THE SPADE OF REASON

Jim Cowan

They say that genius is in the details. As the quirky and brilliant story that follows demonstrates, maybe God is in the numbers . . .

New writer Jim Cowan has published several stories in Century magazine, as well as in the on-line electronic magazine InterText, one of which has been chosen for a best-of-the-Net anthology, eScene. He lives in Bethlehem, Pennsylvania.

When I first came here, the nurses spelled my name wrong. They wrote C-A-X-T-O-N on a slip of pink paper and slid it into the spine of a shiny new aluminum chart-holder. That was four years ago. The aluminum is battered and scratched now, and my chart is very thick.

This will be the last of our many nighttime talks. As usual, I'm lounging in my pajamas in this comfortable old chair by these open French windows, where I can see the moonlight on the lawns. The curtains wave gently in the scented breeze and you come in from the warm night, unbuckle your tool belt, sit there on the corner couch, and choose an orange from my bowl of fruit.

Sometimes we'd talk like this for hours. Sometimes you'd get called away to fix a leaking faucet or replace a fuse. You'd buckle your belt carefully and go into the night, walking slowly to one of the other buildings. No one who's in a hurry can fix stuff right, you said. I remember what you told me: Look for the simplest causes, nothing esoteric, and fix it right the first time, or the nurses will just call you back.

I've learned a lot from you, Pete. More than you might ever guess.

Remember how we met, on my first night here, how you made me laugh? The other patients were asleep and the nurses were eating at the nurses' station. I was sitting in the rec room. The TV was on but the station had gone off the air. I was staring at the gray snow on the screen and listening to the white hiss from the speaker.

"Hi," you said. "I'm Pete."

I already knew that because your name was embroidered in red on the chest of your blue coverall. What I didn't know was that you were the third-shift mechanic and that we would become friends.

You jerked your thumb in the direction of the nurses' station and asked me if I knew the difference between a night nurse and an elephant.
"No."
"About seven pounds."
And I smiled.
Okay. It wasn't a great joke, but at that time in my life I thought I'd never smile again. I'd just been fired from the supercollider, right after I got the message from God... .
Well, I'll get to that part later. I promised I'd tell you the whole story before I left here. When the sun rises an hour from now you'll know everything that happened. About an hour after that, at exactly 7 A.M., I will become a free man, released by the same court that sent me here.
How many men can say they have been certified as sane?
My suitcase is already packed.
I have not always had this lovely corner room with its long French windows. This is my reward for seniority and good behavior. I'll miss it. For the past few months I've enjoyed sitting here and reading, and when I grew tired of reading I could look up at my van Gogh print. You can see the pale patch on the wall above my bed where the print was taped. On my last-day pass I bought a mailing tube at the post office so I could take the print with me when I leave.
On sunny days I would walk outside and wander across the lawns or along the gravel paths under the trees. I always liked to look back at the pale tan-brick buildings, so massive in their institutional certainty. I found them reassuring. But I must leave this place. The court has said so and I am ready to go.
We are on the ground floor here but there are no bars on my windows. Any night, I could have opened the window and walked away across what we call the Eastern Lawn, through the limpid moonlight, until I came to that dark line of trees a mile away that marks the road.
Beyond the road are flat fields of Texas cotton, and far away across the fields is the horizon, that imaginary line where the Earth ends and Heaven begins. Imaginary: Does that mean that there is no line because Heaven and Earth never, never meet? That's what Aquinas said. Or does imaginary mean that there is no line, no division, between Heaven and Earth?"
That was my project, exploring the line between Heaven and Earth. And that's how I got into trouble. Philosophical speculation can be dangerous, and lead to madness. Perhaps a man's time is better spent fixing a faucet than trying to read the mind of God.
Anyway, there are no bars on my windows. Each day I prove I'm sane by staying.
I'll miss this room. I liked sitting here by the window and reading in the afternoon. When I tired of my book I would look across the lawns and watch the crazies walking in the sun instead of staying in the shade. You must have noticed that crazy people always walk real slow? You probably think they shuffle along because they have
nowhere to go, so why hurry, but the truth is they spend so much energy on being mad they have none left for the rest of their bodies. Not so for the manics, of course, but they're all locked up, not out walking on the grass.

I've become very interested in mental things like this recently, how the mind works and so on. I've been reading a lot about the physical basis of thought, about neurobiology.

