



Fearfully and Wonderfully Made

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PREFACE



I first learned about Dr. Paul Brand in 1976 while writing my book *Where Is God When It Hurts?* As I was ensconced in libraries researching the problem of pain, my wife cleaned out the closet of a medical-supply house and in the process stumbled across an intriguing essay he had written on “The Gift of Pain.” The author had a unique point of view. Whereas I had interviewed scores of people who wanted desperately to escape pain, Brand told of spending several million dollars trying to *create* a pain system for his patients. “Thank God for pain!” he said. “I cannot think of a more valuable gift for my leprosy patients.”

An orthopedic surgeon, Dr. Brand had spent most of his medical career in India, where he made a dramatic discovery about leprosy, one of the oldest and most feared diseases. Careful research convinced him that the terrible manifestations of that cruel disease — missing toes and fingers, blindness, ulcers, facial deformities — all trace back to the single cause of painlessness. Leprosy silences nerve cells, and as a result its victims unwittingly destroy themselves, bit by bit, because they cannot feel pain. When he moved to a high-tech laboratory in the United States, he applied what he had learned about painlessness to other diseases, such as diabetes, thus helping to prevent tens of thousands of amputations each year.

Brand's ideas so captivated me that I called him out of the blue from Chicago and arranged an interview. We met on the grounds of the only leprosarium in the continental United States (later closed due to budget cuts). Louisiana authorities who founded the hospital in the nineteenth century situated it well away from population centers, and I drove along the Mississippi River for several hours from New Orleans to reach the tiny town of Carville. Laid out in sprawling, colonial style under massive live oak trees, the leprosarium resembled a movie set of a tropical plantation; it had, in fact, been built on the site of an antebellum plantation. Patients on crutches and in wheelchairs moved slowly along double-decker arched walkways that connected the major buildings.

I knew of Dr. Brand's stature in the world medical community in advance of my visit: offers to head up major medical centers in England and the U.S., distinguished lectureships all over the world, the hand-surgery procedures named in his honor, the prestigious Albert Lasker Award, his appointment as Commander of the Order of the British Empire by Queen Elizabeth II, his selection as the only Westerner to serve on the Mahatma Gandhi Foundation, his service as an expert consultant to the World Health Organization. His face appeared in the most unlikely places: alongside an article extolling the virtues of bare feet in the consumer magazine *Seventeen*, as a guest of Johnny Carson on *The Tonight Show*.

A slight man of less-than-average height and stiff posture entered the room where we had agreed to meet. He had graying hair, bushy eyebrows, and a face that creased deeply when he smiled. In a British accent — a striking contrast to the bayou tones heard in hospital corridors — he apologized for the flecks of blood on his lab coat, explaining that he had just been dissecting armadillos, the only nonhuman species known to harbor leprosy bacilli. He wore outdated clothes, lived in a rented bungalow on the hos-

pital grounds, and drove an economical, run-down automobile. At heart, Paul Brand was still a missionary, unimpressed by and unaccustomed to relative prosperity and fame.

That first visit lasted a week. I accompanied Brand on his rounds, sitting beside him as he studied the ulcerated feet and hands of patients and visiting the labs that whirred with the sounds of early-generation VAX computers. At night in their wooden house on the hospital grounds, I would share a rice-and-curry meal with him and his wife, Margaret, a respected ophthalmologist. Then Paul would prop up his bare feet, and I would turn on the tape recorder for discussions that ranged from leprology and theology to world hunger and soil conservation. Every topic I brought up, he had already thought about in some depth. He quoted Shakespeare and discussed the derivation of Greek, Hebrew, and Latin words. During breaks he taught me such things as how to select a ripe fig (watch the ones butterflies light on several times, testing, before flitting on to their preferred overripe fruit) and how African weaver birds build their elaborate nests using only one foot and a beak.

