



11812456  
INSTITUT  
FÜR METEOROLOGIE U. KLIMATOLOGIE  
UNIVERSITÄT HANNOVER  
HERRENHAUSER STR. 2 • 3000 HANNOVER 21



---

**Biological Effects of Ultraviolet Radiation  
with Emphasis on Human Responses to  
Longwave Ultraviolet**

---

**JOHN A. PARRISH, M.D.**

and

**R. ROX ANDERSON**

*Harvard Medical School*

**FREDERICK URBACH, M.D.**

*Skin and Cancer Hospital  
Temple University School of Medicine*

and

**DONALD PITTS, O.D., Ph.D.**

*College of Optometry  
University of Houston*

**PLENUM PRESS • NEW YORK AND LONDON**

# Contents

<i>Chapter 1</i>	THE SPECTRUM OF ELECTROMAGNETIC RADIATION: UV-A IN PERSPECTIVE .....	1
<i>Chapter 2</i>	SOURCES OF UV-A.....	7
	Introduction .....	7
	Solar Ultraviolet Radiation.....	9
	Summary.....	14
	Artificial Sources of UV-A .....	15
	Ultraviolet Spectral Transmission and Reflection of Common Materials .....	26
	References .....	34
<i>Chapter 3</i>	RADIOMETRY OF ULTRAVIOLET RADIATION .....	37
	Introduction and General Considerations of Radiometry....	37
	Detectors.....	42
	Spectral Filters and Input Optics .....	48
	Appendix: U.S. Manufacturers of UV-Related Instrumentation .....	55
<i>Chapter 4</i>	OPTICAL PROPERTIES OF THE SKIN AND EYES .....	59
	Introduction .....	59
	Structure of the Skin .....	59
	Factors Affecting Penetration and Absorption of Ultraviolet Radiation in the Skin.....	62
	Measurements of the Penetration and Reflection of Optical Radiation in Skin .....	65
	Ultraviolet Optics for the Eye .....	77
	References .....	81

<i>Chapter 5</i>	EFFECTS OF ULTRAVIOLET RADIATION ON MICRO-ORGANISMS AND ANIMAL CELLS .....	85
	Introduction .....	85
	Effect of Ultraviolet on Cells .....	88
	DNA Repair .....	89
	Effects of UV-A .....	95
	Summary .....	101
	References .....	101
<i>Chapter 6</i>	IMMEDIATE AND SHORT-TERM BIOLOGIC EFFECTS OF ULTRAVIOLET RADIATION ON NORMAL SKIN....	107
	Introduction .....	107
	Erythema.....	109
	Histology .....	124
	UV and Epidermal Macromolecular Synthesis .....	126
	Effects of UV-A on Mucous Membrane .....	128
	Tanning .....	128
	References .....	134
<i>Chapter 7</i>	ADVERSE CUTANEOUS REACTIONS TO UV-A .....	141
	Introduction .....	141
	Chemical Photosensitivity.....	141
	Persistent Light Reactivity .....	149
	Actinic Reticuloid .....	149
	Polymorphous Light Eruption .....	150
	Solar Urticaria .....	150
	Porphyrias and Other Endogenous Photosensitization Syndromes.....	150
	Melasma and Ephelides .....	151
	Management of UV-A-Induced Dermatoses .....	151
	References .....	153
<i>Chapter 8</i>	SKIN AGING AND CARCINOGENESIS DUE TO ULTRAVIOLET RADIATION .....	157
	Introduction .....	157
	Incidence of Skin Cancers in Man .....	158
	Epidemiologic Evidence Supporting the Role of Sunlight ..	159
	Mechanisms of UV Carcinogenesis .....	165
	Action Spectrum of Animal Photocarcinogenesis and the Carcinogenic Effects of UV-A .....	166

Other Factors Influencing or Associated with Development of Skin Cancer .....	168
Ultraviolet Radiation and Aging .....	171
References .....	172
<i>Chapter 9</i> EFFECTS OF ULTRAVIOLET RADIATION ON THE EYE	177
Introduction .....	177
Morphology and Histology of the Cornea and the Lens....	179
Histologic Effects of Ultraviolet Radiation .....	185
Action Spectrum of Ocular Effects of Ultraviolet Radiation.....	188
Corneal and Lenticular Effects of Longwave Ultraviolet Radiation.....	193
Effects of UV-A in the Retina.....	211
The Ocular Effects of UV-A Exposure in the Presence of Photosensitizing Compounds (Psoralens).....	212
Summary: UV-A Exposure of the Eye.....	214
References .....	215
<i>Chapter 10</i> USES OF UV-A INVOLVING EXPOSURE OF HUMANS	221
Introduction .....	221
Therapeutic Uses of Ultraviolet Radiation.....	221
Ultraviolet Treatment of Psoriasis .....	222
Photochemotherapy .....	225
Oral Psoralen Photochemotherapy .....	225
UV-A-Activated Polymerization of Resinous Dental Restorations .....	233
Diagnostic Uses of UV-A.....	234
References .....	235
<i>Chapter 11</i> SAFETY MEASURES AND PROTECTION AGAINST ULTRAVIOLET EXPOSURE .....	241
Introduction .....	241
Ultraviolet Exposure Safety Standards .....	242
Sunscreens.....	248
Eye Protection against Ultraviolet Radiation.....	252
References .....	254
INDEX .....	257