Thoughts about books
(Kary Mullis)

I think it's true that the majority of the people who have ever lived on earth are alive today. That would imply, *ceteris paribus*, that at least half of the smartest people who ever wrote are writing today. So at least half of the best books are recent. Those who take more comfort in reading than listening are quite lucky to be alive now. I am one of those people. It's easy for me to start talking about books that mean as much to me as any friendship.

I am very picky. The book must be non-fiction and it must address something that speaks to all of experience. For me that usually means biology or physics.

I make exceptions when they are warranted. Sometimes I read something that I consider to be only entertainment, but it's so good that I read it anyhow. I would put Riddley Walker, by Russell Hoban, in that category. The book came to me in an odd way. One night in Berkeley in the early seventies, I ran into a psychic friend at a restaurant on Shattuck. I'd been in the lab all day and was thinking about going out for a paper. She laid the Chronicle on my table without breaking her stride, said "Your paper, doctor." Before I could be puzzled about that, she delivered another curious message before leaving, "Tonight you will meet Riddley Walker." I discovered what she meant a few hours later when I noticed a book at Moe's book store by that name. I bought it, and around two o'clock the next morning, I called to inform her that I had indeed met Riddley Walker, and was pleased with my new acquaintance.

The entire book was written phonetically. It was science fiction; set in the future about 1000 years after the "master changes" had pretty well eliminated the written word and most people. Writing was starting to come back along with gunpowder, and what people mistakenly hoped would be "the one big one." They were a bit confused about the latter. It was a haunting book. While writing, Russell Hoban was living with a family whose children were learning English grammar by the phonetic method. His other books never achieved the same level of genius.

Most of my favorite books are by physicists trying to make some communicable sense out of that quantum reality that really cannot be understood. Julian Barbour portrays a silent world completely devoid of action in The End of Time. David Bohm, now dead, in a classic from 1980, Wholeness and the Implicate Order, suggests rather convincingly that the structure of our language prevents us from being aware of the fact that nothing actually happens here, shades of Barbour, but heavy on the philosophy. Bohm is way out there, he had devotees when he passed, and you should come away from this book doubting your sanity. The Non-Local Universe, by Robert Nadeau and Menas Kafatos, skillfully lures you to confront the same kind of madness, or either pitch the

book into the nearest body of deep water. But you must accept the disturbing fact of non-locality. This means that things can be immediately and intimately connected to each other even though they are light years apart. In other words there is nothing which corresponds to our classical cognition of geometric distance, and every particle since the so-called and now doubtfully singular Big Bang is in a way the same stinking particle, and there are recent convincing experiments by Alain Aspect and Nicolus Gisin based on theories proposed in 1964 by John Bell that close the lid of doubt on this creepy notion, which Einstein, by the way, despised. In a minor aside it might be pointed out that Feynman, in his amazing practicality, suggested that the reason every electron had the same mass, was that there was only one, buzzing around the 4-D universe, and when it was going backwards in time, relative to us, we perceived it as a positron.

If you have ever wondered what the hell John Bell was up to or what Aspect and Gisin's experiments were about, I've never found it in a more readable format than Nadeau and Kafatos. Don't expect to understand it, because no one still outside of an asylum admits to understanding it, but at least from this book you can get a vague idea of where reality seems to diverge from what you have evolved to know, and what you will probably die uneasy.

The famous string theorist Brian Greene has a nice style, stage presence, and an enthusiastic approach. His Elegant Universe and The Fabric of the Cosmos attempt to bring the concepts of string theory and hyperspace to the curious, but insufficiently prepared mind. Sufficiently prepared minds in this area may be very rare or, on earth, non-existent. I read in Hyperspace by Michio Kaku about the genius Indian mathematician Ramanujan . Either from that book, or somewhere else, I learned that he really could experience the reality of ten-dimensional space in his dreams. No one who knew him doubted that. This was not while he was awake, mind you. The story of his career is phenomenal. Hyperspace is one of the best books I've read lately. There always comes a time, in this kind of book, when I think I'm just about to get it and then I realize that I don't understand it at all. I keep coming back. Maybe I like the befuddled feeling, and there is the continual assurance from the authors that nobody else really understands it either.