The conversations that stand out sharpest to me now are those in which he recalled individual patients, “nobodies” on whom he had lavished medical attention. When he began his pioneering work, he was the only orthopedic surgeon in the world working among fifteen million victims of leprosy. He and Margaret performed several dozen surgical procedures on some of these patients, restoring rigid claws into usable hands through innovative tendon transfers, remaking feet, forestalling blindness, transplanting eyebrows, fashioning new noses.

He told me of his patients’ family histories, the awful rejection they had experienced as the disease presented itself, the trial-and-error treatments of doctor and patient experimenting together. Almost always his eyes would moisten and he would wipe away

tears as he remembered their suffering. To him these, among the most neglected people on earth, were not nobodies, but people made in the image of God, and he devoted his life to try to honor that image.

(Later, as I began working with Brand and following him around the world, I met many other dedicated Christians who devote their lives to healing the wounds of humanity. In India, for example, where less than 3 percent of the population claims to be Christian, nearly a fifth of all medical work is performed by Christian doctors and nurses, many of them trained at Brand's old hospital in Vellore. If you say the word "Christian" to an Indian peasant — who may never have heard of Jesus Christ — the first image to pop into her mind may well be that of a hospital, or of a medical van that stops by her village once a month to provide free, personal care. And most of the medical advances in the treatment of leprosy came from Christian missionaries, not always the best-trained in the field, but often the only ones willing to work with people suffering from that feared disease.)

We made an odd couple, Dr. Brand and I. He was a silver-haired surgeon characterized by proper British reserve, and I an eager young journalist in my mid-twenties with bushy Art Garfunkel — style hair. I had interviewed many subjects: actors and musicians, politicians, successful business executives, Olympic athletes, Nobel laureates, and Pulitzer Prize winners. Something attracted me to Brand at a deeper level than I had felt with any other interview subject. My father died just after my first birthday, and in many ways Dr. Brand became a father-figure to me. Already an adult when I met him, I didn't have to go through teenage rebellion and the agony of individuation. I sat at his feet from the first day we met.

For perhaps the first time, I encountered genuine humility. The apostle Paul pointed to Jesus as an example of humility:

“Your attitude should be the same as that of Christ Jesus: Who, being in very nature God, did not consider equality with God something to be grasped, but made himself nothing, taking the very nature of a servant, being made in human likeness.” Meeting Dr. Brand, I realized that I had misconstrued humility as a negative self-image. Paul Brand obviously knew his gifts: he had finished first throughout his academic career and had attended many awards banquets honoring his accomplishments. Yet he recognized his gifts as just that, *gifts* from a loving Creator, and used them in a Christlike way of service.

When I first met him, Brand was still adjusting to life in the United States. Everyday luxuries made him nervous, and he longed for a simple life close to the soil. He knew presidents, kings, and celebrities, yet he rarely mentioned them. He talked openly about his failures and always tried to deflect credit for his successes to his associates. Most impressive to me, the wisest and most brilliant man I have ever met devoted much of his life to some of the lowest people on the planet: members of the Untouchable caste in India afflicted with leprosy.



After I had spent a few days at Carville and earned his trust, Dr. Brand admitted to me somewhat shyly that he had once attempted a book. Some years before, after he had delivered a series of talks to the Christian Medical College in Vellore, India, other faculty members encouraged him to write them down for publication. He made the effort, but the material filled only ninety pages, not enough for a book. Twenty years had passed, and he had not touched the manuscript since.

I persuaded him to dig through closets and bureau drawers until he located the badly smudged third carbon copy of those chapel talks, and that night I sat up long past midnight reading his remarkable meditations on the human body. I was staying in the hospital's vaulted antebellum guest room, and a ceiling fan periodically scattered the onionskin pages around the room. I kept gathering them up and resorting them, though, for I knew I had struck gold.

Brand wrote, "I have come to realize that every patient of mine, every newborn baby, in every cell of its body, has a basic knowledge of how to survive and how to heal, that exceeds anything that I shall ever know. That knowledge is the gift of God, who has made our bodies more perfectly than we could ever have devised." In ninety pages, he expressed that sense of wonder about the human body.

