SIMPLE PAPER INTERFACES ON LIGHT

How does light work?

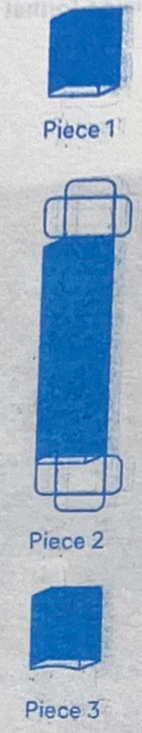
Made on the event of the 2024 Solar Eclipse

THE FIRST ORDER OF BUSINESS

1

Assemble your eclipse ‘theater’

The 3 pieces are inside the nested mailer.



ECLIPSE THEATER

A paper projection screen for viewing or filming the eclipse.

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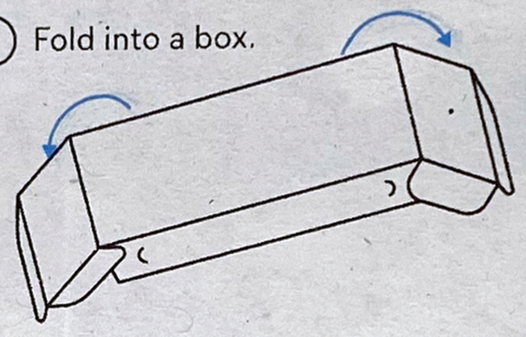
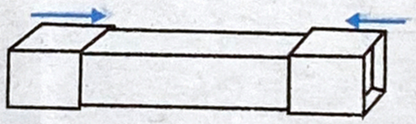
① Fold into a box.



② Tuck the flaps into the ⌒s.

③ Slide the sleeves over each end to make the box lightproof.

