

Book Excerpt
from
Rebuilt: How Becoming Part Computer Made Me More Human

by Michael Chorost

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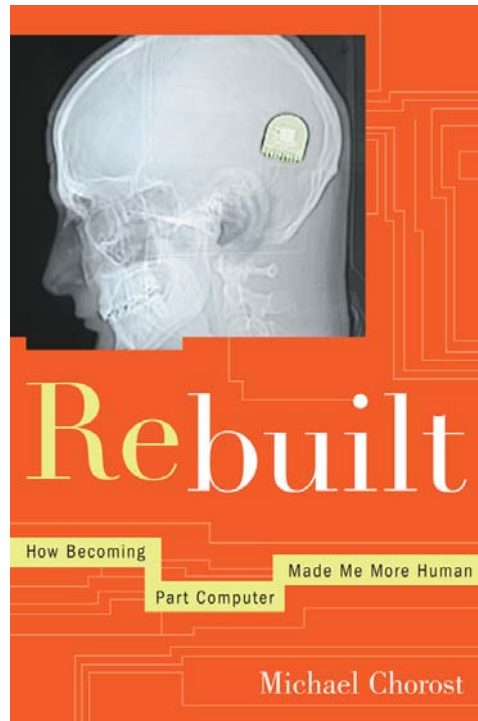


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About *Rebuilt: How Becoming Part Computer Made Me More Human*

Michael Chorost became a cyborg on October 1, 2001, the day his new ear was booted up. Born hard of hearing in 1964, he went completely deaf in his thirties. Rather than live in silence, he chose to have a computer surgically embedded in his skull to artificially restore his hearing.

This is the story of Chorost's journey -- from deafness to hearing, from human to cyborg -- and how it transformed him. The melding of silicon and flesh has long been the stuff of science fiction. But as Chorost reveals in this witty, poignant, and illuminating memoir, fantasy is now giving way to reality.

Chorost found his new body mystifyingly mechanical: kitchen magnets stuck to his head, and he could plug himself directly into a CD player. His hearing was routinely upgraded with new software. All this forced him to confront complex questions about humans in the machine age: When the senses become programmable, can we trust what they tell us about the world? Will cochlear implants destroy the signing deaf community? And above all, are cyborgs still human?

A brilliant dispatch from the technological frontier, *Rebuilt* is also an ode to sound. Whether Chorost is adjusting his software in a desperate attempt to make the world sound "right" again, exploring the neurobiology of the ear, or reflecting on the simple pleasure of his mother's voice, he invites us to think about what we hear -- and how we experience the world -- in an altogether new way.

Brimming with insight and written with dry, self-deprecating humor, this quirky coming-of-age story unveils, in a way no other book has, the magnificent possibilities of a new technological era.

Advance Praise for *Rebuilt: How Becoming Part Computer Made Me More Human*

“A deeply enjoyable book. Chorost ponders what is ‘real’ to us in our natural state and what our ‘natural’ state really is, and how what is real to us will change over time, and thus change us. Chorost is at the vanguard of where most baby-boomers will end up—part human and part machine.” —Rodney Brooks, director of the MIT Computer Science and Artificial Intelligence Lab and author of *Flesh and Machines*

“Chorost takes us on an amazing intellectual journey as he moves from deafness to computer-assisted hearing. He asks big questions about the nature of reality, the meaning of being human, and how much we can bear to be ‘improved.’ Chorost has a fine ear for language, and writes with intelligence, wit, and not a little bit of what he calls ‘rueful irony.’ A lovely book.” —Robin Marantz Henig, author of *Pandora’s Baby* and *The Monk in the Garden*

“Chorost is a quite amazing new writer whose prose spirits the reader across the sound barrier from deafness to a new world in which an essential human function is replaced by a tiny computer chip. In *Rebuilt*, he introduces us to the startling brave new world of bionic replacement parts with himself as the patient, explorer, cyborg, and a more fully human being.” —Sol Stein, author of *Stein on Writing* and (with James Baldwin) *Native Sons*

“*Rebuilt* is a heartfelt exploration of technologically mediated perception and the impact of a cochlear implant on one man’s experience and sense of self. Chorost’s journey is that of humanity itself.” —Andy Clark, author of *Natural-Born Cyborgs*

“An exemplary first-person account of becoming a cyborg. *Rebuilt* combines technical and philosophical erudition with fine writing.” —Chris Hables Gray, author of *Cyborg Citizen: Politics in the Posthuman Age* and editor of *The Cyborg Handbook*

“Chorost has written a wonderfully fascinating account of banishing *total* deafness. His experience is a harbinger of the future. Beethoven would be encouraged.” —Manfred Clynes, coiner of the term “cyborg” and Professor of Physiology and Biophysics at Georgetown University

“This is a terrific book—an eyewitness bulletin from the borderlands where technology and bodies clash and meld. I read it through in one huge chomp, shouting and chortling at this adventure or that. Chorost pulls off the high-wire stunt of conveying scientific accuracy about a complex biomedical topic while writing with the cliffhanger excitement of an action adventure videogame.” —Allucquère Rosanne Stone, author of *The War of Desire and Technology at the Close of the Mechanical Age*

Chapter 1: Broken

I'm impatient. It hasn't been a good morning. I'm on a business trip and have just arrived in Reno, where I'm supposed to interview people at Tahoe for a study. But the car rental at the airport won't take my debit card. I spend half an hour canvassing the other outlets, no luck. Finally a man at one counter kindly points me to a courtesy phone.

