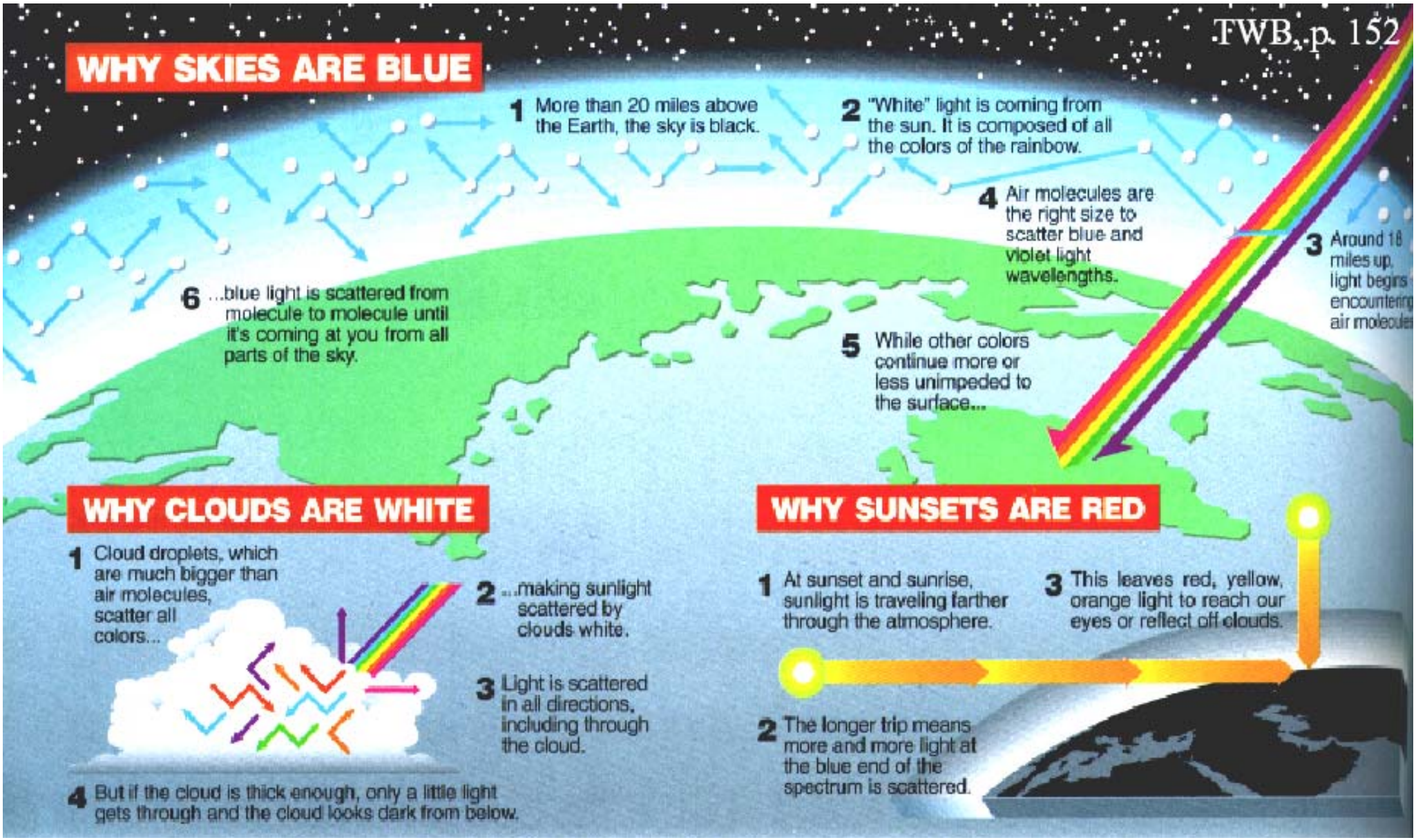
Lecture 31 Atmospheric Optics I



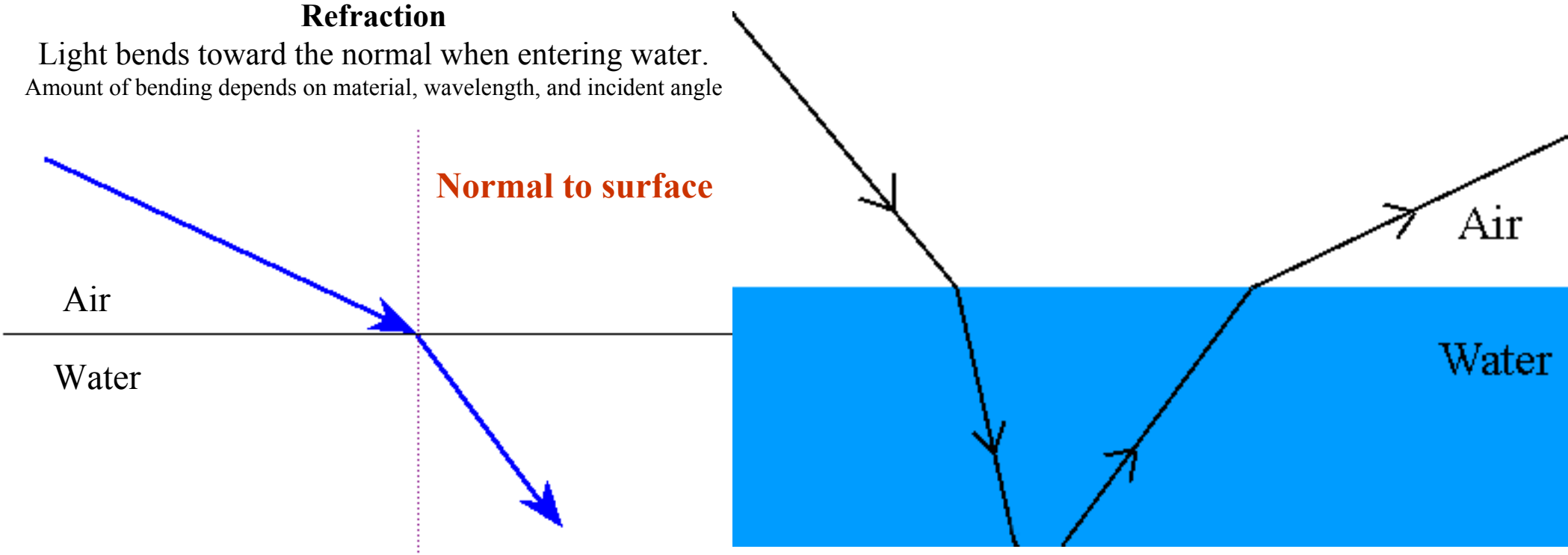
- White light is mixture of all colors in rainbow.
- The color of an object depends on the wavelengths of light which the object best reflects or scatters.
- Light scatters more off particles closer in size to its wavelength:

Air molecules	0.001-0.002 μm across
Blue light	0.4 μm wavelength
Red light	0.7 μm
Pinatubo Aerosols	1 μm across
Cloud drops	20 μm across

