Contents

History of	Spectroscopy.
1.1.	Early Ideas on Color 1
1.2.	The Work of Newton #
1.3.	Early Nineteenth-Century Developments 3
1.4.	Fraunhofer's Discoveries 4
1.5.	Characteristic Spectra 6
1.0.	Airchnoff and Spectrum Analysis 8
1.7.	Standard wave Lengths 10
1.8.	Recent Developments 14
СНА	PTER 2:
Light Sou	rces
2.1.	Continuous Sources 18
2.2.	Line Sources 20
2.3.	Electric Arcs 21
2.4.	The Electric Spark 23
2.5.	Gaseous Discharges 26
2.6.	The Choice of a Light Source 29
СНА	PTER 3:
Spectrosco	ppic Apparatus—General Principles
3.1.	General Theory: Definitions 30
3.2.	Resolving Power 31
	Brightness of Image 35
3.3.	Digitaless of image of
3.3. 3.4.	The Illumination of the Spectrograph Slit 37
3.3. 3.4. 3.5.	The Illumination of the Spectrograph Slit 37 The Use of a Condensing Lens 39
3.3. 3.4. 3.5. 3.6.	The Illumination of the Spectrograph Slit 37 The Use of a Condensing Lens 39 The Conditions for Maximum Illumination and Maximum In- trinsic Energy of a Spectrum 43
3.3. 3.4. 3.5. 3.6. 3.7.	The Illumination of the Spectrograph Slit 37 The Use of a Condensing Lens 39 The Conditions for Maximum Illumination and Maximum In- trinsic Energy of a Spectrum 42 Illumination by a Point Source 43
3.3. 3.4. 3.5. 3.6. 3.7. 3.8.	The Illumination of the Spectrograph Slit 37 The Use of a Condensing Lens 39 The Conditions for Maximum Illumination and Maximum In- trinsic Energy of a Spectrum 49 Illumination by a Point Source 43 Illumination by Sources of Finite Depth 45
3.3. 3.4. 3.5. 3.6. 3.7. 3.8. 3.9.	 The Illumination of the Spectrograph Slit 37 The Use of a Condensing Lens 39 The Conditions for Maximum Illumination and Maximum Intrinsic Energy of a Spectrum 42 Illumination by a Point Source 43 Illumination by Sources of Finite Depth 45 Types of Slit Illumination 46
3.3. 3.4. 3.5. 3.6. 3.7. 3.8. 3.9. 3.10.	The Illumination of the Spectrograph Slit 37 The Use of a Condensing Lens 39 The Conditions for Maximum Illumination and Maximum In- trinsic Energy of a Spectrum 42 Illumination by a Point Source 43 Illumination by Sources of Finite Depth 45 Types of Slit Illumination 46 Photographic Speed of Spectrographs 48
3.3. 3.4. 3.5. 3.6. 3.7. 3.8. 3.9. 3.10. CHA	The Illumination of the Spectrograph Slit 37 The Use of a Condensing Lens 39 The Conditions for Maximum Illumination and Maximum In- trinsic Energy of a Spectrum 42 Illumination by a Point Source 43 Illumination by Sources of Finite Depth 45 Types of Slit Illumination 46 Photographic Speed of Spectrographs 48 PTER 4:
3.3. 3.4. 3.5. 3.6. 3.7. 3.8. 3.9. 3.10. CHA	The Illumination of the Spectrograph Slit 37 The Use of a Condensing Lens 39 The Conditions for Maximum Illumination and Maximum In- trinsic Energy of a Spectrum 42 Illumination by a Point Source 43 Illumination by Sources of Finite Depth 45 Types of Slit Illumination 46 Photographic Speed of Spectrographs 48 PTER 4: troscopes and Spectrographs: Theory and Construction.
3.3. 3.4. 3.5. 3.6. 3.7. 3.8. 3.9. 3.10. CHA Prism Spec 4.1.	The Illumination of the Spectrograph Slit 37 The Use of a Condensing Lens 39 The Conditions for Maximum Illumination and Maximum In- trinsic Energy of a Spectrum 43 Illumination by a Point Source 43 Illumination by Sources of Finite Depth 45 Types of Slit Illumination 46 Photographic Speed of Spectrographs 48 PTER 4: troscopes and Spectrographs: Theory and Construction The Slit 50
3.3. 3.4. 3.5. 3.6. 3.7. 3.8. 3.9. 3.10. CHA Prism Spec 4.1. 4.2.	The Illumination of the Spectrograph Slit 37 The Use of a Condensing Lens 39 The Conditions for Maximum Illumination and Maximum In- trinsic Energy of a Spectrum 43 Illumination by a Point Source 43 Illumination by Sources of Finite Depth 45 Types of Slit Illumination 46 Photographic Speed of Spectrographs 48 PTER 4: troscopes and Spectrographs: Theory and Construction The Slit 50 The Collimator Lens 53

