A Break for Mathematics: An Interview with Joe Gallian

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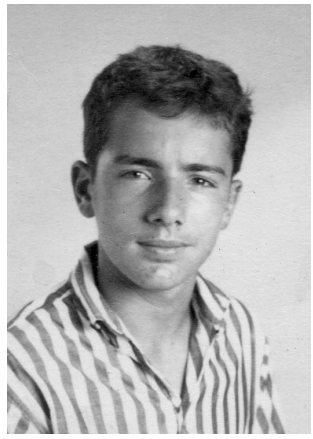
Deanna Haunsperger (dhaunspe@carleton.edu) received her BA from Simpson College and her PhD from Northwestern University in 1991. She taught for three years at St. Olaf College before crossing Northfield to teach at Carleton College, where she is now Professor of Mathematics. She was co-Editor of *Math Horizons* from 1999 to 2003 and has been co-director of the Carleton Summer Mathematics Program for women since 1995, both with her husband Steve Kennedy. She has just completed a two-year term as Second Vice President of the MAA. In her free time she enjoys spending time with her family.

As President of the Mathematical Association of America, Joe Gallian is a very busy man. Not that he wasn't busy before he became President: The man seems to have only one speed—busy. After three days of meetings of the Executive Committee at MAA Headquarters in Washington in May of 2007, on his sixth math-related trip already that year, Joe agreed to talk with me about his activities and thoughts on mathematics one afternoon. I asked if he could spare an hour and a half. Three-and-a-half hours later, he was still going strong, regaling me with personal history, thoughts on the MAA, and wonderful stories. I didn't want the conversation to end.

High school

I grew up in Pennsylvania, in a place called New Kensington, about 20 miles north of Pittsburgh, along the Allegheny River. My mother was a waitress and my father a foreman in a factory, a glass factory. I have one brother, two years younger.

Joe (front, right) with his brother and parents in 1952.



Joe's school photo from 1956.

My teachers noticed that I was good at math because I was good at math, and I enjoyed it, but I failed history just because I was goofing off. I was a class clown. I didn't intend to go to college. I was born in '42, and it wasn't all that common when I was growing up. Where I was from, most people didn't go to college; and since no one in my family had gone, I didn't think about going. I only tried to do well in math because I liked it.

I think I had a very good education in math, probably better than most high school kids now. My math teachers were outstanding. This may sound weird, but people from my generation had the great advantage that there weren't many opportunities for women except teaching and nursing. They didn't become lawyers or doctors, for instance. That meant that people like me had the benefit of women who might have joined those professions becoming teachers. My guess is that the best college math students now do not become high school teachers in the same percentage they used to. Also, back then a lot of men wanted to go into teaching. People with a Bachelor's degree in math graduating now, in 2007, have a lot more opportunities than those in 1957 or 1959.

In high school I just hung out with kids in the neighborhood. Although, come to think of it, my three best friends in high school actually became math teachers. I didn't think of that until this moment. Two went to Slippery Rock, which, it turns out, is why I went to Slippery Rock.

The glass factory

My father was hired by a factory when he graduated from high school at age 17. He worked there his whole life; he died before he retired. In those days, there was no affirmative action. You did not have to give people equal opportunity for hiring. In fact, it was considered a perk for employees that their sons (and maybe their daughters in the office) would be hired in the plant. This was just routine. I don't think you could get a job there without your father or an uncle working there. So I knew that I had this job waiting, and it was a union job. Union jobs in 1959, this may sound ridiculous, but the pay was $2 an hour; and on that, you could actually buy a car (not right away of course), and eventually buy a house and have a family. And your wife didn't even have to work. Of course, the standard of living was lower. Each person didn't feel he

needed his own car. You could have a very modest home. You know, we had no TV and no telephone, but we didn't think that was particularly odd either. People lived much more modestly. They didn't eat out much, didn't travel much, didn't vacation much; they lived more simply. Nevertheless, that was considered a good-paying job when I got it.

I started out as what they call—(Maybe this is too much detail; when you talk to me, it's like pulling your thumb out of a dike.)—a "peeper." I'm sure it's much more sophisticated now, but the machines had these little peep holes right where the glass is in this molten pool, glowing hot. Maybe 4000 degrees, because it's just sand melted. A metal strip with spikes goes down in this pool, then pulls it up, just like taffy, about four stories. When it goes up it's very thick, and they put these rollers against it, adjusting the weight to determine the final thickness, $1/4''$, $3/8''$, or whatever. The peeper's job was to look in this machine [as Joe launches himself off the couch on which he was sitting, and shows me how he would peep into the viewing windows on the glass machines] and see if everything looked okay. I had three machines, first I'd go to this one, then the next one and the next one, making this circle all night long. It wasn't dangerous, but it wasn't very pleasant either. First of all, it was incredibly hot, boiling hot, and secondly, it was incredibly boring. You couldn't talk to anyone; you just went from machine to machine to machine. If you dawdled or did anything you weren't supposed to do, someone would shout, "Watch those machines!"

