Interview with Martin Gardner

Martin Gardner occupies a unique position in the mathematical world. The author of the "Mathematical Games" column that ran for twenty-five years in *Scientific American* magazine, he opened the eyes of the general public to the beauty and fascination of mathematics and inspired many to go on to make the subject their life's work. His column was the place where several important mathematical notions, such as Conway's Game of Life and Penrose tiles, first became widely known. It was also a place where the sheer fun of mathematical games and puzzles was celebrated and savored. His crystalline prose, always enlightening, never pedantic, set a new standard for high quality mathematical popularization. In 1987 he received the AMS Steele Prize for Mathematical Exposition "for his many books and articles on mathematics and particularly for his column 'Mathematical Games' in *Scientific American*."

In addition to writing about mathematics, Gardner has also been a prominent debunker of pseudoscience, starting with his very first book, originally published in 1952, *Fads and Fallacies in the Name of Science*. His many magazine articles and book collections have performed a public service by exposing quackery and fraud that masquerade as science. His lifelong interest in magic—he was once among the top "card mechanics" in the nation and has written technical manuals for professional magicians—has brought him special insights into the methods of spoon-benders and other hucksters who claim their feats have a psychic basis.

Martin Gardner was born October 21, 1914, in Tulsa, Oklahoma. He attended the University of Chicago and earned a bachelor's degree in philosophy in 1936. After four years in the Navy, he worked as a freelance writer of short stories in Chicago. In the mid-1940s he moved to New York City, and for eight years he wrote for *Humpty Dumpty*, a children's magazine. He began his *Scientific American* column in 1957. In the early 1990s he retired to Hendersonville, North Carolina, from where he continued his prolific writing career. A man of wide interests, Gardner is the author of over fifty books, including a novel, *The Flight of Peter Fromm*, and works on philosophy and literature. In 2002 he moved to Norman, Oklahoma, the home base of the University of Oklahoma, where his son, James Gardner, is a professor of education.

What follows is the edited text of an interview with Martin Gardner conducted in November 2004 by *Notices* senior writer and deputy editor Allyn Jackson. Also present were James Gardner and *Notices* editor Andy Magid. Their help with the interview is gratefully acknowledged.

—*A.J.*

Notices: *Was there someone in your early life who inspired you in math and science?*

Gardner: Yes, I had a physics teacher named M. E. Hurst, and he was my most inspiring high school teacher. I got to know him fairly well. I dedicated one of my books to him. He got me interested in physics. Actually, I hoped to become a physicist, and I wanted to go to Caltech, where Millikan was chief physicist. Caltech wouldn't take you until you had at least two years at a liberal arts college. So I went to the University of Chicago and got hooked on philosophy of science. I abandoned my plans to become a physicist. I didn't get any degree higher than bachelor's.

Notices: *You also had an interest in magic from an early age. How did that develop?*

Gardner: My father was not a magician, but he knew a few magic tricks that he showed me as a small boy, and that got me interested. Then I got acquainted with a Tulsa magician, and I discovered the magic periodicals and magic shops. I'm not a performer. The only time I came close to performing was when I was in college in Chicago. I used to work Christmas season at Marshall Field's department store, demonstrating magic sets. That's the closest I ever came to getting paid for doing any magic. It's been a lifelong hobby. I particularly like magic tricks that are based on violating topological laws. I've done a number of books for the magic trade. They sell in magic stores.

Notices: *Your father was a petroleum geologist.*

Gardner: My dad got a Ph.D. in geology, and at that time the oil business was just getting started. So we moved to Tulsa, and he became what they called a wildcatter. He had a small oil production company

that consisted of himself, an accountant, and a secretary. He would go out and look for what they call domes—oil accumulates under limestone domes. He would hire some drillers to drill for oil, and occasionally he would hit and most of the time wouldn't. That's what he did for a living. He contributed occasionally to geological journals.

Notices: *And what about your mother?*

Gardner: She was a kindergarten teacher in Lexington. They met at the University of Kentucky. But she was mainly a housewife.

Heroes of Philosophy

Notices: *Rudolph Carnap was one of your teachers at Chicago.*

Gardner: Yes, he is one of my heroes. I took a seminar from him under the GI bill after I got out of the Navy. It was not when I was an undergraduate. That was the only graduate course I ever took. It was on the philosophy of science, and it had a big influence on me. Later, when Carnap was giving the course in California, I persuaded him to have his wife tape record it. She typed it up and sent me the typed version. I edited it into a book called *Introduction to the Philosophy of Science*. That was the only popular book that Carnap ever did. All I did was edit it into language an average person could understand without knowing any math.

Notices: *What was it about his approach to philosophy that attracted you?*

Gardner: He was in the logical positivist school. The essence of logical positivism is that a philosophical statement is totally meaningless unless you can prove it logically or find some empirical evidence for it. From his point of view, all metaphysical statements are totally meaningless in the cognitive sense. They can have an emotional meaning, but that doesn't prove that they are true. It just means that you want to believe them.