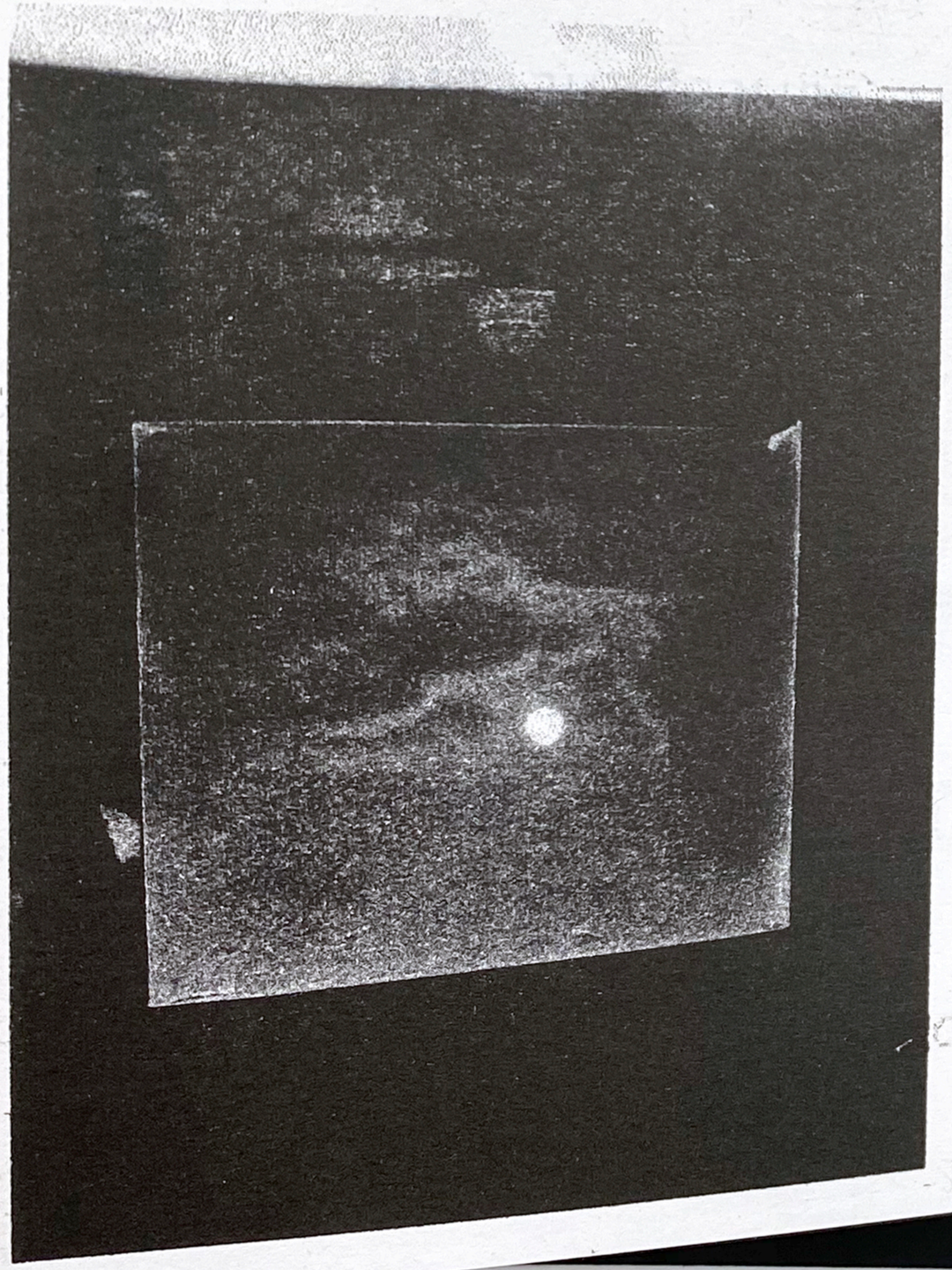


④ Point pinhole at the sun and the eclipse will appear on the screen.

Tape or glue the flaps if you wish.

These sleeves are adjustable. Push them forward or backward to calibrate the amount of shade your eye or camera requires. *Note that one sleeve is forehead-shaped.*

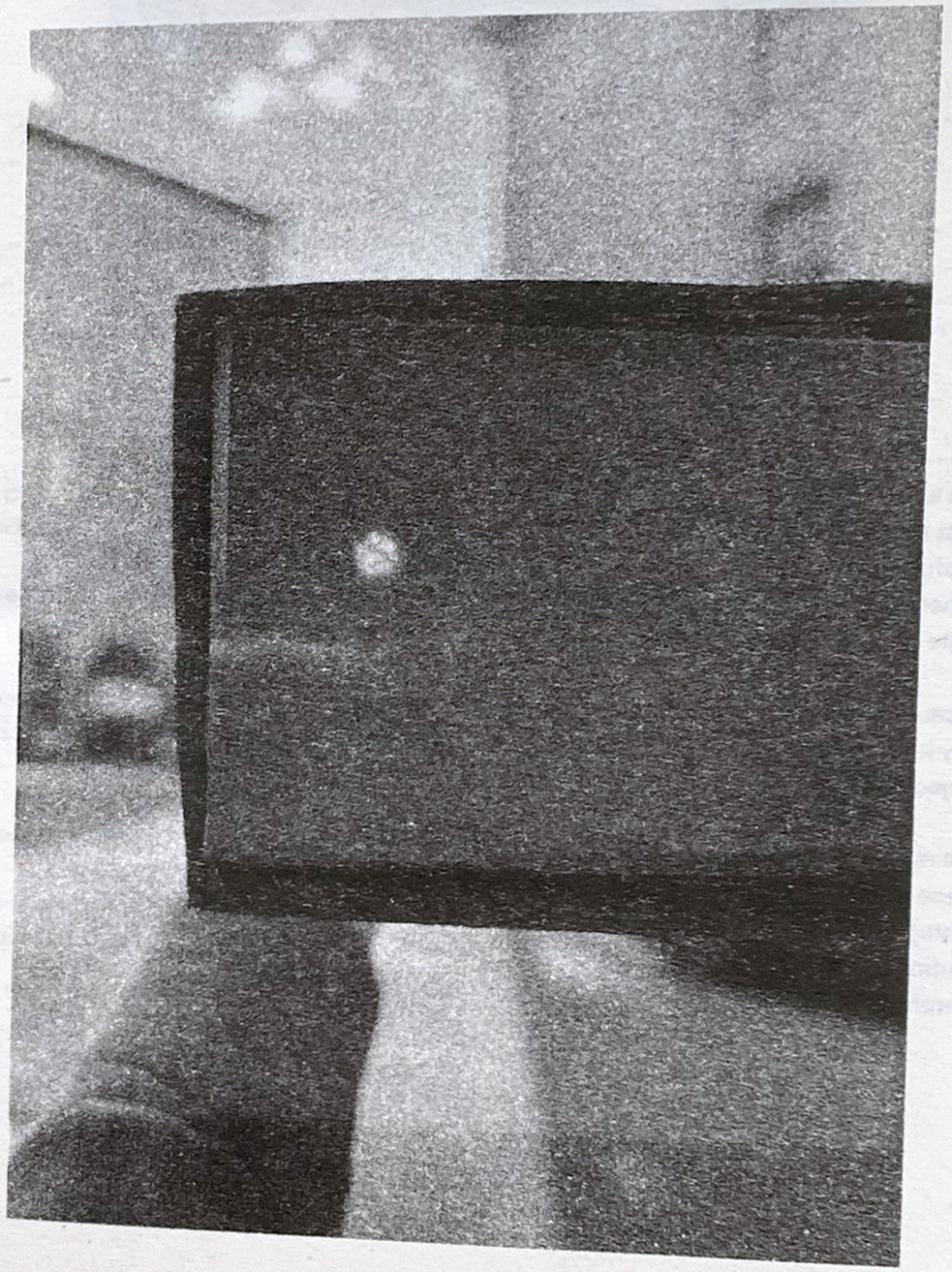
This device sets up a thin paper (it is a cellulose/fiber-based vellum) screen onto which you may project an image of the sun—as well as surrounding trees and clouds. It works the same way that the earliest large format view cameras worked (but using a paper screen instead of ground glass.)



