

CONTENTS

| | Page |
|---|------|
| 1 Introduction | 1 |
| 1.1 Classification of Colorants | 1 |
| 1.2 History of Dyes and Pigments | 4 |
| 1.3 Production of Colorants | 8 |
| 2 Color of Organic Compounds | 11 |
| 2.1 Basic Concepts of Color | 11 |
| 2.2 Empirical Correlations between the Chemical Structures of Colorants and their Color | 14 |
| 2.3 Quantum Chemical Methods for the Description of Light Absorption by Organic Compounds | 16 |
| 2.4 Fluorescence and Phosphorescence | 24 |
| 2.5 Examples for the Quantitative Treatment of Light Absorption by Dyes | 27 |
| 2.6 Influence of the Position of Substituents on the Spectra of Aromatic Compounds | 37 |
| 2.7 Colorimetry and Color Vision | 40 |
| 3 Polyene and Polymethine Dyes | 51 |
| 3.1 Introduction | 51 |
| 3.2 Carotenoid dyes | 52 |
| 3.3 Structure of Polymethine Dyes | 56 |
| 3.4 Technical Methods of Preparation of Polymethine Dyes | 65 |
| 4 Di-and Triarylmethine Dyes and their Aza Analogues | 71 |
| 4.1 Structures of Simple Di-and Triarylmethine Dyes | 71 |
| 4.2 Synthetic Principles for Di-and Triarylmethine Dyes | 74 |
| 4.3 Heteroatom-bridges Di-and Triarylmethine Dyes | 78 |
| 4.4 Aza Analogues of Diarylmethine Dyes | 80 |
| 5 Aza[18]annulenes | 87 |
| 5.1 Structures of Natural Dyes of the Aza[18]-annulene Type | 87 |
| 5.2 Structural Properties of Phthalocyanine Colorants | 98 |
| 5.3 Principles of Preparation | 101 |
| 5.4 Applications of Aza[18]annulenes in Coloration | 104 |
| 6 Nitro and Nitroso Dyes | 107 |
| 7 Azo Dyes and Pigments | 109 |
| 7.1 Nomenclature of Azo Dyes | 109 |
| 7.2 Diazotization of Aromatic and Heteroaromatic Amines and Equilibria of the Diazo Component | 110 |
| 7.3 Azo Coupling Reactions | 117 |
| 7.4 Other Methods for the Synthesis of Aromatic Azo Compounds | 127 |
| 7.5 Some Properties of Azo Compounds | 130 |
| 7.6 Anionic Monoazo Dyes | 137 |
| 7.7 Disperse Azo Dyes | 139 |
| 7.8 Azoic dyes | 143 |
| 7.9 Cationic Azo Dyes | 145 |
| 7.10 Complex-forming Monoazo Dyes | 149 |
| 7.11 Stereochemistry of Metal Complexes of Azo Dyes | 160 |
| 7.12 Direct Dyes | 163 |
| 7.13 Reactive Azo Dyes | 167 |
| 7.14 Azo Pigments | 180 |

