

Preface

This book was originally planned as an updated one-volume edition of the two works co-authored with the late George Bell (Lavis and Bell 1999a, b). However, as the project developed this became a substantially different book under my sole authorship and I am very grateful to Vanessa and Debbie Bell for permission to make use of some of the material from my work with their father.

This is not a book on the foundations of statistical mechanics; attention is restricted to equilibrium systems, with equilibrium defined simply in terms of the Gibbs distribution. The material is also restricted to deterministic systems on lattices. Within these constraints, most interesting and difficult problems arise from cooperative effects, that is from interactions between the constituent particles of the system. This leads frequently to the occurrence of phase transitions and much of the work of equilibrium statistical mechanics concentrates on the investigation of their properties, particularly their classification into universality classes. The book is structured into parts. Part I contains the basic elements of equilibrium thermodynamics and statistical mechanics, phenomenological scaling theory and a survey of a range of different models, many of which are studied in greater detail later in the book. A broad division of the rest of the material can be made between approximation methods and exact results. Parts II and IV are concerned with the former, II being devoted to classical, mean-field, methods and IV to series approximations and the renormalization group. Exact results and methods are presented in Part III. The last part of the book contains a collection of mathematical appendices on a range of relevant topics. For convenience, they have been divided into material related to graphs and lattices and (perhaps rather inexactlly) algebra and analysis. The intention is to minimise the need to refer to other mathematical sources.

Some parts of the material were originally written for an M.Sc. course at King's College London and I am grateful to the many students who, by their questions and comments, helped to reduce errors and obscurities. The exchange of ideas and information with friends and co-workers has contributed to this book. In particular I owe a great deal to the interaction with my two long-term collaborators, the late George Bell, to whom this work is dedicated, and Byron Southern of the University of Manitoba. I should also like to thank Reimer Kühn, who has always been

prepared to spend time in discussion of points of substance and presentation. As was the case with our previous books I acknowledge with gratitude the continued support and encouragement of Prof. Elliott Lieb. During the final stages of production, the book was read by three referees, for whose comments and suggestions I am very grateful. Finally, I wish to express my thanks to Prof. Wolf Beiglböck, Dr. Aldo Rampioni and the staff at Springer for their work in the production of this book.

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