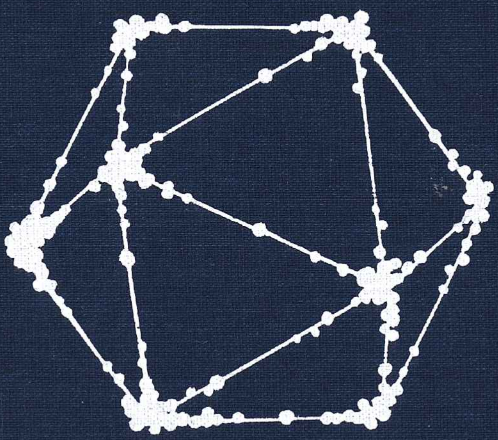
LIQUID DOOR



ISOLA AND NORZI

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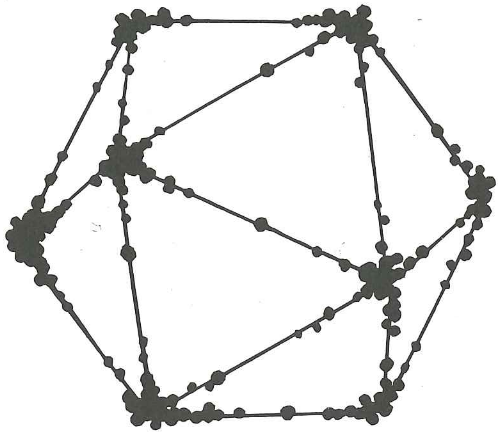

ISOLA AND NORZI

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Looking at the Surface

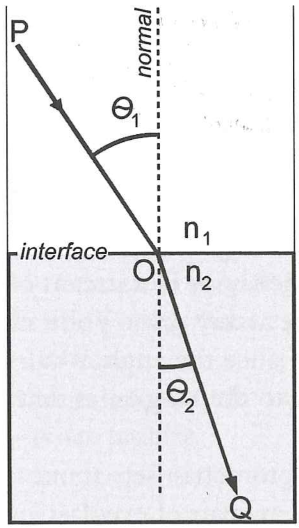
D. Graham Burnett

Why can't we see clearly underwater? Think for a moment about the experience: you dive into a crystalline pool, turquoise-tiled, the filtered water limpid and well lit; you stroke down into the cool thickness and open your naked eyes. A moment of sting, and then blue light. You are looking around underwater. But your vision is not working as it did in the air. This submerged world, for all its brightness and clarity, comes into the eye as a myopic blur; distant contours are imprecise, a haze obscures every form.

Most of us have probably accustomed ourselves to this underwater unraveling of our ordinary ocular experience, and thus the phenomenology of this kind of seeing seldom occasions reflection. I'll come back to that. Let's do the physics first.

Our eyes work like little cameras, which is to say, they have a *lens*, the function of which is to "refract" (bend) incoming light rays in such a way as to configure, on a film at the back of the eye (the retina), a coherent image of the world in front of us. Optically speaking, the sharpness of that image (what we see) is dependent on a tidy, precise, one-to-one correspondence between each point in the world and each point on the retina. Just as in a camera, this is a matter of *focus*—a matter of having a lens that bends each incident light ray just enough to throw it where it needs to go at the back of the eye.

There is a formula for that bending, a lovely formula, known as Snell's Law, discovered more or less simultaneously in the early seventeenth century by the great French metaphysician René Descartes and a Dutch mathematician named Willebrord Snell. It looks like this:



$$\frac{\sin \Theta_1}{\sin \Theta_2} = \frac{n_2}{n_1}$$

Which can be put into words in a general way as follows: when you are dealing with a ray of light going from one substance (say, *air*) into another (say, *water*), that ray is going *bend* in a way that is dependent on the *angle it hits the interface* of those two substances, and also dependent on the *nature* of those two materials. Every material has a different effect on a passing ray of light, and that effect can be calculated. If you know that "index" (called the "index of refraction"; n_1 and n_2 in the diagram) for each of your two materials, and you know the angle that your ray is hitting the surface of the new stuff (θ_1 in the diagram) and you know how to calculate a sine (or can hit the correct button on your calculator), you can sort out exactly how that ray is going to be deflected by its passage across the interface between one substance and another.

So what? As far as intellectual history is concerned, the discovery of this equation had profound implications. It was one of those stupefying moments when, for no reason that anyone could explain, a set of finicky and abstract mathematical operations (in this case, a little trigonometry) happened to express something real about the way the world worked. This sort of thing left deep marks on the metaphysics of modernity. We are really talking about nothing less than the origins of science itself.

