

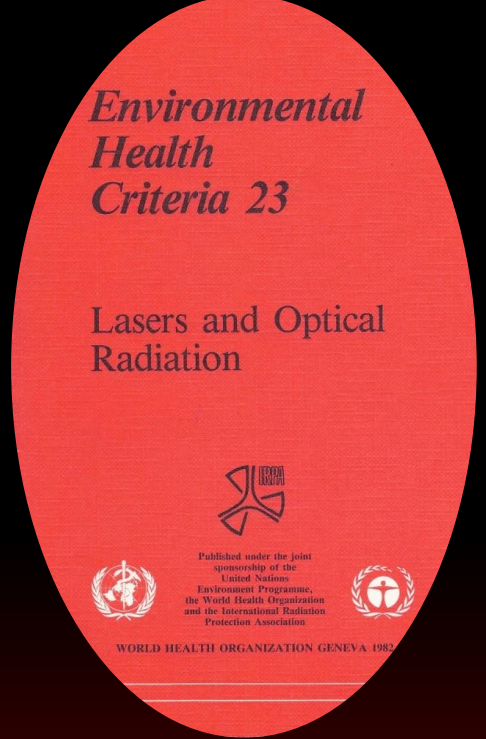
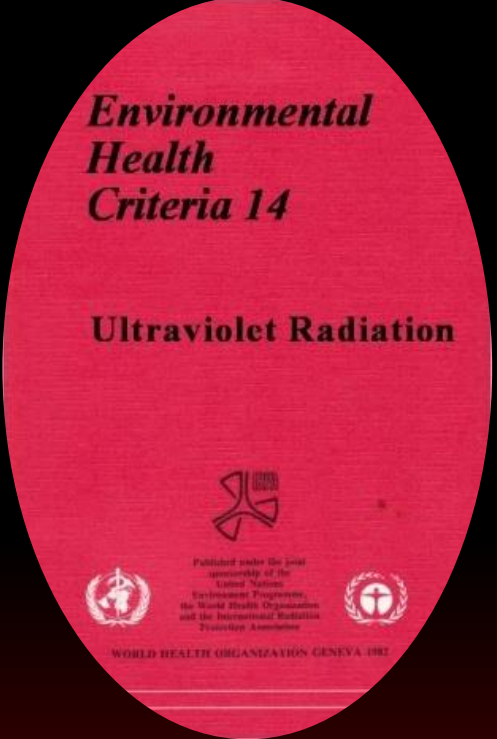
Ultraviolet Radiation & The Eye



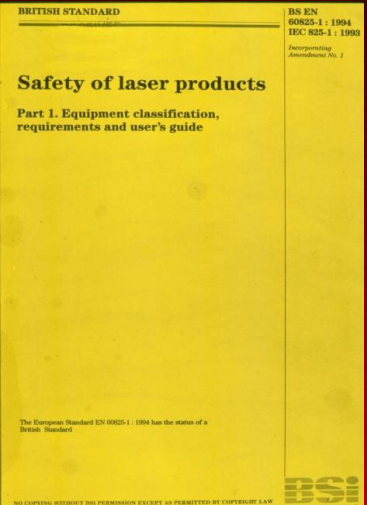
National Institute for Health and Care Excellence
London 22nd July 2014



David Sliney



- British Standards Institution (BSI)**
- National Radiological Protection Board (NRPB)**
- European Community Non Ionising Radiation Advisory Group (EC)**
- International Electro-Technical Commission (IEC)**
- International Committee of the Red Cross (ICRC)**
- International Standards Organization Light Hazards Task Group (ISO)**
- Non-ionizing Radiation Committee of the International Radiological Protection Association**
- United Nations Environmental Programme**
- World Health Organisation (WHO)**



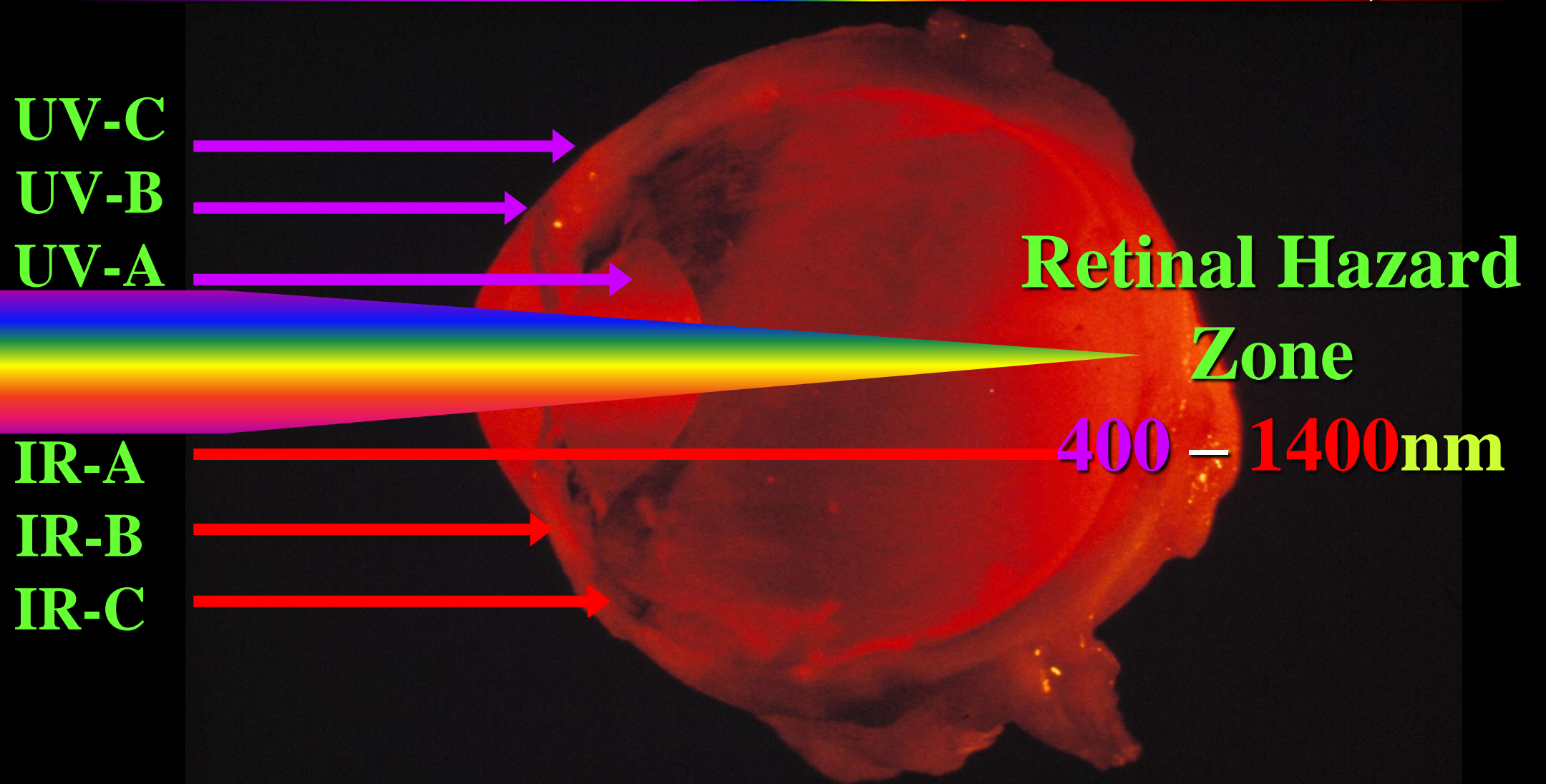
Time (mins) to Exceed UV Exposure Limit (8hr Day)

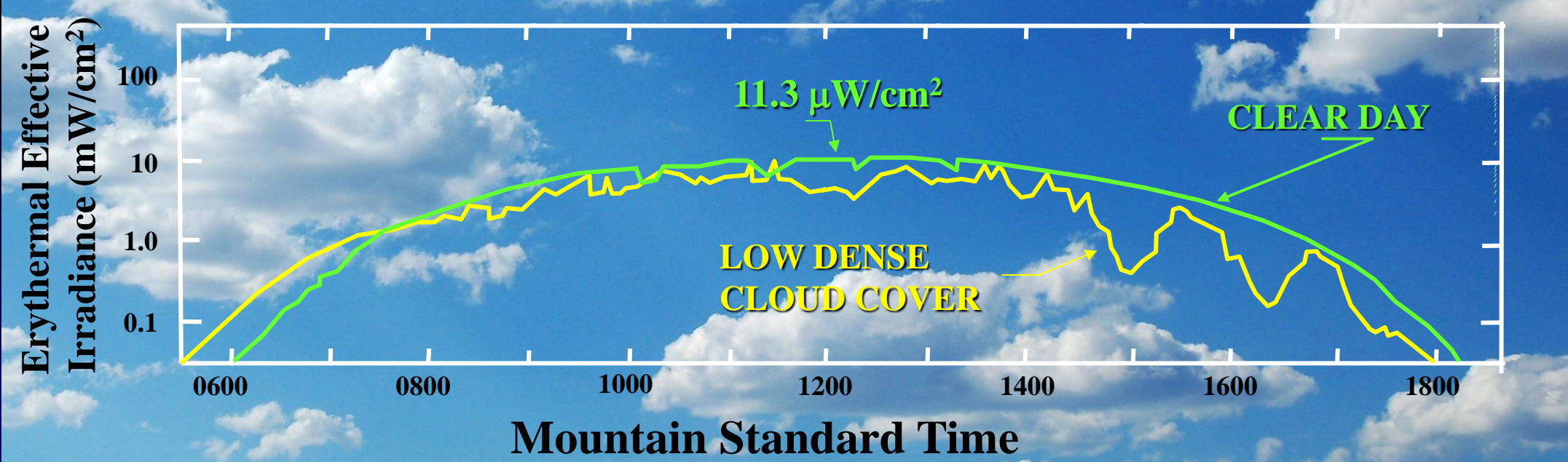
City	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Oslo 60°	>8h	209	99	39	28	20	22	31	67	174	417	>8h
London 50°	174	95	39	25	18	14	15	20	27	74	139	260
Mallorca 40°	74	34	22	15	14	12	12	13	17	29	63	99
Tucson 20°	26	19	13	12	11	10	10	11	11	18	25	37

