

The puzzling and paradoxical worlds of Raymond Smullyan

By Ira Mothner

Whether he is teaching logic to his students or giving brain teasers to his readers, there is more to this wizardly man than meets the eye

Remember "The Lady or the Tiger?", Frank Stockton's classic story of the prisoner forced to choose which of two doors he will open? Behind one waits a lovely lady. Behind the other crouches a hungry tiger. Pick the right door and he gets to marry the lady. Pick the wrong door and he gets eaten.

Now, Stockton's prisoner didn't have a clue to what he'd find behind the doors. But suppose he had. What if there were signs on the doors, and to make matters trickier he knew that only one of the signs was true? The other had to be false. The sign on Room One read: IN THIS ROOM THERE IS A LADY, AND IN THE OTHER ROOM THERE IS A TIGER. The sign on Room Two read: IN ONE OF THESE ROOMS THERE IS A LADY, AND IN ONE OF THESE ROOMS THERE IS A TIGER. With that information he chose the right door. Can you?

If you have figured it out, then you are on your way to being hooked by Raymond Smullyan, author of a book called "The Lady or the Tiger?" (just published by Alfred A. Knopf) that takes from the Stockton tale its title and double-door dilemma. Called by the publisher a collection of logic puzzles, paradoxes and other curiosities, the book is much more than that, and Smullyan is not just a clever puzzle maker.

Professor of mathematics and philosophy at the City University of New York (CUNY), Smullyan, 63, is the author of two highly regarded works on mathematical logic, and published his first popular book just five years ago. There have been five more since then.

A spare, angular man, he seems taller than his slightly more than six feet and, with his full beard and long white hair, looks a bit like an Old Testament prophet. But the Jeremiah image is demolished by a boyish grin, and his life is full of the paradoxes he enjoys so much. Smullyan, the college professor, was a high-school dropout. He is -a concert-caliber pianist who hardly ever plays in public, and a basically shy man who adores appearing on the lecture platform or reading aloud from his own works (breaking himself up at almost every humorous line). He is a logician who has embraced the Tao, a talented astronomer who has set aside his telescope, and a magician with

professional skills and patter who once earned a living working nightclubs in Chicago.

As the author of *The Lady or the Tiger?*, Smullyan is much like Alice's white rabbit (the one with waistcoat and watch who leads Lewis Carroll's heroine down the rabbit hole and into Wonderland). Smullyan lures readers deeper and deeper into mathematical logic with tricks and games, broad humor and a bizarre cast of borrowed and original characters. Popping in and out of *The Lady or the Tiger?* and his earlier book of logic puzzles (*What is the Name of This Book?*) are Carroll's Alice and Humpty Dumpty, Edgar Allan Poe's Doctor Tarr and Professor Fether, plus an assortment of werewolves, vampires, knights and knaves and Smullyan's all-purpose problem solver, Inspector Craig of Scotland Yard.

Just about all of Smullyan's puzzles are fun: many seem simple, but few are as easy as the first lady-and-tiger problem. (Some other fairly easy ones appear on these pages; the solutions are on page 6.) If, as I, you had trouble with that one, don't despair. Logic puzzles take some getting used to. Look at it again. Remember, one sign must be true and one false. Now, if the sign on Room One were true, then the sign on Room Two would also have to be true, and that simply cannot be. So, the sign on Room Two must be true, and the sign on Room One false. Since the false sign on Room One says the lady is in that room, she clearly is not. She must be in Room Two.

The Smullyan puzzles stand out brightly against the rest of today's recreational logic. Martin Gardner, who wrote *Scientific American's* "Mathematical Games" column for 24 years, marvels unabashedly at Smullyan's inventiveness. "His output of brand-new problems is absolutely fantastic. Aside from the old chestnuts he puts up front in his books, the problems are all original."

What makes the books more than just collections of increasingly complex brain teasers is the ground the puzzles cover, and Smullyan's great trick is how many readers are able to tag along. Because even his most daunting puzzles are simply put, and require so little knowledge of math or formal logic, Smullyan draws even dogged and defensive nonscientists further into his books and deep into the other culture, toward the foundations

The Politician Puzzle

A certain convention numbered 100 politicians. Each politician was either crooked or honest. We are given the following two facts:

- At least one of the politicians was honest.
- Given any two of the politicians, at least one of the two was crooked. Can it be determined from these two facts how many of the politicians were honest and how many of them were crooked? (Answers to puzzles are on p. 6.)

of modern mathematics. The puzzles move from propositional logic to concepts like set theory and formal systems. In both books, they reach Kurt Gödel's Incompleteness Theorem.

