

# CONTENTS

PREFACE . . . . .	VII
CONTENTS . . . . .	IX

## I. HIGHER ORDER ABERRATION THEORY

*by J. Focke (Leipzig)*

1.	INTRODUCTION . . . . .	3
2.	MODERN FORMULATION OF SCHWARZSCHILD'S ABERRATION THEORY . . . . .	5
2.1	The Seidel eikonals . . . . .	5
2.2	Connection between the eikonals . . . . .	8
3.	THE SCHWARZSCHILD-SMITH ABERRATION COEFFICIENTS . . . . .	9
3.1	General classification . . . . .	9
3.2	Dependence on the position of the stop . . . . .	11
3.3	The aberration coefficients of a combined system . . . . .	14
4.	THE INTRINSIC COEFFICIENTS OF A REFRACTING SURFACE . . . . .	17
4.1	The angle eikonal of a refracting surface . . . . .	17
4.2	The Seidel eikonal of a refracting surface . . . . .	19
4.3	The spherical parts of intrinsic coefficients . . . . .	23
4.4	The aspherical parts of intrinsic coefficients . . . . .	25
5.	THE HERZBERGER ABERRATION COEFFICIENTS . . . . .	28
5.1	General definition . . . . .	28
5.2	The connection with the Schwarzschild aberration coefficients . . . . .	28
5.3	Dependence on the position of the stop . . . . .	30
5.4	The aberration coefficients of a concentric system . . . . .	32
5.5	The aberrations of a combined system . . . . .	33
5.6	The intrinsic coefficients of a spherical surface . . . . .	34
	REFERENCES . . . . .	36

## II. APPLICATIONS OF SHEARING INTERFEROMETRY

*by O. Bryngdahl (Stockholm)*

1.	INTRODUCTION . . . . .	39
2.	EXAMINATION OF OPTICAL COMPONENTS . . . . .	39
2.1	Preliminary remarks . . . . .	39
2.2	Testing of objectives and mirrors . . . . .	40
2.3	Examination of diffraction gratings . . . . .	57
3.	STUDIES OF ILLUMINATION PROPERTIES . . . . .	59
3.1	Measurement of coherence . . . . .	59
3.2	Determination of spectral profiles . . . . .	59
3.3	Study of scintillation . . . . .	60
3.4	Image position measurement of small light sources . . . . .	60
4.	EXAMINATION OF LARGE TRANSPARENT OBJECTS . . . . .	61
5.	STUDIES OF PHYSICO-CHEMICAL PHENOMENA IN LIQUIDS . . . . .	66
5.1	Measurements of coefficients describing transport processes . . . . .	66
5.2	Recording of the refractive index variations in liquids . . . . .	70

6.	EXAMINATION OF MICROSCOPIC OBJECTS . . . . .	71
6.1	Applications in microscopy . . . . .	71
6.2	Lateral shearing interferometers . . . . .	73
6.3	Longitudinal shearing interferometry . . . . .	78
6.4	Measurement of optical path difference . . . . .	80
REFERENCES	. . . . .	81

### III. SURFACE DETERIORATION OF OPTICAL GLASSES

*by K. KINOSITA (Tokyo)*

1.	INTRODUCTION . . . . .	87
2.	SOME OBSERVATIONS ON CORROSION OF GLASS BY SOLUTIONS . . .	89
2.1	Corrosion by acid solutions . . . . .	89
2.2	Corrosion by alkaline solutions . . . . .	96
2.3	Corrosion by water . . . . .	97
2.4	Effect of silica dissolved in the corrosive . . . . .	98
2.5	Corrosion by electrolytic salt solutions . . . . .	101
3.	CRYSTALLITES GROWN ON THE GLASS SURFACE . . . . .	104
3.1	Electron diffraction studies . . . . .	104
3.2	Direct observation of the crystallites . . . . .	108
3.3	Spectral analysis of the crystallites and the aoyake layer . . .	109
4.	STRUCTURE AND PROPERTIES OF THE AOYAKE LAYER . . . . .	111
4.1	Refractive index of the aoyake layer . . . . .	111
4.2	Inhomogeneity in refractive index of the aoyake layer . . .	115
4.3	Adsorption of water vapor; pore structure of the aoyake layer	119
4.4	Aging of the aoyake layer . . . . .	131
4.5	Detection of slight aoyake . . . . .	136
5.	CONCLUSION . . . . .	140
REFERENCES	. . . . .	141

### IV. OPTICAL CONSTANTS OF THIN FILMS

*by P. ROUARD AND P. BOUSQUET (Marseilles)*

1.	OPTICAL CONSTANTS AND STRUCTURE OF TRANSPARENT THIN FILMS .	147
1.1	Introduction . . . . .	147
1.2	Methods of determining the refractive index and thickness of an ideal transparent thin film . . . . .	148
1.3	Study of the structure of films . . . . .	154
1.4	Results . . . . .	156
1.5	Conclusions . . . . .	160
2.	OPTICAL CONSTANTS OF ABSORBING THIN FILMS . . . . .	161
2.1	Introduction . . . . .	161
2.2	Methods of determining optical constants of absorbing thin films	162
2.3	Experimental results . . . . .	168
2.4	Theoretical interpretation of the experimental results . . . .	184
2.5	Conclusion . . . . .	192
ACKNOWLEDGEMENT	. . . . .	193
REFERENCES	. . . . .	193

## V. THE MIYAMOTO-WOLF DIFFRACTION WAVE

by A. RUBINOWICZ (Warsaw)