Once Bertrand Russell came to the University of Chicago to give a series of seminars, and Carnap attended them. I attended one in which they got into a big discussion about whether their wives existed or not. Carnap is inclined not to call himself a realist. The only reason he recommends the realistic language is that he thinks that's the most efficient language for science. Of course, Russell is a dyed-in-the-wool realist who thinks the universe exists whether anybody observes it or not. So Russell kept turning the argument into a question of whether they had a right to say their wives really existed outside of their own experience. The next day I was in the University of Chicago post office building to pick up some mail, and I saw Professor Hartshorne, from whom I was taking some courses. He asked, "Were you at Russell's seminar yesterday? How did it go?" I said, "Well, Russell tried to convince Carnap that his wife existed, but Carnap wouldn't admit it." And who should walk in

Figure 1. This original of Escher's *Circle Limit* hangs in Martin Gardner's home.

except Carnap! To my great embarrassment Hartshorne said, "Mr. Gardner here attended your seminar last night, and he said you wouldn't admit that your wife existed." Carnap didn't smile at all, he just glowered down at me—he was a very tall fellow—and he said, "Well, that was not the point at all." What exactly the point was, I am not quite sure! This ends on a very tragic note. It was some time later that Carnap's wife committed suicide. She hanged herself. I have no idea why. I know about it only because there was a piece in California newspapers about it. I never asked Carnap about it.

Bertrand Russell is another one of my heroes.

Notices: *Did you meet Russell at that seminar?*

Gardner: No, I never met him personally.

I was at Chicago during the famous Hutchins-Adler period. Mortimer Adler came from an orthodox Jewish background and became fascinated by Catholicism, and he almost joined the Catholic church. Half a dozen or more students of Adler's at Chicago became Catholics as a result of taking courses from him. I never liked Adler. I took one course, a Great Books course he taught with Hutchins. I wrote a letter to the *New Republic*—it was published—saying that readers should all pray for Adler's conversion to the Catholic church, because that would clear the air, and we would know exactly what he believed. I have a very rare document, a speech that Adler gave at Northwestern University, and incredible as it may seem, he argued that, if the Catholic church is a true church, it had

Photo by Allyn Jackson.

Figure 2. These hexaflexagons, some of them handmade, were collected by Martin Gardner after his column on the subject appeared in *Scientific American*. They are kept, together with all of his files from his writing career, in the Martin Gardner archive at Stanford University.

a right to execute heretics. Can you imagine somebody in this day and age saying that the church had a right to execute heretics? That's in this lecture. Adler of course is very much ashamed of it. But the punch line is that, shortly before he died, Adler joined the Catholic church. So it took about half a century for the prayers of the *New Republic* readers to be answered.

Notices: *You wrote that letter at the time you were at Chicago?*

Gardner: Yes, I was an undergraduate. Adler was a character. He had a tremendous ego. He edited the *Encyclopedia Britannica*. If you look through the first volume, which has general articles, you will find very short articles on Bertrand Russell, no article on Carnap, a very short article on Quine—and when you turn to Adler, a big, long article of several columns! But the university was an exciting place partly because Adler aroused so much animosity among the faculty and among the students. This led somebody to propose the "Madman Theory of Education", which says that every university should have a madman on the faculty who gets the students all riled up in opposing his views. There was also a joke going around at the time that the University of Chicago was a Baptist school where Jewish professors were teaching Catholic theology.

Notices: *You didn't take any math or science when you were there?*

Gardner: The university had what they called the "New Plan", and everybody had to take survey courses. There were four survey courses, and one of them was called Physical Science, and you had to take that. That was the closest I came to taking a science course, aside from a geology class that I audited. But I didn't take any math. My knowledge of math is at a very low level. I go up to calculus, and beyond that I don't understand any of the papers that are being written. I consider that that was an advantage for the type of column I was doing for *Scientific American*, because I had to understand what I was writing about, and that enabled me to write in such a way that an average reader could understand what I was saying. If you are writing popularly about math, I think it's good not to know too much math.

Launching a Writing Career

Notices: *When did you decide you wanted to become a writer?*

Gardner: While I was a student at the University of Chicago. I was doing occasional pieces for little magazines that didn't pay anything. Before World War II, I was working in the public relations office of the University of Chicago, mainly writing science releases. When I got out of the service, I could have gotten that job back. At that time I made my first sale. It was a short story for *Esquire* magazine, and I actually got paid for it. That was when I decided I was going to try to freelance. I followed that story with a science fiction story about topology called "The No-Sided Professor". It's about a mathematician who was a student of the properties of the Möbius strip. You take a strip of paper and twist it and glue the ends together. It loses one of its sides and becomes a one-sided surface. So I imagined that the professor had found a way to fold a piece of paper so that it lost both sides and became a no-sided surface and just vanished with a little "pop". So that was the beginning of my "No-Sided Professor". For about a year I lived on sales to *Esquire* magazine—all fiction.

Notices: *Then you moved to New York. When was that?*

Gardner: It was 1944 or 1945.

Notices: *You went to make your living as a writer in New York.*

Gardner: That's right, New York's where all the action is. I married a New York girl. I couldn't make a living freelancing. *Esquire* had moved from Chicago to New York and had a new editor, and the new editor didn't care for the type of story that I was selling. So my market with *Esquire* dropped off. I got a job with *Humpty Dumpty* magazine, a children's magazine. That was how I managed to exist. I worked at home and wrote activity features, a short story for every issue about the adventures of Humpty Dumpty Jr., and a poem of moral advice from Humpty to his son. I did that for eight years. I stopped doing it after I began selling to *Scientific American*.