Think about that orange in your hand, Pete. You see an orange sphere, you feel its waxy dimpled surface. Now imagine the soft ripping sound if you were to tear off its peel, imagine the juice spraying out, imagine taking a bite, imagine the tangy scent, the sweet tartness on your tongue. Is your mouth filling with saliva, Pete? That's because your brain is projecting an image, a mental model, of these sensations inside your head, and the image is so real you can't help salivating.

That image of an orange is a working model of the world, a model that lets you analyze a situation, plan ahead, test alternative strategies, act, survive. Models like that make up what we are.

But some minds create weird models and those minds may be mad. I don't know about that. But I do know that one kind of madness is not knowing that the model is all we will ever know.

All right, if I'm going to tell it I'd better just tell it.

My project began when I was only three years old. I was watching Sesame Street, learning the letters and the numbers like all kids do. Remember? Each show was sponsored by three letters and a number? No? Guess you're just a little too old for that.

Anyway, my favorite letter was X and my favorite number was six. I already had an X in my name and I wanted to have a six. Suddenly I knew, I just knew, that my name was spelled C-A-X-6-T-O-N. The six would be silent, of course, like the silent E that I discovered was hidden at the end of some words.

Three years later, on my first day at school, I told the teacher I could spell my name, and write it too.

"Show me," she said.

I wrote it down. C-A-X-6-T-O-N. "The six is silent," I said. Actually I lisped badly, so I must have said, "The thith ith thilent, Mith Thmith." "Well done, but there is no six." She made me write it without the six. A few minutes later I looked up from my work and she was staring at me, curiously, as if I were a specimen.

At that time my mother and father were fighting a lot. I told my father about the silent six. Once, when they were in the kitchen, making up after a fight, he told my mother, "Our kid's cute, but weird, like me. He told me he had a six in his name, between the X and the T. Strange. I've sometimes thought there should be a six there myself." He laughed, but my mother didn't stop crying.

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One day my father left.

My mother started going to church and taking me with her. When the pastor prayed we were supposed to keep our eyes shut. Sometimes I peeked. The pastor had his eyes open and was looking up into the rafters. That meant that God was up there but I was always too afraid to look up and see Him. Maybe God would bring my father back. But He didn't. Dad didn't even come to see me. Ever.

However, God did speak to me sometimes. He told me that right after the X in my name there really was a six.

My grandpa, my mother's father that is, bought me a Monopoly game for my tenth birthday. But my mother quickly got tired of playing it with me and I had no one else. I remember one rainy afternoon making up my own game. I made up a list of the numbers from two to twelve, arranged in a random order. Then I rolled the two dice. I told myself that if I could roll the dice eleven times to get the numbers I had written down, in the same order as I had written them, then my father would come home. On and off, in idle moments, I played this game for years.

In high school I discovered that the chance of getting eleven numbers in the right order was 2,853,670,611 to one. Those were the odds of my father coming home.

I met Evelyn in junior high, in the waiting room of the school psychologist. Later we discovered we shared the same diagnosis: borderline schizophrenia. She was like me in another way: She was thin and freckled.

Evelyn's father taught math at the community college. She and I knew we were both pretty clever. We were right. In high school we both got a perfect score on the SATs. The math part, of course.

I let my hair grow long while I was in junior high and it's been like that ever since. I grew my mustache when I went to college. Fu Manchus are probably still not in fashion, but I like it.

Evelyn had one of the first Apple II Plus computers. Her father gave it to her for her birthday. It had a Motorola 6502 processor, 48K of memory, a monochrome monitor and a 128K floppy drive. After school I would go over to her house and we would tinker with the Apple. We wrote our programs in a language called Applesoft Basic. It was a horrible language, but at the time we thought it was wonderful.

The Apple had a random-number generator. The function RND(1) produced a random number between zero and one. The function RND(26) gave a number between zero and twenty-six and the function INT(RND(26)) made sure that number was an integer. It was easy to write a program where I = A, 2 = B, and so on. We didn't bother with punctuation marks. We called our program the Motorola Monkey and tested the hypothesis that, typing at random down through the ages, a monkey would eventually produce the works of Shakespeare.

