Excerpts from *I Am A Strange Loop*

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Preface

An Author and His Book

Facing the Physicality of Consciousness

From an early age onwards, I pondered what my mind was and, by analogy, what all minds are. I remember trying to understand how I came up with the puns I concocted, the mathematical ideas I invented, the speech errors I committed, the curious analogies Id reamt up, and so forth. I wondered what it would be like to be a girl, to be a native speaker of another language, to be Einstein, to be a dog, to be an eagle, even to be a mosquito. By and large, it was a joyous existence.

When I was twelve, a deep shadow feel over our family. My parents, as well as my seven-year-old sister Laura and I, faced the harsh reality that the youngest child in our family, Molly, then only three years old, had something terribly wrong with her. No one knew what it was, but Molly wasn't able to understand language or to speak (nor is she to this day, and we never did find out why). Se moved through the world with ease, even with charm and grace, but she used no words at all. It was so sad.

For years, our parents explored every avenue imaginable, including the possibility of some kind of brain surgery, and as their quest for a cure or at least some kind of explanation grew ever more desperate, my own anguished thinking about Molly's plight and the frightening idea of people opening up my tiny sister's head and peering in at the mysterious stuff that filled it (an avenue never explored, in the end) gave me the impetus to read a couple of lay-level books about the human brain. Doing so had a huge impact on my life, since it forced me to consider, for the first time, the physical basis of consciousness and of being — or of having — an "I", which I found disorienting, and profoundly eerie.

Right around that time, toward the end of my high-school years, I encountered the mysterious metamathematical revelations of the great Aus-

trian logician Kurt Gödel and I also learned how to program, using Stanford University's only computer, a Burroughs 220, which was located in the deliciously obscure basement of decrepit old Encina Hall. I rapidly became addicted to this "Giant Electronic Brain", whose orange lights flickered in strange magical patterns revealing its "thoughts", and which, at my behest, discovered beautiful abstract mathematical structures and composed whimsical nonsensical passages in various foreign languages that I was studying. I simultaneously grew obsessed with symbolic logic, whose arcane symbols danced in strange magical patterns reflecting truths, falsities, hypotheticals, possibilities, and counterfactualities, and which, I was sure, afforded profound glimpses into the hidden wellsprings of human thought. As a result of these relentlessly churning thoughts about symbols and meanings, patterns and ideas, machines and mentality, neural impulses and mortal souls, all hell broke loose in my adolescent mind/brain.

The Mirage

One day when I was around sixteen or seventeen, musing intensely on these swirling clouds of ideas that gripped me emotionally no less than intellectually, it dawned on me — and it has ever since seemed to me — that what we call "consciousness" was a kind of mirage. It had to be a very peculiar kind of mirage, to be sure, since it was a mirage that perceived itself, and of course it didn't believe that it was perceiving a mirage, but no matter — it still was a mirage. It was almost as if this slippery phenomenon called "consciousness" lifted itself up by its own bootstraps, almost as if it made itself out of nothing, and then disintegrated back into nothing whenever one looked at it more closely.

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A Shout into a Chasm

When, some ten years or so later, I started working on my first book, whose title I imagined would be "Gödel's Theorem and the Human Brain", my overarching goal was to relate the concept of a human self and the mystery of consciousness to Gödel's stunning discovery of a majestic wraparound self-referential structure (a "strange loop", as I later came to call it) in the very midst of a formidable bastion from which self-reference had been strictly banished by its audacious architects. I found the parallel between Gödel's miraculous manufacture of self-reference out of a substrate of meaningless symbols and the miraculous appearance of selves and souls in substrates

consisting of inanimate matter so compelling that I was convinced that here lay the secret of our sense of "I", and thus my book Gödel, Escher, Bach came about (and acquired a catchier title).

That book, which appeared in 1979, couldn't have enjoyed a greater success, and indeed yours truly owes much of the pathway of his life since then to its success. And yet, despite the book's popularity, it always troubled me that the fundamental message of GEB (as I always call it, and as it is generally called) seemed to go largely unnoticed. People liked the book for all sorts of reasons, but seldom if ever for its most central raison d'être! Years went by, and I came out with other books that alluded to and added to that core message, but still there didn't seem to be much understanding out there of what I had really been trying to say in GEB.

In 1999, GEB celebrated its twentieth anniversary, and the folks at Basic Books suggested that I write a preface for a special new edition. I liked the idea, so I took them up on it. In my preface, I told all sorts of tales about the book and its vicissitudes, and among other things I described my frustration with its reception, ending with the following plaint: "It sometimes feels as if I had shouted a deeply cherished message out into an empty chasm and nobody heard me."

