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We See in the Dark

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Abstract

Do we need light to see? I argue that the black experience of a man in a perfectly dark cave is a representation of an absence of light, not an absence of representation. There is certainly a difference between his perceptual knowledge and that of his blind companion. Only the sighted man can tell whether the cave is dark just by looking. But perhaps he is merely inferring darkness from his failure to see. To get an unambiguous answer, I switch the focus from perceptual knowledge to non-epistemic seeing. My conclusion is that we see even in the limiting case of absolute darkness – regardless of whether we believe we are seeing. We see little of pratical interest. But in terms of basic information, we see about as much as we do when the lights are on. Depending on what has gone before and after, we may even see ordinary objects.

In 1969, Rod Serling followed his television series *The Twilight Zone* with *The Night Gallery*. The second episode, "Eyes", was Stephen Speilberg's directorial debut. Joan Crawford stars as Claudia Menlo, a ruthless fifty-four year old New York dowager—blind from birth. Claudia has learned of an optic nerve transplant that would enable her to see for eleven hours. She locates a desperate bookie who agrees to sell his sight for nine thousand dollars (to avoid being murdered the next day by his underworld creditor). Claudia's eye doctor, Dr. Frank Heatherton, refuses to perform the transplant. She blackmails him. After performing the operation, Dr. Heatherton warns Claudia not to remove the bandages prematurely. Claudia Menlo has prepared for her precious eleven hours of sight by peopling her Fifth Avenue penthouse with artwork and scheduling a tour of the city's finest sites. She dismisses her servants. Alone in her apartment, Claudia is impatient. She unwraps the bandages. Claudia catches a glimpse of a crystal chandelier. But then everything goes black. The enraged Claudia rampages through her suite throwing statuary, the telephone, and anything else in her path. She collapses in tears—unaware that the whole city has suffered a power outage. At dawn

she sees the rising sun. Her vision dims. Claudia Menlo rushes to grasp this vanishing bauble—and crashes through a window to her death.

How many things did Claudia Menlo see? Most people say she saw only the chandelier and the sun (and possibly the pavement on the way down). But I say Claudia saw something in between seeing the crystal chandelier and the rising sun: the darkness of her blacked-out apartment. Claudia had never seen darkness before and mistook this visual experience for an absence of visual experience.

1. Seeing nothing

We are naturally inclined to deny that we see anything in complete darkness. To see, we need light. In the dark there is no light, therefore we do not see.

'We cannot see' is usually restricted to what we are looking for and the manner in which we wish view to it. A man who has lost his spectacles says 'I cannot see' even though he is *looking* for his spectacles. A sailor in a thick fog correctly reports that he cannot see anything even though he sees the shipmate he is addressing. I contend that reports of not being able to see in the dark are continuous with these domain restricted remarks. We see in the dark but not what we generally wish to see or in the manner we generally wish to see.

Commonly, the thing we see in the dark is the dark. Darkness is a puzzling "thing". Thanks to the optical research of Isaac Newton, we know that darkness is the mere absence of light. The privational nature of darkness deepens reluctance to say we see in the dark. For if we are seeing total darkness, we are seeing an absence. Many philosophers say we see a positive state of affairs and then *infer* an absence. Few think we *directly* perceive absences. But I think we directly perceive darkness just as we directly perceive shadows. Shadows are somewhat less puzzling because there is typically a combination of light and dark. But I shall argue that complete darkness is merely shadow unbounded by light.

Philosophers followed Newton's lead in emphasizing the critical role of light in vision. Thomas Reid writes "We see no object, unless rays of light come from it to the eye." (1814–15, essay 2, chap. 1, p. 80). This tight connection between sight and light penetrates well into the twentieth century (Chisholm 1957, 144–9). According to John Hyman, "one does not possess the concept of vision until one can deduce the proposition that *S* cannot see *x* from the proposition that *x* is in darkness" (1993, 214)

However, some later philosophers objected that the light ray requirement implies that we do not see shadows, crows, and the black letters on a page (Hall 1979). And what about the black holes astronomers hope to observe telescopically? We see some objects by virtue of the contrast they make with their illuminated environment.

There is merit to this objection (Sorensen 1999). But seeing in complete darkness cannot involve spatial contrasts with objects that transmit light.

David Lewis is ambivalent about seeing total darkness. On the one hand, there is some theoretical support. According to Lewis's own analysis of seeing, I see if and only if "the scene before my eyes causes matching visual experience as part of a suitable pattern of counterfactual dependence." (1980, 285) In the dark, "the scene before our eyes causes matching visual experience as part of a suitable pattern of counterfactual dependence." (1980, 283) Thus Lewis's unamended analysis of vision implies that we see in the dark.

On the other hand, seeing in the dark seems occult. The ancient Egyptians justified their reverence toward cats by citing the cat's divine ability to see in the dark. A sober analysis of vision avoids attributing supernatural powers. Accordingly, Lewis contemplates adding the condition that the sort of visual experience would not match a wide range of scenes equally well. The visual content of a perceiver in the dark lacks this rich content. With his signature restraint, Lewis leaves the business of revision unconcluded. He says we are of two minds:

> We think we do not see in the dark; but also we think we find things out by sight only when we see; and in the pitch dark, we find out by sight that it is dark. How else—by smell? By the very fact that we do not see?—No, for we also do not see in dazzling light or thick fog, and it is by sight that we distinguish various situations in which we do not see.
>
> In a sense, we do see in the dark when we see that it is dark. In a more common sense, we never see in the dark. There is an ambiguity in our concept of seeing, and the condition of rich content is often but not always required. When it is, it admits of degree and thus permits still another sort of borderline case of seeing. (1986, 283)

I do not think there is any such ambiguity. We see in the dark under all senses of 'see'.

I am not sated by the reason Lewis dishes out in favor of 'We see in the dark'. Upon waking, I check whether my contact lenses are still in my eyes by looking about the room. If I see clearly, then I have perceptual knowledge that my contact lenses are in my eyes. But I only see my contact lenses when they are out of my eyes. I see *through* perfectly transparent objects without seeing them. I learn that they are perfectly transparent by my inability to see them and by my ability to see through them. Visual detection is not sufficient for seeing.

An object must look a certain way to be seen. Dark things look black. When an object looks black to normal subjects in normal conditions, that object is itself black. Under laboratory conditions, a black disk can be made to look white by focusing intense light upon it and concealing the source of

illumination from the subject. This does not refute John Locke's example of a self-evident truth "That White is not Black" (*Essay* I, ii, 18). Just as a green object can be made to look blue in abnormal conditions, a black disk can be made to look white.

