19. Science and Our Inner Lives: Birds of Prey, Bats, and the Common (Featherless) Bi-ped

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The other day in a physiology seminar we were discussing the effect of retinal foveation on visual perception. Animals that move their eyes about (us, but not rabbits) do so because they have foveae - a small portion of the retina densely packed with receptor cells. It is this dense packing of cells, that makes possible those visual tasks that require high spatial resolution, the identification of shape and texture, accurate depth perception and so on. The fovea, however, cannot "see" all of the visual field. So, much like directing a telescope across the night sky, foveated creatures move their eyes - shifting the "interesting" parts of the scene in and out of the foveal area.

Humans, however, are not the only foveated creatures; nor do our foveae have the highest spatial resolution. The African vulture, for example, can discern live prey from dead at an elevation of 3,000-4,000 meters, an elevation at which it is difficult for us to see the bird (Duke-Elder 1958). Eagles, which dive for the ground at speeds greater than 200 mph, have extremely accurate depth perception, an ability also made possible by high spatial resolution. Indeed, the evolutionary "solution" in the eagle was the development of two circular foveae per eye which are connected together by a horizontal band of densely packed receptor cells. The horizontal band serves to scan the horizon. The central fovea, like those of most birds, looks to either side, each one (in the left and right eyes) taking in a different part of the world. Finally, the eagle has an extra pair of (temporal) foveae pointing forward, converging on a shared field - a foveal pair much the same as our own except with three times the density of receptor cells (Duke-Elder 1958). It is this forward-looking foveal region that provides the high spatial resolution. Attending to the scene below via the temporal fovea, eagles spot their prey and dive at fantastic speeds, pulling up at exactly the right moment.

But therein lies the mystery. Given two foveal areas and a horizontal band, how does a bird of prey "attend to" a scene, look at the world? What does that mean and, more interestingly, what would that be like? Here, in my mind's eye, I imagined myself perched high in the top of a dead tree sporting a pair of very peculiar bifocal glasses. More precisely, I pictured myself in a pair of *quadra*focals, with different lenses corresponding to the horizontal band, foveal and peripheral regions of the eagle's eye. I wonder whether it is just like that, I thought, like peering successively through each lens, watching the world move in and out of focus depending upon where I look? First I stare through the horizontal section and scan the horizon for other predators; then I switch to my left central lens and make sure no one is approaching from behind; then I use the high-powered temporal lens to scrutinize the water below for the shadows of some dinner. Is that how an eagle sees the world, I wondered? Is that what it is like to have two foveae?

NAGEL'S CLAIM

In "What is it Like to be a Bat?", Thomas Nagel made the claim that science would not, and indeed, could not, give us an answer to these kinds of questions. When all of science is done and said - when a completed neuroscience has told us "everything physical there is to tell" (Jackson 1982: 127) - we will still not understand the experiences of an "essentially alien" organism. It will not matter that we have in hand the finer and grosser details of neuroanatomy, neurophysiology and hence, the functional characterization of the system at various levels of complexity - nor will the "completed" set of psychophysics provide us with the essential interpretative tool. For all of neuroscience, something would be missed - what it is like to be a particular creature, what it is like for the bat.

In this paper I want to discuss Nagel's claim or, more specifically, the intuitions that ground it. At the outset, let me say that I do not hope to *disprove* this view. I cannot tell you what it is like to be another creature; nor, despite my abundant regard for science, do I think that an *a priori* argument is likely to establish its explanatory reach. Certainly it is not now obvious to me how the trick is to be done - what kinds of facts science could provide such that we would then understand the subjective experience of the bat or bird. On the other hand, I think there are good reasons to pursue the scientific approach and to do so without undue

pessimism about the end result. The deep intuitions that support Nagel's claim are untenable. What is more, they obscure the role that science can play in understanding a point of view - a role that it will have irrespective of whether science, in the end, explains "everything." It is these intuitions, then, that I want to address.

THE INTUITIVE VIEW

The fact of the matter is that our intuitions suggest science cannot tell us what we want to know - and these intuitions are solidly grounded in our everyday experience. We have all, I expect, faced the difficulty of trying to communicate the nature of a particular phenomenal experience. "It was *awful*, absolutely *horrible*!!" you might recount, speaking of a bad migraine headache. But no one, apart from a fellow migraine sufferer, will be the wiser for this description. Frustratingly, further elaboration does little good and this despite the listener's own catalogue of aches and pains. "Yes, it's sort of like that..." you will hedge, worrying that, in this case, a difference in intensity might in fact constitute a difference in kind. Describing the headache seems to do very little. You just have to *have* a migraine or so the sufferer contends.