| | | |
|-------|--|-----|
| 8 | Carbonyl Dyes and Pigments | 187 |
| 8.1 | General Remarks | 187 |
| 8.2 | The Quinone-Hydroquinone Redox System | 188 |
| 8.3 | Indigo and its Derivatives | 191 |
| 8.4 | Introduction of Substituents into Anthraquinone | 199 |
| 8.5 | Color and Structure of Substituted Anthraquinones | 209 |
| 8.6 | Ionic Anthraquinone Dyes | 211 |
| 8.7 | Substituted Anthraquinones as Disperse Dyes | 213 |
| 8.8 | Substituted Anthraquinones as Vat Dyes | 215 |
| 8.9 | Higher Anellated Vat Dyes | 216 |
| 8.10 | Application of Vat Dyes | 232 |
| 8.11 | Leuco Sulfuric Ester Dyes | 235 |
| 8.12 | Carbonyl Pigments | 236 |
| 8.13 | Other Carbonyl Dyes | 246 |
| 9 | Sulfur Dyes | 249 |
| 9.1 | Classification and Structures of Sulfur Dyes | 249 |
| 9.2 | Technical Production of Sulfur dyes | 251 |
| 10 | Fluorescent Brighteners | 255 |
| 10.1 | Optical Principles concerning the Effect of Fluorescent compounds | 255 |
| 10.2 | Major Chemical Types of Fluorescent Brighteners | 257 |
| 10.3 | Synthetic Methods in the Chemistry of Fluorescent Brighteners | 261 |
| 11 | Application of Dyes | 267 |
| 11.1 | Technology of Dye Applications | 267 |
| 11.2 | Introduction to the Physical Chemistry of Dyeing Mechanisms | 268 |
| 11.3 | The Dyeing System in Equilibrium | 274 |
| 11.4 | Kinetics of Dyeing | 282 |
| 11.5 | Dye Aggregation | 288 |
| 12 | Application of Organic Pigments | 293 |
| 12.1 | Introduction | 293 |
| 12.2 | Physical Conditioning of Pigments | 296 |
| 12.3 | Application Methods for Pigments | 298 |
| 13 | Photo-, Thermo- and electrochemical Reactions of Colorants | 301 |
| 13.1 | Introduction | 301 |
| 13.2 | Photochemistry of Dyes in Solution | 302 |
| 13.3 | Photochemical Products of Colored Polymers | 309 |
| 13.4 | Chemical and Physical Factors Affecting the lightfastness of Colored Polymers | 311 |
| 13.5 | Photochemical Degradation of Fluorescent Brighteners | 319 |
| 13.6 | Photosensitized Degradation and Stabilization of Polymers by Dyes and Pigments | 321 |
| 13.7 | Photo- and Thermochromism | 324 |
| 13.8 | Chemiluminescence | 333 |
| 13.9 | Electrochromism, Electrochromism and Photoelectrophoresis | 337 |
| 13.10 | Dyes in Solar Energy Conversion | 339 |
| 13.11 | Dye Lasers | 347 |
| 13.12 | Colorants as Conductors and Catalysts in other than Photochemical Applications | 353 |
| 14 | Colorants for Imaging and Data Recording Systems | 361 |
| 14.1 | Spectral Sensitizing Dyes for Silver Halide Photography | 361 |
| 14.2 | Dyes in Classical Color Photography | 363 |
| 14.3 | Dye Transfer Photography | 368 |
| 14.4 | Azo Imaging Systems | 371 |
| 14.5 | Electrophotography | 373 |
| 14.6 | Dichroic Dyes for Liquid Crystal Displays | 375 |
| 14.7 | Dyes for Optical Data Disks | 379 |
| 14.8 | Other Imaging and Data Recording Systems | 383 |

| | | |
|------|---|-----|
| 14.9 | Color Formers for Carbonless Copy Paper | 393 |
| 15 | Dyes in Biochemistry, Biology, Medicine, and Analytical Chemistry | 397 |
| 15.1 | Introduction | 397 |
| 15.2 | Biological Staining | 398 |
| 15.3 | Fluorescent Stains | 402 |
| 15.4 | Dyes for Affinity Chromatography | 404 |
| 15.5 | Dyes as Titration Indicators in Analytical Chemistry | 407 |
| 15.6 | Chromo- and Fluoroionophores | 410 |
| 15.7 | Solvatochromic Dyes for Solvent Characterization | 413 |
| 15.8 | Color-Specific Application of Colorants for Therapeutic Purposes | 416 |
| 16 | Ecology and Toxicology of Colorants | 421 |
| 16.1 | Analysis and Purification of Colorants | 421 |
| 16.1 | Environmental Assessment of Colorants | 423 |
| 16.2 | Toxicology of Colorants | 425 |
| 16.3 | Food Colors | 427 |
| | References | 433 |
| | Index | 477 |