Instead of following Lewis's focus on perceptual knowledge, I shall concentrate on a more basic form of seeing. I contend we sometimes see in the dark even when we fail to see *that* it is dark. The darkness stops us from seeing most of what we want to see. But not everything. If there is enough contrast over time, we even see objects in the dark.

In pitch darkness, we at least see the darkness. We distinguish between black experiences that lock onto darkness and illusory black experiences. For instance, if a cave explorer is in a completely dark cave dreaming that he is in a completely dark cave, then he does not see the darkness of the cave—or the darkness of anything else. To see the darkness of the cave, the explorer must wake up and look around. The newly awake explorer makes a fresh connection with the darkness of the cave even if there is no discontinuity in his black experience.

2. Divided darkness

If a flashbulb goes off in the cave explorer's face, he will have an after-image that lingers after the resumption of total darkness. Like other after-images, this "blob of light" is at the foreground of a black background. That black background is not part of the after-image; it is a perception of the darkness. A similar figure/ground point holds for hallucinations. If the explorer in total darkness stands up suddenly from a prolonged crouch, the blood rushes from his head and he "sees stars". These white dots swirl against an accurately perceived background.

A standard procedure for experiments with hallucinogens is to have subjects narrate their experiences from within a dark room. The darkness controls for a nuisance variable: If there is any light, subjects might perceive movements of their eyelids or internal structures of their own eyes. The depressant pheonobarbital produces black and white random forms moving about aimlessly. Mescaline causes subjects to hallucinate in color. Powerful hallucinogens may lead to involvement of the whole visual field. But there are intermediate cases in which the subject is partly seeing the dark and partly having a visual experience unrelated to the environment.

To see a lightning bug *flashing* in the dark, we need to see the absences of light between the light flashes. Mere alternation between seeing the light emission and failing to see does not suffice for the perception of flashing. Consider an electrical device that cyclically blinds a subject. If the subject is viewing a steadily glowing light and the cyclical blinder is present, the light may appear to be flashing. The blinder can be synchronized with a flashing light, so that when the blinder is on the blinker is off and vice versa. Now

the light is flashing and looks like it is flashing. But the subject still does not see the light *flashing*.

Our two eyes are normally focused on the same scene. But they can be artificially segregated. Suppose each eye is covered with a blackened cup. Inside the cups are flashlight bulbs. While the bulbs are off, each cup is dark. Although it may seem like one is seeing only one dark scene, one is really seeing two dark scenes. This becomes evident when one light bulb is turned on. You are now seeing one illuminated cup interior and one unilluminated cup interior.

When the light goes out, only one of the scenes changes. Thus the unchanged scene is distinct from the changed scene even though the visual experience seems monolithic.

The entrances of some caves are so small that if you stick your head inside, your body blocks all the light. This illustrates the possibility of seeing the darkness without being in the dark. The next section demonstrates the converse.

3. Seeing in the dark without seeing the darkness

If your only light source for this paper is a fluorescent light bulb, then you are now seeing in the dark. The bulb illuminates the room intermittently. If the on-off alternation were slow, the room would look like a stroboscopic dance hall. But the frequency of the alternation is so high that you fuse the illuminated scenes together. Movie theaters exploit the same phenomenon. To see the film properly, the illuminated scenes must alternate with darkness. Thus the audience is in the dark for half the duration of the movie. Since the audience sees the movie continuously and their illumination is intermittent, they must be seeing in dark.

Seeing by the light of a slow stroboscope is staccato seeing: an alternation between seeing the dancer and not seeing the dancer. Each flash of light lasts long enough for a sighting. These perceptual gaps may stimulate musings about whether one knows what is transpiring during the dark intervals. The musings are vindicated when the stroboscope is aimed at periodic phenomena. For instance, if the flashes of the stroboscope are synchronized with the dripping of a faucet, the intermittent lighting makes it seem as if a single drop of water is suspended in mid-air. Actually, you are seeing many homogenous drops in sequence.

The period of illumination for fluorescent lighting is too brief to permit micro-seeings. The perceiver can see the scenes collectively. This is because the excitation of the retina outlasts the stimulus. The retina is like a bell that rings steadily by being struck intermittently. This uniform excitation of the retina by intermittent stimuli fuses the scenes together.

The darker the environment gets, the longer the excitation. To see at night when light is scarce, one must either prolong the photo receptor's

exposure or widen the receptor. Accordingly, the pupil expands and the retina follows the prolongation strategy. In darkness, the retina takes a long time to calm down. That's why a movie looks most vivid when the theater is nearly lightless.

Visual persistence also shows that healthy people sometimes *fail* to see the darkness in the dark. The dark alternations are entirely missed. Movie goers do not fuse the dark bits together. They fail to see them.

Movie goers are blind to the darkness in the same way we are blind to speedy shadows. When an airplane propeller starts to spin, its shadow seems to disappear. But high speed photography reveals that the shadow is just moving too quickly to be seen.

The speed of darkness is the speed of light. Suppose our nearest star, Proxima Centauri, goes dark. In about a month the starlight from Alpha Centauri A and B ceases. After 1.7 years elapses, Barnard's star can no longer be seen. What is going on? Some astronomers would grimly conjecture that 4.2 years before Proxima Centauri became invisible, all the stars outside the solar system simultaneously vanished. They say the appearance of a sequential darkening of the night sky is a time lag effect. Their "lights out" hypothesis predicts that in 1.7 years, the next closest planet, Wolf 359, will also become invisible. The darkness we see between the stars is old darkness. As time passes, we see more and more of the darkness. But we will never see it all.

4. The dark ganzfeld

Psychologists studying ganzfelds would resist the rich content condition contemplated by David Lewis. A ganzfeld is a structureless visual field. Pilots experience a ganzfeld when flying in a homogeneously blue sky. A simple way psychologists create a ganzfeld in the laboratory is through the use of split ping-pong balls. The psychologists stick half the ball over one eye and half over the other eye. The subjects sit still under the constant illumination of a light bulb. The subjects initially see the innards of the ping-pong balls (contrary to Lewis's rich content condition). Admittedly their visual field *eventually* fades out. Indeed, some subjects suspect that the experimenter has gradually turned down the lights. The speed with which the light appears to dim varies with the color of light. When a red light is used, subjects "black-out" in about ten seconds. These subjects are suffering an illusion because they have a black experience even though they are being stimulated by ample red light.

The subjects will begin to see if an object passes in front of them, thereby creating a shadow. But as long as the stimulation is constant, they fail to see anything. Their visual experience is the default state of "brain gray".

