CAMBRIDGE

Cambridge University Press
978-0-521-47820-5 - The Eye and Visual Optical Instruments
George Smith and David A. Atchison
Index
More information

Index

Abbe *V*-value, 9
Aberrations, 23, 97–130, 601–646, 793
  of the eye, 673–694
  higher order, 101, 113, 126, 627, 630
  longitudinal, 99–100, 634–638
  measurement of, 622–624
  primary, 101, 126, 627–629
  Seidel, *see* Seidel aberrations
  transverse, 99–100, 631–634
  wave, 99–100, 624–638
Aberrations, chromatic, 109–111, 794
  longitudinal, 109–110
  transverse, 111
Aberrations, finite (exact), 623–624
  longitudinal, 623
  transverse, 623
  wave, 624
Aberrations, monochromatic, 101–109
  astigmatism, 104, 794
  coma, 103, 795
  distortion, 108, 796
  field curvature, 107, 797
  Petzval curvature, 107–108
  spherical, *see* Spherical aberration
Absorption, 283
Accommodation, 293
  amplitude, 294
  instrument, 699
Accommodation/convergence
  AC/A ratio, 596
  AC/A response, 734
  demands of instruments, 732–735
  relationships, 595
Achromatic condition, 615
Achromatic doublet, 150, 615–618, 793
Achromatizing correcting lens, 686
Aerial, 793
Afocal, 60, 80, 793
Afocal systems, matrix analysis of, 769–772
Air lens, 149
Airy disc, 544, 656, 793
Alvarez lens, 147–148
Amblyopia, 793
Ametropia, *see* Refractive errors
Amplitude of accommodation, 294
Anaglyphs, 598
Anamorphic lens, 151
Angle measuring instruments, 445–447
  sextant, 446
  theodolite, 445
Angle of deviation, 18
  prism, 175–177
Aniseikonia, 794
Aperture radius, 794
Aperture stop, 205, 207–208, 793
Aplanatic surface, 606
Apochromats, 616
Aspheric surface, 116, 619–623
  Cartesian (Descartes) oval, 119
  conicoid, 116–118, 619–620
  effect on Seidel aberrations, 619–623
  figured conicoid, 118, 622
Aspheric surfaced lenses, 138
Asphericity, 116
Astigmatism of the eye, 297
Auto-collimating telescope, 405
Auto-collimation, 265
Axis, optical, 21, 26, 799
  of the eye, 293
Axis, visual, 293

Back focal point, 52, 764–765
Back principal plane, 56–57
Back principal point, 55, 764–765
  of thick lens, 55
Badal optometer, 577–583
  alternative constructions, 579–582
  and eye positions, 582
  simple, 578
Badal principle, 336, 577–578
Barlow lens (tele-converter lens), 459, 794
Beams, 12
Becke line method, 252
Bessel function, 543
Binoculars, 407
  and binocular convergence, 739–740
  stereoscopic magnification, 735–738
Binocular vision, 311–312, 794
  accommodation and convergence, 311–312
  fusion, 595
  simultaneous foveal perception, 595
  simultaneous perception, 595
  stereopsis, 595
  and visual ergonomics, 727–745
Binocular vision, testing instruments, 595–598
  anaglyphs, 598
  stereoscopes, 597
  synoptophore, 596–597
Bioculars, 329, 350–352, 729
  aberrations, 355–356
  head-up displays, 350
  magnification limits, 351–352
  tolerances to aberrations, 744
Blind spot, 293
Blur disc, *see* Defocus blur disc
Boroscopes, 434
Bravais points, 794

