chapter 4

The Mind's Eye

At the 1992 Matisse exhibition at New York's Museum of Modern Art, a man said to me, "You're standing too close to that painting. You have to stand back to really see it."

He was right. I was standing about a foot from a canvas large enough for most people to view comfortably from a distance of several yards. When I look at a painting from a sighted person's distance, macular degeneration, my form of blindness, obscures or distorts the center of the canvas. My peripheral vision is unaffected, so the edges of the canvas are more or less visible. To get a general sense of the overall composition, I scan the painting systematically, moving my oversized blind spot around it, allowing different regions to emerge into my peripheral vision. My brain slowly identi-

fies the forms and assembles the picture bit by bit. In effect, my mind sketches an outline, or a map: "To the left, there's a table with a basket of fruit. To the right, there's a window with a view of the sea."

To add detail to this rough sketch growing in my brain, I must get very close to the painting, as close as museum guards allow, even closer when they look away. This is where I spend most of my time in art galleries. I edge closer and closer, then stand, usually off to one side, leaning forward, scanning small sections one at a time. But as I approach, the details of texture, depth, and illumination become only so much paint to me, an arrangement of different pigments differently applied. With my face a few inches from the canvas, every painting, even the most representational, becomes an abstraction. Paint is paint. But paint is also the point, isn't it? Looking at a work of art is seldom simply a matter of identifying the objects or people depicted there. Up close, I can appreciate the tricks of the painter's trade, understand how a seemingly random daub or dribble ends up meaning something so precise. I recognize that a stroke of purple may represent the shadowy side of a cathedral tower, a cherry blossom reflected in water, or the sheen on a fold of brown velvet. But the sketch in my head lets me know what this stroke of purple means in the context of a particular painting. I observe that the most "realistic" eye, the kind which seems to follow the viewer's movements around the room, may be no more than a swirl of brown with a thin comma of white laid over. Up close, Monet's waterlilies are wonderfully crusty, while at a distance they look almost liquid. I enjoy these discoveries and marvel at the artist's skill and ingenuity. While my too-close vantage point makes representational paintings seem abstract, with abstract works I sense not only movement and energy but depth and form. The sprays of paint on a Jackson Pollock canvas become a dense, webby mass. Ad Reinhardt's flat planes of color resonate

afterimages, vibrate with ghosts of form. Mark Rothko's exquisite colors bleed beyond their frames, staining the wall and the air around them.

Varnished canvases give me trouble. Puddles of brilliant white obscure the faces of Rembrandt's dark Dutchmen or drape portions of Rubens's corpulent nudes. But since this white part moves when I move, I know to disregard it. I shift my position and slide my gaze back and forth, watching what emerges.

Of course my method of looking at painting takes time and space. I perform a slow minuet before each painting, stepping forward and back, sweeping my gaze from edge to edge. Considering the crowds at most museums nowadays, it may seem surprising that I ever manage to get as close to the paintings as I need to. But current museum practices aid me. People tend to cluster around printed texts displayed at the entrance of each gallery or by particular paintings. Other people rent tape-recorded tours that direct them to certain works, so they bypass others. As they congregate before the texts and prescribed canvases, it leaves space open elsewhere for me.

The man at the Matisse show who told me that I was standing too close was one of these tape-recorded tour-takers. He had to lift his earphones to speak to me. And before I could formulate a response he had wheeled and hurried on to the next correct vantage point, the next preordained view.

So I didn't get a chance to tell him that I am blind. I suspect that it would have stopped him in his tracks. The visual arts are for the sighted, he might have told me. The idea of a blind person in a museum sounds like the punch line to a bad joke. Though, as far as he could tell, any number of his fellow earphone-wearers could have been blind. Why not? Certainly it is no challenge to a skilled blind person to follow recorded directions, to move from room to

room with a crowd of similarly directed people. In fact, a blind person accustomed to reading books on tape would probably get more out of the taped tour than would the average sighted person.

"But," the man would object, "when I stand in front of a painting I know what I'm looking at. The tape only supplements what I'm seeing. When I look at the painting I see it. I don't piece it together like a jigsaw puzzle, like you do. I just see it. You're doing something else. Your brain creates some secondhand version of the painting. You do not experience the painting itself."

To such people there is a right way and a wrong way to see. The dialogue that goes on between my eyes and brain seems something distinctly different from sight. It is not vision but revision, something altered, edited, changed by my mind, subject to my values, expectations, and even moods. I see what I sense is there, what I know is there, what I hope is there, not necessarily what actually is. For the sighted, seeing is both instantaneous and absolute. To see is to take something in at a glance and possess it whole, comprehending all its complexities. Sight provides instantaneous access to reality. The eye is the window on the world. It's a perfect little camera, with a lens that automatically focuses the image on a light-sensitive film. Aim, focus, presto—nothing to it.

The sighted can be so touchingly naive about vision. They apparently believe that the brain stays out of it. Or at best, they extend the camera metaphor and envision a tiny self seated inside the skull, passively watching images as they are projected on a movie screen, then pushing the buttons and pulling the levers that will make the body respond appropriately by speaking, running, reaching, or closing the eyes. A few can describe vision with more specialized language. They explain that light of different frequencies and intensities reflected off an object is refracted through the eye's cornea and lens to hit the retina, where it initiates a chemical change in

the photoreceptor cells, which triggers an electrical impulse to the ganglion cells, which send an impulse to the optic nerve, which relays the message to the lateral geniculate nucleus, which conveys it to the primary visual cortex and other regions of the brain, where different aspects of the image (color, motion, form) are assessed. And thus, you see. Still, despite fancy language, the idea remains the same. The image that hits the retina is presumed to be what you see. That initial image is described as having a constant, inviolable integrity. The visual process is said to work something like a fax machine. Whatever shuffling and rearranging of the image that takes place inside the brain, you end up with the same image you had at the beginning. The sighted preserve this absolute faith in the image despite everyday experiences when their eyes deceive them or when they see more (or less) than actually meets their eyes.