Since I think we see in the dark, I think there is an even simpler way to create a ganzfeld: put the subjects in complete darkness. Most specialists

characterize the ganzfeld in terms of homogenous *stimulation* of the retina. But this must be a mistake because a ganzfeld can be produced by visual persistence. Psychologists have probably done this inadvertently by illuminating their ping-pong ball subjects with fluorescent bulbs.

The phenomenal character of the ganzfeld applies to darkness. Many subjects report at times seeing something vaguely surfacelike in front of the face (Gibson and Waddell 1952). Many observers also describe the field as "close at hand". When prompted, subjects estimate the distance at no further than six inches.

Psychologists have a second reason to resist Lewis's rich content condition. If we require that the visual experience fit a fairly specific range of scenes, we preclude rudimentary vision. That would implausibly limit the number of non-human perceivers and implausibly shorten the history of vision. In explanations of the evolution of sight, the most primitive form of vision consists of a light patch that allows the organism to distinguish light from dark. The content gets richer after that: movement, inference of shapes from shadows, and so on. The primitive organism is seeing—and seeing the darkness. Just as rudimentary digestion is digestion, rudimentary seeing is seeing.

The rich content condition also has the reverse problem of being too quick to judge that vision has ended. Eye disease diminishes sight bit by bit. Before becoming totally blind, the patient has a little sight even though he does not satisfy Lewis's rich content requirement. The evolutionary path to blindness works the same way. Just as the atrophied hearing of human beings is still hearing, the atrophied vision of bats is still vision.

5. Non-epistemic seeing

Seeing *that p* entails believing that *p*. Seeing in this epistemic sense always requires belief about what is seen. But there is also an important kind of seeing that does not entail belief (Dretske 1969, 88). Non-epistemic seeing is compatible with belief but is also compatible with the absence of belief or even disbelief. Do we non-epistemically see in the dark?

Claudia Menlo is an example. She sees the darkness but believes she is not seeing at all.

Inconveniently, Miss Menlo is a medical impossibility. Even if the donor's optic nerve could somehow be spliced in, Claudia lacks the cortical infra-structure to immediately see crystal chandeliers. Congenitally blind animals miss a developmental opportunity to consolidate the neural groundwork for normal vision.

One may also doubt whether Claudia would infer blindness from her experience of blackness. Sighted people tend to conceive of blindness as a steady experience of blackness. But blind people deny that they see blackness (Magee and Milligan 1995, 11). Blindness is an absence of experience rather

than an experience of absence. It is like the "experience" you have behind your head where you have no eyes.

When a sighted man is in complete darkness, he only experiences the darkness in front of his face. He does not experience darkness behind his head. To check whether it is dark behind his head, he must turn and take a look.

A man with blind-sight may be able to visually sense an absence of light stimulation in a room. However, the blind-sighted man does not have a black visual experience. Sensing the darkness with one's eyes is not sufficient for seeing the darkness.

The distinction between visually sensing darkness and seeing darkness raises a skeptical doubt about animal vision. In 1794, Lazzaro Spallanzani was studying the ability of nocturnal animals to navigate under conditions of low illumination. When an owl's beating wings extinguished the small candle that provided the sole source of light, the owl became helpless. Owls cannot see objects in complete darkness. We know they sense the darkness with their eyes because only sighted owls become suddenly cautious when all light is eliminated. But do owls *see* the darkness? Although I am inclined to believe that owls do see the darkness, there is a possibility that they do not. Perhaps owls are like blind-sighted men who can visually sense the darkness but cannot see the darkness.

Spallanzani's more spectacular discovery was that bats can navigate in complete darkness. Even blinded bats performed well. In 1795, a Swiss surgeon, Charles Jurine, conjectured that bats navigate by ear. When he plugged the ears of bars, they could not navigate. Jurine (and later Spallanzani) concluded that the bats navigate by hearing sounds that are inaudible to human beings. The scientific community rejected their empirically well-documented hypothesis in favor of Baron Georges Cuvier's less grounded contention that bats navigate by *feeling* sound waves. Opinion changed only in 1938 after Donald Griffin recorded ultra-sonic bat calls.

We can overcome the technical glitches of Rod Serling's "Eyes". Subjects in sensory deprivation experiments frequently worry that they have become blind (Vernon 1963, 168–9). They could easily be supplied with evidence to strengthen this fear. Suppose kidnappers announce that they will blind their two hostages, Mrs. Atheist and Mr. Agnostic, with a laser blast to their retinas. Each of the hostages sees a flash of red light and then blackness. Mrs. Atheist infers that she is blind. Actually, kidnappers merely turned out the light after the red flash. Mrs. Atheist believes she is not seeing anything but she is really seeing the darkness of the room.

Mrs. Atheist closely parallels Claudia Menlo. A more revealing case is her co-hostage Mr. Agnostic. He is more circumspect than Mrs. Atheist. Mr. Agnostic neither believes nor disbelieves that he is blind. He thinks he does not have enough evidence to settle the issue and so is neutral about whether he sees anything.

The patently non-epistemic nature of Mr. Agnostic's seeing makes him a good candidate for being a seer of negative facts (in particular, the fact that

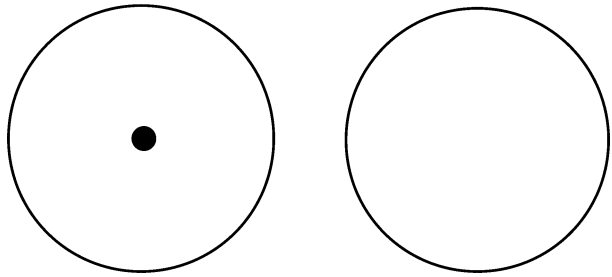

Fig. 1.

there is no light in the room). The case of Mr. Agnostic is an improvement over Richard Taylor's (1952, 444) classic illustration of seeing an absence.

Taylor claims that we directly perceive the dot in the left circle and directly perceive the absence of a dot in the right circle. Critics note that the right circle is also empty of dashes, strokes, squares, triangles, and crosses. We do not see the absence of these alternatives. Taylor's critics insist that we can only perceive the absence of an *F* if we are looking for an *F*. Thus "there *is* something from which we can infer the circle's being empty of dots, other than the fact itself, namely, the perception of the circle and failure to perceive the dot." (Molnar 2000, 80).