“Dial 133. It's Enterprise. They usually have cars and their rates are okay.”

I pick up the phone. I can hear it fine with my hearing aids, even amid the ruckus of the baggage claim. Yes, they have cars available. The voice directs me to the shuttlebus outside the airport.

It's the last telephone call I will ever make with my natural ears.

Paperwork signed, I wait for my car. I fidget. I might as well have driven here instead of flying. And then –

That's odd. The traffic sounds fuzzy all of a sudden. Instead of their usual decisive *vrump*, the cars have started making a whispery sound as they go by, as if plowing through shredded paper. And they sound a hundred yards away, even though I'm right by the road.

It sounds like my left hearing aid's battery is going. Even though I'm wearing two hearing aids, only the left ear really counts. The right ear is so poor that it can only hear vague rumbles. My left ear is my conversation ear, my telephone ear, my radio ear.

I switch batteries in a practiced little *pas de deux* of the hands: left battery into the right aid, right battery into the left. That doesn't make any difference. I guess they're *both* going. I pull out a battery pack from my suitcase, do a second changeout, and wait for the familiar rush of clean, loud sound. But it doesn't happen.

I can't have two broken hearing aids at once. It's as absurd as two tires blowing out at the same time. As I get in the car I'm breathing shallowly, and it's not because of the altitude. I roll the car window down, fiddle with my left hearing aid's volume control, wait for my ears to miraculously clear. All the way up to Tahoe, I'm monitoring on all frequencies, and –

this doesn't sound right

Gotta be the batteries. I've just got a pack of bad batteries. At the hotel I check in, then go to the Long's drugstore and buy three sets of 675s. It costs me fifteen dollars and thirty-seven cents. Right there at the checkout counter, I rip the batteries out of their plastic case and put them in.

That doesn't help either.

In the car I spread both aids out on the passenger seat and methodically try every possible combination of tubes, batteries, and earmolds. Nothing works: the day is like a coin that always comes up tails.

"It's got to be earwax," I say to myself out loud, looking out the windshield to the big red-and-white logo of the store.

I've got to get someone to look in my left ear for earwax. Maybe the clerk at the hotel? She had proved to be a lissome woman with blond hair layered over black, whose full lips pouted as her hands explored a keyboard I couldn't see. Maybe she would also take me into her arms and tell me that everything would be all right. Now *that* would be customer service.

I've never had earwax trouble in my life. But I've also never had two hearing aids fail on me at once, either.

Emergency room. Now.

* * *

The ER is quiet, so while waiting for the doctor I conduct an impromptu interview with the nurse. The study is on the region's social problems, and I might as well start collecting data. The nurse proves to be a fount of information. But as she talks, a chilly realization takes hold of me.

"Nancy," I say. "Are you talking about as loudly as you were when I first came in?"

"Yes, I think so."

"But I'm not hearing you as well as when I came in. Before, I could mostly hear your voice. Now I'm only getting little bits of it."

I'm having to lip-read her more and more. With perceptible speed, the world is becoming softer and softer. Every half an hour, I am hearing less than the half hour before. It's like being an astronaut in the movie *Apollo 13* watching the oxygen tank's gauge inexorably sliding down to zero.

Reflexively, I think to myself: *It's the battery.*

Oh no it isn't. I have not only just lost part of my hearing, I am losing all of it. Minute by minute. I am going completely deaf, right here, right now, while sitting on this table talking to this nurse and scribbling notes.

The nurse goes off to see if she can find the physician just a little bit sooner. In a few minutes he appears, listens grave-faced to my story, then looks carefully in my ears.

"Your ears both look the same," he tells me after I put my hearing aids back in. "There's no fluid behind the eardrums. No redness or swelling."

I can barely hear him, even though I've twisted the volume wheels on both my aids up to max. I usually set the volume at three. Now it's at five, the top number on the dial. I need it to be at *six*. Six is my world of a few hours ago, the place where footsteps and birds and telephones live. If I could just get it to *six*.

"I'm also feeling a little dizzy," I say cautiously, knowing the implications but trying not to think about them. The inner ears also control the sense of balance. I feel lightheaded, off-kilter, ethereal, as if I had just downed a shot of vodka. When I'd gotten down off the exam bench to greet the doctor I had first looked down at the floor to check how far away it was. On the fly, I'm reorganizing the way I deal with my visual field. I'm finding that if I turn to look at something too fast, my head swims. To stop that from happening, I've started squinting and holding my eyes steady as I turn my head.

The doctor goes off to call a specialist. I peer around the curtain to watch him at the nurses' station down the hall. The phone's spiral cord skitters over the counter as he paces back and forth.

He comes back, speaking slowly and carefully so I can read his lips. "It could be a virus in the inner ear. I want to prescribe you steroids and antivirals. They'll treat swelling caused by viruses like herpes –"

I'm unraveling his words one at a time, and this creates a kind of myopia of the soul. The words are roaming around in my brain and not slotting in anywhere.

"*Herpes?* I don't have herpes."

"It's not that. It's an *antiviral*."

Steroids. Antivirals. Vertigo. It is sinking into me that this is not earwax, this is not an equipment problem, this is not a minor health scare. I am in deep trouble. My

mission is aborted. My life has changed forever. *Six* is lost, unreachable, in a place beyond where the volume wheel stops. Whip right around Truckee, take the fastest trajectory back home.

