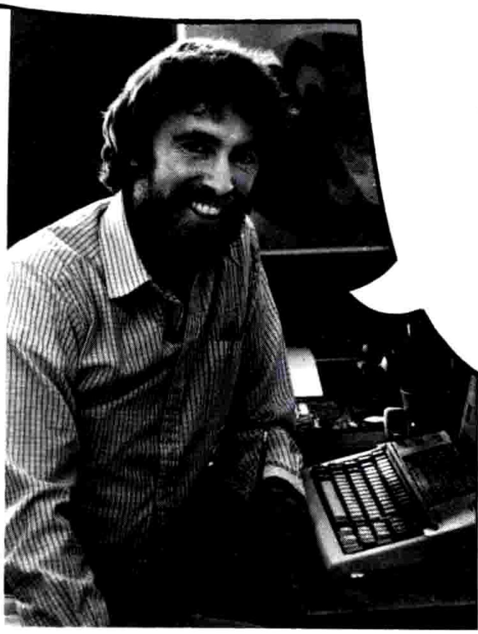
To Frank Oppenheimer
and those like him,
who explore the beauty
that lies in all things

To the Student

PHYSICS CAN BE AN ENJOYABLE EXPERIENCE --- ESPECIALLY SERIOUS PHYSICS WHEN IT'S PRESENTED IN A NONMATHEMATICAL LANGUAGE AND IN A DOWN-TO-EARTH MANNER. I ENJOY PHYSICS AND HOPE TO CONVEY MY ENTHUSIASM FOR IT AS I'LL BE TALKING WITH YOU ABOUT IT IN THE FOLLOWING 35 CHAPTERS. IF YOU BEGIN BY DISCOVERING THE PHYSICS IN THIS BOOK, YOU'LL SOON FIND, I HOPE, THAT YOU'RE DISCOVERING THE PHYSICS THAT'S IN EVERYTHING YOU DO AND SEE.

SINCE THE PHYSICS IN THIS BOOK IS NOT TREATED AS APPLIED MATHEMATICS, YOU WON'T NEED A CALCULATOR. MOST END-OF-CHAPTER PROBLEMS ARE EXERCISES IN THINKING ABOUT THE MEANING AND IMPLICATIONS OF THE IDEAS OF PHYSICS—IN ENGLISH—NOT VIA ALGEBRAIC MANIPULATIONS AND COMPUTATIONS. BUT IF YOU HAVE A CALCULATOR ANYWAY, SAVE IT. AS YOU FIND THAT PHYSICS IS FASCINATING, YOU MAY TAKE A FOLLOW-UP COURSE. THEN YOU CAN USE YOUR CALCULATOR -- WITH UNDERSTANDING.

ENJOY!



PAUL G. HEWITT

To the Instructor

Physics is the basic science; it is the foundation of chemistry, biology, and all disciplines of science. As such, the study of physics should be part of the educational mainstream, for both science students and nonscience students. Unfortunately, the mathematical language of physics often deters the average nonscience student. But when the ideas of physics are presented conceptually and when formulas are seen to be guides to thinking rather than recipes for algebraic manipulation, our discipline is accessible to all students. And for students who will continue in physics instruction, I am convinced that the ideas of physics should be first understood conceptually before they are used as a base for applied mathematics. This book seeks to build that conceptual base. It is a base for nonscience students and science students alike. For the nonscience student, it is a base from which to view nature more perceptively. For the science student, it is this and a springboard to a greater involvement in physics. A first-semester conceptual overview of Newtonian and modern physics for science majors will help to correct a missing essential in physics education: the practice of conceptualizing before calculating. For nonscience and science students alike, a conceptual way of looking at physics shapes analytical thinking.