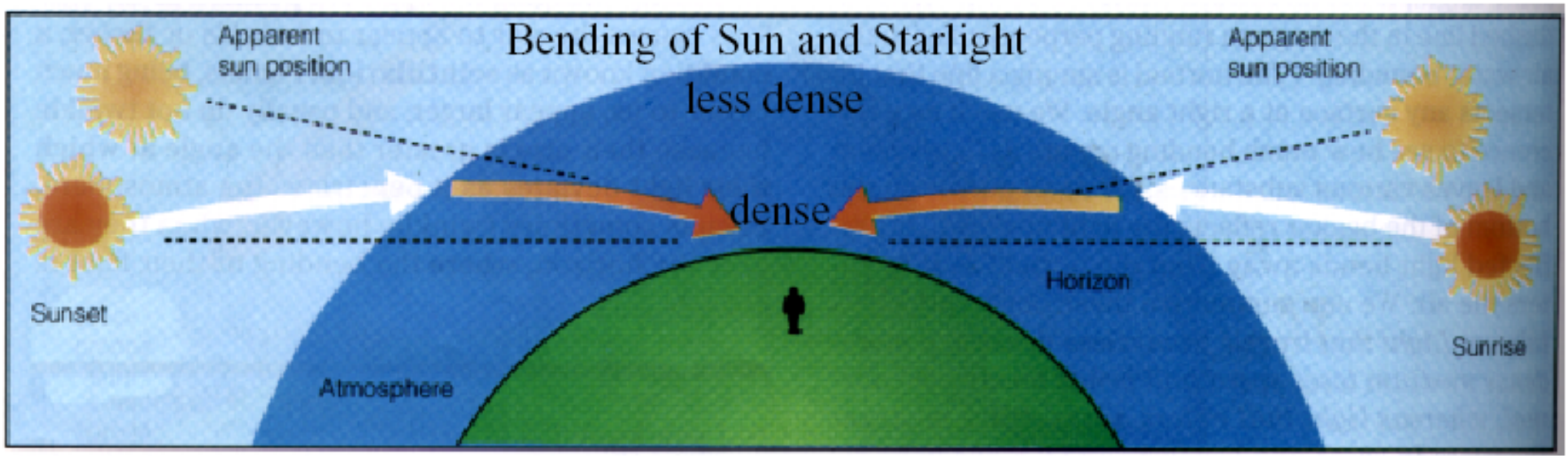
- Cloud drops scatter all wavelengths nearly equally, so clouds look white.
- More short wavelength blue light is scattered by tiny air molecules than long wavelength red light. This light, scattered in all directions, makes sky appear blue.
- If the sun is low above horizon, sunlight passes through lots of atmosphere, so the unscattered light in the sun's beam now is mainly the yellow, orange, red of sunsets (can also reflect off clouds).
- Large aerosol particles can efficiently scatter red light to make red dawn, dusk (Pinatubo, 1991).

Refraction

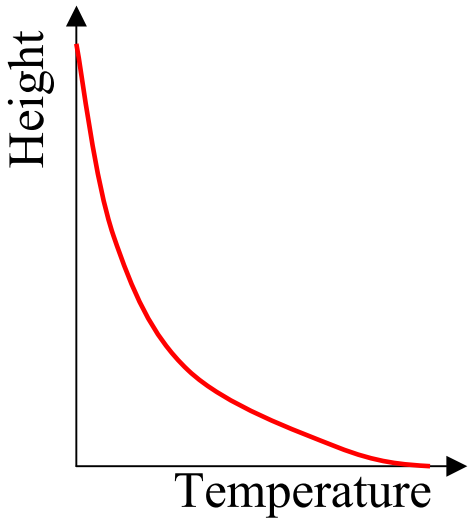
Light *refracts* (bends) toward a denser substance .



