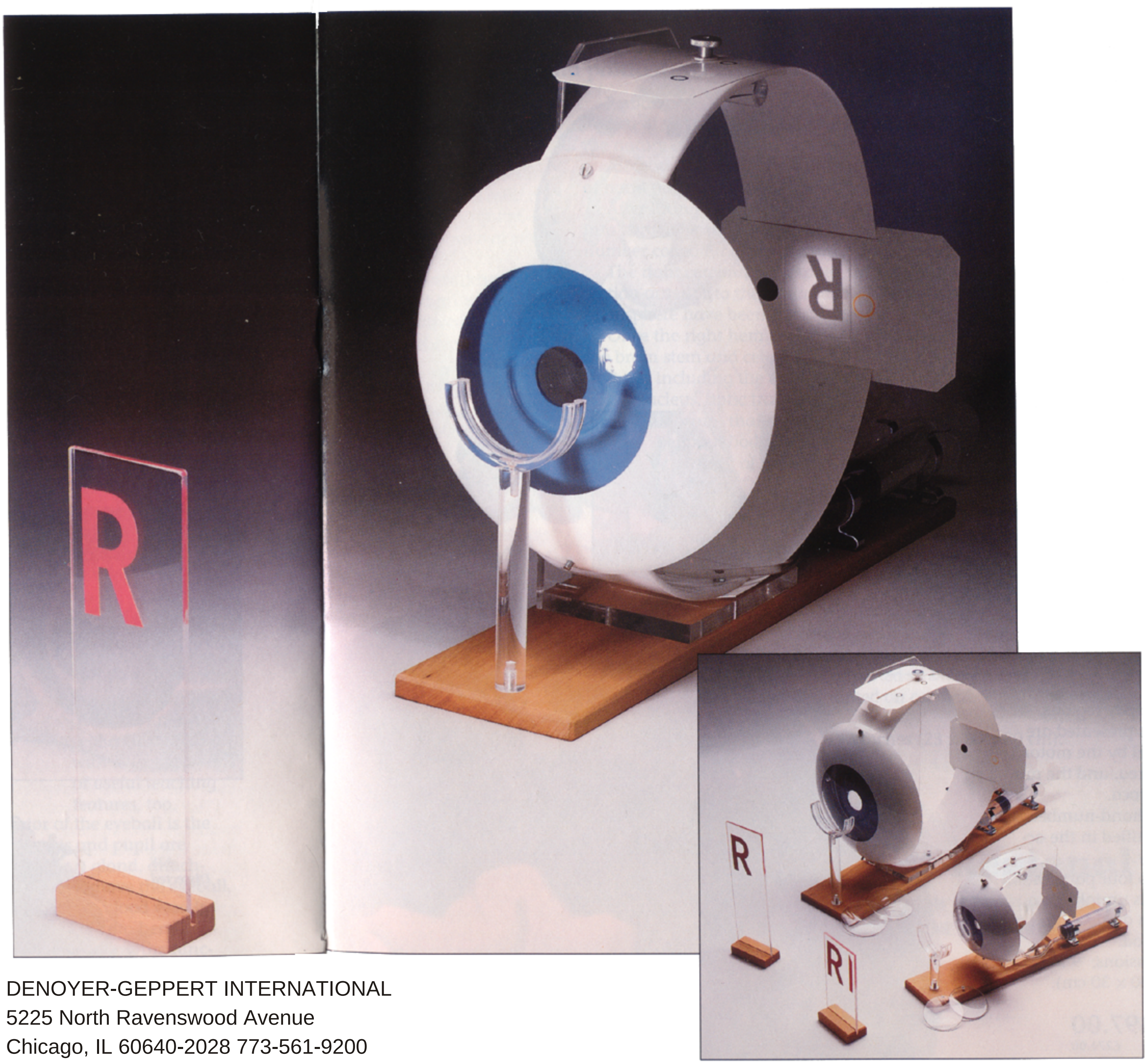
WP4.2:\OENOTE.011

OPTICAL ENGINEERING NOTE #11:
THE DENOYER-GEPPERT EYEBALL MODEL

Sometimes one never gets any closer to the object of desire than the pages of a catalog or magazine. Such is the case with the DENOYER-GEPPERT INTERNATIONAL Functioning Eye Models. (Figure 1.) At $345 for even the Small Functioning Eye, a Science Department has to be really flourishing to purchase this once-a-semester demonstration.



DENOYER-GEPPERT INTERNATIONAL
5225 North Ravenswood Avenue
Chicago, IL 60640-2028 773-561-9200
Wouldn't it be fun to work here painting
Anatomical Models?

Reverse Engineering the Functioning Eye Model: The point of this unit is not to display the anatomy of the eyeball, but its optical properties. Since the crystalline lens of the eye accomodates for object distances by changing its focal length, demonstration of this principle is impossible with solid glass or plastic lenses.