International Commission on Non Ionising Radiation Protection (ICNIRP 1999)

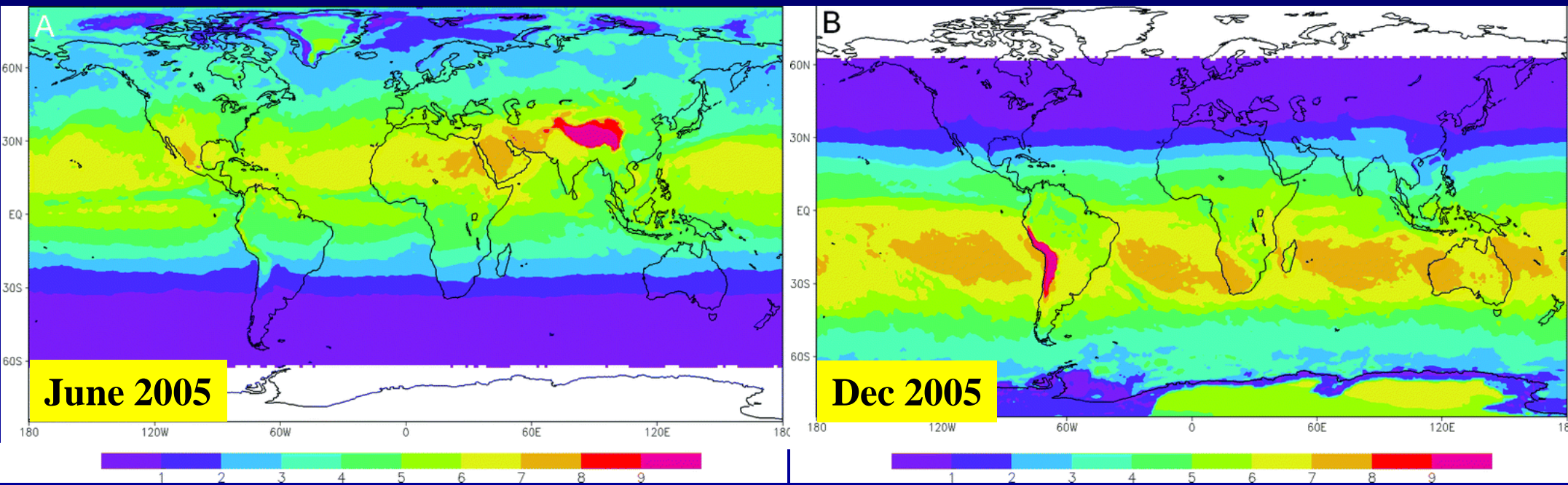
UV C UV B UV A IR A IR B IR C

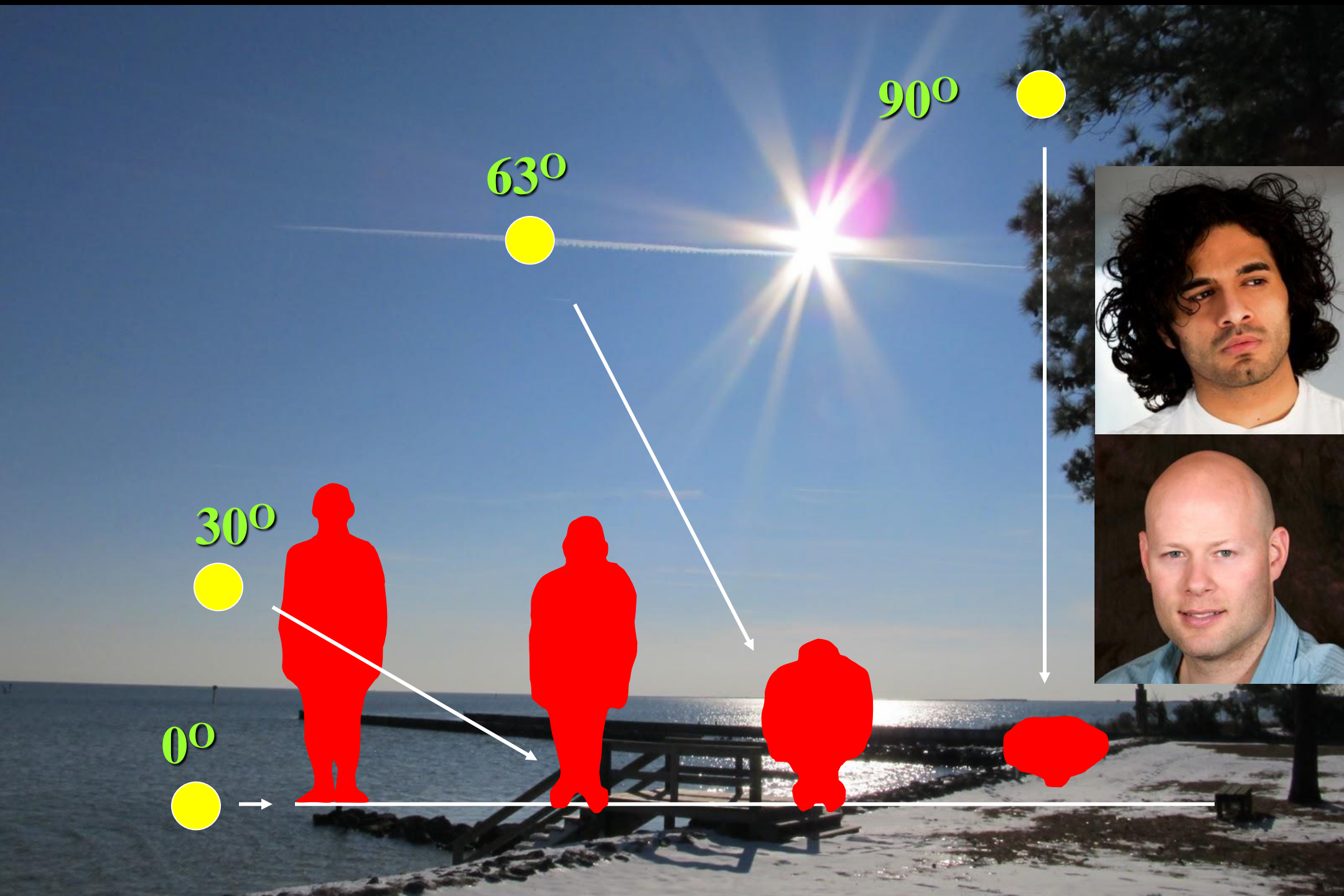
100	280	315		780	1400	3000
280	315	400		1400	3000	10,000





Global distribution of the average cloud-corrected erythemal daily dose (in kJ m^{-2})





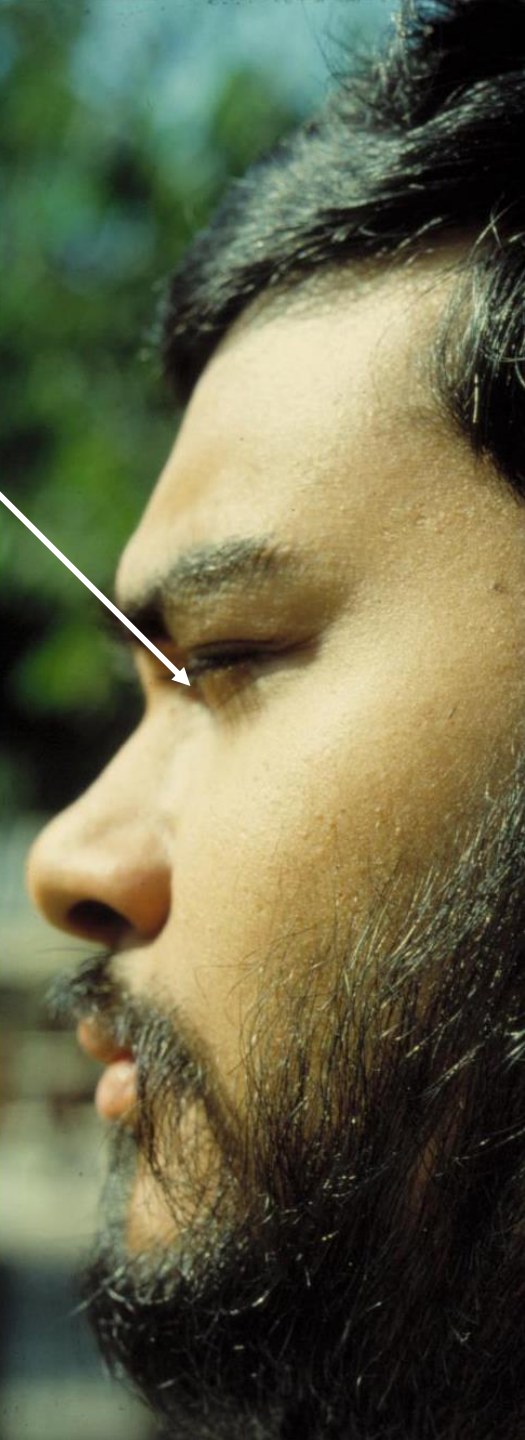
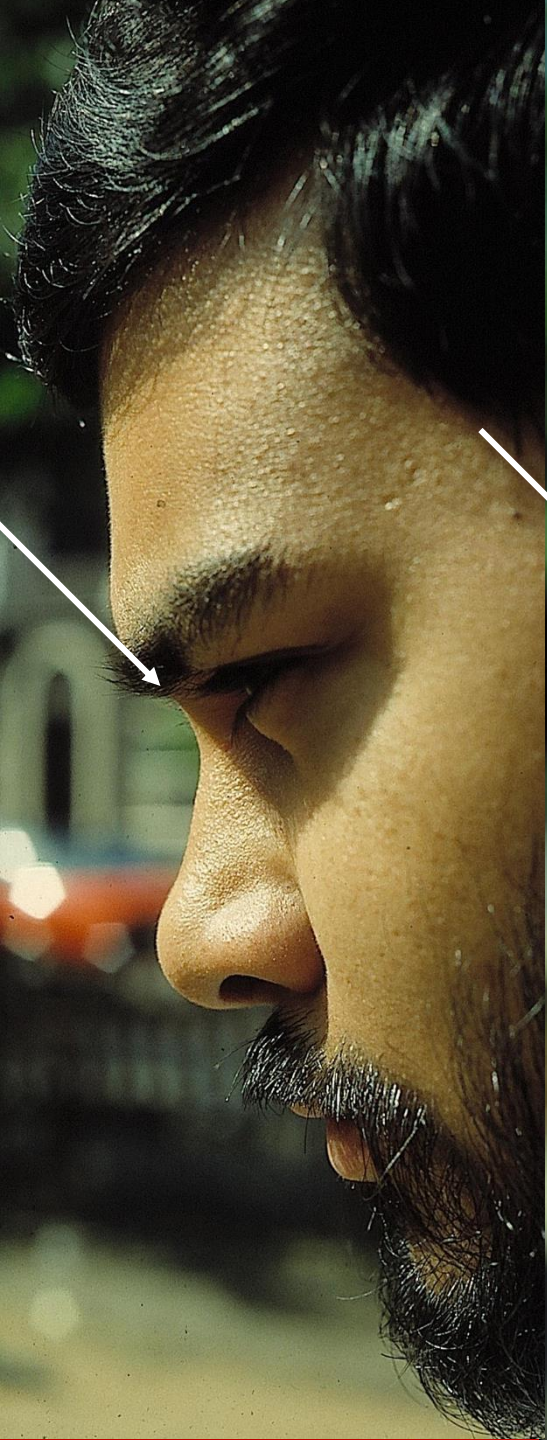
90°