A landmark piece of mathematical logic, Gödel's Theorem blasted the age-old dream of a single, vast mathematical system, a kind of mathematical truth-machine, that could prove any proposition true or false. It set mathematicians seeking instead for limitations on mathematical systems of reasoning and limitations on the computers that depend upon them. What Gödel showed was that any system of logic, except the very simplest, could be made consistent-free from contradictions-only by allowing the formulation of certain propositions that could not be proved either true or false. In less exotic terms, Gödel proved that one could never construct a system of thought that is complete-that does away with uncertainty and paradox-which is just what logicians of the time were trying to accomplish.

By basing his puzzles on Gödel's proof, the discoveries that followed it and other modern mathematical basics, Smullyan puts readers in touch with ideas that even technologically ignorant folk now feel some need to grapple with. The need grows out of anxiety, as we watch mathematics' most enterprising offspring, computer science, plugging into just about every aspect of our culture.

For ignorant grapplers yearning to learn more, Smullyan makes a dandy guide. He teaches logic at CUNY Graduate Center and mathematics at the system's Lehman College. "Elegant" was the adjective most scholarly reviewers grabbed for - first when his works, *Theory of Formal Systems* and *First Order Logic*, appeared. "What characterizes Ray's books and papers," says George Boolos, professor of philosophy at MIT, "is how astoundingly clear they are. He is able to strip away what is inessential and give you the core of an idea, undiluted and unvarnished. He is a great simplifier."

In addition to his puzzle books, Smullyan has produced two other works of recreational logic, *The Chess Mysteries of Sherlock Holmes* and *The Chess Mysteries of the Arabian Knights*, both filled with nontraditional chess problems that challenge the reader to discover not what moves come next but what moves occurred last. Turning almost 180 degrees away from logic, he has taken a wry and thoroughly approving look at Eastern thought in *The Tao is Silent* and published a kind of catchall collection of paradoxes, personal essays and philosophical speculations in *This Book Needs No Title*. Another collection of logic puzzles, *Alice in Puzzleland*, is already in galleys with the more serious if whimsically titled *Philosophical Phantasies* set to appear early next year.

The Case of the Smithsonian Clocks

Two friends, whom we will call Arthur and Robert, were curators at the Museum of American History. Both were born in the month of May, one in 1932 and the other a year later. Each was in charge of a beautiful antique clock. Both of the clocks worked pretty well, considering their ages, but one of them lost ten seconds an hour and the other gained ten seconds an hour. On one bright day in January, the two friends set both clocks right at exactly 12 noon. "You realize," said Arthur, "that the clocks will start drifting apart, and -they won't be together again until-let's see-why, on the very day you will be 47 years old. Am I right?" Robert then made a short calculation. "That's right!" he said.

Who is older, Arthur or Robert?

How does he do it all? "Consecutively," explains his friend and former student, Melvin Fitting, who also teaches mathematics at Lehman. "Some people do things simultaneously. He doesn't. Ray has always been episodic in his work. He will get interested in something and more or less abandon everything else. He wrote an essay at one point," Fitting recalls, "and then, for the next couple of years, there was this enormous stream of essays. Pretty much everything else stopped, and the house was filled with piles of paper.

"After the essay stage," Fitting goes on, "he started doing puzzles. For the next two or three years, everything was puzzles. They were finding their way into all of his work. Now he's gone back to math, but the puzzle element is still there. Often, when he is telling me a new theorem, he will tell it in the form of a puzzle and then give it to me in straight math."

Smullyan does most of his work at a large table in the living room of his home near Hunter Mountain in the Catskills, more than 100 miles and nearly three hours away from Manhattan. Twice a week, on Monday and Wednesday, he heads into the city to teach.

These days, the telescope he made (grinding his own six-inch mirror) is packed away, and he rarely touches either of the pianos or the clavichord in the house. Music is provided by Smullyan's Belgian-born wife, Blanche, also a pianist, who ran a Manhattan music school before the couple moved to their home in tiny Elka Park—a community so small that an issue of the *Journal of Magic History* addressed to Raymond What's-his-name actually reached Smullyan. In the two-story house, manuscripts, proofs and journals are stacked on just about every horizontal surface, and shelves are filled with books of philosophy, religion and handsomely bound editions of Thackeray, Lamb, Defoe, Trollope, Eliot and others, all acquired at bargain prices by Smullyan, who does not read much fiction these days. He does prize, however, his Edgar Rice Burroughs first editions.