If you thought you saw something, you would clang this gong, and an expert would come and look in, and try to fix it. You had a very narrow window. What would happen is that the glass would start to pull unevenly, and you could see something was starting to go wrong. Or there might be a little impurity, a marble-sized lump or something. If you saw this lump, someone would run over and raise the rollers; since if they hit the lump, they'd snap back, and then there'd be big trouble. If the machine went down, it would take about eight hours to bring it back up again. There would be a big mess and it would be very costly. If a peeper caught one mistake in his whole shift, or even one in a whole week, he would save them more than they were paying him.

"Breaker" was the most dangerous job, but I didn't have to do it my first three years. It was a glass factory, and the glass would be pulled up several stories from the molten sand below, cooling somewhat as it went. A machine would make a little scratch on the still-red-hot glass, then the "breaker" would grab it like this [Joe jumps up once again to show me the technique, arms wide apart clasping an imaginary pane of molten glass taller than he is], and lean back, and it would just break off. They usually made them in very big pieces, and cut them to size later. It was a difficult and dangerous job. After it broke, you put it on a rack, and by that time it was time to get another one.

I worked in the glass factory for three years. It's a really good story how I quit. There were about 1100 employees, but about 1200 in the summer. When workers took their vacations, someone would be hired to take their place; then be laid off again as time went on. I would work for three or four months, then get laid off; you'd always work and get laid off, work and get laid off. Because my dad was in the factory all those years—his entire life—he had enough pull that he could keep me from having to break. Maybe twenty or thirty guys were hired the day I was, but I was at the top of the list. When they would call you back, you'd have to take whatever job was open, but there were always enough guys called back that I didn't have to be a breaker. Well, one day, after I had worked there three years, a guy said to me, "Next week you're going to break." A few people did like it because it paid extra, and it was a macho job. Also, there was a choice of machine. There were nine machines running, and workers with seniority would pick the best ones. If you actually accumulated some seniority, it might not be that bad. You could get bonuses and you could avoid the danger. But a

lot of guys got injured: cuts, lost kneecaps, big gashes. So anyway, the guy said to me, "You're breaking next week," and I thought, "Oh, no!"

What happened was that you got a three-day break-in period, and that actually wasn't too bad because they put you with an old guy (that might mean a 5-year breaker or a 3-year breaker), someone with experience who showed you how to do it. But if somebody had experience, that meant he had a better machine since he had more seniority. You broke in on an easy machine, but then had to work on one of the worst machines. So I thought, "Well, this isn't all that bad." Then on the fourth day, I came in and I was at the very bottom of the seniority list and was assigned the last machine available. Sure enough, this machine hadn't been running well; they'd been having lots of trouble with it. Oh brother! So now I'm there, breaking on my own, and I only lasted about three hours. I was terrified I was going to get cut. You lean way back and sometimes the sheet of glass would explode; instead of being in one piece, it would shatter and you're left holding one chunk and another chunk is like a guillotine. So I called the foreman over and said, "I'm leaving—I'm going home." He said, "You mean you're not even finishing your shift?"; and I said, "I'm going home." He said, "If you walk off, you lose your job. Do you realize this?" And I said, "I'm going home and"—here's the exact quote—"I'm not a married guy; I want all my parts. I don't want to lose any fingers or kneecaps—I want all my parts!" It was kind of morbid. Say someone lost a kneecap; the first thing he would do is figure out how much he'd get. You got paid if you got injured; an eyeball might be worth $5,000, a finger $1500. They had a formula. I said, "I don't want any $5000 or $1500. I want all my parts."

I was on a 4-to-12 shift, and I got home about 8 o'clock—I was supposed to be working until midnight. My dad had been working in this factory his whole life, and I come home four hours early. He said, "What are you doing home?" I said, "I quit." And he said, "What do you mean you quit? I don't get you . . . what do you mean, you quit?" I said, "I quit. They had me breaking, and it was so dangerous, I thought I was going to get badly hurt." He said, "I can't get you a job anywhere else; I've worked only one place. We don't have any connections anywhere else. What are you going to do? You're twenty years old, and you're living at home." I said, "Well," and I hadn't thought of this ahead of time—it wasn't as though this had been in the back of my mind—but I said, "how 'bout if I go to college?"

I just threw it out there. And the main reason I threw it out was that he was very upset, and my dad was usually a very low-key guy. And he said, "College? Where would you go to college?" I said, "How about Slippery Rock?", which only came to mind because of those guys I was in high school with. Of course, they were all seniors by then because they had been in college the three years I had been in the factory. I said, "Ray Bitar and John Ciesielski went to Slippery Rock." He said, "What would you do?" and I said, "I'd become a math teacher." His attitude changed completely, and he said, "Well, okay, we'll go up there tomorrow and check this out." That suddenly he made a 180-degree turn. Sure enough, he called the factory the next day and said he couldn't come in, and we drove up to Slippery Rock, about fifty miles away. We didn't call in advance or anything; we just went up there. My dad said he'd like to talk to someone about his son going to college. When I told the admissions guy my story, he said, "Did you take your SATs?" I said, "No, because I didn't intend to go to college." "What were your grades?" "Very poor. I had A's in math, but C's and D's in almost everything else." I had to get a B in English in my senior year in order to graduate, my grades were that low. I told him that I graduated near the bottom of my class, that I was just going for passing since all I needed was a diploma. I told him the story about the breakers, and he said, "We weren't planning to take any more students, and you should have taken these exams, but we're going to let you in because we've found that

people who go to the military, or work in a factory, and then come here are among our best students." They let me in on probation.

