TABLE OF CONTENTS

PART A. THE KINETIC THEORY OF GASES by C. S. Wang Chang and G. E. Uhlenbeck

Chapter I. On the transport phenomena in rarified gases	1
1. Introduction	1
2. Dimensional considerations	3
3. The Hilbert-Enskog theory	5
4. Discussion and questions	10
5. Dispersion of sound	14
References	16
Chapter II. On the dispersion of sound in helium	17
1. Introduction	17
2. The second order pressure tensor and heat flux vector;	
the coefficients ω and θ	18
3. The velocity of sound	21
4. Application to helium	23
References	26
Chapter III. On the theory of the thickness of weak shock waves	27
1. Introduction	27
2. The thickness of shock waves from the Stokes-Navier	
equations	30
3. Higher approximations	35
4. Application to monoatomic gases	39
References	42
Chapter IV. On the propagation of sound in monatomic gases	43
1. Introduction	43
· · · · · · · · · · · · · · · · · · ·	40
2. The Boltzmann equation for a small disturbance from equilibrium	45
3. Propagation of sound in a gas of Maxwell molecules	50
4. Successive approximations of the dispersion law for a	
Maxwell gas	57
5. Extension to other molecular models; final remarks	64

viii CONTENTS

APPENDIX A. Definition and properties of $F(\theta)$	69
APPENDIX B. Properties of the sonine polynomials	71
APPENDIX C. There is no lower bound for the set of eigenvalues	71
APPENDIX D. Proof that the determinant Δ is an even function of σ_{0}	73
APPENDIX E. Justification for eqs. (39a) and (39b) References	74 75
Chapter V. The kinetic theory of a gas in alternating outside force fields: a generalization of the Rayleigh problem	76
1. Statement of the problem	76
2. The Brownian motion limit	78
3. The strong coupling approximation	79
4. Discussion of the approximate results	80
5. The exact solution for Maxwell molecules	83
6. The solution for elastic spheres in the Lorentz limit if	00
$\omega_{\mathbf{O}} = 0$	86 89
7. Concluding remarks	09
APPENDIX A. Proof of the Brownian motion form of the collision operator	89
APPENDIX B. Eigenvalues and eigenfunctions of the Maxwell collision operator	93
APPENDIX C. Eigenvalues and eigenfunctions of the Brownian motion form of the collision operator	95
APPENDIX D. The bracket expression $[\psi_{r'l'm}, \psi_{rlm}]$ in the	
Lorentz limit	96
References	98
Notes	99
PART B. THE DISPERSION OF SOUND IN MONOATOMIC GA	SES
Chapter I. Introduction	103
Chapter II. Sound dispersion from the hydrodynamic equations	107
1. The linearized hydrodynamic equations	107
2. The normal mode solutions	110

3. Case of the ideal monoatomic gas, the simplest results of kinetic theory	115
4. The Chapman-Enskog development, the Burnett equations	119
Notes	125
Chapter III. The linearized Boltzmann equation	128
1. The Boltzmann equation	128
2. The linearized Boltzmann equation	130
3. The Hilbert-Enskog canonical form for J4. The matrix elements with respect to the Burnett func-	133
tions 5. Further properties of the linearized collision operator	137
for hard spheres	146
Notes	148
Chapter IV. The dispersion of sound from the linearized	
Boltzmann equation	155
1. Introduction	155
2. The method of Mott-Smith, Chang and Uhlenbeck	155
3. The perturbation method4. Solution of the equations for Maxwell molecules	161 168
5. Approximate solution of the equations for arbitrary po-	
tentials 6. The dispersion law for power law and Lennard-Jones	171
potentials	177
7. Comparison of the first approximate results with experiment	181
8. Remarks on the convergence of the perturbation expan-	
sion Notes	183
Notes	186
Chapter V. Model equations	191
1. Introduction	191
2. Normal modes of a one-dimensional model equation	193
3. Three-dimensional model equations Notes	205 212
Chapter VI. Outlook	216
1. Experiment	216
2. Theory	218

x CONTENTS

Notes	221
APPENDIX A. The matrix elements of $m{J}$ in terms of the Ω -integrals	
APPENDIX B. Temperature dependence of Δ_1 and Δ_2	227
APPENDIX C. The function Z	228
SUBJECT INDEX	232