The Abdus Salam
International Centre for Theoretical Physics

United Nations
Educational, Scientific and
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Meeting of Modern Science and School Physics: College for School Teachers of Physics in ICTP

27 April - 3 May, 2011

Vision and illusions

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VISION and ILLUSIONS

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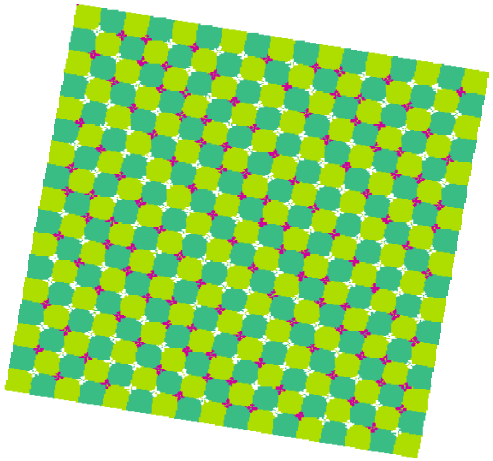
and Institut Universitaire de France



Meeting of Modern Science and School Physics,
ICTP, Trieste, Italy
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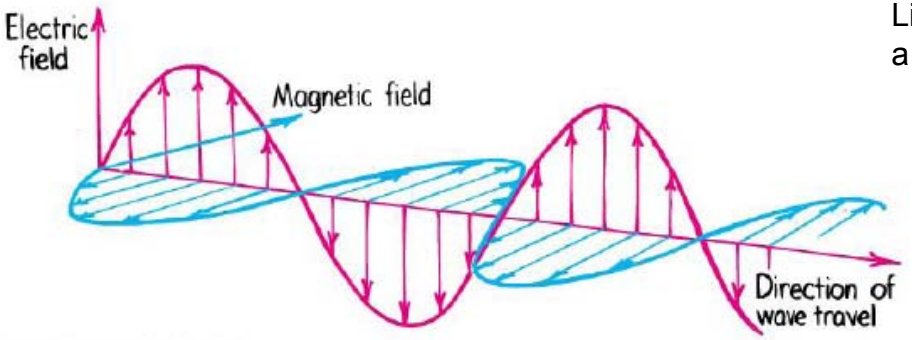
Wavelength and Color

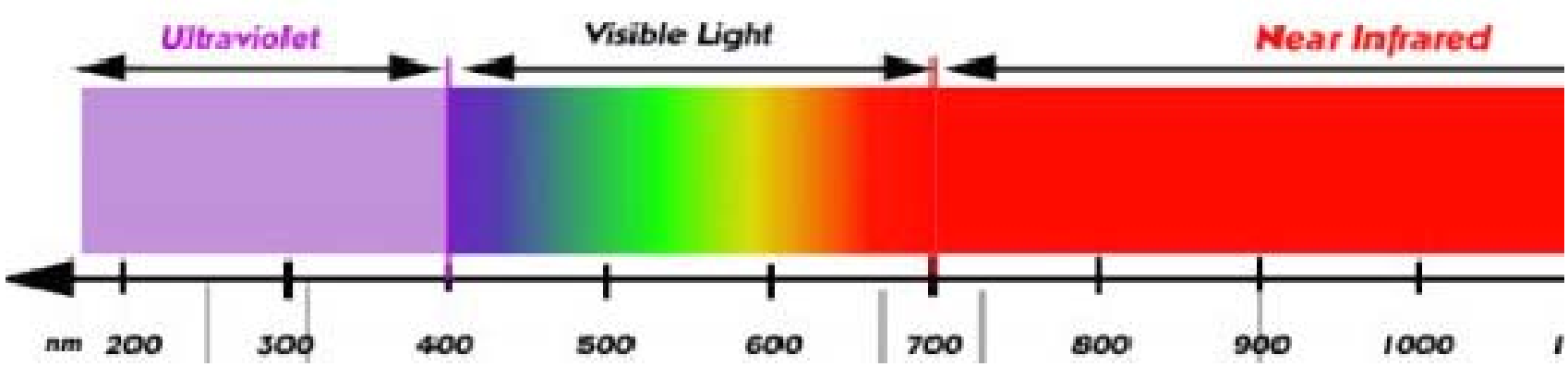
- The light is electromagnetic radiation

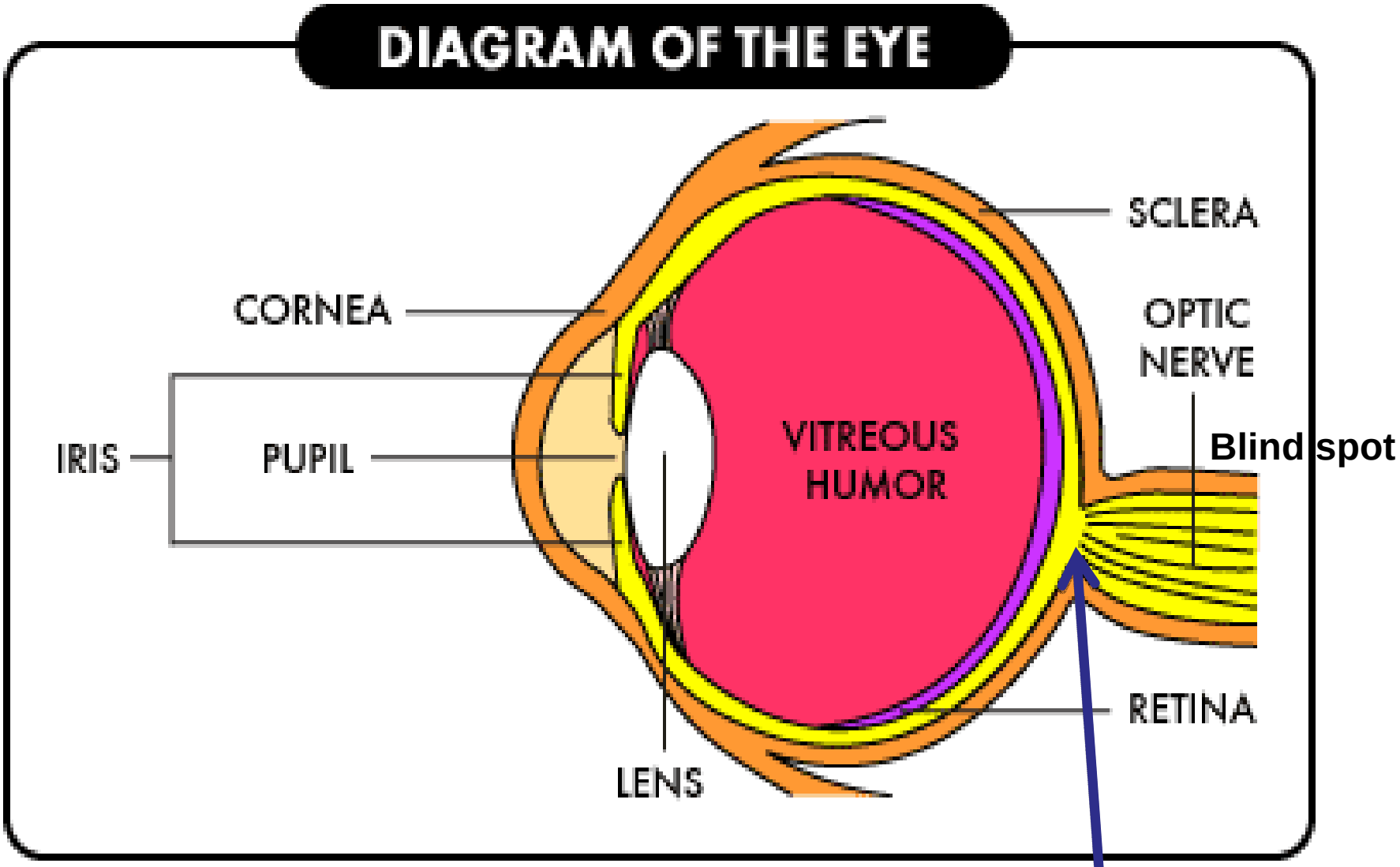


Light from the sun or a light bulb may look white, but it is actually a combination of many colors.

rainbow in the sky

Different wavelengths correspond roughly to the “colors” of the spectrum



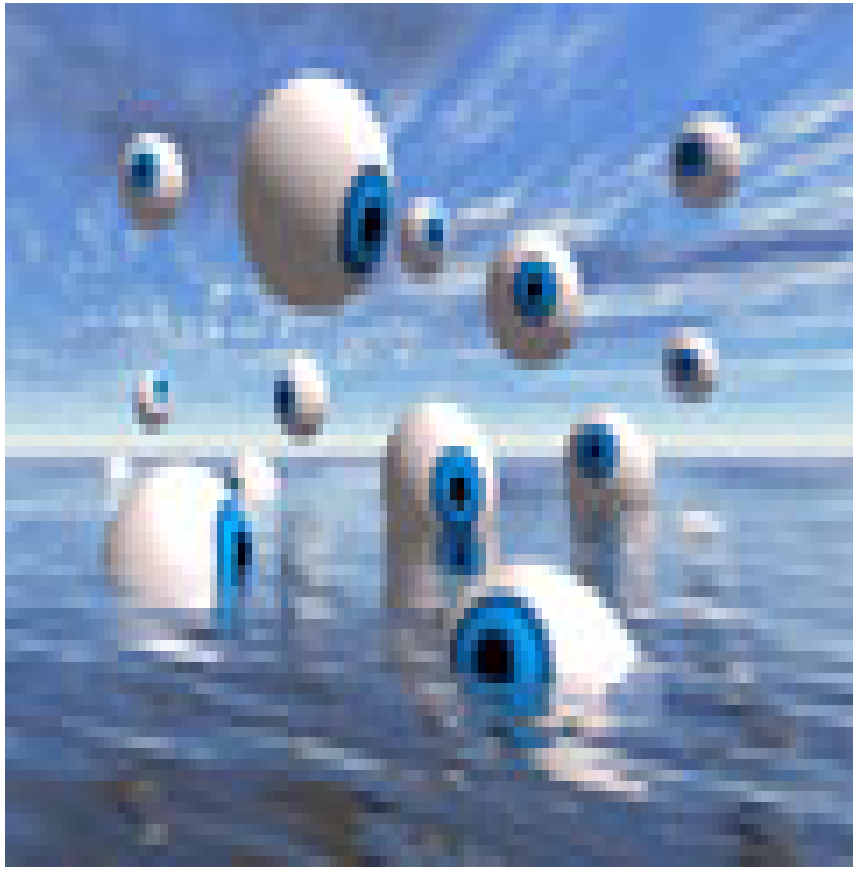


The lens in the eye is a converging lens.