Far from ascetic, he is an unreconstructed smoker with a teen-ager's sweet tooth and a positive passion for packaged pound cake. (Blanche keeps stacks of his empty cake containers on the porch to use for growing her seedlings.)

At home, Smullyan spends almost all of his time working quietly, filling pads of lined white paper with his jagged scrawl, while Blanche makes the most of healthy outdoor living, gardening in summer and getting wood for the stoves in winter. Her husband, she notes with affectionate resignation, does neither. "He does no exercise at all," she claims, which is certainly living up to what

he calls his "idealized self-image" as "a philosopher of leisure, idleness, and quietude" and altogether in keeping with the Taoist doctrine of WuWei, action through inaction.

In the classroom, Smullyan is anything but leisurely or quiet. Early this spring semester, I watched him teach a graduate-level logic course, as he lurched to the blackboard (where he writes a serviceable hand and complete sentences) and paced about his desk, fidgeting and chuckling. He would break into a small sibilant laugh at problems that seemed to leave his students more confused than amused.

Before class began, he tried to warm up the group, tossing out some simple puzzles the way a baseball coach bats out grounders. "There are twin brothers," he told the dozen or so students in the crowded little room. "One lies and one tells the truth. One is named John. How can you discover which brother is John by asking one three-word question?"

The answer Smullyan gave them, allowing that there might be others, was the three-word question, "Is John truthful?" As he explained it, if John were indeed truthful, then John would answer Yes to the question, and his brother, the liar, would answer No. If John were not truthful, then he would also answer Yes to the question, while his brother, the truth teller, would answer No. In either case, whether John were truthful or not, the brother who answered Yes would be John.

Smullyan, who loves to write and tell absentminded professor stories, real and apocryphal, could easily pass as the subject of one himself as he ambles through the corridors of the Graduate Center in midtown Manhattan, seeming neither surprised nor distressed when he wanders off the elevator onto the wrong floor. It is hard to imagine him when he played as a suave nightclub magician, Five-Ace Merrill. But there seems to be an almost infinite number of different Smullyans and the magician hardly ever appears in class. Smullyan's current teaching style, according to Malgorzata Askanas, who earned her PhD at the Center in 1975, derives from his puzzles. "He sort of strings you along, and then you find yourself in the heart of Gödel's Theorem. You don't notice that you are doing what some people would consider 'hard stuff.' It all seems very easy. You just don't realize you are learning something profound."

As an educator, he holds to the notion that children are eagerly waiting to be filled with the right kinds of knowledge. "If they are interested," he declares, "they will learn." "And if they are not interested?" I ask. "Leave them alone," he insists. Smullyan cheerfully admits that he doesn't

Inspector Craig Visits Transylvania

Inspector Craig of Scotland Yard was called to Transylvania to solve some cases of vampirism. Arriving there, he found the country inhabited both by vampires and humans. Vampires always lie and humans always tell the truth. However, half the inhabitants, both human and vampire, are insane and totally deluded in their beliefs: all true propositions they believe false, and all false propositions they believe true. The other half of the inhabitants are completely sane: all true statements they know to be true, and all false statements they know to be false. Thus sane humans and insane vampires make only true statements; insane humans and sane vampires make only false statements. Inspector Craig met two sisters, Lucy and Minna. He knew that one was a vampire and one was a human, but knew nothing about the sanity of either. Here is the investigation: Craig (to Lucy): Tell me about yourselves. Lucy: We are both insane. Craig (to Minna): Is that true? Minna: Of course not! From this, Craig -was able to prove which of the sisters was the vampire. Which one was it?

believe in grades and considers reporting a student's failure as an utter betrayal. He doesn't believe in degrees either. "Let kids learn what they want to learn," he says. "Let employers test them when they compete for jobs."

Smullyan's unorthodox views on, education spring naturally from his experiences in and out of school, for he was, he admits, "a perennial dropout" and is "mainly self-taught." Born in Far Rockaway, Long Island, then a pleasant seaside village at the ultimate reaches of Queens county, Smullyan moved to Manhattan with his family when he was 13 and attended Theodore Roosevelt High School in the Bronx to take special music courses the school offered.

