Preface

Statistical physics — more precisely statistical mechanics and statistical thermodynamics — is almost universally the last of the four basic theory courses for a degree in physics, and is usually taught after theory courses in mechanics, electrodynamics and quantum mechanics, thermodynamics proper, *i.e.* classical thermodynamics, being usually combined with this or covered in some form in connection with basic or experimental physics. Since the quantized form of statistical physics evolved naturally after the development of quantum mechanics in the first half of the twentieth century, this was a natural sequence of steps. Prior to this development thermodynamics proper was the additional basic subject of courses and examinations. The heavy and detailed monograph of Mayer and Mayer [29], first published in 1940, shows how quickly the entire basis of quantum statistics was developed with numerous concurrent applications, so that soon appropriate texts appeared. One of these later texts was the book of Schrödinger [39]. This was the recommended text when the author had his first encounter with quantum statistics in 1956 in the second half of the third and final year for the *Bachelor of Science* degree (the Honours degree requiring an additional fourth year). Almost concurrently the extensive and relatively heavy monograph of Hill [20] appeared which became a leading text for many years. Thereafter, of course, more and more monographs were published, like the very readable second text of Hill [21] and the book of Rushbrooke [38], and today a large number of pedagogically arranged texts is available. Thus the author himself taught the subject repeatedly on the basis of the more extensive of the two widely known books of Reif [35], [36] together with some thermodynamics from Callen [6]. However later, motivated by the introduction of Bachelor degree courses in Germany, the author reconsulted the lecture notes he took in the course of Professor R.B. Dingle at the University of Western Australia in 1956, and realized that this course covered in a clear and logically arranged way the vital basic points of the subject and included a large number of illustrating examples and exercises (in the present text most of the examples with solutions). The following text is a presentation

of the subject arranged along the lines of this course for which the author is indebted to his former teacher who, it may be pointed out here, made significant contributions to the subject, particularly in providing the first valid demonstrations of Bose–Einstein condensation (in an ideal gas). This introduction to Statistical Physics, which took the author's notes of this course as a guide-line and employs only wave mechanics instead of full operator quantum mechanics, may be of interest to others who are interested in a *Bachelor Degree course*, or equivalent introductory course to the subject, though, of course, supplemented by some additions (apart from the introduction, particularly the section on Bose–Einstein condensation and the problems without worked solutions) and slight expansion throughout. The reader may ask, however, how this text — which is meant to be a first introduction to the subject — differs from other texts on the subject. One answer may be that the central issues here are — clearly separated from applications — classical versus quantum physics, *a priori* probability and degeneracy, distinguishability and indistinguishability, differences between conserved and nonconserved elements, differences in counting of arrangements in the various statistics, and maximization versus averaging of these. In particular the text proceeds stepwise to the ultimate Darwin–Fowler method of mean values which not only yields exact results but also provides the basis for the rigorous proof of Bose–Einstein condensation as given by Dingle. Applications are mostly relegated to examples. It will be evident from the text that the author also consulted a number of modern and recent monographs on the subject, and compared the treatment in these with that here, also to provide references with further details. For the convenience of students calculations are generally given in detail.

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