Although the overall organization of this edition is essentially that of the previous editions insofar as the sequence from mechanics to astrophysics is concerned, considerable change and new material occur throughout. Part 1, Mechanics, has been substantially revised. It begins with linear motion in Chapter 2 and then goes immediately to projectile motion in Chapter 3. The study of projectiles leads to satellites in the same chapter. This reordering has two advantages. The first is logical progression: the kinematics of vertically falling bodies logically extends to projectiles, which in turn extends to a simple treatment of satellite motion. The second advantage is the early introduction of a topic of much current interest: the space-shuttle missions and other spacefaring activities that have captured the interest and imagination of most of your students. Newton's laws follow in Chapter 4, and logically following Newton's second and third laws is Chapter 5, on momentum. Chapter 6 on energy follows, with a spiral-approach return to satellite motion and escape velocity. Rotational motion, Chapter 7, and the law of universal gravitation, Chapter 8, complete the mechanics sequence. The fourth edition's chapter on power production and the chapter on electronics have been omitted to allow the introduction of new material without inflating the size of the book. The popular section on exponential growth, à la Al Bartlett, now appears on its own as Appendix V. A new chapter on thermodynamics appears in Part 3, Heat. Part 6, Light, has been revamped. Fermat's principle of least time, à la Richard Feynman, now provides your students with an alternative, interesting view of reflection and refraction. Quantum physics has been considerably revised and expanded. Important to the overall flavor of this edition are the many new insights and, I hope, pleasant surprises that are sprinkled in almost every chapter.

There are a wealth of new exercises in this edition. As in the fourth edition, there are more than enough for fresh assignments each semester or quarter without overlap for several terms. Some exercises are moderately simple and are designed to prompt the application of physics to everyday situations. Others are more sophisticated and call for considerable critical thinking. Some are quantitative and involve simple, straightforward calculations that will help your students capture the idea being treated, without requiring algebraic skills. The challenge to your students will be in the conceptual reasoning and critical thinking that are called for in the exercises. Please don't overload your students and blanketly assign *all* exercises to the chapters you cover. If you favor lengthy written assignments, it is more in order to have your students write up all or most of the review questions. These are relatively straightforward and they summarize, in question form, the essentials of the chapter.

As in previous editions, units of measurement are not emphasized. When used, they are almost exclusively expressed in SI (exceptions include such units as calories, grams/cm^3, and light-years). Mathematical derivations are avoided in the main body of the text and appear in footnotes or in the appendixes.

More than enough material is included for a one-semester course, which allows for a variety of course designs to fit your taste. These are suggested in the Instructor's Manual, which you'll find to be the most different of instructor's manuals. It contains many lecture ideas and topics not treated in the textbook, as well as teaching tips, suggested step-by-step lectures and demonstrations, information on overhead transparency masters and on new videotaped lectures by the author, and much more to assist you in making Conceptual Physics the most interesting, informative, and worthwhile science course available to your students.

