

Contents

Tables, xxiii

1 On Infrared: Its History, Nature, and Application 1

2 Techniques of Infrared Photography 8

Materials and Equipment, 9

Infrared Films and Plates, 9

Camera and Equipment, 16

Lenses and Focusing, 20

Filters, 23

Light Sources, 27

Lighting Methods, 30

Daylight Photography, 30

Indoor Photography, 33

Specialized Techniques, 42

Infrared Luminescence Recording, 42

Masking Procedures, 46

Increasing Contrast Photographically, 49

Photomacrography, 51

Photography in the Dark, 53

Unique Renditions, 54

3 Basic Physics of Infrared Recording	57
Lenses and Mirrors, 57	
<i>Current Practice</i> , 59	
<i>Mirror Systems</i> , 60	
Filters, 61	
<i>Characteristics</i> , 62	
<i>Classification</i> , 63	
<i>Construction</i> , 64	
Films and Plates, 66	
<i>Definition Factors</i> , 67	
<i>Sensitometric Properties</i> , 72	
<i>Exposure Latitude</i> , 73	
<i>Spectral Sensitivity</i> , 76	
<i>Infrared Sensitizing</i> , 79	
Sources of Infrared, 83	
<i>Sunlight</i> , 83	
<i>Artificial Irradiation</i> , 90	
Subject Reflection, Transmission, Emission, 96	
<i>Natural Subjects</i> , 97	
<i>Man-made Materials</i> , 103	
<i>Camouflage</i> , 103	
<i>Laboratory Subjects</i> , 109	
The Atmosphere, 114	
<i>Haze</i> , 116	
<i>Fog</i> , 122	
<i>Thermal Transmission</i> , 124	
4 Documents, Artifacts, Art, Textiles, Graphic Arts	126
Illegible Documents and Inscriptions, 127	
<i>Representative Applications</i> , 127	
Artifacts, 136	
<i>Forensic Objects</i> , 136	

Museum Items, 140
Old Photographs and Engravings, 143

Paintings, 144

Experimental Methods, 148
Use of Masking, 153
Infrared Color Photography, 153

Textiles, 154

Dye Renditions, 155

Graphic Arts, 158

Color Separations, 158
Correcting Masks, 160

Infrared Luminescence, 163

Documents, 163
Artifacts, 165
Paintings, 165

5 Medical Infrared Photography

166

Infrared Biophysics, 166

Transmission and Absorption by Tissues, 167
Photographic Penetration, 174
Blood Studies, 176
Melanin Characteristics, 179

Technical Factors, 182

Selective References, 182
Establishing Norms, 183

Basic Clinical Applications, 185

Recording Veins, 185

Specialized Fields, 191

Transilluminography, 191
Liver Pathology, 193
Varicose Veins and Ulcers, 195
Tumor Study, 197

Dermatology, 202
Dentistry, 204
Ophthalmology, 205

Laboratory Techniques, 210

Photographing Gross Specimens, 211
Improvising a Nitrogen Tent, 213

Biological Thermography, 215

Historical Background, 218
Applications, 220
Use of Liquid Crystals, 222
Sources of Information, 223

6 Investigations in the Natural Sciences

226

Botanical Applications, 226

Spectral Reflectivity and Absorption, 227
Infrared Reflectance of Leaves, 231
Infrared Luminescence Effects, 237