CONTENTS

- 4.3. Prisms 58
- 4.4. Dispersion of a Prism 59
- 4.5. Resolving Power of a Prism 62
- 4.6. Curvature of Lines in Prismatic Spectra 64
- 4.7. Magnification by a Prism 65
- 4.8. Size of Prism Faces 66
- 4.9. Prism Materials 67
- 4.10. Prism Types and Systems 74
- 4.11. The Camera Lens 79
- 4.12. Resolving Power of Prism Spectrographs 85
- 4.13. The Use of Mirrors in Spectrographs 88

CHAPTER 5:

- 5.1. Types of Prism Instruments 89
- 5.2. The Adjustment of Spectroscopic Instruments 100
- 5.3. The Testing of Spectroscopic Instruments 100
- 5.4. Influence of Slit Width and Mode of Illumination on Line Form and Intensity 111
- 5.5. Light Losses in Spectrographs 114
- 5.6. Stray Light in Spectrographs 121
- 5.7. The Effect of Temperature and Pressure on Prism Spectrographs 124

CHAPTER 6:

- 6.1. The Plane Grating 127
- 6.2. Dispersion of a Grating 129
- 6.3. Resolving Power of a Grating 130
- 6.4. The Concave Grating 132
- 6.5. The Astigmatism of the Concave Grating 134
- 6.6. The Wadsworth Arrangement of the Concave Grating 136
- 6.7. The Dispersion of Grating Spectrographs 138
- 6.8. The Production of Gratings 147
- 6.9. The Grating Blank 147
- 6.10. The Ruling of Gratings 149
- 6.11. Replica Gratings 150

CHAPTER 7:

- 7.1. Concave Grating Mountings 152
- 7.2. The Paschen-Runge Mounting 152
- 7.3. The Rowland Mounting 155
- 7.4. The Abney Mounting 157
- 7.5. The Eagle Mounting 158
- 7.6. The Radius Mounting 161
- 7.7. The Wadsworth Mounting 164

viii

CONTENTS

- 7.8. The Adjustment of the Concave Gratiag 165
- 7.9. The Optics of Small Displacements of the Grating 165
- 7.10. The Optics of Small Displacements of the Slit 174
- 7.11. Applications of the Plane Grating 178
- 7.12. Ruling Errors and Ghosts 180
- 7.13. The Testing of Gratings 183
- 7.14. Cleaning and Care of Gratings 185
- 7.15. Sensitivity of Grating Spectrographs to Disturbances 185
- 7.16. Light Losses and Stray Light in Grating Spectrographs 189
- 7.17. Light Distribution in Grating Spectra 190

CHAPTER 8:

- 8.1. The Photographic Emulsion and the Latent Image 192
- 8.2. Properties of the Emulsion-The Characteristic Curve 193
- 8.3. Contrast 195
- 8.4. Emulsion-speed Rating Systems 196
- 8.5. Emulsion Latitude 199
- 8.6. Emulsion Graininess 200
- 8.7. Spectral Behavior of Emulsions 200
- 8.8. Resolving Power of Emulsions 202
- 8.9. The Reciprocity Law 203
- 8.10. The Processing of Photographic Emulsions 205
- 8.11. Available Photographic Emulsions 210

CHAPTER 9:

- 9.1. Standards of Wave Length 215
- 9.2. Spectroscopic Charts and Tables 221
- 9.3. Comparators and Measuring Microscopes 229
- 9.4. Notes on the Use and Testing of Comparators 232
- 9.5. Reduction of Prism Spectrograms 236
- 9.6. The Hartmann Dispersion Formula 240
- 9.7. Wave-Number Determination 245
- 9.8. Reduction of Grating Spectrograms 246
- 9.9. Identification of Lines and Bands 250

CHAPTER 10:

- 10.1. Visual Photometric Methods 254
- 10.2. Objective Photometric Methods 257
- 10.3. Types of Microphotometers 259
- 10.4. Homochromatic Photometry 267
- 10.5. Methods of Recording Emulsion-Calibration Marks 267
- 10.6. The Determination and Use of Characteristic Curves 273
- 10.7. Heterochromatic Photometry 276
- 10.8. Notes on Photographic-Microphotometric Practice \$77
- 10.9. Errors in Photographic Photometry 285

* CONTENTS

CHAPTER 11:

•••••••	
11.1.	Infrared Methods 288
11.2.	Prism Spectrometers 289
11.3.	Grating Spectrometers 291
11.4.	Spectrometer Adjustment and Calibration 298
11.5.	Infrared Detectors 294
11.6.	Elimination of Extraneous Radiation 296
11.7.	Infrared Recorders 297
11.8.	Applications of Infrared Spectroscopy 301
CHA	PTER 12:
The Spec	troscopy of the Vacuum Ultraviolet
12.1.	The Work of Victor Schumann 306
12.2.	Lyman and the Vacuum Grating Spectrograph 308
12.3.	The Grating at Grazing Incidence 310
12.4.	Gratings and Technique for the Ultraviolet 314
12.4. 12.5.	Gratings and Technique for the Ultraviolet 314 Ultraviolet Light Sources 315
12.4. 12.5. 12.6.	Gratings and Technique for the Ultraviolet 314 Ultraviolet Light Sources 315 Applications of Ultraviolet Spectroscopy 316
12.4. 12.5. 12.6. CHA	Gratings and Technique for the Ultraviolet 314 Ultraviolet Light Sources 316 Applications of Ultraviolet Spectroscopy 316 PTER 13:
12.4. 12.5. 12.6. C H A Spectroch	Gratings and Technique for the Ultraviolet 314 Ultraviolet Light Sources 315 Applications of Ultraviolet Spectroscopy 316 PTER 13: emical Analysis
12.4. 12.5. 12.6. CHA Spectroch 13.1.	Gratings and Technique for the Ultraviolet 314 Ultraviolet Light Sources 315 Applications of Ultraviolet Spectroscopy 316 PTER 13: emical Analysis
12.4. 12.5. 12.6. CHA Spectroch 13.1. 13.2.	Gratings and Technique for the Ultraviolet 314 Ultraviolet Light Sources 315 Applications of Ultraviolet Spectroscopy 316 PTER 13: emical Analysis
12.4. 12.5. 12.6. CHA Spectroch 13.1. 13.2. 13.3.	Gratings and Technique for the Ultraviolet <i>\$14</i> Ultraviolet Light Sources <i>\$15</i> Applications of Ultraviolet Spectroscopy <i>\$16</i> PTER 13: emical Analysis
12.4. 12.5. 12.6. CHA Spectroch 13.1. 13.2. 13.3. 13.4.	Gratings and Technique for the Ultraviolet <i>\$14</i> Ultraviolet Light Sources <i>\$15</i> Applications of Ultraviolet Spectroscopy <i>\$16</i> PTER 13: emical Analysis
12.4. 12.5. 12.6. CHA Spectroch 13.1. 13.2. 13.3. 13.4. 13.5.	Gratings and Technique for the Ultraviolet <i>\$14</i> Ultraviolet Light Sources <i>\$15</i> Applications of Ultraviolet Spectroscopy <i>\$16</i> PTER 13: emical Analysis
12.4. 12.5. 12.6. CHA Spectroch 13.1. 13.2. 13.3. 13.4. 13.5. 13.6.	Gratings and Technique for the Ultraviolet <i>\$14</i> Ultraviolet Light Sources <i>\$16</i> Applications of Ultraviolet Spectroscopy <i>\$16</i> PTER 13: emical Analysis
12.4. 12.5. 12.6. CHA Spectroch 13.1. 13.2. 13.3. 13.4. 13.5. 13.6. 13.7.	Gratings and Technique for the Ultraviolet <i>\$14</i> Ultraviolet Light Sources <i>\$15</i> Applications of Ultraviolet Spectroscopy <i>\$16</i> PTER 13: emical Analysis
12.4. 12.5. 12.6. CHA Spectroch 13.1. 13.2. 13.3. 13.4. 13.5. 13.6. 13.7. 13.8.	Gratings and Technique for the Ultraviolet <i>\$14</i> Ultraviolet Light Sources <i>\$15</i> Applications of Ultraviolet Spectroscopy <i>\$16</i> PTER 13: emical Analysis
12.4. 12.5. 12.6. CHA Spectroch 13.1. 13.2. 13.3. 13.4. 13.5. 13.6. 13.7. 13.8. 13.9.	Gratings and Technique for the Ultraviolet 314 Ultraviolet Light Sources 315 Applications of Ultraviolet Spectroscopy 316 PTER 13: emical Analysis
12.4. 12.5. 12.6. CHA Spectroch 13.1. 13.2. 13.3. 13.4. 13.5. 13.6. 13.7. 13.8. 13.9. 13.10.	Gratings and Technique for the Ultraviolet 314 Ultraviolet Light Sources 315 Applications of Ultraviolet Spectroscopy 316 PTER 13: emical Analysis
12.4. 12.5. 12.6. CHA Spectroch 13.1. 13.2. 13.3. 13.4. 13.5. 13.6. 13.7. 13.8. 13.9. 13.10. 13.11.	Gratings and Technique for the Ultraviolet <i>\$14</i> Ultraviolet Light Sources <i>\$15</i> Applications of Ultraviolet Spectroscopy <i>\$16</i> PTER 13: emical Analysis