The next day I asked Brand if he would allow me to collaborate with him, expanding his medical and spiritual insights and adding more stories from his life. "It will be a very different book than this," I warned him. "But I sense something unique in these pages, and I would like to bring it to light." Eventually our collaboration led to two full-length books, *Fearfully and Wonderfully Made* and *In His Image*.*

As Brand saw it, studying the human body, a worthy endeavor in itself, yields an unexpected bonus. It sheds light on a metaphor used more than thirty times in the New Testament: the Body of Christ, in which the church is presented as a universal Body comprising individual members joined to Jesus Christ as Head. A likeness exists between the human body and spiritual Body, a likeness that derives from their common Source.

* In this edition, we have updated the relevant statistics and made slight revisions. We have, however, retained the present-tense voice of Dr. Brand in such phrases as "Now I have my own laboratory" and "Today when I visit India," as expressed in the original.

Dr. Brand described his writing journey this way: “In a sense we doctors are like employees at the complaint desk of a large department store. We tend to get a biased view of the quality of the product when we hear about its aches and pains all day. In this little manuscript, which I set aside long ago, I tried instead to pause and wonder at what God made, the human body. Then I lifted an analogy from the New Testament and updated it with the expanded knowledge we’ve gained from modern science. Curiously, every medical discovery seems to make the body analogy fit even better; not one has weakened the original meanings the apostle Paul set forth.”

The idea of a book based on analogy attracted me because I too appreciate the harmony between the natural and spiritual worlds. Christians have largely abandoned the natural world to physics, geology, biology, and chemistry. In contrast, Brand strove to bring the two worlds, natural and spiritual, back together.

As I worked on this material, I had the sense of wrestling with several different books at once. I wanted to capture the essence of Dr. Brand’s remarkable life practicing medicine on three different continents. In addition, I hoped to convey an appreciation for the human body by rendering medical facts in an appealing style. And, of course, the real core of the book lay in its spiritual application, drawn from analogy, that sometimes expressed reverence, sometimes praise, and sometimes prophetic challenge.

In every chapter, on almost every page, I strained to keep these three disparate kinds of material in balance. I often felt as if one or another of the three books was taking over, and I struggled to shape a unified book out of the three approaches. I persevered because I recognized that Dr. Brand offered a unique blend of gifts. Even after fifty years of medical practice, he retained a boyish enthusiasm for the grandeur of the human body. In two

decades of missionary service in India he had gained fresh and profound insights into Christian truth. And, along the way, he experienced adventures and personal encounters with patients that were as dramatic and poignant as any I had come across.

The book got off to a rough start. The first publisher we approached turned it down. Then I accidentally left the first and only draft in a motel room (a substantial reward helped the motel staff remember that the sheaf of papers had not been thrown away after all). When *Fearfully and Wonderfully Made* finally went to press in 1980, Dr. Brand and I, as well as our publisher, awaited results with some trepidation. It was a difficult book to describe and present. Few books of analogies exist, and we could not predict how the public would respond.

More than two decades have passed, and some 700,000 readers have bought copies of *Fearfully and Wonderfully Made* or its sequel *In His Image*. We have heard from many of them: pregnant women thanking us for helping them appreciate the miracle of life and birth, medical students crediting these books for helping push them toward a career in medicine, high school and college biology teachers who use excerpts in their classes, and many other readers simply grateful for an opportunity to pause and reflect on the multiple wonders of the human body.

Sometime later Dr. Brand and I worked on a third volume, *The Gift of Pain*, a more biographical treatment, which focuses on his theories of pain. In all I have spent almost ten years following the threads of Dr. Brand's life. The more I questioned him, the more I seemed to be unraveling a giant skein. I would tug at one thread, and out would come a story from India I had not heard before, which would lead to a digression on why blue jeans feel cool to the touch while flannel feels warm. Somehow that conver-

sation would lead to a spiritual point, perhaps a dissertation on Job or one of Jesus' parables.