Extend this difficulty to understanding an alien creature. If an organism has sense organs of a completely different sort than our own, and, further, if it processes the information gathered from these strange sense organs in a manner unique to its species (or at least, in a manner unknown to ours), it would have experiences which we do not. Some of its sensations will be nothing like our sensations. So if we think of the organism's entire experience as a sum of all those alien "qualia", the problem of understanding is multiplied a thousandfold. Given that we cannot comprehend the relatively familiar sensations of the migraine sufferer, what are we to say about the experience of an alien creature? How could we understand what those sensations as a whole, the creature's point of view, are like? Even if we did know how the brain of, say, the bat works, it seems strange to suppose that this would help. *It is the very "feel" of the experience that eludes us.* This is the intuitive view of the matter, that the problem of consciousness is largely a problem about the intrinsic or qualitative nature of sensations - and that this is what we will forever lack in our understanding of the bat.

Imagine, then, that I, having dropped in from some future time towards the end of neuroscience, claim to have a film of "what

it is like." I have a film of the phenomenology of the bat. While such a suggestion might at first seem unlikely, let me assure you that this film carries the stamp of approval of future science. For what science has found - just as some people had suspected (Dawkins 1986) - is that the phenomenal "feel" of a bat's auditory experience turns out not to be, well, "auditory." Instead, because the bat's sonar echo is used to construct a representation of spatial relations and objects, there is a strangely visual quality to the experience of the bat. That is why it can be presented on film - by visual means - to us, the human observers. What is more, this film is of the "cinerama" or "Sen-surround" variety. For the sake of realism, the film is projected on a curved screen, 180 degrees around the viewer. And it is, of course, in color.

What, then, does the film look like? First, the "plot" is simple. It shows, from the bat's auditory viewpoint, a boring sort of chase scene: the bat, flying about, uses sonar signals to catch mealworms that have been thrown into the air by an experimenter. (Bats, of course, are not blind - they *see* as well as hear. For the purposes of this thought experiment, however, I am considering only their auditory sensations.) This feat is accomplished with a maneuver characteristic of the brown bat. Flapping into range, the bat somersaults, securing the prey in his tail pouch; then he reaches down to grab it up with his mouth (Figure 1). This happens a number of times. What the film actually shows, however, on the Sen-surround screen, is a kaleidoscopic display of vibrant color forms. Swirling and pulsating, the colored forms move about the screen as the bat pursues its prey. Of course, this is not what *we* would see, if we were acting the part of the bat - if we, with our human visual systems, were trying to catch a mealworm (Nagel 1974). It is not "visual" in the human sense. But it is, I claim - from the vantage point of future science - what it is like to be a bat.

As you will no doubt object, something is wrong with this story. Whether or not the film "accurately depicts" some part of the bat's phenomenology, the sensory "colors", watching the swirling display seems to leave out much of what must be important to the bat's point of view. Unlike our experiences during a film of a roller-coaster ride or a hang-glider's flight, we do not feel any of the additional "sympathetic" sensations appropriate to the moment. It does not seem to us that we are making any of the swooping and diving movements that are made by the bat. Nor do we understand the significance of the colored images. Barring any subtitles of the form "now the somersault