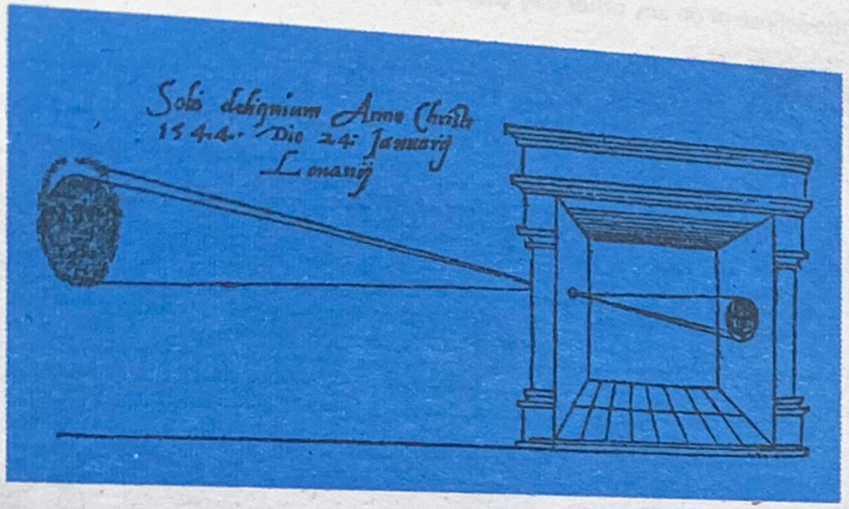
Through the viewer: Full sun with clouds through the viewer

Use it to view the eclipse or on any other day when you want to safely see what the sun is up!

Look closely: Does your projection appear to be upside-down?



Through the viewer: Full sun, but partially blocked by a tree.