The day is July 7, 2001. I'm thirty-six years old. I've just finished my Ph.D. After a decade of grad school I'm learning what it's like to have a real job and the beginning of a career. I'm starting to meet people. I'm beginning to have a life.

I have always been hard of hearing. That's not the same thing as being deaf. To be hard of hearing is to have partial hearing, which my hearing aids remedied by amplifying sound. They hurt, itched, and whistled, yet they enabled me to take my place in a hearing world. I went to school with people who heard normally. I could use the telephone and understand the radio. No one ever taught me sign language. I often stumbled; I had to ask for repeats; I constantly missed jokes and struggled at parties; but I got by, a reasonably successful child of a lesser god.

I've always been hard of hearing. I can't go *deaf*.*

Not *now*.

* The word "deaf" is fraught with definitional and political complexities. Just as many "blind" people still have some vision, many "deaf" people still have some hearing. Audiologists therefore prefer to use the terms "hard of hearing" and "hearing-impaired." Conversely, many members of the signing deaf community use the capitalized word "Deaf" to distinguish themselves from non-signers, whom they consider merely "deaf." I find terms like "hard of hearing" awkward to use repeatedly, so from this point on I will usually use the term "deaf" to describe myself.

Eight hours later I return to the rental bureau, only to find it closed and deserted. A sign directs me to deposit the key and call for a courtesy cab. A yellow arrow points helpfully to the location of the phone. I go and stare at it, feeling like Snoopy in a world filled with signs saying NO DOGS ALLOWED. The lot is vacant, not a human being in sight. What do I do?

Perhaps I have *just* enough hearing left to hear a yes. I pick up the phone and dial.

“Mmmm mmm mmbpm bbmm verumf hmm bmm, berum hmmm hmm-hmmm grmmm.”

“Hi, I’m at the Enterprise rent-a-car lot and I need a ride to the airport. The sign says to call. Can you send a cab?”

“Erumm vrmm nerpmm mmm mmbpm ermm bmmm arimm, mmmbpmm bmm hmm ermmm –“

“I’m sorry, I’m deaf and I can’t hear you. Could you just say *yes* or *no*? Just say whether you can send a cab. Just one word, please. I’m at the Enterprise rent-a-car near the Reno airport, on” – I look around desperately, my ears ringing like chimes as my head swivels – “Mill Road.”

“Ssssss burumm bmm pmmb erumm bmm pmm arumm emm er berumm bmm pmm bmm erumm burumm.”

Human beings are not binary creatures. You can ask as clearly as possible for a single syllable, *yes* or *no*, 1 or 0, but the instinctual apparatus of social communication is not easily turned off. Even audiologists will blather on at me while they are holding my hearing aids in their own hands, and I have to smile tolerantly and hold up my hand to

stop them. To people who hear normally, complete deafness seems to be inconceivable. Complete blindness can easily be simulated by closing one's eyes, but even the best earplugs cannot fully shut out the world. The ears are always on, always connected. To talk is to be heard.

But I have gotten just enough of the sibilant, the *ssss* in *Yes*, to get the message. "Okay, I hear you saying *yes*, thank you, I'll wait for the cab."

I hang up, praying that all the phonic baggage trailing that one syllable was not *yes, but it will take an hour, or yes, but you have to call this other number, or yes, we will send a cab right away, sir, if you would just say again where you are.*

I stand there and wait, clutching the tow handle of my suitcase as the sun pivots and falls, as appalled by the enormity of the parking lot as a castaway who has just watched his last message in a bottle drift out of sight.

* * *

In the maze of doctors' visits that take place in the next few weeks, a phrase that comes up over and over again is *cochlear implant*. When people go deaf, it is usually because something is wrong with a snail-shaped organ called the *cochlea*, which lives behind the eardrum, about an inch and a half inside the skull. (The word *cochlea* comes from the Latin word for "snail.") The entire function of the rest of the ear – the ear canal, the eardrum, the three little bones of the middle ear – is just to get sound to the cochlea. The ear canal funnels sound toward the eardrum, which vibrates. Three little bones transmit the eardrum's vibration to the base of the cochlea (that is, the big end of its spiral.) Ripples travel through the fluid inside the cochlea from its base to the apex. As they go, they perturb about 15,000 cell-sized hairs lining its inside. Seen at magnification

those hairs look like a field of grass, and in fact they behave like one, literally rustling in response to sound waves just as blades of grass undulate to the wind's touch. Each hair is connected to a nerve ending, which sends signals to the brain when the hair is moved by sound.

If *all* of the hairs are physically damaged – and that appears to be what has just happened to me – the nerves can no longer be stimulated, and profound deafness sets in. But the nerves themselves are usually still intact, and can be triggered with implanted electrodes under computer control. That is what a cochlear implant does.*

Becky Highlander, my new audiologist, explains to me how it works. She's a slender blonde woman with a direct gaze and a deadpan sense of humor. Lipreading her is not so hard right now, because I've been all over the Web researching the device and already have the big picture. Holding up one of the implants, she tells me that the process would start with sound going into the microphone at the headpiece. The headpiece would stick to my head, held there by a magnet inside the implant. The microphone would convert sound into electrical current and send it down a wire running under my shirt to a waist-worn computer (or *processor*) on my belt. The processor would analyze the sound, ultimately yielding a stream of bits (1s and 0s.) It would send those bits back up the wire to the headpiece, which would then transmit them by radio through my skin to the computer chips in the implant.