Blind spot
Mariotte, 1666
Louis XIV

The **blind spot**, located where the optic nerve meets the eye, contains no photo-receptors.

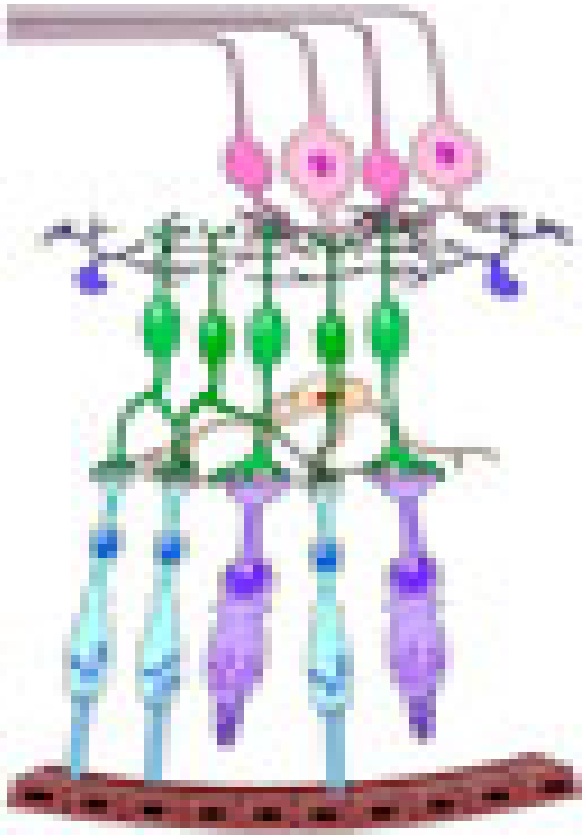
Retina



- Your retina is in the very back of the eye, past the vitreous body. Though it's smaller than a dime, it holds millions of cells that are sensitive to light. The retina takes the light the eye receives and changes it into nerve signals so the brain can understand what the eye is seeing.

Rods and Cones

- The retina uses special cells called rods and cones to process light. Just how many rods and cones does your retina have? How about 120 million rods and 7 million cones - in each eye!
- Rods and cones are most sensitive to yellow-green light.



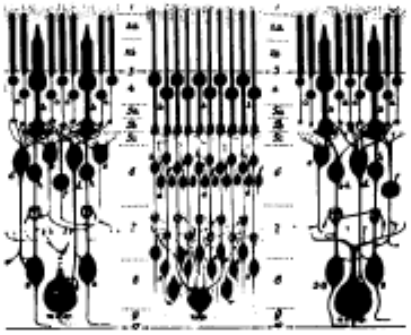
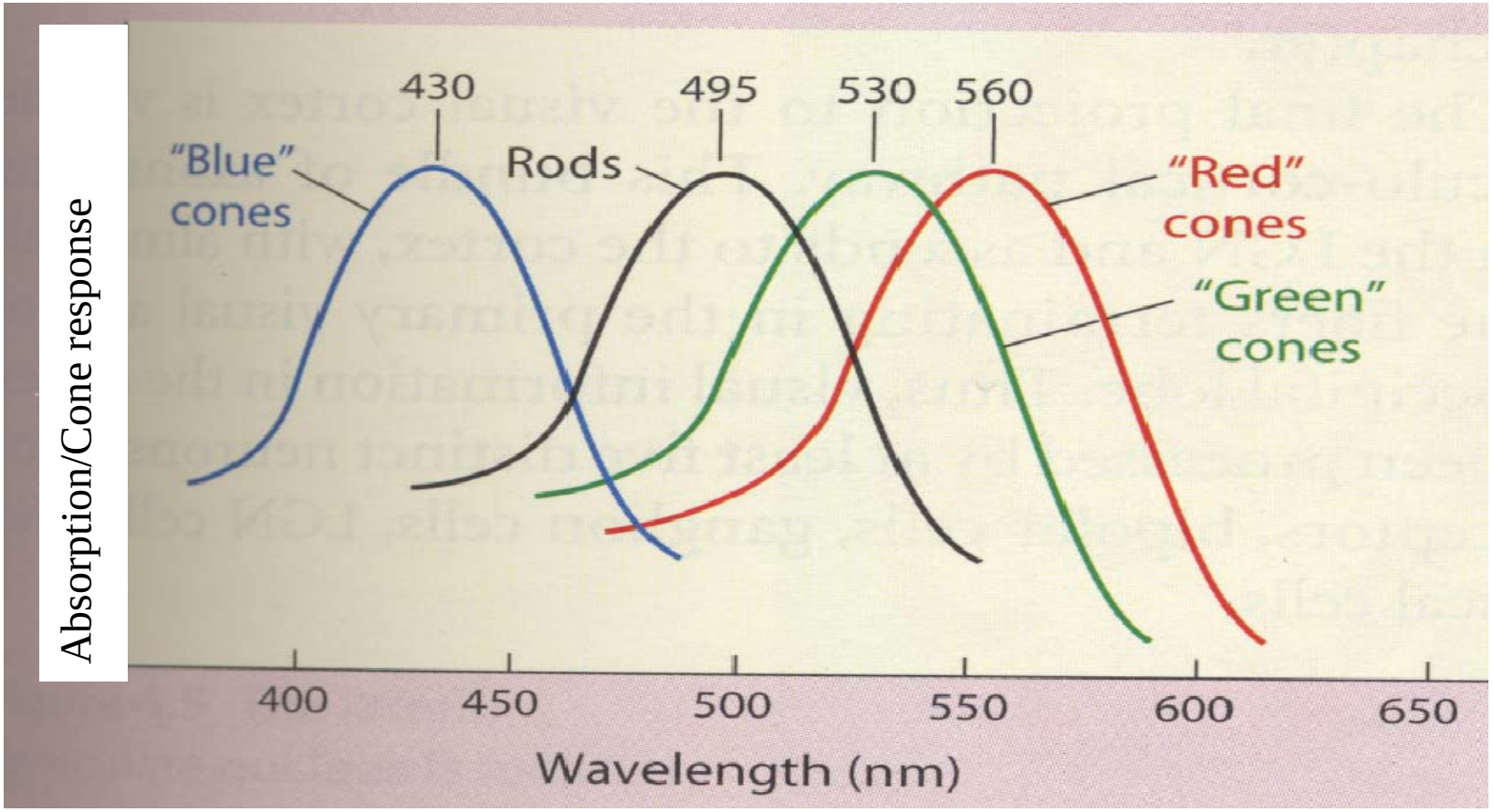


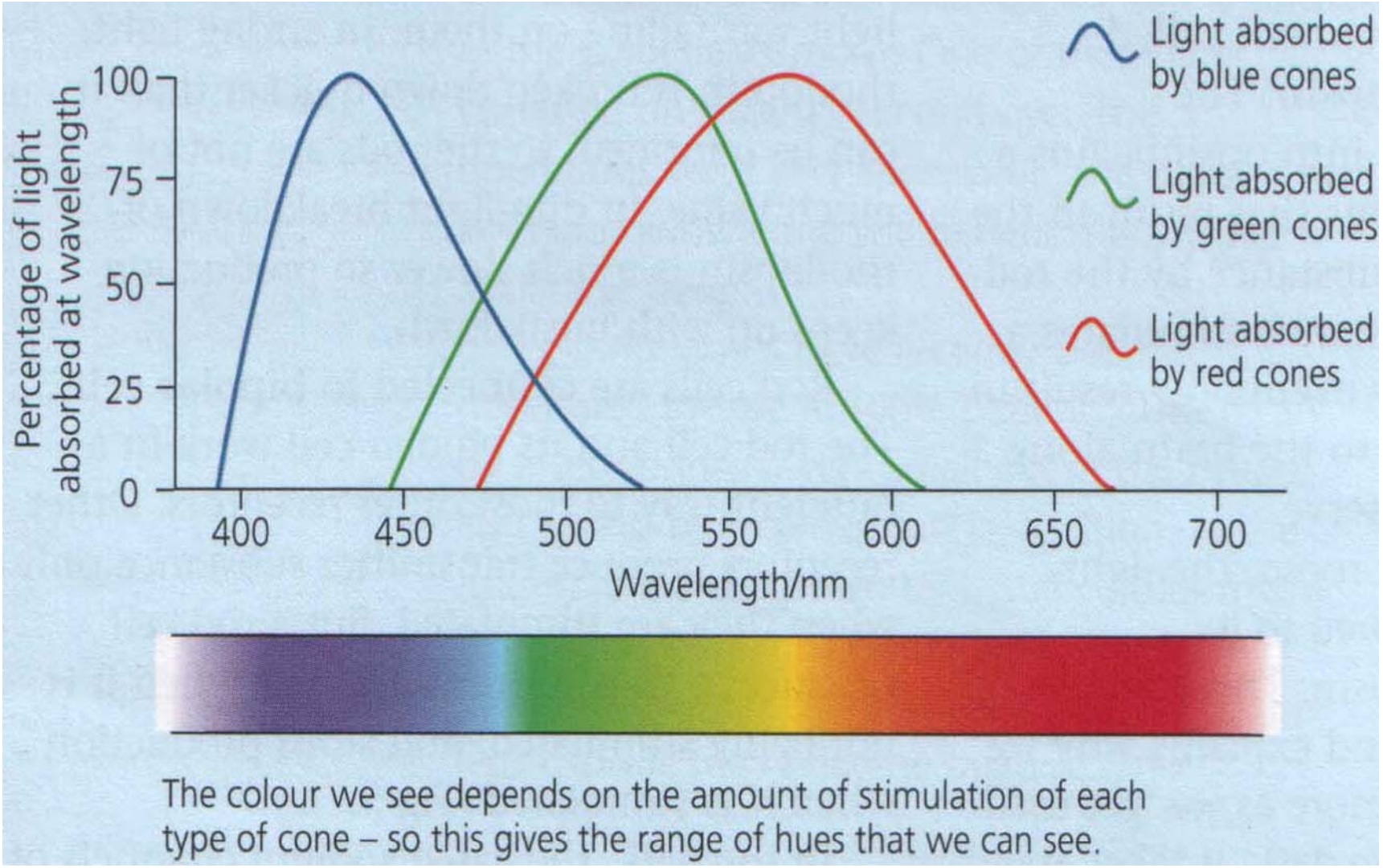
Fig. 35–2. The structure of the retina. (Light enters from below.)