Notices: *How did it come about that you started writing for* Scientific American*?*

Gardner: I was interested in the topic of mechanical devices that solve logic problems. I sold *Scientific American* an article on the history of logic machines. These are mechanical devices that solve problems in elementary logic. This was before the days of computers, of course, which now can do it much more efficiently. With the article they included a pasteboard sheet that was bound into the magazine, and the sheet contained pictures of cards that had windows in them. You could cut the

cards out and cut open the windows. Then you could pick out cards for the two premises of a syllogism and put them on another card. Through the windows you could see the conclusion of the syllogism. They asked me if I had any more articles similar to that one. The second article I sold them was on hexaflexagons. They had been invented by a group of graduate students at Princeton, including, of all people, Richard Feynman.

Notices: *How did you find out about hexaflexagons?*

Gardner: From my magic contacts, believe it or not. There was a stockbroker in New York City named Royal Heath, who was a magic buff. I was in his apartment one day, and he showed me a large hexaflexagon made of cloth. I had never seen one before. He told me that the group at Princeton had invented it. So I saw the possibility of an article, and I made a trip to Princeton. I interviewed John Tukey, one of the coinventors. He became a very famous mathematician much later. That article ran in *Scientific American* in December 1956. Gerry Piel, who was the publisher, called me in to his office and said, "Is there enough similar material to this to make a regular feature?" And I said I thought so. The next issue was the first of the columns, the January 1957 issue. I resigned from *Humpty Dumpty* and rushed around the old book sections of New York to pick up all the math books I could find that had recreational material.

Notices: *There was a big response to the hexaflexagon article, wasn't there?*

Gardner: Yes, it caught on. All over New York, and especially in advertising, people were folding hexaflexagons! During the first year after the article, a lot of advertising premiums came on the market that were paper hexaflexagons with space for an advertisement.

Notices: *This group of magicians you knew in New York—can you tell us about them?*

Gardner: I got acquainted with a lot of famous magicians. I was doing pamphlets for the profession with material that they provided. I lived in Chicago for fifteen years, and I first got acquainted with professional magicians there. They would meet every week at a roundtable. It included a lot of famous performers—the names would mean nothing now, though. Magic has become a TV spectacular, with David Copperfield and his rivals spending millions of dollars on equipment for their shows. But in those days the magicians worked night clubs. My interest is in what they call close-up magic, which you do close-up, rather than on the stage.

Notices: *In New York you met Persi Diaconis in this circle of magicians. How old was he when you met him?*

Gardner: I think he was a late teenager. He was a professional card shark, or a card mechanic, as they call it in the trade. He worked ships between New York and South America. Of course, nobody suspected him of being skillful with cards because he was just a teenager. He was a student at City University of New York, and he paid his way through the university with the money that he got from poker games on ships. At that time Persi was very anxious to get into Harvard. The head of the statistics department at Harvard was Frederick Mosteller, who is a magic buff. He was very active in magic, and his picture has been on the cover of magic magazines. I knew Mosteller slightly, so I wrote him a letter and said, "This young student is one of the best card mechanics in the country. He does a fantastic second deal and bottom deal." (Those are terms for fake deals. When you are dealing from a deck, there is a way to deal the second card instead of the top card, and there is a way to deal the bottom card instead of the top card.) I got back a letter right away from Mosteller, which said, "If he's willing to major in statistics, I can get him into Harvard." So I asked Persi if he was willing to major in statistics, and he said, "Of course!" So he got in, got his Ph.D. in statistics, and is now at Stanford.

By the way, I gave all my math books and math files to Stanford, at the request of Donald Knuth. His *Art of Computer Programming* is filled with

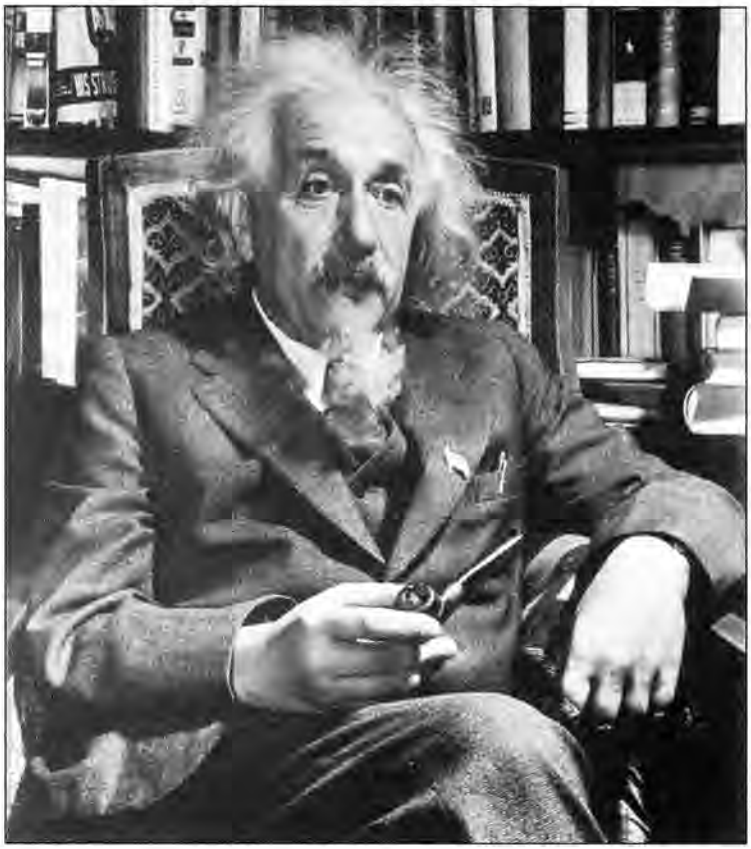

Figure 3. This large-as-life portrait of Albert Einstein was taken by a friend of Martin Gardner's and hangs in Gardner's home.