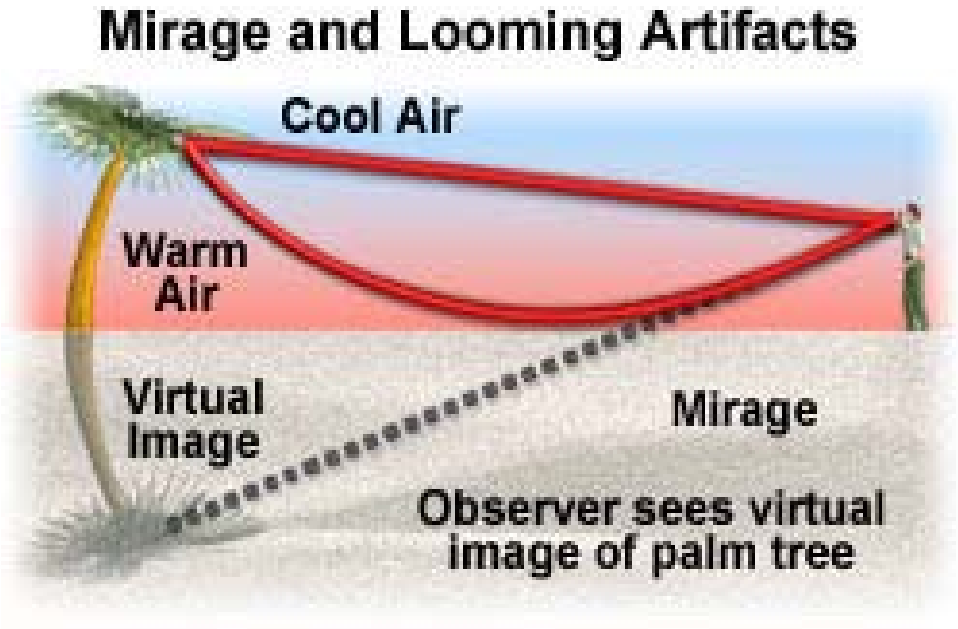
Atmospheric Effects of Refraction



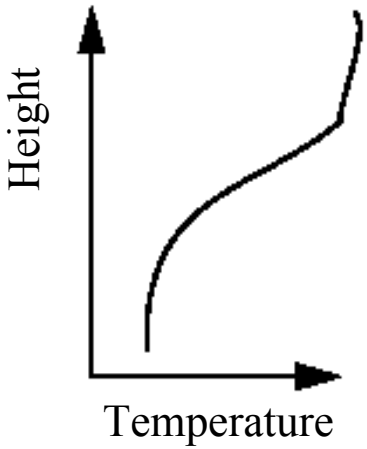
EOM Fig. 15.11. The bending of the sun's rays by the atmosphere causes the sun to rise about two minutes earlier and set about two minutes later than it otherwise would.

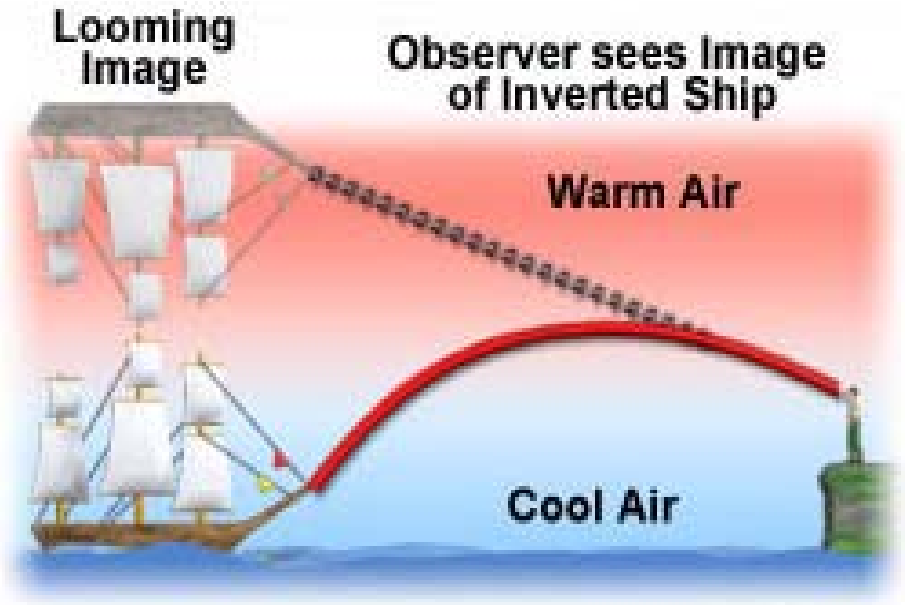


Temperature profile above sand



Fata Morgana ‘Superior’ Mirage





King Arthur’s half-sister, Fata Morgana in Italian, lived in a crystal palace beneath the water and could build fantastic castles from thin air.