It took the Apple about four hours to fill up one floppy disk with what we called
"random text." Once we got the program working Evelyn would start the Monkey on a run before she went to bed at night, change the disk in the morning, and start another run before she left for school. Her mom was worried about the power bill until I told her that turning the Apple on, when there was a lot of whirring and chirping, used more electricity than leaving it running for a week.

After school we would scan the random text, watching it scroll down the screen, looking for a recognizable word, or even a phrase. After the first run we changed the function to INT(RND(27)) and set 27 equal to a space. Reading a scrolling text with no spaces between the words was impossible.

Did I say words? A sample line of output would be:

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GMJRDBRKMHDNFWYNVE OQ FFVH
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After the second run we changed the function to INT(RND(31)) and made the extra five characters all spaces. That way the string of letters was broken down into word-sized chunks:

```
GMJRD BRKMHDFN WVVNVE OQ FFVH
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As you see, inserting more spaces didn't help all that much. Months went by and slowly I realized that looking for meaning in the Apple's random texts was like looking in the mailbox for a letter from my father.

You see, in a line of Shakespeare there are about thirty letters. The odds against getting even a single line of Shakespeare are roughly a fifty-digit number to one. But Evelyn and I didn't figure that out until we were in high school.

Once we discovered what appeared to be part of the table of contents from a physics text published in the year 2247, but we couldn't understand it.

Anyway, that was the first phase of my project, the Applesoft Basic phase, Release 1.0 of the Monkey, so to speak. Much later I learned there is no such thing as a random-number generator and that our effort had been completely wasted.

I went to college in Boston, to a sort of technical school by the Charles River. I wasn't the only student there with 800 on the math SAT. My major was computer science. Evelyn went to study physics somewhere else.

I never found another friend like Evelyn. I've never met anyone else who wondered, seriously, if we were discovering random texts, or creating them. Evelyn and I would argue about this for hours at the Apple's keyboard. I felt we were discovering them, she was for creation. We did agree that Newton discovered calculus while Shakespeare created *Hamlet*.

One day in Boston there was a partial eclipse of the sun. I was walking down a busy street when it happened. Some kids in the street were staring at the sun without eye
protection. Some adults didn't know any better either. I got a sheet of cardboard from the top of a recycling stack waiting on the curb and used my pen to punch a pinhole in the center of the cardboard.

I held the sheet above my head. In its shadow, projected on the sidewalk through the pinhole, there was a bright image of the chewed-up sun. Everyone gathered around me, staring down at the sidewalk. I climbed some steps to make the image larger. The kids cheered and the adults broke into applause. I started to explain some of the celestial mechanics, but just then everyone in the crowd had to leave, probably because their lunch hour was over.

The next morning, early, my mom called to say my father was dead. "A truck backed over him at the plant. It was a freak accident."

I felt numb. Interesting, how we use the same verb to describe sensation-I felt warm-as we use to describe emotion-I felt numb.

Hidden in our language are truths about ourselves. In this case, Pete, the hidden truth is that the neural circuits that process sensation are the same neural circuits that create emotion. The difference between sensation and emotion is that information flows the other way. Emotion is nothing more than sensation in reverse. You know you are afraid because your heart is pounding, your palms sweaty, and your mouth is dry.

The word *itself-e-motion-means* "flowing out. " Emotion is simply sensation we create.

During my first year in college I took a class called Foundations of Mathematics and I learned that building a machine to generate truly random numbers is impossible. I know that you earn your living fixing broken machinery and you probably feel that the universe is not only random, it is perversely so. But serious mathematicians all know that there is no mathematical trick, no equation, capable of producing a truly random series of numbers. Although Evelyn and I hadn't known it, the Motorola Monkey had been stillborn.

The universe isn't a big machine built cunningly by the Cosmic Watchmaker, nor is it a roulette wheel where the atoms rattle around like white balls, settling our fate by chance alone. No. The universe is something else, something in between, something weird, something completely numerical that remains quite unpredictable.

For example: Pour a glass of water into the ocean and wait a few years for that water to mix with all the other water in the ocean. Go down to the beach again and scoop a glass of water back from the sea. The water you scoop out will contain several molecules of the water you poured in ten years ago.