My own writing took a different tack after these three books with Dr. Brand, turning more personal and meditative. Now I look back with nostalgia on the decade we spent working together. I had grand subjects to work with: the entire world of creation and specifically the magnificent human body; the exotic life of a surgeon who brought healing to people who knew no physical pain and therefore much suffering; and the mystery of Christ's Body, surely the most precarious venture ever made by God, entrusting the divine reputation to the likes of us his fickle followers.

Paul Brand was both a good and a great man, and I am forever grateful for the time we spent together. My faith grew as I observed with a journalist's critical eye a person enhanced in every way by his relationship with God.

Dr. Brand and I used to joke about the collaborative process. He said he felt guilty because he merely answered my questions and a few years later a book would emerge. I responded that all I did was ask questions, research, and write up the answers, whereas he had spent a lifetime serving leprosy patients in desolate places.

There was another exchange at work too, I now see — a trade with eternal significance. Wounded by the church, plagued by doubts, I had neither the maturity nor the ability to express much of my own fledgling faith. Yet I could write with utter integrity about Dr. Brand's faith, and through that process his words and thoughts became mine too. I now view the ten years I spent working with him as an important chrysalis stage. As a journalist, I gave words to his faith. In exchange, he gave faith to my words.



True friends get their measure, over time, in their effect on you. As I compare the person I was on our first meeting and the person I am now, I realize that large changes have occurred within me, with Paul Brand responsible for many of them.

I have written honestly about my early struggles, due in large part to lengthy exposure to toxic churches. I can imagine God taking great delight in steering me to Dr. Brand (through my wife's serendipitous discovery of his essay in a closet, of course) at a critical time in my spiritual journey. *Okay, Philip, you've seen some of the worst the church has to offer. Now I'll show you one of the best.*

In the movie *Manhattan*, Woody Allen turns to a woman he's courting and says, "You're God's answer to Job." He explains that when Job whines about how awful the world is, God could at least point and say, "but I can still make one of these." Similarly, as I grappled with the injustices of this world, the problem of pain, and other imponderables of theology, I could look to Paul Brand as a shining example of what God had in mind with the human experiment.

As much as anyone, he has helped set my course in outlook, spirit, and ideals. I look at the natural world, and environmental issues, largely through his eyes. From him I also have gained assurance that the Christian life I had heard in theory can actually work out in practice. It is indeed possible to live in modern society, achieve success without forfeiting humility, serve others sacrificially, and yet emerge with joy and contentment. To this day, whenever I doubt that, I look back on my time with Paul Brand.

As the years passed, our roles inevitably reversed. He started calling me for advice on such matters as which word processing software to use, how to organize research notes, and how to deal with publishers. After retiring from medical practice, the Brands moved to a small cottage overlooking Puget Sound in Seattle, the only home they ever owned. Paul served a few terms as president

of the International Christian Medical and Dental Society, consulted with the World Health Organization, and into his eighties continued to lecture throughout the world. In 2001 he announced with pride that he and Margaret had become U.S. citizens.

Inevitably, health problems set in with age. Brand suffered a stroke on a trip to Turkey and a mild heart attack in London. For a time his speech slurred noticeably and his ability to recall names and events faded. Our conversation moved to issues of aging and mortality.

I got a call in June 2003 informing me that Dr. Brand had fallen while carrying a box of books to the second-floor office in his cottage. He had hit his head on the banister, and was now lying in a coma in a Seattle hospital. My wife and I were due to leave in a few days for a trip to New Zealand, and after some persistent calls United Airlines allowed us to reroute the trip through Seattle.