Slippery Rock

Slippery Rock didn't have any dorm space available. However, I found a place just off campus. A woman who worked in the cafeteria and her mother had the downstairs of a house, and they rented out three places upstairs. Two of my roommates were senior math majors, and this turned out to work to my advantage because they weren't very good at math. On the other hand, I was in precalculus, which was not very exciting. They were taking modern algebra from McCoy's book. That starts with rings, and so they were talking about rings and units all the time. They were struggling with it, but I thought that that was far more interesting than my course. I went out and bought a modern algebra book, and started reading it just for fun. After about two weeks, I was thinking, "This stuff isn't that hard" and "These exercises aren't that tough." I ended up tutoring my roommates, covering the modern algebra right along with them.

Charlene and Joe, May 1966, at a party celebrating Joe's college graduation.

My strategy in high school had been to do almost no studying, just pay attention in class. When I first started in college, I think I misjudged that it was a fairly big step. After a C or D on my first math exam, I started putting in lots of time. When I got to college, I didn't know how to study, math or anything else. But I learned. Let's say I got a B in biology as a freshman. If I had taken the same course as a sophomore, I would have gotten an A with about a third the effort. As a freshman, I studied the wrong things: I didn't know how or what to study. It took me about a semester to learn study habits and the self-discipline that was necessary. After that I did very well. It turned out that the more I studied, the more I enjoyed it. I had a girlfriend at home, so I didn't date on campus, I didn't hang out with the guys or go to football games or social events; I just studied, studied, studied.

Getting married

I married Charlene at the end of my junior year at Slippery Rock. I was her high school sweetheart. She was a senior when we met, but I had been out of school for two years. Our homes were about ten miles apart, but in different towns. There was a place called Henry's, a little diner with a dance floor and a juke box where you could buy a hamburger and a Coke. It was a hangout for high school kids, and I went there five or six nights a week. Charlene hung out there with five other girls (we called them the "Big 6"), and I would come with maybe one or two other guys. Every now and then one of my friends would ask one of the girls to dance, and another friend would ask another one, and so I asked the one who is now my wife to dance. Because she was still in high school, she had to go home early. One night her mother came to pick her up, and her mother was impressed that I walked Charlene out to the car; that's how the whole thing started. We went together for about three years before we married.

Joe and Charlene at Turkey Run State Park in Indiana, 1970.

Charlene had a pretty good job as a secretary at a steel company in Pittsburgh and was making enough to support me. When we got married, since I was at Slippery Rock, she began working for the state of Pennsylvania, a civil service job on campus with a decent income. When I went to Kansas, she had a federal government job, working for the University of Kansas ROTC. She was the breadwinner for many years.

Graduate school

When I started at Slippery Rock, a teacher was the only thing you could be; there was no other degree possible there. Then in my sophomore year, they started to offer a new degree, a liberal arts degree. I talked to a professor I thought the world of, Dr. Anthony Pagano. He was very, very stingy on grades, but a great teacher, a really great teacher. I loved the way he taught. He and I became friends, and I'd occasionally talk to him outside class, so I talked to him about switching degree programs. I told him that I wanted to do what he did, I wanted to be like him. He was the image of what I hoped to become. He replied, "Well, then I recommend you switch over to this liberal arts degree", which of course I did.

I applied to a handful of graduate schools; I remember that I applied to Kansas, Minnesota, Michigan State, Wisconsin, Chicago, and Purdue. I was given advice that big state universities had a lot of financial support and there were lots of options. I had no idea what to do; I was just taking advice from others. I ended up deciding to go to Minnesota because their financial offer was the best. So I wrote the other schools declining their offers, and I wrote Minnesota accepting theirs. This was about a week in advance of the deadline. The day before the deadline, Pagano knocked on my door. "This is Tony; G. Bailey Price called,"—he was once President of the MAA—"he's from Kansas, and he wants to talk to you." So I went up to Pagano's office and called Price back, and he said, "I called you about this letter you sent, and I just wanted you to know that we can offer you this NASA Graduate Training Fellowship. We were supposed to offer it to you in the first round, but there was some kind of mistake." Now, I'm quite sure that what happened was that they had offered it to somebody who then turned it down, but in any case, he said, "If we were to offer it to you, would you accept it?" And I did. I hadn't started college until I was 20, and then I got married while in college, so I wanted to be on a fast track. I thought a fellowship meant no TA-ship, and no TA-ing meant that I could take an extra course or two each semester, and that's exactly what I did.

