None of the waitresses at the restaurant where Thelma had worked knew what had happened to her. She left her job six months before, and they hadn't heard from her since.

No Thelma O'Keefe was in the Tulsa phone book. I drove back to Norman feeling sad and frustrated. Should I hire a detective? The Norman yellow book had a long list of "investigators" and two detective agencies.

I was planning to call one of the agencies when my telephone rang. It was Thelma!

"I heard you were asking about me," she said.

"Yes. How did you get my phone number?"

"It's on the Internet. How are strings?"

"Not so good. It didn't predict dark matter. It didn't predict dark energy. It even failed to pass one of my tests. Lots of stringers are starting to have doubts, including me."

"If we meet again," said Thelma, "don't tell me about it."

Further Reading

Two recent books attacking string/M theory as pseudoscience are *Not Even Wrong*, by mathematician Peter Woit (Basic Books, 2006), and *The Trouble with Physics*, by Lee Smolin (Mariner Books, 2007). See Chapter 18, "Is String Theory in Trouble?" in my book, *The Jinn from Hyperspace* (Prometheus Books, 2008).

Editor's note: A provocative and widely discussed article in which string theory is used to suggest that gravity is not a fundamental force, but is rather a consequence of entropy, is Erik Verlinde's "On the Origin of Gravity and the Laws of Newton" (2010), which can be found at `http://arxiv.org/abs/1001.0785`.

DOI: 10.4169/194762110X525557

Gathering for Gardner

Bruce Torrence

Photographs courtesy of Bruce Torrence

It's a chaotic scene in the lobby of the Ritz-Carlton. There's a dental convention getting under way, and as travel-weary orthodontic professionals trickle into the packed room, they encounter a bewildering display. Every tabletop holds a collection of fascinating objects—puzzles of every imaginable shape and design—around which magicians, mathematicians, and puzzle masters gather to discuss their latest inventions. The conversations are animated, and there is a tangible feeling that something important is unfolding. And indeed there is: unbeknownst to the dentists, the ninth Gathering for Gardner has just begun.

Atlanta has been host to this unlikely convention of tinkerers and free thinkers for almost two decades. They assemble to pay homage to Martin Gardner, the prolific and magnetic author whose interests spanned the seemingly disparate disciplines of mathematics, puzzles, magic, and the spirited debunking of pseudoscience. This invitation-only affair attracts luminaries in all of these fields, and despite their obvious differences, there is a fertile and dynamic common ground and a deep mutual respect among the participants.

What Has Tuesday Got to Do with It?

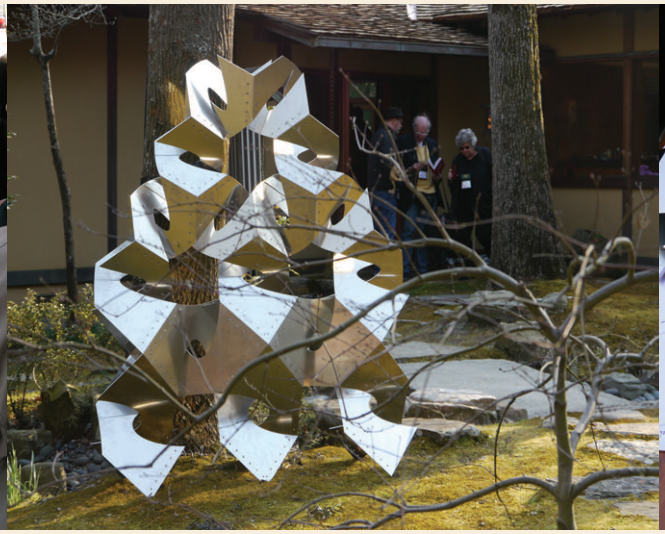
The organization of the conference is simple: there is one grand conference room with a single stage. Speakers give brief presentations in turn and are awarded a dollar coin for each minute that they finish ahead of their allotted time—an innovative and surprisingly inexpensive management tactic. Only one speaker really cashed in: Gary Foshee, a mechanical puzzle collector

and designer, faced the audience and spoke slowly, “I have two children. One is a boy born on a Tuesday. What is the probability I have two boys?” After a pause, he continued. “The first thing you think is ‘What has Tuesday got to do with it?’ Well, it has everything to do with it.” And with that, he stepped down (and collected a hefty stack of coins from the organizers).