Perceiving Color

- Four absorption peaks in retina: 3 cone types plus rods

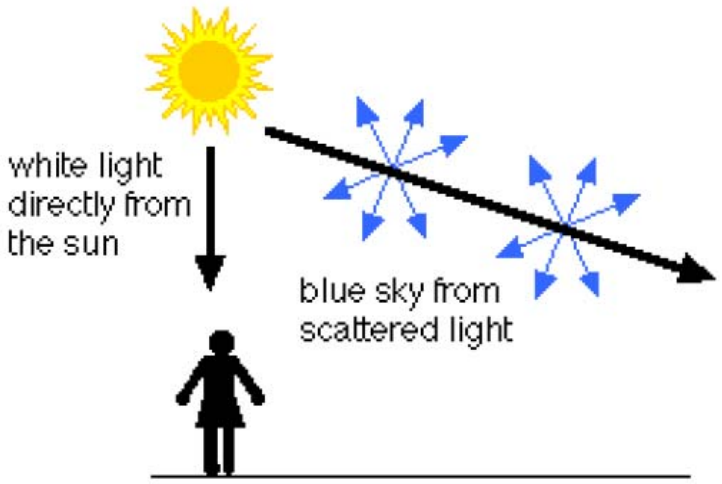


Wavelengths of light absorbed by different cones

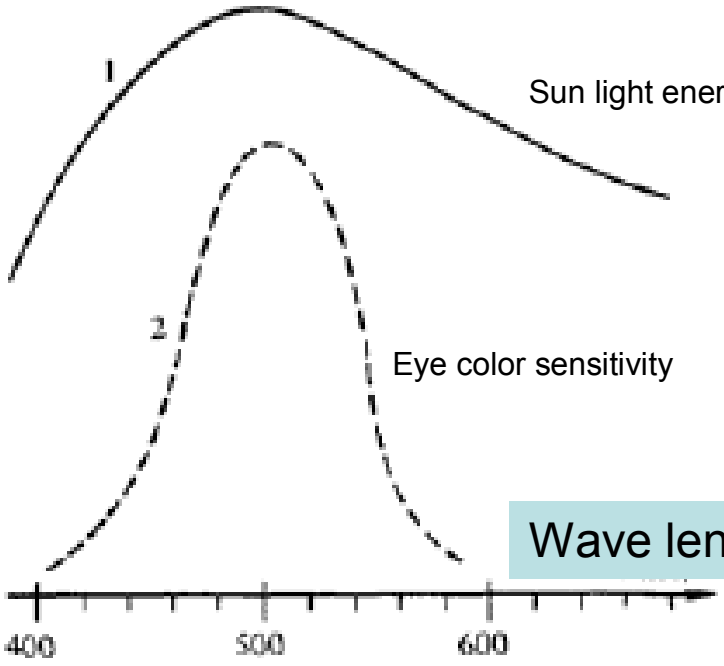


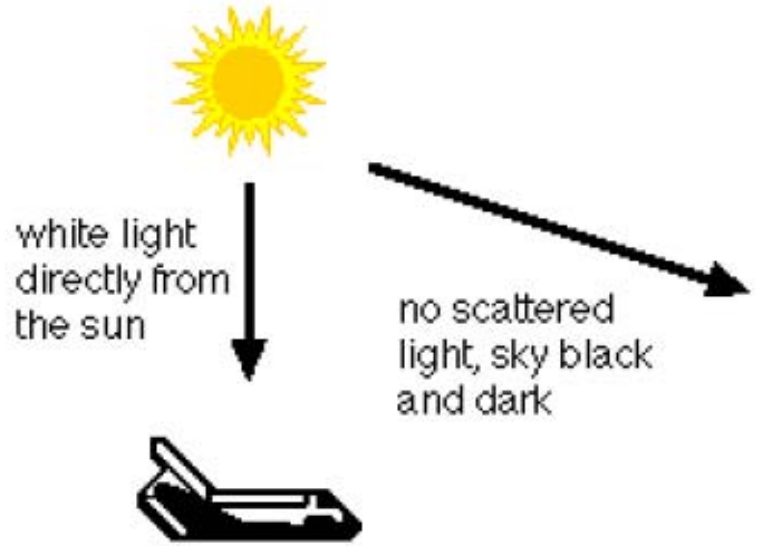
The colour we see depends on the amount of stimulation of each type of cone – so this gives the range of hues that we can see.

Why sky is blue?

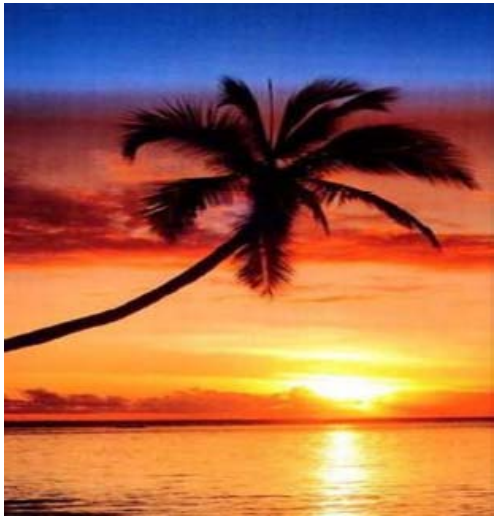


The blue color of the sky is due to Rayleigh scattering.





On Earth, the sun appears yellow. If you were out in space, or on the moon, the sun would look white. In space, there is no atmosphere to scatter the sun's light. On Earth, some of the shorter wavelength light (the blues and violets) are removed from the direct rays of the sun by scattering. The remaining colors together appear yellow.

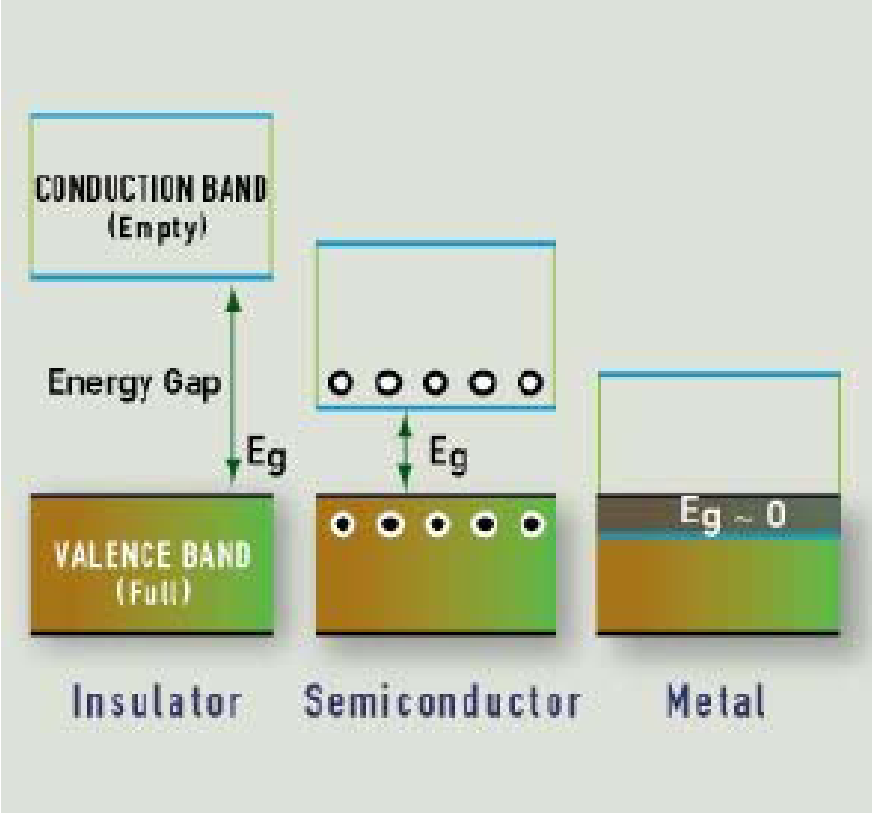


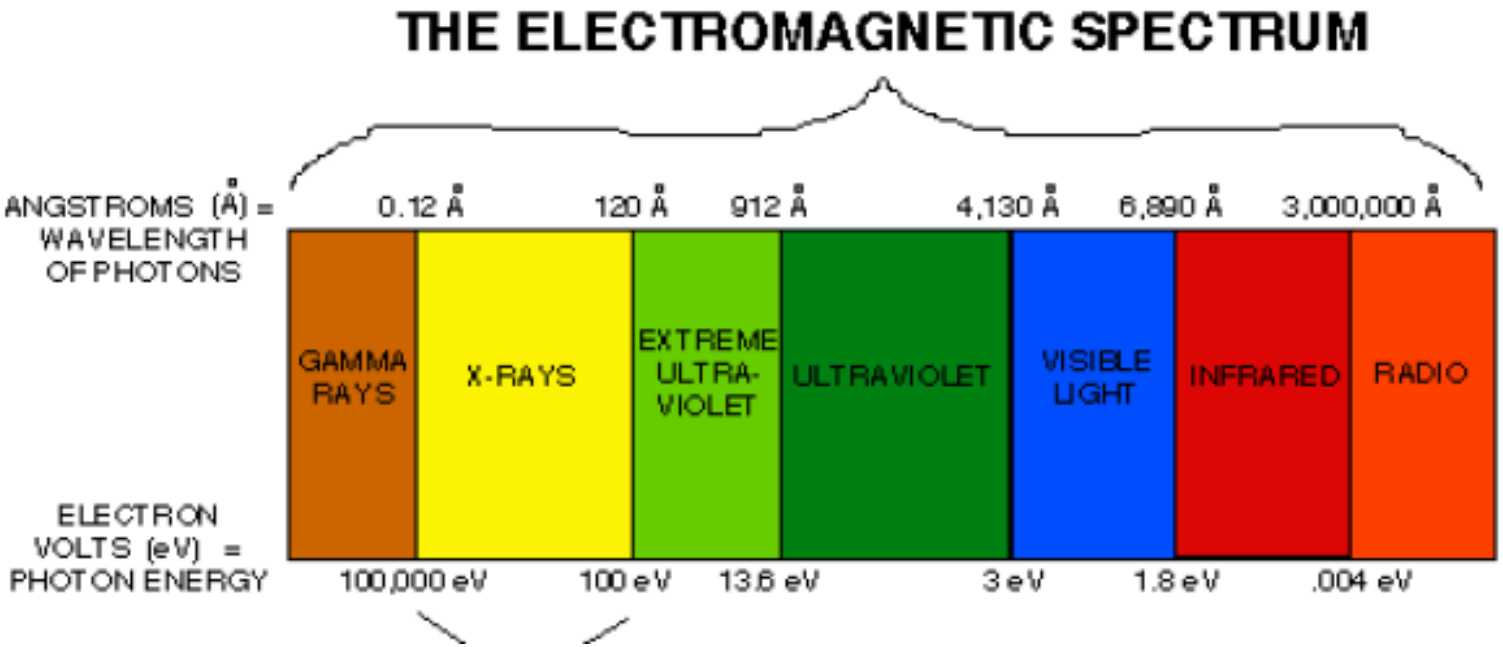
WHY IS THE SUNSET RED?

