

## A NEUROLOGIST'S NOTEBOOK

# TO SEE AND NOT SEE

*What happens when an adult who has been blind since childhood suddenly has his vision restored?  
The experience of Virgil, a fifty-year-old Oklahoman who regained his sight after forty-five years, raises questions  
about perception that have haunted philosophers and scientists for centuries.*

BY OLIVER SACKS

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EARLY in October of 1991, I got a phone call from a retired minister in the Midwest, who told me about his daughter's fiancé, a fifty-year old man named Virgil, who had been virtually blind since early childhood. He had thick cataracts, and was also said to have retinitis pigmentosa, a hereditary condition that slowly but implacably eats away at the retinas. But his fiancée, Amy, who required regular eye checks herself, because of diabetes, had recently taken him to see her own ophthalmologist, Dr. Scott Hamlin, and he had given them new hope. Dr. Hamlin, listening carefully to the history, was not so sure that Virgil had retinitis pigmentosa. It was difficult to be certain at this stage, because the retinas could no longer be seen beneath the thick cataracts, but Virgil could still see light and dark, the direction from which light came, and the shadow of a hand moving in front of his eyes, so obviously there was not a total destruction of the retina. And cataract extraction was a relatively simple procedure, done under local anesthesia, with very little surgical risk. There was nothing to lose - and there might be much to gain. Amy and Virgil would be getting married soon - wouldn't it be fantastic if he could see? If, after nearly a lifetime of blindness, his first vision could be his bride, the wedding, the minister, the church!

Dr. Hamlin had agreed to operate, and the cataract on Virgil's right eye had been removed a fortnight earlier, Amy's father informed me. And, miraculously, the operation had worked. Amy, who began keeping a journal the day after the operation-the day the bandages were removed-wrote in her initial entry: Virgil can SEE!... Entire office in tears, first time Virgil has sight for forty years.... Virgil's family so excited, crying, can't believe it! ... Miracle of sight restored incredible!" But the following day she remarked problems: "Trying to adjust to being sighted, tough to go from blindness to sighted. Has to think faster, not able to trust vision yet.... Like baby just learning to see, everything new, exciting, scary, unsure of what seeing means."

A neurologist's life is not systematic, like a scientist's, but it provides him with novel and unexpected situations, which can become windows, peepholes, into the intricacy of nature - an intricacy that one might not anticipate from the ordinary course of life. "Nature is nowhere accustomed more openly to display her secret mysteries," wrote Thomas Willis, in the seventeenth century, "than in cases where she shows traces other workings apart from the beaten path." Certainly this phone call-about the restoration of vision in adulthood to a patient blind from early childhood-hinted of such a case. In fact," writes the ophthalmologist Alberto Valvo, in "Sight Restoration after Long-Term Blindness" (1971), "the number of cases of this kind over the last ten centuries known to us is not more than twenty."

What would vision be like in such a patient? Would it be "normal" from the moment vision was restored? This is what one might think at first. This is the commonsensical. Notion - that the eyes will be opened, the scales will fall from them, and (in the words of the New Testament) the blind man will receive" sight.

But could it be that simple? Was not *experience* necessary to see? Did one not have to learn to see? I was not well acquainted with the literature on the subject, though I had read with fascination the great case history published in the *Quarterly Journal of Psychology* in 1963 by the psychologist Richard Gregory (with Jean G. Wallace), and I knew that such cases, hypothetical or real, had riveted the attention of philosophers and psychologists for hundreds of years. (There is a hint of it even in the Bible, in Mark's description of the miracle at Bethsaida; for here, at first, the blind man saw "men as trees, walking," and only subsequently was his eyesight fully restored.) The seventeenth-century philosopher William Molyneux, whose wife was blind, posed the following question to his friend John Locke: "Suppose a man born blind, and now adult, and taught by his touch to distinguish between a cube and a sphere [be] made to see: [could he now] by his sight, before he touched them ... distinguish and tell which was the globe and which the cube?" Locke considers this in his "Essay Concerning Human Understanding" (1690) and decides that the answer is no. In 1709, examining the problem in more detail, and the whole relation between sight and touch, in "A New Theory of Vision," George Berkeley concluded that there was no necessary connection between a tactile world and a sight world-that a connection between them could be established only on the basis of experience.

Barely twenty years elapsed before these considerations were put to the test-when, in 1728, an English surgeon named William Cheselden removed the cataracts from the eyes of a thirteen-year old boy born blind. Despite his high intelligence and youth, the boy encountered profound difficulties with the simplest visual perceptions. He had no idea of distance. He had no idea of space or size. And he was bizarrely confused by drawings and paintings, by the *idea* of a two-dimensional representation of reality. As Berkeley had anticipated, he was able to make sense of what he saw only gradually, and insofar as he was able to connect visual experiences

with tactile ones. It had been similar with many other patients in the two hundred and fifty years since Cheselden's operation: nearly all had experienced the most profound, Lockean confusion and bewilderment.

And yet, I was informed, as soon as the bandages were removed from Virgil's eye he saw his doctor and his fiancée, and laughed. Doubtless he saw *something* but what did he see? What did "seeing" for this previously not-seeing man mean? What sort of world had he been launched into?

VIRGIL (nearly all the names in this account have been changed, and some identifying details have been disguised) was born on a small farm in Kentucky soon after the outbreak of the Second World War. He seemed normal enough as a baby, but (his mother thought) had poor eyesight even as a toddler, sometimes bumped into things, seemed not to see them. At the age of three, he became gravely ill with a triple illness—a meningitis or meningoencephalitis (inflammation of the brain and its membranes), polio, and cat-scratch fever. During this acute illness, he had convulsions, became virtually blind, paralyzed in the legs, partly paralyzed in his breathing, and, after ten days, fell into a coma. He remained in a coma for two weeks. When he emerged from it, he seemed, according to his mother, "a different person" and "sort of dull inside"; he showed a curious indolence, nonchalance, passivity, seemed nothing at all like the spunky, mischievous boy he had been.

The strength in his legs came back over the next year, and his chest grew stronger, though never, perhaps, entirely normal. His vision also recovered significantly - but his retinas were now gravely damaged. Whether the retinal damage was caused wholly by his acute illness or perhaps partly by a congenital retinal degeneration was never dear.

In Virgil's sixth year, cataracts began to develop in both eyes, and it was evident that he was becoming functionally blind. That same year, he was sent to a school for the blind, and there he eventually learned to read Braille and to become adept with the use of a cane. But he was not a star pupil; he was not as adventurous or aggressively independent as some blind people are. There was a striking passivity all through his time at school-as, indeed, there had been since his illness.

Yet Virgil graduated from the school and, when he was twenty, decided to leave Kentucky, to seek training, work, and a life of his own in a city in Oklahoma. He trained as a massage therapist, and soon found employment at a Y.M.C.A. He was obviously good at his job, and highly esteemed, and the Y was happy to keep him on its permanent staff and to provide a small house for him across the road, where he lived with a friend, also employed at the Y. Virgil had many clients-it is fascinating to hear the tactile detail with which he can describe them-and seemed to take a real pleasure and pride in his job. Thus, in his modest way, Virgil made a life: had a steady job and an identity, was self-supporting, had friends, read Braille papers and books (though less, with the years, as Talking Books came in). He had a passion for sports, especially baseball, and loved to listen to games on the radio. He had an encyclopedic knowledge of baseball games, players, scores, statistics. On a couple of occasions, he became involved with girlfriends, and would cross the city on public transport to meet them. He maintained a close tie with home, and particularly with his mother - he would get hampers of food regularly from the farm, and send hampers of laundry back and forth. Life was limited, but stable in its way.