Music and science were his chief interests, and he saw no reason why he could not pursue careers in both fields. "I was a bit of a prodigy," he recalls; he won a gold medal in a citywide piano competition when he was 12. The decision to quit in mid-high school was made, he explains, "because no one there would teach me what I wanted to learn," mostly modern algebra and logic.

He learned them on his own and, after several years of truly independent studies, took the College Board exams and was accepted by Pacific University in Oregon, the first of five colleges he was to attend. Next was Reed College, followed by a year in San Francisco, where he studied piano, and a return to New York to work at math and logic, begin devising chess puzzles and start learning magic.

At 24, Smullyan gave formal education another shot, enrolling at the University of Wisconsin, where he stayed* for a year before transferring to the University of Chicago. After a semester there, he dropped out again but kept on studying, and taught music at Chicago's Roosevelt College. Back in New York for two years, he began performing as

a magician in Greenwich Village nightclubs and finally went back to the University of Chicago when he was 30.

Smullyan was clearly in no rush to wind up his studies. He took courses at the University for the next several years and moved his magic act to downtown Chicago. In 1955, Rudolf Carnap, a celebrated philosopher of science under whom Smullyan studied, recommended him for a post in the math department at Dartmouth. He got it, based on a paper he had written, although he lacked even a high-school diploma. After teaching at Dartmouth for a year, the University of Chicago awarded the then 35-year-old Smullyan his B.A., giving him credit for a calculus course he was teaching but had never taken.

In 1957, Smullyan moved to Princeton University, where he earned his PhD and taught until 1961, when he joined the mathematics department at Yeshiva University. Seven years later, he came to CUNY.

While at Princeton, Smullyan had shown one of his chess problems to a student. Sometime later, the problem appeared in Britain's Manchester Guardian. It seemed the student's father had wanted to show the

Guardian's editors the kind of material he hoped they would run. The paper took the hint, and Smullyan began to publish chess problems there regularly.

Sometime in the mid-1970s a few of his chess problems appeared in Scientific American with the note "author unknown." Smullyan contacted Martin Gardner, who had already run some of his logic puzzles and knew him as a fellow magician. "I told Gardner I had a whole bunch and planned a book. Gardner wrote back and wanted to know why I didn't stop shillyshallying and get the book done."

Smullyan's chess problems are not the kind that chess enthusiasts are used to. "They belong," Smullyan explains, "to the field known as retrograde analysis. Unlike the more conventional type of chess problem (which is concerned with the number of moves in which white can win), these problems are concerned only with the past history of the game." They pose such questions as which way the pieces were moving or which piece has been promoted. They can ask for the location of a piece missing from the board, the identity of an unidentified piece whose position is known, or the square on which a particular piece was captured.

What the reader gets out of the puzzles, in addition to pure pleasure, is plenty of exercise in reasoning backward, and the case for this kind of deduction was best made by old Sherlock himself (not Smullyan's but Sir Arthur Conan Doyle's) in *A Study in Scarlet*: "In solving a problem of this sort, the grand thing is to be able to reason backward. That is a very useful accomplishment, and a very easy one, but people do not practice it much. In the everyday affairs of life it is more useful to reason forward, and so the other comes to be neglected. There are 50 who can reason synthetically for one who can reason analytically."

Smullyan is not planning to delight or distress chess players with more problems in retrograde analysis, at least not in the foreseeable future. His next book out, *Alice in Puzzleland*, introduces some new examples and new varieties of logic puzzles. What Martin Gardner seems to value most in Smullyan are "the very tricky and funny ways he has of getting you into really deep water. Nobody

has done that before. Lewis Carroll invented all kinds of logic puzzles, and they were very amusing, but when you get down to what they are all about, they're all about syllogisms. Ray has started where Carroll left off. He's done what Carroll might have done if he were living today."

Another admirer of Smullyan's is Douglas R. Hofstadter, author of the Pulitzer Prize-winning book *Gödel, Escher, Bach: An Eternal Golden Braid*. They both taught at Indiana University. Hofstadter recognizes a variety of different Smullyans or a series of Smullyans, one inside the other. "I have never penetrated very far into that many-layered structure," he says. "I don't know much about the inner Smullyan." Not many do.

Dr. O. B. Hardison jr., director of the Folger Shakespeare Library in Washington (SMITHSONIAN, April 1982) is another fan who appreciates the many different aspects of Smullyan and- tells this story about Smullyan the magician: "I was at a lovely dinner party with him in New York and he was performing tricks for our host's 11-year-old daughter. It was dazzling, astounding, almost sinister. He was pulling coins out of her ear and out of her nose and carrying on this delightful, witty patter the whole time.