What is the color of shadows?

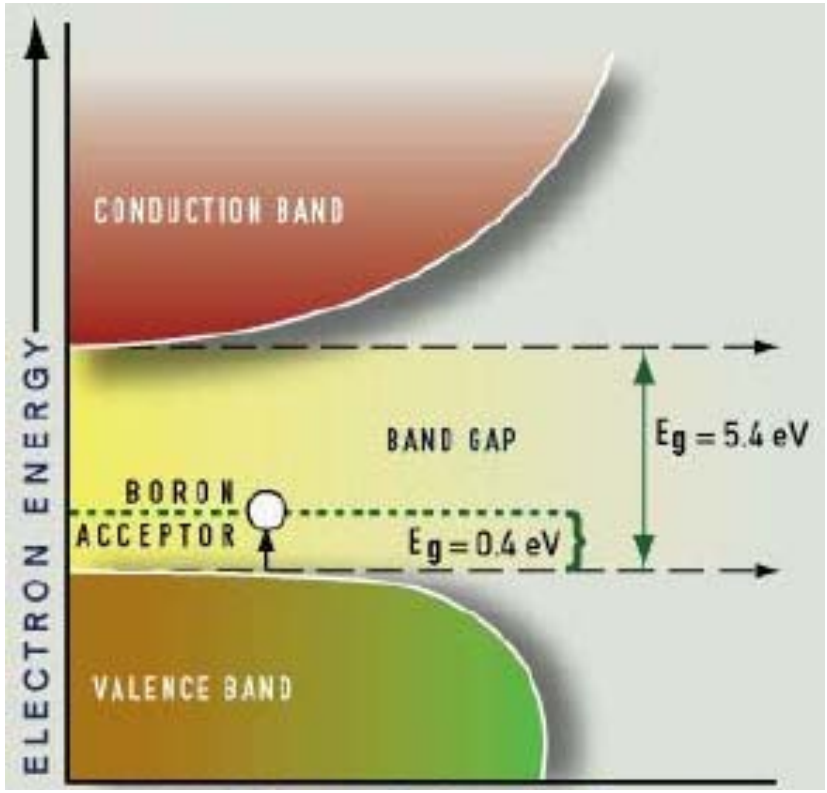
Levitan's painting

Colors of pure crystals and the band structure





Crystals of Cadmium sulfide *CdS* (yellow, Eg =2.5eV) and CdSe (black, Eg = 1.6eV)



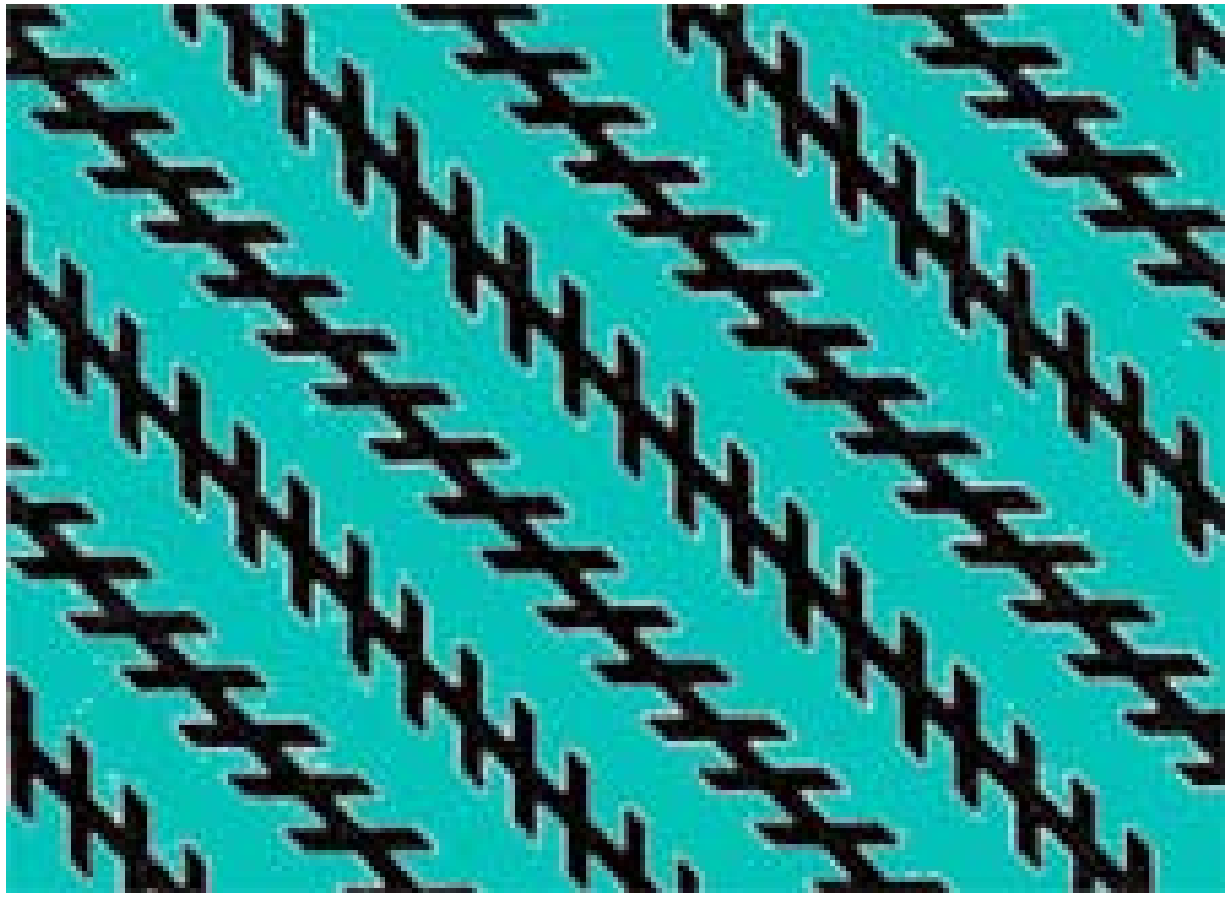
If the substance has a large band gap, such as the 5.4 eV of diamond or the similar value of corundum, then no light in the visible spectrum can be absorbed. These substances transmit all incident light, and are colorless in their pure forms.

The optical width of the *corundum* (aluminium oxide (α-Al_2O_3))
band gap is known to be 9.5 eV

The **ruby** is a pink to blood-red colored gemstone, a variety of the mineral corundum (aluminium oxide). The red color is caused mainly by the presence of the element chromium.

Sapphire (Greek: σάπφειρος; *sappheiros*, "blue stone"[1]) is a gemstone variety of the mineral corundum, an aluminium oxide (α-Al_2O_3). Trace amounts of other elements such as iron, titanium, can give corundum blue color