Then, in 1991, he met Amy - or, rather, they met again, for they had known each other well twenty or more years before. Amy's background was different from Virgil's: she came from a cultivated middle-class family, had gone to college in New Hampshire, and had a degree in botany. She had worked at another Y in town, as a swimming coach, and had met Virgil at a cat show in 1968. They dated a bit-she was in her early twenties, he was a few years older - but then Amy decided to go back to graduate school in Arkansas, where she met her first husband, and she and Virgil fell out of contact. She ran her own plant nursery for a while, specializing in orchids, but had to give this up when she developed severe asthma. She and her first husband divorced after a few years, and she returned to Oklahoma. In 1988, out of the blue, Virgil called her, and, after three years of long phone calls between them, they finally met again, in 1991. "All of a sudden it was like twenty years were never there," Amy said.

Meeting again, at this point in their lives, both felt a certain desire for companionship. With Amy, perhaps, this took a more active form. She saw Virgil stuck (as she perceived it) in a vegetative, dull life: going over to the Y, doing his massages; going back home, where, increasingly, he listened to ballgames on the radio; going out and meeting people less and less each year. Restoring his sight, she must have felt, would, like marriage, stir him from his indolent bachelor existence and provide them both with a new life.

But Virgil was passive here as in so much else. He had been sent to half a dozen specialists over the years, and they had been unanimous in declining to operate, feeling that in all probability he had no useful retinal function; and Virgil seemed to accept this with equanimity. But Amy disagreed. With Virgil being blind already, she said, there was nothing to lose, and there was a real possibility, remote but almost too exciting to contemplate, that he might actually get reasonable sight back and, after forty-five years, see again. And so Amy pushed for the surgery. Virgil's mother, fearing disturbance, was strongly against it. ("He is fine as he is," she said.) Virgil himself showed no preference in the matter; he seemed happy to go along with whatever they decided.

Finally, in mid-September, the day of surgery came. Virgil's right eye had its cataract removed, and a new lens implant was inserted; then the eye was bandaged, as is customary, for twenty-four hours of recovery. The following day, the bandage was removed, and Virgil's eye was finally exposed, without cover, to the world. The moment of truth had finally come.

Or had it? The truth of the matter (as I pieced it together later), if less "miraculous" than Amy's journal suggested, was infinitely stranger. The dramatic moment stayed vacant, grew longer, sagged. No cry ("I can see!") burst from Virgil's lips. He seemed to be staring blankly, bewildered, without focussing, at the surgeon, who stood before him, still holding the bandages. Only when the surgeon spoke - saying "Well?" - did a look of recognition cross Virgil's face.

Virgil told me later that in this first moment he had no idea what he was seeing. There was light, there was movement, there was color, all mixed up, all meaningless, a blur. Then out of the blur came a voice that said, "Well?" Then, and only then, he said, did

he finally realize that this chaos of light and shadow was a face - and, indeed, the face of his surgeon. His experience was virtually identical to that of Gregory's patient, S.B.:

When the bandages were removed ... he heard a voice coming from in front of him and to one side: he turned to the source of the sound, and saw a "blur." He realized that this must be a face.... He seemed to think that he would not have known that this was a face if he had not previously heard the voice and known that voices came from faces.

The rest of us, born sighted, can scarcely imagine such confusion. For we, born with a full complement of senses, and correlating these, one with the other, create a sight world from the start, a world of visual objects and concepts and meanings. When we open our eyes each morning, it is upon a world we have spent a lifetime learning to see. We are not given the world: we make our world through incessant experience, categorization, memory, reconnection. But when Virgil opened his eye, after being blind for forty-five years-having had little more than an infant's visual experience, and this long forgotten-there were no visual memories to support a perception, there was no world of experience and meaning awaiting him. He saw, but what he saw had no coherence. His retina and optic nerve were active, transmitting impulses, but his brain could make no sense of them; he was, as neurologists say, agnostic.

Everyone, Virgil included, expected something much simpler. A man opens his eyes, light enters, and falls on the retina: he sees. It is as simple as that, we imagine. And the surgeon's own experience, like that of most ophthalmologists, had been with the removal of cataracts from patients who had almost always lost their sight late in life - and such patients do indeed, if the surgery is successful, have a virtually immediate recovery of normal vision, for they have in no sense lost their ability to see. And so, though there had been a careful surgical discussion of the operation and of possible postsurgical complications, there was little discussion or preparation for the neurological and psychological difficulties that Virgil might encounter.

WITH the cataract out, Virgil was able to see colors and movements, to see (but not identify) large objects and shapes, and, astonishingly, to read some letters on the third line of the standard Snellen eye chart-the line corresponding to a visual acuity of about 20/100, or a little better. But though his best vision was a respectable 20/80, he lacked a coherent visual field, because his central vision was poor, and it was almost impossible for the eye to fixate on targets; it kept losing them, making random searching movements, finding them, then losing them again. It was evident that the central, or macular, part of the retina, which is specialized for high acuity and fixation, was scarcely functioning, and that it was only the surrounding *paramacular* area which was making possible such vision as he had. The retina itself presented a moth-eaten or piebald appearance, with areas of increased and decreased pigmentation-islets of intact or relatively intact retina alternating with areas of atrophy. The macula was degenerated and pale, and the blood vessels of the entire retina appeared narrowed.

Examination, I was told, suggested the scars or residues of old disease but no current or active disease process; and, this being so, Virgil's vision, such as it was, could be stable for the rest of his life. It could be hoped, moreover (since the worse eye had been operated on first), that the left eye, which was to be operated upon in a few weeks' time, might have considerably more functional retina than the right.

I HAD not been able to go to Oklahoma straightaway--my impulse was to take the next plane after that initial phone call-but had kept myself informed of Virgil's progress over the ensuing weeks by speaking with Amy, with Virgil's mother, and, of course, with Virgil himself. I also spoke at length with Dr. Hamlin and with Richard Gregory, in England-to discuss what sort of test materials I should bring, for I myself had never seen such a case, nor did I know anyone (apart from Gregory) who had. I gathered together some materials--solid objects, pictures, cartoons, illusions, videotapes, and special perceptual tests designed by a physiologist colleague, Ralph Siegel; I phoned an ophthalmologist friend, Robert Wasserman (we had previously worked together on the case of a color-blind painter), and we started to Plan a visit. It was important, we felt, not just to test Virgil but to see how he managed in real life, inside his house, outside, in natural settings and social situations; crucial, too, that we see him as a person, bringing his own life history~his particular dispositions and needs and expectations-to this critical passage; that we meet his fiancée, who had so urged the operation, and with whom his life was now so intimately mingled; that we look not merely at his eyes and perceptual powers but at the whole tenor and pattern of his life.

VIRGIL and Amy - now newlyweds - greeted us at the exit barrier in the airport. He was of medium height, but exceedingly fat; he moved slowly and tended to cough and puff with the slightest exertion. He was not, it was evident, an entirely well man. His eyes roved to and fro, in searching movements, and when Amy introduced Bob and me he did not seem to see us straightaway - he looked toward us but not quite at us. I had the impression, momentary but strong, that Virgil did not really look at our faces, though he smiled and laughed and listened minutely.

I was reminded of what Gregory had observed of his patient S.B.-that "he did not find faces 'easy' objects," and that "he did not look at a speaker's face, and made nothing of facial expressions." Virgil's behavior was certainly not that of a sighted man, but it wasn't that of a blind man, either. It was, rather, the behavior of one *mentally* blind, or agnosticable to see but not to decipher what he was seeing. He reminded me of an agnostic patient of mine, Dr. P. (the man who mistook his wife for a hat), who, instead of looking at

me, taking me in, in the normal way, made sudden strange fixations - on my nose, on my right ear, down to my chin, up to my right eye - not seeing my face as a whole.

We walked out through the crowded airport, Amy holding Virgil's arm, guiding him, and out to the lot where they had parked their car. Virgil was fond of cars, and one of his first pleasures after surgery (as with S.B.) had been to watch them through the window of his house, to enjoy their motions, and spot their colors and shapes - their colors, especially. He was sometimes bewildered by shapes. "What cars do you see?" I asked him as we walked through the lot. He pointed to all the cars we passed. "That's a blue one, that's red-wow, that's a big one!" Some of the shapes he found very surprising. "Look at that one!" he exclaimed once. "I have to look down!" And, bending, he felt it - it was a slinky, streamlined V-12 Jaguar - and confined its low profile. But it was only the colors and general profiles he was getting; he would have walked past his own car had Amy not been with him. And Bob and I were struck by the fact that Virgil would look, would attend visually, only if one asked him to or pointed something out - not spontaneously. His sight might be largely restored, but seeing, looking, it was clear, was far from natural to him; he still had many of the habits, the behaviors, of a blind man.