But put all that aside. Sticking with practicalities, Snell's Law made "rational optics" possible—made it possible to calculate what shape of lens, say, will refract incident rays of light cleanly and properly, throwing each one back out the other side in a predictable way. By forming a chunk of glass with Snell's Law in mind, one can literally control the behavior of a stream of light. (Changing the shape of the interface at any given point changes the angle of incidence at that point, since the angle is calculated with respect to a line perpendicular to the tangent at that point, the "normal" in the diagram.)

Upshot? This is how your optometrist sets about fixing your vision when she grinds you a new pair of eyeglass lenses. She's creating a supplementary lens that will correct for problems in the lens of your eye: where your eye has stopped bending rays enough, her extra lens will give them an extra nudge; where the lens in your eye is over-bending, hers will compensate. Both the *shape* of the lens and its actual *stuff* are essential to these calculations.

★

We are now ready to come back to the bottom of the swimming pool. There you are, looking, and yet you cannot really *see*. Why? The water is just as clear as the air. The lens of your eye is the very same shape as before, when you stood on the diving board surveying the sharp outlines of the trees, the crisp edges of each form.

What has changed, of course, is the *interface*. Before, the surface of the lens of your eye was in contact with the air.

Light came from the air into the clear jelly of your eyeball. Across that juncture every refraction worked perfectly, the curve of your lens having evolved to make use of the deflections that happen when light passes from the great outdoors into the wet humor of a cornea. The images taking shape on your retina were a point by point mapping of the world beyond.

But after that splash, you literally *collapsed into yourself.* You are, as you know, mostly water. Your eye, its lens—all of this is basically water. Now, when you stare into the liquid around you, there is, in effect, *no interface*. Every refraction of every ray of light entering your eye is "off" because the index of refraction of the stuff outside your eye and the index of refraction of the stuff inside your eye are the same. You need that difference to see.

Which is to say, the interface between air and water *makes our vision possible.*

★

By building a body of work around the idea of the "liquid door," that shimmering interface between air and water, Hilario Isola and Matteo Norzi ask us to attend to the role of this non-homogenous boundary in the constitution of experience. Again and again their interventions—arranging for an obscuring veil of algae on an aquarium window, presenting imagery within the frame of a scuba mask, refilming a classic dive documentary through a fishtank—draw attention to the ways that vision is predicated on disjuncture of medium and discontinuity of matrix. Milling through an exhibition of these striking and playful pieces, we see surfaces and we see across surfaces, but most significantly we are reminded that we see *because* of surfaces. And underwater this is an absolutely literal proposition, because, underwater, our eyes fail. They require these sheets of glass—the *hatch*, the *mask*, the *goggles*, the *window-wall*—all of which give us back that pocket of the air on which our vision depends.

Sight itself is a matter of a *liquid door,* the one we call the *eye*. Flood it, and our vision clouds. We become nebulous squinters, swimming through a world of formless light. Underwater, we need bubbles to see. In this sense, all those dear and desperate submarine technologies—the diving bells, SCUBA gear, the rebreathers, SeaLabs, bathyscaphs, and all the Captain Nemo accoutrements of underwater warfare, fantasy, science, and commerce—amount to a vast equipage to help us to carry our bubbles before our eyes, to maintain our interface anywhere we go. It is the only way we can control the swerve of the light that is forever diving into us through our watery portals.

★

How do fish handle all this? They aren't blind, after all—at least not most of them. And yet their water eyes are flush against the water world through which they must look. The short answer is that they have evolved eyes that manage the problem. Because they cannot take advantage of the added *bend* afforded by a ray of light crossing the interface from air to water, they must compensate with powerfully curved lenses (they are basically spherical), and other tricks (including onion-like concentricities of lens-matter, each with slightly different indices of refraction) to manage incoming light and configure a coherent image on their retinas. In the air, they are as lost as we are down below.

There is one great exception to that basic incommensurability, and it will afford us a fitting place to close this reflection on vision at the interface of water and air. The family of fish known as the *Anablepidae* includes a mess of not very impressive mudskippers that spend their lives hanging around in the shallows looking for stuff to eat and trying not to get killed. It is a tough way to make a living, not least because unfriendly stuff can get at you two ways—from above, in the air; and from below, through the water. But the little genus of *Anablepidae* known as "four-eyed fish" (*Anableps sp.*) bring a unique adaptation to this unpleasant scenario.

Their eyes are up on the top of their heads like frogs, and they are each divided into two halves, top and bottom. The upper part is configured as an air-eye, shaped to trade on the refractive interface between the air and the surface of the eyeball. The bottom part, however, is a water-eye, with a powerful lens that can function within its medium.

These unassuming creatures float perpetually at the junction of water and air, and literally see *at the surface*—continuously integrating the views above and below the discontinuity that splits their field of vision.

Anableps anableps. Metaphor? Mascot? Do we have to choose? Looking at the liquid door is learning to see double.