- Angles efects : exemple, illusion of Zöllner

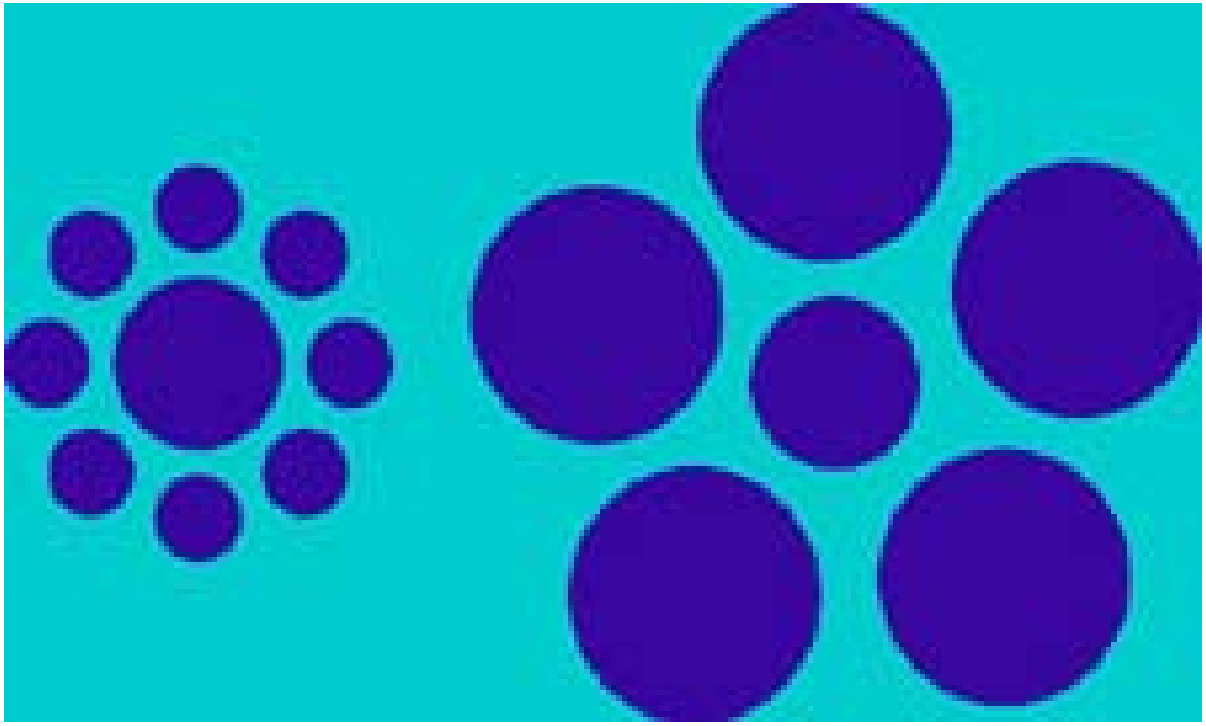


The tilted lines seem to be intersecting . But they are paralllel…

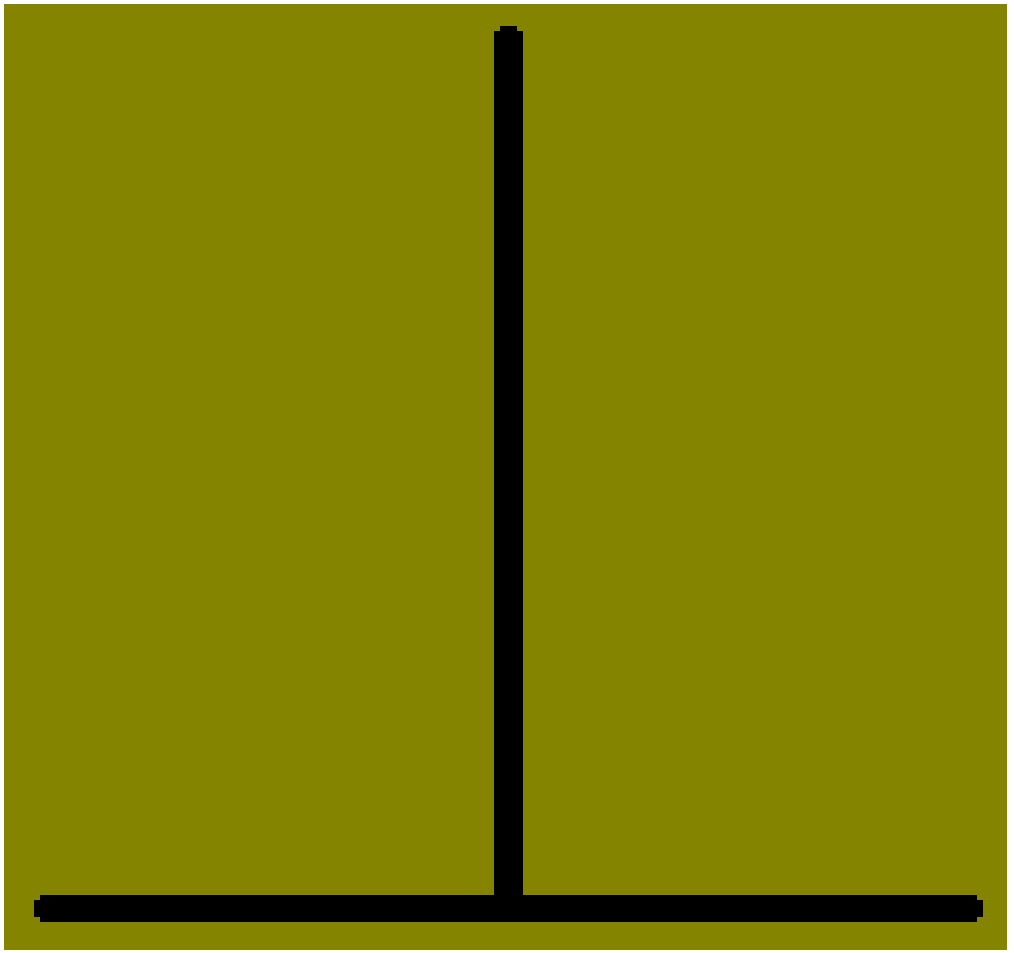
Geometric illusions

a) Illusions due to the brain

- Comparaison of the size: illusion of Titchener



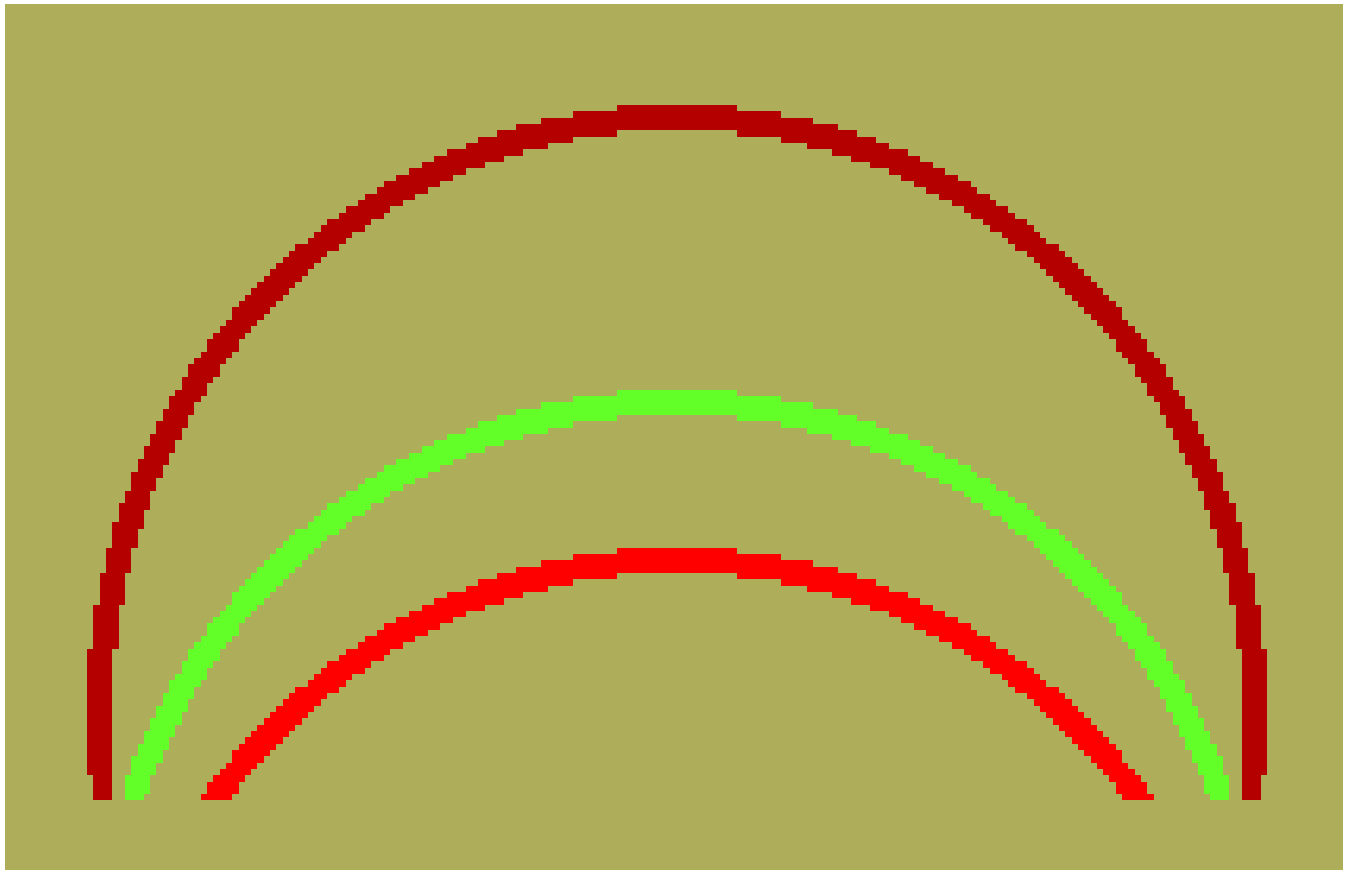
Le cercle central de la figure de gauche paraît plus grand que celui de la figure de droite. Pourtant, ils sont identiques.



Verical line seems to be longer than the horizontal one.

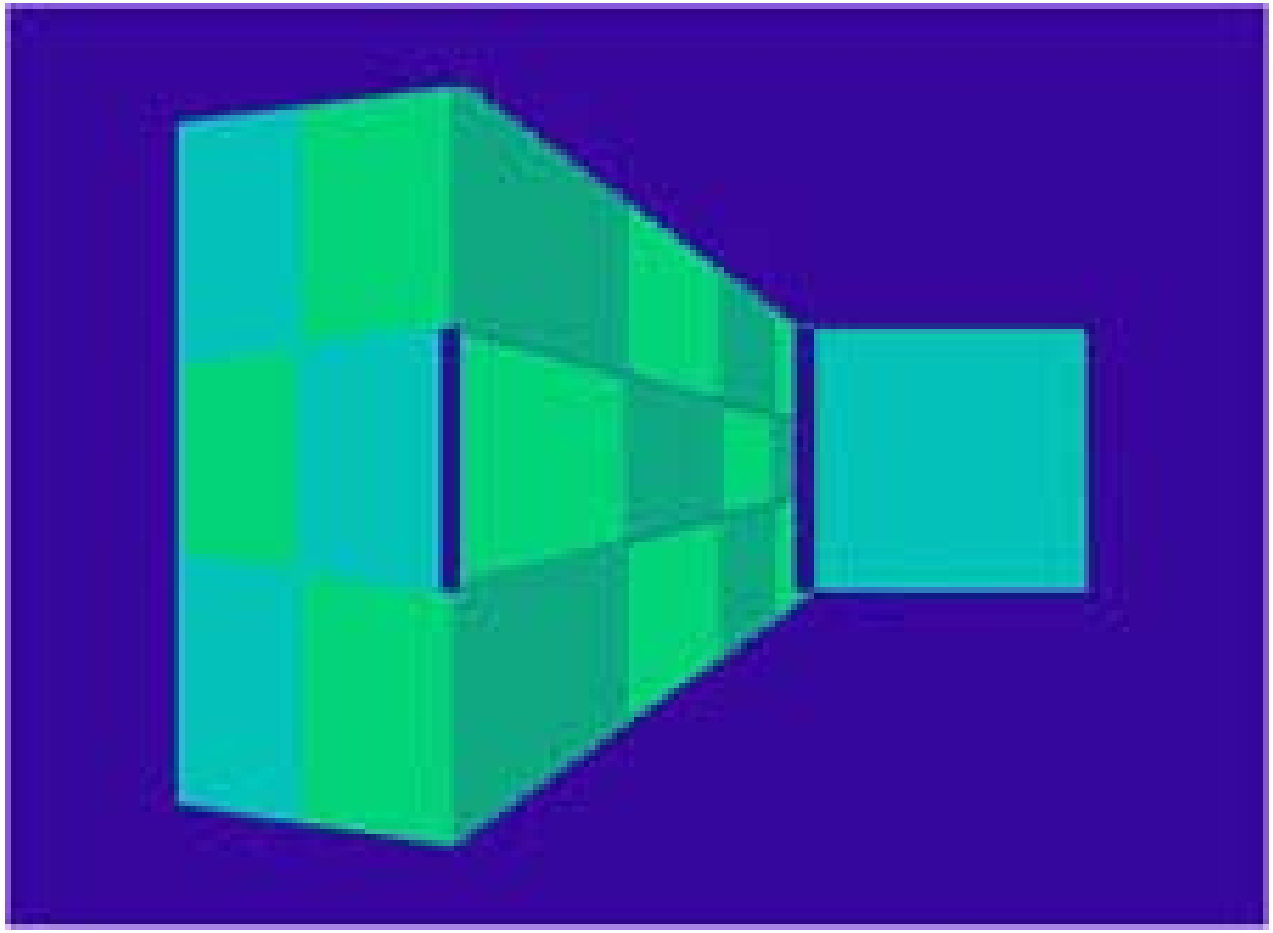
Eye motion along horizontal is easier than along vertical direction.