The drive from the airport to their house was a long one; it took us through the heart of town, and it gave us an opportunity to talk to Virgil and Amy, and to observe Virgil's reactions to his new vision. He clearly enjoyed movement, watching the ever-changing spectacle through the car windows, and the movement of other cars on the road. He spotted a speeder coming up very fast behind us, and identified cars, buses (he especially loved the bright-yellow school buses), eighteen-wheelers, and, once, on a side road, a slow, noisy tractor. He seemed very sensitive to, and intrigued by, large neon signs and advertisements, and liked picking out their letters as we passed. He had difficulty reading entire words, though he often guessed them correctly from one or two letters, or from the style of the signs. Other signs he saw but could not read. He was able to see and identify the changing colors of the traffic lights as we got into town.

He and Amy told us of other things he had seen since his operation, and of some of the unexpected confusions that could occur. He had seen the moon; it was larger than he expected. On one occasion, he was puzzled by seeing "a fat airplane" in the sky - "stuck, not moving." It turned out to be a blimp. Occasionally, he had seen birds; they made him jump, sometimes, if they came too close. (Of course, they did not come that close, Amy explained. Virgil simply had no idea of distance.)

Much of their time recently had been spent shopping--there had been the wedding to prepare for, and Amy wanted to show Virgil off, tell his story to the clerks and shopkeepers they knew, let them see a transformed Virgil for themselves. It was fun; the local television station had aired a story about Virgil's operation, and people would recognize him and come up to shake his hand. But supermarkets and other stores were also dense visual spectacles of objects of all kinds, often in bright packaging, and provided good "exercise" for Virgil's new sight. Among the first objects he had recognized, just the day after his bandages came off, were rolls of toilet paper on display. He had picked up a package, and given it to Amy, to prove he could see. Three days after surgery, they had gone to an I.G.A., and Virgil had seen shelves, fruit, cans, people, aisles, carts--so much that he got scared. "Everything ran together," he said. He needed to get out of the store and dose his eyes for a bit.

He enjoyed uncluttered views, he said, of green hills and grass - especially after the over-full, over-rich visual spectacles of shops - though it was difficult for him, Amy indicated, to connect the visual shapes of hills with the tangible hills he had walked up; and he had no idea of perspective. But the first month of seeing had been predominantly positive: "Every day seems like a great adventure, seeing more for the first time each day," Amy had written, summarizing it, in her journal.

WHEN we arrived at the house, Virgil, caneless, walked by himself up the path to the front door, pulled out his key, grasped the doorknob, unlocked the door, and opened it. This was impressive--he could never have done it at first, he said--and was something he had been practicing since the day after surgery. It was his showpiece. But he said that in general he found walking "scary" and "confusing" without touch, without his cane, with his uncertain, unstable judgment of space and distance. Sometimes surfaces or objects would seem to loom, to be on top of him, when they were still quite a distance away; sometimes he would get confused by his own shadow--the whole concept of shadows, of objects blocking light, was puzzling to him--and would come to a stop, or trip, or try to step over it. Steps, in particular, posed a special hazard, because all he could see was a confusion, a flat surface, of parallel and crisscrossing lines; he could not see them (although he knew them) as solid objects going up or coming down in three-dimensional space. Now, five weeks after surgery, he often felt more disabled than he had felt when he was blind, and he had lost the confidence, the ease of moving, that he had possessed then. But\* he hoped all this would sort itself out with time.

I was not so sure; every patient described in the literature had faced great difficulties after surgery in the apprehension of space and distance--for months, even years. This was the case even in Valvo's highly intelligent patient H.S., who had been normally sighted until, at fifteen, he was corneally scarred by a chemical explosion, and had regained his vision twenty-two years later. He encountered grave difficulties of every kind, which he recorded, minutely, on tape:

During these first weeks [after surgery] I had no appreciation of depth or distance; streetlights were luminous stains stuck to the window panes, and the corridors of the hospital were black holes. When I crossed the road the traffic terrified me, even when I was accompanied. I am very insecure while walking; indeed I am more afraid now than before the operation.

WE gathered in the kitchen at the back of the house, which had a large white deal table. Bob and I laid out all our test objects--color charts, letter charts, pictures, illusions--on it, and we set up a video camera to record the testing. As we settled down, Virgil's cat and dog bounded in to greet and check us and Virgil, we noted, had some difficulty telling which was which. This comic and embarrassing

problem had persisted since he returned home from surgery: both animals, as it happened, were black-and-white, and he kept confusing them-to their annoyance-unless he could touch them, too. Sometimes, Amy said, she would see him examining the cat carefully, looking at its head, its ears, its paws, its tail, and touching each part gently as he did so. I observed this myself the next day~Virgil feeling and looking at Tibbles with extraordinary intentness, correlating the cat. He would keep doing this, Amy remarked ("You'd think once was enough~% but the new ideas, the visual recognitions, kept slipping from his mind.

Cheselden described a strikingly similar scene with his young patient in the seventeen-twenties:

One particular only, though it might appear trifling, I will relate: Having often forgot which was the cat, and which the dog, he was ashamed to ask; but catching the cat, which he knew by feeling, he was observed to look at her steadfastly, and then, setting her down, said, So, puss, I shall know you another time .... Upon being told what things were ... he would carefully observe that he might know them again; and (as he said) at first learned to know, and again forgot, a thousand things in a day.

Virgil's first formal recognitions when the bandages were taken off had been of letters on the ophthalmologist's eye chart, and we decided to test him, first, on letter recognition. He could not see ordinary newsprint clearly~his acuity was still only about 20/80-but he readily perceived letters that were more than a third of an inch high. Here he did rather well, for the most part, and recognized all the commoner letters (at least, capital letters) easily~as he had been able to do from the moment the bandages were removed. How was it that he had so much difficulty recognizing faces, or the cat, and so much difficulty with shapes generally, and with size and distance, and yet had little-or at least much less-difficulty recognizing letters? When I asked Virgil about it, he told me that he had learned the alphabet by touch at school, where they had used letter blocks, or cutout letters, for teaching the blind. I was much struck by this. Moreover, as Gregory relates of S.B., "much to our surprise, he could even tell the time by means of a large clock on the wall. We were so surprised at this that we did not at first believe that he could have been in any sense blind before the operation." But in his blind days S.B. had used a large hunter watch with no glass, telling the time by touching the hands, and had apparently made an instant "crossmodal" transfer, to use Gregory's term, from touch to vision.

But while Virgil could recognize individual letters easily, he could not string them together-could not read, or even see words. I found this puzzling, for he said that they used not only Braille but English, in raised or inscribed letters, at school-and that he had teamed to read fairly fluently. Indeed, he could still easily read the inscriptions on war memorials and tombstones by touch. But his eyes seemed to fix on particular letters, and to be incapable of the easy movement, the scanning, that is needed to read. This was also the case with the literate H.S.:

My first attempts at reading were painful. I could make out single letters, but it was impossible for me to make out whole words; I managed to do so only after weeks of exhausting attempts. In fact, it was impossible for me to remember all the letters together, after having read them one by one. Nor was it possible for me, during the first weeks, to count my own five fingers: I had the feelin~ that they were all there, but ... it was not possible for me to pass from one to the other while counting.

Further problems became apparent as we spent the day with Virgil. He would pick up details incessantly-an angle, an edge, a color, a movement-but would not be able to synthesize them, to form a complex perception at a glance. This was one reason the cat, visually, was so puzzling: he would see a paw, the nose, the tail, an ear, but could not see all of them together, see the cat as a whole.

