

Becker · Theory of Heat



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Theory of Heat

Second Edition revised by

Günther Leibfried

With 124 Figures

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Revised Translation of the first German Edition „Theorie der Wärme“.

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Preface to the first English Edition

This first English edition of BECKER's "Theory of Heat" is a slightly revised translation of the first German edition. BECKER's presentation is so highly personal and original that I did not feel entitled to make substantial changes. Actually, they would have deprived the book of its original impact. I did not even dare to mention the "third law of thermodynamics" except in a footnote because I know BECKER would not have liked that. BECKER's command of the German language was extraordinary, and his way of presenting, illustrating and expressing things was very pointed and personal. I have tried to keep this "flavo(u)r" by doing the translation myself. In this difficult task I enjoyed the assistance of Mrs. P. WHITMIRE, Oak Ridge, who typed the earlier version of the manuscript and translated my English into acceptable American. This smoothed version was checked once more by Professor J. S. KOEHLER, Urbana, whose help I gratefully acknowledge. If there are any Germanisms or unusual expressions left, I insisted on them and they are entirely mine.

The book is meant as a textbook, an introduction to the theory of heat for graduate students. The first section, on phenomenological thermodynamics, requires only simple calculus. In the two following sections, on classical and quantum statistical mechanics, some knowledge of classical and quantum mechanics is necessary even though the elements are reviewed briefly. Here the various statistical ensembles, so important for an understanding of thermodynamics, are treated in great detail. The main part of the book contains applications to gases and solids. These examples should illustrate the general theory. In the last two sections, fluctuations are discussed and a short introduction to the theory of irreversible processes is given. What was said about the literature in the preface of the German edition still holds true. A few more recent references have been added.

As was said above, only minor changes have been made. In particular: The density fluctuations at the beginning of Sect. II are treated in more detail in order to give a more extensive introduction to probability theory; in quantum statistics the density matrix is introduced and the transition to classical theory is demonstrated; volume fluctuations are discussed more thoroughly to show that the usual formulation only holds for macroscopically defined volumes; the treatment of the sound velocity in gases is extended to include adiabatic behavior; the concept of negative temperatures is explained in connection with magnetic phenomena; further, more use of DIRAC's δ -function is made throughout.

I gratefully acknowledge discussions with my colleagues, Professors J. MEIXNER and F. SCHLÖGL. Drs. P. H. DEDERICHS and K. DETTMANN were of great assistance in proof reading. Mrs. ORTMANN typed the later versions of the manuscript.

On this occasion one could realize the difference between American and English: For Mrs. ORTMANN'S, "vapour" was the word, but is was "vapor" for Mrs. WHITMIRE. Both versions might occur in this book, depending on who saw the galley proofs last. All those who have helped and assisted in producing this translation I want to thank again, last but not least the publisher, whose interest made this edition possible.

G. LEIBFRIED

Preface to the first German Edition

For many years RICHARD BECKER was urged by his friends, colleagues and students to write up *his* "theory of heat". He was fond of this area of physics, the main reason perhaps being that, in thermodynamics, experiment and theory are so closely related that physical common sense is particularly needed. This kind of physics was his favorite subject. His lectures on thermodynamics were famous, and the wish of his many friends to have them in writing was only too understandable.

Eventually, RICHARD BECKER was persuaded and set to work, five years ago. The outline was readily available, from years of lecturing, but the details took time and effort. It was not difficult to present the facts, but often, having written it up, he was no longer satisfied with his own formulation; it was not clear or pointed enough. So, the problems were looked over again, were rehearsed on the blackboard until he was satisfied once more. Thus, most problems in this book have been formulated, rejected, and rewritten again and again. Even as the galley proofs arrived he still was not satisfied with some parts, but then it was too late to make changes. In this manner the book proceeded, with many secret sighs from his collaborators, and it was essentially finished by the end of 1954.

RICHARD BECKER did not live to experience the publication of his book, but he did correct part of the first galley proofs and the book was actually completed when he passed away.

The book is intended as a textbook, to guide students into the wide area of heat phenomena. But even experienced scientists will appreciate many of the problems as presented from BECKER's characteristic point of view. The first section on thermodynamics requires no special knowledge. The next two sections assume some familiarity with classical and quantum mechanics, but the basic theory is summarized. A very detailed discussion of the various distributions and the corresponding physical situations is given. Most of the book is devoted to applications, since a deeper understanding of the field can be gained only through the discussion of applications.

Most of the references cited appear as footnotes. A list of some comprehensive books, articles and more recent papers is added at the end, but the references are by no means complete.

Dr. F. KUHRT contributed a great deal to section I. Dr. G. HÖHLER did most of the proof reading, with the assistance of Dr. G. SÜSSMANN. Dipl.-Phys. W. LUDWIG did the drawings, and Mrs. H. GEIB typed the manuscript. I wrote, at the request of the author, Sections 61—65, and I mention this only to prevent BECKER's being blamed for the shortcomings of this part. The collaboration with the publisher was pleasant and without friction. All should be thanked sincerely in the name of RICHARD BECKER.

Göttingen, June 1955

G. LEIBFRIED

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