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And so, after just about forty-five years (good grief !), I've come full circle, writing once again about souls, selves, and consciousness, banging up against the same mysteriousness and eerieness that I first experienced when I was a teen-ager horrified and yet riveted by the awful and awesome physicality of that which makes us be what we are.

An Author and His Audience

Despite its title, this book is not about me, but about the concept of "I". It's thus about you, reader, every bit as much as it is about me. I could just as well have called it "You Are a Strange Loop". But the truth of the matter is that, in order to suggest the book's topic and goal more clearly, I should probably have called it "'I' Is a Strange Loop" — but can you imagine a clunkier title? Might as well call it "I Am a Lead Balloon".

In any case, this book is about the venerable topic of what an "I" is. And what is its audience? Well, as always, I write in order to reach a general educated public. I almost never write for specialists, and in a way that's because I'm not really a specialist myself. Oh, I take it back; that's unfair. After all, at this point in my life, I have spent nearly thirty years working with my graduate students on computational models of analogymaking and

creativity, observing and cataloguing cognitive errors of all sorts, collecting examples of categorization and analogy, studying the centrality of analogies in physics and math, musing on the mechanisms of humor, pondering how concepts are created and memories are retrieved, exploring all sorts of aspects of words, idioms, languages, and translation, and so on — and over these three decades I have taught seminars on many aspects of thinking and how we perceive the world.

So yes, in the end, I am a kind of specialist — I specialize in thinking about thinking. Indeed, as I stated earlier, this topic has fueled my fire ever since I was a teen-ager. And one of my firmest conclusions is that we always think by seeking and drawing parallels to things we know from our past, and that we therefore communicate best when we exploit examples, analogies, and metaphors galore, when we avoid abstract generalities, when we use very down-to-earth, concrete, and simple language, and when we talk directly about our own experiences.

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Chapter 7, The Epi Phenomenon

As Real as it Gets

Thanks to the funneling-down processes of perception, which lead eventually — that is, in a matter of milliseconds — to the activation of certain discrete symbols in its brain, an animal (and let's not forget robot vehicles!) can relate intimately and reliably to its physical environment. A mature human animal not only does a fine job of not slipping on banana peels and not banging into thorn-bristling rosebushes, it also reacts in a flash to strong odors, strange accents, cute babies, loud crashes, titillating headlines, terrific skiers, garish clothes, and on and on. It even occasionally hits curve balls coming at it at 80 miles an hour. Because an animal's internal mirroring of the world must be highly reliable (the symbol elephant should not get triggered by the whine of a mosquito, nor should the symbol mosquito get triggered if an elephant ambles into view), its mirroring of the world via its private cache of symbols becomes an unquestioned pillar of stability. The things and patterns it perceives are what define its reality — but not all perceived things and patterns are equally real to it.

Of course, in nonverbal animals, a question such as "Which things that I perceive are the most real of all to me?" is never raised, explicitly or implicitly. But in human lives, questions about what is and what is not real inevitably bubble up sooner or later, sometimes getting uttered consciously

and carefully, other times remaining unexpressed and inchoate, just quietly simmering in the background. As children and teen-agers, we see directly, or we see on television, or we read about, or we are told about many things that supposedly exist, things that vie intensely with each other for our attention and for acceptance by our reality evaluators — for instance, God, Godzilla, Godiva, Godot, Gödel, gods, goddesses, ghost, ghouls, goblins, gremlins, golems, golliwogs, griffins, gryphons, gluons, and grinches. It takes a child a few years to sort out the reality of some of these; indeed, it takes many people a full lifetime to do so (and occasionally a bit longer).

By "sorting out the reality of X", I mean coming to a stable conclusion about how much you believe in X and whether you would feel comfortable relying on the notion of X in explaining things to yourself and others. If you are willing to use griffins in your explanations and don't flinch at other people's doing so in theirs, then it would seem that griffins are a seriously real concept to you. If you had already pretty much sorted out for yourself the reality of griffins and then heard there was going to be a TV special on griffins, you wouldn't feel a need to catch the show in order to help you decide whether or not griffins exist. Perhaps you believe strongly in griffins, perhaps you think of them as a childish fantasy or a joke — but your mind is made up one way or the other. Or perhaps you haven't yet sorted out the reality of griffins; if it were to come up in a dinner-party conversation, you would feel unsure, confused, ignorant, skeptical, or on the fence.