For example, picture this. You are waiting to meet a friend in a crowded train station. You are able to spot him from across the large waiting room, a distance of perhaps forty yards or so. The next day you are there again, waiting for someone else. Your friend of the day before also shows up and walks toward you, but you do not recognize him until he is much closer, perhaps only a yard or two away. Why? The image projected on your retina is pretty much the same. And you're alert to it, actively scanning the crowd. Your friend's image is there in your eye on Tuesday as it was on Monday. You should see him, but you don't.

Or picture this. You are pitching in the final game of the World Series. You must throw a strike. You look at the catcher. You focus on his glove, the precise spot in his glove where you want the ball to hit. As you do this, you do not see the fans in the stands, even though (since these are not your home fans) they are waving banners, hats, towels, seat cushions, and generally trying to distract you. You do not see the hitter at the plate or the umpire crouching

behind the catcher, or even the catcher, just that spot in his glove. You don't see those other things even though their images appear on your retinas. Why? Your eyes, unlike cameras, are not equipped with zoom lenses that can alter the field of view and allow you to zero in on the catcher's mitt that way.

Is this just a manner of speaking, a way to spice up the postgame interview by re-creating the suspense of the moment? Or are there really instances when stress, fatigue, illness, and emotion (not to mention drugs or alcohol) distort or alter what you see? A smoke alarm sounds in your favorite restaurant and, in your haste to escape, you see nothing between you and the Exit sign, though the lights are still shining and your eyes can see the waiters and other diners overturning tables as they rush toward the door. When you describe the experience, you will blame your eyes, not your brain, and call it "blind panic." Some enchanted evening you will see a stranger and be "blinded by desire," utterly unconscious of all the other people and objects in that crowded room even though all these things are right before your eyes.

"So occasionally the brain plays tricks," the man at the Matisse exhibition might argue. "Sometimes the brain ignores, even dumps, part of the image that the eyes receive and highlights, even enhances, other parts. But this only happens under certain circumstances. The rest of the time I see exactly what's there. I see everything that's there. My vision is both impartial and democratic. My brain doesn't intervene or intrude. It merely receives and responds." To this I would say, "Look again."

Try this. Picture the world as I see it. My world has a hole in its center. The central region of my retina, the macula, no longer functions. So when light entering my eyes hits the retinas, only the cells on the periphery, and a few good cells scattered around the center, send messages to the brain. In the most common form of macular

degeneration, now called "age-related" but once called "senile" or "wet," abnormal blood vessels form behind the retina. These leak and damage the delicate photoreceptor cells. In my form of the condition (which is rare and, some feel, so different from the common form that it deserves a different name), there were no leaky blood vessels. My photoreceptors seem to have been genetically programmed simply to give up the ghost. I have no memory of this. It happened when I was about ten years old, and probably very gradually, perhaps even cell by cell. Whatever the cause, the damaged cells do not regenerate or grow back. As my most recent ophthalmologist put it, patches of my retinas are entirely "worn through." The affected area is small. The whole macula measures about 5 millimeters across its diameter. But it contains a higher concentration of photoreceptors than the peripheral areas. More important, the macula is densely packed with the sensitive cone cells that allow for the perception of fine details. So I lack not only central vision but also the visual equipment designed to perform such tasks as reading print or recognizing a face. In effect, I have an extremely large blind spot in the center of my visual field. Every human eye has a blind spot. It is the place where the optic nerve meets the retina, where there are no photoreceptors. The reason you do not see your blind spot most of the time is because it is out of the central region of vision. Also, since you have two eyes, there are two blind spots, but they do not overlap. When something is obscured by the blind spot in your left eye, your right eye will see it. And your brain knows the blind spots are there and always have been. Your whole visual system works around the fact of your blind spot, so you can disregard it. My blind spot is simply larger and more central than yours. You can crudely simulate macular degeneration by putting a blob of toothpaste in the center of your eyeglasses, so wherever you aim your eyes you see only toothpaste. But this is not exactly what I see.

With effort, I can force myself to see my blind spot. When I stare directly at a blank wall, this flaw in my retina does not appear as a black hole or splotch of darkness. When I am very tired I see an irregularly shaped blotch, which throbs slightly and is either an intense blue-violet, or a deep teal green. More often, I see a blur slightly darker in color than the wall overlaid with a pattern of tiny flecks. Depending on lighting conditions these flecks are bright white, sometimes edged in violet or a golden yellow. Sometimes the flecks are less vividly colored, and the wall appears like a surface of water dappled by a breeze or soft rain. These flecks or dapples vibrate, pulsate, shiver but stay closely packed and never migrate from the central region. Around this movement, in the periphery of my visual field, there is calm.