We spent five hours in an intensive-care room with the Brands' immediate family. Their five daughters and one son had gathered from scattered homes in England, Hawaii, Minnesota, and Washington. Paul was receiving expert medical attention (one daughter is a doctor, two are nurses, and two of their husbands are doctors), but it was clear to everyone that he would not recover. Dr. Brand had always insisted on no extraordinary measures should he ever reach a brain-damaged state, and an emotional family council had honored his wishes. He was receiving hydration, but no ventilator assistance with his breathing.

The fall itself had not caused the main damage. Only later that day, after he had complained of headaches, had his wife driven him to the emergency room. After the fall, a blood clot developed in the brain, and subsequent surgery, combined with blood-thinning medication that he took for strokes, led to further bleeding that destroyed most of his higher brain functions. First he became

uncharacteristically combative, then lost speech, then slipped into the coma from which he never awoke.

Now he lay curled almost in a fetal position, his breathing heavy and raspy, his body moving restlessly from side to side. A long S-shaped scar creased his shaved head, blotched here and there with purple bruises, a mark of the surgery. Monitors flashed digital readouts of his pulse, blood pressure, and respiration, and a tube drained excess brain fluid into a plastic container. The hospital room overlooked beautiful Seattle and the mountain ranges that Dr. Brand so loved, but his eyes were vacant, uncomprehending.

In an email I had read on the plane, his daughter Pauline had recalled a scene from *The Lion, the Witch and the Wardrobe*: “It’s when the two girls find Aslan’s body shaved and bound up, and see that although such things had been done in order to strip the lion of his dignity they have only succeeded in emphasizing it. That’s how it is with Dad’s poor half-shaved head, and the ugly semi-circle of staples from the surgery, and the multitude of tubes taped to his face, neck and chest. Within it all, there is his grand old face....”

By his bedside, suddenly I was overcome with emotion and could not speak. For nearly thirty years Paul Brand had been the towering giant in my life, the one to whom I turned for guidance, wisdom, inspiration, and faith. Now only a shell was left, the physical body we had written about. I bent over and kissed the smooth, baby-like skin on his shaven head.

His left hand grasped out for something to hold, and I put my hand in his. Incredibly, almost eerily, he began examining it with his fingers, running his own fingers up and down mine, squeezing, testing, analyzing. As I stood there, he did the same thing with his own right hand, which lay useless at his side. The instincts of fifty years of hand surgery had so imprinted on the synapses of his

brain that even with much of it destroyed, this remained. Often he had told me that he could remember his patients' hands better than their faces. Now he could not speak, probably could not think, could barely breath, but still he reached out with the hands that had brought healing to so many.

A few days later, from an email received halfway around the world, I learned he had taken his last breath on July 8, a week before his eighty-ninth birthday. All that week, at unexpected times — waking up, in the shower, while praying — I would find myself sobbing. “What’s wrong?” my wife asked the first few times. “I miss Dr. Brand,” was my only answer. A phrase kept going through my mind: *I am not ready to walk alone.*

We returned to Seattle a month later for a public memorial service on the campus of CRISTA, a Christian relief organization, which both of the Brands served as board members. “A celebration of the life of Paul Brand,” the service was billed, and indeed it was. Representatives from the hand-surgery society and leprosy missions, a delegate from the hospital in Vellore, India, as well as medical residents and ordinary citizens of Seattle and elsewhere who had been touched by his life gathered to pay tribute.

When it came my turn to speak, first I removed my shoes and socks and stood barefoot. It seemed somehow appropriate to honor in this small way a man who slipped off his own shoes at any opportunity, who lobbied against “No shoes, no shirt, no service” policies, and who had spent thousands of hours investigating how best to protect the insensitive feet of his leprosy patients, for whom tight shoes or rough sandals represented danger.

I also borrowed an object lesson from Dr. Brand himself, one I had seen him give in the stately chapel of Wheaton College in Illinois. In the middle of his address, he had reached in his pocket and pulled out a cluster of grapes. He stopped talking, took a plump,

juicy grape, chewed it, then spat out the seeds on the plush carpet. After the audience laughter died down, he went on to make a serious point. He was speaking on the fruit of the Spirit described by Paul in Galatians 5: love, joy, peace, patience, kindness, goodness, faithfulness, gentleness, and self-control.