Surprised?

The explanation's simple. There are far more water molecules in a single glass of water than there are glasses of water in the ocean. What you can do with numbers is
amazing. Particularly large numbers.

Using the same idea, you can see that every glass of water you drink contains molecules of water that once were in the body of Jesus Christ. There's a mathematical proof of the Holy Communion.

Not that I ever bothered with Jesus Christ. My style was more mystical. Experience God directly, that sort of thing, a Communion of Big Numbers.

You'll see what I mean.

After the death of my father I entered the white-noise phase of my lifelong project. The white-noise period really began when the guy across the hall got a new TV and gave his old twelve-inch black-and-white to me. There was no cable in the dorm so reception was poor, just a couple of channels with a weak picture and nothing but a lot of snow on the other stations.

It was the snow that gave me the idea.

When you see snow on a dead channel your TV is picking up cosmic background radiation left over from the Big Bang. Strange, yet wonderful. Every night, in your own home, you can watch the Creation.

At Radio Shack I bought twenty dollars' worth of electronics parts. You've seen the rows of stuff in pale blue blister packs hanging at the back of the store where only guys go? I got one IC analog-to-digital converter complete with pin-out diagram, an assortment of loose resistors and capacitors, a twelve-volt power supply, and a blank printed-circuit board for breadboarding the circuit I was going to build.

The input was amplified RF from the tuner of the TV. I ripped the set out of its case and mounted the tuner on the PC board. The RF output from the tuner was fed through six inches of coax cable into the analog-to-digital converter. I tuned to a dead channel and the output from the AID converter on the breadboard was a random string of digits. Truly random.

The computer I owned at that time was a PC-AT, 12-megahertz Intel 286 processor, 40-MB hard drive, two floppies. A state-of-the-art machine back then. I rewrote the Motorola Monkey in Borland's Turbo Pascal so the Monkey would run on the IBM. Release 2.0.

I had a lot of trouble getting the hookup from the breadboard to the computer's serial port to work, but in the end I got it right. So, Pete, do you understand what I was doing? White noise from the random hiss of the Big Bang, left over from the beginning of time, was captured and amplified by the TV tuner, converted into a string of bits in the AID converter, fed into the PC, turned into a string of letters, and the final product, random text, was stored on the hard drive.

Release 2.0 of the Monkey had some successes. I still remember the most surprising random text I discovered, or as Evelyn would say, created:

One of the greatest surprises in the history of science is that the end
of the twentieth century marked the end of the age of reason and the
death of the four-hundred-year-old dream of the rationalists of the
Enlightenment. Those closing years saw reason's demarcation of the
boundaries of reason. Thoughtful men saw that the universe contains
limits on reason which cannot be broken. Speeds faster than the speed
of light are not possible and, in the same way, some of the workings of
the universe are simply not accessible to reason. This idea was not
new. In the middle of the century the far-sighted philosopher
Wittgenstein had written:

*When I have exhausted my justifications I have reached bedrock and
my spade is turned.*

Through the twentieth century science stumbled upon a series of
fundamental, cunningly constructed unresolvable enigmas. Slowly, the
truth of Wittgenstein's remark became apparent to all.

Another text, as I remember, read something like this:

Another canvas of size thirty. Here color is to do everything. This
time is just simply my bedroom. The walls are pale violet. The floor is
of red tiles. The wood of the bed and chairs is the yellow of fresh
butter and pillows very light lemon green. The coverlet scarlet. The
window green. The toilet table orange, the basin blue. The doors lilac.
When I saw my canvases after my illness the one that seemed best to
me was the *Bedroom.*

After some research I discovered this was a series of fragments from letters by van
Gogh to his brother Theo. This text made Evelyn realize we might have rediscovered
the same content in the original Dutch and then we wondered how many secrets the
Monkey was printing in languages we didn't know, in languages long dead, or
languages yet to be created. But that was all we could do: wonder.

Van Gogh killed himself a few months after painting his bedroom. The Apple had a
monochrome display but the IBM had a crude color graphics capability, 640 X 480
pixels. Sixteen colors, I think. That made us think about programming a pixel-based
Monkey to paint the screen with random dots of colors. We knew we might create, or
discover, a van Gogh that van Gogh would have painted, had he not killed himself,
but we never got the pixel-Monkey project off the ground.

I have always been surprised at how you can stumble upon the same idea from
different viewpoints, as if the idea were out there, somewhere, waiting to be found.