- Curvature



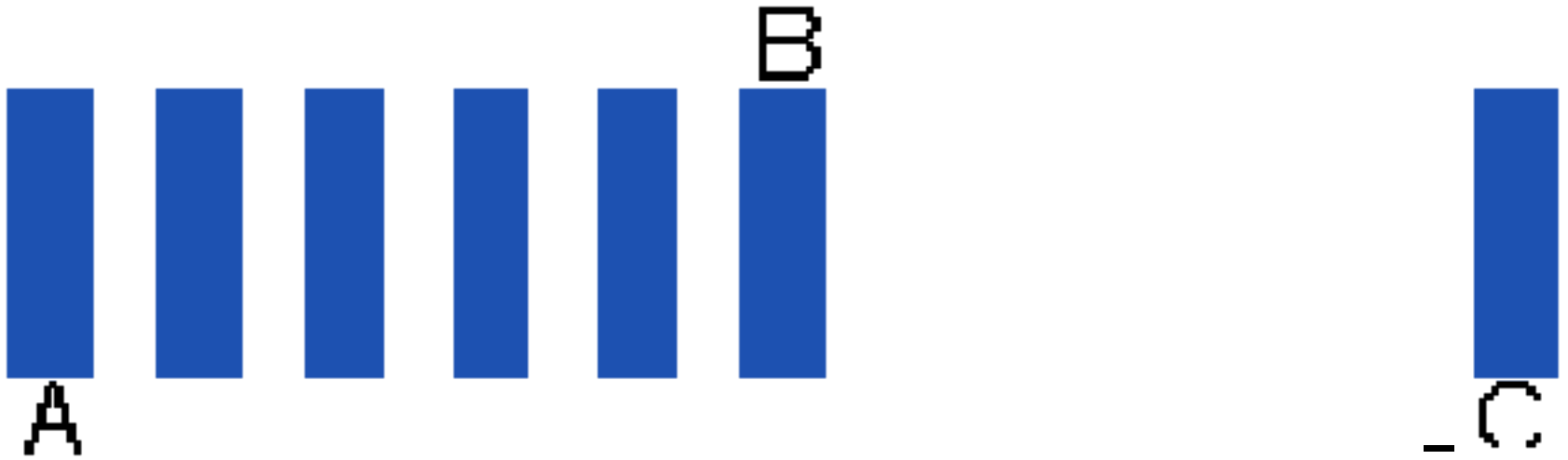
3 **arcs of a circle look to have different curvatures.**

- Perspective :



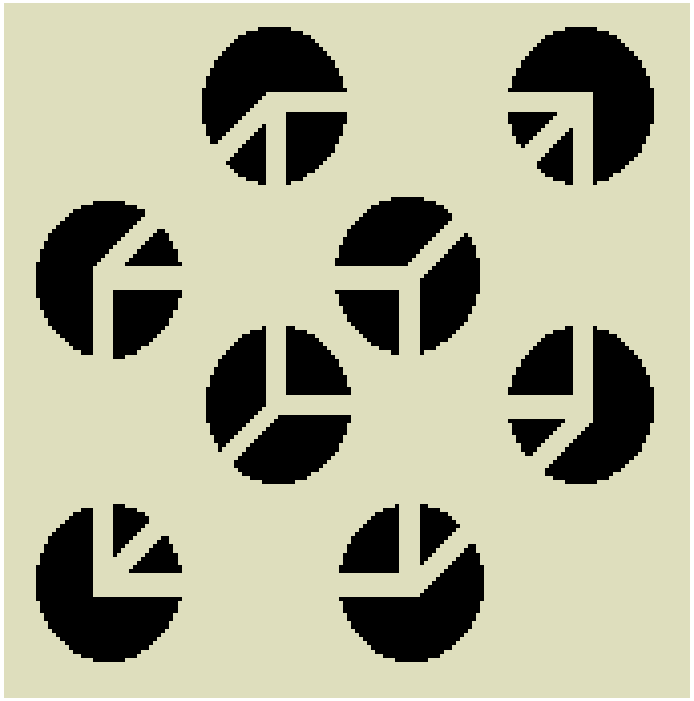
Right blue line seems to be longer than the left one.

- Space division: exemple, illusion of Oppel-Kundt

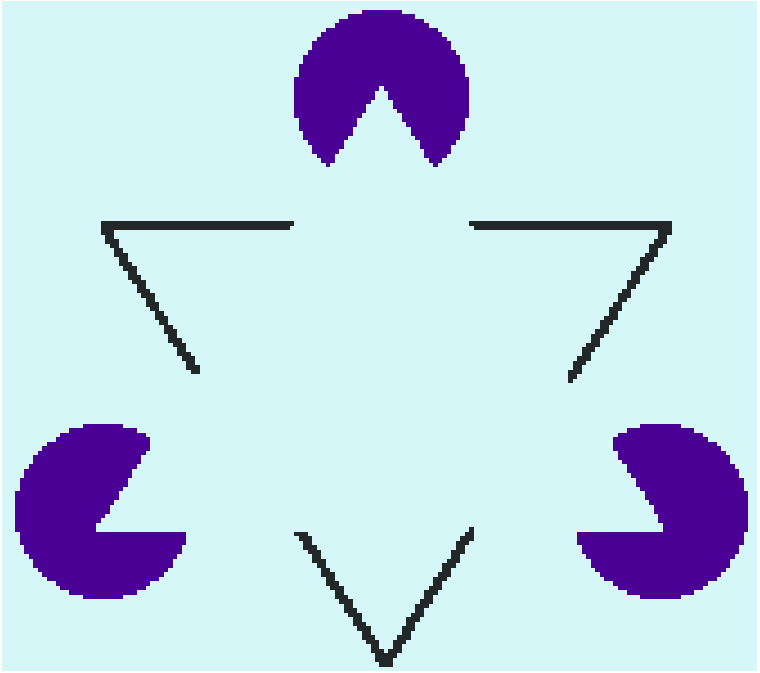


The distance between A and B seems to be larger than that between B and C, though they are equals.

- Subjective illusions :

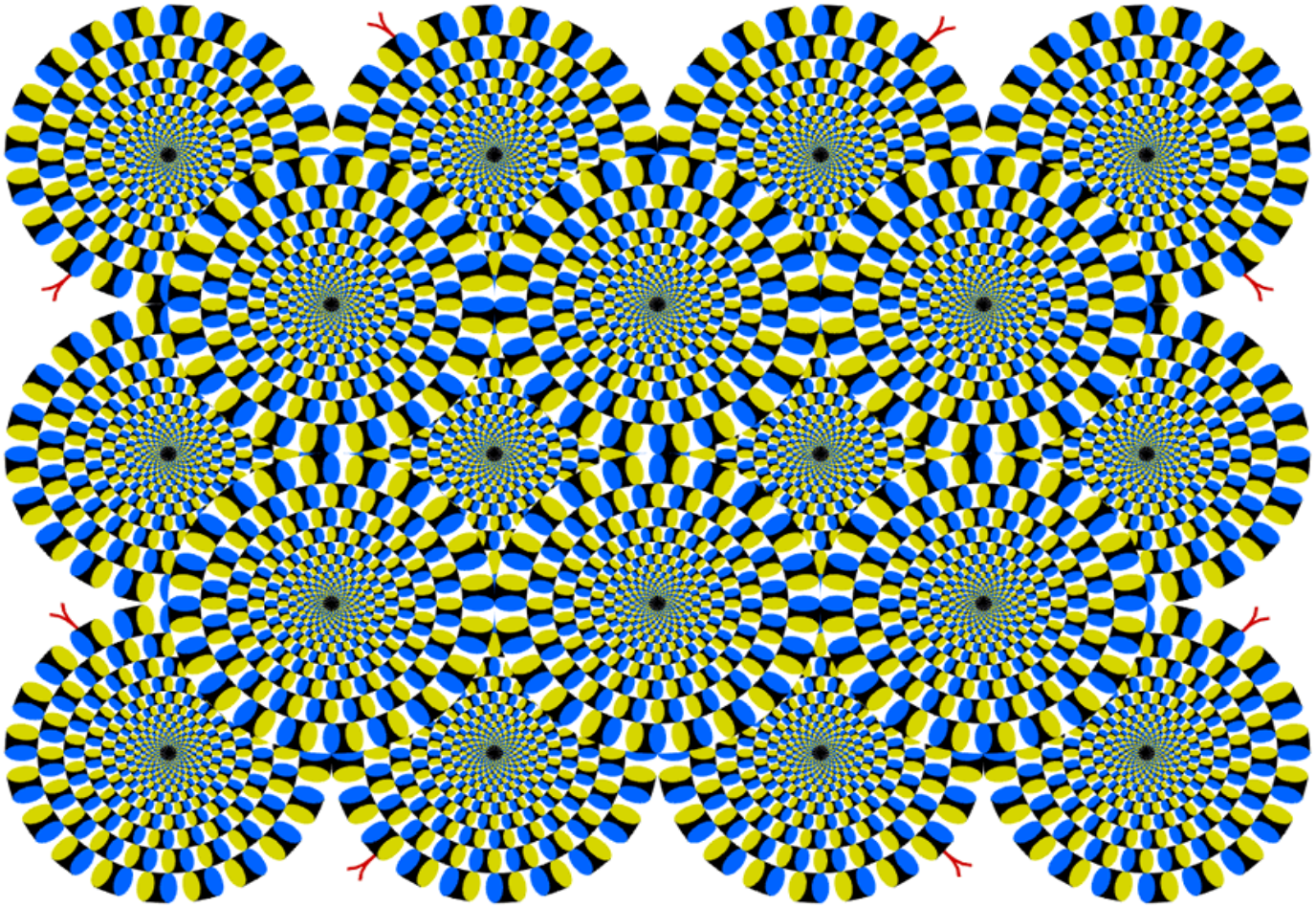


We have impression that the cube is drawn.