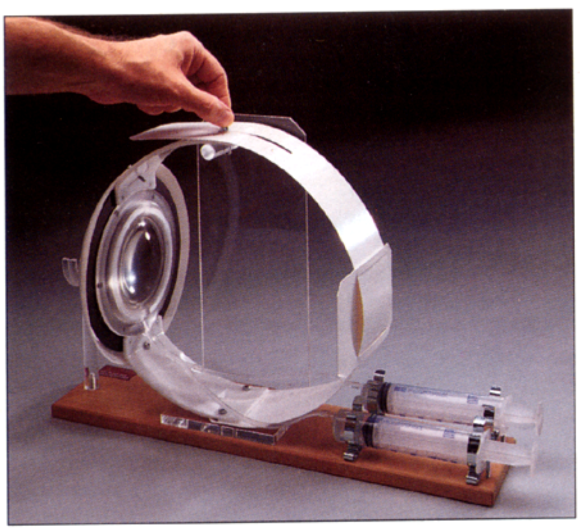
But thanks to some genius at DGI, an optical mockup has been made possible by hydraulic engineering. Pumping water into the "crystalline lens" of the model plumps it outward, decreasing the radius of curvature of the back surface of the lens, which in turn decreases its focal length, just like the way the crystalline lens in our eyes accomodates. (Figure 2 below.)

NEW
Functioning Eye Model

Life-like performance never before possible.

Flexible lens changes shape to focus (accommodation).

Eyeball lengthens or shortens to demonstrate nearsightedness, farsightedness, or normal vision.

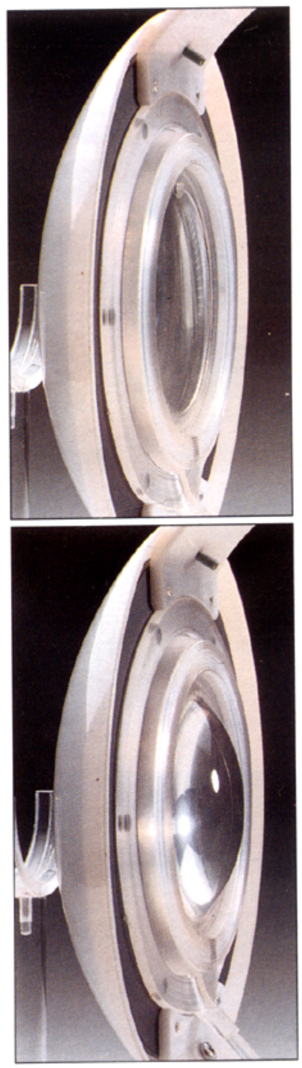


Changing length of eyeball.

Your own eye focuses on near or distant objects by altering the shape of its internal lens. This has been impossible to duplicate in a model — UNTIL NOW!

Simulating the visual performance of the human eye, you can control the shape of the flexible lens within this ingenious model, changing the focus of images projected onto its retina.

Molded of optically-clear silicone elastomer, the lens is a water-filled chamber connected by tubing to a syringe. By manipulating the plunger, water can be forced into the lens, increasing its thickness and curvature, or withdrawn from it, flattening its profile, changing its focus.



Accommodation (focusing on near objects) is accomplished by pumping water into lens, increasing its curvature.

But that's not all! You can even lengthen or shorten the eyeball itself to demonstrate nearsightedness (myopia), farsightedness (hyperopia), and normal vision.

Used in conjunction with a bright light source, such as an ordinary slide projector, you can dramatically demonstrate: accommodation (focusing on near objects by increasing lens curvature) • nearpoint of vision • yellow spot and blind spot • presbyopia (age-related lack of accommodation due to loss of lens elasticity) • myopia • hyperopia • and use of corrective lenses.

Complete with illustrated instructions, external corrective lenses — one convex, and one concave, lens holder and projection object on stand.

Choice of Two Sizes — Identical Functions

Large Functioning Eye
for maximum visibility.
18 x 12 inches (450 x 300 mm)
AP45 $554.00
£378.00

Small Functioning Eye
for small hands-on groups.
12 x 7 inches (320 x 180 mm)
AP46 $397.00
£271.00

An "R" on plexiglass is provided to be used as the object. By backlighting it with a slide projector, its image on the "retina" can be seen in normal roomlighting conditions. Since the letter has no symmetry to it, the lateral and horizontal reversals of the real image are made apparent. Look back at Figure 1.

If the Functioning Eye were being demonstrated, the R would be placed far away from it, being focussed onto the sheet metal retina set for normal vision. Then the R would be moved closer to the lens, with the image going out of focus. Correcting for the new object distance would be effected by injecting more H_2O into the lens to shorten its focal length.

The distance to the retina can be lengthened or shortened to mock up myopia or hyperopia respectively by loosening the nut at the top of the eyeball and sliding the metal eyeball exterior housing in or out. (See where the hand is in Figure 2.)

When lengthened, and the lens drained to show the relaxed state, the target R needs to be moved in closer to form an image on the retina, just like in the nearsighted eyeball. Pumping the lens up allows the R to be moved in only closer.

When the distance to the retina is shortened, the lens needs to be pumped to its max to image even a moderately far object, as is the farsighted case. Only a short focal length lens will image an object in that limited space. The nearest object point of the optical system in this configuration is not very close since the limit of expansion of the lens during accomodation is reached quickly.

A pair of supplementary lenses are included to correct the two conditions, snapping into a monocle stand in front of the cornea. A negative lens lessens the bending power of the crystalline lens, lengthening its focal length so that the distant object's image will fit onto the stretched retina, while the positive one shortens the focal length of the farsighted condition so that the image can be formed on the closer focal plane.

The trick to making a homegrown version of this item is to find a clear material that is flexible enough to expand when pumped full of water, yet not so thin that it would rupture or spring leaks around the edges. This part is the key to the success of the model. An "A" would be awarded to any student who can successfully fabricate this device, regardless of any previous test or quiz grades.