THE HISTORY OF THE DIFFRACTION WAVE . . . . .	201
---	-----

## I. THE SCALAR DIFFRACTION THEORY

1. THE HELMHOLTZ-HUYGENS PRINCIPLE . . . . .	203
2. DIFFRACTION WAVE FOR AN ARBITRARY INCIDENT WAVE . . . . .	206
3. THE MIYAMOTO-WOLF DERIVATION OF THE VECTOR POTENTIAL $\mathbf{W}(P, Q)$ . . . . .	210
4. SIMPLE DERIVATION OF THE VECTOR POTENTIAL $\mathbf{W}(P, Q)$ . . . . .	213
5. VECTOR POTENTIAL $\mathbf{W}(P, Q)$ IN CASE WHERE THE SOLUTION $u(Q)$ SATISFIES THE SOMMERFELD CONDITION AT INFINITY . . . . .	213
6. A GEOMETRIC DERIVATION OF THE VECTOR POTENTIAL $\mathbf{W}(P, Q)$ . . . . .	214
7. TWO FURTHER REPRESENTATIONS OF THE VECTOR POTENTIAL $\mathbf{W}(P, Q)$ . . . . .	217
8. VECTOR POTENTIALS FOR BOUNDED SPACES . . . . .	218
9. THE TWO-DIMENSIONAL HELMHOLTZ EQUATION . . . . .	220
10. PHYSICAL PROPERTIES OF THE VECTOR POTENTIAL $\mathbf{W}(P, Q)$ AND OF THE CORRESPONDING DIFFRACTION WAVE . . . . .	221
11. APPROXIMATE FORMULAE FOR THE VECTOR POTENTIAL $\mathbf{W}(P, Q)$ . . . . .	224
12. REFLECTION CONES . . . . .	228
13. DIFFRACTION WAVE FOR THE SCALAR WAVE EQUATION . . . . .	230

## II. DIFFRACTION THEORY OF ELECTROMAGNETIC AND DIRAC-ELECTRON WAVES

1. TENSOR POTENTIALS OF ELECTROMAGNETIC FIELDS DERIVED USING THE LORENTZ-LARMOR PRINCIPLE . . . . .	231
2. TENSOR POTENTIALS OF THE ELECTROMAGNETIC FIELDS DERIVED FROM KOTTLER'S FORMULATION OF THE HUYGENS PRINCIPLE . . . . .	235
3. DIFFRACTION WAVE IN THE KIRCHHOFF THEORY OF DIRAC-ELECTRON WAVES . . . . .	238
CONCLUSION . . . . .	239
REFERENCES . . . . .	239

## VI. ABERRATION THEORY OF GRATINGS AND GRATING MOUNTINGS

by W. T. WELFORD (London)

1. INTRODUCTION . . . . .	243
2. ABERRATION TYPES . . . . .	243
3. FIRST ORDER PROPERTIES OF CONCAVE GRATINGS . . . . .	244
3.1 The classical mountings . . . . .	247
3.2 Astigmatism of the classical mountings . . . . .	249
3.3 Spectrum line curvature . . . . .	251
4. PROPERTIES OF CONCAVE GRATINGS DEPENDENT ON TERMS OF THE FOURTH DEGREE IN THE GRATING COORDINATES . . . . .	253
4.1 Astigmatic curvature . . . . .	255
4.2 Coma and spherical aberration . . . . .	257
4.3 Ray-tracing through gratings . . . . .	259
5. THE NEWER MOUNTINGS OF THE CONCAVE GRATING . . . . .	259

6.	PLANE GRATING MOUNTINGS . . . . .	263
6.1	Aberrations of the concave mirror . . . . .	268
6.2	Point imaging aberrations of plane grating mountings . . . . .	268
6.3	Image field curvature in plane grating mountings . . . . .	273
6.4	Plane grating mountings with non-collimated light . . . . .	275
6.5	Realizations of plane grating mountings . . . . .	275
7.	NON-SPHERICAL GRATINGS AND NON-LINEAR RULINGS . . . . .	276
8.	ABERRATION TOLERANCES . . . . .	277
	REFERENCES . . . . .	278

## VII. DIFFRACTION AT A BLACK SCREEN

### *Part I: KIRCHHOFF'S THEORY*

by F. KOTTLER (Rochester, N.Y.)

1.	INTRODUCTION . . . . .	283
2.	THE FIRST SALTUS PROBLEM . . . . .	287
2.1	The mathematical expression of Kirchhoff's formulation . . . . .	289
2.2	Huygen's principle and Green's theorem . . . . .	291
2.3	Kirchhoff's 'boundary' values and their reinterpretation . . . . .	293
2.4	The deformability of the illuminated part of the black body . . . . .	295
2.5	Point of observation outside the black body . . . . .	298
2.6	Deformability of the shadowed side of the black body . . . . .	302
2.7	Introduction of a nonphysical space . . . . .	302
2.8	The thickness of the black screen . . . . .	305
3.	THE SECOND SALTUS PROBLEM . . . . .	305
4.	CONCLUDING REMARKS . . . . .	307
5.	MATHEMATICAL APPENDIX . . . . .	309
5.1	Green's theorem . . . . .	309
5.2	Stokes' theorem . . . . .	309
6.	EXPERIMENTAL APPENDIX . . . . .	310
	REFERENCES . . . . .	313
	AUTHOR INDEX . . . . .	315
	SUBJECT INDEX . . . . .	321