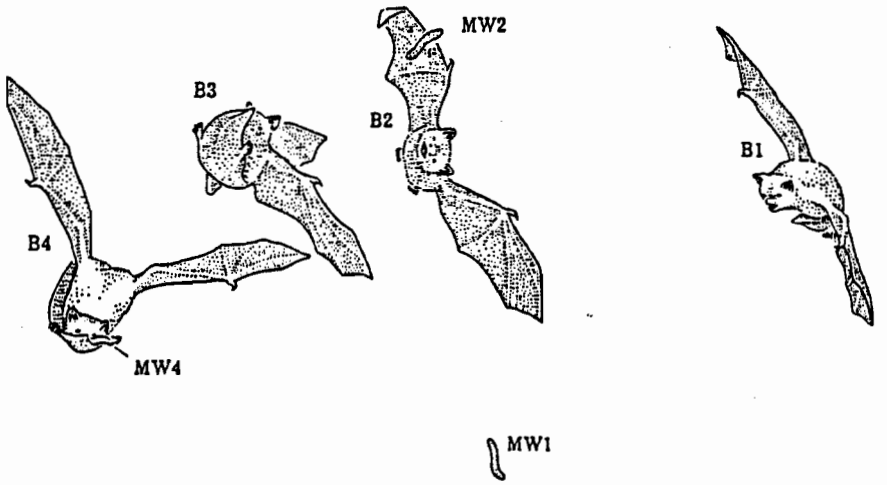

Figure 1. A filmed sequence of a bat (*Myotis lucifugus*) capturing, by a somersault maneuver, a mealworm tossed into the air. Shown are the four sequential positions, beginning with the rightmost figure. In the first frame, the bat (B1) spots the mealworm (MW1), which is still rising from the toss. In the second frame the bat uses its wing to deflect the worm downward. Next the bat catches the mealworm in a pouch between his tail and two legs. Finally, the bat ducks down to scoop out his meal (adapted from Webster & Griffin 1962).

begins" and "now you've got the mealworm", you will not know what is happening - what we, as bats, are doing. When the bright red image swirls across your left "auditory" field, is something (the mealworm? a background object?) moving past you or are you moving relative to it (maybe this is a somersault?)? Then again, is anything even *moving* at all? Can you infer that the movement of the colors stands for movement in the world? Probably not. The colored images hold little insight for the human observer if one is trying to understand "what it is like."

Let me make explicit what is wrong with this thought-experiment, why a Sen-surround film could not tell us what we want to know about the bat. Note first that, while not particularly helpful in this instance, such films are extremely useful in

understanding *the human point of view*. When we watch a film of, say, the hang-glider's flight, the pictures go proxy for the real world. The brain interprets the intensity, frequency and spatial cues of the film in much the same way as it would these same properties of light, reflected by real objects in the three-dimensional world. Hence, we really *do* see (more or less) what is seen during a hang-glider's flight. Indeed, because the visual system informs both the vestibular and the sympathetic nervous systems, we even *feel* the non-visual sensations - the terror before the leap, the drop in the stomach that follows. Through watching the film, seeing from this novel perspective the world rush by and feeling the sympathetic sensations of movement, a good deal about the experience of hang-gliding is communicated. In other words, we can simulate another person's point of view just because (1) we share a similar visual/representational system, and (2) we can artificially create the hang-glider's visual input.

Similarly, when we watch the film of "bat experience," we use the spectral cues in ways typical of human vision (what other choice could there be?). But what exactly does that mean? Unfortunately, we do not really know how color vision works, in what "typical" ways spectral cues are employed. What we do know, is that the colors we see depend upon the current ambient light plus the profile of wavelengths that specific materials are disposed to reflect. Further, we suspect that spectral signals are involved in just those visual tasks for which intensity cues prove inadequate. For example, it is often postulated that such cues are used to define equi-luminescent borders, highlight the contrast between object and background, and to differentiate objects that are similar in all other respects (e.g. the ripe and unripe pear). (For a short explanation of color pathways, see De Yoe & Van Essen 1988; for a more thorough review of color vision see Gouras 1984.) In other words, while we may think of the color system as whatever neural machinery produces color sensations, the color system is more than that: it is that part(s) of the visual system that responds to, discriminates, and utilizes spectral cues. It is this system, then, whatever it might be, that is activated when we see the film of the "bat experience."

Needless to say, a bat's "color" sensations (of acoustic stimuli) would be quite another matter. Certainly its sensations would not be tied to the ways in which external objects reflect ambient light, for sound waves do not carry information about spectral composition - nor would the sensations be a part of a system that uses spectral information for various tasks. In the

case of the bat film, I was imagining that the color sensations represent the sound field as filtered through the sensory apparatus of the bat. The hue of the sensations (red, green, blue, etc.) encodes the frequency of the sound waves; the brightness of the colors gives the volume or intensity of the sound; the configuration of the patches shows, straightforwardly, the spatial properties of the sound waves. The film also encodes the bat's *distance* from surrounding objects. By making the colored patches appear at different depths, spatial disparity mimics a disparity in time - the amount of time it takes for the bat's outgoing cry to bounce off a distant object and return. The longer the delay between the cry and the echo, the further "back" the colored patches appear in the "visual" field. In this way, distance is represented by stereoscopic display. Of course, in order to have a *system* of spatial representations, these "color" sensations would have to be hooked up with various other neural processes (with the bat's pattern analyzers that decode object shape, with its vestibular and motor systems and, well, who knows what else), but I leave these details to your imagination. Assume for the moment that the bat's color sensations are generated in something like the above manner.

