Journal of Statistical Physics, Vol. 98, Nos. 5/6, 2000

Book Review: *Molecular Thermodynamics*

Molecular Thermodynamics. D. A. McQuarrie and J. D. Simon, University Science Books, Sausalito, California, 1999, 656 pp.

This book represents a sort of down-sized version of the Magnum Opus by the same authors: Physical chemistry, A molecular Approach. For those readers who are already familiar with this book and like it, I can only say: this one gives you basically the same goodies but in a more digestible form. It is based on the same molecular approach that the authors use as a point of departure for the whole development of thermodynamics and statistical mechanics. Molecular approach in this context means that the authors start with an exposition of quantum mechanics and then use these ideas in subsequent developments. In this respect the book is more self-contained then some other undergraduate texts on thermodynamics and statistical mechanics.

I liked it and certainly intend to use parts of it in my undergrad courses. Together with his other books I believe that McQuarrie is emerging as one of the best writers on undergrad thermodynamics and statistical mechanics around.

The table of contents of the book is pretty standard and I could not spot anything out of the ordinary there. What one does not see in the table of contents is that the book has many worked out numerical examples which always come in handy in an undergrad course. It appears though that quite a few of these calculations are too simple. The same goes for the problems that trail each chapter, or at least those that I tried (and this is a very small proportion of the whole number, I must admit). Also, quite a few of the problems were written for computer literate students and I find this very welcome too.

The book is a very detailed, worked out presentation of statistical mechanics and thermodynamics. It starts with the main results of quantum mechanics that are relevant for subsequent developments (Chap. 1). The

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properties of gases and the equation of state are introduced in Chap. 2. The subsequent two chapters deal with the definition of the partition function and its form for molecular ideal gases. Chapters 5 through 8 introduce the first and the second laws of thermodynamics on a molecular level together with the principal thermodynamic state functions. Chapter 9 deals with the chemical potential and the phase equilibria and the next two are principally concerned with solutions. Chemical equilibrium and thermodynamic equilibrium constants are introduced in Chap. 12 with electrochemical cell treated in Chap. 12. The last chapter deal with the fundamentals of non-equilibrium thermodynamics. All the chapters include worked out numerical examples that are well marked from the main text and are in the form of a problem or a query and its solution. They are all concluded with a Problems section with usually between 40 and 60 problems. The answers to the numerical problems are listed at the end of the book.

In many graduate textbooks on statistical mechanics its quantum mechanical underpinnings somehow do not occupy their well deserved Chapter One. They creep in at around the Gibbs paradox when one really has to explain the $N!$ in the denominator of the partition function. But that many times appears to be the end of the story. Not in this book. Quantum mechanics (at an appropriate level of course) features prominently and I believe that from a pedagogical perspective this really makes good sense. The student gets the correct impression that quantum mechanics and statistical mechanics are intimately and tightly connected.

There are lots of graphs and tables in the text that I really appreciated. Also the sections and subsections have very suggestive titles which should help the students in memorizing the material. They read as a short synopsis of the material discussed. In this respect even the table of contents is quite fun to read. Each chapter starts with a short biographical sketch of an important personality, together with a portrait, that was involved in the work discussed later. I find this very appropriate too.

The only thing that I find reproachable in this book are the formal mathematical chapters interspersed between the chapters dealing with the physical-chemical material. The authors are convinced that this enhances the pedagogy of this text. I am a bit ambivalent about that. On the one side it is of course better to introduce the necessary mathematics "on the fly," just when it is needed. On the other side it gives the whole structure of the book a certain punctuated style. I would opt for the mathematical chapters being assembled at the end of the book as is also more usual in other textbooks. I believe not completely without reason. I find that preferable but also do not think that the book has lost anything in a deeper sense by the authors' choice of putting them alongside the real subject matter of the book.

This is pedagogically a well thought out book and I believe that the students, who were scared by the mere size of the Physical Chemistry, A Molecular Approach, will find it a good and user-friendly companion in their studies.

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