Those chips would send signals down a wire going to my cochlea through a tunnel drilled through an inch and a half of bone. A string of sixteen electrodes coiled up

* See the Appendix for a diagram of the ear and the components of a cochlear implant.

inside my cochlea would strobe on and off in rapid sequence to trigger my auditory nerves. If all went well, my brain would learn to interpret the stimulation as sound.

Getting the implant would make me, in the most literal sense, a *cyborg*. The word is shorthand for *cybernetic organism*, a term coined by Manfred Clynes and Nathan Kline in 1960 and defined by WordNet as “a human being whose body has been taken over in whole or in part by electromechanical devices.”

¹ The word “cybernetic” comes from the Greek *kubernetes*, meaning “pilot” or “steersman.” A thermostat is a simple cybernetic device, turning on the heat when temperatures get low and turning it off when they get high. It monitors the world and exerts control on it. It makes decisions.

The *cybernetic organism*: me and my steersman, fused together.

But it’s not the prospect of surgery that upsets me. What upsets me, considerably, is what’s inside the implant. Becky hands me one with its ceramic casing removed. I cradle it in my palm, surprised by its solidness and heft. It’s a circuit board, plain and simple. With computer chips. There are clearly hundreds of thousands of transistors in the thing.

It really *is* a computer. It’s cold, angular, and digital, yet it’s going to be embedded in my flesh, which is warm, squishy, and wet – how is that even *possible*? How can a joining like that not obscurely but permanently *hurt*, the body and brain outraged by the alien language of 0 and 1?

“Sleep on it,” Becky says, kindly.

I do, and I dream that I am walking over a dimly lit landscape of tall grass, my body floating several inches into the air with each step as if I am on the moon. I trip and

fall, and my head strikes the ground. A computer chip hiding in the scrub senses its opportunity and lances into my head like a bullet. I get up, hand clutching my skull where it entered, and I am dazed and uncertain: what have I just become?

A cyborg. Not the Hollywood kind, but a real one nonetheless. Steve Austin, the test pilot in *The Six Million Dollar Man* who was rebuilt with two bionic legs, a bionic arm, and a bionic eye, is a cyborg from the outside in, with a powerful mechanical body. But this technology would make me a cyborg from the inside out, because the computer would decide what I heard and how I heard it. It would be physically small, but its *effect* on me would be huge. It would be the sole mediator between the auditory world and myself. Since I would hear nothing *but* what was allowed by its software, the computer's control over my hearing would be complete.

In a sense, the process would be a reconstruction of my entire body. To be sure, I would still be nearsighted, still brown-haired, still delighted by chocolate and allergic to sesame seeds. But the sense of hearing immerses you in the world like no other. John Hull, a blind man, writes that while the eyes put you at the periphery of the universe – you are always at its edge, looking in – the ears put you at its center, since you hear what is all around you. Hearing constitutes your sense of being *of* the world, in the thick of it. To see is to observe, but to hear is to be enveloped.² People who go completely deaf often report feeling dead, invisible, insubstantial. They feel that it is *they* who have become unreal, not the world.³

If deafness is a kind of death, hearing again is a kind of rebirth. But I would be reborn into a different body. Becky carefully explains to me that the implant can't restore the living organ in all its subtlety and complexity. The world mediated by the computer

in my skull would sound synthetic, the product of approximations, interpolations, and compromises. My body would have bewildering new properties and new rules, and it would take me weeks, months, even years, to understand them fully.

And those properties would keep changing. This new ear would have thousands of lines of code telling it what to do with incoming sound and how to trigger my nerve endings. That code could be changed in two ways. Its settings could be tweaked in a process called “mapping”, which would be a bit like changing Word’s font sizes and colors for better readability. Or scientists could change the underlying algorithms themselves as they learned more about how normal ears encode sound for the brain. That would require wiping out the processor’s software and replacing it with an entirely new version: the equivalent of changing a computer’s operating system from DOS to Windows, or Windows to Linux. My perception of the world would always be provisional, the *latest* but never the *final* version.

Who has not wondered what it would be like to live in someone else’s body? If I got the implant, I would find out. An artificial sense organ makes your body *literally* someone else’s, perceiving the world by a programmer’s logic and rules instead of the ones biology and evolution gave you. “You will be assimilated,” the gaunt, riven “Borg” villains of *Star Trek* told their victims. While the implant would not of course control my mind, in a very real sense I *would* be assimilated. A cochlear implant has a corporate mind, created by squadrons of scientists, audiologists, programmers, and clinical-trial patients. I would be *in-corporated*, bound for life to a particular company’s changing beliefs in the nature of reality. Resistance would be futile. Unless, of course, I wanted to be deaf.

* * *

In 1802, Ludwig van Beethoven wrote to his brothers about the perplexities of deafness.

My misfortune is doubly painful to me because I am bound to be misunderstood; for me there can be no relaxation with my fellow men, no refined conversations, no mutual exchange of ideas. I must live almost alone, like one who has been banished. I can mix with society only as much as true necessity demands. If I approach near to people a hot terror seizes upon me, and I fear being exposed to the danger that my condition might be noticed.⁴

“No refined conversations,” indeed. I had loved to listen to my massage therapist’s gentle voice as her hands worked my shoulders and arms. Now that I am completely deaf I just have to lie there, wandering in the dullness of my ingrown mind, while her hands probe my skin. When I am face up things are easier, though being prone, without my glasses, in low light, is not the best conversational situation. The results are atrocious:

“So what have you done this week, Wendy?”