Other talks focused on space-filling curves and genome folding, origami mazes, Lewis Carroll’s mathematics, dancing tessellations, psychological explanations for children’s magic theory, the history of Rubik’s cube, the relation between computer hacking and invention, self-replicating machines, illusion and perception, and on and on. The topics bounced so completely from one idea to the next that the effect was both intoxicating and refreshing. Spontaneous discussion arose in and out of the conference room. “What does Tuesday have to do with it?”

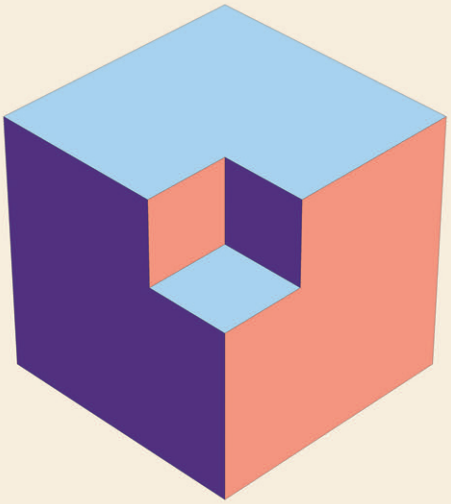
Foshee’s puzzle proved a perfect catalyst for discussion, and it is both fun and instructive to reason through it. One first has to make a few assumptions, and most of the people I spoke with agreed that it’s best to keep it simple. Let’s assume that there are no multiple births, and that any single birth is equally likely to be a boy or a girl. Assume further that births are uniformly distributed among the seven days of the week and that births are independent of one another. With these assumptions in hand, the puzzle succumbs easily to elementary probability theory. If one denotes a single birth by a two-tuple such as (boy, Tuesday) or (girl, Sunday), then there are 14 equally likely scenarios for a single birth. Foshee has two children, and with no other information, it follows that there are $14^2 = 196$ equally likely poss bilities for two children. But at least one of his children is a (boy, Tuesday), and some simple counting reveals that just 27 of the 196 outcomes satisfy this criterion. To see this, simply note that there are 14 cases where the Tuesday boy is the first born, and 14 where he is the second born, and subtract the single case that was counted twice. Among these 27 equally likely poss bilities, how many include two boys? Exactly 13—there are seven with (boy, Tuesday) as the first child, and seven with (boy, Tuesday) as the second child, from which we subtract the one we counted twice. Hence, the answer to Foshee’s riddle is 13/27, close to, but not exactly, 1/2.

Of course, the riddle leads naturally to a host of other questions. Does “one is a boy born on a Tuesday” mean that the other was *not* born on a Tuesday? I don’t read it this way. After all, the question makes clear that there is a poss bility that the second child is a boy, so why shouldn’t the child be allowed to arrive on a Tuesday also? More glaring is the counterintuitive nature of the result itself. Why should something like the day of the week affect the outcome? In thinking about this, it’s important to understand that had the day of the week not been mentioned, the answer would be 1/3, not 1/2, for only one of the three equally likely gender scenarios BB, BG, GB yields two boys. It’s all about counting the possible outcomes. If you are still wondering what Tuesday has to do with it, you may wish to consult the Further Reading section at the end of the article.


Just as Foshee's riddle yields to elementary probability theory, the vast majority of questions and puzzles posed at the gathering can be approached using basic principles. Each question has some clever twist, and of course this is the hallmark of a good brainteaser. Not all yield so easily, however. Bill Gosper, discoverer of the "glider gun" in Conway's game of life and considered by many to be the founder of the hacker community, proudly shared his "Dozenegger" puzzle. This is a physical puzzle in which twelve circles, each a different size meticulously laser-cut from a sheet of acrylic, must be snuggly packed (but not forced) into a larger elliptical cavity. (You can find it on his website—see the Further Reading section.)

Magic and illusion played a big part in the proceedings. Individual presentations in this area fell squarely in the field of cognitive psychology, highlighting peculiarities in human perception. A cube with a corner removed can be interpreted at least three ways (a large cube with a smaller cube cut out of it; a large cube with a smaller cube jutting out from it; and a large three-sided "room" with a cube sitting in its back corner). Verses of Led Zepplin's "Stairway to Heaven," played backwards can be made to say pretty much whatever you want provided the listener reads those words as it plays. Cinematic scenes in which actors changed costumes out of frame and returned in their new garb went unnoticed by the entire audience (until we were prompted to look for the change in a second showing). Performance artists and magicians also took to the stage and presented stunning illusions with amazing skill. Attendees were treated to close-up magic after hours by some of the best in the business. The net effect was one of fascination with a subtly disturbing aftertaste. Everyone came away with a similar feeling: how is it that we can be deceived so easily? Seeing and believing will never again be the same.