Acknowledgments

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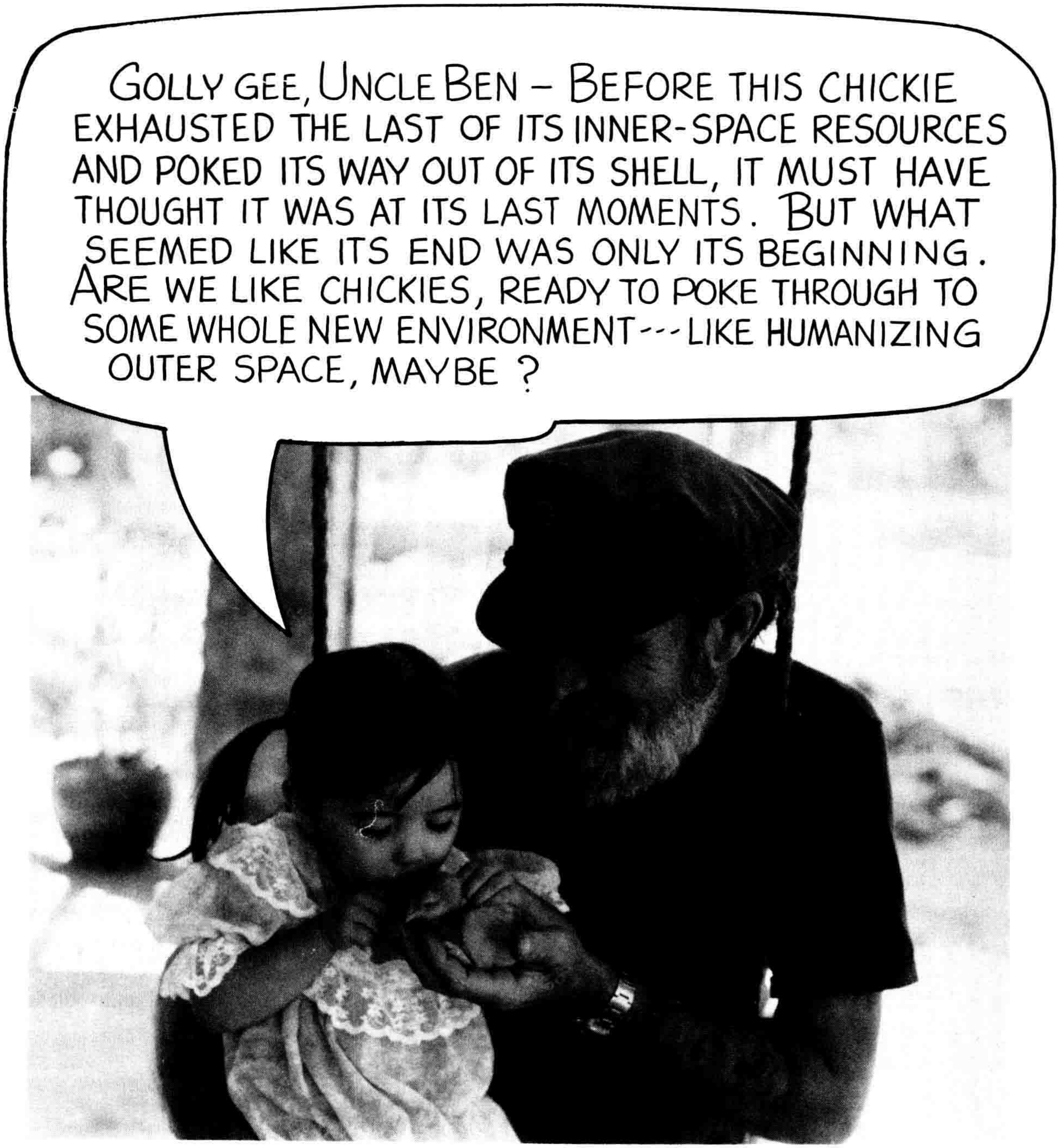
San Francisco *Paul G. Hewitt*

CONCEPTUAL Physics

By trying to understand the natural world around us, we gain confidence in our ability to determine whom to trust and what to believe about other matters as well. Without this confidence, our decisions about social, political, and economic matters are inevitably based entirely on the most appealing lie that someone else dishes out to us. Our appreciation of the noticings and discoveries of both scientists and artists therefore serves, not only to delight us, but also to help us make more satisfactory and valid decisions and to find better solutions for our individual and societal problems.

Frank Oppenheimer


GOLLY GEE, UNCLE BEN – BEFORE THIS CHICKIE EXHAUSTED THE LAST OF ITS INNER-SPACE RESOURCES AND POKED ITS WAY OUT OF ITS SHELL, IT MUST HAVE THOUGHT IT WAS AT ITS LAST MOMENTS. BUT WHAT SEEMED LIKE ITS END WAS ONLY ITS BEGINNING. ARE WE LIKE CHICKIES, READY TO POKE THROUGH TO SOME WHOLE NEW ENVIRONMENT---LIKE HUMANIZING OUTER SPACE, MAYBE?

Contents in Brief

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