Amy had commented in her journal on how even the most "obvious" connections-visually and logically obvious had to be learned. Thus, Amy told us, a few days after the operation "he said that trees didn't look like anything on earth," but in her entry for October 21st, a month after the operation, she noted, "Virgil finally put a tree together-he now knows that the trunk and leaves go together to form a complete unit." And, on another occasion: "Skyscrapers strange, cannot understand how they stay up without collapsing."

Many - or perhaps all - patients in Virgil's situation had had similar difficulties. One such patient (described by Eduard Raehlmann, in 1891), though she had had a little vision preoperatively and had frequently handled dogs, "had no idea of how the head, legs, and ears were connected to the animal." Of such difficulties, which may seem almost incomprehensible, or absurd, to the rest of us, Valvo remarks, "The real difficulty here is that simultaneous perception of objects is an unaccustomed way to those used to sequential perception through touch." We, with a full complement of senses, live in space and time; the blind live in a world of time alone. For the blind build their worlds from sequences of impressions (tactile, auditory, olfactory), and are not capable, as sighted people are, of a simultaneous visual perception, the making of an instantaneous visual scene. Indeed, if one can no longer see in space then the idea of space becomes incomprehensible and this even for highly intelligent people blinded relatively late in life. This is powerfully conveyed by John Hull in his remarkable autobiography, "Touching the Rock," when he speaks of himself, of the blind, as "living in time" almost exclusively. With the blind, he writes,

this sense of being in a place is less pronounced.... Space is reduced to one's own body, and the position of the body is known not by what objects have been passed, but ~y how long it has been in motion. Position is thus measured by time.... For the blind, people are not there unless they speak.... people are in motion, they are temporal, they come and they go. They come out of nothing; they disappear.

ALTHOUGH Virgil could recognize letters and numbers, and could write them, too, he mixed up some rather similar ones ("A!" and "H," for example) and" on occasion, wrote some backward. (Hull describes how, after only five years of blindness in his forties, his own

visual memories had become so uncertain that he was not sure which way around a "Y" went, and had to trace it in the air with his fingers.) Still, Virgil's performance was an impressive one for a man who had not seen for forty-five years. But the world does not consist of letters and numbers. How would he do with objects and pictures? How would he do outside, in the real world?

His first impressions when the bandages were removed were especially of color, and it seemed to be color, which has no analogue in the world of touch, that excited and delighted him-this was very clear from the way he spoke, and from Amys journal. (The recognition of colors and movement seems to be innate.) It was colors to which Virgil continually alluded, the chromatic unexpectedness of new sights. He had had Greek salad and spaghetti the night before, he told us, and the spaghetti startled him: "White round strings, like fishing line," he said. "I thought it'd be brown."

Seeing light and shape and movements, seeing colors above all, had been completely unexpected, and had had a physical and emotional impact almost shocking, explosive. ("I felt the violence of these sensations," wrote Valvo's patient H.S., "like a blow on the head. The violence of the emotion ... was akin to the very strong emotion I felt on seeing my wife for the first time, and when out in a car, I saw the huge monuments of Rome.")

We found that Virgil easily distinguished a great array of colors, and matched them without difficulty. But, confusingly, or confusedly, he sometimes gave colors the wrong names: yellow, for example, he called pink, but he knew that it was the same color as a banana. We wondered at first whether he could have a color agnosia or color anomia-defects of color association and color naming that are due to damage in specific areas of the brain. But these difficulties, it seemed to us, came from lack of learning-from the fact that early and long blindness had sometimes prevented his associating colors with their names or had caused him to forget some of the associations he had made. Such associations and the neural connections which underlay them, feeble in the first place, had become disestablished in his brain, not through any damage or disease but simply from disuse.

Although Virgil believed that he had visual memories, including color memories, from the remote past-on our drive from the airport he had spoken of growing up on the farm in Kentucky ("I see the creek running down the middle," "birds on the fences," "the big old white house")-I could not decide whether these were genuine memories, visual images in his mind, or mere verbal descriptions without images (like Helen Keller's).

How was he with shapes? Here matters were more complicated, because in the weeks since his surgery Virgil had been practicing shapes, correlating their look and their feel. No such practice had been required with colors. He had at first been unable to recognize any shapes visually-even shapes as simple as a square or a circle, which he recognized instantly by touch. To him, a touch square in no sense corresponded to a sight square. This was his answer to the Molyneux question. For this reason, Amy had bought, among other things, a child's wooden pegboard, with large, simple blocks-square, triangle, circle, and rectangle-to be fitted into corresponding holes, and had got Virgil to practice with it every day. Virgil found the task impossible at first, but quite easy now, after practicing for a month. He still tended to feel the holes and shapes before matching them, but when we forbade this he fitted them together quite fluently by sight alone.

Solid objects, it was evident, presented much more difficulty, because their appearance was so variable; and much of the past five weeks had been devoted to the exploration of objects, their unexpected vicissitudes of appearance as they were seen from near or far, or half concealed, or from different places and angles.

On the day he returned home after the bandages were removed, his house and its contents were unintelligible to him, and he had to be led up the garden path, led through the house, led into each room, and introduced to each chair. Within a week, with Amys help, he had established a canonical line-a particular line up the path, through the sitting room to the kitchen, with further lines, as necessary, to the bathroom and the bedroom. It was only from this line, at first, that he could recognize anything-though this took a great deal of interpretation and inference; thus, he learned, for example, that "a whiteness to the right," to be seen as he came obliquely through the front door, was in fact the dining table in the next room, although at this point neither "table" nor "dining room" was a clear visual concept. If he deviated from the line, he would be totally disoriented. Then, carefully, with Amys help, he started to use the line as a home base, making short sallies and excursions to either side of it, so that he could see the room, feel its walls and contents from different angles, and build up a sense of space, of solidity, of perspective.

As Virgil explored the rooms of his house, investigating, so to speak, the visual construction of the world, I was reminded of an infant moving his hand to and fro before his eyes, wagging his head, turning it this way and that, in his primal construction of the world. Most of us have no sense of the immensity of this construction, for we perform it seamlessly, unconsciously, thousands of times every day, at a glance. But this is not so for a baby, it was not so for Virgil, and it is not so for, say, an artist who wants to experience his perceptions individually and anew. Cézanne wrote to his son, "The same subject seen from a different angle gives a subject for study of the highest interest and so varied that I think I could be occupied for months without changing my place, simply bending more to the right or left."

We achieve perceptual constancy~ the correlation of all the different appearances, the transforms of objects-very early, in the first months of life. It constitutes a huge teaming task, yet is achieved so swiftly and automatically that its enormous complexity is scarcely realized (though it is an achievement that even the largest supercomputers cannot begin to match). But for Virgil, with half a century of forgetting whatever visual engrams he had constructed, the teaming, or relearning, of these transforms required hours of conscious and systematic exploration each day. This first month, then, saw a systematic exploration, by sight and touch, of all the smaller things in the house: fruit, vegetables, bottles, cans, cutlery, flowers, the knickknacks on the mantelpiece-turning them round and round, holding them close to him, then at arm's length, trying to synthesize their varying appearances into a sense of unitary objecthood.

Despite all the vexations that trying to see could entail, Virgil had stuck with this gamely, and he had learned steadily. He had little difficulty recognizing the fruit, the bottles, the cans in the kitchen, the different flowers in the living room, and other common objects in the house.

Unfamiliar objects were much more difficult. When I took a blood-pressure cuff from my medical bag, he was completely flummoxed and could make nothing of it, but he recognized it immediately when I allowed him to touch it. Moving objects presented a special problem, for their appearance changed constantly. Even his dog, he told me, looked so different at different times that he wondered if it was the same dog. He was utterly lost when it came to the rapid changes in others' physiognomies. Such difficulties are almost universal among the early blinded restored to sight. Gregory's patient S.B. could not recognize individual faces, or their expressions, a year after his eyes had been operated on, despite perfectly normal elementary vision. What about pictures? Here I had been given conflicting reports about Virgil. He was said to love television, to follow everything on it-and, indeed, a huge new TV stood in the living room, an emblem of Virgil's new life as a seeing person. We tried him first on still pictures, pictures in magazines, and with those he had no success at all. He could not see people, could not see objects-did not comprehend the idea of representation. It was similar with Cheselden's young patient:

We thought he soon knew what pictures represented ... but we found afterwards we were mistaken; for about two months after he was couched, he discovered at once they represented solid bodies, when to that time he considered them only as party-coloured planes, or surfaces diversified with variety of paint; but even then he was no less surprised, expecting the pictures would feel like the things they represented, . . . and asked which was the lying sense, feeling or seeing?