Herman Hesse, in his great novel *The Glass Bead Game,* describes an imaginary
country whose culture centers around a game in which the players juxtapose frag-
ments of ideas from many disciplines of human thought. Masters of the game are adept at placing ideas to reveal new beauty and new truths. The interpretation of random texts required a similar facility with the whole realm of human thought and what Hesse imagined Evelyn and I rediscovered from a surprising and totally different direction—random texts. Random texts are a variation of Hesse's Glass Bead Game.

I should mention one other text that may help you understand my story. It is probably from a philosophy text but it's impossible to date. This one could be from the past, or from the future, or from nowhere:

In those dark years, when more and more effort was required to discover less and less knowledge, an unknown genius asked the question: Why struggle to discover facts through experiments? Why not look for texts from the future that already contain those facts? Ideas have always come from nowhere. Creativity is an eternal enigma. Random texts are nothing but a device for creating ideas from nothing.

In our time, rational science has assumed its rightful place as one of many tools in the toolbox of human thought. Random texts are an infinite flood of ideas, each of which can be tested against other ideas. Selecting those random texts that describe the universe most accurately is the task of the human mind for the rest of eternity. And in this task we join ourselves with God, for this is His eternal task.

Enigmatic, for sure. Could be a sixteenth-century text by Sir Francis Bacon, perhaps a gloss on his Novum Organum, but it could also be a fragment from a religious text that will be written in the future. But, Pete, I tell you these things so you can see that we weren't just fooling around.

In fact, we gave a lot of thought to the fact that random texts may be from the future or the past or from nowhere, and in each case may be true or false. So how do you decide if they are true or false? There are two ways, Pete.

Internal consistency: Does the text make sense with itself? If it contradicts itself, it can't be true.

External consistency: does it agree with other truths?

The first text passes on both criteria. Of course, there could be a little more internal consistency, but at least there is no inconsistency. The second passes also. The third—who knows?

Later, I realized that these texts, although appealing in many ways, were nothing but random noise. Listening to fading echoes from the Big Bang was as likely to reveal truth as was a newborn babe likely to articulate the Einstein-Podolsky-Rosen paradox.

You see, when the universe was young, God knew nothing.
But I'm getting ahead of myself.

Although my major was computer science I took a lot of math and physics classes and for an easy credit I registered for Professor Kuhl's Epistemology of Science: Fundamental Problems. We met for two hours every Thursday afternoon in the spring semester in a classroom that was an old amphitheater with oak paneling and tall leaded windows facing west. Sloping beams of light fell on the shoulders of the students and the sunlight lay in pools at the feet of Professor Kuhl.

The professor was a tiny white-haired old man who always wore the same tweed jacket with leather patches on the elbows. He smelled of pipe tobacco and spoke slowly, with a thick East European accent. There was a sadness in his voice, a mourning for something lost and irreplaceable.

The course was an overview of mathematical physics and the philosophy of science. In the first class, when the trees by the river were still bare, Professor Kuhl proved mathematically that time and space were relative, unique for each observer. That's Einstein's theory of relativity.

Later in the semester Kuhl showed that we could never measure the exact position and the exact momentum of a particle at the same time. That's Heisenberg's uncertainty principle.

As the days grew longer the Professor proved that the ultimate building blocks of matter are both particles and waves, depending on what experiment you perform, and that random fluctuation of these enigmatic entities is the basis of all that exists. That's quantum mechanics.

When the trees were covered with new leaves, Professor Kuhl deduced on the blackboard the existence of statements that are true, but unprovable. That's Godel's Theorem. Think about that idea applied to the whole universe, Pete. Godel's Theorem is itself such a statement. See what I mean about weird?

Finally, as summer began, he showed that the behavior of all but the simplest systems cannot be predicted. Two pendulums, one hanging from the other, and all our mathematics fails. Two pieces of string and two lead weights stump the finest human minds, and always will. That's chaos theory.

What Professor Kuhl taught me was that the Cartesian idea of a complicated but predictable clockwork universe is impossible. Even theoretically, the future is totally unknowable. Not unknown, but unknowable. Sure, reason works to fix a leaking faucet, but most of the universe is simply not accessible to reason. Reason. The most elegant function of the human brain.