Camera lenses
  aberrations, 473–474
  apertures and pupils, 460–461
  depth-of-field, 465–468
  field-of-view, 453–454
  F-number, 460–461
  focussing range, 469
  F-stops, 461
  hyperfocal distance, 468
  inverse telephoto, 456, 458–459, 798
  telephoto, 456–457, 801
Cameras
  and film plane illuminance, 461–464
  single lens reflex, 471–472
  viewfinders of, 469–472
Cardinal points, 72–74, 763–768, 794
  focal, 52, 72, 764–766, 797
  of lens, 135–136
  macroscopes, 415–416
  measurement, 267–268
  microscopes, 360–361
  nodal, 73–74, 765–766, 798
  principal, 73, 764–765
Cartesian (Descartes) oval, 119
Cascaded systems, 79, 216–218
Cassegrain telescope, 378
Catadioptric, 87, 93, 153, 794
Catoptric, 87, 153, 794
Cauchy formula, 9
Caustic curve, 103
Centre of rotation of the eye, 136, 311, 731
Chromostereopsis, 687
Circle of least confusion, 106
Coherence, 509–514, 794
  spatial, 512
  temporal, 512–513
Coherent imaging, 794
Coherent light, 513, 795
Cold light source, 440
Collimation (and collimators), 487–495, 795
  aberrations of, 494
  and auto-collimation, 491
  design, 494
  precision in, 491–492
  visual, 490–492
Colorimeters, 498–501
Colour fringing, 182
Compensating plate, 522
Condensor, 138, 220, 795
Cones, 290
Conicoid, 116–118, 619–620
  ellipsoid, 116–117
  paraboloid, 116–117
Conjugate points, 22, 795
Contact lenses, 324
  aberrations, 325
Contrast, 795

© Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
978-0-521-47820-5 - The Eye and Visual Optical Instruments
George Smith and David A. Atchison
Index
More information

Contrast threshold function of the eye, 691
Cornea, 291, 795
Cos^4 law, 286
Coupling of eye and optical system
  coherent, 714–716
  incoherent, 716
Critical angle, 18, 247–248, 795
Crossed torics (or crossed cylinders), 145–146
Curvature (of a surface), 32, 795
  measurement by contact methods, 257–260
  measurement by non-contact methods, 257, 260–262
Cylindrical lens and axis, 143

Defocus, 225–243
  quantification, 225
  sources, 227–230
Defocus blur disc, 225–226, 230–234, 236–237
  of eye, 304–305
  model, 701–702
Density, 795
Depth-of-field/focus, 225, 235–237
  of afocal systems, 704
  cameras, 465–468
  of eye, 304–306
  geometrical approximation, 236–237
  hyperfocal distance, 468
  of microscopes, 703
  of simple magnifiers, 703
Diaphragm, 460
Dielectric, 795
Diffraction, 24, 527–553, 795
  and aberrations, 547–548
  Airy disc, 544, 656, 793
  circular aperture, 542–547
  efficiencies of Fresnel zone plate, 536–540
  Fraunhofer, 541–547, 796
  Fresnel, 532–540, 795
  Fresnel zones and zone plate, 532–540
  Huygens' principle, 530
  Kirchhoff integral, 530–531
  laser speckle, 241, 540–541, 587
  single slit pattern of, 547
  Young's boundary wave, 548–550
Diffraction grating, 548–552
  angular dispersion, 550–551
  resolving power, 551–552
Diffuse, 796
Diffuser, perfect, 274
Dioptre, 34, 796
Diplopia, 596, 796
Disc of least confusion, 639
Dispersion, 8–10, 109, 796
  principal, 10
  of a prism, 182–183
Dissociation, 796
Doubling of image, 184–186
Drysdale principle, 260, 561–562
Duochrome test, 587, 686

Edge spread function, 660
Electromagnetic radiation
  amplitude, 5
  complex representation, 5
  frequency, 5, 7
  intensity, 5
  wavelength, 5, 7
Emmetropia, 295, 796
Endoscopes, 433
Equivalent focal length, 74–75
Equivalent power, 53–55, 751–752, 799
  component, 752–753
  measurement, 262–265
  thick lens, 53–55, 59
Equivalent viewing distance, 332, 334–335
Exposure, 461, 796
  correction factor, 463
Eye, 291–316
  and ametropia (refractive errors), 295–300
  axes, 293
  blind spot, 293
  centre of rotation of, 136, 311, 731
  depth-of-field of, 304–306
  optic disc of, 293
  photometry of, 308–311
  pupil, entrance, 300–302
  pupil, exit, 300
  and refractive errors (ametropia), 295–300
  and visual acuity, 302–304
Eye, aberrations of, 673–694
  chromatic, 681–687
  monochromatic, irregular, 680–681
  monochromatic, regular, 674–680
Eye, retinal image quality of, 687–691
  contrast threshold function, 691
  line spread function, 689–690
  modulation transfer function, 690–691
  point spread function, 689–690
Eye, schematic, 307–308, 777–792
  finite (wide angle), 308, 674
  paraxial, 307, 674
Eye lens, 308, 344, 796
Eye relief, 218, 323, 704–706, 796
  Keplerian telescope, 383
  microscopes, 366–367
Eyepieces, 344–348, 796
  aberrations of, 355
  eye lens in, 344
  field lens in, 344, 385
  Huygens, 346
  micrometer, 347
  in microscopes, 371
  negative power, 348
  Ramsden, 346