Nor were things any better with a moving picture on a TV screen. Mindful of Virgil's passion for listening to baseball games, we found a channel with a game in progress. It seemed at first as if he were following it visually, because he could describe who was batting, what was going on. But as soon as we turned off the sound he was lost. It became evident that he himself perceived little beyond streaks of light and colors and motions, and that all the rest (what he *seemed* to see) was interpretation, performed swiftly, and perhaps unconsciously, in consonance with the sound. How it would be with a real game we were far from sure-it seemed possible to us that he might see and enjoy a good deal-but in the representation of reality, pictorial or televisual, he was at this point completely at sea.

Virgil had now had two hours of testing, and was beginning to get tired-both visually and cognitively tired, as he had tended to do since the operation-and when he got tired he could see less and less, and had more and more difficulty making sense of what he could see.

Indeed, we were getting restless ourselves, and wanted to get out after a morning of testing. We asked him, as a final task before going for a drive, if he felt up to some drawing. We suggested first that he draw a hammer. (A hammer was the first object S.B. drew.) Virgil agreed, and, rather shakily, began to draw. He tended to guide the pencil's movement with his free hand. ("He only does that because he's tired now," said Amy.) Then he drew a car (very high and old-fashioned); a plane (with the tail missing: it would have been hard put to fly); and a house (flat and crude, like a three-year-old's drawing).

WHEN we finally got out, it was a brilliant October morning, and Virgil was blinded for a minute, until he put on a pair of dark-green sunglasses. Even ordinary daylight, he said, seemed far too bright for him, too glary-, he felt that he saw best in quite subdued light. We asked him where he would like to go, and after thinking for a little he said, "The zoo." He had never been to a zoo, he said, and he was curious to know how the different animals looked. He had loved animals ever since his childhood days on the farm. ,

Very striking, as soon as we got to the zoo, was Virgil's sensitivity to motion. He was startled, first, by an odd strutting movement; it made him smile-he had -never seen anything like it. "What is it?" he asked.

"An emu."

He wasn't quite sure what an emu was, so we asked him to describe it to us. He had difficulty, and could say only that it was about the same size as Amy-she and the emu were standing side by side at that point-but that its movements were quite different from hers. He wanted to touch it, to feel it all over. If he did that, he thought, he would then see it better. But touching, sadly, was not allowed.

His eye was caught next by a leaping motion nearby, and he immediately realized-or, rather, surmised-that it must be a kangaroo. His eye followed its motions closely, but he could not describe it, he said, unless he could feel it. We were wondering by now exactly what he could see-and what, indeed, he meant by "seeing."

In general, it seemed to us, if Virgil could identify an animal it would be either by its motion or by virtue of a single feature-thus, he might identify a kangaroo because it leaped, a giraffe by its height, or a zebra by its stripes-but he could not form any over-all impression of the animal. It was also necessary that the animal be sharply defined against a background; he could not identify the elephants, despite their trunks, because they were at a considerable distance and stood against a slate-colored background.

Finally, we went to the great-ape enclosure; Virgil was curious to see the gorilla. He could not see it at all when it was half hidden among some trees, and when it finally came into the open he thought that, though it moved differently, it looked just like a large man. Fortunately, there was a life-size bronze statue of a gorilla in the enclosure, and we told Virgil, who had been longing to touch all the animals, that he could, if nothing else, at least examine the statue. Exploring it swiftly and minutely with his hands, he had an air of assurance that he had never shown when examining anything by sight. It came to me-perhaps it came to all of us at this moment-how

skillful and self-sufficient he had been as a blind man, how naturally and easily he had experienced his world with his hands, and how much we were now, so to speak, pushing him against the grain: demanding that he renounce all that came easily to him, that he sense the world in a way incredibly difficult for him, and alien.

His face seemed to light up with comprehension as he felt the statue. "It's not like a man at all," he murmured. The statue examined, he opened his eyes, and turned around to the real gorilla standing before him in the enclosure. And now, in a way that would have been impossible before, he described the ape's posture, the way the knuckles touched the ground, the little bandy legs, the great canines, the huge ridge on the head, pointing to each feature as he did so. Gregory writes of a wonderful episode with his patient S.B., who had a long-standing interest in tools and machinery. Gregory took him to the Science Museum in London to see its grand collection:

The most interesting episode was his reaction to the new display screw cutting lathe which is housed in a special glass case.... We led him to the glass case, which was closed, and asked him to tell us what was in it. He was quite unable to say anything about it, except that he thought the nearest part was a handle.... We then asked a museum attendant (as previously arranged) for the case to be opened, and S.B. was allowed to touch the lathe. The result was startling... He ran his hands eagerly over the lathe with his eyes tight shut. Then he stood back a little and opened his eyes and said: "Now that I've felt it I can see."

So it was with Virgil and the gorilla. This spectacular example of how touching could make seeing possible explained something else that had puzzled me. Since the operation, Virgil had begun to buy toy soldiers, toy cars, toy animals, miniatures of famous buildings-an entire Lilliputian world-and to spend hours with them. It was not mere childishness or playfulness that had driven him to such pastimes. Through touching these at the same time he looked at them, he could forge a crucial correlation; he could prepare himself to see the real world by learning first to see this toy world. The disparity of scale did not matter, any more than it mattered to S.B., who was instantly able to tell the time on a large wall clock because he could correlate it with what he knew by touch from his pocket watch.

For lunch, we repaired to a local fish restaurant, and as we ate I stole glances, from time to time, at Virgil. He started eating, I observed, in the normal sighted fashion, accurately spearing segments of tomato in his salad. Then, as he continued, his aim grew worse: his fork started to miss its targets, and to hover, uncertainly, in the air. Finally, unable to "see," or make sense of, what was on his plate, he gave up the effort and started to use his hands, to eat as he used to, as a blind person eats. Amy had already told me about such relapses, and described them in her journal. There had been similar reversions, for example, with his shaving, where he would start with a mirror, shaving by sight, with tense concentration. Then the strokes of the razor would become slower, and he would start to peer uncertainly at his face in the mirror, or try to confirm what he half saw by touch. Finally, he would turn away from the mirror, or close his eyes, or turn the light off, and finish the job by feel.

That Virgil should have periods of acute visual fatigue following sustained visual effort or use was scarcely surprising; A of us have them if too much is demanded of our vision. Something happens to my own visual system if, for instance, I look at EEGs non-stop for three hours: I start missing things on the traces, and seeing dazzling afterimages of the squiggles wherever I look-the walls, the ceiling, all over the visual field--and at this point I need to stop and do something else, or, even better, close my eyes for an hour. And Virgil's visual system, by comparison with the normal one, must have been at this stage labile in the extreme.

Less easy to understand, and alarming, perhaps ominous, were long periods of "blurriness"-impaired vision or gnosis-lasting hours, or even days, coming on spontaneously, without obvious reason. Bob Wasserman was very much puzzled by Virgil's and Amy's descriptions of these fluctuations; he had been practicing ophthalmology for some twenty-five years, and removed many cataracts, but he had never encountered fluctuations of this sort.