When we reason we are using the same circuits in our brains that we use to process sensation and emotion because those are the only circuits we have inside our heads. At the neural level, there is no difference between thinking and feeling.

We only like to think there is because thinking makes us feel good.

Inside our mammalian brains, which are the only ones we'll ever have, incoming sensation, outgoing emotion, and the internal activity we call thought are jumbled
joyously.

You're following all this, Pete? I hope your beeper doesn't go off, just as I'm getting to the interesting part. It's a full moon tonight and some crazy's probably stuffing ten rolls of toilet paper down the john over in Building T, half a mile away.
I know how you just love those kinds of calls, how you look on them as a punishment.

The mathematician Gauss was punished once, when he was a schoolboy. His class was kept in late for some misdemeanor, and each boy was to add up all the numbers from one to one hundred. The eight-year-old Gauss, who would grow up to be the greatest mathematician of his century, turned in the correct answer after a few seconds' work.
You see, you can write down all the numbers and add them up, or you can get an answer quickly by using the formula \( n(n+1)/2 \), which Gauss discovered in those first few seconds of his detention.
Adding all the numbers from one to one hundred is a problem that mathematicians say is *algorithmically compressible*. It can be reduced to a formula.
As I listened to Professor Kuhl's final lecture I realized that God has crafted an algorithmically incompressible universe so that even He cannot know the future. Sure, the universe is computable, but the computation of the universe is algorithmically incompressible. There are no shortcuts, no quick method that will give an answer.
It's as if we have to write down all the numbers and add them up, one by one. Second by second, atom by atom, quantum event by quantum event, we simply have to wait and see what is going to happen next.
That was when I understood the sadness in Professor Kuhl's voice. He was mourning the end of the Enlightenment, the end of the great dream of using reason as a tool to understand all that lies in Heaven and Earth.
Later, in the library, I discovered that the idea of an algorithmically incompressible universe was not new. Two sixteenth-century Polish clerics, brothers living in Rome, suggested that God was omnipotent, but not omniscient. These Sozinian brothers argued that God was growing in knowledge and understanding while His creation unfolded. They were excommunicated and the Sozinian doctrine declared heretical.
Wrongly. Mathematics has proven that the Sozinians were right.
But the important thing to realize is that, as I said, God knew nothing when the universe was young. Release 2.0 of the Monkey was another case of garbage in, garbage out.

I was spending a lot of time in the library, thinking about things like this. I discovered that Evelyn and I were not the first to wonder about random texts. The earliest known writings on the subject were the work of the fourteenth-century
scholar, Lulio. The philosopher John Stuart Mill had also written about them. Strangely, Mill was concerned with the idea of random music, not words, and worried that melody was exhaustible. Later, Kurd Lasswitz, an obscure nineteenth century German science-fiction writer, explored some of the possibilities of random texts.

And then I discovered Borges, the Argentinean minimalist. In Borges's story "The Library of Babel," a librarian describes the infinite library where he toils endlessly. In this library everything that has been written, will be written, has never been written, and will never be written is stored on the bookshelves of an endless library of hexagonal rooms. Unfortunately, the books are not shelved in any order and almost all of them are nothing but meaningless streams of letters with a word or a phrase scattered here and there in the jumble. The librarian spends his life searching for a single comprehensible text. The Holy Grail, of course, is the text which is the catalog of the library. It must be somewhere on the shelves. At the end of the story the librarian escapes from the library.

I have a copy of Borges on my bookshelf. Here, take it.

Evelyn graduated with a doctorate in nuclear physics. She went to work for Pantex, in Amarillo, and I went to visit her. Have you ever been to Amarillo, Pete? Outside the town there is a sign that says:

AMARILLO
We know who we are.

Now there's a town of lucky people.

You know when you're getting close to Pantex. First there's nothing but desert, then you come to the razor wire that marks the perimeter of the sixteen-thousand acre site, then you see one of the Chevrolet Suburbans with its roof cut off for the swivel-mounted M-60.

Sounds scary. Evelyn met me at the first gate. Pantex was the final assembly point for nuclear warheads, she told me. "Detonators, timers, altimeters, parachutes are packed around what we call the physics package," she said. " What a lovely euphemism. But now we're into disassembly."

That's why I got a tour. Even The New York Times had got a tour. At that time Pantex was trying to reinvent its image.

While Evelyn was helping me into a protective suit she told me that there were six thousand parts in a typical thermonuclear weapon and the cost of demilitarizing a single weapon was about $500,000.