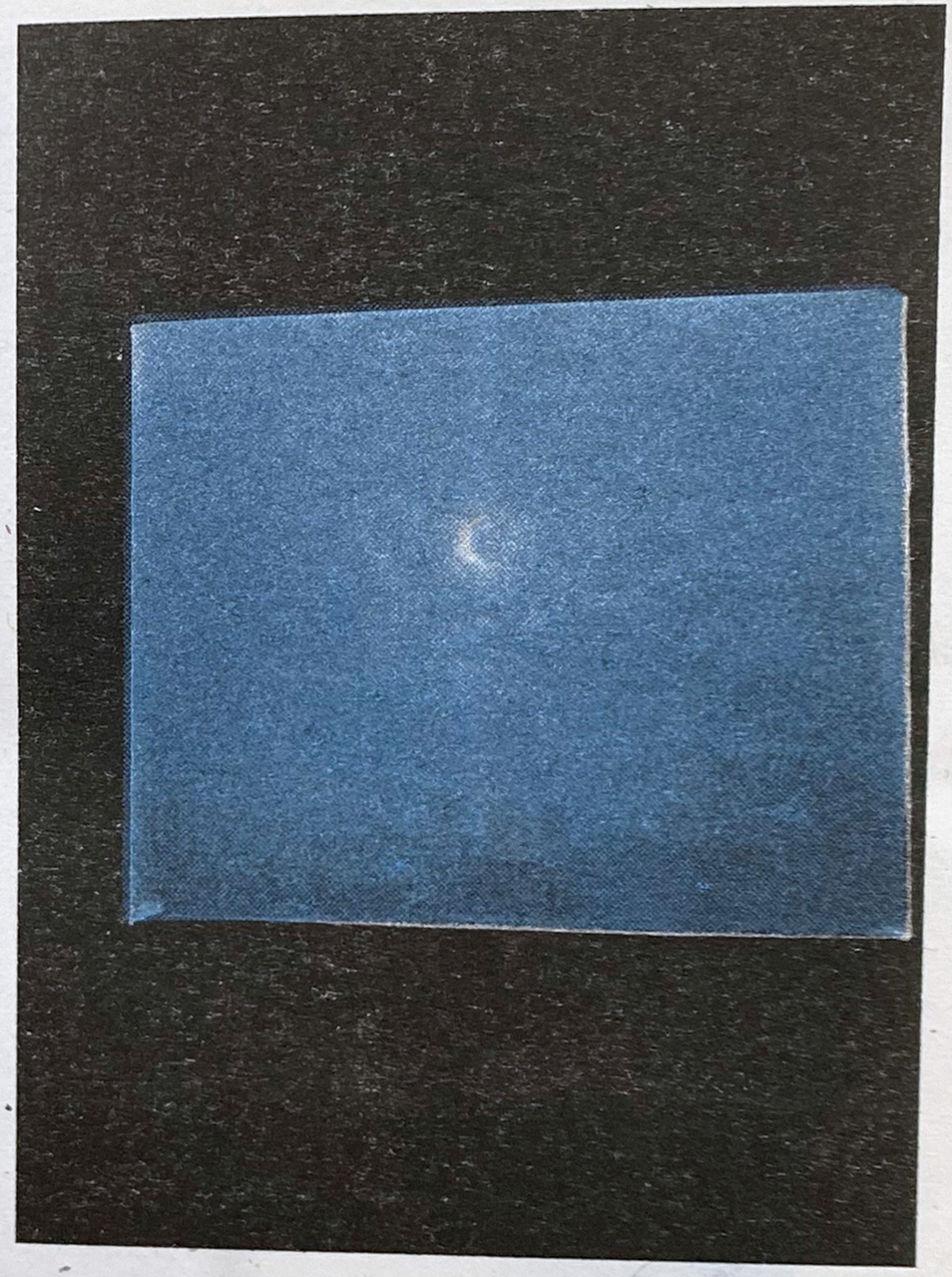


First published picture of a camera obscura in Gemma Frisius' 1545 book De Radio Astronomica et Geometrica

This eclipse 'theater' is a type of *camera obscura* (also known as a pinhole camera), which is most simply described as a 'lightproof box with a hole.' While it is ancient technology, it is helpful to think of this as a device whose function is to *filter*. The lightproof-ness of the camera obscura filters out most of the cacophony of light that bounces around us from every angle direction, making the 3-dimensional world visible.

Because a fundamental principle of light is that it can only travel in a straight line, a pinhole only lets rays of light from a single vantage-point/snapshot enter. It therefore renders a 2-D projection onto a screen (or wall or, if inside of a camera, onto photo paper).