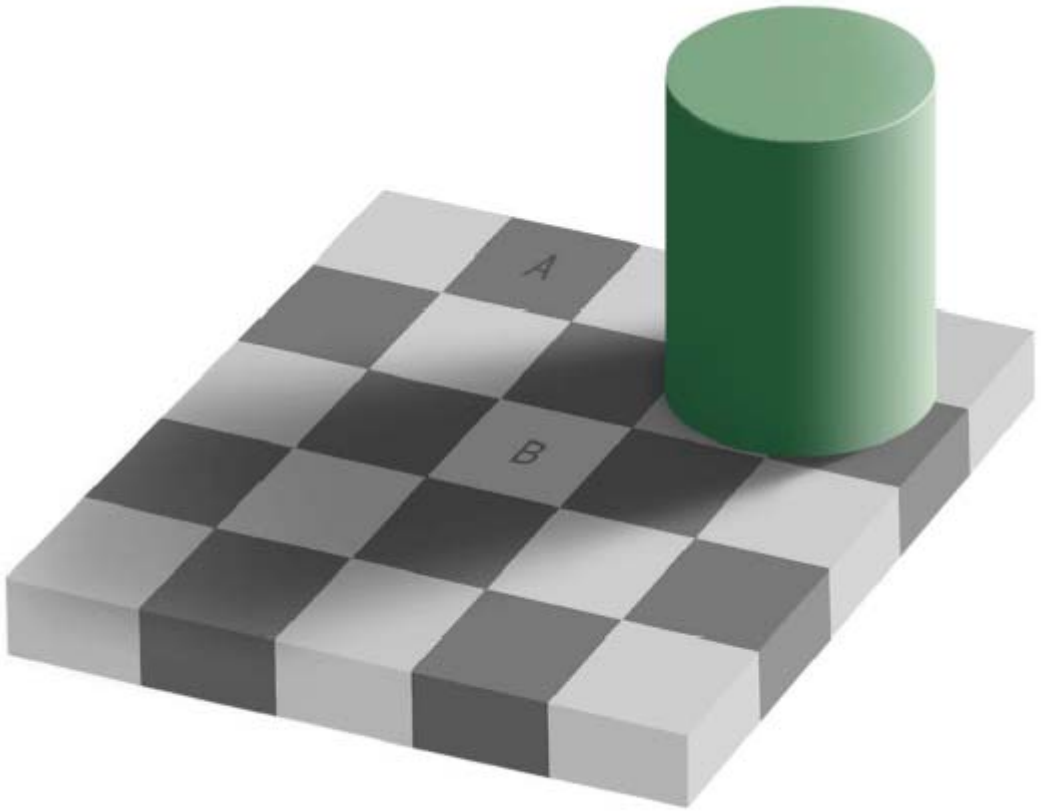
We see the white triangle with a well defined limit…

- Illusions of mouvements : exemple, illusion of Kitaoka

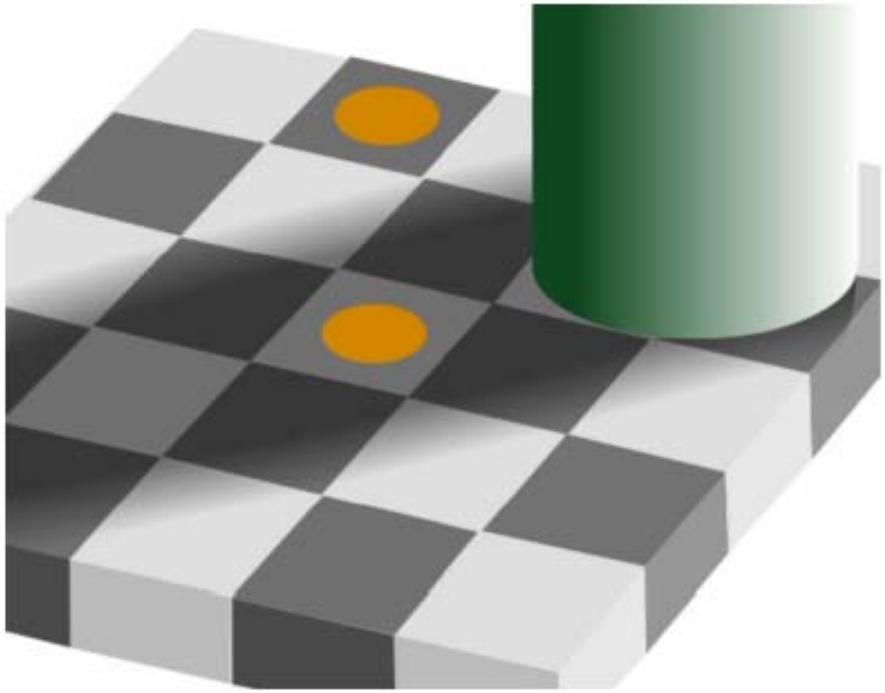


We see the rotating circles. If we fixe one cirles it stops to move but others

- Illusions of color : exemple, illusion of Adelson

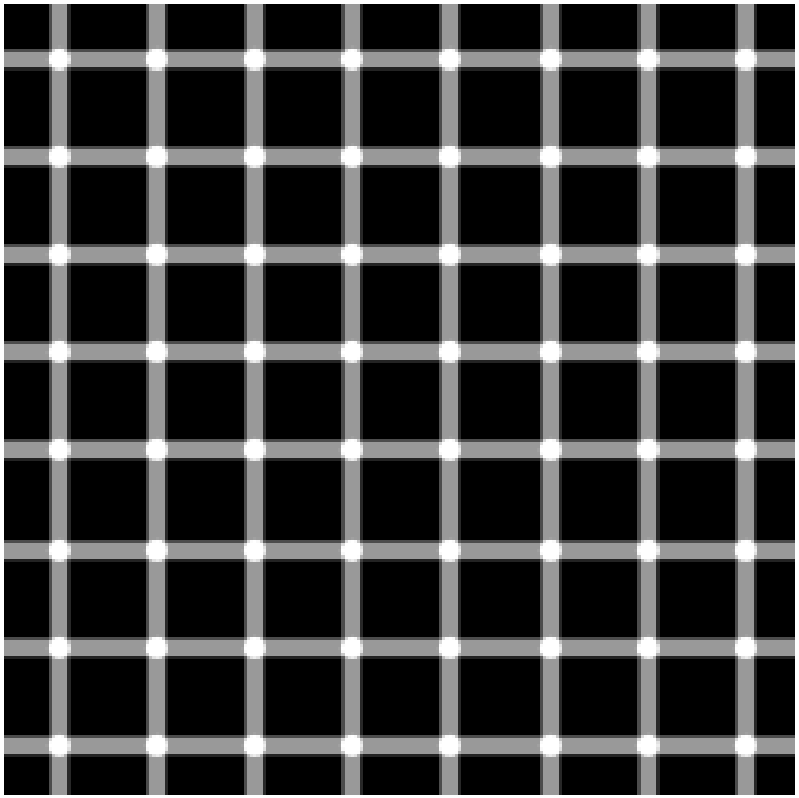


The square A seems to be more dark than B.
But they are of the same shade.



In this illusion, the colored regions appear rather different, roughly orange and brown. In fact they are the same color, and in identical immediate surrounds, but the brain changes its assumption about color due to the global interpretation of the surrounding image.

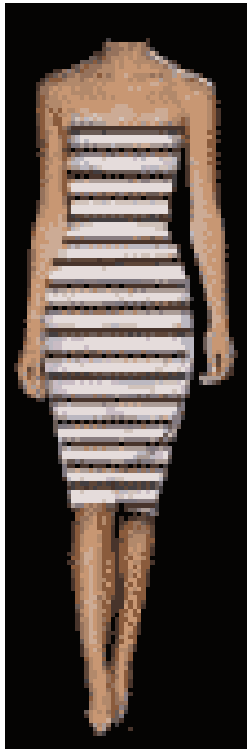
A scintillating grid illusion.



. Shape, position, colour, and 3D contrast converge to produce the illusion of black (white) dots at the intersections.

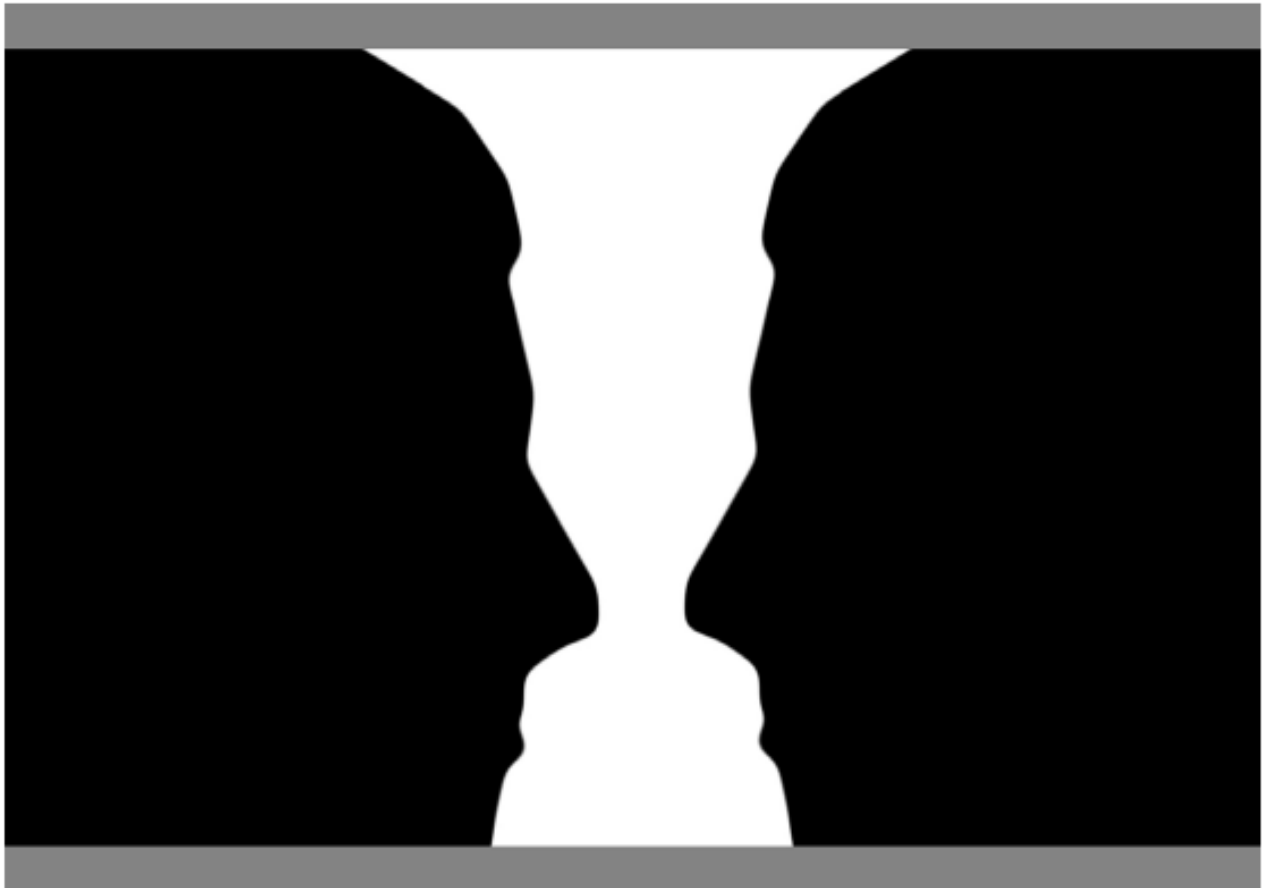
3) Fashion

➔Mode : The vertical stripes provide impression to be more slim than the horisontal ones…



Left person seems to be more slim.