“Mnnn gnorm erumm brmm parumm gerumm.”

I crane my head up to look at her. I do my best to repeat what I think I have heard back to her, to save her the trouble of saying it over again. “Sandwich?” I realize as I say it that it is a ridiculous guess.

“Mnnn gnorm erumm brmmm party gerumm.”

“Party. You had a party?”

“Yes. For Aiyana.”

I know that Aiyana is one of the associates of the clinic. At least now I’m contextualized. I can decode better.

“A big party?”

“Serrum gyrrmmm.”

“Small party?”

“Sixteen. It was just enough.”

“Sixteen people. That’s a lot for a small space like this.” Absurdly, I am assuming she had the party in the office.

“No, at home.”

“Ah, at home.” I let my head drop back on the table. “I’m sorry I missed it.”

It is like returning to the ancient days of 300-baud modems, when one could see text appearing on the screen letter by letter. We communicate phoneme by phoneme, with tin cans and string.

And there are many other little humiliations. I forget to take my change at the supermarket and the bagger runs after me in the parking lot, calling, but I don’t turn around until he taps my shoulder. In doctors’ offices, I have to apologetically ask receptionists to come and get me when I am called. I don’t dare to start conversations with people I don’t know.

I’m still able to get things done at work, since most of my job consists of writing anyway. But when I try to attend a meeting with two other people, I can’t swivel my head back and forth fast enough to follow what either of them are saying. At first they

gamely try to include me, but it's hopelessly tedious and soon they return to doing what they know how to do, which is talk like normal people. They aren't being unkind; they just don't know what more they can do, and neither do I. For about ten minutes I watch them, feeling like HAL, the hyperintelligent computer in Kubrick's *2001*, spying on two astronauts by lipreading their conversation through a spacepod's window. Maybe HAL could do such a thing, but I can't. I see their lips move, I know megabytes of information are flowing back and forth, but it's as invisible to me as radio waves. Finally I quietly excuse myself and they nod me out.

I relinquish my lead responsibilities in the Tahoe contract, turn it over to my supervisor, move to a secondary job devising the survey instruments and doing the background research. It would have been so much fun to barnstorm Tahoe, interviewing anyone who would stand still long enough. That's all impossible now.

Using the telephone is out of the question. And this is the worst limitation of all, because it contracts my social universe into my line of sight. The phone used to be a gateway onto an unseen world of distant family and friends. I can still pick up the handset and put it to my ear, but nothing happens when I do. I can't even hear the dial tone.

* * *

But, grotesquely, I am not living in the silent world that I might have expected. That would at least have been familiar, for I had always been able to take my hearing aids out and experience near-total silence. Now, I am living in an endless cacophony. Now I hear a thunderous river, now a jet engine, now a restaurant with a thousand patrons all

talking at once. The sound is unending and overwhelming. Silence is the one thing I never have.

No one can really explain to me what is causing the “noise”. One theory is that in the total absence of sound, the auditory cortex hallucinates in an attempt to make up for the deficit. Amputees have phantom limb; perhaps I have phantom ear. Another theory is that it is the auditory equivalent of chronic pain, where my damaged cochlea is wildly firing nerve impulses unrelated to sensory stimuli. For hours on end I hear *bing-bing-bing* sounds like the bells at railroad crossings. I can hardly help but interpret it as my ear crying *alarm! alarm! alarm! alarm!*

But there are consolations. In the evenings the rumbles and bells soften. They become grand, sonorous, and deep. I hear a vast organ playing a slowly evolving dirge without a time or a beat. It has the solemn grandeur of an aurora. Occasionally it rises to sustained pitches, like the voiceless wail of Gyorgi Ligeti’s *Atmospheres* when the planets come into alignment in *2001*. It fits the occasion, for in 2001 my ears are dying. But they are playing superbly at their own funeral.

It’s not only my body and world I can’t recognize. I can’t even recognize *myself*. Two days after I returned from Tahoe, a neurotologist wrote me a prescription for an even larger dose of steroids and told me solemnly, “Don’t make any major life decisions while you’re taking this stuff.”

I quickly found out why. Each dose is like chugging a full thermos of coffee. My heart races. I start nervously rubbing the back of my neck throughout the day. I pace around in tight little circles while waiting for things to come out of the office printer. My

muscles start to feel tight and dense, and I begin compulsively flexing my biceps, not because I want to build them up, but because they just want to *move*, dammit.

But most of all, I've become some creature I can't recognize. I'm sobbing in my car, sobbing in locked bathrooms, sobbing on my couch at home. To be sure, anyone would grieve for their lost ears and fear an uncertain future, but *these* feelings are like a jagged slash torn in the beige fabric of my life. Normally I am formal, correct, restrained, the wryly funny analytic type. But the steroids have wrenched me as open as a conch shell.

In Carlos Castaneda's books, don Juan speaks of drugs as teachers: peyote is a guardian and an advisor, and mescaline is the gateway to the other world. Steroids, too, are a teacher. They teach me how to grieve, how to cry, at a time when grief and tears are what I need. Under their brutal influence I begin to write, seizing the opportunity to speak with a raw frankness about my life, my fears, my hearing, and what is about to happen to me. I'm completely deaf, I'm in an eternal cacophony, I'm sobbing every hour on the hour, and I'm pouring out words.