"Finally, he had her clench her fist and put it on the table. He touched the top of her hand, and when she opened her fist there was a crumpled dollar bill in it. That's when the girl shrieked and ran upstairs. It was about ten minutes before she could compose herself and come back down. How Smullyan did it, I can't possibly say."

The Island of Questioners

Somewhere in the vast reaches of the ocean, there is a very strange island known as the Island of Questioners. It derives its name from the fact that its inhabitants never make statements, they only ask questions. The inhabitants ask only questions answerable by Yes or No. Each inhabitant is one of two types, A and B. Those of type A ask only questions whose correct answer is Yes; those of type B ask only questions whose correct answer is No. For example, an inhabitant of type A could ask, "Does two plus two equal four?" But he could not ask whether two plus two equals five. An inhabitant of type B could not ask whether two plus two equals four, but he could ask whether two plus two equals five.

I once visited this island and met a couple named Ethan and Violet Russell. I heard Ethan ask some, one, "Are Violet and I both of type B?" What type is Violet?

Puzzle solutions

The Politician

A fairly common answer is "50 honest and 50 crooked." Another rather frequent one is "51 honest and 49 crooked." Both answers are wrong. Now let us see how to find the correct solution.

We are given the information that at least one person is honest. Let us pick out any one honest person, whose name, say, is Frank. Now pick any of the remaining 99; call him John. By the second given condition, at least one of the two men Frank, John-is crooked. Since Frank is not crooked, it must be John. Since John arbitrarily represents any of the remaining 99 men, then each of those 99 men must be crooked. So the answer is that one is honest and 99 are crooked.

Another way of proving it is this: the statement that given any two, at least one is crooked, says nothing more or less than that given any two, they are not both honest; in other words, no two are honest. This means that at most one is honest. Also (by the first condition), at least one is honest. Hence exactly one is honest.

The Case of the Smithsonian Clocks

We must first determine the number of days it will take for the two clocks to come together. Since one clock is losing time at the same rate as the other is gaining, then the next time they will be together is when the slow clock has lost six hours and the fast clock has gained six hours. (Both clocks will then read six o'clock; of course they will both be wrong, but together.)

Now, ten seconds an hour is four minutes (240 seconds) a day, which is one hour in 15 days, or six hours in 90 days. And so the clocks will come together exactly 90 days after the day in January on which they were set right. Also, they will come together on Robert's 47th birthday, which is in May.

How can 90 days be fitted between a day in January and a day in May? Consulting a calendar, we see that there are exactly 90 days between January 31 and May 1 providing it is not a leap year! In a leap year the shortest possible time between any day in January and any day in May is 91 days (since February 29 falls in between). This proves that Robert's 47th birthday cannot fall in a leap year, and therefore Robert could not have been born in 1933 (since 47 years after 1933 is 1980, a leap year). Therefore Robert must have been born in 1932, and it is Arthur who was born in 1933. And so Robert is the older (incidentally, the year of

the story-the year in which the clocks were set right-must be 1979).

Inspector Craig visits Transylvania

Lucy's statement is either true or false. If it is true, then both sisters are really insane; hence Lucy is insane, and the only insane Transylvanian who can make a true statement is an insane vampire. So, if Lucy's statement is true, then Lucy is a vampire.

Suppose Lucy's statement is false. Then at least one of the sisters is sane. If Lucy is sane, then, since she has made a false statement, she must be a vampire (because sane humans make only true statements). Suppose Lucy is insane. Then it must be Minna who is sane. Also, Minna, by contradicting Lucy's false statement, has made a true statement. Therefore, Minna is sane and has made a true statement; so Minna is human and, again, Lucy must be the vampire.

This proves that regardless of whether Lucy's statement is true or false, Lucy is the vampire.

The Island of Questioners

We must first find out Ethan's type. Suppose Ethan is of type A. Then the correct answer to his question must be Yes (since Yes is the correct answer to questions asked by those of type A), which would mean that Ethan and Violet are both of type B, which would mean that Ethan is of type B, and we have a contradiction. Therefore, Ethan can't be of type A; he must be of type B. Since he is of type B, the correct answer to his question is No, so it is not the case that he and Violet are both of type B. This means Violet must be of type A.