How totally weird can it get? Have you ever read Kurt Godel? He showed on paper that in any system complicated enough to contain multiplication and division there were some true statements that could not be proven in that system. That sounds innocent enough to non-philosophers. Who cares about a few strays? But taken to its logical extreme this was very unsettling to important thinkers like Bertrand Russell and Alfred North Whitehead, who had written Principia Mathematica in 1910, a monumental work said to have been read completely by only one person (and it wasn't Russell) in which it was implicit that math was an orderly place. Godel casts serious doubt on that. His proof hinged on systematically ordering everything that was provable within a

certain system like arithmetic. These provable statements could be ordered in a list where all the elements were numbers constituting an infinite matrix. Considering the element that could be construed as the diagonal of the matrix, as a potential member of the list, on multiplying every term in that element by (-1), a new element would be formally created. Creepy as this was, it proved logically, to those who were still awake, that the newly coined negative of the diagonal was **not** on the list, because it differed from every other element in at least one position. Therefore it was not a member of the provable set. This is important to understand if you want to consider yourself to be logically literate in this century. The same sort of diagonalization technique was employed by Cantor in his proof that the real numbers outnumber the countables, Contributions to the Founding of the Theory of Transfinite Numbers, but the best place to learn about it is not from Godel himself, or Cantor. Godel was the consummate logician, who was portrayed in Who Got Einstein's Office: Eccentricity and Genius at the Institute for Advanced Study by Ed Regis, as a lunatic who, convinced that someone was going to poison him, starved himself to death. Very logical, but not repeatable—logicians do not often espouse empiricism, in fact, they see no use for it. There is a sane lady named Rebecca Goldstein, who has written Incompleteness: the Proof and Paradox of Kurt Godel, and I would recommend this as a good substitute for Godel himself.

The book by Dean Radin called Entangled Minds, either pulls a lot of this I-feel-like-I-might-be-on-the-wrong-planet stuff together, by adding another piece to it, or it just adds another confounding piece to the diabolic puzzle, a piece that almost fits, but there's no cigar and there is a soaring feeling of "how do I get back to Kansas."

I have a wooden puzzle that I made from patterns published in Scientific American in the 1970s (see an example at http://www.learningthings.us/acatalog/pentaminoes.html). The twelve pieces are differently shaped polygons, each of which could be decomposed into five squares. Properly assembled they fit together into a rectangle with the corners chopped off. Improperly assembled, all of the pieces but one can fit together promisingly. There is a polygonal space there that a suitable polygon could fit into, but the one you're holding definitely isn't it. You feel cheated.

Today's scientific reality has that quality. Unlike most of the aforementioned books about things outside the realm of common sense, Radin's book has lots of empirical observations, but still it doesn't fit in the hole that is left for it. Gisin's work is also empirical, but it fits nothing at all.

The experimental set-up is not that hard to understand, just the results. That's what makes the whole thing not just a little strange, but freaking enigmatic. That's what makes the nineteenth century so desirable, not just the fashion.

Let's take a short break. There are books about mathematics which stretch your mind but not your sanity. There is A Tour of the Calculus by David Berlinski, Zero by Charles Seife, and then another book about nothing, The Nothing That Is: A Natural History of Zero by Robert Kaplan.

Then there is the groundbreaking work by Benoit Mandelbrot, Fractals: Form, Chance and Dimension. This came out while I was a graduate student at UC Berkeley, and I had to wait about a month for a copy to free up from the math library. It was certainly not a disappointment. I wrote a program to generate my own "Mandelbrots" with my first personal computer, an Amiga, chosen specifically for its graphics capabilities. Fractal geometry is to Euclid as quantum gravity is to Newton. The patterns are warm and somehow familiar and look stunning projected onto a human body. They have a complexity that is theoretically infinite, limited only by the ability of your computer to meaningfully subtract larger and larger similar numbers from each other. As long as your processor keeps crunching, you can zoom in forever on whatever these things are and they never run out of interesting detail.

How about the weather? If you'd like to know more about global weather than is provided by the gladiators for hire on both sides, and you remember that global climate has been here, quite variable, for a long time all by itself, with names like Miocene, Pliocene and Pleistocene to adorn it, and hint that it may not always be the same, you might try The Maunder Minimum And the Variable Sun-Earth Connection by Willie Sun and Steven Yaskell, or The Long Summer, How Climate Changed Civilization, by Brian Fagan.