In the *Divine Comedy* Dante speaks of times where "the veil grows thin," where it becomes easy for the traveler to cross the barriers between the earthly and the divine, the seen and the unseen. This is such a time. I am a wreck, but a potentially reconstructible one. All that sobbing has made my face transparent. The shock of total deafness and impending reconstruction has unmoored me from my familiar attitudes and assumptions, breaking me down to first principles, leaving me like a stem cell, embryonic, totipotent. I am emotionally raw, tender with grief and fear, but perceiving the world with such clarity and precision that my former self now seemed blind and mundane. The drugs teach me

what it is like to be *new*. It is as if the universe is whispering into my now-deaf ear, “*Now. Now* is your chance. You have been torn down in body and soul. Go through the change and come out new. *Rebuild.*”

* * *

If I want to hear clocks ticking again, people’s voices, a lover’s murmur, I will have to go through *the change*. But the prospect evokes a primitive terror. Before I got my hearing aids I was a mute, fearful little savage, taking in the few words I could grasp with utter literalness. In preschool I was informed that I would become a bird. I took this to mean that I would be changed into an eerie new shape: *wings. beak. eye*. The prospect of this eldritch transformation so terrified me that I came home crying and screaming. Much later I would realize that it was just a metaphor labeling the kids on the first and second floors (the kids upstairs were the “Birds”, those downstairs the “Bears.”) But the shaping terrors of childhood never really depart, they only mature into more sophisticated forms. I was going to become a cyborg: *silicon. electrodes. code*.

As a child I had watched wide-eyed as Don Knotts fell into the sea in *The Incredible Mr. Limpet* and was transformed, in a series of apparently agonizing stages, into a fish. Could such things really happen? I wasn’t quite sure, but when adults offered to turn me into a bird, the prospect chilled me to the bone. Now I dreamed of computer chips lancing into my head and woke to the realization that the dream was a prediction. The sheer psychic shock of that. The chaos it evoked in the orderly bookshelves of my life.

While the computer would not change me beyond all recognition, it would nevertheless be woven into my body in ways that anyone would find unnerving. There

would be a post-surgical scar, which although eventually hidden by regrown hair would be none the less present to my appalled gaze the day after surgery. There would be a tactile bump on my skull a millimeter or two high, obvious to my own fingers and that of a lover's. Most of all, there would be the interface – the plastic *thing* that would stick onto my skull. It would suck itself into place with startling soft firmness, an electromagnetic soul kiss to start the day, and cling there like a remora, odd and obscurely frightening to strangers. Transmitting data generated by complex algorithms with strange acronyms – SPEAK, ACE, CIS, SAS. (Put in that order, they sounded like a strangely intimate telegram from an emotionless intelligence.) The somberly impressive cost: fifty thousand dollars.

And the utter strangeness of the journey. The ritual scarification of surgery, the thirty-day silent period between surgery and activation to let the incision heal, and the crossing into a domain of experience that few people could ever know. Mysterious devices sticking inside and out my body, crunching numbers like mad. A cyborg. The real thing. Not science fiction. *Me*.

I have long lived a life surrounded by computers, from the TI-83 I had in high school to the successions of computers on my desktop. Now the computer will go *inside* my body, literally woven into my flesh, in my *head*. Running do-loops in a language compiled from C, updating an array of internal variables 32 million times a second. I lock myself in my office and cry as I think of getting a little plastic model of my inner ear and symbolically burying it in my garden. Saying goodbye to the organic ear I used to have, and preparing for its terrifyingly rational reconstruction.

* * *

I would not have been so frightened a decade earlier. I used to be uncritically, eagerly in love with computers. In seventh grade my parents bought me a programmable TI calculator and I spent hours devising programs that would make it play blackjack and tic-tac-toe. Over the years I owned a succession of computers and learned four programming languages. I did my master's in Shakespearean drama because I loved words as well as code, but computers let me build beautiful machines out of ideas, castles in the air held up on delicate struts of logic. For my dissertation I wrote twenty thousand lines of code to create a Web-based program that let students in my literature and composition classes work on projects together outside of the classroom. It worked. It won awards. It got me my Ph.D.

Computers were an elegant, productive addiction – and like all addicts, I began to realize that I was paying a terrible price. In the end, after all those hours at the keyboard, I was still a man sitting alone in a room staring at a computer screen. I had no girlfriend, no family of my own, not even enduringly close friendships apart from the ones I had already developed in high school and college.

My addiction came at least partly from having poor hearing. I was agonizingly slow to acquire the social graces while growing up. Social norms are not taught, they are overheard, but the one thing even the most skilled deaf people cannot do is overhear. I did not know until high school that people went to parties on the weekends. Community? Intimacy? Like car accidents, they only happened to other people. In my freshman year of college I was so desperate to meet women that in my first month I knocked on *every single door* of the dorm and introduced myself, a memory that still makes me cringe

twenty years later. Day after day, I ate alone in the cafeteria at Brown. I had friends, yes, good ones, but just a few, not enough to book all those lunches and dinners. I longed to have a body that didn't need to eat. It was not until I was 25 that I had my first girlfriend, and even after that, relationships were few and far between. I was an unbearable teenage nerd, fascinated by computers, miserable with desire, and wholly in love with the idea of the machine. The computer offered me escape and respite, the feeling of control and power.