Far point, 294, 796
Fermat's principle, 13–14, 112
Field expanders, 407
Field flattener, 220
Field lens, 218–220, 797
  and aberrations, 220
  and field-of-view, 218–220
  in eyepieces, 344, 385
Field of half illumination, 205
Field-of-view of
  bioculars, 351
  camera lenses, 453–454
  field lens, 218–220
  Galilean telescopes, 392–394
  Keplerian telescopes, 386–388
  microscopes, 369
  monocular systems, 700
  simple magnifiers, 339–342
Field stop, 206, 220, 797
Film exposure, 461–464
Fincham coincidence optometer, 589–590
Finite (real) ray, 21, 27–31, 800
F-number, 214, 796
  and camera lenses, 460–461
Focal, 797
Focal lengths, 52, 797
  equivalent, 74–75
  measurement, 262–266
  vertex, 55–56, 74–76
Focal points, 52, 72, 764–765, 797
Focimeter, 266, 557–560, 797
  and astigmatism measurement, 558
  collimation errors, 519
  principle, 266–267, 557–558
  and prism power measurement, 559
  and residual power in telescope measurement, 559
Foco-collimator method, 264–265
Focus, 797
Focussing techniques, 238–242
  effect of aberrations, 242
  knife-edge (Foucault method), 240, 643
  laser speckle, 241, 540–541, 587
  rangefinding, 241
  Scheiner principle, 240–241, 588
  simple perception of blur, 238, 586
  split image, 239–240, 589
Foucault knife-edge test, 240, 643
Fourier transform, 665
Fovea, 292
Fraunhofer diffraction, 541–547, 795
Fresnel biprism, 184–186
Fresnel diffraction, 532–540, 796
Fresnel lens, 138–140
Fresnel zones and zone plate, 532–540
Fringe, zero order, 522
Front focal point, 52, 765
Front principal plane, 56–57
Front principal point, 55, 765
  of thick lens, 55
F-stops, 461, 796

Gain
  photometric, 712
  of screen, 484
Galilean telescopes, 391–394
  aberrations of, 407
  field-of-view, 392–394
  pupils, 391–392
Gaussian optics, 80, 126–127, 797
Geneva lens measure, 260
Geometrical optics, 12, 548, 797

© Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
978-0-521-47820-5 - The Eye and Visual Optical Instruments
George Smith and David A. Atchison
Index
More information

Ghost image, 649
Goniometer, 246, 797
Gradient refractive index, 10
Graticule, 698, 797
Grating acuity, 302

Hartmann equation, 9
Head-up displays, 350
Helmholtz–Smith relation, *see* Optical invariant
Heterophoria, *see* Phoria
Heterotropia, *see* Tropia
Homogeneous, 797
Huygens eyepiece, 346
Huygens' principle, 530
Hyperfocal distance, 468
Hypermetropia (hyperopia), 296

Illuminance, 275, 797
  and circular source, 277–278
  and point source, 276–277
  of image, 284–286
Image
  ideal, 23–24
  illuminance, 284–286
  magnification, 43–44
  off-axis, 42–44
  Purkinje, 87, 93, 293
  real, 22, 152, 800
  space, 21
  virtual, 22, 153, 801
Image doubling, 184–186
  in keratometry, 562
Image quality criteria
  optical transfer function, 662–669
  point spread function, 653–662
  resolving power, 670
  veiling glare, 648–650
  wave aberration function, 650–653
Imagery, off-axis, 42–44
Instrument myopia/accommodation, 585, 699
Interferometers
  multiple beam, 509
  Twyman–Green, 517–521
  Young's double slit, 514–517
Interferometers, white light, 522–523
  and compensating plate, 522
  Lotmar, 523
Interferometry, 505–525
  angular spatial frequency limit, 523–524
  and coherence, *see* Coherence
  coherent and incoherent sources, 513
  division of amplitude, 511
  division of wavefront, 511
Intensity, electromagnetic radiation, 5
Intermediate resting point of accommodation, 699
Inter-pupillary distance, 311
Interval of Sturm, 104
Intra-ocular lenses, 149, 324
  aberrations, 325
Inverse square law, 277–279
Inverse telephoto lens, 456, 458–459, 798

