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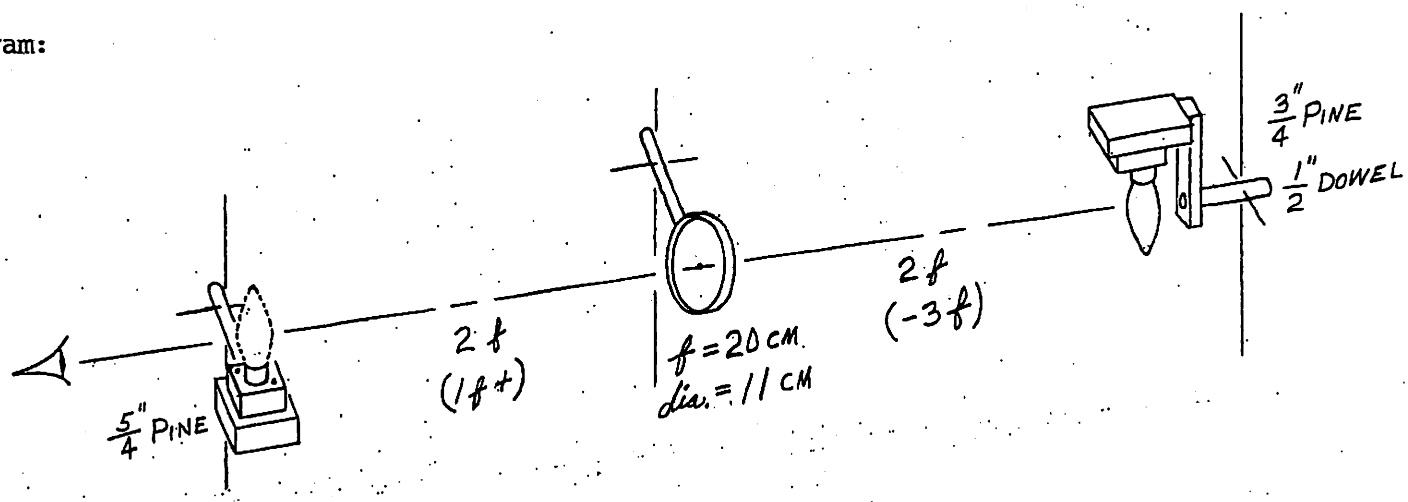
Light and a real image - a real image via refraction.

Here are two more fine examples of real images, this time due to refraction; the importance of a double convex lens is also appreciated. These demos involve illusion (an aerial image) and secrecy for maximum effect. The lamp fixtures may be homemade; the 11 cm dia., 20 cm focal length lens, or something close to it, must be purchased. (This lens has several other important uses, thus, making it well worth having.) The recommended bulbs (2) are 25W torpedo (white).

Diagram:

(a)

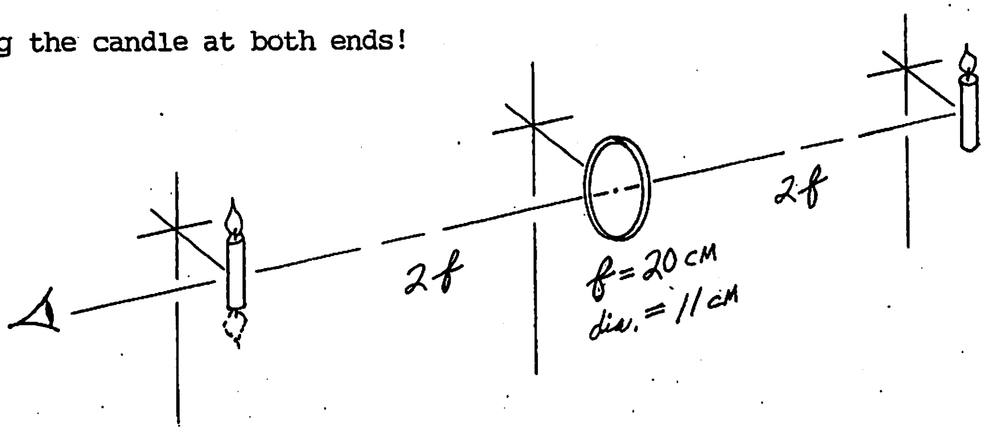


translucent screen - a translucent lid from a coffee can?
the "flipping" technique - shows the convergence and divergence of light well, along the principal axis

suggestion: Start the static demo so the students can see the two bulbs in their "normal" positions. When the students have left the room, remove the "image" bulb, flip the "object" bulb upside down, and check the final alignment.

Note: Special thanks to Edward P. Wyrembeck and Jeffrey S. Elmer for their major article, "Investigating an Aerial Image 1st" in The Science Teacher magazine (Feb. 2006).