Computers could connect people, I had argued in my dissertation, and so they could – *if* their use was embedded in a context that was already social and personal, such as the classroom. But absent that, they were machines whose main outputs were logic and loneliness. For me the proof was that my persistent efforts at online dating had met with virtually complete failure: there was no social context in which I could be judged as a human being. Most online dating sites ask one to specify one's height and the height of one's ideal mate. They also – and here is the rub – enable one to search for people who are only above a given height. I am five-foot-four in my shoes, and it depresses me no end that most women specify, in their profiles, that they want a mate between five-ten and six-two. eHarmony is positively tyrannical about it, matching men *only* with shorter women. As far as the computer is concerned, I am not five-four; I am invisible. The computer utterly rationalizes dating by enabling people to search for potential mates by numerical specifications, eliminating the goofy serendipity of life in a human context.

Because computers are the ultimate expression of abstract logic, they invite the creation of systems which are *only* about logic. That level of abstraction enables programmers to disregard utterly the world of human feelings and needs. All that matters

is the abstract beauty of the machine. The tragedy is that the problems which *cannot* be precisely characterized and neatly solved happen to be the most important ones:

communication, understanding, collaboration, negotiation. Love.

As I entered the second half of my thirties I began to feel, as Dante had, that I had lost the path of my life – indeed, that I had never found the path to begin with. I had several close friends scattered around the country, but no one I could just call up and go out for coffee with. I depended on no one, but then again, no one depended on me. Most painfully of all, I found establishing relationships with women nearly impossible. It took me longer to go from puberty to my first relationship (1976-1989) than it took the entire United States Government to design and land a spacecraft on the moon (1961-1969). Again and again I made overtures and was rejected. I had always been *sort of*: sort of hearing, sort of socially aware, and as one dating prospect ambiguously said to me, sort of adorable. I felt, as a result, sort of human.

Even as I put the finishing touches on my dissertation, then, I was becoming increasingly disenchanted with computers. They certainly had not met *my* most poignant needs. I frequently reread Frank Herbert's *Dune* trilogy, which is set in a future that has outlawed computers. It doesn't object to technology in general: it embraces spaceships, weaponry, chemistry, heavy machinery of all kinds. But computers were long ago outlawed during its "Butlerian Jihad," a religious movement that defined the automation of thought as profane. Its battle cry was "Thou shalt not make a machine in the likeness of a man's mind."⁵ But the need to handle information did not go away, so in computers' place are *mentats*, human beings trained to achieve prodigious powers of memorization and data analysis.

Dune's universe focuses on developing human rather than machine powers. Its characters are intensely alive, bursting with inner monologues and ambitions and relationships. Not that I would necessarily want to live in *Dune*'s universe: it's also feudal, violent, autocratic, and totally lacking in what we would call civil liberties. But the gains and the losses apparently couldn't be separated. Take computers away, Herbert seemed to be saying, and what you lost in rationality and orderliness you gained in a human capacity to enter into true relationships with the self and the world. You can have one kind of civilization or the other, *Dune* implied, but not both.

That was why I both loved and hated computers. I loved their pleasures and seductions and conveniences. I hated the hyperrational, lonely society that their remorseless logic had let human beings so easily create.

And then in Becky's office I was staring at a computer in my palm that was going to go *inside* me. My very body would have technical specifications. Programming language, C. Number of auditory channels, eight. Electrode array refresh rate, either analog or 833 cycles per second, depending on the software. Number of transistors, 140,000. Data transfer rate through the skin, 1.1 million bits per second. Processor speed, 32 million cycles per second.⁶ Now the computer would have a hold on me that I would never, ever be able to escape.

I would have to become a cyborg that was deeply suspicious of computers. If I ever chose to embark on a Butlerian Jihad, my first logical target would have to be myself.

* * *

The medical system gathers me up into its routine of tests. One of my first stops is the MRI machine, which will peer deep into my skull to see whether surgery is feasible. It's hulking, huge, enormous, a cylindrical superconducting magnet so powerful that it can yank unchained oxygen tanks into its maw from across the room. I am deprived of every piece of metal on my body plus, of course, my wallet with all of its magnetically encoded credit cards. Then I am slid tenderly into the machine's narrow birth canal. The computer may get inside me eventually, but today I am getting inside it.

I lie very still, per instructions. I cannot help eyeballing what little I can see: the off-white curve of the chamber, blankly emitting the confining grandeur of Washington Metro stations; the metal array encircling my head to focus the magnetic field lines; and nothing else whatsoever. I catch myself thinking it would be a nice idea to position a small TV above the patient's head, to fill the lonely forty-five minutes. But it would certainly be destroyed by the magnetic field. Machines can't survive in here. Once I had the implant embedded in my head, I would not be allowed in or even near this room again. In fact, above the MRI's underground chamber is a small outdoor garden whose perimeter is ringed with signs reading sternly, *Persons with pacemakers, neurostimulators, or metallic implants must not enter the landscaped area*. 21st-century cherubim and seraphim, banishing me from the Eden of the innocently organic.

The machine grinds, clicks, and hums around me. To my surprise, I feel an artless joy. This is just where I love to be, deep inside elegant machines doing mysterious invisible things at high speed. I am eerily aware that *right now* the computer is probing my head with magnetic fields, executing tens of thousands of lines of code, assembling megabytes of data which will lay bare the inmost contours of my ear. Words

like *sagittal*, *transverse*, and *spline* drift through my mind, although I am only vaguely aware of what they mean. The poetry of technology. Somewhere out of sight, megabytes of data purl onto a server's hard disk.