recreational material. One time he wanted to get access to my files and asked if he could visit me when I was living in Hendersonville. He came and stayed a week. I had rented an apartment just to contain my books and files. Knuth stayed in the apartment. It had a kitchen, so he cooked his own meals, and on Sunday he walked to a nearby Lutheran church. He pulled out from my files a stack of papers about this high, which I photocopied for him. Now my files are being indexed by someone at Stanford.

For every column I did there may be four or five folders containing research and notes that I took. I subscribed to seven or eight math journals that had recreational material, and I would clip articles and file them in appropriate folders.

When the column started, the math was on a pretty low level. It slowly got a little more technical, partly because I was learning math myself while I was writing the column, and partly because I was getting material from top mathematicians who were interested in recreational math. So the column became much more interesting a few years after it started, because I was publishing material that hadn't been published before. It was coming from Sol Golomb, John Conway, Ron Graham, and Frank Harary, among others.

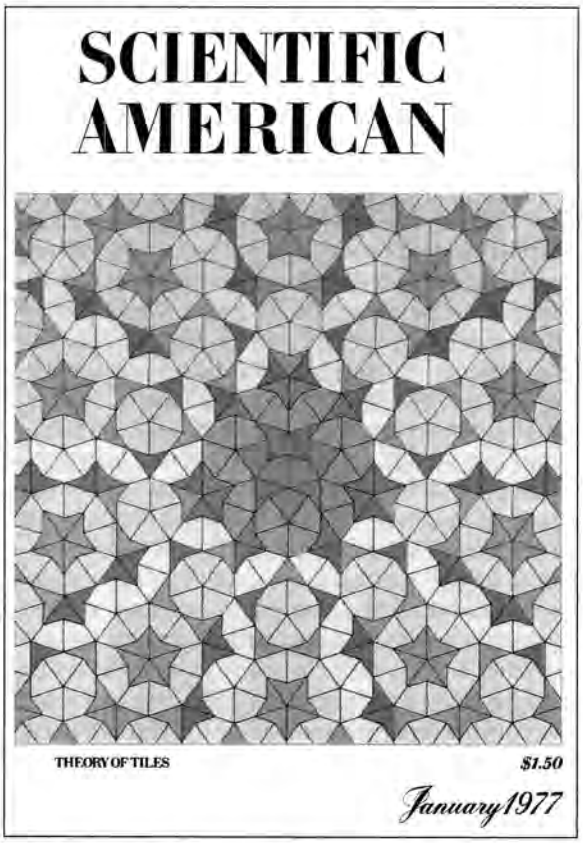

Figure 4. Cover of the January 1977 issue of *Scientific American* that carried a column by Gardner about Penrose tiles. The set of Penrose tiles shown was originally drawn for Martin Gardner by John H. Conway. (Courtesy of *Scientific American*.)

One of the frequent contributors was Sol Golomb. In a paper that he had written when he was quite young, he introduced the idea of polyominoes. When I did the column on polyominoes, it was the first introduction to the general public and to mathematicians. That was one of my very successful columns. A lot of mathematicians began experimenting with polyominoes, and especially the pentominoes.

The Game of Life

Notices: *How did you get in contact with Golomb?*

Gardner: I think I had a copy of the paper in which he first named the polyominoes. I think I just wrote to him and got into correspondence with him, and then we became pretty good friends.

One of my most popular columns was based on Conway's Game of Life. During a visit with me, Conway rapidly went over maybe twenty different things that he was working on at the time, and one of them happened to be the Game of Life. He didn't think there was anything special about it. Of the things he told me, I thought that was the most interesting. When I wrote that up, it really caught on. Computer people all over the U.S. were trying to write algorithms for their computers to play the game. There was one fellow I heard about who had a button under his desk at work, so that he would be working on Life configurations on his computer, but if someone in management walked in, he would press the button, and the computer would go back to something related to his job.

Notices: *How was it that out of this list of twenty different things you picked the Game of Life?*

Gardner: Well, I got columns out of some of the other ideas too.

Notices: *But you knew the Game of Life was something special.*

Gardner: That's right. If I had known more about mathematics, I might not have thought that. But I approached it as a sort of a half-layman. I later did a second column on Life, because Conway had offered $50 to anybody who could create what he called a Glider Gun. That is a configuration that, when you applied the transition rules of Life, would shoot off gliders. It was discovered by Bill Gosper, who at the time was working for Marvin Minsky at MIT in the artificial intelligence program there. The Glider Gun opened up all kinds of possibilities. So I did a second column based on the Glider Gun. It turned out that by using gliders and shooting them down with another gun, you could actually use the Game of Life to do anything you could do on a general purpose computer, which was a surprising

discovery, made by Conway. So the game turned out to be far from trivial.

