The Doors Of Perception

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Galen would have had some big problems as a color photographer. His outdated ideas about color are incompatible with modern cameras and film. For more than a thousand years the second-century physician for whom I was named was considered one of the trio of master Greek scholars who brought about scientific enlightenment. Then he was toppled from his pedestal when his theories about how the human body worked were disproved by Renaissance scientists. History dealt more kindly with the two remaining scholars; Aristotle and Ptolemy still hold their ground long after blows from a legion of heavyweights, including Copernicus, Galileo, and Einstein, knocked many of their favorite theories down for the count. We humans are much more tolerant of bad information about the Earth and the sky than about the workings of our own bodies.

Galen believed that vision and color were produced by rays powered by body heat that came out of a magical fluid in the eye. He claimed to have confirmed this notion by direct observation as chief doctor to the gladiators. He sounded so convincing that were he alive today, he would probably be on daytime television.

It would be fun to see how Galen might respond to using a Polaroid camera that delivers a color image even when his eyes are closed as he pushes the shutter. Would the result pique his scientific curiosity? Or would he modify his theory to explain how that camera was just like the eye after all, and continue to blithely take photographs that he thought were images of what he saw?

Photographic history has followed the latter course, which explains why we are stuck with devices that have modern bells and whistles but hide antiquated functions based on nineteenth-century ideas about color and vision.

As with the rest of us, poor Galen's initial thrill with photography would give way to disappointment that his pictures bore too little resemblance to the colors he believed he had seen in the real world. He would eventually become conditioned to throwing out 90 percent of his photographs to keep only the ones that looked right. After a while, his keepers would begin to appear so convincingly real, even though they were not quite what he had seen, that instead of questioning the basic truth of the photographic process, he would question his own ability as a photographer.

Most photographers behave in a similar way. They scratch their heads when their photos don't resemble what they think they saw, but congratulate themselves on the few that "come out" and try to find the same types of situations to shoot again. When they discover a "personal style" by default, they stick within its confines more out of fear of failure with other subject matter than out of choice.

Failure to pleasingly render colors in natural light is one of the greatest stumbling blocks to a career in outdoor photography. That color is a property of light itself, rather than of objects or the mind, is an idea that took the world by storm in the seventeenth century. A twenty-three-year-old whiz kid named Isaac Newton—the guy who brought us gravity and calculus during the same year when he was hiding out from

the plague—proved to most everyone's satisfaction but his own that light and color had a fixed relationship wholly separate from the human body. He did this by simply focusing the colored light that came out of one prism into another. It came out white again.

Newton's cautious statement that the concept of color should properly be applied to perception and not to light itself was not taken seriously enough by later researchers. When the race was on at the turn of the century to invent a practical color film, trial emulsions were solidly based on the part of Newton's theory that separated white light into specific colors by wavelength. Early films didn't work nearly as well as expected. The best results came from a sleight of hand beginning with black-and-white emulsions and adding color later in the process. Colors could be assigned to particular wavelengths of light only so long as lighting conditions were rigidly standardized, which is almost never the case in outdoor photography.

Today, good color is almost a given in controlled studio situations, but when a whole outdoor shoot rather than just the rare successful image is analyzed, perfectly colored photographs are rare exceptions rather than the rule. Modern science textbooks continue to explain color vision by Newton's three-color theory, with some fine tuning by later scientists such as Young and Helmholtz. We are taught that the cones of our retinas respond to the color of objects, while the rods that work in low light see only black and white. Only a few texts mention in passing an alternative theory advanced by another young genius who also made major discoveries in his twenties.

Edwin Land's retinex theory of color vision has remained out of mainstream thought both because it challenges basic assumptions about color and because it never directly resulted in a marketable product, as did his inventions of the polarizing filter and the first instant film. Retinex is a contraction of retina plus cortex. Ansel Adams, a close friend of Land's, found the theory of "immense importance." It not only answered some of his questions about reflectance, but firmed his resolve to stick to black and white and drop further experiments with color except for some demonstration Polaroids for his friend's company.

Newtonian color theory simply falls on its face in outdoor situations. Most conventionally educated cognitive scientists can't properly explain why we can see correct flesh tones under a broad range of lighting conditions, yet are unable to correct them in the same way when we look at photographs. When I've posed the question in interviews and letters, the top experts either don't answer or attribute it to our visual color correction for the wavelength of the dominant light source. This explanation fails to account for why our vision will adjust to see the proper color of a face under the strong amber bias of tungsten light, but won't adjust to see that face's same color in a photograph made on daylight film, no matter what light source is used to view it.

Land's radical answer is that our eyes don't respond to color at all. Quite literally, color is a figment of our imagination. Gordon Rattray Taylor, chief science advisor for the BBC, states in his book, *The Natural History of the Mind,* that because of Land, classic color theory "lies in ruins." Back in the fifties, Taylor watched Land project two special black-and-white negatives through two different yellow light sources to form a scene that displayed a full range of colors.

In another experiment that I have replicated for advanced workshops, two black-and-white slides

projected on top of one another take on a full range of colors when only a red filter is added to one side. Take away the other black-and-white, shot with different filtration to have different gray values, and the screen shifts to the expected shades of red. Land conclusively demonstrated in several other ways that the eye senses only black and white and that our experience of color is entirely a construct of our minds that varies tremendously.

Although texts continue to say that the cones in our eyes see color, while the rods see only black and white, Land has turned the tables to make subjects sense color strictly with their rods in extremely low light. He has also demonstrated how almost all common colors can be made to appear from information delivered by a triplet of cones that are not responsive to individual "colors." In a process somewhat like merging black-and-white negatives made with different filters, the three types of cones deliver colorless responses to broad, overlapping bands of wavelengths, together with all-important lightness information about reflectivity derived by comparison of the triplet of responses. The color is in our heads. This explains why I often wake up in a dark room shortly before dawn and can't tell if the sky is clear enough to go out and take sunrise photos. Even though the sky is bright enough to trigger my cones instead of my rods, it looks gray through the window so long as I have no reference to reflective lightness information. The color is not "there" on its own. I am unable to tell if the sky is blue or gray until I step outside or to the window.

The triplet comparison system gives our vision a reality detector that served us well in the days before photography. Our color and lightness sensations are fine tuned to ascertain the stable properties of objects rather than the wavelength of light reflected from them, but our film is designed for a lockstep color response that does not fairly represent the real world. We can't see that proper flesh tone in a photograph made on daylight film at sunset because our retinex reality detector is telling us the truth: We're seeing orange hues on paper rather than a real face.

For this same reason, a landscape photographed at sunset looks more vivid on film than it does to the eye. The difference is usually less striking than when the same daylight film is used with a similar orange wavelength of artificial light to photograph a face. This is partly due to the way our visual system more easily adjusts to known subjects seen in person, but also to the fact that when we are outdoors we take a portion of our lightness cues from objects in the shadows that reflect parts of the sky that we perceive as blue. Thus we really do "see" more of the red in the sky at sunset than red in a face indoors, but in both cases we see far less than our daylight film will record.

What all this means is that outdoor photographers who shoot color film can't consistently make good photographs by trusting their eyes alone. Proper knowledge of color vision won't solve the technical problems, but it can help guide a person to be in the right place at the right time to record great natural events in the different visual language of film. After spending years trying to learn how to read the subtle clues of color perception, I may, like my namesake, have some ideas that are later proved to be wrong, but I have two distinct advantages. The first is my ability to directly judge the effectiveness of my mental experiments by my photographic results. The second is living after Edwin Land.