When I got to Kansas, I wasn't placed in any graduate courses right away, but instead into what were called "senior/graduate level," although most of the students were undergraduates. For abstract algebra, we used Herstein, a big step up from Slippery Rock. Some of the best students were freshmen and sophomores, and a lot of them became professional mathematicians.

When I got into that abstract algebra class, I thought Lee Sonneborn was the worst teacher ever, because I was used to Pagano. Pagano would go down to the finest detail, explaining every step. Sonneborn was just the opposite; he would say, "Well, you can finish the rest yourself," or "This proof is by induction." Or he'd say, "For the proof, mod out by the center." Anyway, he just threw out these hints, and I'd think, "What is this? This guy's ridiculous; that isn't a proof." But his idea was that he'd give you the big steps and you'd fill in the details. After the first week, I thought he was great. I really admired him, and I had him for five courses in one nine-month period. I knew several of his PhD students who were in this group theory seminar, and I was convinced I was going to do a thesis under him too.

Then Sonneborn came in one day and said that he had taken a job at Michigan State. I was very upset, but there was a young guy named Dick Phillips who was also a group theorist. They both did infinite group theory, so I switched over to Phillips. I took his courses, and he said that I had to write a Master's thesis, which I did with him. But then one day he came in and said that he was leaving for Michigan State too. Now there weren't any group theorists left at KU. By this time I knew I wanted to work in group theory, so I decided to apply elsewhere.

I ended up going to Notre Dame because they had someone in infinite group theory and they gave me the best offer by far. After I was there about two weeks, I went to the professor who did research in infinite group theory and told him that I had come to Notre Dame to work with him. He responded by telling me that he was leaving! When I told my tale to the department head, he said, "I really think you should consider working in finite groups instead."

I had already signed up for a course in finite group theory since I had never had one. The professor was Warren Wong, who was both a good group theorist and an excellent teacher. He was involved in the classification of finite simple groups, which was an incredibly hot area in those days. Eventually I went to him and said, "I'm looking for a thesis advisor. I'm taking my candidacy exams next week, and I think I'll probably

do OK." He replied, "Well, I'm going to New Zealand next year on sabbatical; would you like to come along and work with me there?" My wife didn't want to leave, and I didn't want to either, so I turned him down.

Wong had been a student of Richard Brauer at Harvard. Brauer was one of the most famous people in group representations, a pioneer in modular representations of groups over fields. In a sense you could say he started the classification of finite simple groups, through something called the Brauer-Fowler theorem. It was the first approach to this whole classification problem, although he himself never thought it could be done. I ended up writing my thesis under Karl Kronstein, another student of Brauer's. That worked out very well because he gave me a good problem. That is, I was able to get two papers out of it, published in very good journals. He gave me almost no help beyond giving me the problem, but that worked to my advantage, because when I eventually got to Duluth, there was nobody to work with. But I was already used to working on my own.

Getting a job

I was at Notre Dame for three years, graduating in '71. However, I didn't get a job that year, for quite a good reason. About five years ago, the AMS had a chart at the joint meetings, showing unemployment rates for mathematicians. The worst year ever was 1971. When you're at the beginning of a bad period, you don't know that that's the case. In fact, people who graduated in '68 and '69 got great offers. So I wasn't worried, my advisor wasn't worried; there was no hint that things were going to go south. Also there was no affirmative action, which is very important to my story, because you didn't know where the jobs were, they weren't posted. It was literally an old boys' network: If a school had an opening, the department head—say he got his degree at Ann Arbor—would call there and say, "Got any good graduates coming out? We have an opening." That was the way it worked.

When I applied for jobs, Charlene and I both wanted to live where our families lived, so I only applied to colleges in western Pennsylvania and a few places in Ohio. My letters simply said, "I'm going to finish my PhD at Notre Dame. I'm in finite group theory and have submitted a paper. If you have a job for which I might be qualified and you would like more information, please let me know." Of course, at that time there was no word processing or even photocopying. Every letter had to be typed, one by one. Out of whatever it was, twenty-some schools, it might have been that none of them even had a opening. Anyway, I got no replies, nobody asked for an interview, nobody even asked for any further information. So I went into the office of my chair, O. Timothy O'Meara, and said that I hadn't received any responses. He said, "Don't worry about it, you can stay here as a post-doc, but next year I want you to look all over." So the next year I sent out 145 applications, and I did get six requests for more information. I sent them the information they asked for, and then I waited. Nothing—I heard nothing from any of them. Well, that's not quite true. Southern Oregon asked me to come for an interview, but then called again and said, "The job's been frozen. There is no job." Finally, I started making phone calls. The other places I called, including Duluth, said that they had hired somebody else. So now I'm down to zero, and it's May. I talked to O'Meara again, and he said, "Don't worry about it, you can stay here another year." I'm extremely loyal to Notre Dame, because they always treated me extremely well from the day I got there. They treat their students and faculty like family. That may sound like a cliche, but there's truth to it.

Oh, I forgot to tell you another part of the story. We adopted two boys during my last year of grad school.