When I look at a simple object—a white 3-by-5-inch index card on my desk, for example—it disappears. More accurately, the beige wood color of the desktop flows into the central blurry region of vision, while flecks of white pulsate above. The card seems to disintegrate into tiny, quivering particles, to dissolve into the desktop and the air. If I shift my eyes slightly in any direction, the card reappears. It seems to emerge from the desk's surface, to differentiate itself from the pale wood grain. I shift my gaze back and it's gone. When the object is larger and there's a higher degree of contrast between it and the background—a 5-by-8-inch paperback book—its disappearance is less complete. When I aim my eyes at its center, only the top two thirds disappear, while the lower two inches or so remain. Also, the colors of the cover design disintegrate into pulsating flecks, invading the pale surface around it. I see the book losing solidity, becoming translucent while a cluster of vibrating speckles dance just above it. It's something like what they do on the TV news to protect the identity of a courtroom witness

or accused criminal. The person's face is blotted out by a moving pattern of tiny squares. But for me the pattern is less regular and moves faster.

My blind spot always occupies the central region of my visual field. The wider the field, the larger the blind spot. When I look at my hand from arm's length, it vanishes. When I bring it close to my face, only the fingertips are gone. To see the picture on the cover of the book I bring it close to my eyes. With the book an inch from my face the blind spot is only about the size of a silver dollar. I can see enough of the picture to identify the book.

I cannot perceive a straight line, because wherever I aim my eye, the line appears severed. The line that designates the edge of an object bows, wobbles, or oscillates from side to side. The more straight lines in the object, the more distortion. A bookcase with its uprights and shelves full of books is a haze of motion. The color of the shelves bounces up and down, bleeding into the color of the books, which vibrate from side to side. A filmy veil seems to hang over it, blurring the spines of books into a smudgy, variegated haze. I look down. A sheer, white-violet fog hangs over my computer keyboard, slashed here and there with streaks of yellow. My fingers pierce the fog as I type, sinking in up to the first knuckle. One of my cats sleeps on my desk. Every curve and contour of her body oscillates outward, forming a translucent ghost cat emerging from the real one. All around there are pulsating speckles of violet and gold, dazzlingly at odds with the cat's immobility. When I touch her, the shadow cat grays my hand.

As solid objects seem to dissolve or shimmy, insubstantial shadows and patches of light acquire solidity and form. The shadow in the corner could be a pair of shoes. Bright specks of light shining through prismatic glass blocks appear as scraps of colored paper.

Lamplight reflected off a polished table might make me gasp—spilled milk to me.

I "see" more than I'm supposed to. Ophthalmology textbooks predict that people with macular degeneration will in fact see a black (or perhaps white) hole in the middle of what they're looking at. Ophthalmologists are not necessarily well versed in the neurology and psychology of vision. What goes on in the brain is someone else's province. Research to identify the specific functioning of cells in the retina, and the corresponding nerve fibers and neurons in the brain, is relatively recent and somewhat inconclusive. But it allows me to speculate. The scintillating motion, vibrant speckles, shadowy emanations, and changing forms may have to do with the few remaining good photoreceptors scattered over the macula. When I stare at an object, the few functioning cells in my maculas may be dutifully sending reliable messages to the brain, oblivious to the blank space, the vacant silence that surrounds them. If these are cones (I know I must have some since I see color), the brain pays more attention. There is a one-to-one ratio of cones to ganglion cells, while several rods synapse on one ganglion cell. Each cone has a private line to the brain. Also, a disproportionate amount of cortical space is devoted to the central region of the retina. Whatever messages get through from those last few holdouts are scrutinized by a large number of neurons. My brain receives these messages without the millions of other messages that should corroborate or enhance them. My brain takes what little it has to go on and does the best it can. It hedges its bets. There might be a white index card there on the desk, my brain tells me. Then again, maybe not.

Leaving aside this neurological speculation (which is probably more whimsy than fact), I surmise that my general visual experience is something like your experience of optical illusions. Open any college psychology textbook to the chapter on perception and look at the optical illusions there. You stare at the image and see it change before your eyes. In one image, you may see first a vase and then two faces in profile. In another, you see first a rabbit then a duck. These images deceive you because they give your brain inadequate or contradictory information. In the first case, your brain tries to determine which part of the image represents the object and which part represents the background. In the second case, your brain tries to group the lines of the sketch together into a meaningful picture. In both cases there are two equally possible solutions to the visual riddle, so your brain switches from one to the other, and you have the uncanny sensation of "seeing" the image change. When there's not much to go on—no design on the vase, no features on the faces, no feathers, no fur—the brain makes an educated guess.

When I stare at an object I can almost feel my brain making such guesses. And there are usually more than two alternatives. Before my eyes, the hazy blur that conceals the object oscillates and shudders, taking on new colors and contours. I "see" my brain's confusion as it mulls over the amorphous shapes before my eyes. The red coffee mug on my desk becomes a green mug, then a green ball, then a black box, then . . .

But this is not what I really see. In my attempt to specify my own visual experience, I distort it. The effort required to fixate on an object long enough to "see" this brain activity (if that's what it really is) wears me out. The pulsating speckles put me on edge. My head aches. I am using both my eyes and brain in an unaccustomed, unnatural way. This hole in my vision has been there a long time. I've learned to work around it. Normally, I am more or less unaware of my blind spot. Or else I disregard it. I know objects have form and solidity, sharp edges, stability. I know that the central area of my visual field is unreliable, plays tricks, so I focus my

attention elsewhere. My peripheral vision is unimpaired. Out there on the edge of the image, there is stasis and certainty. I move my attention off center, viewing the world askance. I ignore the center, move around it. My gaze circumambulates the object, tracing its contours. If I want to see the index card, I aim my eyes at the coffee mug behind it. The mug disintegrates, but the card lies still, flat, rectangular, identifiable. I can lay my hand on it. If I want to look at the cat, I stare at the book. I move my eyes to the far side of the cat, up and around her. Of course, peripheral vision is not as accurate or precise as central vision. You cannot read with peripheral vision. Hold a book off to the side and stare straight ahead. You will see the general shape of the book, be aware that there's print on the page, but unless you cheat and glance that way, you will have trouble making out the words.