The reason that the image is upside down is diagrammed by the X above. The part of the scene that falls above the pinhole bounces-back light in a straight line. From the vantage-point of the [lower] pinhole, that means that the image-carrying beam of light—in continuing in a straight line—is angled downward. The projection of the top of the scene therefore end up being projected onto the bottom of the screen inside.



Through the viewer: What the eclipse might look like (artist's drmatization)

BOB MILLER'S LIGHT WALK

All light is a projection of its source

I first learned about Bob Miller when I was a fellow in residence at the Exploratorium in San Francisco. I was invited on a recreation of his "light walk" wherein we used an oddly-punched sheet of paper as an interface on sunlight.

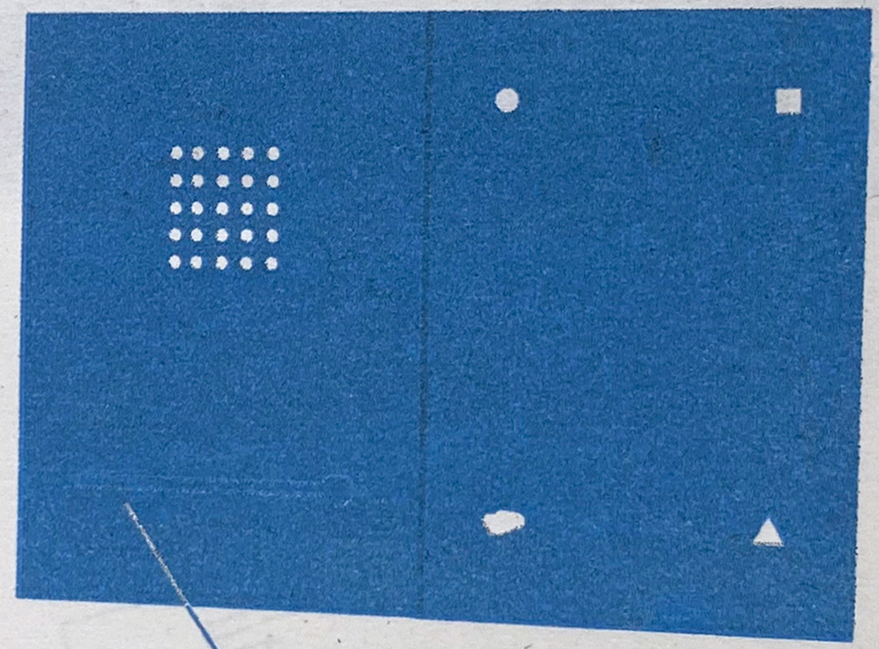
Bob set out to demonstrate, through firsthand demonstrations, that light is always a projection of an image of its source. Under normal conditions, a round hole in a piece of paper will yield a round projection of light because the sun itself is round. During an eclipse, however, that same round hole will yield crescents. Have an "F"-shaped lightsource (as there is in the Light Walk exhibit at the exploratorium)? It will indeed yield little "F"s, counterintuitive as that seems.

Left unaided, our perception leads us to clear, if inaccurate, conclusions about the nature of reality. A tether to a reality outside of our heads is needed to prove that certain perceptual conclusions are false. In acting as a simple interface, Miller's deceptively humble piece-of-paper-with-a-hole-in-it fits Don Norman's definition of a cognitive object.