Iris, 291
Iso-magnification, 335
Isotropic, 797

Keratometer, 262–263, 797
  image doubling in, 562
Keplerian (astronomical) telescopes, 383–390
  aberrations, 407
  eye relief, 383
  image erection, 388–390
  field lenses, 385
  field-of-view, 386–388
  pupils, 383–385
Kirchhoff integral, 530–531
Knife-edge (Foucault method), 240, 643
Köhler illumination, 370

Lagrange invariant, *see* Optical invariant
Lambertian, 274, 797
Lambert's law, 437
Laser, 315
Laser optometer, 587–588
  plane of stationarity, 588
Laser speckle, 241, 540–541, 587
Lens
  cardinal points, 135–136
  equation, 49, 51, 67
  image formation, 152–153
  maximum aperture radius, 137–138
  negative power, 132
  positive power, 132
  power, 50–52, 59
  as a prism, 186–187
  prismatic effect, 186–187
  shape factor, 134–135
  thick, 53–59
  thin, 50–51, 797
Lenses
  achromatic doublet, 150, 615–618, 793
  air, 149
  Alvarez, 147–148
  anamorphic, 151
  Barlow (tele-converter), 459, 794
  collimator, 136, 487–495, 795
  condensor, 138, 220, 795
  cylindrical, 143, 145–146
  Fresnel, 138–140
  intra-ocular, 149, 324
  inverse telephoto, 456, 458–459, 798
  objective, 371, 799
  progressive addition, 147
  projection, 477–478
  rotationally symmetric, 131–140
  spherical, 131–138
  telephoto, 456–457, 801
  toric, 140–147
  variable power, 147–148
Lenses, ophthalmic, 14
  contact, 324
  intra-ocular, 149, 324
  spectacle, 317–324
Lens systems, 150
  catadioptric, 157
  catoptric, 157
  general, 59–76
  three lens systems, 59
  two thick lenses, 59
  two thin lenses, 58
Letter or Snellen acuity, 302
Line spread function, 660, 689, 798
  of eye, 689–690
Longitudinal, 798
Lotmar white light interferometer, 522–523
Lumen, 273, 797
Luminance, 274–275, 798
Luminous efficiency functions, 271–272
Luminous flux, 273, 798
  collected by an optical system, 279–282
  leaving an optical system, 284
  transmitted by a system, 282
Luminous intensity, 273–274, 798

Macroscopes, 413–428, 798
  aberrations, 427
  adapting telescopes, 423–426
  cardinal points (Galilean), 415–416
  cardinal points (Keplerian), 415–416
  conversion to a telescope, 426–427
  equivalent power, 414
  magnification, 416–420
  pupils (Galilean), 420, 422–423
  pupils (Keplerian), 420–422
Magnification, 23, 330
  empty, 717
  longitudinal, 71–72, 798
  of macroscopes, 416–420
  of microscopes, 361–363
  nominal, 330
  relative, 167
  of simple magnifiers, 328–331, 333–334
  spectacle, 317, 321–323, 337
  stereoscopic, 735–738
  of telescopes, 379–383
  transverse (lateral), 43, 68–71, 798
Maréchal criterion, 651–652
Matrix representation of paraxial optics, 41, 752–756, 769–770
Maxwellian view, 518, 720–721
Metrology, optical, 245–269
Microscopes, 359–373, 798
  aberrations, 372
  cardinal points, 360–361
  equivalent power, 363–364
  eyepieces, 371
  eye relief, 366–367
  field-of-view, 369
  illumination, 369
  image formation, 359–360
  image luminance, 710
  limits of magnification, 363, 717–718
  magnification, 361–363
  objectives, 371
  pupil imagery, 365–369
  pupil matching, 368–369
  tube length, 359
  working distance, 364–365
Mirror equation, 91, 164

© Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
978-0-521-47820-5 - The Eye and Visual Optical Instruments
George Smith and David A. Atchison
Index
More information

Mirrors, 87
Mirrors, conicoid, 169–172
  cardinal points, 171
  conjugates free of spherical aberration, 171–172
  ellipsoidal, 172
  hyperboloidal, 172
  paraboloidal, 172
Mirrors, plane, 157–163
  effect of rotation, 162
  image formation, 157–159
  roof, 161
Mirrors, spherical, 163–168
  cardinal points, 164–166
  image formation, 166–168
  magnification, 166
  power, 163
  ray tracing, 168
  relative magnification, 167–168
Modulation transfer function, 663, 798
  of eye, 690–691
Monocular, 798
Myopia, 295
  instrument, 585, 699

Near point, 293, 798
Near point cap, 424–425, 798
Newtonian telescope, 377
Newton's equation, 76–78
  longitudinal magnification, 78
  transverse magnification, 78
Nodal points, 73, 765–766, 798
  measurement, 268
Nodal ray, 73–74
Nodal slide, 268
Numerical aperture, 212–214, 799
  and *F-number*, 212–214
  in prisms, 201–202
  and stop radius, 212–213
Nystagmus, 799

Objectives, 799
  in microscopes, 371
Object space, 21
Ophthalmic lenses, 14
  contact, 324
  intra-ocular, 149, 324
  spectacle, 317–324
Ophthalmoscopy, 219–220
  direct, 565–569
  indirect, 569–576
  indirect binocular, 575
Optical centre, 799
Optical distance, *see* Optical path length
Optical element, 799
Optical fibres, 434–443
  cladded, 438
  coherent, 440
  incoherent, 440
  numerical aperture, 435, 438, 439–440
  stepped index, 438
Optical instrument/system, 799
Optical invariant, 210–211, 608, 749–751
Optical path length (also optical distance), 11–12, 799
  and travel time, 14
Optical transfer function, 662–669
  derived criteria, 669
  diffraction limited, 666–667
  effect of aberrations and defocus, 667–669
  white light, 648
Optical tube length (also tube length), 359, 799
Optic disc, 293
Optometers, Badal, 577–583
Optometers, objective, 589–592
  Fincham coincidence optometer, 589–590
  photographic systems, 592
  retinoscopy, 590–592
Optometers, subjective, 586–589
  laser, 587–588
  longitudinal chromatic aberration of eye, 586
  Scheiner principle, 588
  simple perception of blur, 586
  split image/vernier alignment, 589

Paraxial approximation, 32
  of prism, 178–179
Paraxial marginal ray, 209–212, 800
Paraxial optics, 25, 799
  advanced, 749–772
  matrix representation, 41, 752–756, 769–770
Paraxial pupil ray, 209–212, 800
Paraxial reflection equation, 91
Paraxial refraction equation, 31–33, 47, 57–58, 59–62
Paraxial region, 33
Paraxial transfer equation, 36–37, 47–49
Periscopes, 429–430
Petzval surface/curvature, 107, 639
Phase transfer function, 663
Phoria (heterophoria), 183, 799
  esophoria, 796
  exophoria, 796
Photometers, 497–498
  Lummer–Brodhun, 497
  objective, 498
Photometry, 271–288
  absorption, 283
  of eye, 308–311
  illuminance, 275, 797
  image illuminance, 284–286
  luminance, 274–275, 798
  luminous flux, *see* Luminous flux
  luminous intensity, 273–274, 798
  reflectance, 282–283
  relation between photometric quantities, 276–279
  scatter, 283–284
  transmittance, 282–284
  units, 275–276
Photons, 6
Physical optics, 12, 798
Planck's constant, 6
Planes
  focal, 72
  principal, 56–57
Points
  cardinal, 72–74, 763–768, 794
  focal, 52, 72, 764–765, 797
  nodal, 73, 765–766, 798
  principal, 55, 73, 764–765
Point source acuity, 304
Point sources, 266
Point spread function, 98, 541–547, 653–662, 689–690, 799
  derived criteria, 659–660
  diffraction limited, 541
  effect of aberrations and defocus, 658–659
  of eye, 689–690
  half-width, 660
  white light, 648
Polarization, 5, 799
Ports (or windows), 220
Power
  equivalent, 53–55, 751–752, 799
  physical interpretation, 52
  of a surface, 33, 91, 799
  thick lens, 53–55, 59
  thin lens, 50–52, 59
  thin lens in air, 51
  units, 34
  vertex, 55–56, 75–76, 799
Presbyopia, 295, 297
Principal dispersion, 10
Principal points/planes, 55–57, 73, 764–765, 799
  positions, 57
Principle of reversibility, 14
Principle of superposition, 506
Prism dioptre, 179
Prisms
  aberrations, 201
  achromatic, 182–183
  angle of deviation, 175–177
  dispersion, 182–183
  image doubling/splitting with, 184–186
  minimum angle of deviation, 177
  power, 178–179
  reflecting-only, 193–201
  refracting and reflecting, 187–193
  refracting-only, 175–187
  thin, 178–179
  unfolding of, 175
  variable power, 180–181
Prism types
  Amici, 195
  corner cube (trihedral retro-reflector), 192
  double Dove, 193
  Dove, 187–190
  Dove with roof, 190
  Fresnel biprism, 184–186
  NAP, 190–192
  NAP unfolded, 192
  optical trombone, 200–201
  Pechan, 199–200
  penta, 196–198, 450
  penta unfolded, 196
  penta with roof, 197–198

© Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
978-0-521-47820-5 - The Eye and Visual Optical Instruments
George Smith and David A. Atchison
Index
More information

Porro, Type 1 and Type 2, 199
rhomboidal, 194
right-angle, 195
Risley, 180–181
Schmidt, 198
Progressive addition lenses, 147
Projectors, 477–486
aberrations, 485
aperture stop and pupils, 482–483
illumination system, 479–482
lens, 477–478
polarization effects, 485
screens, 483–485
system, 477
Pupil
auto-correlation of function of, 665
entrance, 208–209, 794
exit, 208–209, 794
exit, of eyepieces, 347
function, 654
telecentric, 215, 228, 230, 801
Pupil matching, 216–218
and binocular systems, 730–732
and microscopes, 704–709
and monocular systems, 368–369
Pupil of eye, 300–302
and age, 301
and centration, 302
entrance, 300
exit, 300
and light level, 300–301
Purkinje images, 88, 93, 293

Radiant flux, 272
Radiometry, 272
Radiuscope, 561–562
Radius of curvature measurement, 257–262
Drysdale method, 260
keratometry, 261–262, 562–563
radiuscope, 561–562
spherometer, 258–260
Rainbow, 8, 254
Ramsden eyepiece, 346
Rangefinders/rangefinding, 242, 447–451
binocular, 450–451
cameras (monocular), 448
monocular, 447–450
Ranging telescopes, 448
Ray, 10–12, 800
angle of deviation, 18
central, 98
effective pupil, 216
finite (real), 21, 27–31, 800
marginal, 31
meridional, 26, 800
nodal, 73–74
paraxial, 21, 25, 31
paraxial marginal, 209–212, 800
paraxial pupil, 209–212, 216, 800
skew, 26, 800
Rayleigh criterion, 661–662, 803
Rayleigh fourth order scatter law, 437
Ray tracing, finite, 27–31
Ray tracing, paraxial, 31–42, 47–49
with mirrors, 168
through toric surfaces, 141–143
using distances, 773–774
using vergences, 775
Real image, 22, 152, 800
Reference sphere, 624
Reference units, xii–xiii
Reflectance, 282–283
Reflecting telescopes, 376–378
Cassegrain, 378
Newtonian, 377
Reflection, 12, 14–19
Refracting telescopes, 375–376
Galilean, 376, 391–394
Keplerian, 376, 383–390
Refraction, 12, 14–19
Refractive errors, 295–300, 794
astigmatism, 297
axial, 298–299
population distribution, 297
refractive, 298–300
spherical, hypermetropia (hyperopia), 296
spherical, myopia, 295
spherical, presbyopia, 295, 297
Refractive index, 6–7, 800
absolute, 7
dispersion, 8–10
gradient, 10
of liquids, measurement, 256
of liquids used in liquid immersion methods, 251
relative, 7
sign on reflection, 88–89
of solids, measurement, 246–256
Relative luminous efficiency functions, 271–272
Relay lenses and system, 429–443
Resolution charts, 803–809
NBS chart (ISO Test Chart Number 2), 806
Sieman's star, 807
USAAF chart, 806–807
Resolution limit, 800
Resolving power, 670
of projection screens, 485
Reticule, *see* Graticule
Retina, 292–293, 800
Retinoscopy, 240, 590–592
Retro-reflection, 192, 484, 800
Reverse stereoscopic effect, 729–730
Rods, 292
Rotationally symmetric lenses, 131–140