Becoming a parent

Charlene had always wanted to have kids, but wanted to wait until I was ready to graduate. She wanted to have one child of her own and adopt one. You have to remember, this was the ’60s. The Beatles spoke to me: All You Need is Love, Give Peace a Chance, Imagine. That’s my Bible. That’s how I frame my life, the way I think about things. So we thought it would benefit the world if we adopted somebody who needed a family.

Joe with his sons William and Ronald, 1976.

When we went to an adoption agency, we of course had in mind some brand-spanking-new baby, perfectly healthy and so on, like in a movie from the ‘40s. But of course, there are many kids who are hard to place, and those were the ones they showed us. There were two natural brothers, one five and one three, and they were hard to place because they were older and the agency didn’t want to split them up. They showed us their pictures and said, “We can arrange a visit.” The boys came once for a short time one Saturday afternoon, and then came back a week later and stayed overnight, and then—I might have it wrong, it was 35 years ago—then they came back for another overnight visit. Then they never left. [Along with their sons William and Ronald, Joe and his wife Charlene have a daughter Kristin, born in 1976.]

Starting in Duluth

Back to the job story, the important thing was that O’Meara said I could come back. Now it’s June of 1972, and it turns out that the person hired at Duluth backed out. When they called to ask if I was still interested in the job I had applied for, I said, “I already accepted a job here at Notre Dame, but they are just doing me a favor. I think that if I had a job offer, they’d get by without me.” So I went on that interview.

Joe and Charlene with their children William, Ronald, and baby Kristin, August 1976.

Hundreds of things came up at the interview, little conversations, but one question I didn't consider important at the time turned out to be crucial: "Every math major has to do a senior project. It could be an expository history of math paper or a report on a paper or a chapter in a book." I was asked, "Are there any group theory topics for math majors to do as a senior project?" I said, "Finite group theory is loaded with them; there are all kinds of good ideas." That question turned out to be crucial because every math major had to find their own project advisor. The other guy who interviewed for the job was an infinite group theorist. When they asked the same question of him, he said, "Group theory's too complicated." He didn't realize it at the time, but it sunk him. When I got to Duluth, I immediately latched onto student projects and had more students than anyone else the first year. And that turned out to lead to my REU program.

The REU business

A few of my students actually did some original research. I was able to get something in *Math Magazine* based on some of the senior projects, and I wrote a joint paper with a few students. Even in projects that weren't publishable, I tried for some new things, not just exercises. I was trying to stretch the students. In 1976, I read in the *Notices of the AMS* that there was a program called a URP—an Undergraduate Research Participation program—run out of the education division of the NSF. It said that there was money available for faculty members to run a summer program in which students would read seminal papers and make presentations to other students and their advisors, and for that they'd get a stipend. These weren't quite REUs because the expectations were lower; it was more like a literature search. I applied for this grant and sure enough it came in. There were only a handful in the whole United States: I knew of five total, including my own. The great thing is that I had the whole country to myself, in a way. I sent letters to places like Princeton, Harvard, and MIT, just like I do now. Since there weren't many places offering these opportunities, I had really good students from the outset. There wasn't much competition.

Over the years I've had 152 REU students. That doesn't count multiplicity; some were there for two or three years, and they count as just one. I like to take some who

Joe with his URP students, August 1980.

are very young, like Melanie Wood. I took her after her first year. I knew Melanie was extra special, first woman ever on the United States IMO team. I wrote her a letter when she was in high school, and I said, "I hear a lot about you. People tell me you did well in the Olympiad training program. As soon as you get into college I'd like you to write me a letter asking to be in my program." This she did, and it's been great; she's come every year since. This year she's going to be the coach of the Girls in Math Olympiad team in China, so I'll get her for only ten days, but I'll take her.

About 150 papers have resulted from the REU. For about twenty years, there have been about as many as students in the program. Not everyone gets a paper, but a fair number write more than one. Melody Chan wrote three, and Jason Fulman got three in one summer, all published in good journals. Doug Jungreis got five one summer and three the next. And by the way, almost all of these are in the *Journal of Combinatorial Theory*, *Journal of Algebra*, *Pacific Journal of Math*, *Journal of Number Theory*, *Electronic Journal of Combinatorics*, *Discrete Math*. I treat the summer program like a mini-PhD thesis. I want to give them a PhD-level problem, and while they might not do as much as there would be in a thesis, I'm hoping it will be a good start, a basis for a PhD thesis. That's my goal.

At first, my students worked only in finite group theory, because that was the only thing I knew, but then I backed into graph theory by way of Cayley graphs. These are graphs on groups. One referee's report on a group theory paper said, "You are really looking at this the wrong way. These are Cayley graphs." Once I saw that, I thought, "This is really a good thing. This is easy to visualize, and there are natural graph theory questions that might not seem like natural group theory questions, and this is a good way to give students problems." We hit a gold mine. One incredible stroke of luck concerned Hamiltonian circuits on Cayley graphs. This was a rich area that undergraduates could easily be funneled into. Some of those papers are cited very often now as they actually contain some of the major theorems in the area. David Witte [now known as David Morris] has what I think are the best theorems on the topic, the Witte Theorems.