Peripheral vision exists to give you a general sense of your surroundings—the forest, not the trees. It allows you to see things coming at you from all sides, and to avoid obstacles as you move through space. When I walk, my lack of central vision is less noticeable because it is less necessary. My blind spot precedes me like a giant flying jellyfish. Large objects—fire hydrants, people, cars—fall into it several yards away, then reappear a few feet in front of me. I aim my eyes straight ahead, straight into the floating blob, but I remain conscious of what surrounds that blank center. When I look down I cannot see my feet or what's directly in front of them. So I lift my eyes, and my feet and what's in front of them emerge from my blind spot into my peripheral vision. I get a general sense of an obstacle here or directions there, though I can't necessarily identify it as a rock or a roller skate.

People often ask me directions—apparently I look like I know where I'm going. My directions tend to mystify people because

they're too topographical. I may not know street names, but I retain a memory of the contours of land, of architectural features, of landscaping. Peripheral vision is not only the side-to-side view but what's overhead and underfoot. I give details about the periphery of the route, where trees or buildings close in overhead, where the sidewalk narrows or widens. I tell people to keep going to the top of the hill, or to cross the street at the corner when the street begins to bank to the right. Since bodies of water tend to be low points, I say, "Head toward the river," even in cities where this is not a commonplace idiom. Sighted people are apparently oblivious to these aspects of their surroundings. They keep their eyes gripped in taut focus, scanning for road signs, house numbers, numbing their other senses. I say, "There's a red awning, a blue door." They're speechless. My landmarks are not theirs. And when I ask directions they say, "It's over there," gesturing in a general direction. "You'll know it when you see it." It's a wonder we can get anywhere.

Expectation plays a large role in what I perceive. I know what's on my desk because I put it there. If someone leaves me a surprise gift, it may take a few seconds to identify it, but how often does that happen? At home, at work, on the street, and in stores, museums, theaters, parking garages, airports, train stations, even unfamiliar cities, there is a finite number of objects that I am likely to encounter. I can recognize most things through a quick process of elimination. And that process is only truly conscious on the rare occasions when the unexpected occurs, as when my cats carry objects out of context. A steel wool soap pad appears in the bath tub. I see it as a rusty, grayish blob. Though touch would probably tell me something, it can be risky to touch something you cannot identify some other way. I wait for it to move. When it doesn't, I sniff. It smells faintly metallic and vaguely soapy. Is it a massive hair clog

regurgitated by the drain? This seems implausible. I think, "What is that?" and then, almost in the same moment, I come up with a better question, "What's it doing there?" and know the answer.

I once encountered a rabid raccoon on a sidewalk near my house. I learned what it was from a neighbor watching it from his screened porch. What I saw was an indistinct, grayish mass, low to the ground and rather round. It was too big to be a cat and the wrong shape to be a dog. Its gait was not only unfamiliar but unsteady. It zigzagged up the pavement. I moved my gaze around it as my brain formed a picture of a raccoon. The raccoon in my mind had the characteristic mask across its face, a sharply pointed nose, striped tail, brindled fur. Nothing in the hazy blob at my feet, no variations in color or refinements in form, corresponded with that image. Its position was wrong. The raccoon in my mind was standing up on its haunches, holding something in its front paws. And what does a rabid raccoon look like? Was it foaming at the mouth?

Without my neighbor's information I wouldn't have gone through this mental process. I could tell that it was an animal, and probably not a pet. That's all I needed to know to proceed with caution. But I still might have guessed it was a raccoon. In this part of the world there are only so many animals it could have been. Groundhog, woodchuck, raccoon, my brain would have proposed, but not sloth or koala.

But such unexpected encounters happen so rarely that they become anecdotes. In the normal course of events I encounter only those objects, animals, and people that I can predict I will. If I see them as wobbly shadows, or semi-translucent blobs, it hardly ever startles me. And the fact that I can distinguish one shadow from another is no miracle. I cannot see people's faces well enough to recognize them, but often I know them from their posture or gait. At the supermarket I distinguish the Cheerios from the Wheaties

because one hazy blur is yellow and the other is orange. But in a way, you do this too. Marketing experts chose that color to catch your eye, and the eye of your three-year-old, who can't read the words yet. Also, while I actively seek that color to identify the brand, you and your child may be responding to subliminal messages about sunshiny cheerfulness. Otherwise, all cereal boxes could be white.

The unimpaired human eye provides the brain with such a surfeit of visual information that only a certain amount consciously registers at any moment. In effect, your brain privileges certain aspects of the retina's images and disregards others. Each eye sends the brain a billion messages per second. Together the two eyes transmit twice as much information to the brain as the rest of the body combined. With all this information flooding in every second, the perceptual system seems designed to adapt readily to losses and distortions, whether because of eye damage or other circumstances.