The problem with the bat film, then, is just this. As a result of differences between the human and bat representational systems, we cannot expect that by inducing color sensations in *ourselves* we will understand the role that sound plays in the bat's phenomenal world - the representational system that underlies the production of color sensations in the bat. Because the Sensurround film elicits color sensations through the usual means, we will see the colors as we must, as the projection of moving colored lights upon a curved screen. We will *understand* color sensations as we normally do - however that might be - but not as does the bat.

Let me go back now and tie this thought experiment to my original purpose. As I said at the outset, the strong intuitions that favor Nagel's claim have their foundations in our everyday experience. We construe our failure to understand another creature's point of view as the result of our inability to imagine its particular phenomenal qualities. Focusing upon individual sensations, the pain of a migraine headache or the "essence" of flamingo pink, we despair that we will ever comprehend "that." Yet in the case of the bat film, we could not understand the inner life of the bat even when "that" is given. Watching a swirl of colors, we could not understand the bat's point of view. That is,

even if, *ex hypothesi*, we were able to produce in ourselves the "qualitative" aspect of the bat's experience, we would not know how the bat views the world. It is not for lack of the "quality" of the bat's experience, therefore, that his world eludes us.

More generally, our intuitions have led us astray in the following way. In concentrating upon the "feel" of sensory events, we seem to have treated consciousness as a mere collection of qualia, as a bunch of individual sense datum somehow wrought together to form a mottled whole. (Certainly, this is the route that most analytic philosophical debates have taken. For example, in the "inverted spectrum" problem, the question is asked whether it would be possible for two people to have exactly the same neural structures and functions and yet have their color experiences be "spectral inversions", one of the other. Could you, my neurological equivalent, see the sky as red even though I see it as blue? What does this mean - is it even a sensible question - and how would we determine the answer? And so on.) A point of view, however, is not a jumble of qualia. In the normal, non-pathological case, consciousness is *systematic, representational, and intentional.* Moreover, these properties, systematicity, intentionality and representational capacity, are not "optional" parts of a conscious experience, if they can be considered parts at all. Rather, they are *constituitive* of a point of view. That the world seems any way at all - that it is like anything at all to be a bat - is made possible by an organism's representational capacities.

Regardless of our intuitions, then, knowing the phenomenal experience of another creature requires an understanding of its representational system. The question of consciousness is not largely an issue of its qualitative character. If, then, we set ourselves the task of understanding an alien creature, we must know about its means of representation. We must turn to those disciplines that study the nature of mental representation - to neurophysiology, psychology and artificial intelligence among others.

What the above argument makes plausible, I hope, is that there is a good reason to study the sciences, that they will make a necessary contribution to the understanding of consciousness. Unfortunately, this way of putting things does not quite get to the root of the problem - say what is really wrong with our native intuitions or why there is no good reason to believe that science will fail.

Let me try a different route. In formulating the thought experiment above, I presupposed that there could be a separation of the "qualitative" and "representational" aspects of phenomenal experience. "What the bat hears is *just like* color, except of course, the sensations mean something quite different. Imagine that!" This was how the thought experiment got off the ground. As sensible as that request might have seemed, however, we may have no idea how to comply with it. As Daniel Dennett has often pointed out (see for example, Dennett 1988), what one is *asked* to imagine, what one *can* imagine, and what one *actually* imagines are three distinct things. It is not clear that we *do* know how to separate our conscious experiences into two parts, the representational and qualitative aspects, or whether, indeed, this notion even makes sense.

To illustrate this point, suppose that, instead of referring to the bat film, I had requested that you do the following. "Open your eyes and look around your office - at the stacks of books and papers, at the piles of articles, unopened mail and ungraded papers. Note the way the scene looks to you, the inner phenomenology of the event. Now, a bat's consciousness is just like that - except, of course, all those visual sensations would mean something quite different if you were a bat. Imagine that!" The problem is, I do not think you can imagine that, no matter how sincerely you try. First, it would require that you "strip away" the representational content of the entire office scene. Then, by some process (perhaps akin to laying two transparencies one upon the other), the intentional content of the bat's representations must be "overlaid" upon the bare sensory qualities. This, I contend, is not something we have any idea how to do: we do not know what the two "parts" would be like, of and by themselves, nor do we have any inkling how to put them together. In other words, *we have no concrete distinction between the qualitative and representational aspects of perceptions.*