“These qualities are good for you in every way,” he went on to explain. “They are qualities of God, and God’s Spirit wants to grow them inside you. Yet as someone who has grown fruit trees, I also know that from the fruit’s perspective, the ultimate goal is reproduction. The fruit is attractive and beautiful so that a bird or perhaps a person will find that grape, or apple, or blackberry, pick it, and do just what I have done: spit out the seed on the ground. If we were meeting outside, rather than in this beautiful chapel, I could come back in ten years or so and find a grape vine growing as a result of my sermon illustration this morning.”

Later, in private conversation, I got a fuller version. Brand described how an apple or pear is weighted so that when it falls to the ground, it makes a slight indentation in the soil, and contains just enough meat to nourish the seeds inside. He observed, somewhat presciently, “My active life is mostly behind me. But I pray that my life and the principles that God has helped me to live by will continue to influence young lives. When we die we not only leave seed, but we also leave an effect on the soil in which future children grow and future spiritual seed will be nourished.”

The morning of the memorial service, despite visits to several Seattle supermarkets, my wife and I could find only seedless grapes. I resorted to cherries, liberally spraying the seeds around the carpeted platform as I explained the object lesson. I then switched analogies, for in the hospital room where Dr. Brand lay dying I had remembered a trip we took to the Quinalt rain forest on the Olympic peninsula. In that moss-covered forest, which supports

the greatest biomass of vegetation on earth, he pointed out to me a feature known as a “colonnade.”

When one of the giant evergreen trees falls to the ground, seeds from the cones sprout and send out roots in search of soil. They find instead the dead bark and meat of the mother tree, which becomes a “nurse log” providing the nutrients needed for growth. After many years pass, you can return to the site of the fallen tree, which has now disintegrated, and see its very shape from the long colonnade of young trees whose roots form a series of arches over where the mother tree once lay.

I still am not ready to walk alone. But that I walk at all on this perilous journey of faith depends in large part on the strength I received from a giant of faith against whom I leaned for thirty years as one leans against a towering tree of the forest. As we heard in that memorial service, the colonnade left by Paul Brand stretches long and far, spanning continents, affecting not just fellow surgeons, but nurses, leprosy patients, neighbors, and ordinary people whose lives he touched.

I know no one who better illustrates Jesus’ most-quoted statement, that “whoever loses his life for my sake will find it.” From the perspective of a success-obsessed culture, an orthopedic surgeon spending his professional life among some of the poorest and most oppressed people on the planet is an example of “losing his life.” Yet Dr. Brand lived as full and rich a life as anyone I know, combining humility, gratitude, and a grand sense of adventure.

Simone Weil once said, “Imaginary evil [such as that portrayed in books and movies] is romantic and varied; real evil is gloomy, monotonous, barren, boring. Imaginary good is boring; real good is always new, marvelous, intoxicating.” I saw real goodness in Paul Brand, and found it new, marvelous, and intoxicating. I feel privileged, as his coauthor, to have had some role in shining a light

on his life. You need only meet one saint to believe, to silence the noisy arguments of the world, and I had the inestimable privilege of spending leisurely hours getting to know a distinguished and faithful follower of Jesus. For that, Paul Brand, I thank you.

Philip Yancey

CELLS



MEMBERS

I have been trying to think of the earth as a kind of organism, but it is no go. I cannot think of it this way.... The other night, driving through a hilly, wooded part of southern New England, I wondered about this. If not like an organism, what is it like, what is it most like? Then, satisfactorily for that moment, it came to me: it is most like a single cell.