Consider depth perception. You see the world as three-dimensional even though the image on your retina is two-dimensional. Part of the reason is that you have two eyes. The brain fuses the eyes' two images so you don't see double. But it also analyzes the slight differences between the two images and calculates the spatial relationships between objects. Thus, you see some objects as closer to you than others. You also see some parts of objects as jutting out toward you while other parts recede. Close one eye. Why doesn't the world suddenly look two-dimensional? Because your brain takes into account other aspects of the image. A ball looks different from a flat disk because of the play of light and shadow off its surface. In this world, light tends to shine down on objects, so the upper contour of a convex object will reflect light while the lower contour will show shadow. Your brain assesses these variations in color, and you see a three-dimensional form. Similarly, your brain responds to other "pictorial" cues to depth. Nearby objects look

bigger than faraway ones because they overlap or obscure parts of the faraway objects. Even when you have one eye closed, your brain still has an array of clues to go on. Your brain evaluates these, and you perceive depth. For this reason an artist can draw a picture observing the rules of linear perspective and create the illusion of depth, even though the surface is flat.

The human eye, though capable of a variety of visual tasks, is relatively delicate, easily injured, subject to all sorts of diseases and disorders. For our species to survive, the perceptual system had to be adaptable. For about a century, scientists, conscious of this evolutionary fact, have devised ingenious ways to test how much distortion the human visual system can tolerate. Typically, researchers would mount prisms in eyeglass frames or goggles. These prisms would, for example, turn the world upside down or shove it off center by several degrees. In a relatively short amount of time, the subjects (who were sometimes the researchers themselves) could walk around without bumping into things, lay their hands on objects, even read and write. They "saw" the world as normal again. Of course, when a researcher designs an experiment and performs it on himself, the results may be skewed. And even the neutral subject of such an experiment, told to walk around the room with goggles on, will struggle to adapt in a way very different from what happens when someone wakes up one morning to find the visual world radically altered. Still, the implication of all this research is that the human perceptual system tends to be resilient, flexible, and adaptable. You may experience visual adaptation on a small scale when you wear eyeglasses with a new prescription. For the first few minutes or more, you may see the world spinning at a dizzying speed every time you move your head. Then you get used to it. Your brain adapts without your even having to think about it.

Our brains have been adapting to new visual conditions since infancy. Each phase of physical, cognitive, and motor development necessitates the mastery of new visual and perceptual skills. For instance, as the baby's head grows and her eyes move slightly farther apart, her brain has to make minuscule adjustments in order to keep the eyes' two images perfectly fused. As the baby learns to crawl and then walk, her brain will adapt to a whole new set of visual situations. Feats of eye-hand coordination also involve the brain's capacity to make determinations about motion and space. When she goes to school and begins to read, she will develop not only the ability to distinguish between characters but also the skill to move her eyes in an orderly way from left to right, as well as the finesse to focus the eyes first on the page and then on the blackboard.

Perceptual development takes about the first ten years of life. But it may not stop there. Certain people in certain lines of work seem to train their perceptual systems to perform specific visual tasks that other people would find impossible. Such people may have only average eyesight but seem to see more, more quickly and more accurately. Senator Bill Bradley claims that during his basketball playing days he trained himself to use his peripheral vision more accurately, as a way to give himself an advantage on the court. He would walk past a store window with his eyes aimed straight ahead and try to identify the objects on display. Then he would go back and check. Over time, he claims, he actually expanded his visual field. In fact, the placement of the eyeballs in the skull limits how far a person can see in any direction. The maximum angle of vision for humans is 180 degrees from side to side, and 70 degrees from top to bottom. But most people do not consciously register at the farthest reaches of their visual fields. Bradley saw no more than other passersby or players, but he heightened his sensitivity

to what was going on in the periphery. He taught his brain to recognize objects or people from minimal details—a flash of motion, a wavy line.

If Bradley's story raises eyebrows, it is because normal vision is supposed to be immediate, spontaneous, now-you-see-it-now-you-don't, not a continual game of "Where's Waldo?" To the blind with some sight, however, Bradley's story makes perfect sense. Relative to the type and degree of our conditions, we learn to interpret the world through minimal visual information. We learn to combine these imperfect and incomplete images with our other sensory perceptions, plus what we know about the laws of nature, and call it the world. But when we do this, when we make claims about our adaptation to subnormal vision, is when we become most alien. The idea that some people, through habit or even conscious effort, can use visual information and skills differently, seems to indict the averagely sighted as lazy, slack, perhaps even stupid. Because we get by with less, wringing meaning out of mere scraps of images, we seem to wag our fingers at the sighted for their wastefulness.

The sighted seem more comfortable thinking of someone like Ted Williams. Some years after Williams retired from baseball he performed an informal experiment to prove that he could actually see the seams of the baseball as it hit his bat. A hitter with a "good eye" will swing only when the ball appears to be in a particular region of the strike zone. He looks for the white blur of the ball to cross that imaginary line, but other details about the ball do not necessarily register in his brain. Williams saw the ball as more than a blur. He saw the orientation of the ball—where the seams were relative to the bat—at the split second of impact. Optically speaking, the image on the retina of both hitters would be the same, but Williams's brain apparently got more from the image. Hitters on a good streak often describe the ball as looking bigger than usual.

