Thermodynamics: a grass roots approach
(Sixth Revision)

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Preface

Very few students bother reading the preface of a textbook, but I feel compelled nevertheless to try to put this book in context. Historically, thermodynamics began with the study of macroscopic systems, first looking at concepts such as heat and temperature, and then linking these concepts with the help of entropy and energy. Later, statistical mechanics was introduced and showed that many of the fundamental concepts in thermodynamics could be understood by studying the behavior of systems on a molecular level.

As a result, two types of courses have emerged with textbooks to support them: thermodynamics and statistical mechanics. Invariably, they are taught in that order. Some hybrid courses begin with thermodynamics and conclude with statistical mechanics. There seems to be an underlying assumption that physics students need to learn first what is happening on a macroscopic level before studying their microscopic underpinnings.

I once visited a third grade class to give them an introduction to the phases of matter. I had them stand up and arrange themselves in an orderly way to mimic the atoms in a solid. I slowly got them to move around more to simulate the warming up of the solid, its melting, the warming of a liquid and its transition to a gas. Later we did an experiment using carbon dioxide (formed with baking soda and vinegar) to blow up a balloon. I then asked the students, what is causing the balloon to expand? The first two answers were vague, but the third student got it right: the gas molecules hitting the side of the balloon push it out.

Third grade students can develop an understanding of why things happen by looking at behavior on a microscopic level. I think it is time we trust that physics majors are able to make the same kinds of connections! In a traditional thermodynamics course, several principles and concepts are introduced as if they have no connection with the students' prior learning. In this "grass roots" approach, you will instead begin by building on several concepts found in your introductory physics course. I hope you will see thermodynamics as an *extension* of the physics you already know, not as a collection of new and abstract concepts.

This text was written in part while I was supported by a sabbatical at Eastern Michigan University, for which I am very grateful. The rest was written at the expense of spending time with family, friends, and students, for which I am (somewhat) apologetic.

I have benefited greatly from discussions and critical readings by Helene C. Bers and John S. Thomsen. The time they freely donated to reading this book and discussing it with me is much appreciated.

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June, 2006