You might well ask, however, why, if there is no such distinction, the bat example worked at all. There, we imagined meaningless colored patches - it seemed possible that the colors could play some role for a bat. Sometimes abstract paintings cause us to stare perplexedly, scanning the blobs of color for form, when, suddenly, a figure emerges. The seemingly meaningless shapes assume a clear role. These are the cases in which content and "mere color" are distinguished. After the "aha!" experience, the painting has meaning; before, it contained only formless colored blobs. It was this kind of distinction that I played upon in

constructing the original bat film. Given our familiarity with pictures and drawings, we *think* we can imagine "meaningless" colored shapes, nonintentional and nonrepresentational sensory qualities that, if we only knew the proper "squint" of the bat, would have meaning for us as well.

The problem here is that the comparison is not apt. The experience of suddenly seeing form in an abstract artwork is not the experience of having sensory stimuli, devoid of content, instantaneously gain intentional properties. Even if we cannot see the colored shapes as the ghostly portrait of a man, we do see the colors as something - *as* colored shapes upon a canvas, external to us, three feet dead ahead. The same is true for the patches of color in the bat film. Perceiving a colored patch is an intentional - or at least, quasi-intentional - experience, despite the fact that we find it difficult to express what red "means."

Where does this leave the argument? Nagel has claimed that we will never understand the point of view of an alien creature. The intuitions that support this claim advert to "that something" which cannot be known by description, the *quality* of a phenomenal experience. From what I have said above, however, two things follow. First, the intentional "aspects" of experience are not accidental or inconsequential to a point of view and, for this reason, the experience of another creature cannot be understood without the knowledge of the representational processes that give rise to it. Second, introspection does not yield any clear distinction between the representational and qualitative "parts" of experience. Hence, we do not know, *a priori*, what insights or even what *kinds* of insights will result from empirical investigation. Certainly, one cannot confidently declare that science *must* fail to unearth "that something", for we have no clear idea what "that" amounts to; nor can one say *what*, if anything, the scientific approach must leave out.

OURSELVES AS SUBJECTS

A further consequence of framing the problem of consciousness in the above way is that the nature of our own subjective experience is opened to investigation (Sellars 1963; Dennett 1978; P.S. Churchland 1983). It is as legitimate a subject of inquiry as the experience of other creatures. Because the questions about phenomenology are no longer focused on the intrinsic quality of particular sensations but on a phenomenology as a whole - complete with its representational/intentional nature

- our ignorance extends to ourselves as well. We, as the "owners" of sensations, do not thereby understand their representational character. Hence, our study of representational systems is also an investigation into our own point of view.

This consequence is somewhat counterintuitive. If anyone knows about my subjective experience, it is certainly *me* - or at least that is what we have always thought about the matter. By way of lending some small amount of plausibility to this result, then, I want to end this paper with a suggestive example - an example of how science can nudge our conception of self. This is the example with which I began, that of the bird of prey. What did learning a simple anatomical fact, that the eye of an eagle has two foveae, tell us about that creature's experience? What does it suggest about us?

What learning one anatomical fact did was to open the gates of possibility. The experience of the eagle, it seems, must be different than our own. But when I tried to imagine what it would be like to have two foveae, I immediately adopted a hypothesis that incorporated my own visual system. Was it, I wondered, like the experience *I* would have while wearing quadrafocals? In other words, I pictured *my* foveal field shifting from one lens to another of the multifocal glasses. (This would give me, in effect, *eight* different levels of visual acuity - four lenses imposed upon my foveal and nonfoveal regions.) Nothing we know about the visual system of the bird of prey, however, constrains its "attention" in a similar way. Although my fovea must move from lens to lens, the bird need not have any analogous "inner" eye that receives, serially, the information from the two foveae and the horizontal band. Because there are parallel lines from all regions of the retina, there is no *a priori* reason why the brain must process the information sequentially - no reason why the eagle must first attend to the left, then forward, then to the horizon. The eagle might "attend" simultaneously to all this information at once - however this might conflict with our intuitive notion of visual attention. This is a possibility that the anatomical data reveals.