After lunch, we all went to Dr. Hamlin's office. Dr. Hamlin had taken detailed photographs of the retina right after surgery, and Bob, examining the eye now (with both direct and indirect ophthalmoscopy) and comparing it with the photographs, could see no evidence of any postoperative complications. (A special test-fluorescein angiography~ had shown a small degree of cystoid macular edema, but this would not have caused the rapid fluctuations that were so striking.) Because there seemed to be no adequate local or ocular cause for these fluctuations, Bob wondered whether they could be a consequence of some underlying medical condition-we had been struck by how unwell Virgil looked as soon as we met him--or whether they could represent a *neural* reaction of the brain's visual system to conditions of sensory or cognitive overload. It is no effort for the normally sighted to construct shapes, boundaries, objects, and scenes from purely visual sensations; they have been making such visual constructs, a visual world, from the moment of birth, and have developed a vast, effortless cognitive apparatus for doing so. (Ordinarily, a half of the cerebral cortex is given over to visual processing.) But in Virgil these cognitive powers, undeveloped, were rudimentary; the visual-cognitive parts of his brain might easily have been overwhelmed.

Brain systems in all animals may respond to overwhelming stimulation, or stimulation past a critical point, with a sudden shutdown. Such reactions have nothing to do with the individual or his motives. They are purely local and physiological, and can occur even in isolated slices of cerebral cortex: they are a biological defense against neural overload.

Still, perceptual-cognitive processes, while physiological, are also personal-it is not a world which one perceives or constructs but *one's own* world-and they lead to, are linked to, a perceptual self, with a will, an orientation, and a style of its own. This perceptual self may also collapse with the collapse of perceptual systems, and alter the orientation and the very identity of the individual. If this occurs, an individual not only becomes blind but ceases to behave as a visual being, yet offers no report of any change in inner state, is



completely oblivious of his own visuality or lack of it. Such a condition, of total psychic blindness (known as Anton's syndrome), may occur if there is massive damage, as from a stroke, to the visual parts of the brain. But it also seemed to occur, on occasion, with Virgil. At such times, indeed, he might talk of "seeing" while in fact appearing blind and showing no visual behavior whatever. One had to wonder whether the whole basis of visual perception and identity in Virgil was as yet so feeble that under conditions of overload or exhaustion he might go in and out of not merely physical blindness but a total Anton-like psychic blindness.

A QUITE different sort of visual shutdown—a withdrawal—seems to be associated with situations of great emotional stress or conflict. And for Virgil this period was indeed as stressful a time as he had ever known: he had just had surgery, he had just been married; the even tenor of his blind, bachelor life had been shattered; he was under a tremendous pressure of expectation; and seeing itself was confusing, exhausting. These pressures had increased as his wedding day approached, especially with the convergence of his own family in town; his family had not only opposed the surgery in the first place but now insisted that he was in fact still blind. All this was documented by Amy in her journal:

October 9: Went to church to decorate for wedding. Virgil's vision quite blurry. Not able to distinguish much. It is as though sight has taken a nosedive. Virgil acting "blind" again... Having me lead him around.

October 11: Virgil's family arrives today. His sight seems to have gone on vacation.... It is as though he has gone back to being blind! Family arrived. Couldn't believe he could see. Every time he said he could see something they would say, "Ah, you're just guessing." They treated him as though he was totally blind—leading him around, giving him a thing he wanted.... I am very nervous, and Virgil's sight has disageared.... Want to be sure we are doing the right thing.

October 12: Wedding day. Virgil very calm ... vision little clearer, but still blurry.... Could see me coming down aisle, but was very blurry.... Wedding beautiful. Party at Mom's. Virgil surrounded by family. They still cannot accept his sight, he could not see much. Said goodbye to his family tonight. Sight began clearing up right after they left.

Thus there seemed to be two distinct forms of "blind behavior" or "acting blind"—one a collapse of visual identity on a neurological basis, the other a massive withdrawal or regression on a strategic basis, in the face of overwhelming emotional stress.

Then again, given the extreme physiological instability of his vision, who was to know exactly what was going on? When a specific organic weakness exists, emotional stress can easily press toward a physical (or psychosomatic) form; thus, asthmatics get asthma under stress, parkinsonians become more parkinsonian, and someone like Virgil, with borderline vision, may get pushed over the border and become (temporarily) blind. It was, therefore, exceedingly difficult at times to distinguish between what was physiological and what was psychological in him—what was "motivated behavior" and what was physiological weakness.

Marius von Senden, reviewing every published case over a three-hundred-year period in his classic book "Space and Sight" (1932), concluded that every newly sighted adult sooner or later comes to a "motivation crisis"—and that not every patient gets through it. He tells of one patient who felt so threatened by sight (which would have meant his leaving the Asylum for the Blind, and his fiancée there) that he threatened to tear his eyes out; he cites case after case of patients who "behave blind" or "refuse to see" after an operation, and of others who, fearful of what sight may entail, refuse operation (one such account, entitled "L'Aveugle Qui Refiise de Voir," was published as early as 1771). Both Gregory and Valvo dilate on the emotional dangers of forcing a new sense on a blind man—how, after an initial exhilaration, a devastating (and even lethal) depression could ensue.

Precisely such a depression descended on Gregory's patient: S.B.'s period in the hospital was full of excitement and perceptual progress. But the promise was not fulfilled. Six months after the operation, Gregory reports,

we formed a strong impression that his sight was to him almost entirely disappointing. It enabled him to do a little more ... but it became clear that the opportunities it afforded him were less than he had imagined.... He still to a great extent lived the life of a blind man, sometimes not bothering to put on the lights. He did not get on well with his neighbors [now], who regarded him as "odd," and his workmates [previously so admiring] played tricks on him and teased him for being unable to read.

S.B.'s depression deepened, he became ill, and, two years after his operation, he died. He had been perfectly healthy, he had once enjoyed life; he was only fifty-four.

Valvo provides us with six exemplary tales, and a profound discussion, of the feelings and behavior of early-blinded people when they are confronted with the "gift" of sight, and with the necessity of renouncing one world, one identity, for another.

A major conflict in Virgil, as in all newly sighted people, was the uneasy relation of touch and sight—not knowing whether to look or feel. This was obvious in Virgil from the day of the operation, and was very evident the day we saw him, when he could hardly keep his hands off the pegboard, longed to touch all the animals, and gave up spearing his food. His vocabulary, his whole sensibility, his picture of the world, was couched in tactile—or, at least, nonvisual—terms. He was, or had been until his operation, a touch person through and through.

It has been well established that in congenitally deaf people (especially if they are native signers) some of the auditory parts of the brain are reallocated for visual use. It has also been well established that in blind people who read Braille the reading finger has an exceptionally large representation in the tactile parts of the cerebral cortex. And one would suspect that the tactile (and auditory) parts of the cortex are enlarged in the blind, and may even extend into what is normally visual cortex. What remains of the visual cortex,

without visual stimulation, may be largely undeveloped. It seems likely that such a differentiation of cerebral development would follow the early loss of a sense and the compensatory enhancement of other senses.

If this was the case in Virgil, what might happen if visual function was suddenly made possible, demanded? One might certainly expect some visual learning, some development of new pathways in the visual parts of the brain. There had never been any documentation of the kindling of activity in the visual cortex of an adult, and we hoped to take special PET scans of Virgil's visual cortex to show this as he learned to see. But what would this learning, this activation, be like? Would it be like a baby first learning to see? (This was Amy's first thought.) But the newly sighted are not on the same starting line, neurologically speaking, as babies, whose cerebral cortex is "equipotential"-equally ready to adapt to any form of perception. The cortex of an early-blinded adult such as Virgil has already become highly adapted to organizing perceptions in time and not in space.

An infant merely learns. This is a huge, never-ending task, but it is not one charged with irresolvable conflict. A newly sighted adult, by contrast, has to make a radical switch from a sequential to a visuospatial mode, and such a switch flies in the face of the experience of an entire lifetime. Gregory emphasizes this, pointing out how conflict and crisis are inevitable if "the perceptual habits and strategies of a lifetime" are to be changed. Such conflicts are built into the nature of the nervous system itself, for the early-blinded adult who has spent a lifetime adapting and specializing his brain must now ask his brain to reverse all this. (Moreover, the brain of an adult no longer has the plasticity of a child's brain—that is why learning new languages or new skills becomes more difficult with age. But in the case of a man previously blind, learning to see is not like learning another language; it is, as Diderot puts it, like learning language for the first time.)