Notices: *Did Conway tell you how he came up with the specific transition rules in the Game of Life?*

Gardner: All Conway would say is that he experimented with a wide variety of rules and that the rules he finally settled on were the most productive and the most interesting. I got to know Conway fairly well, and he is an authentic genius. His name appears quite often in the column. He sent me marvelous material. I had the great privilege of introducing him to Benoit Mandelbrot. This was when I was still living in New York. Mandelbrot was living in Westchester, not too far away. Conway visited me and stayed maybe several days. I was slightly acquainted with Mandelbrot, so I called him, and he rushed over to meet Conway, because Conway was working on the Penrose tiles. The Penrose tiles have a fractal quality—you can keep magnifying portions of them and you always get the same tiling. So Mandelbrot was quite fascinated by the tiles.

Ciphers, Quantum Mechanics, and the Nature of Reality

Notices: *How did you first find out about the Penrose tiles?*

Gardner: I think Penrose sent me a copy of the piece that he had done on them for a magazine, and I got into correspondence with him and found out more about them. Then Conway got intrigued by them. Actually, most of the pioneer discoveries about the Penrose tiles were made by Conway.

Another column I did was on trapdoor ciphers, and that aroused a lot of controversy. One of the discoverers of the trapdoor cipher, Ron Rivest, came to see me to tell me about it and also to give me materials for a column. The cipher introduced a whole new era in cryptography, because it was an unbreakable code. I had said in the column that if you want to know more about Rivest's trapdoor cipher, he has an unpublished technical paper on it, and he has offered to mail it to anyone who sends him a stamped, self-addressed envelope. Rivest got flooded with thousands of letters. Then the government stepped in and forbade him from mailing out his paper. It was a year or two before the government allowed him to release information on the code. For about a year I got angry letters from people who said, "I followed your advice and I wrote to Rivest and I asked for the paper, and I never heard from him!"

Rivest gave me a short sample written in the code, and he offered a prize to anyone who could crack it. It was many years before somebody cracked this particular message that I had published. It was cracked by a lot of computers working in tandem, running for many, many hours. As a result, Rivest had to revise his code a little bit, so he used larger primes. The code is based on multiplying two primes together. I think he had to go to a much larger prime to keep the code sound.

Figure 5. This illustration appeared on the cover of the issue of *Discover* magazine that carried Martin Gardner's article on quantum mechanics, "Quantum Weirdness". A framed version hangs on Gardner's wall.

Notices: *Have you followed developments in quantum coding?*

Gardner: Yes, I have a very low-level understanding of quantum codes. Apparently it's possible to base a code on quantum mechanics, though I don't know how it's done exactly. If I were younger, I would try to understand quantum mechanics. It's such a fascinating field. An illustration that ran with an article I did for *Discover*, called "Quantum Weirdness", shows an eye looking at a tree, illustrating the question of whether the tree exists if nobody is observing it. Of course, quantum mechanics is tinged with this kind of solipsism, because there is a sense in which an electron doesn't really have any properties until you measure it. There is a subjective aspect to quantum mechanics. Some experts like Eugene Wigner were convinced the universe wouldn't exist if it didn't have observers in it. He argued that, without a conscious mind observing the quantum events, the events don't really exist, which I think is a crazy point of view. But it is defended by a number of quantum mechanics experts. Einstein thought this approach was completely ridiculous. He liked to say, "Does the tree exist if a mouse observes it?" That was one of Einstein's famous rebuttals