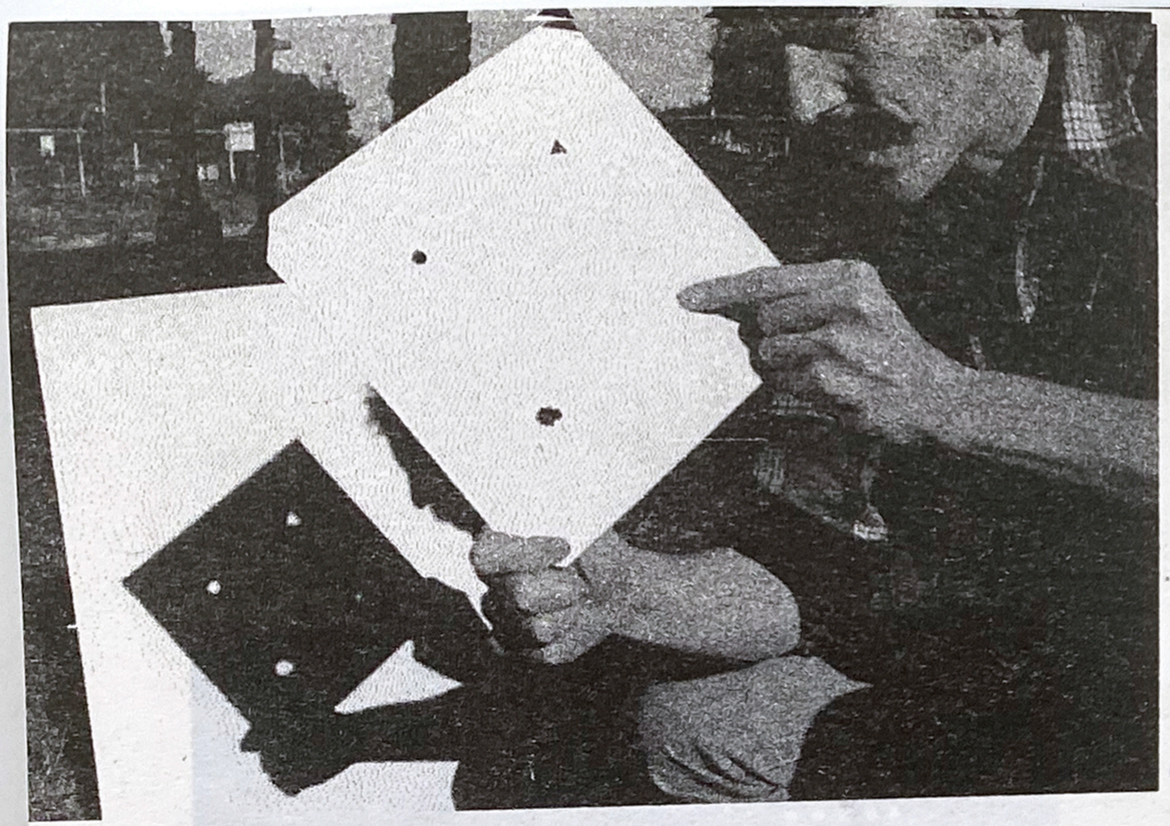
Whenever the world feels lusterless, I pull out the perforated sheet to remind myself of the surrealism and mysteries lurking in even the most basic places.

The cover of this book is die cut to provide the pieces for Bob Miller's Light Walk.

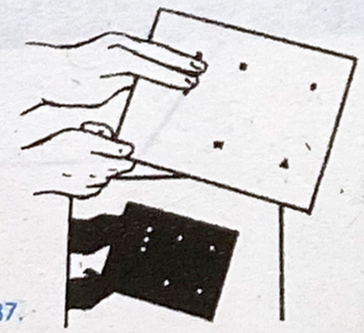
Use it during the eclipse and then during the non-eclipse to experiment with a few of Bob Miller's light demonstrations.