In the newly sighted, learning to see demands a radical change in neurological functioning and, with it, a radical change in psychological functioning, in self, in identity. The change may be experienced in literally life-and-death terms. Valvo quotes a patient of his as saying, "One must die as a sighted person to be born again as a blind person," and the opposite is equally true: one must die as a blind person to be born again as a seeing person. And here, blindness is no more a negative condition, a privation, than seeing. It is a *different* condition, a different form of being, with its own sensibilities and coherence and feeling. It is indeed what John Hull calls "deep blindness ... one of the orders of human being."

On October 31st, the cataract in Virgil's left eye was removed, and revealed a retina, an acuity, similar to the right. This was a great disappointment, for there had been hope that it might be a far better eye—enough to make a crucial difference to his vision. His vision did improve slightly: he fixated better, and the searching eye movements were fewer, and he had a larger visual field.

With both eyes working, Virgil now went back to work, but found, increasingly, that there was another side to seeing, that much of it was confusing, and some downright shocking. He had worked happily at the Y for thirty years, he said, and thought he *knew* all the bodies of his clients. Now he found himself startled by seeing bodies, and skins, that he had previously known only by touch; he was amazed at the range of skin colors he saw, and slightly disgusted by blemishes and "stains" in skins that to his hands had seemed perfectly smooth. (Gregory observes of S.B., "He also found some things he loved ugly (including his wife and himself), and he was frequently upset by the blemishes and imperfections of the visible world.") Virgil found it a relief, when giving massages, to shut his eyes.

He continued to improve, visually, over the ensuing weeks, especially when he was free to set his own pace. He did his utmost to live the life of a sighted man, but he also became more conflicted at this time. He expressed fears, occasionally, that he would have to throw away his cane and walk outside, cross the streets, by vision alone; and, on one occasion, a fear that he might be "expected" to drive, and take up an entirely new, sighted job. This, then, was a time of great striving and real success—but success achieved, one felt, at a psychological cost, at a cost of deepening strain and splitting in himself.

There had been one outing, a week before Christmas, when he and Amy went to the ballet. Virgil enjoyed "The Nutcracker": he had always loved the music, and now, for the first time, he saw something as well. "I could see people jumping around the stage. Couldn't see what they were wearing, though," he said. He thought he would enjoy seeing a live baseball game, and looked forward to the start of the season in the spring.

Christmas was a particularly festive and important time—the first Christmas after his wedding, his first Christmas as a sighted man—and he returned, with Amy, to the family farm in Kentucky. He saw his mother for the first time in more than forty years—he had scarcely been able to see her, to see anything much, at the time of the wedding—and thought she looked "real pretty." He saw again the old farmhouse, the fences, the creek in the pasture, which he had also not seen since he was a child; he had never ceased to cherish them in his mind. Some of his seeing had been a great disappointment, but seeing home and family was not—it was a pure joy.

No less important was the change in the family's attitude toward him. "He seemed more alert," his sister said. "He would walk, move around the house, without touching the walls—he would just get up and go." She felt that there had been "a big difference" since he was first operated on, and his mother and the rest of the family felt the same.

I phoned them, the day before Christmas, and spoke to his mother, his sister, and others. They asked me to join them, and I wish I could have done so, for it seemed to be an affirmative time for them all. The family's initial opposition to Virgil's seeing (and perhaps to Amy, too, for having "pushed" it) and their disbelief that he could actually see had been something that he internalized, something that could literally annihilate his seeing. Now that the family was "converted," a major psychological block, one hoped, might dissolve. Christmas was the climax, but also the resolution, of an extraordinary year.

What would happen, I wondered, in the coming year? What might he hope for, at best? How much of a visual world, a visual life, might still await him? We were, frankly, quite unsure at this point. Grim and frightening though the histories of so many patients were, some, at least, overcame the worst of their difficulties and emerged into a relatively unconflicted new sight.

Valvo, normally cautious in expression, lets himself go a little in describing some of his patients' happier outcomes:

Once our patients acquire visual patterns, and can work with them autonomously, they seem to experience great joy in visual learning ... a renaissance of personality.... They start thinking about wholly new areas of experience.

A renaissance of personality-this was just what Amy wanted for Virgil. It was difficult for us to imagine such a "renaissance" in him, for he seemed so phlegmatic, so set in his ways. Despite a range of problems-retinal, cortical, psychological, possibly medical-he had done remarkably well in a way, had shown a steady ability to increase his power to apprehend a visual world. There seemed no reason that, with his predominantly positive motivation, and the obvious enjoyment and advantage he could get from seeing, he should not progress further. He could never hope to have perfect vision, but he certainly might hope for a life radically enlarged by seeing.

THE catastrophe, when it came, was very sudden. On February 8th, I had a phone call from Amy: Virgil had collapsed, had been taken, gray and stuporous, to the hospital. He had a lobar pneumonia, a massive consolidation of one lung, and was in the intensive-care unit, on oxygen and intravenous antibiotics.

The first antibiotics used did not work: he grew worse; he grew critical; and for some days he hovered between life and death. Then, after three weeks, the infection was finally mastered, and the lung started to re-expand. But Virgil himself remained gravely ill, for, though the pneumonia itself was clearing, it had tipped him into respiratory failure - a non-paraJysis of the respiratory center in the brain, which made it unable to respond properly to levels of oxygen and carbon dioxide in the blood. The oxygen levels in his blood started to fall - fell to less than half of normal. And the level of carbon dioxide started to rise - rose to nearly three times normal. He needed oxygen constantly, but only a little could be given, lest his failing respiratory center be further depressed. With his brain deprived of oxygen and poisoned' by carbon dioxide, Virgil's consciousness fluctuated and faded, and on bad days (when the oxygen in his blood was lowest and the carbon dioxide highest) he could see nothing: he was totally blind.

Much contributed to this continuing respiratory crisis: Virgil's lungs themselves were thickened and fibrotic; there was advanced bronchitis and emphysema; there was no movement of the diaphragm on one side, a consequence of his childhood polio; and, on top of all this, he was enormously obese-obese enough to cause a Pickwickian syndrome (named after the somnolent fat boy, Joe, in "The Pickwick Papers"). In Pickwickian syndrome, there is a grave depression of breathing, and failure to oxygenate the blood fully, associated with a depression of the respiratory center in the brain.

Virgil had probably been getting ill for some years; he had gradually been increasing in weight since 1985. But between his wedding and Christmas he had put on forty pounds-had shot up, in a few weeks, to two hundred and eighty pounds-partly from fluid retention caused by heart failure, and partly from non-stop eating, a habit of his under stress.

So he now had to spend three weeks in the hospital, his blood oxygen still plummeting to dangerously low levels, despite his being given oxygen-and each time the level grew really low he became lethargic and totally blind. Amy would know the moment she opened his door what sort of day he was having where the blood oxygen was-depending on whether he used his eyes, looked around, or fumbled and touched, acted blind. (We wondered, in retrospect, whether the strange fluctuations his vision had shown from almost the day of surgery might be explained, at least in part, by fluctuations in his blood oxygen, with consequent retinal or cerebral anoxia. Virgil could have been close to respiratory failure and anoxia even before his acute illness.)

There was another, intermediate state, which Amy found very puzzling; at such times, he would *say* that he saw nothing whatever, but would reach for objects, avoid obstacles, and *behave* as if seeing. Amy could make nothing of this singular state, in which he manifestly responded to objects, could locate them, was seeing, and yet denied any consciousness of it. This condition, called implicit sight, unconscious sight, or blindsight, occurs if the visual parts of the cerebral cortex are knocked out (as they might be by a lack of oxygen, for instance) but the visual centers in the subcortex remain intact. Visual signals are perceived and are responded to appropriately, but nothing of this perception reaches consciousness at all.