Another way of thinking about "how real X is to you" is how much you would trust a newspaper article that took for granted the existences of X (for example, a living dinosaur, a sighting of Hitler, insects discovered on Mars, a perpetual-motion machine, UFO abductions, God's omniscience, out-of-body experiences, alternate universes, superstrings, quarks, Bigfoot, Big Brother, the Big Bang, Atlantis, the gold in Fort Knox, The South Pole, cold fusion, Einstein's tongue, Holden Caulfield's brain, Bill Gates' checkbook, or the proverbial twenty-mile "wall" for marathon runners). If you stop reading an article the moment you see X's existence being taken for granted, then it would seem that you consider X's "reality" highly dubious.

Pick any of the concepts mentioned above. Almost surely, there are plenty of people who believe fervently in it, others who believe in it just a little, others not at all (whether out of ignorance, cynicism, poor education, or excellent education). Some of these concepts, we are repeatedly told by authorities, are not real, and yet we hear about them over and over again in television shows, books, and newspapers, and so we are left with a curious blurry sense as to whether they do exist, or could exist, or might exist. Others, we are told by authorities, are absolutely real, but somehow we

never see them. Others we are told were real but are real no longer, and that places them in a kind of limbo as far as reality is concerned. Yet others we are told are real but are utterly beyond our capacity to imagine. Others are said to be real, but only metaphorically or only approximately so — and so on. Sorting all this out is not in the least easy.

Concrete Walls and Abstract Ceiling

To be more concrete about all this, how real is the marathoners' twenty-mile wall, mentioned above? If you're a marathoner, you almost surely have a well-worked-out set of thoughts about it. Perhaps you have experienced it personally, or know people who have. Or perhaps you think the notion is greatly exaggerated. I've never hit the wall myself, but then my longest run ever was only fifteen miles. What I know is that "they say" that most runners, if they haven't trained properly, will bang up against a brutal wall at around twenty miles, in which their body, having used up all of its glycogen, starts burning fat instead (I've heard it described as "your body eating its own muscles"). It comes out of the blue and is extremely painful ("like an elephant falling out of a tree onto my shoulders", said marathoner Dick Beardsley), and many runners simply cannot go any further at that point, and drop out. But is this a universal phenomenon? Is it the same for all people? Do some marathoners never experience it at all? And even if it is scientifically explicable, is it as real and as palpable a phenomenon as a concrete wall into which one bangs?

When I entered math graduate school at Berkeley in 1966, I had the self-image of being quite a math whiz. After all, as an undergraduate math major at Stanford, not only had I coasted through most of my courses without too much work, but I had done lots of original research, and on graduating I was awarded the citation "with Distinction" by the Math Department. I was expecting to become a mathematician and to do great things. Well, at Berkeley two courses were required of all first-year students — abstract algebra and topology — and so I took them. To my shock, both were very hard for me — like nothing I'd ever encountered before. I got good grades in them but only by memorizing and then regurgitating ideas on the finals. For the entire year, my head kept on hurting from a severe lack of imagery such as I had never before experienced. It was like climbing a very high peak and getting piercing headaches as the air grows ever thinner. Abstraction piled on abstraction and the further I plowed, the slower my pace, and the less I grasped. Finally, after a year and a half, I recognized the situation's hopelessness, and with a flood of bitter tears and a crushing loss of self-

confidence, I jettisoned my dream of myself as a mathematician and bailed out of the field forever. This hated, rigid "abstraction ceiling" against which I had metaphorically banged my head without any advance warning was a searingly painful, life-changing trauma. And so ... how concrete, how genuine, how real a thing was this abstract "abstraction ceiling"? As real as a marathoner's wall? As real as a wooden joist against which my skull could audibly crash? What is really real?

Although nobody planned it that way, most of us wind up emerging from adolescence with a deeply nuanced sense of what is real, with shades of gray all over the place. (However, I have known, and probably you have too, reader, a few adults for whom every issue that strikes me as subtle seems to them to be totally black-and-white — no messy shades of gray at all to deal with. That must make life easy!) Actually, to suggest that for most of us life is filled with "shades of gray" is far too simple, because that phrase conjures up the image of a straightforward one-dimensional continuum with many degrees of grayness running between white and black, while in fact the story is much more multidimensional than that.

All of this is disturbing, because the word "real", like so many words, seems to imply a sharp, clear-cut dichotomy. Surely it ought to be the case that some things simply are real while other things simply are not real. Surely there should be nothing that is partly real — that wouldn't make sense! And yet, though we try very hard to force the world to match this ideal black-and-white dichotomy, things unfortunately get terribly blurry.