We waddled robotically into a disassembly shop, a gravel Gertie, a bunker with thirty tons of dirt on its roof. If there's an explosion, the Gertie collapses, containing the radioactive material and crushing everything inside.

We watched two men easing an electromechanical device from a complex mechanism of wires, printed circuits, and relays. One man read instructions line by line
from a manual while the other unscrewed the subassembly from its mounting and exposed the shiny surface of what looked like a metal bowling ball.  
"That's plutonium," she said.  "We call it a pit. Right now we have five thousand pits stored safely here at Pantex."

We saw some of them in another bunker, stored in thirty-gallon steel drums, stacked in 'rows in the dim cool air. "We monitor for radiation leaks. We've never had any, of course."

I listened carefully to the hiss from the Geiger counter.

In 1991 I finished graduate school and moved to Waxahachie, Ellis County, Texas. Back in '79 the high-energy physics community had asked the federal government for "a multi-TeV accelerator to elucidate the physics of electroweak symmetry binding necessary for continued progress in high-energy physics." In other words, they wanted to find the basic building blocks of matter and they needed a machine that was twenty miles in diameter. In fact, to get down to the level of quarks they would need a machine several light-years across, but they didn't tell that to Congress.

This is how the argument went. The superconducting supercollider would prove, maybe, the existence of the Higgs boson, an elusive particle that existed shortly after the Big Bang and may have given matter the important property of mass. The Higgs boson, if it is ever found, will be a step on the road to unifying the electroweak and strong forces of nuclear physics, bringing us closer to unifying these forces with gravity, closer to a grand unification theory, a so-called theory of everything. The mathematical physicist Stephen Hawking wrote, "If we do discover a complete theory... we should know the mind of God."

Higgs boson first, mind of God next. Get the picture?

In October, 1993, seventeen shafts had been sunk two hundred feet under the chalk of east Texas and eleven of the proposed forty-two miles of tunnel had been dug. Two billion taxpayer dollars had been spent. That's real progress toward knowing the mind of God. That month a congressman from Ohio said, "Finding basic building blocks of the universe won't change the way people live." Many other congressmen were feeling pressure from their constituents. One voter commented, "If I want to know the mind of God, I pray."

Congress canceled the project.

What would Professor Kuhl have said?

But he had died in 1991.

At the time of the cancellation I was working at the SSC's Particle Detection Simulation Facility, which represented one hundred million of the taxpayers' two billion dollars.

We were running at twelve billion instructions per second (that's twelve thousand million instructions per second, or twelve thousand MIPS) and had on-line storage measured in terabytes. There was nothing else like the PDSF in the world.
Ten of our staff of thirty were laid off and my boss began to scramble to find a use for the twelve-thousand MIPS PDSF, another two thousand MIPS in the iPS/ 860 Intel hypercube, a 550,000-square-foot facility, eight million dollars of network infrastructure, thirteen million dollars of personal computers, and fourteen million dollars of UNIX workstations.

My boss was a sharp guy. While the SSC consortium was renting tunnels to local mushroom growers my boss got the PDSF transferred to the state of Texas. The state renamed it and told him to earn his keep by renting computer time to the scientific community. I prepared a homepage for the World Wide Web, sort of an advertisement focused at well-heeled academics with generous funding from the National Science Foundation. I remember the first page:

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High Performance Computing Center
[At this point there were two images of large rooms full of equipment.]
High Performance Computing Center Available at no cost to User
until further notice. Get acquainted with the capabilities of the HPCC
during this limited-time offer. If you are interested in using the High
Performance Computing Center at no cost please define your
requirements and query caxton@texas.ssc.gov.

Now you have to put yourself in my situation, sitting at my Sun SPARC 10 work-
station with no application to run. Imagine, an aficionado of random text sitting there
with twelve thousand MIPS of idle processing power literally at my fingertips. All I
needed was to write a few lines of C++ code to create an updated Motorola Monkey.
Release 3.0.
Oh, and I needed a suitable source of random numbers.
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Professor Kuhl had shown me the only real random-number generator in the universe.
I was watching the dust dance in the sunbeams while he was describing the quantum
dance of particles.

"Quantum events are truly without cause. There is a veil through which we cannot
pass, an ephemeral, flimsy veil, a barrier more mental than physical, yet totally
impenetrable."

He paused, giving us time to absorb what he was saying. "If there were a cause for