Plant Pathology, 241

Ground Photography of Foliage, 242
Laboratory Projects, 243

General Paleontology, 249

Luminescence of Fossils, 253

Zoological Applications, 253

Photography in Darkness, 255
Luminography, 261
Other Animal Studies, 261

7 Infrared Photomicrography

262

Basic Techniques, 264

Lamps and Filtering, 266
Exposure, 268

Emission Photomicrography, 269
Cinephotomicrography, 269

Focusing, 270

Applications, 273

In Biology, 274

In Anatomy and Morphology, 277

Infrared Color Photomicrography, 282

Indirect Photomicrography, 283

In Textile Industry, 283

Documents and Artifacts, 286

8 Technical Applications

287

Long-Distance Photography, 287

Haze and Fog, 287

Photographic Surveys, 290

Long-Distance Cameras, 293

Infrared Rainbows, 293

Illustrative Renditions, 294

Scenes and Buildings, 296

Color Effects, 296

Phototechnical Methods, 297

For Dramatic Effects, 297

Photoflash Uses, 298

In Archeology, 300

For Diamonds and Pearls, 300

Heat and Herschel Effects, 301

Color Photography, 302

Photography in the Dark, 303

Typical Applications, 306

Motion Picture Industry, 309

Traveling Mattes, 309

Special-Effects Filming, 310

Other Uses of Infrared, 311

Industrial Applications, 312

- Infrared Recording Ranges, 312*
- Photographing Hot Objects, 313*
- Calibration Methods, 315*
- Representative Subjects, 316*

Practical Testing and Research, 319

- Measurement of Infrared, 319*
- Photography of Scattering, 321*
- Quality Control Experiments, 322*

Infrared Spectroscopy, 323

- Historical Background, 325*
- Equipment, 326*
- Photographic Methods, 327*

Astronomical Photography, 330

- Stars, 330*
- Nebulae, 333*
- Solar System, 333*

9 Remote Sensing, Aerial and Orbital**336****Systems, 337**

- Nomenclature, 337*
- Conventional Photography, 338*
- Infrared Photography, 338*
- Infrared Sensing, 339*
- Microwave Sensing, 339*
- Multispectral Photography, 339*
- Multiband Sensing, 339*
- Spectrazonal Photography, 339*
- Television Sensing, 340*
- Purposes, 340*

Equipment, 340

- Aerial Cameras, 340*
- Thermal Scanners, 344*
- Multispectral Scanners, 345*
- Electro-optical Radiometers, 345*

- Microwave Radiometers*, 345
- Radar Apparatus*, 346
- Television Cameras*, 346
- Data Processing, 347
 - Image Manipulations*, 347
- Platforms, 348
 - Balloons*, 349
 - Aircraft*, 351
 - Rockets*, 352
 - Spacecraft*, 353
 - Extraterrestrial Platforms*, 356
- Sources of General Information, 357
 - Books*, 357
 - Reports, Symposia*, 358
 - Bibliographies, Lists*, 358
 - Papers*, 359
- Technical Factors, 361
 - Aerial Photography*, 361
 - Selecting Cameras*, 362
 - Light Conditions, Exposure*, 364
 - Indirect Sensing Factors*, 367
 - Scale*, 368
 - Interpretation Signatures*, 368
 - Forestry*, 370
 - Geology*, 374
 - Other Fields*, 376
 - High Altitude Images*, 377
 - Extracting Information*, 378
- Special Infrared Photographic Techniques, 380
 - Modified Infrared Photography*, 380
 - Multispectral Photography*, 380
 - Spectrazonal Photography*, 383
 - Infrared Color Photography*, 383
- Applications, 386
 - Land Resources*, 387
 - Geomorphology*, 388

<i>Geology</i> , 390	
<i>Natural Vegetation</i> , 392	
<i>Cultivated Vegetation</i> , 400	
<i>Livestock, Range Animals</i> , 408	
<i>Water Resources</i> , 409	
<i>Hydrology</i> , 410	
<i>Oceanography</i> , 412	
<i>Meteorology</i> , 413	
<i>The Environment</i> , 414	
<i>Planetary Research</i> , 421	
<i>Archaeological Research</i> , 421	
10 Herschel Effect and Indirect Recording	426
Herschel Effect, 426	
<i>Applications</i> , 428	
Phosphorography, 429	
<i>Photographic Recording</i> , 430	
Evaporography, 433	
<i>Imaging Apparatus</i> , 434	
Use of Image Tubes, 437	
<i>Image Amplification</i> , 437	
<i>Applications</i> , 438	
Thermography, 438	
<i>Detectors</i> , 438	
<i>Equipment</i> , 439	
<i>Industrial Applications</i> , 441	
<i>Liquid Crystals</i> , 444	
References	447
Index	531