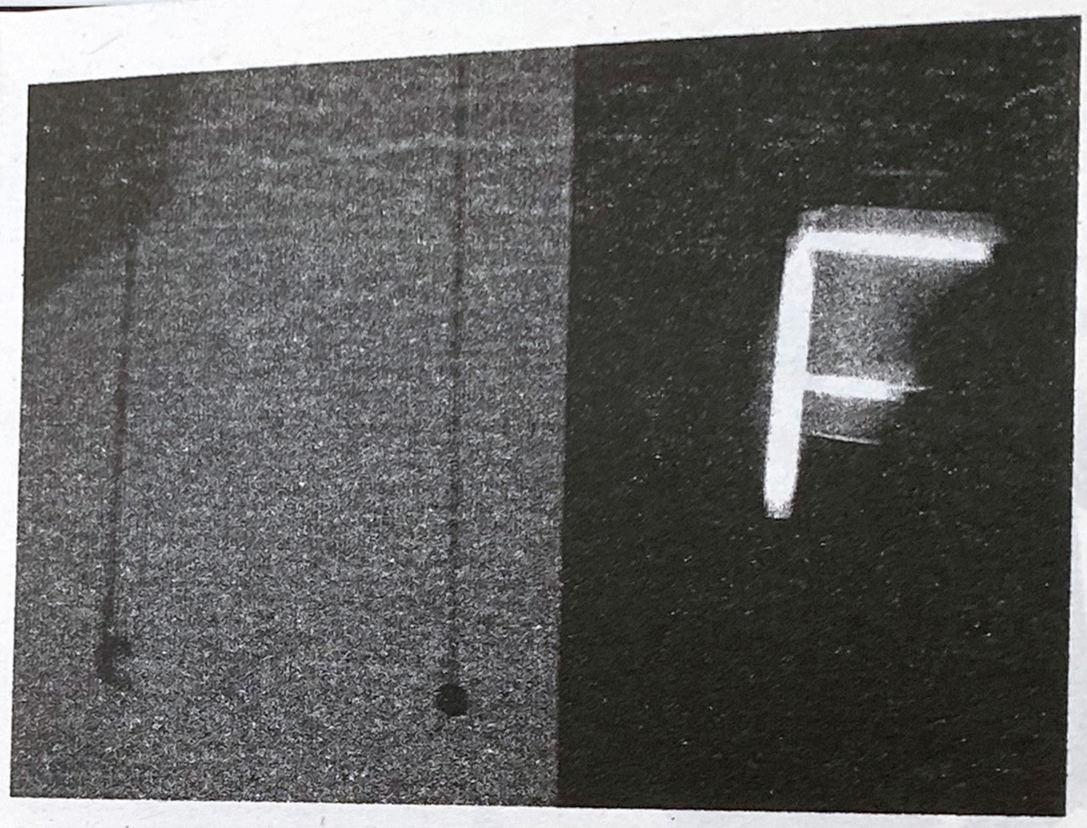
Hold onto this part, so you can dangle/punch-out a shadow.



Hold the card about a foot from the posterboard and let sunlight shine through the holes. At this distance, the spots of light will be the shape of the holes. Gradually move the holes away from the posterboard. The spots will become more rounded. When the holes are about 6 feet from the posterboard, the spots will be round. As you move the holes even farther from the posterboard, the spots remain round, but get larger and larger.