63°

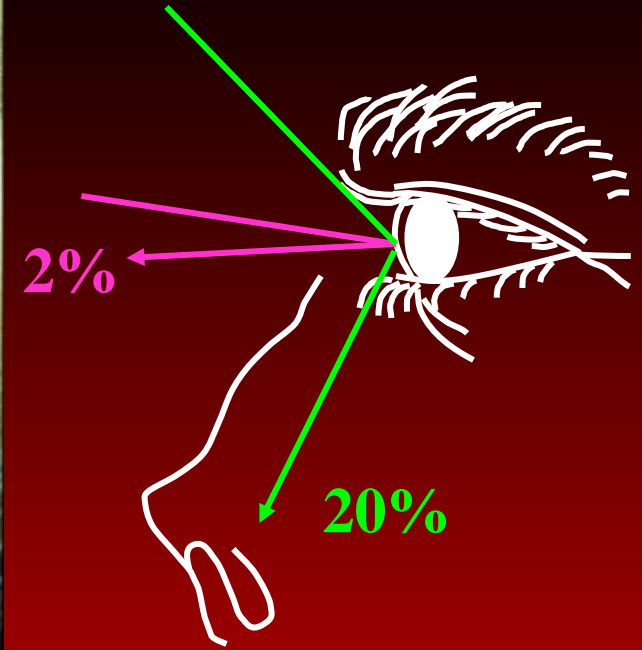
30°

0°

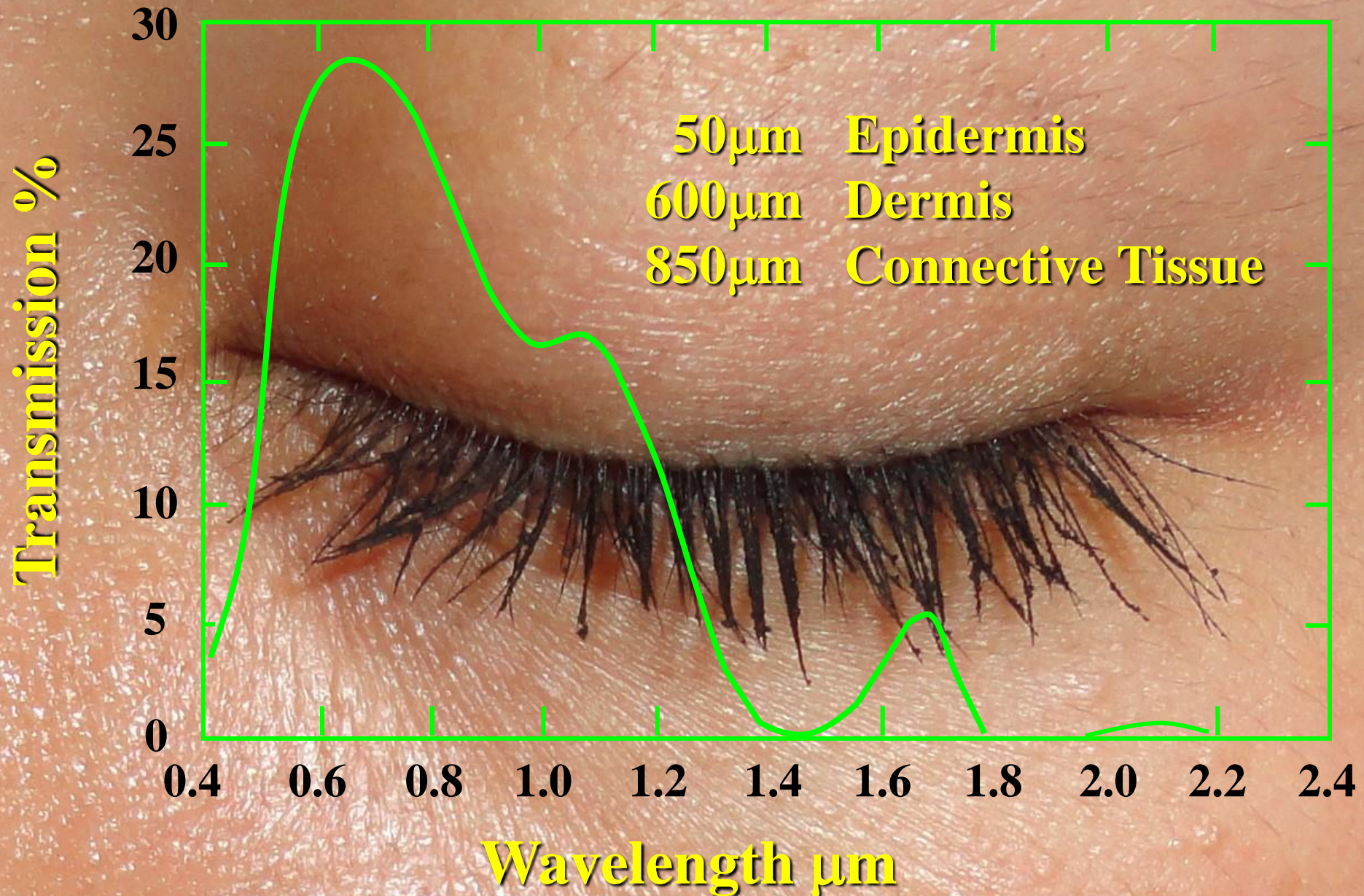


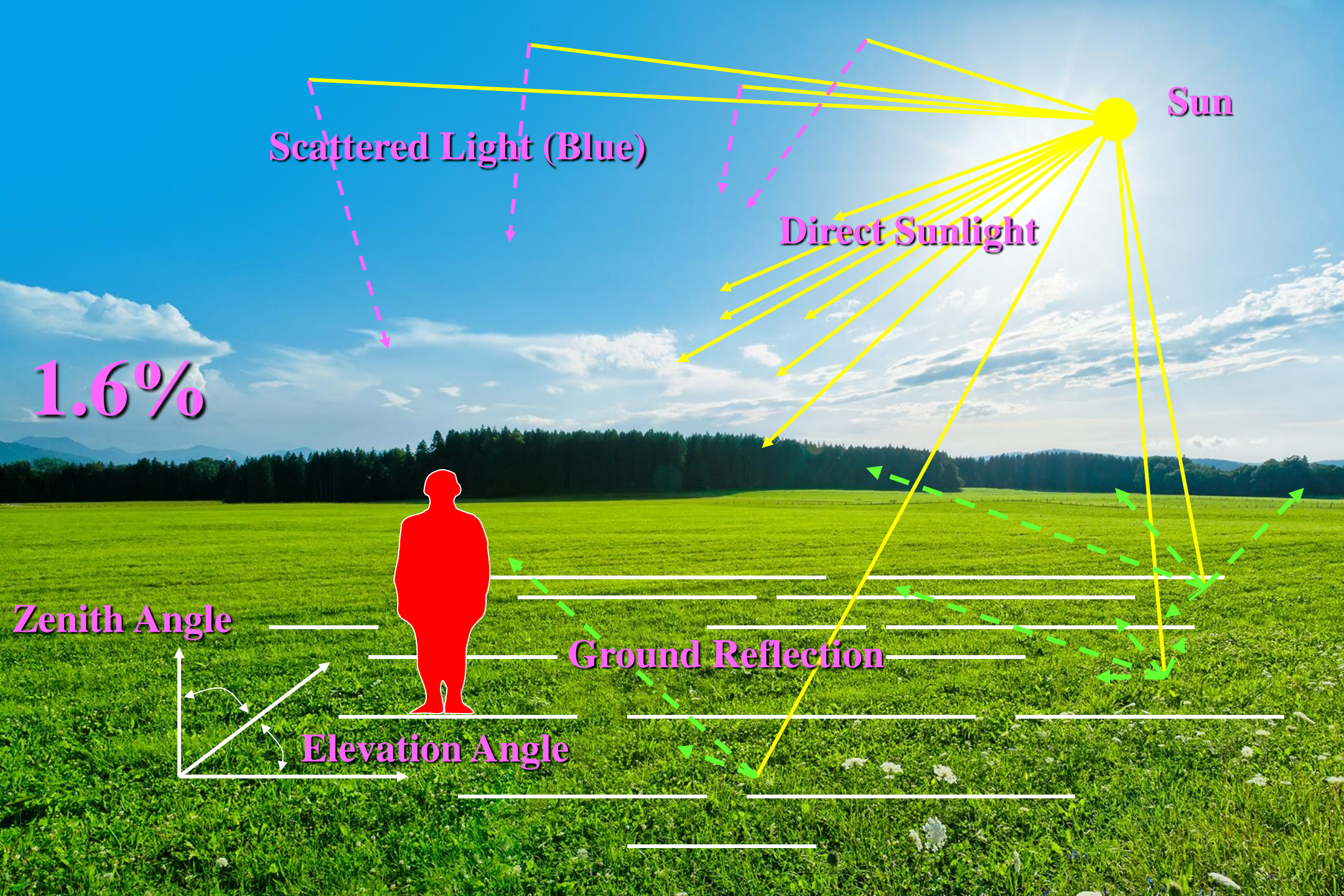


Reflection of UV



TRANSMISSION THROUGH EYELIDS





Sun

Scattered Light (Blue)

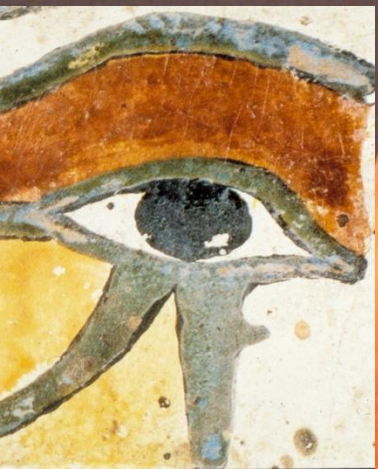
Direct Sunlight

1.6%

Ground Reflection

Zenith Angle

Elevation Angle









UVC

100 nm – 280 nm

Acute

Photoconjunctivitis
Photokeratitis

Chronic

?