Williams seems to have seen it this way all the time. A lifetime of practice presumably trained his brain to evaluate the image on his retina at a higher rate of speed. Practice makes perfect, but practice cannot turn an average hitter into a Ted Williams. Williams probably had better than average vision. He was a fighter pilot too, a job that usually requires acuity of 20/20 or better. Still, half of baseball is 90 percent mental. A great hitter like Williams combines great physical, and in his case visual, resources with a high level of intellectual discernment. But vision, the sighted assert, is a God-given gift rather than a well-honed skill. Superman was born with X-ray vision; he didn't pick it up along the way. And the vision that separates some—the artist, the scientist, the leader—from the rest of humanity is always said to be innate and a little bit otherworldly. The sighted seem to want to preserve the mystery. Intelligent and highly educated people are often a bit vague about visual processes. A friend who teaches visual perception reports that her students, who are preparing for careers as clinical psychologists, often find the subject perplexing and irrelevant. If you can see, you don't need to know why you see. And if you see more than other people, you should accept the gift without question. Visionaries do not always choose their own fates. The exceptional vision that the gods occasionally bestow dictates what path to follow. As Branch Rickey said of Ted Williams, "How can a man with eyes like that not be a great hitter?"

Your eyes are supposed to make you who you are. If you are clear-sighted, you are probably also level-headed and open-minded. So what do my eyes make me, I wonder. Does the fact that everything I see seems on the verge of disintegration mean I'm in a constant state of anxiety about imminent loss? Does the scintillating motion that I perceive in static objects mean I'm actually in contact with the seething energy of subatomic particles? Or else,

since my gaze erases everything in its path, does it make me harbor a delusion about my own divine power?

Perhaps I ask for this. All my speculation about how I see more than I should given my marred retinas is beside the point. In most circumstances I rely very little on sight. A cat still sleeps on my desk. To see her well enough to identify which of my two cats she is, I must look at her very closely. I lower my face toward her so that my entire visual field is full of cat, and my distorting blind spot affects a smaller area. I move my gaze around, taking in the details of her markings that will allow me to know which one she is. But I do this only because I am writing about my vision, attempting to specify how my perceptual system works. Under normal circumstances I would simply touch her. The fur of one cat has a slightly coarser texture than the other. When a surprise gift appears on my desk, I can stare at it, watching it transmogrify before my eyes, or I can pick it up and handle it. Touch takes a second but seeing takes more time, and a kind of concentration better directed elsewhere. Since my sight is so unreliable, I tend to ignore it altogether or to trust it only when what I see is confirmed by something else I know.

The notion that one might deliberately ignore sight seems to threaten sighted people in a way that I cannot fully understand, since there are situations when sighted people do this too. As a teenager I studied at the Martha Graham School of Contemporary Dance. My lack of central vision was not the hindrance that one might assume. Though teachers and choreographers often demonstrate positions and steps, they also give oral instructions. Once a dancer learns the vocabulary of a particular technique, directions and corrections can be communicated in words. Also, part of a dancer's training involves giving up an absolute reliance on sight. My best teachers regularly made the class turn away from the mirror or close our eyes while performing an exercise. There is a risk

for a dancer of becoming too dependent on the mirror, since there is never a mirror on stage. But more important, a dancer has to know, without looking, what her body is doing at all times. She may be obliged to enter the stage in the dark, to find her position and begin moving without the luxury of sight. Even when the stage is lit, the angles of particular lights may hit the dancer's eyes in ways that make it impossible to see the floor or the edge of the stage. When she is dancing with a partner or as part of the corps de ballet, she must be conscious not only of her own body but also of the bodies of the dancers around her. Part of this perfect unity comes from rehearsal, of course, but in a live performance, with live music, the tempo may not be exactly the same as it was in rehearsal. Adjustments must be made without looking. There can be no shifting eyeballs, no sideways glances to see where someone else is. A dancer develops eyes in the back of her head, on the soles of her feet. To illustrate this point, one of our teachers used a negative example. She would mime one of those ludicrously inept people you encounter at parties or standing in a movie line, who back into you, apparently unaware that you were standing there. "Can you imagine?" she'd say as we laughed, vowing never to be like that. "Not knowing there was someone behind you!"

A good baker smells when the bread is done. An auto mechanic hears the trouble in the engine—isn't that why they call it a tune-up? You can fasten a necklace at the back of your neck without looking, shampoo your hair with your eyes closed and find the light switch in the dark.

"But when I do those things I'm not renouncing sight," you may argue, "I just sometimes get by without it." This hits on a dilemma that faces the blind like me who have, in the phrase of experts, "some usable sight." The phrase is troubling because it seems to denote a hierarchy with a visual elite (20/20 or better) on top and

the blind with absolutely no sight on the bottom. Also, the phrase is imbued with the notion that there is a right and wrong way to use sight. Do you always make the best possible use of your sight? You may never need to ask yourself this question. But if your sight fails, if your acuity dips below the magic 20/200 line, or your visual field narrows to less than 20 degrees, you will hear the question all the time. We live in an age of high-tech low vision innovations. Optometrists can prescribe dozens of different aids designed to help patients perform all sorts of visual activities. But unlike the eyeglasses you may already be used to wearing, no single device, or even a gambit of gadgets, can completely compensate for the sight you've lost. The handheld magnifier you use to read the newspaper does not help you read a street sign or do embroidery or watch TV. To be an informed consumer of all the equipment now on the market, you will have to think of vision in a new way. Vision is a series of discrete activities, not a constant, seamless, pervasive ebb and flow of information. What's more, you will need to prioritize, decide which activities are worth performing visually. Otherwise you may leave the doctor's office laden with cumbersome and expensive paraphernalia but little guidance on how to deal with the world without sight.