Fata Morgana

Plate 7-4. Fata morgana mirage showing an apparent wall over the Arctic Ocean ice. (Photographed at Pt. Barrow, Alaska, by the author)

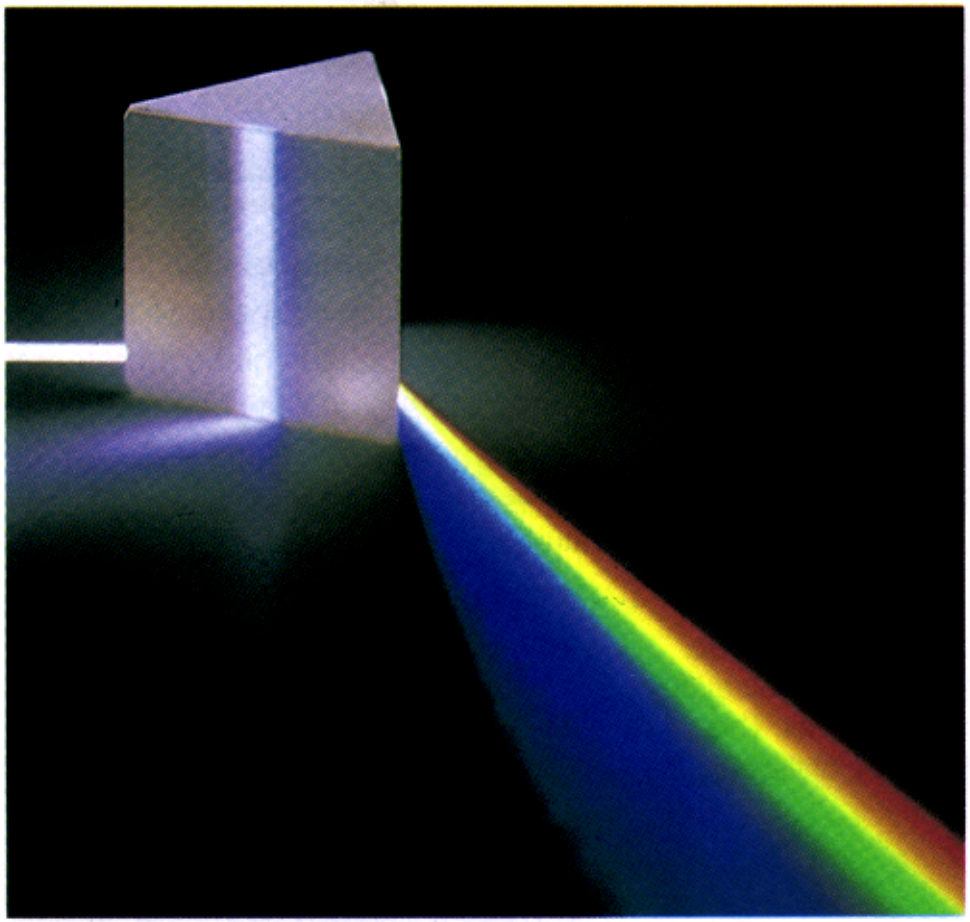
Plate 7-5. Fata morgana mirage showing columns and spires over the Arctic Ocean. (Photographed by the author)

Plate 7-6. Fata morgana mirage showing an apparent detached wall over the Arctic Ocean. (Photographed by the author)

Plate 7-7. Another variation of the fata morgana mirage over the Arctic ice. (Photographed by the author)

Dispersion

Blue (shortest wavelength) light refracts slightly more than red light, so refraction can *disperse* light into its component colors.