UVB

280 nm – 315 nm

Acute

Photoconjunctivitis
Photokeratitis

Chronic

Arcus senilis
Pterygium
Droplet keratopathy
Pinguecula
Cataract

UVA

315 nm – 400 nm

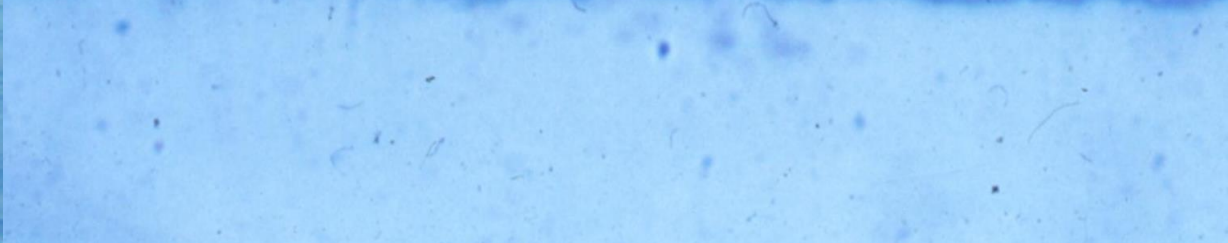
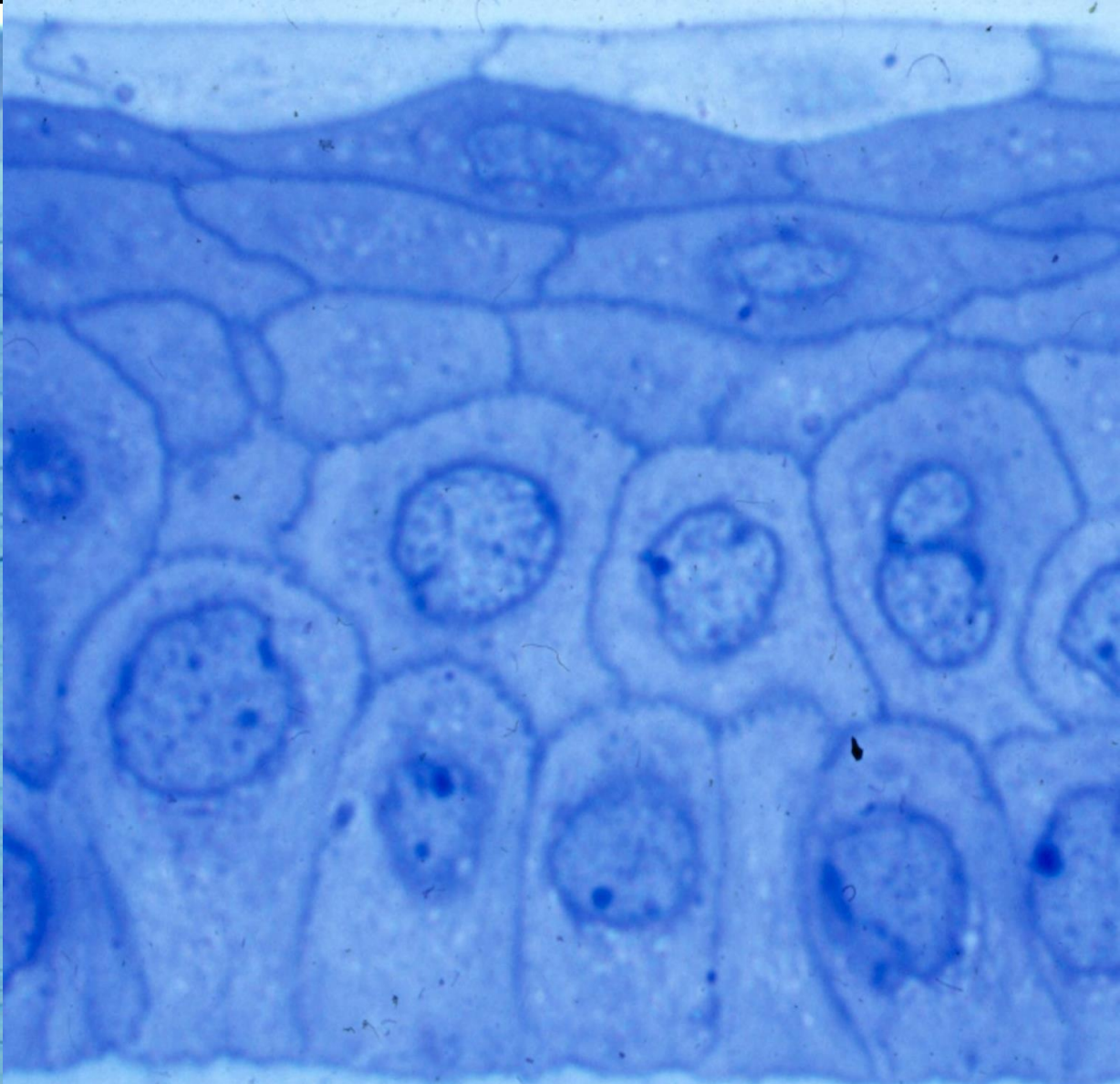
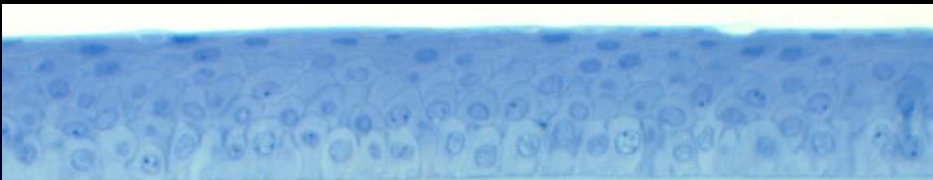
Acute

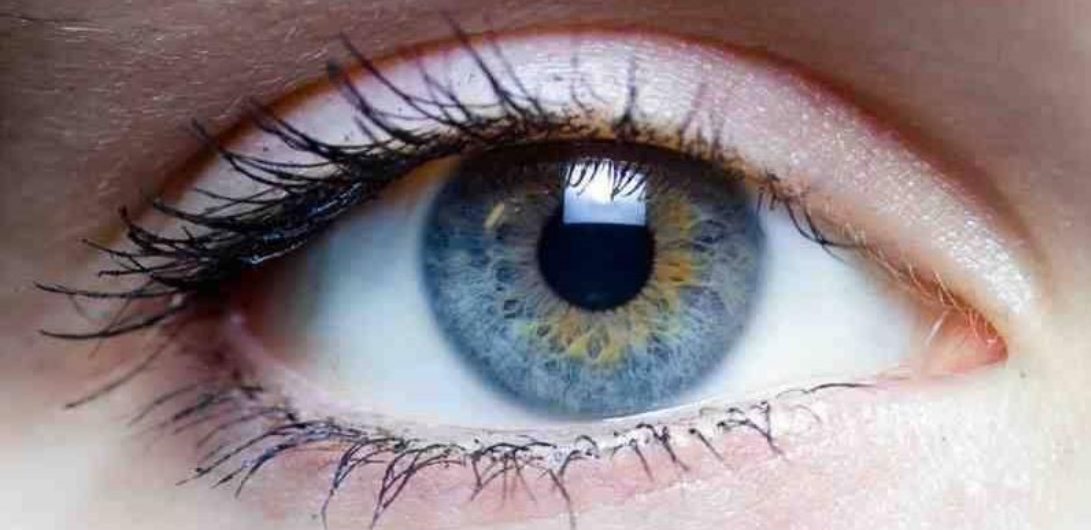
?