James M. Buchanan, who won a Nobel in Economics, wrote a book with Gordon Tullock in 1962, which puts an interesting light on a lot of socio-political weirdness like that associated with the climate/governmental thing. The book is called The Calculus of Consent. It wasn't originally intended to address climatic issues, but it throws some light on governmental reaction to things like that and it makes me feel less alone.

Now I am going to go out on a limb by talking about astrology. It may be of some consternation for those who have spoken condescendingly about the unsophisticated principles of astrology, to discover upon reading a few books that have been available at our booksellers for three or four hundred years, and looking at some statistics, that in fact there is an easily discernible connection between a person's date of birth and the attributes that distinguish that person from others.

What has been done to investigate this connection? Scientifically, nearly nothing. Why don't we check out astrology instead of burying it with all other non-Catholic notions?

Someone did. Gunter Sachs noticed that people were often similar to the descriptions of them assigned by astrologers by the simple date of their birth, without knowing about astrology. Having the money and staff that he needed for such a project, he did a systematic study with government data. It must be understood here that Gunter could hire statisticians and he did. Aristocratic scientists are not the rage these days, but they do exist, and one thing they are not accused of is forging data for purposes of grants. He published a book, The Astrology File, which establishes clearly that questions like who marries or divorces, who commits violent crimes, who wrecks their car, who plays soccer, who works, who doesn't work, have more than a random connection to when the person was born.

Now who could possibly believe that in the twenty-first century?

It's not that much more difficult to accept than non-locality, which Gisin's experiments verified years ago. An electron with its spin angular momentum pointed in no particular direction relative to the north going lanes of the Golden Gate Bridge in San Francisco, is entangled with another electron whose spin angular momentum is likewise at this time undetermined. They are entangled because they were both created out of the same quantum state last year. They are now about two light years apart. In response to the observation by some extraterrestrial physicists that the spin angular momentum of one of the electrons is parallel to the north going lane of the bridge, the spin angular momentum of the other electron, wherever it is, will in no measurable time be directed parallel to the south going lane of the bridge. Prior to the measurement no one knew the direction of its spin angular momentum. Much worse for my little brain is, that prior to the measurement, neither spin angular momentum had a direction. So something happened to two things two light years apart instantaneously.

Very cool. Scientists have to accept this, even if we don't like it, because incidents of this type of behavior have been shown to occur over and over again.

If you can believe this, you can accept the data in Mr. Sachs' book.

I don't know where to put Jared Diamond in here, but I don't want to leave him out, so make sure to read Guns, Germs and Steel, in which for starters he suggests that individually, hunter gathers in the New Guinea highlands are more intelligent than those of us who have an industrialized base and a great many books to depend on. He points out some things that are so simple that most of us have missed them, like for instance, if you migrate along a line of latitude with your seeds and your animals, you are more likely to find a hospitable new homeland than if you set out along a line of longitude. The consequences are immense. In his next book Collapse, he cleverly describes why Greenland was not a great place for expatriate Norwegians to raise cows.

Diamond goes very deeply into the successes and failures of human civilizations, avoiding the standard history textbook version which tends to stress governments and particularly adept or particularly inadequate leaders. Big decisions do matter, he concludes, but the meaningful ones all relate to whether a population understands the particular richness and especially the limitations of the land it depends on.

Richard Dawkins is one of my favorite scientists. The first book of his that I remember was published in 1979, The Selfish Gene. It made a lot of people uncomfortable by suggesting that our genes were not really ours, and that they had no serious interest in us, except as convenient vessels in which they could copy themselves with minor errors and thus generate similar but identical pools of genes on which the process of natural selection could operate. The novelty here is that the genes do the evolving, not us. We are the big, well-equipped containers that carry them around--what we call their phenotype.

Individual genes evolve. They become, for whatever reasons, more frequent than their less well-adapted closely related genes. They are competing for reproductive equipment resources, and that is the beginning and it is the end of genetic evolution. This was a little difficult for people with a humanistic bent to swallow, but most of them have washed it down over a great many bottles of scotch by now, and the arguments have faded.

In the first edition of The Selfish Gene, almost as an after-thought, another idea was floated, namely the meme, a totally shocking idea. Dawkins asked us to pronounce it like "cream" and in the new edition, ten years later, he gives it more of the attention that it deserves.

As of July 2006, there are about 225,000,000 references to this new word in Google. By comparison, there are 42,000,000 references to PCR.