There is wide agreement that there is no *direct* perception of negative things. Jean-Paul Sartre has a famous illustration of perceiving an absence. He has an appointment to meet his punctual friend Pierre at a cafe. When Sartre arrives fifteen minutes late, he sees that Pierre is not there. Sartre contends he has witnessed a genuine absence and lengthily affirms the reality of nothingness. Yet he carefully emphasizes that "It is evident that non-being always appears within the limits of human expectation" (1969, 38).

'Expectation' wrongly suggests that Sartre must believe that Pierre might be at the cafe. Sartre would see the absence of Pierre even if he believed that Pierre would definitely not wait for fifteen minutes. Sartre need only be psychologically primed. Sartre does not see the absence of the Duke of Wellington at the cafe because Wellington's presence never became a live issue for Sartre.

Neuro-scientists find Sartrean subjectivism congenial. They have measured neurons firing in recognition of pauses and gaps in tone sequences (Hughes et al. 2000). The scientists deny that there is any direct perception of absences. They emphasize that the brain has been forming expectations by listening to other tones that lead up to the missing tone.

We should be suspicious of Sartre and his fellow-travelers. Who made human beings the arbiters of non-being? When a bear follows you into a cave, he sees the same darkness as you. This darkness existed long before anyone saw it and would have existed even if no creature ever beheld it.

Non-being is as objective as being. When Mr Agnostic sees the darkness without believing that it is dark, he is not making an inference that it is dark. He does not employ the premise 'I am not seeing anything'. He is not drawing any conclusions. Therefore, Mr Agnostic's expectations are not playing any role. He sees the darkness of the room just as a scuba diver sees the blueness of the water (even if the scuba diver worries that he is merely hallucinating the blueness).

According to Sartre "in perception there is always the construction of a figure on a ground" (1969, 41). As Sartre surveys each face in the cafe ("Could this be Pierre?"), its candidacy for being at the forefront of attention is defeated. This first wave of negations form the ground. If Pierre were spotted, he would pop out from the crowd.

> But now Pierre is not here. This does not mean that I discover his absence in some precise spot in the establishment. In fact Pierre is absent from the whole cafe; his absence fixes the cafe in its evanescence; the cafe remains ground; it persists in offering itself as an undifferentiated totality to my only marginal attention; it slips into the background; it pursues its nihilation. Only it makes itself ground for a determined figure; it carries the figure everywhere in front of it, presents the figure everywhere to me. This figure which slips constantly between my look and the solid, real objects of the cafe is precisely a perpetual disappearance; it is Pierre raising himself as a nothingness on the ground of the nihilation of the cafe. So that what is offered to intuition is a flickering of nothingness; it is nothingness of the ground, the nihilation of which summons and demands the appearance of the figure—the nothingness which slips as a *nothing* to the surface for the ground. It serves as foundation for the judgment—"Pierre is not here." (1969, 42)

I do not know what Sartre would say about the perception of utter darkness. A uniform black experience does not have a figure-ground structure. Nor need there be any judgment that it is dark.

The case of Mr. Agnostic has the advantage of homogeneity. True, total blackness echoes the phenomenal curiosities of ganzfelds. In a cave, the darkness seems vaguely surface-like and close to one's face. But these impressions are not constitutive of the black experience. Since darkness is merely the absence of light, we should expect the black experience of darkness to echo this simplicity.

6. Black illusions

In psychology, the reigning account of vision is the opponent process theory. The basic principle is that healthy human beings have three antagonistic pairs of photo receptors: red-green, yellow-blue, and white-black. Blackness is the appropriate visual response to the absence of light.

One of the roles of the 'appropriate' qualification is to exclude visual experiences that are independent of seeing. Colors can be experienced by pressing your eyeballs, imbibing hallucinogens, or by receiving a blow to the head. Isaac Newton excluded such experiences when trying to explain color (*Optics* Book I, Part II, Prop. VII, p. 443). Contemporary color scientists extend this tradition. For instance, Leo Hurvich's classic *Color Vision* orients the reader by segregating color experiences that help us see from non-functional visual experiences:

> These forms of stimulation are, of course, inappropriate for vision, and although the phenomena emphasize the role of the nervous system in light and color perception, they are of interest mainly to the visual scientist. Ordinarily, we see objects and colors only when our eyes are open and light enters them. (1981, 26)

Hurvich (1981, 61) goes on to explain how particular color responses are produced by direct light stimulation on a given retinal locus. The single exception is the blackness response. Blackness must be elicited by either a simultaneous or successive contrast.

> Blackness is not evoked by the direct action of light from any particular portion of the spectrum; blackness does result indirectly from the contrast between stimuli (one of which is "white") presented side by side to different places on the retina. It also results at the same place on the retina when "white" stimulation is terminated. (1981, 61)

Blackness is a functional visual response to darkness. In this unique case, we see by virtue of an absence of light.

Absence of light stimulation differs from absence of light. An astronaut with his back to the sun would see space as black even though he is bathed in much light. Unless light energy is directed right into the eye, it is invisible. That is why photographs of light beams must use smoke or some other medium that scatters or reflects or refracts or diffracts the light. Since darkness is the absence of light, the astronaut's black experience is a *false* representation of darkness. The darkness is pictured as filling the conical region emanating from his eyes (not just the region immediately in front of his eyes). The astronaut is experiencing an illusion because he is in an unusual situation in which the ambient light fails to make its way into his eyes.

There are other ways of having black experiences in illuminated environments. To film the black-out scene of "Eyes", Joan Crawford performed within a limbo set. She was surrounded by black drapes and illuminated from above. Since Crawford was dazzled by the lights, acting like a blind woman was not a stretch. She could not see the camera or any other familiar

object. She only saw the bright light. What would happen if Crawford were instead illuminated from behind and clothed head to toe in a black gown? Since material such as black velvet absorbs almost all light, Crawford would have an experience comparable to the black illusion of the astronaut.

7. Temporally contrastive seeing

In Robert Redford's movie *The Horse Whisperer* there is a kissing scene that makes a sophisticated use of silhouettes. The movie delicately develops a romance between a Montana horse trainer (played by Robert Redford, who also directed) and a New York magazine editor. The relationship climaxes with the pair kissing in silhouette. As the camera advances toward the couple, cinematic voyeurism becomes self-defeating: the couple's heads block out all the light. As their heads move slightly away from the camera, the outlines of their heads re-appear. The head outlines again disappear as the pair move slightly closely to the camera. Thus their privacy is protected by the *intimacy* of the close-up. The philosophical question raised by the romantic scene is almost anatomical: Are we seeing the lovers' heads even while the whole scene goes black? I answer that we continuously see the lovers' heads.