The Many-faceted Intellectual Grounding of Reality

That marble over there in that little cardboard box on my desk is certainly real because I see the cardboard box sitting there and because I can go over and open it and can squeeze the marble, hefting it and feeling its solidity. I hope that makes sense to you.

The upper edge of that 75-foot-tall Shell sign near the freeway exit is real, I am convinced, because every road sign is a solid object and every solid object has a top; also because I can see the sign's bottom edge and its sides and so, by analogy, I can imagine seeing its top; also because, even though I'll certainly never touch it, I could at least theoretically climb up to it or be lowered down onto it from a helicopter. Then again, the sign could topple in an earthquake and I could rush over to it and touch what had once been its upper edge, and so forth.

Antarctica, too, is real because, although I've never been there and almost surely will never go there, I've seen hundreds of photos of it, I've seen

photos of the whole earth from space including all of Antarctica, and also I once met someone who told me he went there, and on and on.

Why do I believe what certain people tell me more than I believe what others tell me? Why do I believe in (some) photos as evidence of reality? Why do I trust certain photos in certain books? Why do I trust certain newspapers, and why only up to a certain point? Why do I not trust all newspapers equally? Why do I not trust all book publishers equally? Why do I not trust all authors equally?

Through many types of abstraction and analogy-making and inductive reasoning, and through many long and tortuous chains of citations of all sorts of authorities (which constitute an indispensable pillar supporting every adult's belief system, despite the insistence of high-school teachers who year after year teach that "arguments by authority" are spurious and are convinced that they ought to be believed because they are, after all, authority figures), we build up an intricate, interlocked set of beliefs as to what exists "out there" — and then, once again, that set of beliefs folds back, inevitably and seamlessly, to apply to our own selves.

Just as we believe in other peoples' kidneys and brains (thanks almost entirely to arguments from analogy and authority), so we come to believe in our own kidneys and brains. Just as we believe in everyone else's mortality (again, thanks primarily to arguments from analogy and authority), so we come, eventually, to believe in our own mortality, as well as in the reality of the obituary notices about us that will appear in local papers even though we know we will never be able to flip those pages and read those notices.

What makes for our sense of utter sureness about such abstract things? It comes firstly from the reliability of our internal symbols to directly mirror the concrete environment (e.g., we purchase a cup of coffee and instantly, somewhere inside our cranium, God only knows where, there springs into existence a physical record reflecting this coffee, tracking where it is on the table or in our hand, constantly updating its color, bitterness level, warmth, and how much there is left of it). It comes secondly from the reliability of our thinking mechanisms to tell us about more abstract entities that we cannot directly perceive (e.g., the role of Napoleon in French history, the impact of Wagner on late-romantic French composers, or the unsolvability by radicals, such as Évariste Galois, of the quintic equation). All of this more abstract stuff is rooted in the constant reinforcement, moment by moment, of the symbols that are haphazardly triggered out of dormancy by events in the world that we perceive first-hand. These immediate mental events constitute the bedrock underlying our broader sense of reality.

Inevitably, what seems realest to us is what gets activated most often.

Our hangnails are incredibly real to us (by coincidence, I found myself idly picking at a hangnail while I was reworking this paragraph), whereas to most of us, the English village of Nether Wallop and the high Himalayan country of Bhutan, not to mention the slowly swirling spiral galaxy in Andromeda, are considerably less real, even though our intellectual selves might wish to insist that since the latter are much bigger and longer-lasting than our hangnails, they ought therefore to be far realer to us than our hangnails are. We can say this to ourselves till we're blue in the face, but few of us act as if we really believed it. A slight slippage of subterranean stone that obliterates 20,000 people in some far-off land, the ceaseless plundering of virgin jungles in the Amazon basin, a swarm of helpless stars being swallowed up one after another by a ravenous black hole, even an ongoing collision between two huge galaxies each of which contains a hundred billion stars — such colossal events are so abstract to someone like me that they can't even touch the sense of urgency and importance, and thus the reality, of some measly little hangnail on my left hand's pinky.

We are all egocentric, and what is realest to each of us, in the end, is ourself. The realest things of all are my knee, my nose, my anger, my hunger, my toothache, my sideache, my sadness, my joy, my love for math, my abstraction ceiling, and so forth. What all these things have in common, what binds them together, is the concept of "my", which comes out of the concept of "I" or "me", and therefore, although it is less concrete than a nose or even a toothache, this "I" thing is what ultimately seems to each of us to constitute the most solid rock of undeniability of all. Could it possibly be an illusion? Or if not a total illusion, could it possibly be less real and less solid than we think it is? Could an "I" be more like an elusive, receding, shimmering rainbow than like a tangible, heftable, transportable pot of gold?