It's a little tricky saying what success means in an REU. Some years ago I had a really great student, nearly perfect in every way: great attitude, hard-working, easy-going, background from Michigan, and so on, but I couldn't find the right problem for

him. I gave him one problem that didn't work out; it wasn't his mathematical ability, it was just a poor problem. And then a second problem and a third problem, and by the end of the program, he really didn't have anything to show for it. I couldn't say, "Write up your stuff and send it in." There was nothing to write. I felt really bad about that. About six months later, I needed to get hold of him. I had his home phone number, so I called his mother and said, "This is Joe Gallian; I'm trying to reach your son. Can you give me his phone number?" And she said, "Professor Gallian, it's such a pleasure to talk to you. My son had such a great time in your program. He just enjoyed that summer so much, talking math day and night with all those bright kids. It was just a wonderful summer, and he learned so much." Anyway, I learned a lesson from that: you can still get a lot out of an REU experience even if you don't have anything on paper to show for it. Ideally, I like for students to have a good time, to network, to get a paper in a respectable journal, and to give a talk at the January meetings. That's the perfect ending. But even if they learn something, some new branch of mathematics, some new problem in mathematics, if they go through the process, the research process, and learn something, that's a success.

Stories about REU students

Manjul Bhargava is an interesting story. He agreed to come to my REU, but he had very close ties to a grandfather in India. There was to be a family reunion in India the first week of the program, and he asked if he could he go there before coming to Duluth. I said, "Sure, fine." He also said that if I gave him a problem in advance he'd work on it. When he arrived in Duluth, he had completely finished it except for the write-up, so he asked whether I had another problem for him. I gave him a number theory problem, and it turned out that that was beautiful, it worked out so well, because he ended up with a spectacular, completely novel approach. It was in number theory, but he had this ingenious ring-theoretic approach. He won a Morgan prize for that.

When Melanie Wood came, she was just a young woman, having just finished her first year of college, and I really underestimated her. I gave her a bad problem, a really bad problem. It was a graph theory problem, and after about a week, she said to me (this is what's very nice about Melanie: It's not that she's impolite, but she's willing to express her opinion), "This is really a bad problem." I said, "OK, but the problem is that you don't have much time. You've already lost several weeks from arriving late to the REU, and now you've lost another week on this bad problem. You've only finished one year of college, and I don't really have any problems that would be good for you. I said, "Manjul has a lot of open problems, but I'm afraid they're too hard for you." She said, "Let me take a look at them." She came in the very next day and said, "I love this." It went really well. She wrote a very nice paper that got accepted by the *Journal of Number Theory*, a very high-class journal. In large part, she won a Morgan Prize for that.

Here's a good story: one of the youngest people ever in my program was Danny Goldstein. He started as an undergraduate at the University of Chicago at sixteen. When he went to the Olympiad training program, he was the youngest person ever to be invited at that time. When he got into my REU program, he was eighteen. He had already taken graduate algebra at Chicago. The summer he was in Duluth I was working on the first edition of my abstract algebra book. I don't include Galois theory when I teach this course at Duluth; it's too difficult. Nevertheless I have a chapter on Galois theory in the book for others. There were some exercises on Galois theory in the book, which meant that at one time I could do them quickly. However, when

I tried to do one of them again, I couldn't recall how I had solved it before. So I called down to the student apartments. This is another good story. That year there were three students in the program, Danny Goldstein, Larry Penn, and Irwin Jungreis. Irwin had finished sixth on the Putnam while Danny and Larry were in the top five, so they kept joking all summer long about how Irwin was the slacker, the weak one of the bunch. Anyhow, I called down there; it didn't really matter who answered the phone, but Danny answered and I said, "Danny, I have this Galois theory problem, and I can't figure out how I solved it. Can you solve it?" He said he'd call me back. Fifteen seconds later he called and said, "Here's how you solve it."

In 1994, the AMS and MAA had a joint summer meeting in Minneapolis. I don't normally take my REU students to the summer meeting because I want them to go to the winter meetings. But since this was in Minneapolis, the travel cost would be minimal; we'd just drive down. Ron Graham was President of the AMS at the time, so I wrote him a letter and said, "Ron, I'm bringing my whole REU down there, and I'd like to invite you, in your capacity as President of the AMS, to meet these students and have either breakfast, lunch, or dinner with us." Ron has always been supportive of my program, and I got this nice reply, "Yes, let's make it dinner." As soon as I got that letter, I wrote to Don Kreider, President of the MAA, "I just invited Ron Graham for breakfast, lunch, or dinner, and I'd like to do the same for you to give the MAA equal opportunity." So on one day, these students had breakfast with the President of the MAA and dinner with the President of the AMS.

The Beatles

A great thing about having been born in 1942 is that I was 13 in 1955 when rock and roll was born—Elvis, Little Richard, Fats Domino. I listened to the Pittsburgh radio stations that would play rock and roll. My father loved music, but it was a completely different kind. In those days, there was just one record player, no TV, and maybe two radios. I listened to my dad's records, and he'd have to listen to mine. My dad had lots of records, Bing Crosby, Al Jolson, the Ink Spots, Tony Bennett, Frank Sinatra. I would hear those types of music all the time, and also they played them on the radio all the time. Then when rock and roll came, I started buying rock and roll records. By that time I had a little attic room. It wasn't finished, but it had electricity, and I'd play my rock and roll up there. I liked all my dad's music, but I thought this new music was really energetic and great stuff. I thought that rock was exciting, and I bought lots of records, and I had the words memorized.