Well, it is just a movie. Many insist we are only seeing images of heads, not heads. This objection could be circumvented by re-enacting the scene on stage. Drawing inspiration from Rene Magritte's painting "The Lovers", we put black hoods on the lover's heads. A member of the audience moves up to the kissing pair of actors until their heads overflow his visual field.

It is simpler to instead use a black balloon that will be viewed through an aperture (such a blackened paper towel roll). The outline of the balloon is initially visible. When the balloon is inflated, the outline expands beyond the range set by the diameter of the tube. Thus the scene through the tube is black. When the balloon is deflated a bit, the outline again becomes discernible. The black balloon oscillates quickly back and forth in this manner.

If the balloon were fluorescent green, then one would see the balloon even when it overflowed the optical boundary. One does not need to see the spatial outline of an object to see the object. Obviously, the outline of an object is very useful for *recognition* of the object. But the issue is non-epistemic seeing. The only hitch introduced by making the balloon black is that the overflowed optical field is black instead of fluorescent green.

This hitch is not enough to prevent the tube viewer from seeing the black balloon. For the rapidly oscillating balloon gives him sufficient contrast over time. In the case of spatially contrastive seeing, we see by virtue of what is illuminated and unilluminated at one moment. Temporally contrastive seeing also involves an interplay of illumination and non-illumination, but over the dimension of time. There is no reason to treat time differently than space. This impartiality is encouraged by physics. Given a static, block

universe in which time is treated as a fourth dimension, we should be indifferent between temporal and spatial contrasts.

I do not see the black balloon if it remains permanently inflated. If I am in a room which is completely darkened by the closing of a door, then I see the darkness of the room but I do not see the door. If the door is rapidly opened and closed, then I do see the door even during the intervals in which it is briefly closed. As the openings and closings slow down, it becomes increasingly doubtful whether I am seeing the door in the dark. We are unable to ascertain how quickly the door must move to be seen. This is a benign manifestation of the vagueness of 'see'.

8. How much do we see in the dark?

Visual persistence aside, we see little of practical value in a complete absence of light. That is why darkness is alarming to human beings. We are highly visual animals who are greatly disadvantaged when the lights go out:

> for in utter darkness, it is impossible to know in what degree of safety we stand; we are ignorant of the objects that surround us; we may every moment strike against some dangerous obstruction; we may fall down a precipice the first step we take; and if an enemy approach, we know not in what quarter to defend ourselves; in such a case strength is no sure protection; wisdom can only act by guess; the boldest are staggered, and he who would pray for nothing else towards his defence, is forced to pray for light. (Burke 1757, chapter four, section xiv)

Edmund Burke is rebutting John Locke's (*Essay*, II, vii, 4) contention that darkness is not naturally feared. Locke suggests that the ghost stories told to children lead them to associate supernatural threats with darkness (*Essay*, II, xxxiii, 10). For many, the superstition persists into adulthood. Locke advises parents to keep their children away from the purveyors of superstition. Children will then never fear the dark. Burke objects to this nurture theory:

> surely it is more natural to think that darkness being originally an idea of terror, was chosen as a fit scene for such terrible representations, than that such representations have made darkness terrible. The mind of man very easily slides into an error of the former sort; but is very hard to imagine, that the effect of an idea so universally terrible in all times, and in all countries, as darkness, could possibly have been owing to a set of idle stories, or to any cause of a nature so trivial, and of an operation so precarious. (Ibid.)

The belief that darkness is dangerous is a promising counterexample to Locke's thesis that there is no innate knowledge. Proto-human beings who did not fear the dark were not as reproductively successful as those who did

have the fear. Thus the generate and eliminate mechanism of natural selection is a plausible explanation of the reliability of our belief that darkness is dangerous. Under the innateness hypothesis, frightened toddlers are not even vicariously relying on the experience of non-ancestors who were injured by darkness. Children know without relying on anyone's experience that dark places are dangerous.

The possibility that children are merely *learning* that the dark is dangerous can be excluded by the developmental regularity with which the fear matures (Valentine 1930). Children begin to manifest fear of the dark at about the age of two, and the fear intensifies until about age five.

Since human beings are menaced by darkness and aided by light, it is little wonder that evil is symbolized by darkness and that goodness is symbolized by light.

Still, I am not willing to go as far as Burke. He mistakenly believed that the darkness is actually painful to our eyes (1757, chapter four, section xvii). In fact, it is sudden bright light that is painful. Bony fish are even more prone to dazzlement than we are. Fish kept in a darkened tank are wide-eyed because they lack eyelids and have their iris and pupil fixed in an open position. If suddenly exposed to bright light, they fall to the bottom stunned and blinded.

All mammals are descended from nocturnal ancestors that took refuge in the dark in the days of the dinosaurs. Being warm-blooded, they could be active when the cold-blooded dinosaurs were torpid. Under the cover of darkness, these early mammals evolved good night vision and felt safest at night. If they used the light/dark continuum to symbolize good and evil, they chose daylight as evil and dark gray as good.

Pre-historic human beings prized caves as dwellings. Thus they must have tolerated darkness in the way they also tolerated heights and crowding and fire. Greater toleration of darkness proved an asset to a chimpanzee named Austin (Jolly 1988). He was dominated by another chimp Sherman. Sherman was so afraid of the dark that he would not leave their joint cage at night. Austin would go out at night and make strange noises (tapping pipes, windows, etc.) and then come rushing inside again, hair bristling. Instead of bossing Austin, the frightened Sherman would seek a hug of reassurance.

Fear of the dark accounts for the thrill obtained from safe exposures to darkness (or more accurately, those that we *believe* to be safe). Unlike a roller coaster ride and bungee jumping (which involve artificially safe accelerations), the adrenaline rush from extreme light deprivation occurs in quiet, immobile circumstances. Consequently, our emotional state is more apt to cross the Burkean threshold from fear to awe. Little wonder that caves are popular religious sites.

Michelangelo extols the fragile beauty of total darkness:

Any place covered, any sheltered room,
Whatever any solid circumscribes,
Preserves the night as long as day's alive,
Against the sun playing it glittering game.