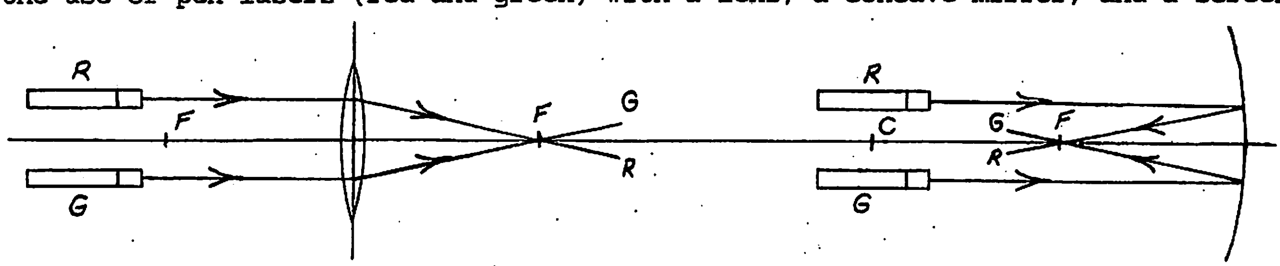
(b) Burning the candle at both ends!



Note: Special thanks to John E. Armstrong of Pueblo, CO for suggesting this demo to me.

A review: the use of pen lasers (red and green) with a lens, a concave mirror, and a screen.

Diagram:



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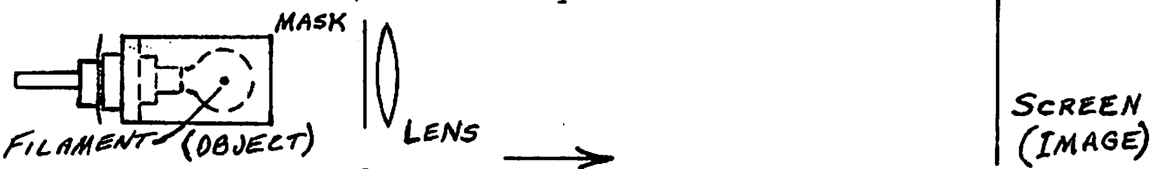
The 4½" or 11.5 cm dia. (7" or 18 cm FL), double convex demo lens with three different masks.

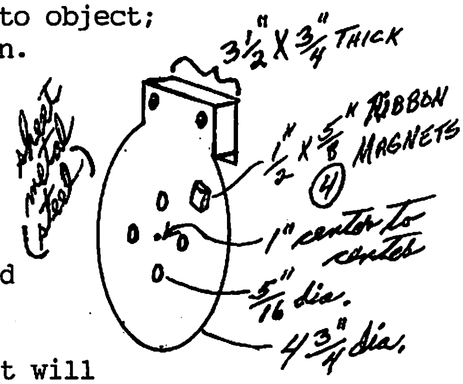
Studies of points of light with a lens and focusing. Studies of chromatic and spherical aberrations.

Part I - Points of light with a lens and focusing.

Procedure: (a) Align the assembly according to the diagram below, making sure that the screen is out of focus, too far away.

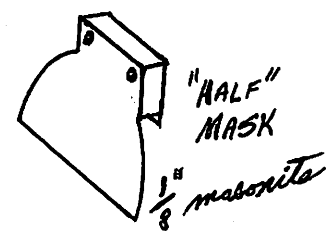


60 W globe clear (pentagonal) — Start with lens close to object;
60 W crystal clear (straight) — then move toward screen.



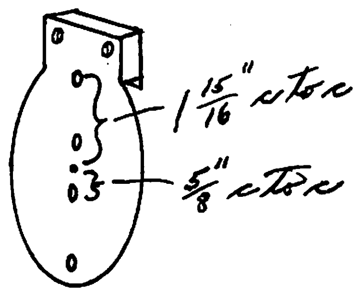
Add the four-holed mask (square pattern) with holes covered. Turn on the pentagonal light filament (object) and remove one of the covers; note the image on the screen. Uncover the remaining three holes and observe the total of four images on the screen. Now slowly move the lens with mask toward the screen and watch the images merge as one. Remove the mask and slowly move the lens back to its original position. What's happening?

(b) Move the lens back to the "best" focus position. Ask what will happen when the "half" mask is added. Add the "half" mask. Also, move the "half" mask around the lens. Do the students make the connection between (a) and (b) and the concept of points of light with a lens?



Part II - Aberrations

Procedure: (a) Align the assembly as in the above diagram, again making sure that the screen is out of focus, too far away. Add the four-holed mask (vertical pattern) with holes covered. Turn on the straight, horizontal light filament (object) and remove the covers of the two outside holes; note the spectra of the two images. Uncover the two inside holes and observe the white light of the two images. The comparison of the two sets of images demonstrates the chromatic aberration that results from light passing through the outer edges of the "complete" lens.



(b) Now move the lens with mask slowly toward the screen. Note that the two outside, chromatic images pass through ("over") the inside, white light images and come to a focus first. If the lens with mask is moved even closer to the screen, the chromatic images begin to spread out, passing back through the white light images that are continuing to come to a focus. The relative movement of the two sets of images illustrates the spherical aberration that results from light passing through the outer edges of the lens compared to that passing through the center portion of the lens.