Notices: *So you don't believe in these ideas?*

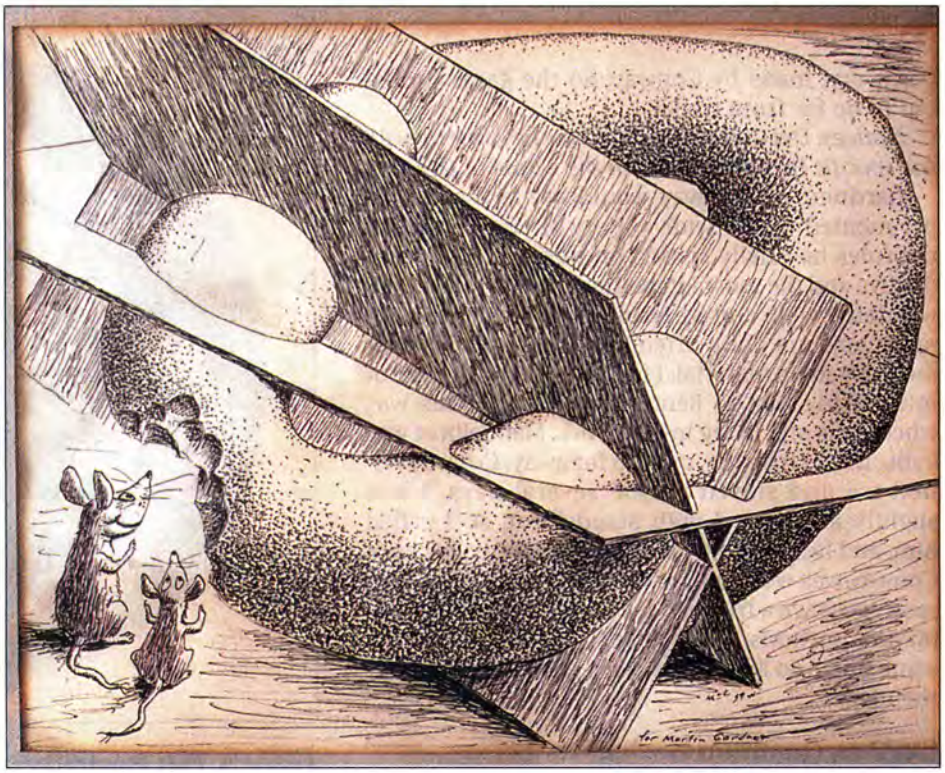

Figure 6. An artist friend drew this picture for Gardner, illustrating the maximum number of pieces into which a bagel can be sliced by three planes.

Gardner: No, I'm a hardheaded realist. I think the universe exists even if life ceased to exist. Most philosophers of science are realists. Bertrand Russell certainly was. And of course Einstein and his friend Kurt Gödel were devout realists.

Notices: *Did you ever get interested in the philosophy of mathematics and the question of the reality of mathematical objects?*

Gardner: Yes, I have. I have published a number of pieces defending mathematical realism.

Notices: *Have you ever met a mathematician who was not a realist?*

Gardner: I have not actually met any, but there are a number of mathematicians who are not realists. Reuben Hersh is a marvelous example of a person who thinks that mathematics is entirely a human product and has no reality outside of human culture. He has written a whole book about this called *What Is Mathematics* ***Really?*** To Reuben Hersh, mathematics is no different from art or fashions in clothes. It's a cultural phenomenon. The postmodernists in France have essentially this point of view. And it drives me up the wall. I like to say, "If two dinosaurs met two other dinosaurs in a clearing, there would be four of them even though the animals would be too stupid to know that." Of course, the argument as to whether the universe exists outside of the human mind goes back to the middle ages.

Roger Penrose is a good example of a staunch realist in mathematics. He likes to talk about the Mandelbrot set as an example of something out there, independent of human minds, because as you keep magnifying portions of it and exploring it, you discover new properties. It's like walking through a jungle and charting the mountains and rivers and so on. Something is out there, independent of your mind. It doesn't have the same kind of reality as sticks and stones, but it has its own peculiar reality. In the new book of Penrose, *The Road to Reality*, he has a whole chapter defending mathematical realism.

I once asked Raymond Smullyan, who is an expert on set theory, if he knew of any experts on set theory who are not realists. He could not think of a one.

Notices: *That's an interesting example, of course, because set theorists use things that are really exotic, like inaccessible cardinals.*

Gardner: They exist in this peculiar mathematical world of their own. They don't exist the way the Sun exists or the Moon exists. But they exist the way complex numbers exist, for example, or imaginary numbers. They have a peculiar reality.

The last math conference I went to was in some town in North Carolina. It was a conference to honor the mathematician Hermann Weyl. Penrose was speaking, and I went there partly to hear him speak and to meet him. I also went because Ed Witten was talking on superstrings. I understood everything that Penrose said in his lecture, and I didn't understand a single sentence of Witten. Not a single sentence. Superstring theory has been absorbed into membrane theory, or M-theory, as they call it. There is not a scintilla of empirical evidence to support it. Although I have only a partial understanding of M-theory, it strikes me as comparable to Ptolemy's epicycles. It's getting more and

Martin Gardner's Notes on the Illustrations

Some of the illustrations in this article are photographs of artworks owned by Martin Gardner and displayed on the walls in his home. He kindly wrote the following notes about each work.

Figure 1. Maurits Escher's *Circle Limit*, so called because the circle is the limit of an infinite set of smaller and smaller fishes. I devoted a *Scientific American* column to Escher many years before he became famous. I first learned of Escher from pictures in Donald Coxeter's classic *Introduction to Geometry*. Coxeter told me in a letter that Escher still had copies of this picture for sale. I bought it directly from Escher for sixty dollars. Had I anticipated his fame, I could have bought many of his black and white pictures for a paltry sum. The picture is based on Poincaré's model of the hyperbolic plane. The model is used to prove that if Euclidean geometry is consistent, so is hyperbolic geometry.

Figure 3. Einstein. This picture was taken by a college friend, David Eisendrath, a professional photographer in New York City. It ran on the first page of a short-lived newspaper called *PM* that had been funded by Marshall Field. Einstein had just become a U.S. citizen, as indicated by the tiny flag in his lapel. Dave told me that although Einstein was dressed in a business suit and tie, he wore tennis shoes with no socks. The cloud of smoke resembles a goatee.

Figure 5. The eye looking at a tree. This was an illustration for my article "Quantum Weirdness" that ran in *Discover* (October 1982). Quantum theory has a tinge of solipsism in the sense that basic particles have no definite properties until they are measured. A few physicists have argued that the Moon doesn't exist unless it is observed. Einstein, who disliked quantum mechanics, liked to ask: "Observed by a mouse?" Bishop Berkeley claimed that "to be is to be perceived." This prompted Ronald Knox to write a famous limerick:

There once was a man who said: "God
Must think it exceedingly odd
  If he finds that this tree
  Continues to be
When there's no one about in the Quad."