Then some time around 1959, the original wave went down. Elvis was drafted into the military. Buddy Holly died in a plane crash. Little Richard got religion. That early era just sort of died. Then they had Frankie Avalon, Bobby Vinton, Fabian, these artificial, manufactured singers—they didn't have the raw edge. They didn't have the energy and the personal magnetism that I thought the early people had. They'd try to get someone who looked good. Little Richard wasn't handsome. Buddy Holly wasn't good looking. Elvis had sex appeal, but these other people didn't. I hated their music. I sort of lost interest in rock and roll and turned to folk music, Bob Dylan and Joan Baez. When the Beatles arrived—February 7, 1964—it took me a month or two to get to like them, but when I did, I just loved them.

Now I have a tremendous collection of Beatles stuff. There's a museum in Duluth called the Depot. They have a summer exhibit, and one summer the whole exhibit was my stuff and that of another Beatles collector in Duluth. Big billboards in town said, "Beatles Memorabilia Exhibit at the Depot." I've spent many, many, many thousands

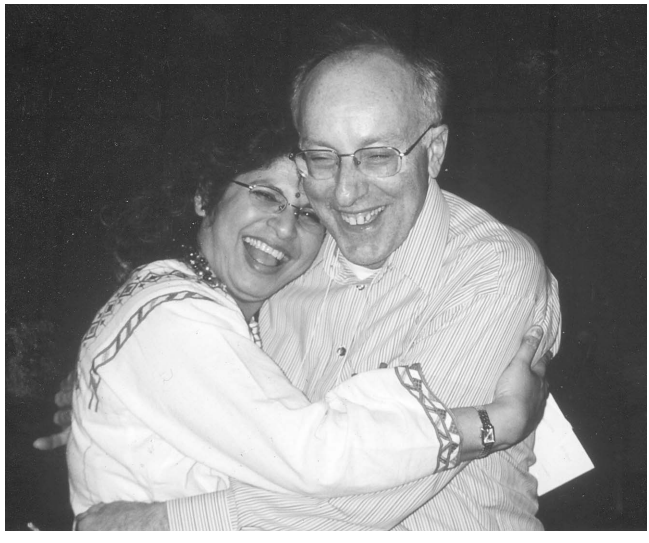
of dollars on Beatles stuff, and I still buy tremendous amounts. There are a thousand Beatles books in print, and I probably own about three or four hundred. What's great about having a hobby like the Beatles, is that there's always new stuff. Always. It's unbelievable. So every birthday, every holiday, every Father's Day, my family can buy me Beatles memorabilia. I probably have more than a dozen Beatles neckties.

I listened to the Beatles for years and years, and then one day, as a Christmas present, my wife brought me a book called *Beatles Forever* and it completely changed things for me. This is not an exaggeration; it changed my life. I hadn't realized that you could study the Beatles in an academic way. In this book, the author carefully analyzed, the way a sociologist would study some tribe or something like that, the Beatles. Many people have written dissertations on the Beatles, and how they're impacting the culture. For about twenty-five years now, I've regularly taught a course on the Beatles. In fact, I now teach it fall, winter, and spring. I first started teaching the course through the sociology department. The curriculum committee, which had to approve the course, asked what my qualifications were for teaching a humanities course. I wrote back and said, "I've spent more time studying the Beatles than I did writing my PhD thesis." That's true—by now it's about 20:1. And they accepted that. It's an incredibly popular course. Not an easy one, though.

Project NExT

In 1998 when Jim Leitzel died, and Chris Stevens needed a replacement, I became a director of Project NExT. Chris's strategy was to get two people to replace Jim Leitzel. I'd already been helping Project NExT and so had Aparna Higgins. We had both been presenters, so it was a natural fit. That too changed my life. It's very likely that without it, I wouldn't be President of the MAA; my visibility in Project NExT gave me a big advantage.

Project NExT energizes the profession with all the young people contributing. For example, a lot of math journals hunt for referees. I can put a message out to the Project NExT fellows that the *College Math Journal* and *Math Magazine* would be happy to



Aparna Higgins with Joe, enjoying another successful year of Project NExT.

have Project NExT fellows serve as referees. We always get outstanding responses. The MAA has about 130 committees, and we often look for Project NExT volunteers to serve on these committees. They energize the profession in that way. They show up at meetings, and they give talks. I didn't go to a national meeting and give a talk in my first years after my PhD, but they think this is perfectly natural because we tell them it's natural. We tell them to go and give talks, this is what they should be doing. I've got this mnemonic, CEO. We give them the Confidence, the Encouragement, and the Opportunity to make a contribution to the profession quickly.

