

CONTENTS

PART I: ELEMENTARY THEORIES

I. ATOMIC FORCES

1. Theoretical Considerations	1
2. Ionic Radii	15
3. Heuristic Expressions for Lattice Energies	19

II. LATTICE VIBRATIONS

4. Simple Approximate Treatment of Thermodynamical Behaviour	38
5. Vibrations of a Diatomic Chain	55
6. Frequency Spectrum of Lattice Vibrations and Specific Heats	61
7. Long Lattice Vibrations in the Optical Branches	82
8. Infra-red Dispersion and the Retardation Effect on Lattice Vibrations	89
9. Atomic Theory of Long Optical Vibrations and Infra-red Dispersion	100
10. Experimental Aspect of Infra-red Dispersion by Ionic Crystals	116

III. ELASTICITY AND STABILITY

11. Homogeneous Deformation and the Elastic Constants	129
12. Mechanical Stability of Simple Lattices	140
13. Relative Stability and Polymorphism	154

PART II: GENERAL THEORIES

IV. QUANTUM MECHANICAL FOUNDATION

14. Quantum Mechanics of Molecular Systems	166
15. Normal Coordinates	173
16. Statistical Mechanics of Systems of Oscillators	178
17. Statistical Mechanics of a Molecular System under External Forces	181
18. Static Polarizability and Polarizability in Variable Fields	189
19. The Rayleigh and Raman Scattering of Light	199
20. Placzek's Approximation	204
21. Expansion of the Optical Parameters and the Classification of Optical Effects	208

V. THE METHOD OF LONG WAVES

22. The Geometry of Perfect Lattices	213
23. The Infinite Lattice Model and General Invariance Relations	217
24. Lattice Waves	223
25. Failure of the Method of Homogeneous Deformation and the Method of Long Waves	225
26. Long Acoustic Vibrations	229
27. The Elastic Constants for Non-ionic Crystals	236
28. Equilibrium Conditions (vanishing stresses) and Further Invariance Relations	240

29. Central Forces	245
30. Coulomb Field in a Dipole Lattice—Ewald's Method and Separation of the Macroscopic Field	248
31. Acoustic Vibrations in Ionic Lattices (rigid ion model)	255
32. The Elastic and Piezoelectric Constants and the Dielectric Tensor	262
33. Phenomenological Discussion of the Dispersion Formula for Complex Lattices	265
34. Long Optical Vibrations in Ionic Lattices (rigid ion model) . .	270
35. Polarizable Ions	272
VI. THE FREE ENERGY	
36. The Specification of Finite Strains	278
37. Phenomenological Discussion of the Free Energy of a Lattice .	282
38. Normal Coordinates of a Lattice	293
39. Normalization of Physical Parameters, Selection Rules and Expansion Methods	302
40. The Normalized Hamiltonian	306
41. The Free Energy	312
42. The Static (Non-vibrating) Lattice	319
43. The T^4 -law	322
VII. THE OPTICAL EFFECTS	
44. The Microscopic Theory of Dispersion	328
45. The Local Treatment of Optical Effects	339
46. The Effect of the Anharmonic Potential on Dispersion	341
47. The Dispersion Formula with Damping	355
48. The Effect of the Second-order Electric Moment	363
49. The First- and Second-order Raman Effects	367
50. The Brillouin Components of the Thermal Scattering of Light .	373
APPENDIXES	
I. Some Common Lattice Structures (p. 1)	382
II. Madelung's Energy (p. 3)	385
III. Evaluation of Simple Lattice Sums (p. 23)	388
IV. The Approximation to the Vibrational Spectrum with the help of the Cyclic Boundary Condition (p. 45)	391
V. Energy Density in Ionic Crystals (p. 83)	396
VI. The Inner Field in Uniformly Polarized Crystals with Tetrahedral Symmetry (the Lorentz Field) (p. 104)	398
VII. The Adiabatic Approximation (p. 170)	402
VIII. Elimination of the Electronic Motion (p. 172)	406
IX. Double Refraction and Optical Rotation (p. 333)	408
X. Recent Publications	411
INDEX	415