I use some low vision aids. For example, I have a pair of reading glasses with a magnifying lens mounted on the right side, which allow me to read print (mostly large print) when I get very close to the page. I also have a closed-circuit television system that projects a magnified image of books and letters. My computer allows me to work in print as large as I like. From time to time I investigate other devices. Every month something new comes on the market, but I do not buy everything that's available. For one thing, most low vision aids are very expensive, and health insurance companies are still rather stingy about them. Still, I could afford to buy them for myself. The question is: Do I need them? I could get a pair of glasses with small telescopes mounted on the lenses which would allow me to make out a person's face. These would be custom-made, with the telescopes carefully placed and permanently focused at a predetermined distance. My doctor suggested that such glasses might be useful in the classroom, so I tried on a pair. Since these were not made for me, it took a while to figure out how to make them work. Eventually I managed to see my doctor's face as he stood in the doorway, about ten feet from me. In fact, I could see his face only about as well as I would if he were sitting across a table from me. His features were merely a hazy smudge on his face. I could, however, see his lips move, which was an undeniable improvement. But the glasses also created an extremely disconcerting distortion. While I saw a closeup of his face through the telescopes, I simultaneously saw his body at the proper distance. He appeared like a truncated cartoon figure, and I found myself laughing uncontrollably. Over time, I could have gotten used to the distortion. But I would still have to decide at what distance to have the telescopes set. Ten to fifteen feet would allow me to see the students in the back row in a small classroom, but not those in the middle or front rows. Would I have to get three different pairs and keep switching? And for what—the pleasure of knowing that a student in the back row is snoozing or that another's lips move while he's speaking? I know these things already.

Fortunately, my optometrist was not offended by my rejection of available technology, much less my laughter. He knew that an aid one person finds indispensable another will find useless, even though both share the same type and degree of blindness. Not all eye care specialists are so gracious. Some are perplexed, even annoyed by blind patients who reject visual aids. Few offer or even possess much information about nonvisual skills for the blind, such

as braille or white cane use. Patients, especially those who bring with them myths and prejudices about blindness, can end up with the impression that it is better to do something with the eyes than without, no matter how cumbersome and expensive the equipment required. Eye specialists are committed to the mission of preserving sight and preventing blindness. Blindness is the enemy, to be kept at bay at all costs. When a patient rejects visual aids for nonvisual techniques, many eye specialists take it as an insult, as ingratitude, or worse yet, as a defection to the other side.

In 1991, researchers at a clinic of the National Institutes of Health implanted tiny electrodes in the brain of a woman who had been blind for twenty years. When they stimulated the electrodes, the woman "saw" colored dots, as if before her eyes. In the not so distant future these researchers and others will be able to implant a greater number of electrodes. These will be attached to tiny TV cameras mounted in eyeglass frames so the user would "see" the world as patterns of dots similar to the array on a stadium scoreboard. These researchers are quick to point out that this artificial vision is meant to "aid reading and mobility, not restore normal vision to the point you could go into an art gallery and appreciate a Rembrandt." I admire the unnamed woman who volunteered for this experiment. The research has far-reaching implications that will benefit many more people than the few blind individuals who might choose to have the operation done. At the same time, like many blind people (even those with no sight at all) who can read and get around through nonvisual means, I find news of such research unsettling. If such artificial vision won't let you see a Rembrandt, is it really worth getting a hole cut in your head?

The newspaper accounts of this experiment included no references to the woman's feelings about what she "saw." Psychologists and physicians who have studied blind people whose sight has been

restored by an operation (usually a cornea transplant) often report that patients eventually experience some degree of depression. Some end up rejecting sight and the advantages that sight provides. They continue to read braille rather than print, to identify objects through touch, and to sit in the dark. The usual explanation for this depression is that learning to see is such a daunting task that it leads to discouragement. Or else they are overwhelmed with regret for the long lost years of darkness. The thought never occurs to the sighted researchers who have devoted themselves to the study of vision that the depression may be due to another cause. After a lifetime of hearing about the miracle of sight, the reality may be disappointing. The visible world may turn out to be uglier than expected.

If I got my sight back, I would be able to read print effortlessly and would learn to drive a car. I doubt that I would get depressed, but I probably wouldn't be continually elated either. I have a pretty good idea about how seeing works. As it is, by some people's standards I rely too much on sight. Since I never underwent official rehabilitation training for the blind, my nonvisual skills are not as well honed as they could be. For instance, I have only recently begun to learn braille and am nowhere near proficient. I have also recently begun using a white cane to indicate to sighted people, especially those driving cars, that I do not see well. But in many situations I find it more convenient to leave the cane at home and maneuver through space using my peripheral sight. My closets, cupboards, drawers, and refrigerator do not always stay arranged so that I can find things without looking. And I make mistakes. I talk to the sweater lying on the couch, thinking it's a cat. I try to pick a scrap of shiny gift wrap off the carpet and find that it is only a patch of reflected light. So I make resolutions, vow to improve myself, as you probably do. The difference is that my resolutions tend to turn on the debate about when to use and when not to use the sight I have.