Sagittal section, 104–105
Sagittal surface, 104, 106, 638–642
Scatter, 283
Scheimpflug photography, 472–473
Scheiner principle, 240–241, 588
Schematic eyes, 307–308, 777–792
Emsley reduced, 790–791
finite (wide angle), 308, 674
Gullstrand number 1, 778–783, 791–792
Gullstrand number 2 (simplified), 788–789, 791–792
Le Grand full theoretical, 784–785, 791–792
Le Grand simplified, 786–787, 791–792
paraxial, 307, 674
Secondary spectrum, 183, 616
Sections, sagittal and tangential, 104–105
Seidel aberrations, 101, 126, 602–606
of general lens system, 602–606
of thick parallel plate, 619
of thin lens, 606–612
Seidel aberrations, chromatic, 612–618
central, 613
effect of aperture stop shift, 614
non-central, 614
Seidel aberrations, monochromatic, 606–612
central, 607–611
effect of aperture stop shift, 611–612
effect of surface asphericity, 619–623
non-central, 611–612
Sellmeir's dispersion formula, 9
Sextant, 446
Shape factor of a thin lens, 134–135
Sign convention, 28
Simple magnifiers, 329–332
aberrations of, 355–356
binocular, 348, 352–355
bioculars, 329, 350–352, 355–356
depth-of-field, 703
equivalent viewing distance, 332, 334–335
field-of-view, 339–342
image vergence, 337–339
limits of magnification of, 348
and magnification, 328–331, 333–334
measurement of image vergence of, 343–344
nominal magnification of, 330
pupil imagery, 329
stereoscopic, 355
Sine condition, 127–128
Skew ray, 26, 798
Snell's law, 15–16
for a reflection, 87–88
Spectacle lenses, 317–324
aberrations of, 325
effect on eye pupil, 323
effect on working distance, 319
image luminance, 709
power, 317–319
Spectacle magnification, 317, 321–323, 337
Spectrometer, 246, 800
Specular surface, 801
perfect, 275
Spherical aberration, 102–103, 111–123, 801
of aspheric surface, 116–119
free surface, 119–123
higher order, 113
of plane surface, 114–116
primary, 113
of spherical surface, 112–114

© Cambridge University Press www.cambridge.org

CAMBRIDGE

Cambridge University Press
978-0-521-47820-5 - The Eye and Visual Optical Instruments
George Smith and David A. Atchison
Index
More information

Spherical lenses, 131–138
Spherometer, 258–260
Split image/vernier alignment, 239–240, 589–590
Spot diagram, 98, 656
Spurious resolution, 669, 801, 804
Star test, 109, 644, 656–657
Stereoscopes, 597
Stereoscopic acuity, 302
Stereoscopic magnification, 735–738
Stereoscopic magnifiers, 355
Stereoscopic systems, 728–730
Stigmatoscope, 294, 801
Stiles–Crawford effect, 308–311, 713
Strehl intensity ratio, 659–660
Surface curvature, *see* Radius of curvature
Surface power, 33, 91, 799
Superposition, principle of, 506
Symbols, signs and other conventions, xi–xiii
Synoptophore, 596–597, 734–735