The answer was supplied by an anonymous author in an equally famous limerick:

Dear Sir, your astonishment's odd,
I am always about in the Quad.
  And that's why the tree
  Will continue to be
Since observed by yours faithfully, GOD.

Figure 6. The sliced doughnut. In an early *Scientific American* column I asked for the maximum number of pieces into which a torus could be sliced by three planes. An old puzzle concerned slicing a pie or cake with three cuts. I generalized it to a torus. An artist friend, John McClellan, who ran an art store in Woodstock, New York, sent me this picture as a gift. The answer is 13 pieces. The formula for n cuts is $\frac{n^3+3n^2+8n}{6}$.

Figure 7. The domino picture was made by Ken Knowlton, a mathematician who pioneered this technique. He makes similar pictures with other objects such as playing cards, sea shells, etc.

more baroque. Penrose thinks that M-theory is very ingenious and very beautiful but has no relation to physical reality. That's his opinion.

Notices: *Because of the lack of empirical evidence?*

Gardner: Yes. But Penrose has a rival theory that he calls twistor theory. I only partially understand it, but twistors are structures that he thinks are the basic elements of spacetime. The theory is based on earlier work on what are called spinors. I have only a very dim grasp of his twistor theory. He has a big section on it in his latest book, and he has published numerous papers on twistor theory. I noticed that when he discusses twistor theory in this new book, he speaks of efforts that have been made to combine it with membrane theory. He comes to the conclusion that there is no way they could be combined, and he states flatly that if one is true, then the other has to be false. Now, whether twistor theory has any relevance to the universe, I haven't the foggiest notion. But there is a whole group of mathematicians working on it.

Notices: *So there is no empirical evidence for twistor theory either?*

Gardner: None whatever.

Debunking Pseudoscience

Notices: *How have you managed the professional aspects of your writing career? Are you part of a professional author's guild or something like that?*

Gardner: I used to be a member of the Author's League, and I finally dropped out of it because it kept getting more and more expensive to be a member, and they weren't really helping me in any special way. I don't have an agent, for example. I finally learned enough about contracts so I could do them on my own. I did have an agent for my first book, *Fads and Fallacies in the Name of Science*. A high school friend of mine was a literary agent. Actually, he persuaded me to do that book. I had done an article for the *Antioch Review* on pseudoscience called "Hermit Scientists". My friend said, "Why don't you expand this into a book?" So he handled the book for me and sold it to Putnam's. It did so poorly with Putnam's that they remaindered it after they sold a few copies! Then it was picked up by Dover, and it became one of Dover's best sellers. There was a nighttime radio program by a man named Long John Neville. He picked up on this book, and for about a year he had on his program cranks who attacked the book. It was the attacks on the Long John Neville show that boosted the sales. It hasn't been out of print since. I have chapters in the book attacking pseudosciences that at the time I wrote the book I would never have expected to survive.

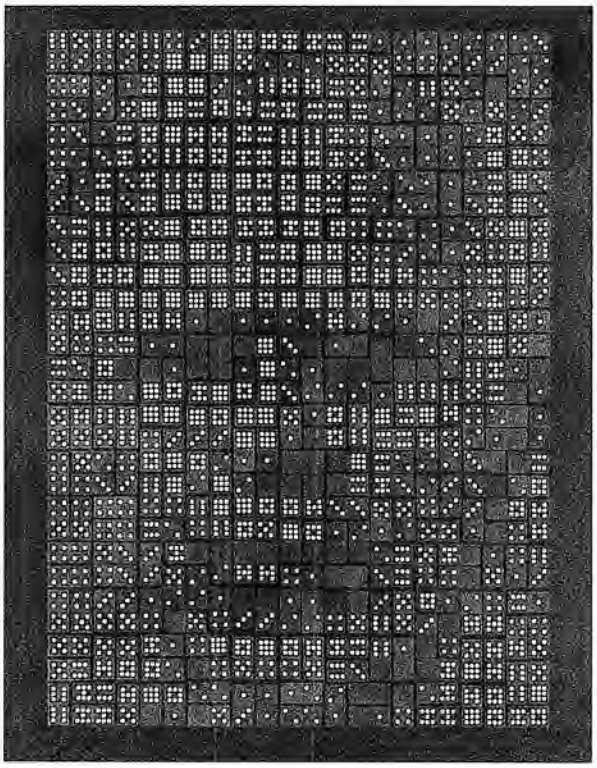

Figure 7. This enigmatic portrait of Martin Gardner is made of dominoes.

Notices: *But some of them have, like Scientology.*

Gardner: Yes, I have a chapter on Scientology—in those days it was called Dianetics. It was such a crazy point of view I couldn't imagine that it would last more than a few years. It became a tremendous movement. There are Hollywood stars who are Scientologists. I think L. Ron Hubbard originally thought of it just as a way to make money. But then later on he began to believe it himself.