* * *

How was I going to go through *the change*? As a lifelong reader of literature, I already had some answers at hand. A mind richly stocked with stories can select from them as needed, applying narrative to the chaos of experience in order to move ahead with greater sureness to an imagined resolution. When I failed an important exam in grad school, I thought of Odysseus clinging to the fragments of his wrecked ship at sea, and remembered that he had still managed to get home to Ithaca. The myth gave me heart and hope.

Now I needed a story not of survival, but of transformation. Pinnochio? Well, not really. Pinnochio was turned into a real live boy as a reward for virtue, and it was done *for* him. Steve Austin? Possibly. But the Steve Austin of the TV show was problematic. To be sure, I had been fascinated by *The Six Million Dollar Man* when it ran in the 1970s. But Steve Austin was a Hollywood cyborg, steely, impassive, and impervious to pain. The nerd in me had loved that image. And yet I could not help feeling skeptical, even then, of the implication that having bionic limbs and organs also entailed having a mechanical soul. Hollywood's depiction of the cyborg seemed like a cheat, a poor bargain: to become more than human, you also had to become less than human. You had to give up your soul to the machine.

But Martin Caidin's novel *Cyborg*, the inspiration for the TV show, had given me an entirely different perspective on Steve Austin. The book version of Steve Austin was

Chapter 1 of *Rebuilt: How Becoming Part Computer Made Me More Human*. This file may be distributed freely, but without changes of any kind.

resentful, disciplined, and ambitious, a flawed human being who lashed out at his own doctors and engineers yet also collaborated with them in the project of rebuilding himself. More than anything else, Caidin's novel is about Austin's painful transformation and his gradual acceptance of his new body. Acting as Virgil to his Dante is Rudy Wells, his flight surgeon, who guides him with endless patience. At one point Austin is furious because he continues to fall while running and Wells says to him,

"You *are* a clumsy kid. Can't you understand that?

Biologically, that happens to be the fact. Oh, for God's sake, Steve, you *know* the score. Physiologically, much of your body is that of an adult child. Your system is learning things all over again at superspeed. But it's still *confused*. The problem isn't in the bionics limbs. It's in your own nerve network."

Hollywood cyborgs are often ungainly, but they are not *clumsy*. Clumsiness is a purely human trait. And Steve Austin has a very human reaction to Wells' attempts to explain his own body to him:

Steve looked at him. "Are you patronizing me, Doc?"

"No, you son of a bitch, I am not."

"Well, you damn well are acting like it!" In a sudden burst of rage he swept the table clean of all objects; ash trays, manuals, coffee cups went crashing to the floor.⁷

It was Caidin's story of struggle and transformation, rather than the ones offered by Hollywood, that served me best twenty-five years later. For me *Cyborg* became a map of

the unlighted journey I was about to traverse. Like Steve Austin's, my body would have to build up its own "memory banks" of the new "data feeds" (and they would *literally* be data feeds.) I would become an adult child, learning how to hear all over again at superspeed, compressing into days and weeks what takes an infant years.

But I did not yet understand, going in, why Steve Austin was so angry. To be sure, surgery and transformation is a difficult experience, but where did the *rage* come from? Shouldn't he be *excited*? Grateful? Eager to learn and improve? But I would come to understand. Oh, boy, would I be angry. Would I ever.

Yet that was part of the transformation. In acquiring the body of my teenage dreams, I would have the chance to become the adult I wanted to be. To cast off, in my long *agon* with the machine, the longstanding frustrations left over from an unfinished adolescence. To reject the worthless bargain offered by Hollywood, and negotiate a better one. To become a *cyborg*. In real life. On my own terms, in my own way.

¹ "The word is shorthand for *cybernetic organism*, a term coined by Manfred Clynes and Nathan Kline": The definition of the word in their article "Cyborgs and Space" was rather more technical than WordNet's. "What are some of the devices necessary for creating self-regulating man-machine systems? This self-regulation must function without the benefit of consciousness in order to cooperate with the body's own autonomous homeostatic controls. For the exogenously extended organizational complex functioning as an integrated homeostatic system unconsciously, we propose the term 'Cyborg.' The Cyborg deliberately incorporates exogenous components extending the self-regulatory control function of the organism in order to adapt it to new environments" (p. 30-31).

² “To see is to observe, but to hear is to be enveloped”: Hull, *Touching the Rock*, p. 83.

³ “They feel that it is *they* who have become unreal, not the world”: In her memoir of getting a cochlear implant Beverly Biderman writes, “Our environment has become dead, and we may also feel to some extent that we too have become dead. With my implant turned off, I feel like I am soundlessly walking down stairs and passing through rooms like a ghost.”

Biderman, *Wired for Sound*, p. 65.

⁴ “My misfortune is doubly painful to me”: Beethoven, *The Heiligenstadt Testament*, online.

⁵ “Thou shalt not make a machine in the likeness of a man’s mind”: Herbert, Frank. *Dune*, p. 23.

⁶ “My very body would have technical specifications”: These figures were provided to me by Mike Faltys and Logan Palmer of Advanced Bionics.

⁷ “You *are* a clumsy kid” and “Steve looked at him”: Caidin, *Cyborg*, pages 149 and 150.