Chronic

Lens
Yellowing



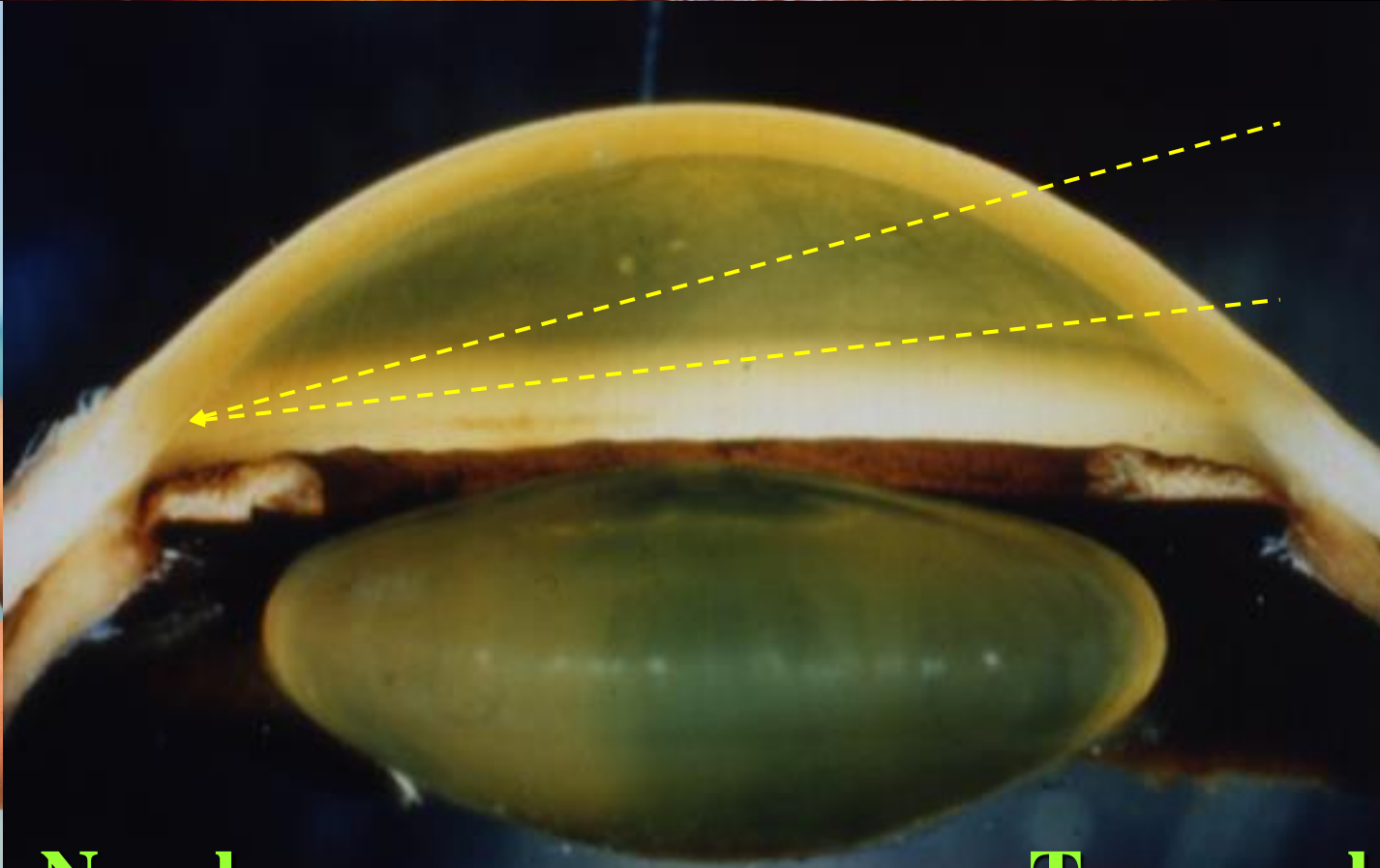
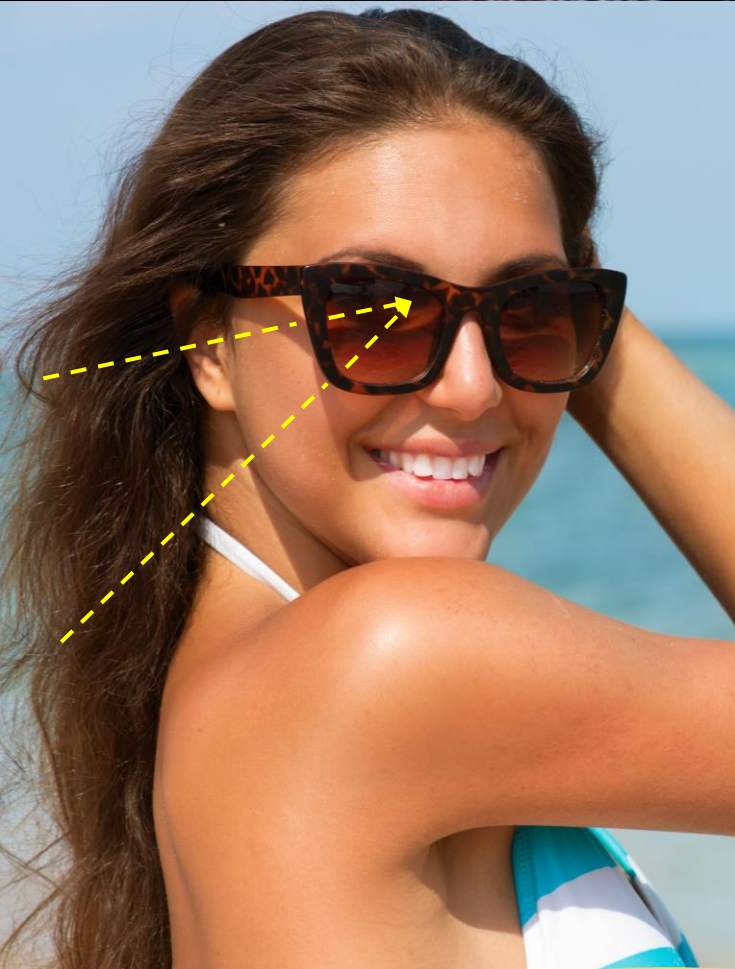