the radioactive decay of an atom, that cause would be what has been called a 'hidden
variable' in the equations. Within the mathematics of quantum mechanics there is
proof that there are no hidden variables. The chain of cause and effect comes to an
end. The quantum event is an effect without a cause."

Later I imagined this veil to be like a curtain blowing in an open window on a
summer night. God was the warm dark breeze making the quanta dance.

Needing effects that had no causes, I called Evelyn. Yes, she could supply a billion
truly random digits per second. Five thousand pits could supply a lot more, but that
was all the PDSF could handle. Using all the power of my texas.ssc.gov Internet address I commandeered enough bandwidth on the Net's high-speed backbone. Soon I was pumping a billion random Pantex digits per second into the PDSF. That translates to over a hundred million characters per second. That's thirty times more text every second than Shakespeare wrote in his entire life.

I could have used any other quantum phenomenon to generate randomness. But I knew Evelyn and so that was the easiest way for me.

Of course, I needed some help to scan it all. I uploaded the CD-ROM version of the Oxford English Dictionary, wrote a little more C++ code, an algorithm to recognize texts with English or almost-English words-sort of a reverse spellchecker looking for words that were misspelled, but still could be words-and I was in business.

What was I looking for?

Well, you remember I said my style was mystical?

I wanted God to whisper to me through the quantum veil. I knew He was there. All I had to do was listen with all my attention and He would tell me what I needed to know.

The God who would be whispering to me was the God who is alive today. Not the infant God whose mewling still echoes through the universe as cosmic background radiation. No, the God behind the quantum veil is still at work, crafting the growing universe, solving for the first time the great puzzle of the cosmos. Just like us, He is eager to find out what will happen next.

Pete, your wife is Mexican, right? Perhaps you're wondering: Suppose the secret of the universe is written in Spanish instead of English?

It doesn't matter. The beauty of searching through an infinity of random text is that the secret of the universe will be written in Spanish, and English, and all other human languages, and all nonhuman languages too. In fact, there will be an infinite number of documents that reveal the secret of the universe. All I needed to do was to find one written in English. It could be the original scientific paper that will one day win the Nobel Prize, it could be a news story about that paper, a philosophical criticism of the work, a chapter from a textbook, a children's version of the Theory of Everything, anything would do.

So I got all my equipment set up, the feed from God's random ticking in the plutonium, the translation into text, the automatic flagging of documents that were mostly English, and I churned out the equivalent of a thousand Shakespeare plays a second.

One day I am sitting, stunned, at my workstation, and my boss comes in and sees the random text scrolling across the screen. He takes the printout I am clutching in my hand, and reads:

> the chance against you receiving this message of 372 characters from the rafters from behind the veil is a number far greater than all
the protons in the universe so you know this is not an accident by way of confirmation let me tell you that you were right mith thmith was wrong the six is there and yes the sixth ith thilent the secret of the universe is I dont know yet

Immediately, you will notice that the message exhibits both internal and external consistency. But remember, truth is not the same as meaning.

My boss discovered the feed of random digits and the sequestration of twelve thousand Texas MIPS for my own devices.

Misappropriation of government resources was the phrase they used in the indictment. When the dust settled they sent me here instead of jail, saying I was crazy.

Ah! There goes your beeper. But wait a moment. Do you see those headlights, there on the road, behind the trees? Someone is parking outside the East Gate. My story took longer than I thought. It's almost seven o'clock and the sun has risen.

I am sane, and I am ready to leave.

Look outside. Like lightning drawn to a lightning rod, the night's dew has condensed on the very tip of each blade of grass. The laws of physics are written so that the dew must collect as tiny globes of water on each blade's tip, not as a film of moisture smeared over the whole lawn. Each drop will scatter the low light of the rising sun. While I am walking to the gate the lawn will look as if someone has thrown away a million diamonds. Why should it be so beautiful? I can't explain it, and that's how I know I'm sane. Reason is only the sixth sense, the silent sixth sense, no more reliable than the other five. As imperfect, and as capable of causing pain or ecstasy.

So maybe the message was truly random. Or maybe there is a God who takes an interest in things, dazzling us with the morning dew and sending us messages. But don't forget that some religions have trickster gods.

And on that note, Pete, it's clearly time for me to go.