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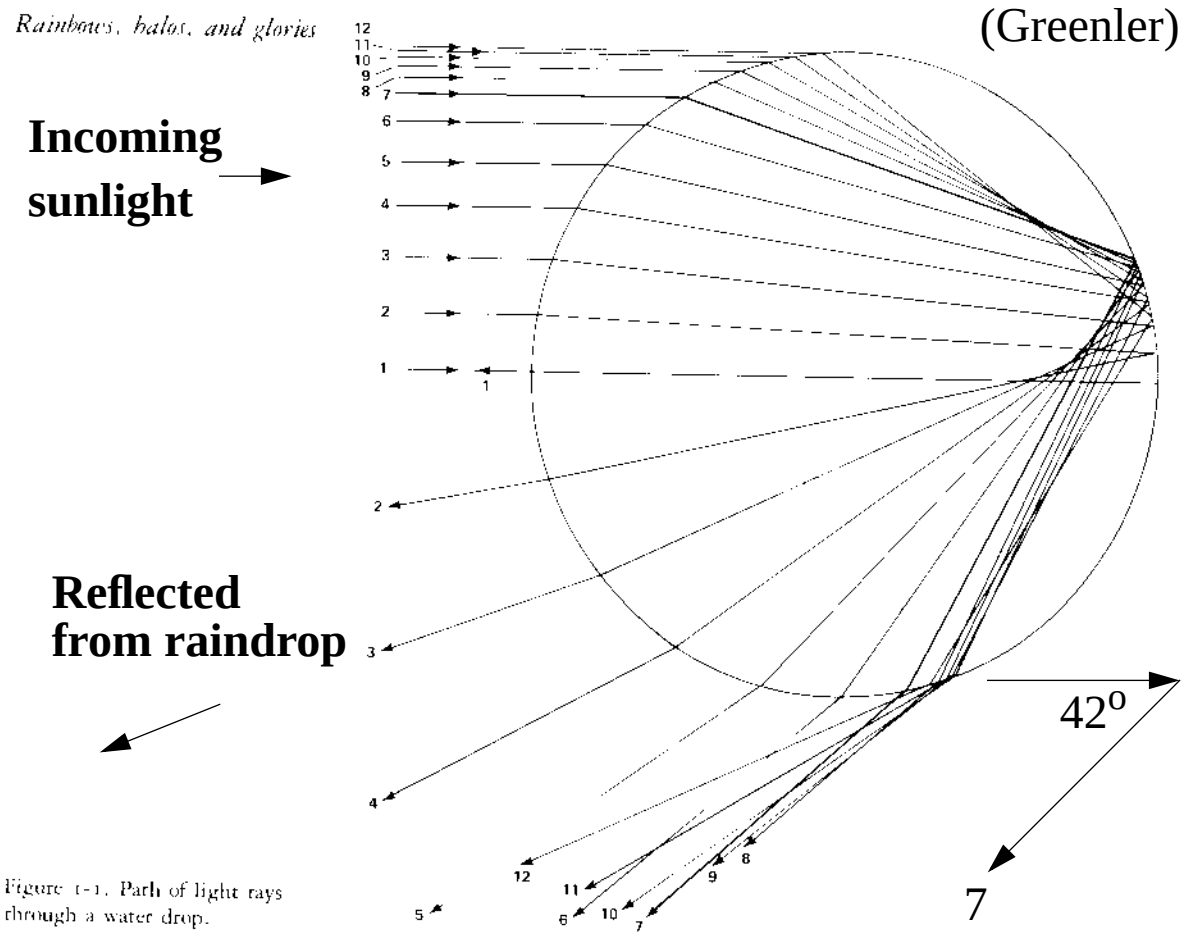
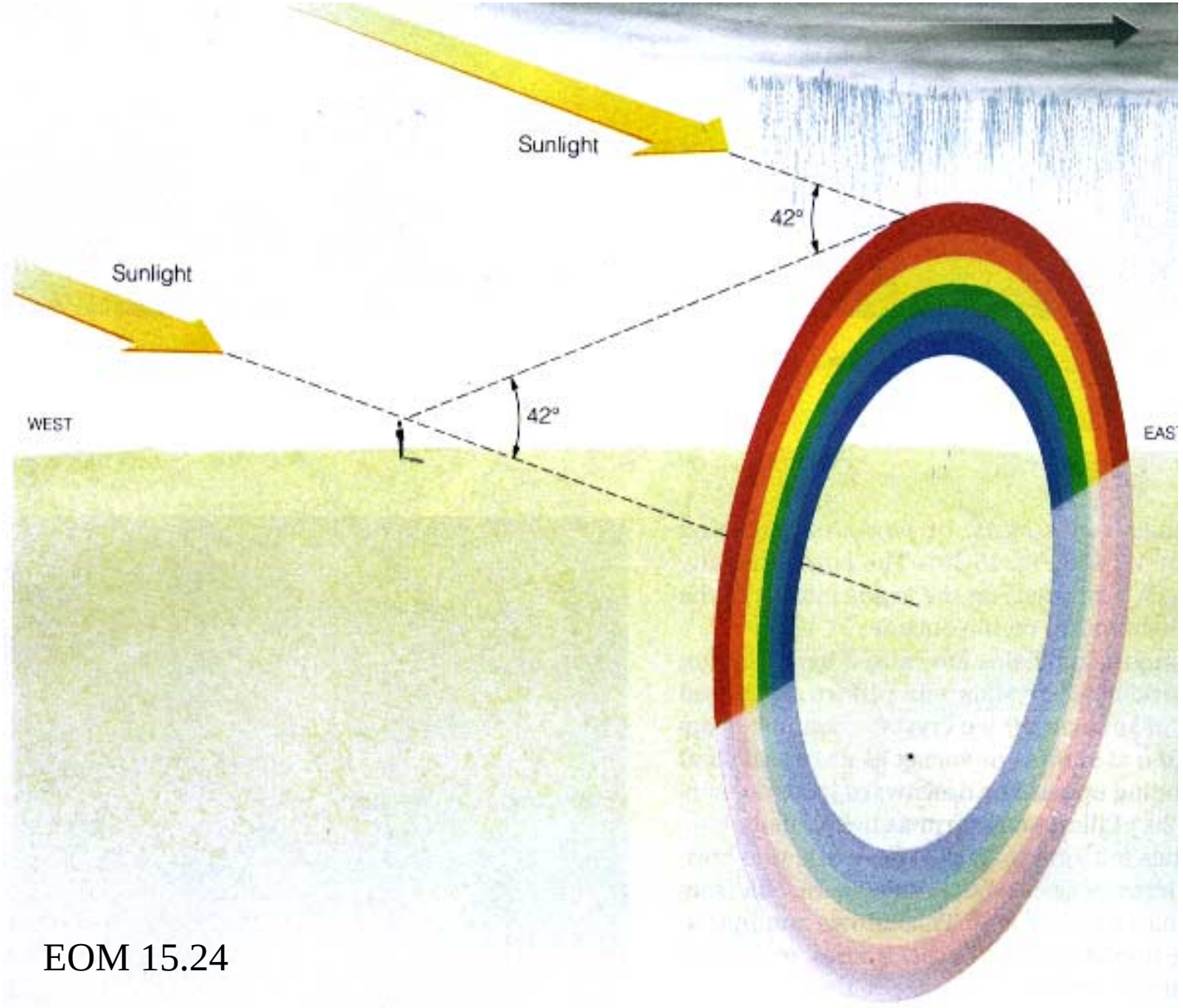
Rainbows



- Rainbows are formed when sunlight reflects off the inside of raindrops.
- Reflection angle depends on how obliquely beam hits drop, but is nearly 42^{o} for many rays near the Descartes ray (7), which reflects at largest angle.

Position of a Rainbow



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