I used to thread a needle using vision. I would hold the needle in my left hand, between my thumb and index finger. I could not see its eye, so I felt for it with my finger, then turned the needle until the eye was facing me. I took the thread in my right hand, with about an inch protruding between my thumb and index finger. Behind a magnifying lens I would aim my eyes a little to one side of the needle. I could see its straight, silvery sheen. I drew the thread to that line of light and slid it upward to where I knew the eye to be. When I felt it miss its mark, I would try again, guiding the thread a millimeter to the left or right. Eventually the end of the thread would catch. I'd carefully make the thread perform slow, regular undulations until I felt it pass all the way through the needle's eye.

I don't do this anymore. Now I know better. I ask someone else to thread the needle for me. Or I use a self-threading needle. More likely, I take the garment to the dry cleaners and pay someone to sew on the button or mend the tear. It may seem ludicrous that I ever did it at all. Threading a needle is a daunting task even to the visual elite. But for the blind in the sighted world, where blindness is the enemy, synonymous with ignorance, indifference, and sin, the simple question—to see or not to see—takes on substantial significance.

Sight is perhaps not my primary sense, but I still use it. I know my vision is not trustworthy, so I tend to seek corroboration from my other senses for what I see. But I don't know how to turn it off. Besides, I like what I see. Color, for instance, gives me great pleasure. On gray winter days I long for vivid colors, as I sometimes crave certain tastes. I suspect that I don't see color as well as the average viewer. My retinas don't have many cones, the photoreceptors that allow for color perception. But the colors that I see fascinate and refresh me. I close my eyes and imagine colors, summoning up memories of particular hues. Perhaps I am practicing.

Although whatever caused my maculas to degenerate has probably done all the damage it ever will, there is no guarantee that something else might not go wrong. Everything I know about the retina tells me it's a wonder anyone can expect to have an undamaged one for a lifetime. And there is so much else that can happen to the eyes. If I lost the sight I have, I would miss it. But to mourn that loss as I mourn the loss of loved ones would be to buy the assertion that human experience is always, first and foremost, visual. I see through that now.

Perhaps I had no business at the Matisse exhibition. Perhaps I should give up my affection for the visual arts and seek aesthetic enrichment only in concert halls and opera houses. But I have been going to museums and art galleries since childhood. When I was growing up in New York, such field trips were a routine part of my education. And since both my parents were visual artists, looking at works of art always seemed a natural part of life. It requires concentration and patience, but for now, this effort still seems worth it.

I stand before the two versions of *The Dance*. The man with the earphones tells me that I am standing too close, then moves on before I can ask him, "Do you make the best possible use of your sight?"

"What?" he would probably say. "Do I what?"

It's too bad. We might have had an interesting conversation about vision or art or something. "When you look at this painting, what do you see? How do you know that's what you're supposed to see? What makes you so sure?"

I let him go. He's right; I am standing about a foot away from the wall. No one else is standing this near. Matisse is not a painter who inspires close examination. The world he paints is devoid of the kind of fine detail that demands such intense perusal. Still, there could be other reasons to stand at this viewing distance. I might be

a painter examining brush strokes at close range. Except that I don't even seem to be looking at the painting. I have my eyes aimed at the wall between the two canvases. I might be a gallery owner, examining how the canvases are framed or the precise shade of the wall on which to hang such works. In fact, I am, out of the corners of my eyes, trying to gauge the difference between the two versions. In the version I have never seen before the dancers seem redder, but the other colors seem about the same. These colors please me. The green in particular has a freshness that I find very satisfying. I step back to where you're supposed to stand. I aim my blind gaze at the center of the first version, and it is ringed by dancers. I have known this painting since childhood, and my appreciation of it is naive and rather personal. The figure in the lower left resembles one of my teachers at the Graham school, perhaps because her pose is the most dancerly. And the circle is a powerful symbol to me. I move closer again, because it is the green that gets to me today.

Behind me, all along the bench below the window, sit people wearing earphones. I do not know whether the recorded message has told them to sit there or whether they are just resting, letting the tapes play out. The sound of the tapes hovers around them like a swarm of whispering bees.

In the future, art lovers won't need to rent those machines. Museums will hang tape players or perhaps video screens by every canvas, and people will select which ones to plug their earphones into. These devices will become more and more interactive, allowing people to select from a menu of possible topics, perhaps even ask questions. "Why is that one red?" I would ask, or, "Tell me something about this green." And CD-ROM and multimedia technologies soon will allow me to view this entire show, or any museum collection, on my home computer screen. I could boot up an image of this painting, zoom in on any detail, access volumes of

historical, biographical, and critical information, all from the privacy of my own home.

I do not question the value of all this technology, and I will probably make use of some of it. But I will still come to museums. I assume that they will be less crowded, more peaceful, with no one there to bother me and tell me how to look at art.

It is late in the afternoon. The crowd is thinning. I will leave soon, missing more than half the show. The work I need to do to see these paintings is physically wearying and mentally taxing. But I linger. "Red," I think, looking at the unfamiliar version of the painting. "Red changes everything." It makes the outline of the dancers less distinct, which gives a slightly greater sense of motion. This may just be me. Red and black is a tricky combination in my eyes. Red print on a black background registers as pure black to me. I am uncertain if the redder color of the dancers in that version will have the same effect on another viewer. I have come to this show alone, and there's no one around to ask.

I take a final look. I know I probably don't see what I'm supposed to see. I'm sure that I don't see what you do. But I don't delude myself either. I know that what I see, or think I see, is primarily a product of my brain working around my visual limitations and doing the best it can. You may believe you see something else. I live with my uncertainty and you with your unwavering faith. We may never see eye to eye on this. But I can live with that, too.