

CONTENTS

	PAGE
PREFACE.	vii

Chapter I

ELASTIC WAVES IN A ONE-DIMENSIONAL LATTICE OF POINT MASSES: EARLY WORK AND INTRODUCTION

SECTION

1. Historical Background; Eighteenth Century.	1
2. Historical Background; Nineteenth Century. Cauchy, Baden-Powell, and Kelvin	3
3. Later Work on Models Similar to That Treated in Sec. 2	11

Chapter II

PROPAGATION OF WAVES ALONG ONE-DIMENSIONAL LATTICES. GENERAL RESULTS AND QUALITATIVE DISCUSSION

4. General Remarks	17
5. A Lattice of Free Particles	19
6. Longitudinal Vibration in a Row of Equidistant Coupled Oscillators	21
7. Longitudinal Vibrations in a Row of Diatomic Molecules	22

Chapter III

MATHEMATICAL TREATMENT OF A ONE-DIMENSIONAL LATTICE OF IDENTICAL PARTICLES

8. Equation of Motion of a One-dimensional Lattice of Identical Particles.	26
9. Rigorous Discussion for the Case of Interactions between Nearest Neighbors Only	31
10. Discussion of the Distance of Interaction.	33
11. The Low-pass Electric Filter	37
12. Analogies between Electrical and Mechanical Systems	40

Chapter IV

MATHEMATICAL TREATMENT OF
MORE COMPLICATED ONE-DIMENSIONAL LATTICES

SECTION	PAGE
13. Equations of Motion for the One-dimensional NaCl Lattice.	44
14. Electrical Analogue of the One-dimensional Diatomic Lattice.	47
15. Discussion of the One-dimensional NaCl Lattice. . . .	50
16. Transition from a Diatomic to a Monatomic Lattice. .	57
17. The One-dimensional Lattice of Polyatomic Molecules	65

Chapter V

ENERGY VELOCITY, ENERGY FLOW,
AND CHARACTERISTIC IMPEDANCE

18. General Discussion; Phase Velocity	69
19. A Theorem from the Theory of Complex Variables . . .	70
20. Energy Density, Energy Flow, and Energy Velocity . .	72
21. Group Velocity and Propagation of a Signal.	74
22. Preliminary Definition of Characteristic Impedance . .	80
23. Junction of Two Lattices.	85
24. General Definition of Characteristic Impedance	88

Chapter VI

TWO-DIMENSIONAL LATTICES

25. Direct and Reciprocal Lattices in Two Dimensions. . .	94
26. Doubly and Triply Periodic Functions	99
27. Zones in a Two-dimensional Lattice	102
28. Propagation of Waves in a Continuous Two-dimensional Medium with a Periodic Perturbation	107
29. The Exceptional Waves of Case 2 and Bragg Reflection	115
30. Transition Near the Discontinuity	118
31. Examples and Discussion of Zones in Two Dimensions.	121

Chapter VII

THREE-DIMENSIONAL LATTICE

32. Direct and Reciprocal Lattices in Three Dimensions . .	131
33. Zones in Three Dimensions and Bragg Reflection; Ewald's Construction	136

SECTION	PAGE
34. General Results for a Wave Propagating in a Three-dimensional Periodic Medium.	139
35. Waves in a Homogeneous Isotropic Medium with a Small Periodic Perturbation.	143
36. General Remarks on Waves in a Discontinuous Lattice	147
37. Some Examples of Zones in Three Dimensions.	148
38. Zones in the Direct Lattice; Principle of the Wigner-Seitz Method	155
39. Frequency Distribution for Waves in an Actual Crystal	157
40. The Energy of a Solid; the Characteristic Temperatures	164
41. Thermal Expansion and Entropy of a Solid Body.	167

Chapter VIII

MATHIEU'S EQUATION AND RELATED PROBLEMS

42. Mathieu's Equation	172
43. Mathieu Functions: General Discussion.	175
44. Hill's Equation with a Rectangular Curve	180
45. The Self-excited Oscillator	186
46. Free Electrons in Metals	190

Chapter IX

MATRICES AND THE PROPAGATION OF WAVES ALONG AN ELECTRIC LINE

47. General Remarks	193
48. Expressions for Energy.	197
49. Definition of a Four-terminal and Equation for Its Circuit.	200
50. Matrix Notation for a Four-terminal.	201
51. Combination of Two Four-terminals; Multiplication of Matrices	203
52. Inverse and Reversed Four-terminals and Transformations.	204
53. Four-terminal Matrices and the Group C_2	206
54. Surge, Iterative, or Characteristic Impedance of a Four-terminal	209
55. Propagation along a Line of Four-terminals.	211
56. Application of the Theory to a Reversible Four-terminal	214
57. Passing Bands and Attenuation in a Line of Four-terminals	216

SECTION	PAGE
58. Reflected Waves in a Line Terminated by an Impedance ζ_0	217
59. A Continuous Line Loaded with Two-terminals	218
60. A Continuous Line Loaded with Four-terminals	224

Chapter X

CONTINUOUS ELECTRIC LINES

61. Transition from a Line of Four-terminals to a Continuous Line	227
62. Examples of Four-terminal Representation of Continuous Lines	229
63. Application of Hill's Equation to a Continuous Line	232
64. Normalization of the Matrix (ϵ_{ij}) and the Pauli Matrices	234
65. Three-phase and Polyphase Lines	236
INDEX.	241