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how to look at nothing

Is it possible to see absolutely nothing? Or do you always see something, even if it is nothing more than a blur or the insides of your own eyelids?

This question has been well investigated. In the 1930s, a psychologist named Wolfgang Metzer designed an experiment to show that if you have nothing to look at, your eyes will stop functioning. Metzer put volunteers in rooms that were lit very carefully so there was no shadow and no gradients from light to dark. The walls were polished, so it was impossible to tell how far away they were. After a few minutes in an environment like that, the volunteers reported "gray clouds" and darkness descending over their visual field. Some experienced an intense fear and felt as though they were going blind. Others were sure that dim shapes were drifting by, and they tried to reach out and grab them. Later it was found that if the room is illuminated with a bright color, within a few minutes it will seem to turn dull gray. Even a bright red or green will seem to turn gray.

Apparently the eye cannot stand to see nothing, and when it is faced with nothing, it slowly and automatically shuts down. You can simulate these experiments at

figure 32.1

Picture of nothing.

home by cutting ping-pong balls in half and cupping them lightly over your eyes. Since you can't focus that close, your eye has no detail to latch on to, and if you're sitting in a place with fairly even illumination, you won't have any shadows or highlights to watch. After a few minutes, you will begin to feel what the people in those experiments experienced. For me, it is a slow creeping claustrophobia and an anxiety about what I'm seeing—or even *if* I am seeing. If I use a red lightbulb instead of a white one, the color slowly drains out until it looks for all the world as if the light were an ordinary white bulb.

(This experiment won't work, by the way, if you close your eyes. The slight pressure of your eyelids on your corneas and the tiny flicker of your eye muscles will produce hallucinations, called entoptic lights, which will give you something to look at. The only drawback to using ping-pong balls is that your eyelashes get in the way. The experimenters recommend using "a light coating of nonirritating, easily removed, latex-based surgical adhesive" to fasten the eyelashes to the upper lid—but it's probably better to get along without it.)

These experiments are interesting but they are also artificial. It takes something as contrived as a polished white wall or halves of a ping-pong ball, to create a wholly uniform visual field. There is another way to see nothing that I like much better, and that is trying to see something in pitch darkness. In recent decades scientists have figured out that it takes only between five to fifteen photons entering the eye before we register a tiny flash of light. That is an unimaginably tiny quantity, millions of times fainter than a faint green flash from a lightning bug. Unless you have been in a cave or a sealed basement room, you have never experienced anything that dark. And yet the eye is prepared for it.

It takes at least five photons to produce the sensation of light, instead of just one, because there is a chemical in the eye that is continuously breaking down, and each time a molecule breaks, it emits a photon. If we registered every photon, our eyes would register light continuously, even if there were no light in the world outside our own eyes. The chemical that emits the light is rhodopsin, which is the same chemical that enables us to see in dim light to begin with. So as far as our visual system is concerned, there is no way to distinguish beteween a molecule of rhodopsin that has broken down spontaneously and one that broke down because it was hit by a photon. If we saw a flash every time a rhodopsin molecule decomposed, we would be seeing fireworks forever, so our retinas are designed to *start* seeing only when there is a little more light.

Five to fifteen photons is an estimate and there is no way to make it exact, but the reason why it can't be exact is itself exact. It has to do with quantum mechanics,

the branch of physics that deals with particles like photons. According to quantum physics, the action of photons can be known only statistically and not with utter precision. The precise theory shows that the answer is imprecise. There is also a second reason why we can never know exactly how little light we can see. The human visual system is "noisy"—it is not efficient and it fails a certain percentage of the time. Only cave explorers and volunteers in vision experiments have ever experienced perfect darkness, and even then they see spots of light. Those are "false positives," reports that there is light when there isn't. We see light when we shouldn't and we fail to see light when, by the laws of physics, we should. Also, the two eyes take in different photons and so they never work in perfect harmony. In extremely low light, a report of light from one eye might be overruled by a report of darkness from the other. Many things can happen along the complicated pathway from the rhodopsin in the retina to the centers of visual processing.

These phenomena of false positives are called by the wonderful name "dark noise" and the not-so-wonderful technical term "equivalent Poisson noise." Then there's the light generated inside the eye itself, called the "dark light of the eye." It may have a photochemical origin, such as the light from rhodopsin; wherever it comes from, it contributes to the sensation of light.

Entoptic light, the dark noise, the dark light of the eye—this is the end of seeing. But they are wonderful phenomena. To see them, you have to find a perfectly dark spot—a windowless basement room or a hallway that can be entirely closed off—and then you have to spend at least a half hour acclimitizing to the dark. Where I live, in the city, it is impossible to find real darkness. There is a bathroom in our apartment that opens onto an interior hallway, but even if I close all the curtains, close off the hallway, and shut the bathroom door behind me, light still comes in under the doorway. I don't see it at first, but after ten minutes my eyes pick out a faint glow. Real darkness is elusive.

In the end, when there is nothing left to see, the eye and the brain invent lights. The dark room begins to shimmer and with entoptic auroras. They seem to mirror my state of mind—if I am tired I see more of them, and if I rub my eyes they flower into bright colors. In total darkness, entoptic displays can seem as bright as daylight, and it takes several minutes for them to subside. Looking at them, it is easy to be sympathetic with anthropologists who think that all picture-making began with hallucinations. Some entoptic displays are as lovely and evanescent as auroras, and others as silky and seductive as a ghost. Pure dark, in the absence of entoptic colors, is still alive with dark noise. If I try to fix my gaze on some invisible object—say my hand held up in front of me—then my visual field starts to sparkle with small

flashes of dark noise, the sign that my neurons are trying to process signals that aren't really there. They can also become quite strong, like the sparks that come off bedsheets on a cold winter night. I can also try to erase all sense of illumination by letting my eyes rest or wander wherever they want. When I do that, I am still aware of the sensation of light—really it is too dim to be called light; it is more the memory of light. Perhaps that is the "dark light of the eye," the chemicals splitting and reforming in the eye in the normal processes of molecular life.

So I am left with this strange thought: even though we overlook so many things and see so little of what passes in front of us, our eyes will not stop seeing, even when they have to invent the world from nothing. Perhaps the only moments when we truly see nothing are the blank, mindless stretches of time that pass unnoticed between our dreams. But maybe death is the only name for real blindness. At every other moment our eyes are taking in light or inventing lights of their own: it is only a matter of learning how to see what our eyes are bringing us.