BAND KERATOPATHY



PTERYGIA



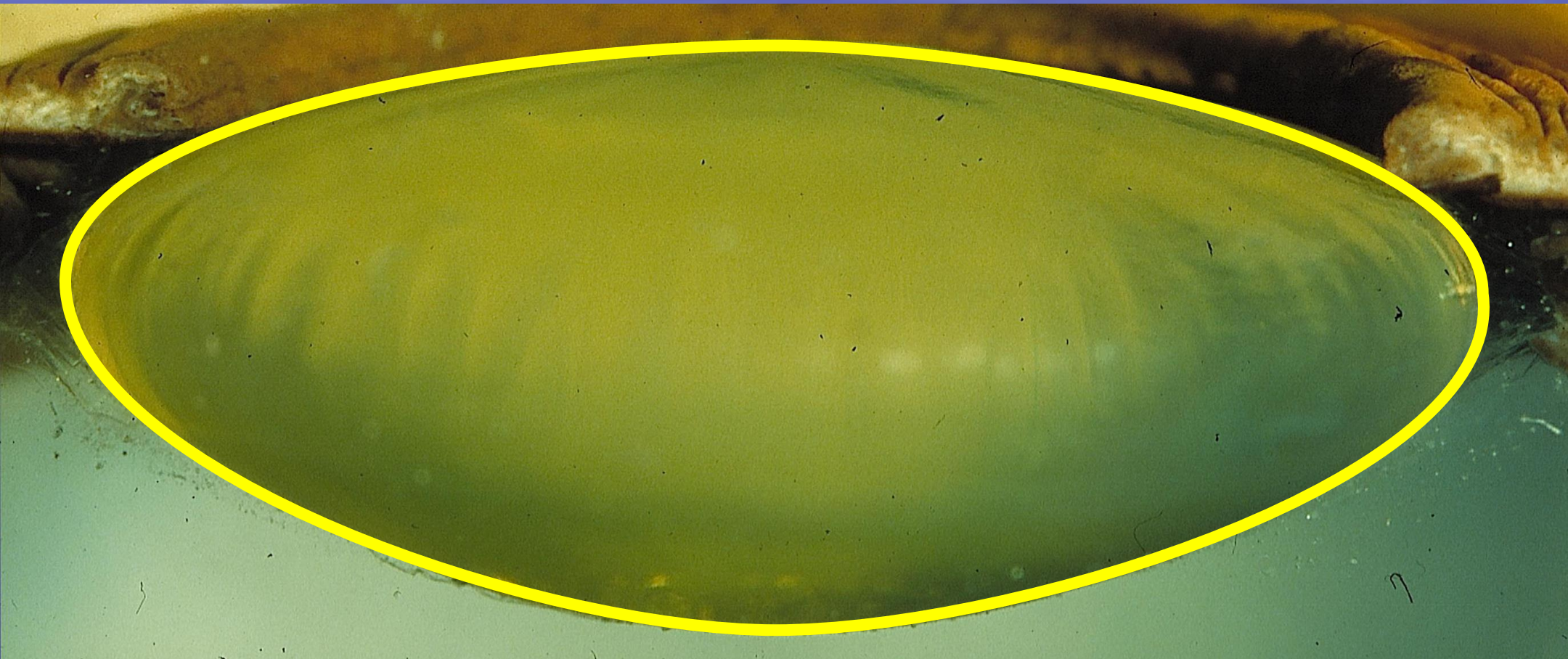
Nasal

Temporal

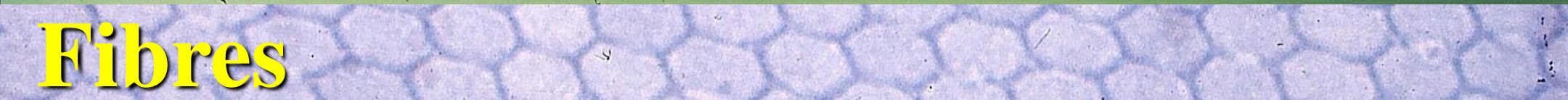
Arcus Senilis

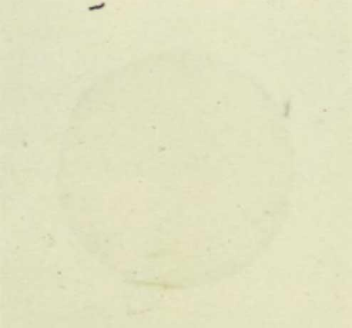


Capsule



Fibres





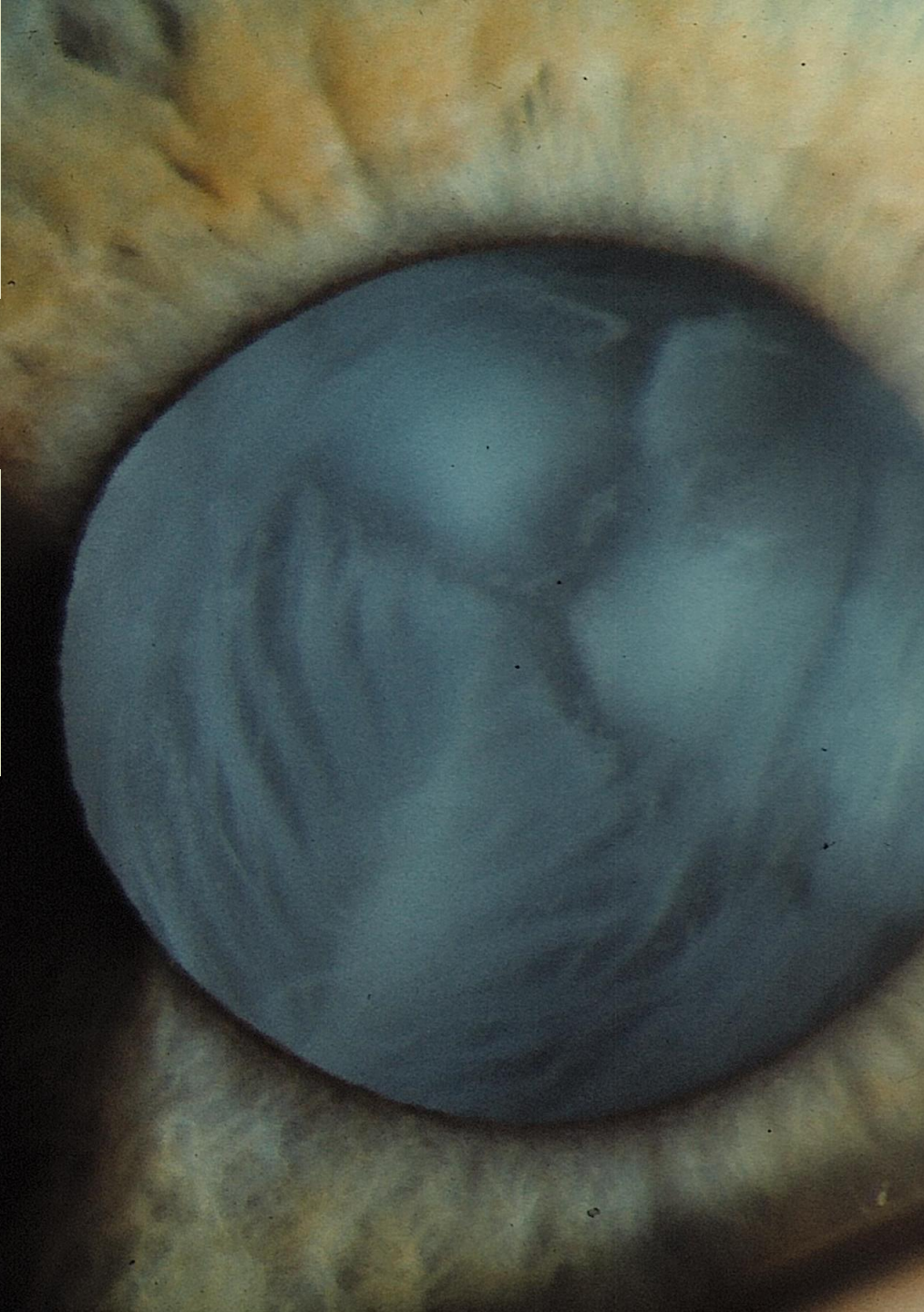
6 months



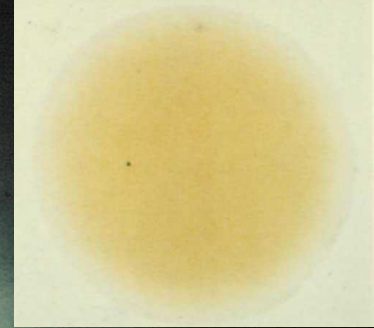
8 years



15 years



47 years



70 years



82 years



60 years



90 years

Waterman Chesapeake Bay (1989)

- (1) People with Cortical Lens Opacities had a 21% higher UV-B exposure per year of life than those without**
- (2) A doubling of lifetime UV-B exposure gives a 60% increase in risk of Cortical Opacities**
- (3) High annual exposure to UV-B increased risk over threefold**



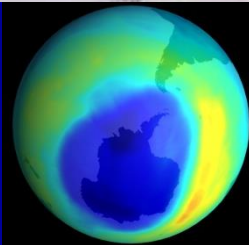
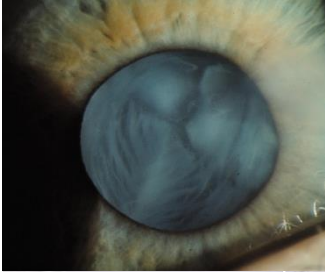
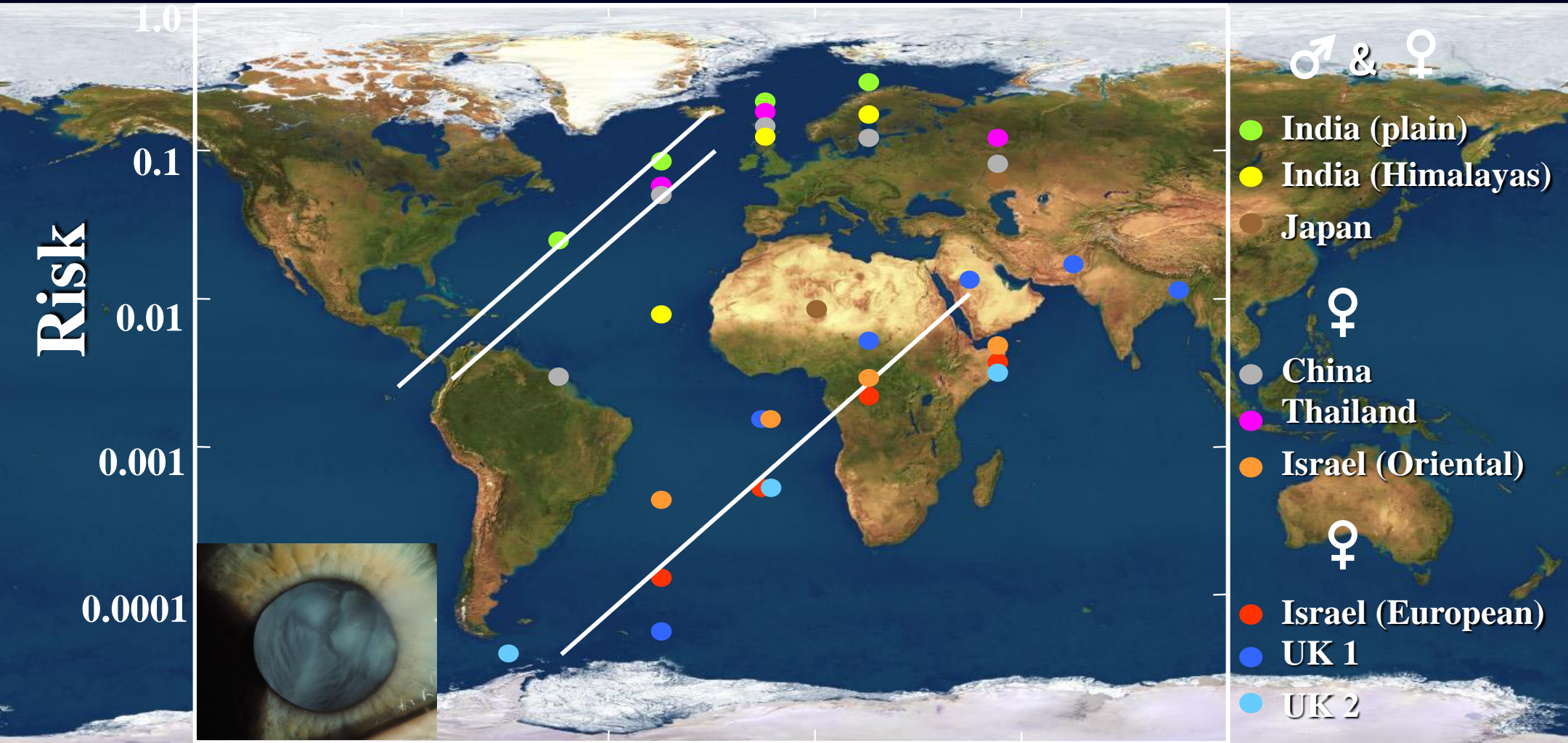
**5 ZONES EXPRESSED
AS
ERYTHEMAL UNITS
OF UVB /DAY**



CATARACT PREVELANCE IN ABORIGINES BY ULTRAVIOLET ZONE

UV Zone	Age		
	0 - 39	40 – 50	60 +
1	0%	1.7%	13.6%
2	0%	2.6%	24.2%
3	0.1%	3.7%	29.5%
4	0.1%	3.8%	30.5%
5	0.2%	5.1%	29.8%