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Chapter 14, Strangeness in the "I" of the Beholder

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Trapped at the High Level

For us conscious, self-aware, "I"-driven humans, it is almost impossible to imagine moving down, down, down to the neuronal level of our brains, and slowing down, down, down, so that we can see (or at least can imagine) each and every chemical squirting in each and every synaptic cleft — a gigantic shift in perspective that would seem to instantly drain brain activity of all

symbolic quality. No meanings would remain down there, no sticky semantic juice — just astronomical numbers of meaningless, inanimate molecules, squirting meaninglessly away, all the livelong, lifeless day.

Your typical human brain, being blissfully ignorant of its minute physical components and their arcanely mathematizable mode of microscopic functioning, and thriving instead at the infinitely remote level of soap operas, spring sales, super skivaganzas, SUV's, SAT's, SOB's, Santa Claus, splashtacular scuba specials, snorkels, snowballs, sex scandals (and let's not forget sleazeballs), makes up as plausible a story as it can about its own nature, in which the starring role, rather than being played by the cerebral cortex, the hippocampus, the amygdala, the cerebellum, or any other weirdly named and gooey physical structure, is played instead by an anatomically invisible, murky thing called "I", aided and abetted by other shadowy players known as "ideas", "thoughts", "memories", "beliefs", "hopes", "fears", "intentions", "desires", "love", "hate", "rivalry", "jealously", "empathy", "honesty", and on and on — and in the soft, ethereal, neurology-free world of *these* players, your typical human brain perceives its very own "I" as a pusher and a mover, never entertaining for a moment the idea that its star player might merely be a useful shorthand standing for a myriad of infinitesimal entities and the invisible chemical transactions taking place among them, by the billions — nay, the millions of billions — every single second.

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The human condition is thus [that we can neither] see [nor] even imagine the lower levels of a reality that is nonetheless central to its existence.

First Key Ingredient of Strangeness

Why does an "I" symbol never develop in a video feedback system, no matter how swirly or intricate or deeply nested are the shapes that appear on its screen? The answer is simple: a video system, no matter how many pixels or colors it has, *develops no symbols at all*, because a video system does not *perceive* anything. Nowhere along the cyclic pathway of a video loop are there any symbols to be triggered — no concepts, no categories, no meanings — not a tad more than in the shrill screech of an audio feedback loop. A video feedback system does not attribute to the strange emergent galactic shapes on its screen any kind of causal power to make anything happen. Indeed, it doesn't attribute anything to anything, because, lacking all symbols, a video system can't and doesn't ever *think* about anything!

What makes a strange loop appear in a brain and not in a video feedback system, then, is an *ability* — the ability to think — which is, in effect, a one-

syllable word standing for the possession of a sufficiently large repertoire of triggerable symbols. Just as the richness of whole numbers gave PM the power to represent phenomena of unlimited complexity and thus to twist back and engulf itself via Gödel's construction, so our extensible repertoires of symbols give our brains the power to represent phenomena of unlimited complexity and thus to twist back and to engulf themselves via a strange loop.

Second Key Ingredient of Success

But there is a flip side to all this, a second key ingredient that makes the loop in a human brain qualify as "strange", makes an "I" come seemingly out of nowhere. This flip side is, ironically, an *inability* — namely, our inability to see, feel, or sense in any way the constant, frenetic churning and roiling of micro-stuff, all the unfelt bubbling and boiling that underlies our thinking. This, our innate blindness to the world of the tiny, forces us to hallucinate a profound schism between the goal-lacking material world of balls and sticks and sounds and lights, on the one hand, and a goal-pervaded abstract world of hopes and beliefs and joys and fears, on the other, in which radically different sorts of causality seem to reign.

When we symbol-processing humans watch a video feedback system, we naturally pay attention to the eye-catching shapes on the screen and are seduced into giving them fanciful labels like "helical corridor" or "galaxy", but still we know that ultimately they consist of nothing but pixels, and that whatever patterns appear before our eyes do so thanks solely to the local logic of pixels. This simple and clear realization strips those fancy fractalic gestalts of any apparent life or autonomy of their own. We are not tempted to attribute desires or hopes, let alone consciousness, to the screen's swirly shapes — no more than we are tempted to perceive fluffy cotton-balls in the sky as renditions of an artist's profile or the stoning of a martyr.