Notices: *How did you get interested in debunking pseudoscience?*

Gardner: First I have to talk about my religious background. When I was in high school, I was an evangelical Protestant, due mainly to the influence of a Sunday school teacher I knew. He had a wonderful name for an evangelical Christian, George Getgood. He was also a counselor in a summer camp that I attended in Minnesota every year. I went through a temporary phase of considering myself an evangelical Christian. There was a period in which I was doubtful about the theory of evolution, mainly because of reading a crank book called *The New Geology*, by a creationist named George McCready Price. His attack on evolution was fairly sophisticated. He was a Seventh Day Adventist who believed that the fossils were remnants of life that perished at the time of the flood. He argued that the theory of evolution is largely based on the fact that when you consider the fossils in the different strata, you find very simple forms in the older strata, and then as you get into younger and younger strata, you get more complicated forms. But, he said, this is circular reasoning, because the way they date the beds is by the type of fossils they contain. So his *New Geology* is filled with photographs of places where the fossils are in the wrong order: you find the complicated fossils in the lower beds and the simpler fossils in the higher beds. What he didn't realize is that these "upside- down" fossils are due to folding of the strata or cleavage along a fault line. But if you don't know this fact, his arguments are quite strong. It was not until I took courses in geology at the University of Chicago that I understood where Price went wrong. His book is one of the great crank works of all time. Modern creationists are still citing it and recommending it—sometimes without giving him credit! I think that was the first time that I became interested in pseudoscience. I probably would not have followed it up if my friend had not recommended I do a book about it. Later I got acquainted with the philosopher Paul Kurtz, the magician James Randi, the sociologist Marcello Truzzi, and the psychologist Ray Hyman. We started the Committee for Scientific Investigation of Claims of the Paranormal, or CSICOP, as we called it. I began doing a column in the *Skeptical Inquirer*, and those columns have come out as book collections.

Notices: *Have you been present at demonstrations by psychics, like Uri Geller, who bends spoons?*

Gardner: I have never actually seen Uri Geller, though I have written two booklets exposing his methods, under the pseudonym of Uriah Fuller. His methods are well known to magicians. The magicians understood what he was doing from the very start.

Notices: *When you wrote those booklets, didn't that break the magician's code of not giving away the secret of the tricks?*

Gardner: Not really, because the things that Uri Geller does are not done by magicians. Magicians would be ashamed to stand up in front of an audience and bend a spoon! It seems too silly. The booklets don't expose anything that magicians do. They just expose what Geller does.

Notices: *So how does he bend a spoon?*

Gardner: He gains access to the spoons before the demonstration. If you take an ordinary spoon, it's easy to bend it. You can bend it back and forth a few times to weaken the metal to the point where if you just stroke the spoon it bends. That's the whole secret of Uri Geller's metal bending—getting to the material in advance and preparing it.

Art and Aesthetics

Notices: *If you had been a mathematician, what area do you think you would have worked in?*

Gardner: Topology fascinates me, because you are dealing with such basic properties.

Notices: *You argue in your book* Whys of a Philosophical Scrivener *that there exist absolute aesthetic standards for art.*

Gardner: Yes, though it's very hard to state what they are. Ed Rinehart made a fortune painting canvases that were just one solid color. He had his black period in which the canvas was totally black. And then he had a blue period in which he was painting the canvas blue. He was exhibited in top shows in New York, and his pictures wound up in museums. I did a column in *Scientific American* on minimal art, and I reproduced one of Ed Rinehart's black paintings. Of course, it was just a solid square of pure black. The publisher insisted on getting permission from the gallery to reproduce it.

Notices: *And they gave it?*

Gardner: They gave it.

Notices: *If there are absolute standards for aesthetics in art, do they also exist in mathematics?*

Gardner: Dirac was a great believer in having beautiful equations. "There is no room in mathematics for ugly mathematics," was, I think, one of his statements. But in physics you can have very beautiful theories that turn out to be totally false. There is a predecessor of string theory called vortex theory, in which all the basic particles were supposed to be knots in the ether. Since there is no friction in the ether, once a little particle would form, it could not lose its shape. I was doing some checking on it, and I ran into statements by top physicists (including James Maxwell, Lord Kelvin, J. J. Thomson, and Albert Michelson) that this theory is too beautiful not to be true. See Chapter 32 in my *New Ambidextrous Universe.*

Speaking of art, several times I met Salvador Dali in New York. We would have lunch together. He had read my writings about mathematics. He was interested in mathematics in a funny way. Some of his paintings show a reflection in a cylinder or a cone, which is called anamorphic art. He also did paintings that turn into other pictures when you give them a rotation of 90 degrees. He liked to experiment with strange art.

Notices: *What was he like as a person?*

Gardner: He seemed perfectly normal.

Notices: *Really? Even with that mustache!*

Gardner: Yeah, he had that funny mustache. I remember after one lunch, he wanted to go to Brentano's bookstore. We walked down Fifth Avenue, and we could take only about five steps before someone handed him a pen and a piece of paper and wanted his autograph. He would scribble really fast, and then we would walk on.

About the Cover

Martin Gardner, the subject of this month's feature interview, was photographed at his residence in Norman, Oklahoma, on March 3, 2005. Gardner is holding the 1999 "Definitive Edition" of his book *The Annotated Alice*, first published in 1960. There are now over 500,000 copies in print. In the background is Ken Knowlton's portrait of Gardner, constructed from dominos. (This photograph, in addition to the uncredited photos in the article, were taken for the *Notices* by Gilbert Jain Photography.)

—Andy Magid