Variation in onset of Age Related Cataract with Latitude

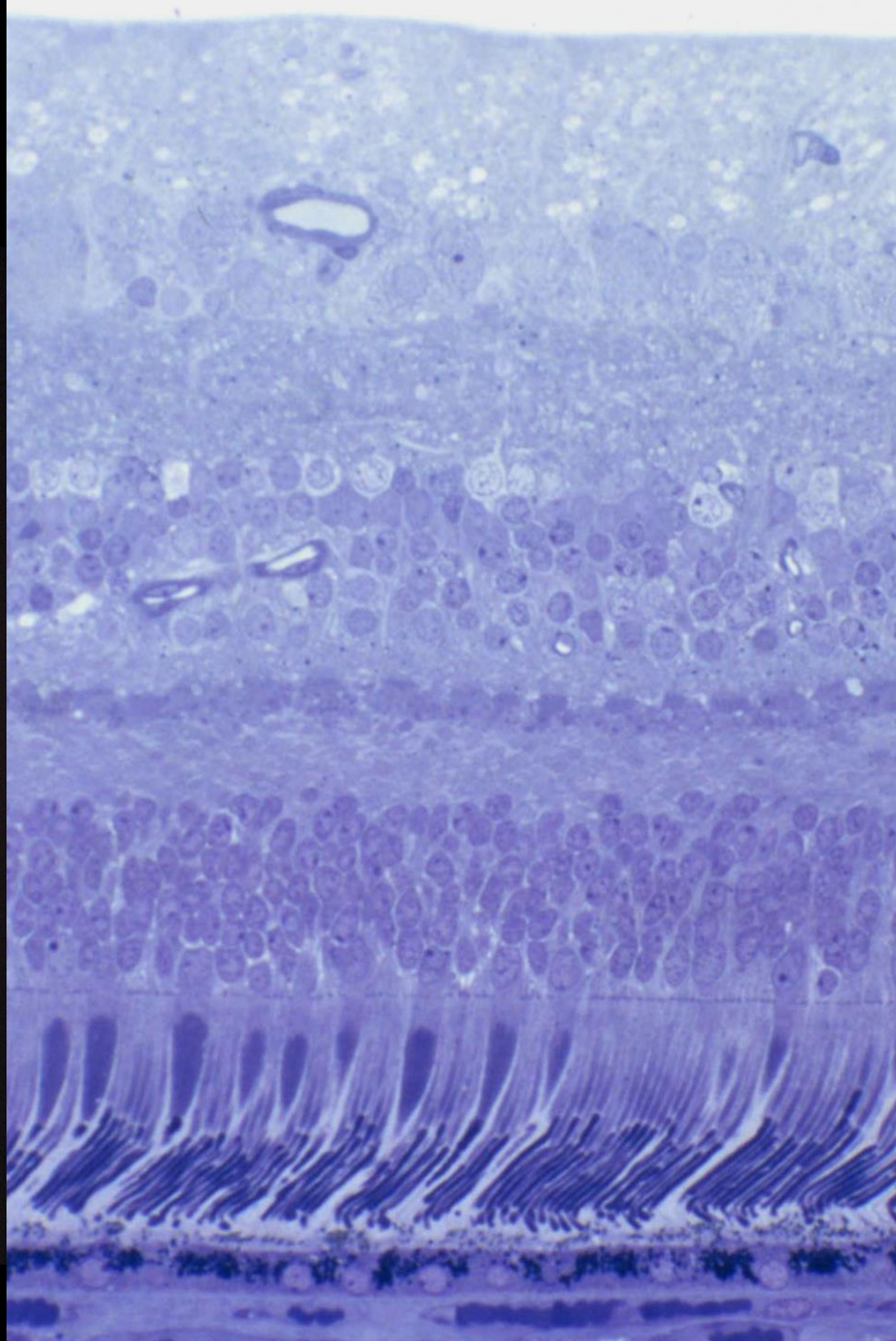
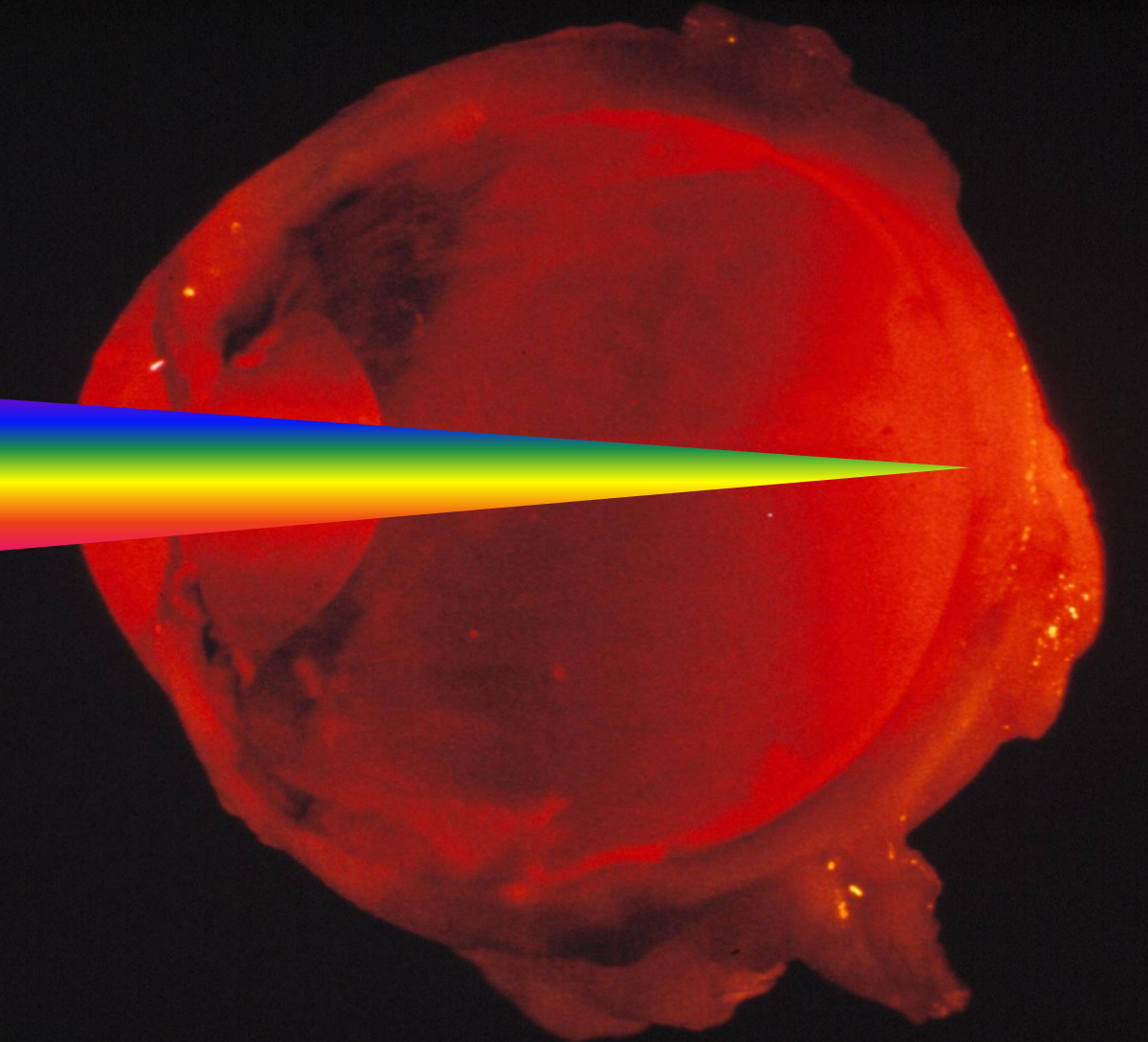


