HUMAN EYE AND COLORFUL WORLD

ATMOSPHERIC REFRACTION

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It is the deviation of light from a straight line as it passes through the atmosphere due to the variation in air density as a function of altitude. Atmospheric refraction can make distant objects appear to shimmer or ripple.

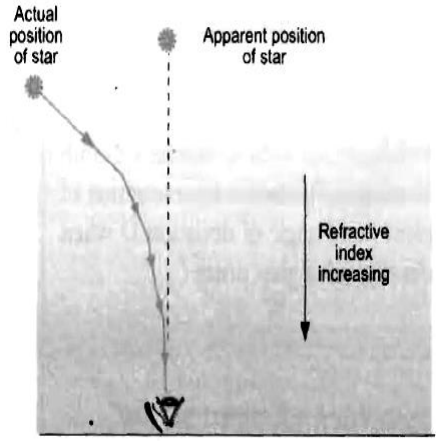
Atmospheric refraction causes astronomical objects to appear higher in the sky than they are in reality.

The situation gets worse when the atmospheric refraction is not homogenous, when there is turbulence in the air for example. This is the cause of twinkling of the stars and deformation of the shape of the sun at sunset and sunrise.

1 Common Phenomenon of Atmospheric Refraction of Light

1. Twinkling of Stars:

Light emitted by stars passes through the atmosphere of the earth before reaching our eyes. The atmosphere of the earth is not uniform but consists of many layers of different densities. The layers close to the surface of the earth are optically denser. As we go higher and higher, the density of layers and refractive index decreases progressively. As the light form a star enters the upper – most layer of the atmosphere, it bends towards the normal as it enters the next layer. This process continues till the light enters our eyes. So due to refraction of light, the apparent position of the star is different from the actual position of the star (Figure)



Moreover, the different layers of the atmosphere are moveable and the temperature and the density of layers of atmosphere changes continuously. Hence, the apparent position of the star changes continuously. The change in the apparent position of the star leads to the twinkling of a star.

Note:

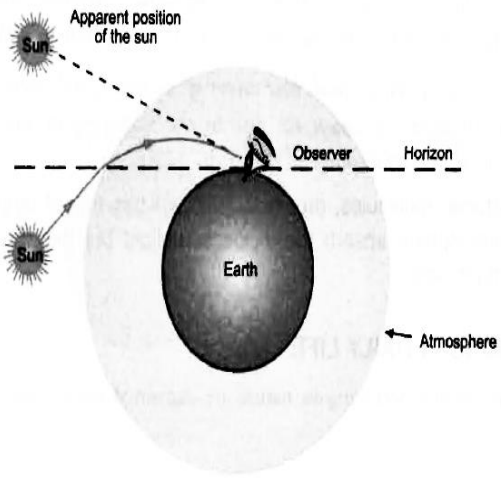
Planets do not twinkle :

Planets are very close to the earth as compared to the stars. So the intensity of light we receive from the planets is very large. Therefore, the variation in the brightness of the planets is not detected. Hence planets do not twinkle.

When light from a far distant star enters the atmosphere of the earth. It passes through rarer to denser air atmosphere. Therefore, it suffers atmospheric refraction and light bends towards the normal. This changes the apparent position of the star for a person viewing it from the earth's surface. Further, air molecules are in a state of continuous random motion. The random motion of air molecules keeps changing the refractive index in various atmospheric regions. This continuously changes the apparent position of a star for a person viewing it from earth's surface, making it twinkle.

Advance Sunrise and Delayed Sunset :

We can see the sun for few minutes even after it has actually set :We can see the sun for few minutes even after it has actually set; Actual sun sets when it is below horizon in the evening. The rays of light from the sun below the horizon reach our eyes because of refraction of light. These rays appear to come from the apparent position of the sun which is above the horizon as shown in figure. Hence we can see the sun for few minutes (about 2 minutes) even after it has actually set. Similarly, the sun can be seen about 2 minutes before it actually rises. Thus, we gain 4 minutes of additional daylight each day.



A diagram showing the atmospheric refraction of sun's rays causing apparent early sunrise and late sunset is shown in figure.