Tangential section, 104–105
Tangential surface, 104, 106, 638–642
Teacup and saucer diagram, 106
Telecentric pupil, 215, 228, 230, 801
Tele-converter (Barlow lens), 459
Telephoto lens and ratio, 151, 801
Telescopes, 375–411, 801
  aberrations of, 407
  effect of refocussing, 396–401
  image luminance, 710–712
  photometric gain, 712
  power, 402
  specification of parameters, 402–403
  thick lens telescope, 394–395
  verification of parameters, 403–404
Telescopes, Galilean, 391–394
  aberrations of, 407
  field-of-view, 392–394
  pupils, 391–392
Telescopes, Keplerian (astronomical), 383–390
  aberrations, 407
  eye relief, 383
  field lenses, 385
  field-of-view, 386–388
  image erection, 388–390
  pupils, 383–385
Telescopes and magnification
  angular, 379–380
  limits, 380
  longitudinal, 382–383
  pupils (Galilean), 391–392
  pupils (Keplerian), 383–385
  transverse, 382
Telescope types
  auto-collimating, 405
  binoculars, 407
  dioptric, 404–405
  field expander, 407
  low vision aids, 406
  ranging, 448
  reflecting (Cassegrain), 376–378
  reflecting (Newtonian), 376–377
  refracting (Galilean), 375–376, 391–394
  refracting (Keplerian), 375–376, 383–390
  spectacle/contact lens, 406
Theodolite, 445
Thick lens, 53–59
  equivalent power, 53–55, 59
  principal points, 55
Thin lens, 50–51, 795
  focal lengths, 152
  power, 50–52, 59
  Seidel aberrations, 606–618
  shape factor, 134–135
Three component system, 59
Throw, 263, 801
Toric lenses, 140–147
  notation of, 144–145
Toroidal surfaces, 141–143
  paraxial ray tracing, 146–147
Total internal reflection, 18, 801
Translucent, 801
Transmittance, 282–284
Transparent, 801
Transverse aberrations, 623, 631–635, 801
Transverse electromagnetic radiation, 4, 801
Tropia (heterotropia), 183, 801
Tube length (also optical tube length), 359, 799
Two conjugate methods, 262–264
Two lens systems, 59
Twyman–Green interferometer, 517–521

Unfolding of a prism, 175

V-value (or Abbe *V*-value), 9
Variable power lenses, 147–148
Variable power prisms, 180–181
Veiling glare, 648–650
Vergence, 76, 801
  reduced, 76
Vernier acuity, 239, 304
Vertex distance, 318
Vertex focal lengths, 55, 74
  thin lens, 52
Vertex powers, 55–56, 75–76
  measurement by auto-collimation method, 265–266
  measurement by focimeter method, 266–267, 557–560
Vertometer, *see* Focimeter
Viewfinders
  cameras, 469–472
  reversed Galilean telescopes, 470
Vignetting, 205, 801
  simple magnifier, 339–342
Virtual image, 22, 153, 801
Virtual reality, 355
Visual acuity, 302–304, 801
  grating, 302
  letter or Snellen, 302–303
  point source, 304
  stereoscopic, 304
  vernier, 304
Visual acuity charts, 803–809
  Bailey-Lovie, 809
  Snellen, 808–809
Visual ergonomics of binocular and biocular systems, 727–745
  aberration tolerances, 743–744
  accommodation and convergence, 732–735
  binocular convergence in telescopes, 739–740
  convergence of binocular tubes, 730
  instrument focussing, 730
  inter-pupillary distances and pupil matching, 730–732
  non-stereoscopic constructions, 727–728
  optical tolerances, 740–743
  stereoscopic constructions, 728–730
  stereoscopic magnification, 735–738
  visual performance, 740
Visual ergonomics of monocular systems, 697–725
  aberration tolerances, 719–720
  depth-of-field, 701–704
  empty magnification, 717
  field-of-view, 700
  image luminance, 709–713
  instrument accommodation, 699
  instrument focussing, 697–700
  magnification limits, 716–718
  Maxwellian view, 720–722
  pupil matching, 704–709
  visual performance, 713–716
Visual space, 802

Wave aberration, 99–100, 110–116, 624–638
  function, 624–631, 650–653, 802
  and Maréchal criterion, 651–652
  polynomial, 626–630, 802
  variance of, 650–651
Wavefront, 10, 802
Wave guides, 18
Wavelength, 5, 7
Wavelengths, reference, xi
White light interferometer, 522–523
Windows (or ports), 220
Working distance, 802

Young's double slit interferometer, 514–517

© Cambridge University Press www.cambridge.org