Lewis Thomas



I remember the first time I saw a living cell under a microscope. I was twenty-one years old and taking a short course in tropical hygiene at Livingstone College in England. We had been studying parasites, but our specimens were dead; I wanted to see a living amoeba. Early one morning, before the laboratory was cluttered with students, I sneaked into the old science building. The imposing red brick structure stood next to a pond from which I had just scooped some water in a teacup. Bits of decomposing leaves floated in the turbid water, smelling of decay and death.

But when I touched one drop of that water to a microscope slide, a universe sprang to life. Hundreds of organisms crowded into view: delicate, single-celled globes of crystal, breathing, unfurling, flitting sideways, excited by the warmth of my microscope light. I

edged the slide a bit, glancing past the faster organisms. Ah, there it was. An amoeba. A mere chip of translucent blue, it was barely visible to my naked eye, but the microscope revealed even its inner workings.

Something about the amoeba murmurs that it is one of the most basic and primordial of all creatures. Somehow it has enlisted the everyday forces of millions of spinning atoms so that they now serve life, which differs profoundly from mere matter. Just an oozing bit of gel, the amoeba performs all the basic functions that my body does. It breathes, digests, excretes, reproduces. In its own peculiar way it even moves, plumping a hummock of itself forward and following with a motion as effortless as a drop of oil spreading on a table. After one or two hours of such activity, the grainy, watery blob will have traveled a third of an inch.

That busy, throbbing drop gave me my first graphic image of the jungle of life and death we share. I saw the amoeba as an autonomous unit with a fierce urge to live and a stronger urge to propagate itself. It beckoned me on to explore the living cell.



Years later I am still observing cells, but as a physician I focus on how they cooperate within the body.

Now I have my own laboratory, at a leprosy hospital on swampy ground by the Mississippi River in Carville, Louisiana. Again I enter the lab early before anyone is stirring, this time on a chilly winter morning. Only the soft buzz of fluorescent lights overhead breaks the quietness.

But I have not come to study amoebae. This morning I will examine a hibernating albino bat who sleeps in a box in my refrigerator. I rely on him to study how the body responds to injury and

infection. I lift him carefully, lay him on his back, and spread his wings in a cruciform posture. His face is weirdly human, like the shrunken heads in museums. I keep expecting him to open an eye and shriek at me, but he doesn't. He sleeps.

As I place his wing under the microscope lens, again a new universe unfolds. I have found a keyhole. The albinic skin under his wing is so pale that I can see directly through his skin cells into the pulsing capillaries which carry his blood. I focus the microscope on one bluish capillary until I can see individual blood cells pushing, blocking, thrusting through it. Red blood cells are by far the most numerous: smooth, shiny discs with centers indented like jelly doughnuts. Uniform size and shape make them seem machine-stamped and impersonal.

More interesting are the white blood cells, the armed forces of the body which guard against invaders. They look exactly like the amoebae: amorphous blobs of turgid liquid with darkened nuclei, they roam through the bat's body by extending a finger-like projection and humping along to follow it. Sometimes they creep along the walls of the veins; sometimes they let go and free-float in the bloodstream. To navigate the smaller capillaries, bulky white cells must elongate their shapes, while impatient red blood cells jostle in line behind them.

Watching the white cells, one can't help thinking them sluggish and ineffective at patrolling territory, much less repelling an attack. Until the attack occurs, that is. I take a steel needle and, without waking the bat, prick through its wing, puncturing a fine capillary. An alarm seems to sound. Muscle cells contract around the damaged capillary wall, damming up the loss of precious blood. Clotting agents halt the flow at the skin's surface. Before long, scavenger cells appear to clean up debris, and fibroblasts, the body's reweaving cells, gather around the injury site. But the most dramatic change

involves the listless white cells. As if they have a sense of smell (we still don't know how they "sense" danger), nearby white cells abruptly halt their aimless wandering. Like beagles on the scent of a rabbit, they home in from all directions to the point of attack. Using their unique shape-changing qualities, they ooze between overlapping cells of capillary walls and hurry through tissue via the most direct route. When they arrive, the battle begins.