And if she's overmatched by fire or flame,
By the sun she'll be ravished and deprived
Of her divine look, baser things besides
Can break her more or less, even any worm

Michelangelo 1963, Sonnet 101

This aesthetic reaction is evidence that darkness has a characteristic appearance. As John Locke points out "The idea of black is no less positive to [one's] Mind, than that of White, *however the cause* of that Colour in the external Object, may *be only a privation*. . . . And thus one may truly be said to see Darkness. For supposing a hole perfectly black, from whence no light is reflected, 'tis certain one may see the Figure of it, or it may be Painted" (*Essay*, II, viii, 3 and 6)

Locke had in mind paintings that show a mixture of light and darkness. Could there be a picture of total darkness? The paintings of Ad Reinhardt (1970) became more minimal as his career progressed. Eventually, he painted nothing but five foot by five foot black squares. Reinhardt took special care to eradicate any sign of brushstrokes and to have a matte finish to minimize the reflectivity of the surface. Although unsure whether Reinhardt intended it as a representation of darkness, I think his imposing paintings would make it a better depiction of darkness than my miniature reproduction in figure 2:

Fig. 2.

Size matters. The darkness of a cave *envelops* the observer; a big painting conveys this completeness better than a small one. The symmetry conveyed by a square shape is also appropriate (though a circle might have been even better).

Light deprivation has always been a common punishment. English prisoners were jailed in darkness at Pevril Castle. This is a Norman castle in the Peak District in Derbyshire. Pevril Castle stands above a dark stream. The stream emerges from a large cave system underneath. The locals call this cave system the "The Devil's Arse". Prisoners were thrown into the Devil's Arse by jailers who claimed that "If the fall doesn't kill them then the darkness will drive them mad".

When tourists sample the darkness of the Devil's Arse, how much do they see? Some quantitatively minded people answer that the amount of information presented by pitch blackness is a single bit, in particular, that there is no light as opposed to some light. This is a big under-estimation. Consider a 10 by 10 matrix of light bulbs. Each of the hundred light bulbs can be on or off. Thus there are 2^{100} possibilities. Any on-off listing of all 100 bulbs carries 100 bits of information. That includes the report that lists each bulb as being off. The report that all the light bulbs are off is easier to remember than any other report (except for the one which lists each bulb as being on). Most of the reports are equivalent to random sequences and so cannot be compressed into a short summary. But this lack of memorability does not mean they carry more information; the report merely requires more information to express.

In a thin sense, the Rand Corporation's tome *A Million Random Digits* contains as much information as books of equal heft on the library shelf. I am claiming that the complete blackness experienced by a sighted person is informative in a thicker sense: the blackness indicates facts about the environment. There is a reliable connection between each black portion of one's visual field being black and there being an absence of light in the corresponding region of the environment. The above remarks imply that a high resolution photograph of an utterly black tunnel is more informative than a low resolution photograph.

My analogy with the ten by ten matrix of light bulbs is also over-simplified in its failure to reflect depth. If a person in complete darkness suddenly sees the light of a candle, he can judge how far away that light source is. If the candle is not lit, then the observer's black experience accurately reflects an absence of a light at that distance. Despite the feeling that you are seeing a black surface close to your eyes, you are actually seeing three dimensionally in the dark.

You are also seeing right side up. George Stratton (1896) wore spectacles that inverted the image on his retina. Since the image is normally "upside-down", Stratton is sometimes hailed as the first man to see the world right side up. In any case, the spectacles made the world *look* upside-down. He

wanted to see how well he would adapt to transposed vision. To protect the adaptation process, Stratton would take the spectacles off at night in a totally dark room. I maintain that as Stratton removed his spectacles, he switched from seeing upside-down to seeing right side up.

Using two eyes increases the amount of light available to the brain. The increase is not as dramatic as with hearing. Under almost any circumstances, we hear noticeably less by covering an ear. Covering an eye in daylight yields little or no noticeable increase in brightness. But the increase is noticeable when we are watching very dim things. Since more dim things can be discerned by two eyes, our failure to see even a very dim object is more instructive when the search has been conducted with two eyes. Therefore, we see more in complete darkness with two eyes than with one eye.

In his *Science of Logic*, Georg Hegel says "In absolute clearness there is seen just as much, and as little, as in absolute darkness." This contradicts his famous quip against romantic monists such as Frederich Schelling. They felt that the underlying unity of reality implied that all distinctions are illusory. Hegel stood up for distinctions:

> To set this One Knowledge, that everything is equal in the Absolute, against the cognition that distinguishes and is fulfilled (or seeks and demands fulfillment)—or to give one's Absolute out for the Night in which, as the saying goes, all cows are black, is the naiveté of the void in cognition. (*Phenomenology*, sect. 16)

The correct answer to 'Do we get as much information in total darkness as we get in daylight?' is a qualified no. We get less information because our cones only perform a negative service.

We have two visual systems, one suited for day, the other for night. Our night vision relies on our rods. Rods only let us represent scenes in black, white, and shades of gray. As is well-known amongst astronomers, our night vision has its best resolution when we view objects a little off-center. The center of the eye is dominated by cones (which require much more light to perform a positive service). The richest distribution of rods lies outside this region. Thus the region that gives us the most information in daylight becomes subordinated at night.

In "the dim", night vision is enough to maneuver about, to hunt, flee, and find your way home. Monochromats, who are truly color blind, are handicapped but are far from blind. So it is still striking that the amount of raw information conveyed by total blackness is equal to the information used in achromatic vision.

There is a tendency to think that we see no more than a monochromat at night. But a trichromat, a person with normal color vision, sees more. If a green glow worm were to shine in the dark, the trichromat would see the greenness. The monochromat would not.

The trichromat's intrinsic ability to see hues *increases* in dim conditions; his cones are at peak sensitivity when dark-adapted. What decreases is the trichromat's opportunity to exercise that ability in a positive fashion. Relative to dim lighting conditions, the trichromat is insensitive to the hues of almost all objects. He cannot tell whether a shirt is red or blue. More profoundly, he cannot tell whether the shirt is red or gray; that is, he cannot discriminate between things that have hues and those that have an absence of hues. If the shirt is gray, then he does not see the grayness even though the shirt looks gray.

The hues of luminescent objects and unusually reflective objects can be seen when there is no general illumination. At night, an Alaskan trichromat can see a *green* aurora, a *blue* moon, and *red* brake lights. When marine biologists descend to great ocean depths in a diving bell, they experience utter blackness until "the stars come out" in the form of bioluminescent fish. The scientists are seeing in color even though they are being careful to preserve their night vision (by keeping the illumination low in the diving bell).

Less obviously, the trichromat sees more than the monochromat even when nothing in the scene has a hue. For the trichromat is seeing an absence of hues. Our cones still operate in complete darkness. There is a difference between being turned off and registering an absence.