Abstract Structures

Another highlight of the gathering was an afternoon dedicated to socializing and sculpture building. Attendees were invited to participate in the construction and installation of several mathematical sculptures at the home of Tom Rodgers, one of the main organizers of the event. On the lighter side, literally, Vi Hart led a group that created geometric balloon art. At the other extreme, Chaim Goodman-Strauss collaborated on a weighty steel sculpture that suggested a space-filling curve packed neatly into a cube. Other sculptures were created using materials such as aluminum, wood, bamboo, and plastic. Under the direction of their designers—George Hart, Carlo Séquin, Akio Hizume, Rinus Roelofs, among others—it was a tour de force of master craftsmen at the top of their game. The collaborative enterprise also emphasized to the pure mathematicians among us some of the practical difficulties that arise when an abstract idea is realized as a solid structure. Every sculpture presented unique challenges, and their successful resolution led to a deep sense of fulfillment as the day came to a close.

Back in the grand conference room, the onslaught of ideas continued. Princeton mathematician John H. Conway gave a spirited presentation on the arithmetic

of lexicographic codes, or lexicodes as he calls them. Pure mathematics par excellence! Later, Scott Morris and Bruce Oberg gave back-to-back presentations heralding and bemoaning, respectively, the number nine (this being the ninth Gathering for Gardner). Pure nonsense, with a nod to Gardner's fictitious numerologist and polymath, Dr. Matrix.

As the barrage of topics flowed from the podium, what at first seemed a disparate hodgepodge of individually fascinating ideas began to gel into a coherent form. There was mathematics, there were puzzles, there was sleight of hand and deception, and there was mathematical artwork—the realization of abstract ideas into concrete form. There is beauty in all these, of course. But together the topics celebrate nothing less than our capacity to reason, and they demonstrate the supremacy of that endeavor. It is reason, after all, that enables us to solve mathematical problems and puzzles, and it is reason that enables us to test our often flawed perceptions and arrive at the truth. Collectively, the topics also pay homage to Martin Gardner himself, as they are precisely the themes that arose again and again in his writing. In the end, it is deeply inspiring to witness the extent to which his legacy lives on.

Further Reading

For more on Foshee's Tuesday birthday problem, see Andrew Gelman's *Statistical Modeling, Causal Inference, and Social Science* blog entry for May 27, 2010, titled "Hype about conditional probability puzzles" at `http://www.stat.columbia.edu/~cook/movabletype/archives/2010/05/hype about cond.html`.

To feel the sting of Bill Gosper's twelve-circle problem, download a (free) playable computer version of the puzzle at `http://demonstrations.wolfram.com/TheTroublesomeTwelveCircleProblem/`.
View the "Dozenegger" at `http://gosper.org/Dozenegger3.pdf`.

To test your skill at spotting a sleight of hand, check out "The Color-Changing Card Trick" at `http://www.youtube.com/watch?v=voAntzB7EwE`.

The Ambiguous Corner Cube was first discussed in C. L. Strong's "The Amateur Scientist" column in the November 1974 issue of *Scientific American*, p. 126. A template for constructing a physical model can be found at `http://www.bu.edu/lite/inkjetscience/pdfs/ProjectLITECornerCubeThirdCut.pdf`.

A brief introduction to Conway's lexicode theorem is available at `http://www.dpmms.cam.ac.uk/seminars/Kuwait/abstracts/L25.pdf`, and a more complete treatment can be found in *MASS Selecta: Teaching and Learning Advanced Undergraduate Mathematics*, edited by S. Katok, A. Sossinsky, and S. Tabachnikov (AMS, 2003).

For an introduction to the mysterious Dr. Matrix, see Martin Gardner's *The Magic Numbers of Dr. Matrix* (Promethius Books, 1985). You might also enjoy the "Ask Dr. Matrix" online tool at `http://www.iread.it/ask matrix.php`.

About the author: *Bruce Torrence is the Garnett Professor of Mathematics at Randolph-Macon College, and a co-editor of* Math Horizons.

email: `btorrenc@rmc.edu`

DOI: 10.4169/194762110X525593