Dawkins realized that the *sine qua non* of natural selection was not dark little slippery things pulling themselves up out of the primeval ooze, trying to look ultimately like people. It was imperfect replicators in competition for existence with other imperfect replicators. They didn't even have to be organisms or molecules. They could be phrases or even words. You can read about this almost anywhere, as the quarter billion Google references imply. After reading more of Dawkins: The Extended Phenotype, The Blind Watchmaker, Climbing Mt. Improbable, Unweaving the Rainbow, you could try someone else's take on memes, The Electric Meme by Robert Unger, or The Meme Machine by Susan Blackmore.

Daniel Dennett is also fascinated by memes. He and Dawkins are trans-Atlantic friends, and they speak a similar language: logic, learning, culture. By culture I am not referring to multicultural-studies in a liberal arts curriculum. I'm referring to the slow progression of the Greek tradition of looking at things as

having a certain inner logic, through the Arab translational and creative years of what we call the Middle Ages, to the Renaissance of scientific observation and thought in the 17th and 18th centuries in Europe, and the period of scientific outward observation that we are passing through now. I bring this up because Consciousness Explained, and Darwin's Dangerous Idea, by Dennett are maybe the finest examples of the philosophical literature of our times.

I recently watched an old Monty Python skit. It portrayed a soccer match with philosophers from Greece against philosophers from Germany. They marched past the ball in flowing robes. Aristophanes, Hegel, Plato, Heidegger, Kant, Socrates, Thales--all approached the ball thoughtfully, murmuring. Nobody kicked it. Finally Nietzsche, wildness in his eyes, kicked it into the net.

In Daniel Dennett's last book, Breaking the Spell, he kicks the ball. I don't know whether it will go into the net, but it is a courageous attempt. He approaches, in his very careful way, offending only those who, in his considered opinion, have offended humanity, the long out of bounds issue of religious **tolerance**. He wants to know, and suggests that we all have the right to know, why we do not have the privilege to question personal religious convictions. He doesn't say it with venom, and he is careful to avoid the direct notion that after much sincere questioning, some religious beliefs are socially destructive and morally repugnant to a great number of us. He says it slowly, leaving the door open, and asks the equally important question, "How did this happen to humanity, how does it keep happening to otherwise intelligent young students?"

The book is unlike V. S. Naipaul's, Among the Believers: An Islamic Journey, which really issues a warning of terrible things to come, but Dennett reminds us that the world is not a mature civilization yet, and some big questions about interpersonal respect are still at issue.

What about Harvey Bialy? His book, Oncogenes, Aneuploidy and AIDS, A Scientific Life and Times of Peter H. Duesberg, though directed to one man's life, speaks to issues of power in the scientific establishment which will outlive the author and his hero. Harvey was a graduate student of Peter's in Molecular Biology at UC Berkeley in the 1960s when Peter located the first mutation which could be called an oncogene, a single base-change in a gene that could result in the unstoppable growth of an errant animal cell, a cancer. Peter was given the California Scientist of the Year Award. His colleagues took his lead and soon papers exploded with the news of oncogenes. Then Duesberg saw the illogic of the whole thing from the unassailable point of view of arithmetic, and recanted his own theory. Unfortunately, scientists don't generally do this. I can't think of a single person, including Einstein, who, confronted with all the reasons in the world to back off from a bad position, ever did, except for Duesberg. His colleagues refused to follow his lead and his career fell into decline. Everybody cared about cancer, but nobody knew that the only man

who really understood it was being scorned by his peers because he had changed his mind.

Theories of cancer would stagnate in the twenty or so years between then and the time when Peter would once again take up the challenge. Now he is at it again, with colleagues jumping on the bandwagon, but not necessarily giving Peter the credit that is due. There are turf wars. All of this is beautifully portrayed by Harvey Bialy, who lives safely south of the border, reflecting and recording. He fills the pages with direct quotes and in so doing, allows a number of the unsavory characters in the story to hoist on their own inelegant petards. It is a wonderful book, for the information, the author's humor and his subtle craft. I have left out the best part for you to discover yourself.

If you have noticed and are irritated by the fact that, except for Susan Blackmore, and Rebecca Goldstein, I have only listed male authors, you could read Adam's Curse by Bryan Sykes, which foresees the extinction of the Y-chromosome, and therefore men as we know and love them, within a couple hundred thousand years.

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July 25, 2006