Human color vision is concentrated at the center of the visual field. At the periphery of the visual field, a healthy human being can only see in black and white. Further out in the periphery, one sees only *moving* objects (just as a frog sees only *mobile* flies). Yet further to the periphery, all that is discernible is that *something* moved. And at the extreme periphery, a moving object does not cause any visual experience but does cause the head to turn toward the object.

Suppose a person is in a room that is completely dark except for one stationary spot of light at the periphery of his vision. Since that portion of the eye is only sensitive to moving things, the spot would be invisible except when it moved. If the spot were made more peripheral, the black experience would be uninterrupted even though the man sensed movement. Messages could be sent to the viewer by Morse Code via the "invisible" light.

When a man is unsure whether he is in complete darkness, he puts a hand in front of his face. If nothing is seen, he makes the further test of waving his hand. Our sensitivity to motion suggests that the man's supplemental test is not redundant.

If the observer himself moves through the darkness, he will see more than if stationary. Interestingly, the moving observer has an impression that the blackness is itself moving. This cannot be entirely due to tactile sensations. For the experience of moving blackness can be experienced at the movie theater. The three dimensional movie "Aliens" contains roller coaster scenes in which one rides through several tunnels. The blackness of the tunnels

seems to accelerate as one hears the quickening sound of the roller coaster tracks.

Aristotle's waterfall illusion also involves an impression of movement in a static visual field. Motion detectors become fatigued by staring at a waterfall. When one then gazes at neighboring rocks, they seem to move in the direction opposite of the waterfall's. If the rushing blackness were a species of the waterfall illusion, then one should have the impression of moving *backwards*. But one's apparent movement through the tunnel is forwards. This suggests that hearing and expectation play a role in how things look—even when they look totally black.

9. Individuating privations by origin

Tourists pay to experience the total blackness of the Devil's Arse. Visitors to this cave cannot experience this particular blackness by staying home and turning out the lights in their cellar at midnight. Although the experiences are indistinguishable, they differ by virtue of their distinct origins.

Objects have hues in virtue of their causal powers. Ditto for objects that have achromatic colors. Enclosures can cause a black experience by blocking light.

Suppose that you are in a light-tight container which is itself suspended within a larger light-tight container. If the interior of the larger container is illuminated, the darkness you see is the darkness of the small container. But what happens when the light bulb of the big container is turned off?

Do you still see the darkness of the small container, or do you see the darkness of the big container? Most people say that you see the darkness of the small container. All agree that you would not see the darkness of the

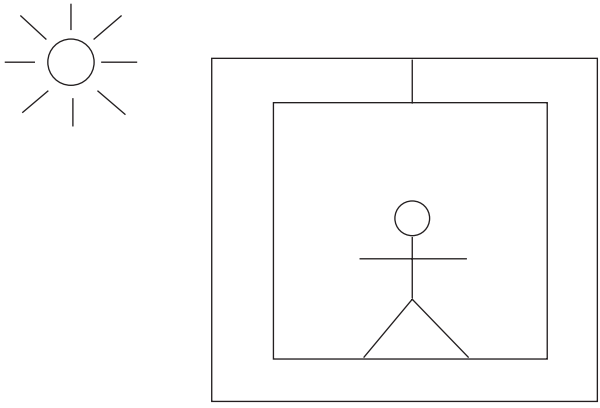

Fig. 3.

small container if it were riddled with holes. For then the container would not be blocking light. But actually the container is just as causally idle when there are no holes. Only the big container is blocking light. Hence, you see the darkness of the big container.

It does not follow that one is seeing through the walls of the small container. You are seeing in the dark but not seeing any further than the walls of the small container. For the walls of the small container prevent you from seeing any light that might be beyond the inner walls. You cannot see the walls of the small container. The walls constitute a limit to your field of vision. If the walls were removed, you would see further into the darkness. In sum, you see the darkness of the big container but only that part of the big container's darkness that lies within the small container.

By metonymy, the locution 'the darkness of x' can be read as an absence of light associated with x. The value of x can be temporal as in 'the darkness of night'. The value of x can also be a place. Consider a region of the universe that has no light sources. There are no shadows in this region. Yet it is dark. I only speak of this extended usage to prevent confusion.

In its primary causal sense, 'the darkness of x' works like 'the shadow of x'. As one closes the door to a light-tight room, the shadow of the door grows until the room is completely enveloped in darkness. We then speak of the darkness of the room rather than the shadow of the door because we can no longer differentiate the shadow of the door from the shadows cast by the walls. But the darkness of the room is just a seamless composite of shadows. Those who deny that a completely dark room has shadows are letting the epistemology of shadows distort the metaphysics of shadows.

The darkness at night is the earth's shadow. Since transparent substances are not perfectly transparent, they can cast shadows when thick enough. The darkness of the ocean is a shadow cast by the top layer of water. At night, the ocean is still dark even though the top layer of ocean is no longer blocking light. Here we are talking about the darkness of the region bounded by the ocean. In this extended use of 'darkness', the man in the box can see the darkness in the region bounded by the small enclosure. Similarly, if the universe goes dark, the observer sees the darkness of the universe. He does not see all of the darkness because his range of vision of limited. The limit is not imposed by an obstruction. The observer just has limited acuity, like a man amidst the vast expanse of the ocean.

Resemblance theories of vision falsely imply I see the same thing when I have indistinguishable experiences. If an experimenter places ping-pong ball halves over my eyes, my left-eye sees a different ball innard than my right eye. There are also counterexamples involving duplicates that each contain much detail. When I see the pristine interior of the new McDonald's Restaurant in Scranton, Pennsylvania, I see that interior rather than its identical twin in Rutland, Vermont. For it is the Scranton interior that is the appropriate cause of my experience.

Just as origins individuate positive experiences, origins individuate privational experiences. If blacked-out tourists in the Devil's Arse were merely having the absence of an experience, origin would be irrelevant. The blindness that arises from a stroke and the blindness that arises from eye damage are not distinct kinds of experience.

I am free to grant that the tourists in the Devil's Arse see the blackness only for a while. Maybe their visual systems soon revert to the default state of brain gray. Although brain gray is still very dark, it may not count as a black experience. (On the other hand it might; if you are in a scarlet room, the redness eventually becomes less dark.) In any case, few tourists notice the transition from black to brain gray. Maybe the tourists are not getting as much black experience as they paid for. But they are still getting some black experience.

There are acceptable impurities in the initial black experience. When the lights first go out, you may experience after-images and other residues of recent viewing. It takes about ten minutes for your eyes to reach the base-line state psychologists call "dark adaptation". Failure to be dark adapted in the first ten minutes is compatible with seeing. Your vision does not need to be perfect to see. I still see without my contact lenses. Pilots still see when they experience tunnel vision. Of course, they do not see in the region of the "tunnel wall". In this area, they are blind.