At last, Virgil was able to leave the hospital and return home, but to return a respiratory cripple. He was tethered to an oxygen cylinder, and could not even stir from his chair without it. It seemed unlikely at this stage that he would ever recover sufficiently to go out and work again, and the Y now felt that it had to terminate his job. A few months later, he was forced to leave the house where he had lived as an employee of the Y. This was the situation last summer: Virgil had lost not only his health but his job and his house as well.

BY October, however, he was feeling better, and was able to go without oxygen for an hour or two at a time. It had not been wholly clear to me, from speaking to Virgil and Amy, what had finally happened to his vision after all these months. Amy said that it had "almost gone" but that now she felt it was coming back as he got better. When I phoned the visual-rehabilitation center where Virgil had been evaluated, I was given a different story. Virgil, I was told, seemed to have lost all the sight restored the previous year, with only a few bits remaining. Kathy, his therapist, thought he saw colors but little else-and sometimes colors without objects: thus he might see a haze or halo of pink around a PeptoBismol bottle without clearly seeing the bottle itself. This color perception, she said,

was the only seeing that was constant; for the rest he appeared almost blind, missed objects, groped, seemed visually lost. He was showing his old, blind random movements of the eyes. And yet sometimes, spontaneously, out of the blue, he would get sudden, startling moments of vision, in which he would see objects, quite small ones. But these percepts would then "vanish," as suddenly as they came, and he was usually unable to retrieve them. For all practical purposes, she said, Virgil was now blind.

I was shocked and puzzled when Kathy told me this. These were phenomena radically different from anything he had shown before: what was happening now with his eyes and his brain? From a distance, I could not sort out what was happening, especially since Amy, for her part, maintained that Virgil's vision was now improving. Indeed, she got furious when she heard anyone say that Virgil was blind, and she maintained that the visual-rehab center was actually "teaching him to be blind." So in February of 1993, a year after the onset of his devastating illness, we brought Virgil and Amy to New York, to see us again and to get some specialized physiological tests of retinal and brain function.

AS soon as I met Virgil, at the arrival gate at LaGuardia Airport, I could see for myself that everything had gone quite terribly wrong. He was now almost fifty pounds heavier than when I had met him in Oklahoma. He was carrying a cylinder of oxygen strung over one shoulder. He groped, his eyes wandered, he looked totally blind. Amy guided him, her hand under his elbow, everywhere they went. And yet sometimes as we drove over the Fifty-ninth Street Bridge into the city he would pick up something—a light on the bridge - not guessing but seeing it quite accurately. But he could never hold it or retrieve it, and so remained visually lost.

When we came to test him in my office - first using large colored targets, then large movements and flashlights - he missed everything. He seemed totally blind - blinder than he had been before his operations, because then, at least, even through his cataracts he could detect light, its direction, and the shadow of a hand moving before him. Now he could detect nothing whatever, no longer seemed to have any light-sensitive receptors: it was as if his retinas had gone. Yet not totally gone - that was the odd thing. For once in a while he would see something accurately: once, he saw, described, grasped a banana; on two occasions, he was able to follow a randomly moving light bar with his hands on a computer screen; and sometimes he would reach for objects, or "guess" them correctly, even though he said he saw "nothing" at such times—the blindsight that had first been observed in the hospital.

We were dismayed at his nearuniform failure, and he was sinking into a demoralized, defeated state - it was time to stop testing and take a break for lunch. As we passed him a bowl of fruit, and he felt the fruit with swift, sensitive, skillful fingers, his face lighted up, and he regained his animation. He gave us, as he handled the fruit, remarkable tactile descriptions, speaking of the waxy, slick quality of the plum skin, the soft fuzz of peaches and smoothness of nectarines ("like a baby's cheeks"), and the rough, dimpled skin of oranges. He weighed the fruits in his hand, spoke of their weight and consistency, their pips and stones; and then, lifting them to his nose, their different smells. We included an exceedingly clever wax pear among the real fruit; with its realistic shape and coloring, it had deceived sighted people completely. Virgil was not taken in for a moment: he burst out laughing as soon as he touched it. "It's a candle," he said immediately, somewhat puzzled. "Shaped like a bell or a pear." While he may indeed have been, in von Senden's words, "an exile from spatial reality," he was deeply at home in the world of touch in time.

But if his sense of touch was perfectly preserved, there were now, it was evident, just sparks from his retinas—rare, momentary sparks, from retinas that now seemed to be ninety-nine per cent dead. Bob Wasserman, too, who had not seen Virgil since our visit to Oklahoma, was appalled at the degradation of vision, and wanted to reexamine the retinas. When he did so, they looked exactly as before - piebald, with areas of increased and decreased pigmentation. There was no evidence of any new disease. Yet the functioning of even the preserved areas of retina had fallen to almost zero. Electroretinograms, designed to record the retina's electrical activity when stimulated by light, were negative, and visual evoked potentials, designed to show activity in the visual parts of the brain, were absent—there was nothing, electrically, going on in either the retinas or the brain that could be recorded. This could not be attributed to the original disease, retinitis, which had long been inactive. Something else had emerged in the past year and had, in effect, extinguished his remaining retinal function.

We remembered how Virgil had constantly complained of glare, even on relatively dull, overcast days—how glare seemed to blind him sometimes, so that he needed the darkest glasses. Was it possible (as my colleagues Kevin Halligan and Gerald Edelman suggested) that with the removal of his cataracts—cataracts that had perhaps shielded his fragile retinas for decades—the ordinary light of day had proved lethal, burned his retinas? It is said that patients with other retinal problems, like macular degeneration, may be exceedingly intolerant of light—not merely ultraviolet but light of all wavelengths—and that light may hasten the degeneration of their retinas. Was this what had happened with Virgil? It was one possibility—the Halligan-Edelman hypothesis. Should we have foreseen it, and rationed Virgil's sight, or the ambient light, in some way?

Another possibility - a likelier one - related to Virgil's continuing hypoxia, the fact that he had not had properly oxygenated blood for a year. We had clear accounts of his vision waxing and waning in the hospital as his blood gases went up and down. Could the repeated, or continuing, oxygen-starving of his retinas (and perhaps also of the visual areas of his cortex) have been the factor that did them in? The extinction, in either case, seems to be irreversible.

THIS, then, is Virgil's story, the story of a "miraculous" restoration of sight to a blind man, a story basically similar to that of Cheselden's young patient in 1728, and of a handful of others over the past three centuries—but with a bizarre and ironic twist at the end. Gregory's patient, so well adapted to blindness before his operation, was first delighted with seeing, but soon encountered intolerable stresses and difficulties, found the "gift" transformed to a curse, became deeply depressed, and soon after died. Almost all the earlier patients, indeed, after their initial euphoria, were overwhelmed by the enormous difficulties of adapting to a new sense; though a very

few, as Valvo stresses, have adapted and done well. Could Virgil have surmounted these difficulties and adapted to seeing where so many others had foundered on the way?

We shall never know, for the business of adaptation-and, indeed, of life as he knew it-was suddenly cut across by a gratuitous blow of fate: an illness that, at a single stroke, deprived him of job, house, health, and independence, leaving him a gravely sick man, unable to fend for himself. For Amy, who incited the surgery in the first place, and who was so passionately invested in Virgil's seeing, it was a "miracle" that misfired, a calamity. Virgil, for his part, maintains philosophically, "These things happen." But he has been shattered by this blow, has given vent to outbursts of rage: rage at his helplessness and sickness; rage at the smashing of a promise and a dream; and, beneath this, most fundamental of all, a rage that had been smoldering in him almost from the beginning-rage at being thrust into a battle he could neither renounce nor win. At the beginning, there was certainly amazement, wonder, and sometimes joy. There was also, of course, great courage. It was an adventure, an excursion into a new world, the like of which is given to few. But then came the problems, the conflicts, of seeing but not seeing, not being able to make a visual world, and at the same time being forced to give up his native competence-a torment from which no escape seemed possible. But then, paradoxically, a release was given, in the form of a second and now final blindness-a blindness he received as a gift. Now, at last, Virgil is allowed to not see, allowed to escape from the glaring, confusing world of sight and space, and to return to his own true being, the touch world that has been his home for almost fifty years.