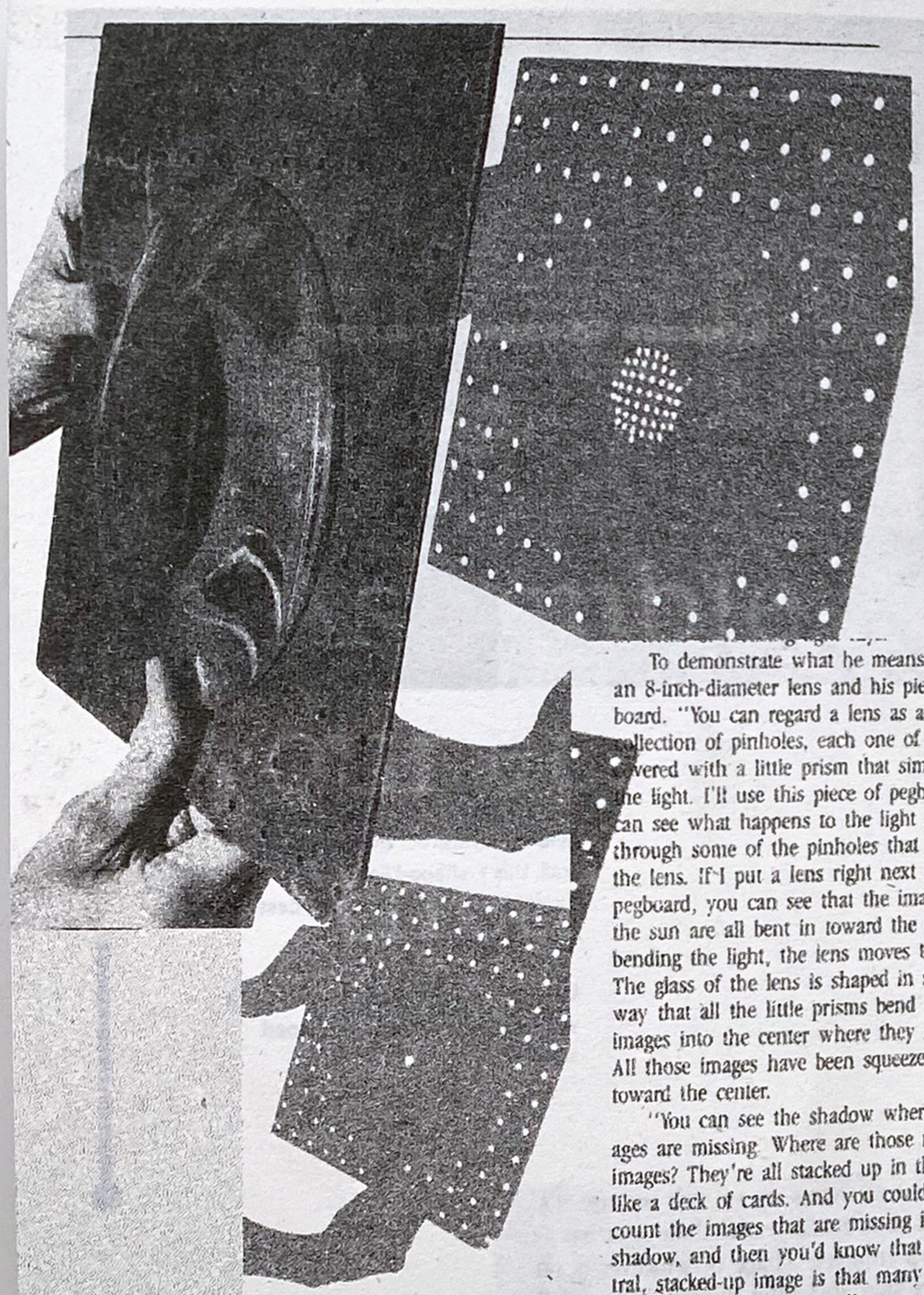
Excerpted from *The Exploratorium Quarterly*, Winter 1987.



A shadow is essentially a punched-out/missing image of its source. When a round pendant is held at the correct distance from the wall, this F-shaped light at the Exploratorium, for example, casts an F-shaped shadow.

Use the provided pendant and see if you can make an eclipse-shaped shadow.

The sun shows up so well because it's so bright. But actually, each hole also lets through a complete image of whatever is on the other side, including the blue sky and the clouds. All that information is in the light.



To demonstrate what he means, Bob takes an 8-inch-diameter lens and his piece of pegboard. "You can regard a lens as a whole collection of pinholes, each one of which is covered with a little prism that simply bends the light. I'll use this piece of pegboard so we can see what happens to the light that goes through some of the pinholes that make up the lens. If I put a lens right next to the pegboard, you can see that the images of the sun are all bent in toward the center. By bending the light, the lens moves the images. The glass of the lens is shaped in such a way that all the little prisms bend all the images into the center where they all overlap. All those images have been squeezed in toward the center.

"You can see the shadow where the images are missing. Where are those missing images? They're all stacked up in the center, like a deck of cards. And you could actually count the images that are missing in the shadow, and then you'd know that the central, stacked-up image is that many times as bright as any single image."

To Do and Notice

Take the "Array of Holes" card from the center of the magazine or your piece of pegboard. Use the card or the pegboard to make an array of sun images on the posterboard. As you move the card or the pegboard away from the posterboard, the images will begin to overlap. Notice that all the images are the same size.

Use masking tape to make some of the holes a little smaller. If you're using the "Array of Holes" card, you can also make some of the holes a little bigger. Now make another array of sun images. Though all of the images are still the same size, some will be brighter than others. The bright images are from light shining through larger holes.