Normal generalizations about improving vision extend for the condition of complete darkness. Near-sighted people see better in the dark if they are wearing their corrective lenses. In complete darkness, partially blind people see only where they are not blind.

Dark adapted eyes are affected by retinal noise. They are straining to see just as an amplifier strains to pick up a faint signal. Under these circumstances, there will be the hum of random fluctuations and even the occasional false alarm. You can experience retinal noise by sitting in the dark after you wake up in a dark room. You will begin to "see" shifting clouds of floating light spots (Hurvich and Jameson 1966, 20). Some observers describe them as curved bands with dark intervals between them. Some describe them as cloud-like streamers and ribbons. The effects have attracted many labels: light chaos, light dust, self-light, intrinsic light, idio-retinal light. If you try to move about in the room, the retinal light swirls may be confused with real objects in the room. The visual experience is not one of blackness. Only with increased illumination do we experience the deep black of a black telephone.

10. Sight without light

If I am seeing without any current light, does it follow that I have been exposed to light earlier or later? No. Babies are born seeing. They have trouble focusing, and their vision is undeveloped in several respects. But they see well enough to distinguish light from dark. Consequently, if a girl is

born into an utterly dark room, the infant sees the darkness even though she has never seen the light. If she dies soon after birth, then she will have seen without ever having been exposed to light.

The conditions I have described have probably transpired with sad frequency. So I think that there have been actual cases of sight without light. Sight only requires sensitivity to light.

Sight is historically connected to light in the sense that eyes would not have evolved had there not been light. Animals that become permanent cave dwellers eventually bear descendants with atrophied eyes and in some cases, no eyes at all. Eyes are metabolically expensive and so begin to disappear when there is no longer any pressure to have them.

11. Extension to our other senses

What goes for vision, goes for all forms of human perception. This includes our less familiar senses that track internal bodily conditions. When you feel the emptiness of your stomach, you are perceiving an absence of food.

In addition to concluding that visual persistence provides a loophole by which we see normally in complete darkness, I also answered yes to a string of more specific questions: Do we see darkness? Are there illusory black experiences? Can signals be visually detected when one experiences only blackness? Are there circumstances in which some ordinary objects can be seen in the dark? Is there a difference between seeing the darkness of the Devil's Arse and the darkness of one's cellar?

Extending these answers to other *complex* senses requires more elaborate scenarios. Consider hearing. Complete silence is much more difficult to achieve than complete darkness. Our bodies make noise. If the kidnappers of Mrs. Atheist wanted to make it appear that she had been deafened, they would have to prevent her from shouting or clapping hands. They would have to muffle her breathing, intestinal gurgles, and heartbeats. Perhaps if Mrs. Atheist were paralyzed in a sound-proof room and wrapped in heavy blankets, she would mistake her experience of the silent room as an absence of hearing.

In the future, the kidnappers might be able to exploit the phenomenon of destructive interference. The basic idea is to destroy sounds by making opposite sounds. Already there are headphones that quiet engine noise by creating counter sound waves. If such noise-canceling headphones were perfected, then the small region abutting the ear would be genuinely silent. The cabin of a jet would seem as quiet as a sound proof chamber even though it is filled with the ruckus of air travel.

Of course, many practical barriers will be encountered. For instance, the kidnappers still need to contend with the fact that sounds are also transmitted through the hearer's bones. Some music players exploit this mode of

transmission. Presumably the method of destructive interference can also be directed at the bones near Mrs. Atheist's ears.

Normally, we are not in the business of fooling people into thinking that they are deaf. Hence, our standards for 'silence' are usually compatible with the existence of audible but insignificant noises (such as the soft rustling of our clothing). Librarians are not asking for the impossible when they request silence.

"Sounds of Silence" (made famous by the singers Paul Simon and Art Garfunkel) is a contradiction in terms. However, silence does not need to make a sound to be heard. John Cage's piece 4′ 33″ consists of a pianist sitting still for four minutes and thirty three seconds. (4′ 33″ equals 273 seconds and at −273 degrees centigrade, all molecular motion stops.) Many denied that this piece was music on the grounds that it could not be heard. But 4′ 33″ can be heard. Indeed, it can be recorded. If your music player malfunctions, you may mistakenly believe that your are listening to 4′ 33″ when you are hearing nothing at all.

Given my earlier emphasis on the importance of temporal contrast, I concede that it may not be possible to hear all of 4′ 33″. But one can hear its beginning. Hearing a sufficiently representative part of a musical piece suffices for hearing the piece. Contestants in the game show "Name that Tune" can identify many pieces by listening to a five second sample. Contestants with a good musical education should be able to identify John Cage's 4' 33" from such a sample.

12. Extension to exotic senses

Visual persistence is a portable gift from science. When people learn of the role of visual persistence in perceiving movies, they sometimes are grateful for our ability to synthesize static images into moving images. But this gratitude wrongly construes visual persistence as a positive phenomenon. It is actually an engineering limit. To perceive when there is little information, one must either increase the amount of gathering time or spatially widen the field from which one gathers. Bats do both. They have evolved big ears and adjust the excitability of their ear drums to the availability of sounds. Thus a bat will form a continuous sonar image even for intermittent stimuli.

We can be grateful for the *low threshold* for visual persistence. If we had the higher threshold of a bee, the movie would look like a slide show. To adjust, we would have to use more film and faster motors. But we ought not to be grateful that there is some threshold or other. That's inevitable. And it is inevitable for all the senses—even the exotic senses of other organisms. In principle, bats could have sonar movies. Star nose moles could have olfactory movies. And sharks could have magnetic movies for their magnetic sense.

We should not stop at the boundaries of *our* planet. Biologically literate astronomers have mounted a compelling case for the existence of extra-terrestrial perceivers. The persistence effect almost certainly applies to aliens.

Such confidence would be rash if it rested on the postulation of a special perceptual mechanism that positively enables fusion. However, the generality of perceptual persistence springs from its negative nature as an engineering limit. Persistence is a side-effect of a limited budget for building a perceiver. Limited budgets are pervasive. Therefore, we can soberly generalize: the "feat" of perceiving in the midst of privation is achieved by extra-terrestrials throughout the universe.[1]

Note

[1] Earlier versions of this paper were presented at the Australian National University, Macquarie University, the University of New England, and the University of Wisconsin at Madison. I thank members of the audience for their comments and suggestions.

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