

CONTENTS

General introduction, B. R. A. Nijboer	1
1. Literature	1
2. Aim of statistical mechanics	1
3. Kinetic derivation of the H -theorem	3
4. Objections against the H -theorem	6
5. The H -theorem considered statistically	7
6. The Ehrenfest-model	11
7. Equilibrium represented by a microcanonical ensemble	14
8. Liouville's theorem	16
9. Gibbs' H -theorem	17
10. Classical equilibrium ensembles	19
11. Molecular distribution functions	25
12. Quantumstatistics	28
Fluctuations, stochastic processes, Brownian motion, H. Wergeland	33
I. Fluctuations	33
a. Gibbs' theory	33
b. Einstein's method	35
c. Decay of fluctuations	36
References	37
II. Stochastic processes	37
a. Stationary processes	38
b. Gaussian processes	39
c. Markov processes	39
d. The correlation function	40
e. Spectral resolution of a stationary process	41
f. Ergodicity	42
References	43
III. Ionization tracks	43
a. The spectrum	43
b. Distribution of the ordinates	45
c. Improvement of small angle approximation	46
References	48
IV. Brownian motion	48
a. Dynamics of the linear chain	49
b. Velocity distribution of a single particle	50
c. Correlations and spectrum	52

d. Finite chain	53
e. Quantum mechanics	54
References	55
V. Recurrence time	55
References	58
Liquid Helium, K. Huang	59
1. Experimental facts	59
2. Two-fluid model of Tisza	61
3. Theory of Landau	62
4. Theory of Feynman	63
5. Equilibrium properties near $T = 0$	68
6. Motion of the superfluid	70
7. Quasi-equilibrium thermodynamics	73
8. Two-fluid model	76
9. Superfluid flow	80
References	85
Many particle aspects of the Fermi gas, N. M. Hugenholtz	86
Introduction	86
1. The ground state of a system of interacting fermions	86
2. Derivation of the Brueckner-Goldstone formula	91
3. The grandcanonical ensemble	96
4. The limit $T \rightarrow 0$	103
References	108
The Boltzmann equation and its generalization to higher densities, E. G. D. Cohen	110
Introduction	110
1. The Boltzmann equation and its solution	111
a. The Boltzmann equation	111
b. The hydrodynamical equations and the transport coefficients	116
2. The Bogolubov solution of the hierarchy in the kinetic stage	118
a. Introduction	118
b. Liouville equation and hierarchy	119
c. Principle of Bogolubov method for solving hierarchy	122
d. Hierarchy for $F_s(F_1)$ ($s \geq 2$)	125
e. Boundary conditions for $F_s(F_1)$	128
f. Solution for $F_s^{(0)}(F_1)$	130
g. Solution for $F_s^{(1)}(F_1)$	132
h. Formulae for $F_s^{(1)}(F_1)$	136
3. The derivation and generalization of the Boltzmann equation	137
a. Introduction	137
b. Expansion of $F_2^{(0)}(x_1, x_2 F_1)$ and $F_2^{(1)}(x_1, x_2 F_1)$ in powers of μ	138

c. Derivation and generalization of the Boltzmann equation	141
d. Boltzmann equation and irreversibility	143
4. The solution of the generalized Boltzmann equation in the hydrodynamical stage	146
a. Introduction	146
b. Formal solution of the generalized Boltzmann equation	147
c. The hydrodynamical equations and the transport coefficients	153
References	156
Master equation and approach to equilibrium for quantum systems, L. Van Hove	157
1. Introduction	157
2. The Pauli master equation and the statistical assumptions involved	157
3. Special properties of the interaction	160
4. Sketch of the improved derivation of the master equation	163
5. Relation to the Kubo formula	165
6. Higher order effects	167
Reference	172
Fundamental problems in statistical mechanics of irreversible processes, N. G. Van Kampen	173
Introduction	173
I. Classical derivation of the master equation	175
II. Quantummechanical derivation of the master equation	185
III. Consequences of the master equation	194
Literature	201
Statistical considerations on the basis of non-equilibrium thermodynamics, P. Mazur	203
1. Introduction	203
2. Time reversal invariance	203
3. Extensive state variables and their fluctuations	205
4. Microscopic reversibility; detailed balance	207
5. Time correlation functions	210
6. Reciprocal relations	213
7. The fluctuation dissipation theorem	215
8. The gaussian Markoff process	219
9. Entropy and random fluctuations	224
Bibliography	229

Some remarks on the integral equations of statistical mechanics, Elliott W. Montroll	230
Introduction	230
1. Fundamental equations of dynamics and statistical mechanics	231
2. Integral equation form for fundamental equations	234
3. Perturbation theory	237
4. Diagonal elements of the density matrix	240
5. The Pauli equation	244
References	249