Lennart Nilsson, the Swedish photographer famous for his remarkable closeups of activity inside the body, has captured the battle on film as seen through an electron microscope. In the distance, a shapeless white cell, resembling science fiction's creature "The Blob," lumbers toward a cluster of luminous green bacterial spheres. Like a blanket pulled over a corpse, the cell assumes their shape; for awhile they still glow eerily inside the white cell. But the white cell contains granules of chemical explosives, and as soon as the bacteria are absorbed the granules detonate, destroying the invaders. In thirty seconds to a minute only the bloated white cell remains. Often its task is a kamikaze one, resulting in the white cell's own death.

In the body's economy, the death of a single white cell is of little consequence. Most only live several days or several weeks, and besides the fifty billion active ones prowling the adult human, a backup force one hundred times as large lies in reserve in the bone marrow. At the cellular level, massive warfare is a daily fact of life. Fifty thousand invaders may lurk on the rim of a drinking glass, and a billion can be found in a half-teaspoon of saliva. Bacteria enshroud my body — every time I wash my hands I sluice five million of them from the folds of my skin.*

* The quantities of bacteria viewed through the first effective microscopes so overwhelmed scientists that subsequent generations have lived in vivid awareness of "germs." Astute promoters market disinfectants to sterilize our environment, but too often the germ-killer, merely a cell-killer, also destroys the body's good cells. Today we

To combat these threats, some of the blood's white cells are specifically targeted to one type of invader. If the body has experienced contact with a severe danger, as in a smallpox vaccination, it imprints certain white cells with a death-wish to combat that single danger. These cells spend their lives coursing through the bloodstream, waiting, scouting. Often they are never called upon to give battle. But if they are, they hold within them the power to disarm a foreign agent that could cause the destruction of every cell in the body.



Often I have reflected on the paradox of the amoeba and its mirror image, the white cell. The amoeba, a self-contained organism, alone performs all the basic functions of life, depending on other cells only when it ingests them as food. The white cell, though similar in construction and makeup, in a sense is far less free. A larger organism determines its duties, and it must sometimes sacrifice its life for the sake of that organism. Although more limited in self-expression, the white cell performs a singularly vital function. The amoeba flees danger; the white cell moves toward it. A white cell can keep alive a person like Beethoven or Newton or Einstein ... or you and me.

I sometimes think of the human body as a community, and then of its individual cells such as the white cell. The cell is the basic unit of an organism; it can live for itself, or it can help form and sustain the larger organism. I recall the apostle Paul's use of analogy in 1 Corinthians 12 where he compares the church of Christ to the human body. That inspired analogy takes on even

need better publicity for our bodies' able defenses and perhaps less fear of germs — the average American household is in more danger from chemical germ-killers than from germs. I prefer to leave the battle to my own cells.

more meaning to me because of the expanded vistas allowed by the invention of microscopes. Since Paul's analogy renders a basic principle of God's creation, I can augment it like this:

The body is one unit, though it is made up of many cells, and though all its cells are many, they form one body.... If the white cell should say, because I am not a brain cell, I do not belong to the body, it would not for that reason cease to be part of the body. And if the muscle cell should say to the optic nerve cell, because I am not an optic nerve, I do not belong to the body, it would not for that reason cease to be part of the body. If the whole body were an optic nerve cell, where would be the ability to walk? If the whole body were an auditory nerve, where would be the sense of sight? But in fact God has arranged the cells in the body, every one of them, just as he wanted them to be. If all cells were the same, where would the body be? As it is, there are many cells, but one body.

That analogy conveys a more precise meaning to me because though a hand or foot or ear cannot have a life separate from the body, a cell does have that potential. It can be part of the body as a loyalist, or it can cling to its own life. Some cells do choose to live in the body, sharing its benefits while maintaining complete independence — they become parasites or cancer cells.