The data also lead me to question one common view of our own experience. Here, I am thinking of the many models of consciousness that utilize, in one form or another, the "spotlight" metaphor: The "inner eye" of consciousness shifts like a searchlight from one neural event to another, successively attending to different mental events. This, too, is a "foveal" theory, not of another organism's consciousness but of ourselves. We apply the foveal metaphor to our conscious experience as a

whole. Certainly, this analogy has intuitive plausibility. Something about it seems right. The question, of course, is about the *basis* of the appeal.

First, the spotlight theory might seem plausible because, on looking inwardly at ourselves, we can see by inspection that our consciousness is sequentially focused on single events. That is, the introspective evidence coheres with the metaphor. But is this so? Recall what it is like to struggle through a recalcitrant screen door weighed down by several bags of groceries. First, you juggle the groceries and grasp the door handle; then you feel a mosquito land on your ankle; then you hear the creaking door hinge and the rip of a paper bag; then the mosquito makes a stab with his proboscis; then... Somehow, this strictly sequential narrative does not quite capture the phenomenon. The very problem is that "everything happens at once." Exactly what events we are conscious of at a given time or the order in which they occur is not apparent.

Perhaps, then, the explanation goes the other way about: Perhaps the searchlight metaphor, combined with our story-telling practices, confer order upon the conscious events only in retrospect. What I am suggesting is that the spotlight metaphor may be adopted just because (1) we are foveated animals and (2) we do not actually perceive any firm order in the events (i.e. such events are not "tagged" for time). Because we are such strongly visual organisms and because eye movements are required for our perception of the world, the metaphor seems plausible. Needing an explanation, we mistake our intuitive grasp of the visual perception of external events for an accurate description of our inner lives. We co-opt the visual notions of "searching", "focusing" and "watching" and apply them to all of conscious experience. This, I think, is possible; I do not think that any introspective evidence proves otherwise.

I take the above example to be merely suggestive. It offers a small glimpse of the ways we might reconceive of our own experiences in the light of discovery. Still, the central idea of this paper has been that we do not know what science will explain, just because we lack a firm grasp on the subject matter - the nature of conscious events. If so, we are in a funny position. We will know what science can tell us only after it has done so. Hence, *only* suggestive examples are now possible. What we can provide, however, are good reasons to wait - to see what science will do. In effect, this is what I have attempted above.

ACKNOWLEDGEMENTS

This paper began as an introduction to another paper, "What it is Like to Be Boring and Myopic" (unpublished); in a much abbreviated form, it served to justify the neuroscientific approach to the problem of consciousness used there.

In a deep sense, this paper contains no original philosophical insights - I have merely taken my own route to familiar conclusions. These conclusions - about the inseparable nature of intentionality and conscious experience, the failure of introspection to provide unmediated knowledge about ourselves, and the incoherence of the notion of intrinsic sensory qualities - can be found in the works of Heidegger, Wittgenstein, Sellars, P.S. and P.M. Churchland and Daniel Dennett.

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LITERATURE CITED

Churchland, P.S. 1983. Consciousness: The transmutation of a concept. *Pacific Philosophical Quarterly* 64, 80-95.

Dawkins, R. 1986. *The Blind Watchmaker.* Essex: Langman Scientific and Technical.

Dennett, 1978. *Brainstorms: Philosophical Essays in Mind and Psychology.* Montgomery, Vermont: Bradford Books.

Dennett, D.C. 1988. Quining qualia. In: *Consciousness in Contemporary Science* (ed. by A. Marcel and E. Bisiach), pp. 42-77. Oxford: Oxford University Press.

DeYoe, E.A. & Van Essen, D.C. 1988. Concurrent processing streams in monkey visual cortex. *Trends in Neuroscience* 11, 218-226.

Duke-Elder, S. 1958. *System of Opthamology: The Eye in Evolution.* Volume 1. St. Louis: The C. V. Mosby Company.

Gouras, P. 1984. Color vision. In: *Progress in Retinal Research.* Volume 3. (ed. by N. Osborn and J. Chader), pp. 227-261. New York: Pergamon Press.

Jackson, F. 1982. Epiphenomenal qualia. *Philosophical Quarterly* 32, 127-136.

Nagel, T. 1974. What is it like to be a bat? *Philosophical Review,* 83, 435-450.

Sellars, W. 1963. *Science, Perception and Reality.* London: Routledge and Kegan Paul.

Webster, F.A. & Griffin, D.R. 1962. The role of the flight membranes in insect capture in bats. *Animal Behaviour* 10, 332-340.