Perceptual organization



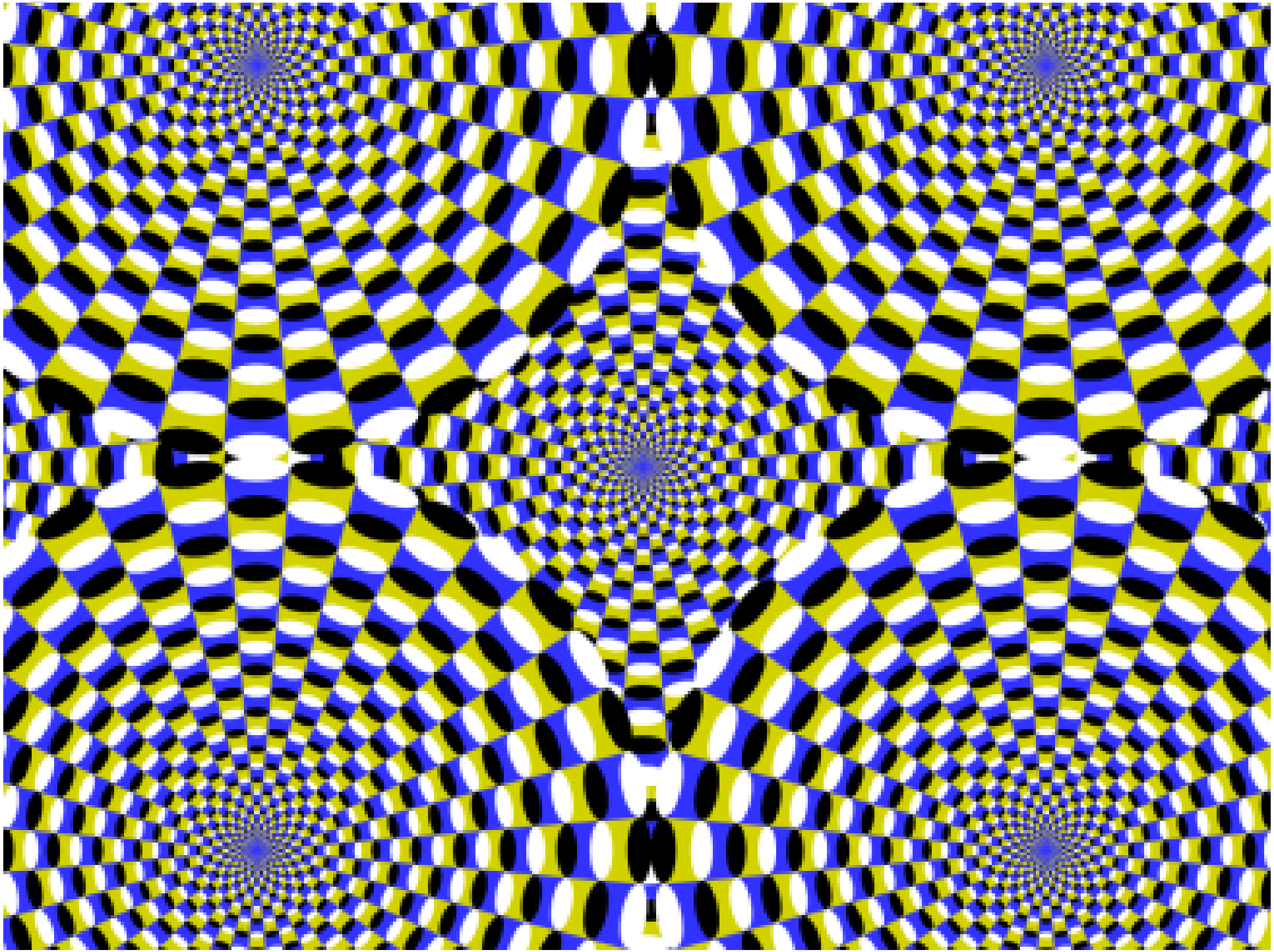
Two silhouette profile or a white vase

Vogue Illusion

Cognitive figure-ground optical illusion (#24v)

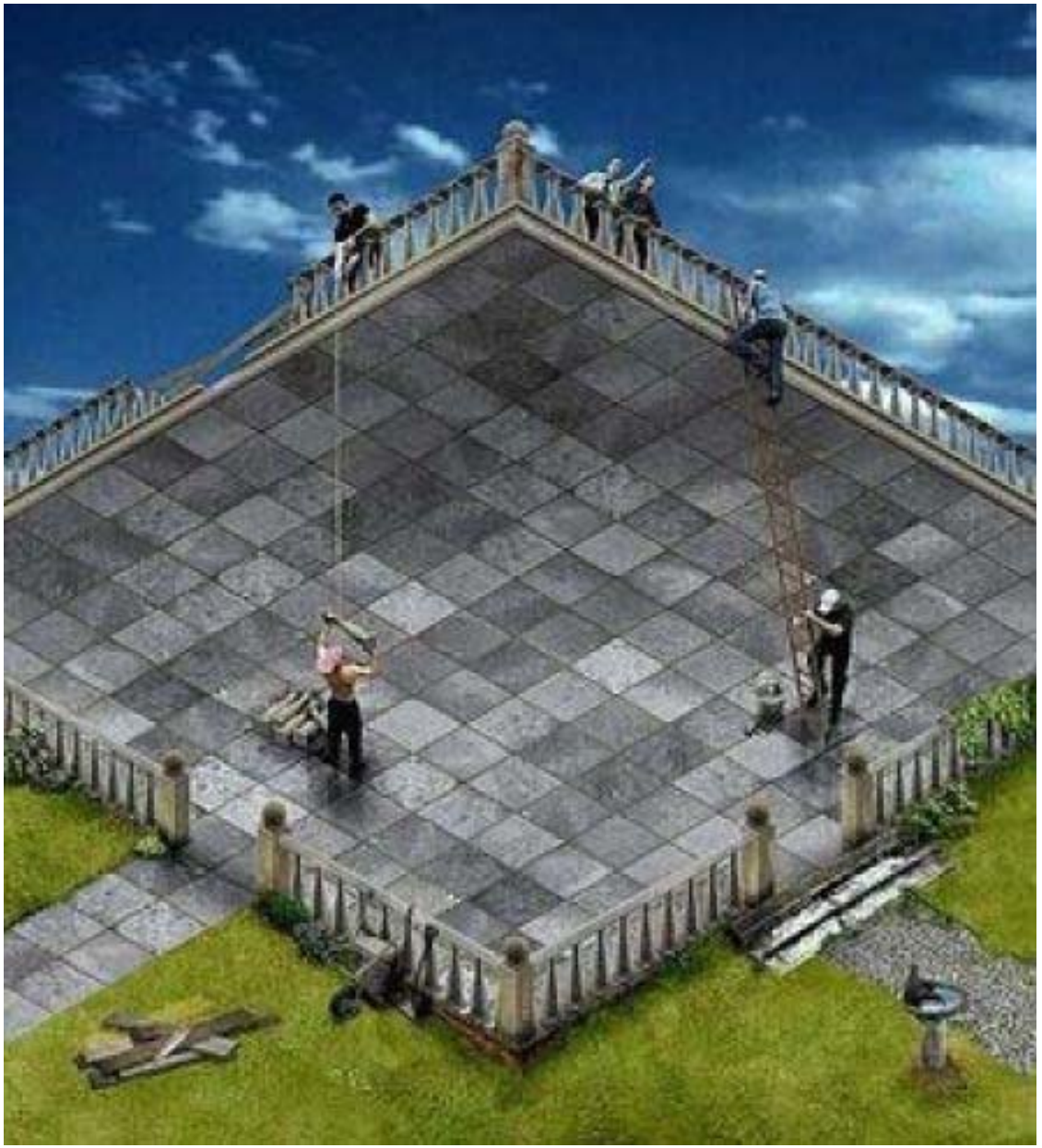
Do you see two or three elegant women? Illusions that generally feature two figures whose contours match seamlessly the contours of another figure inducing the viewer with a mental choice of two interpretations, each of which is valid, are related to Rubin's vase illusion, named after the Danish psychologist ***Edgar Rubin*** who introduced this illusion in his work 'Synsoplevede Figurer' ("Visual Figures") published around 1915.

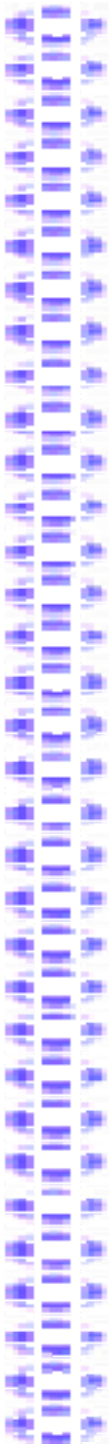
This image was taken from our book '**Curiopticals**', reviewed by "**The Sun**".



The **Mystery Spot** is a tourist attraction located near Santa Cruz, California. It was opened in 1939.

Maurits Cornelis ESCHER





http://www.youtube.com/watch?v=bOP37A1EhEs