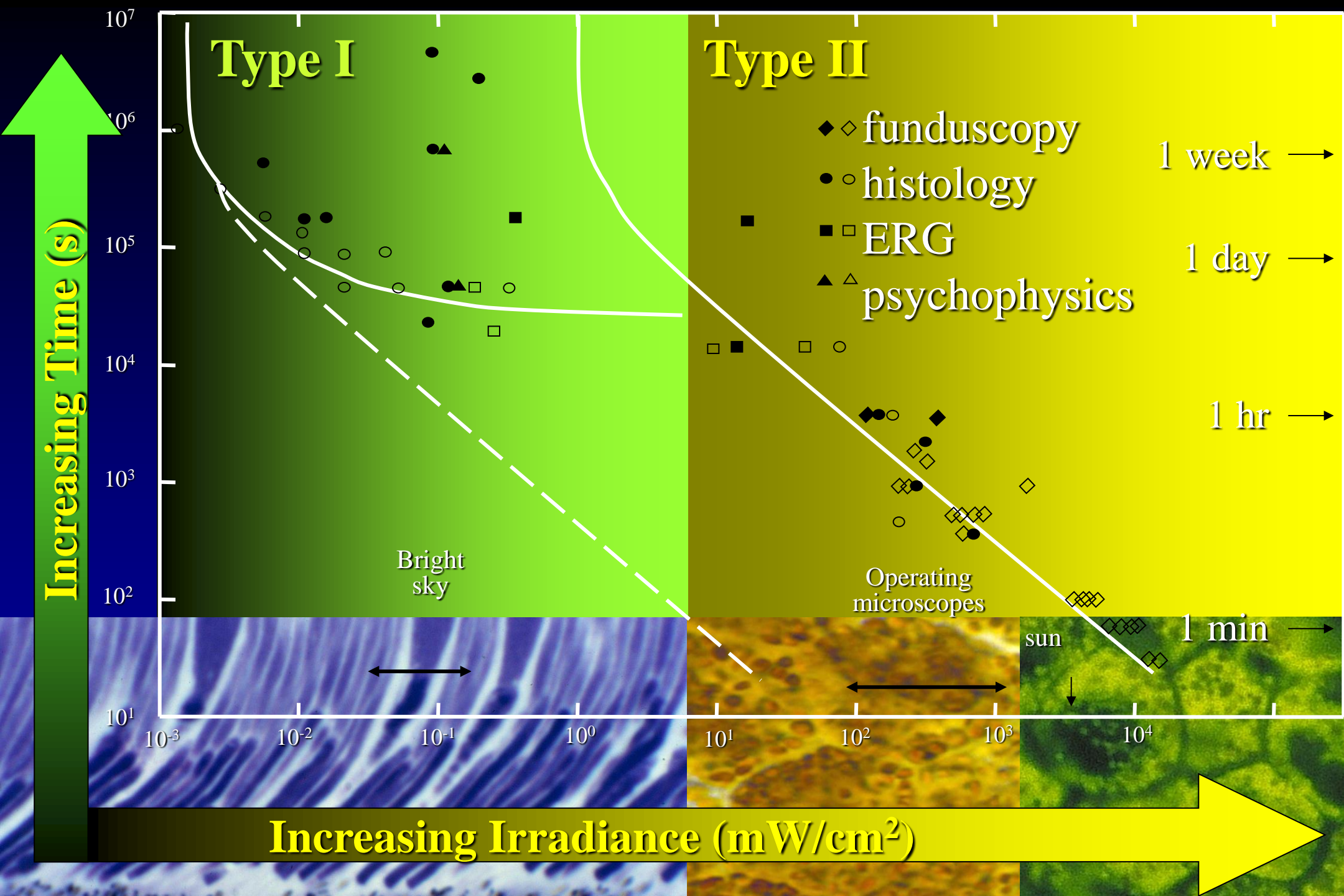
RA Weale, Br.J. Ophthalmology Jan 1982

Hole in Ozone Layer over Antarctica 11.4 million sq miles

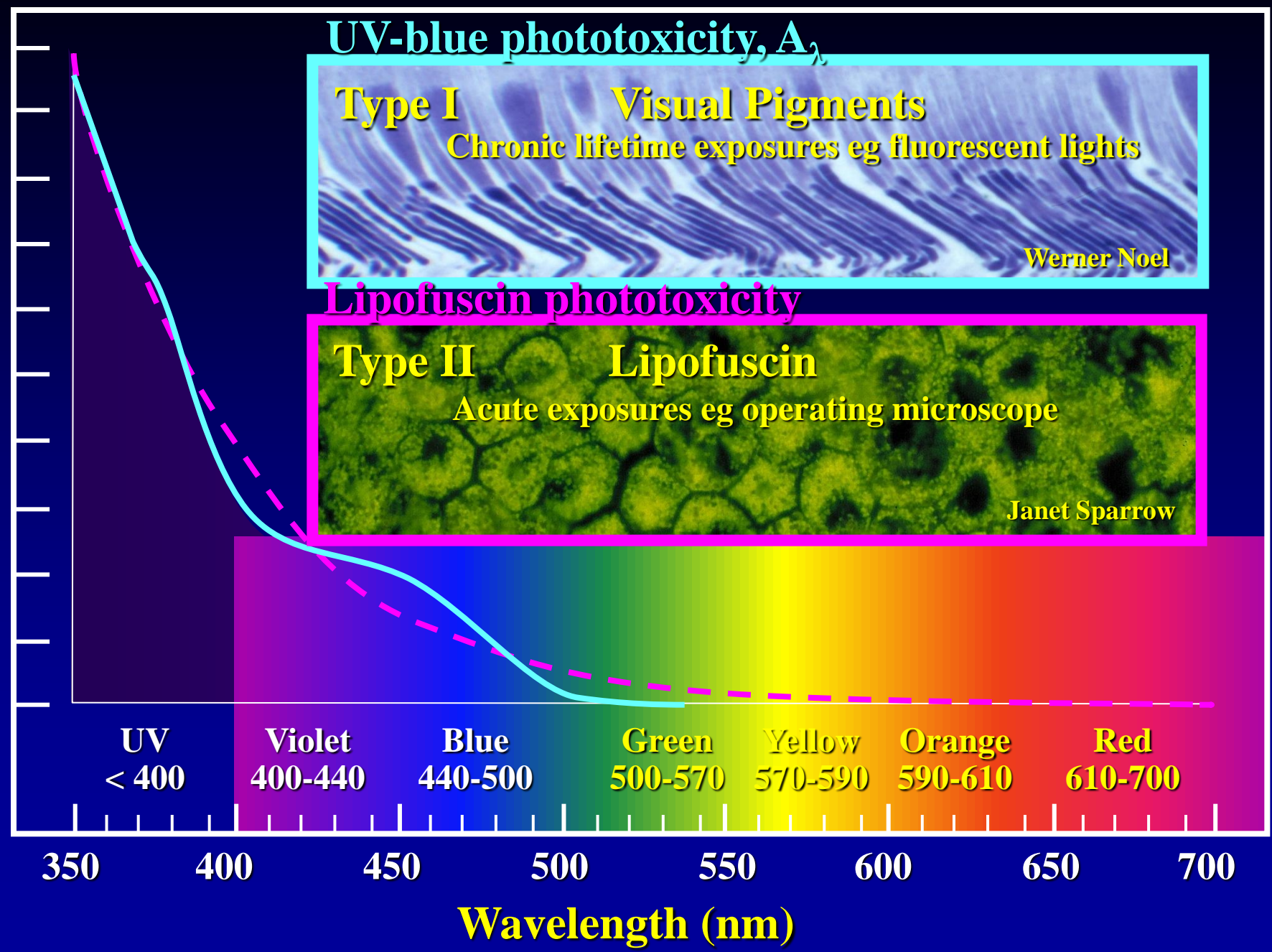
Retinal Hazard Zone

400 – 1400nm

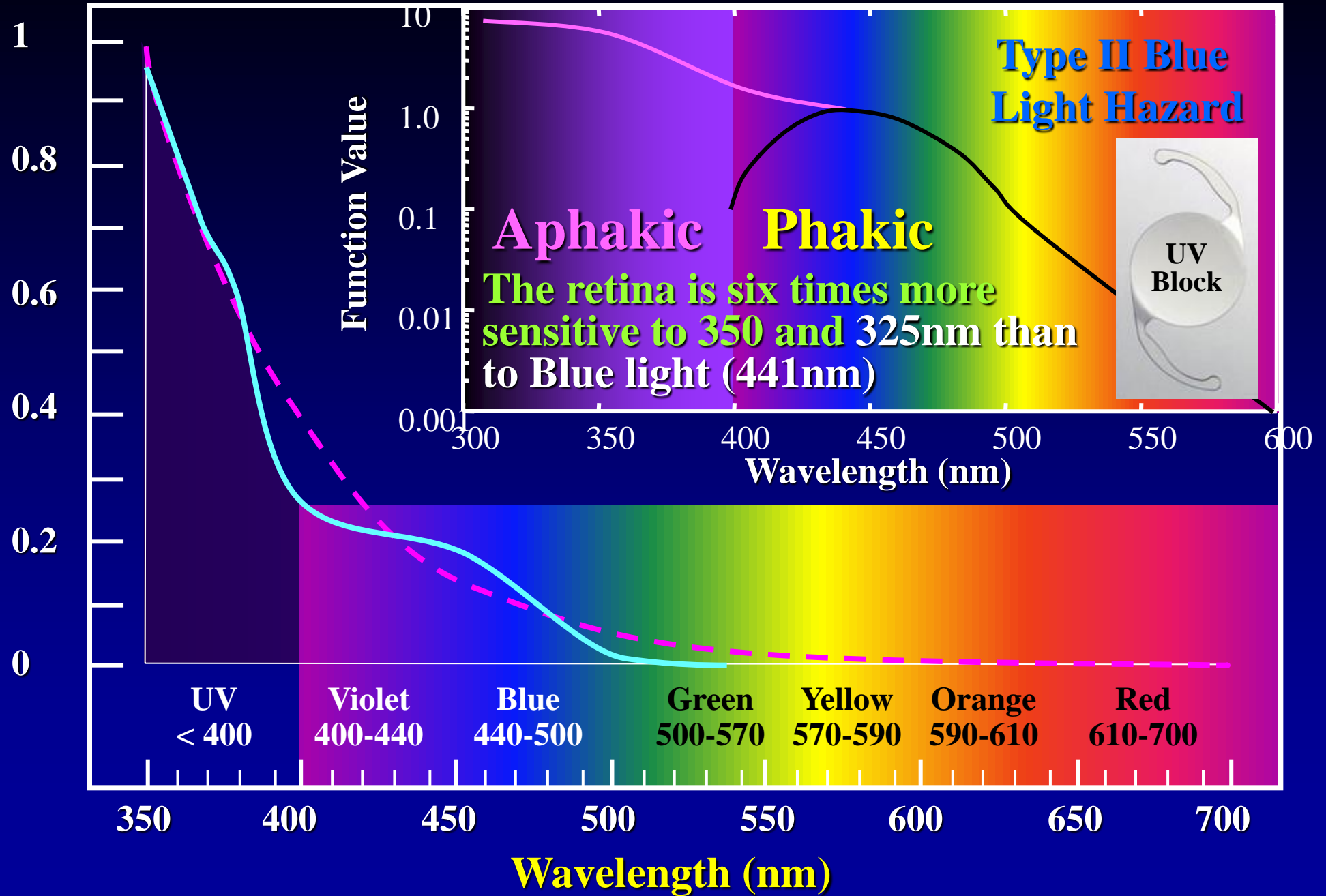




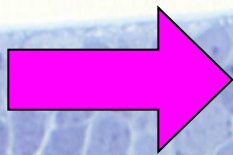
Spectral dependence of phototoxicity



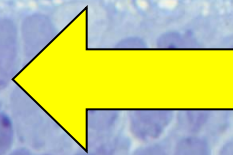
Spectral dependence of phototoxicity



Light Off



Melanopsin 470nm
1% Ganglion Cells
"photoreceptors"

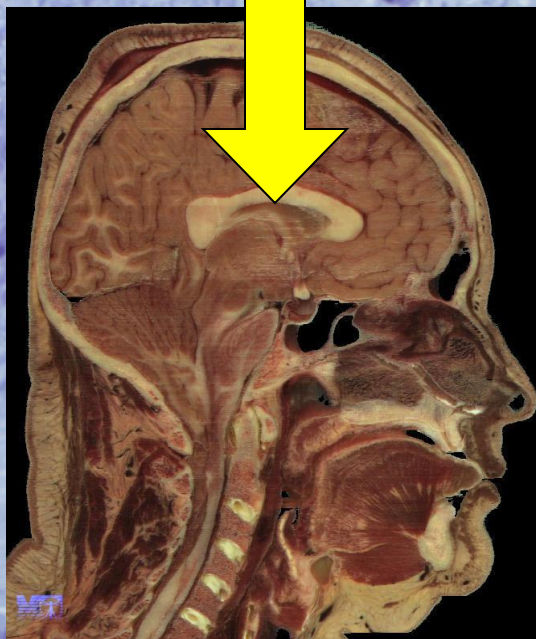
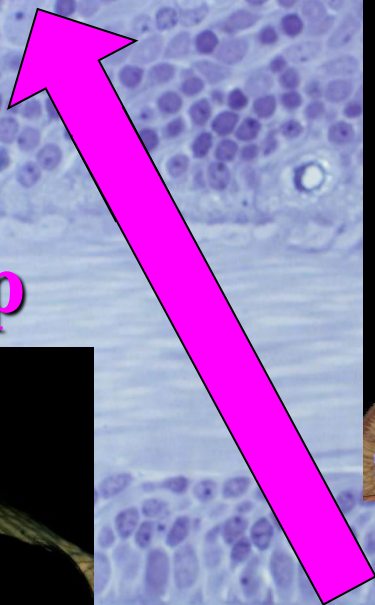


Light On

Melatonin
Increase



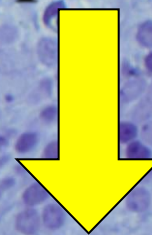
Go to sleep



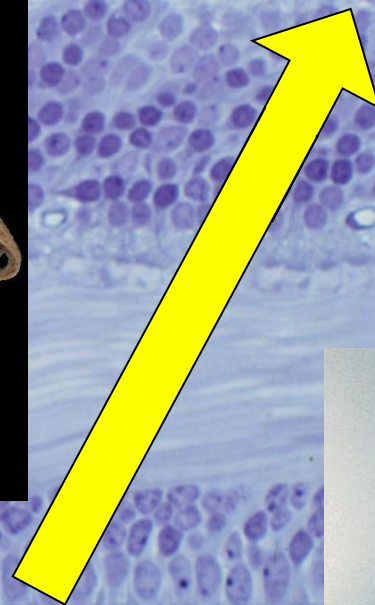
suprachiasmatic nuclei
anterior hypothalamus

Master Clock

Melatonin
Suppression



Wake up





Fashion Tints



Sunglasses



High Performance Filters