And yet when it comes to perceiving ourselves, we tell a different story. Things are far murkier when we speak of ourselves than when we speak of video feedback, because we have no direct access to any analogue, inside our brains, to pixels and their local logic. Intellectually knowing that our brains are dense networks of neurons doesn't make us familiar with our brains at that level, no more than knowing that French poems are made of letters of the roman alphabet makes us experts on French poetry. We are creatures that congenitally cannot focus on the micromachinery that makes our minds tick — and unfortunately, we cannot just saunter down to the corner drugstore and pick up a cheap pair of glasses to remedy the defect.

One might suspect neuroscientists, as opposed to lay people, to be so familiar with the low-level hardware of the brain that they have come to understand just how to think about such mysteries as consciousness and free will. And yet often it turns out to be quite the opposite: many neuroscientists' great familiarity with the low-level aspects of the brain makes them skeptical that consciousness and free will could ever be explained in physical terms at all. So baffled are they by what strikes them as an unbridgeable chasm between mind and matter that they abandon all efforts to see how consciousness and selves could come out of physical processes, and instead they throw in the towel and become dualists. It's a shame to see scientists punt in this fashion, but it happens all too often. The moral of the story is that being a professional neuroscientist is not by any means synonymous with understanding the brain deeply — no more than being a professional physicist is synonymous with understanding hurricanes deeply. Indeed, sometimes being mired down in gobs of detailed knowledge is the exact thing that blocks deep understanding.

Our innate human inability to peer below a certain level inside our cranium makes our inner analogue to the swirling galaxy on a TV screen — the vast swirling galaxy of "I"-ness — strike us as an undeniable *locus of causality*, rather than a mere passive epiphenomenon coming out of lower levels (such as a video-feedback galaxy). So taken in are we by the perceived hard sphericity of that "marble" in our minds that we attribute to it a reality as great as that of anything we know. And because of the locking-in of the "I"-symbol that inevitably takes place over years and years in the feedback loop of human self-perception, causality gets turned around and "I" seems to be in the driver's seat.

In summary, the combination of these two ingredients — one an ability and the other an inability — gives rise to the strange loop of selfhood, a trap into which we humans all fall, every last one of us, willy-nilly. Although it begins as innocently as a humble toilet's float-ball mechanism or an audio or video feedback loop, where no counterintuitive type of causality is posited anywhere, human self-perception inevitably ends up positing an emergent entity that exerts an upside-down causality on the world, leading to the intense reinforcement of and the final, invincible, immutable locking-in of this belief. The end result is often the vehement denial of the possibility of any alternative point of view at all.

Sperry Redux

I just said that we all fall into this "trap", but I don't really see things so negatively. Such a "trap" is not harmful if taken with a grain of salt; rather, it is something to rejoice in and cherish, for it is what makes us human. Permit me once more to quote the eloquent words of Roger Sperry:

> In the brain model proposed here, the causal potency of an idea, or an ideal, becomes just as real as that of a molecule, a cell, or a nerve impulse. Ideas cause ideas and help evolve new ideas. They interact with each other and with other mental forces in the same brain, in neighboring brains, and, thanks to global communication, in far distant, foreign brains. And they also interact with the external surroundings to produce *in toto* a burstwise advance in evolution that is far beyond anything to hit the evolutionary scene yet, including the emergence of the living cell.

When you come down to it, all that Sperry has done here is to go out on a limb and dare to assert, in a serious scientific publication, the ho-hum, run-of-the-mill, commonsensical belief held by the random person on the street that there is a genuine reality (*i.e.*, causal potency) of the thing we call "I". In the scientific world, such an assertion runs a great risk of being looked upon with skepticism, because it sound superficially as if it reeks of Cartesian dualism (wonderfully mystical-sounding terms such as *élan vital*, "life force", "spirit of the hive", "entelechy", and "holons" occasionally spring into my mind when I read this passage).

However, Roger Sperry knew very well that he wasn't embracing dualism or mysticism of any sort, and he therefore had the courage to take the plunge and make the assertion. His position is a subtle balancing act whose insightfulness will, I am convinced, one day be recognized and celebrated, and it will be seen to be analogous to the subtle balancing act of Kurt Gödel, who demonstrated how high-level, emergent, self-referential meanings in a formal mathematical system can have a causal potency just as real as that of the system's rigid, frozen, low-level rules of inference.