The networking is incredible among the NExT fellows. If you looked at the network of mathematicians I had after five years in the profession, theirs is often greater by the end of one year. One way that this happens is through the colored dots; it's an automatic opening for a conversation in an elevator, at a talk, or wherever. NExT really has made a difference.

I give the NExTers a regular, one-hour spiel of advice. There's a phrase, a catch phrase, that they always throw back at me. "Just say yes." I got it from Nancy Reagan, because she said to just say no to drugs. I say, "Just say yes." If somebody asks you to be on a committee, just say yes. If somebody asks you to teach a course that you've never taught before, just say yes. If somebody asks you to come give a talk, just say yes.

When you join a new department, your top priority is to make yourself valuable. That's why I say, for example, if they need somebody to teach a new course and no-one else wants to do it, you can volunteer. That's my advice. A huge number of people have told me they've followed my advice. Not 100% of the time of course, but they try to keep it in mind, and they say, "You know, it does work."

I tell them there are many ways to succeed and many ways to contribute. One of the ways to contribute is through the MAA. The MAA is a friendly organization, especially to younger people. You're going to be welcomed. The MAA is interested in how you can contribute. Can you serve on a committee? Are you willing to do work? I say, make yourself known, go to a Section meeting and say, "I'd like to help out; do you have anything I can do?" I tell them to write to the editors of journals and say, "I'd like to referee for your journal. Here are my credentials: I got my PhD in finite group theory, I wrote the following three papers, and I'd like to start out as a referee." My advice is to immerse yourself in the profession. Teach, do service, do some research, volunteer. The more you do, the more you learn; the more opportunities you create, the more you succeed.

Heroes

Two of my heroes are Ron Graham and John Conway. Why them? Well, first of all, they're incredibly versatile mathematicians. Secondly, do you realize how often they say yes? For example, Ron Graham spoke at my 65th birthday conference. John Conway spoke at the Hudson Valley Conference for Undergraduate Research some years ago. Not many mathematicians at his level would be willing to take the time to speak to a group of students, but Conway did. Conway and Graham give talks at MAA meetings. Ron Graham took the time to serve as President of the MAA. In addition to being outstanding mathematicians, and being incredibly versatile, too—they take the time to be part of the math community, and I admire them for that.

I have other heroes. Lennon and McCartney are my cultural heroes. Martin Luther King, Robert Kennedy, Paul Wellstone, Ralph Nader before the year 2000, those are my political heroes. Some people might say, "You know many of your heroes were

assassinated." It's not that they're my heroes because they were assassinated, they were assassinated because of what they stood for. The fact that they stood for something admirable is why I admire them so much.

President of the MAA

When I came to Duluth, my chair Sylvan Burgstahler was very high on the MAA, and he was definitely encouraging people to join. I started going to meetings and giving talks, and that way I met people. It was a very positive experience, but I didn't join at the time. My pay was low, and I just didn't want to pay the dues. In my fourth year there, I said I wanted to be considered for promotion. Bill McEwen, the division chair and a member of the math department, asked to see my vita. He said, "I noticed you aren't a member of the AMS or the MAA. Why's that?" And I said that I didn't see any particular benefit to it. He said—and this has stuck with me ever since— "Whether it has a direct benefit to you or not, it's your duty to support your professional organization." My wife and I contribute to various organizations (like Mothers Against Drunk Driving) even though we don't directly benefit from them. It's the same philosophy. It's an obligation that one has to the larger community. Once I joined, the opportunity arose to edit the section newsletter. I agreed to do it, and from that became President of the North Central Section.

One of the MAA's strengths is our volunteerism. The MAA is very welcoming; I like the camaraderie of it. We can easily take in a lot of energy and talent, and benefit from it; young people can make a contribution quickly. If the MAA weren't around, it would have to be invented. There really is a niche for us. Although the AMS does a good job communicating to the general public, I think we are needed there, too. Certainly our work with students, like the math competitions and the Putnam exam, is definitely a major contribution to the profession. Without such opportunities for students, there's a good possibility that Melanie Wood and others like her would not be mathematicians.

It would be nice if the MAA had a great source of money that we could do our work with. The Halmos grant has made an enormous impact, of course. Three million dollars to the AMS would not be such a big deal to the AMS, but to us it's a quantum leap. As President, I wanted to find additional support for Project NExT, and I think I've actually done quite well on that. I also want to improve the public awareness of mathematics, its value and its beauty. I am happy with what I have done with that, too. We have a documentary film about the 2006 U.S. Math Olympiad team coming out in 2008, we are working on a women-in-math poster, and we have an exciting public lecture series at the MAA headquarters.

The MAA has given me a tremendous amount. It's an incredible honor to be President. The REU has been unbelievable. I couldn't have imagined in 1972 when I arrived in Duluth, at a branch campus in northern Minnesota, that I would get the chance to work with some of the top math students in the country. It's amazing that this could have happened, such a series of serendipities in which one good thing led to another. It's a good example of how you can make things happen. You can chart your own course. If you're hustling, saying yes, doing things, trying to help others, you can end up doing really well. I never could have predicted such a thing.

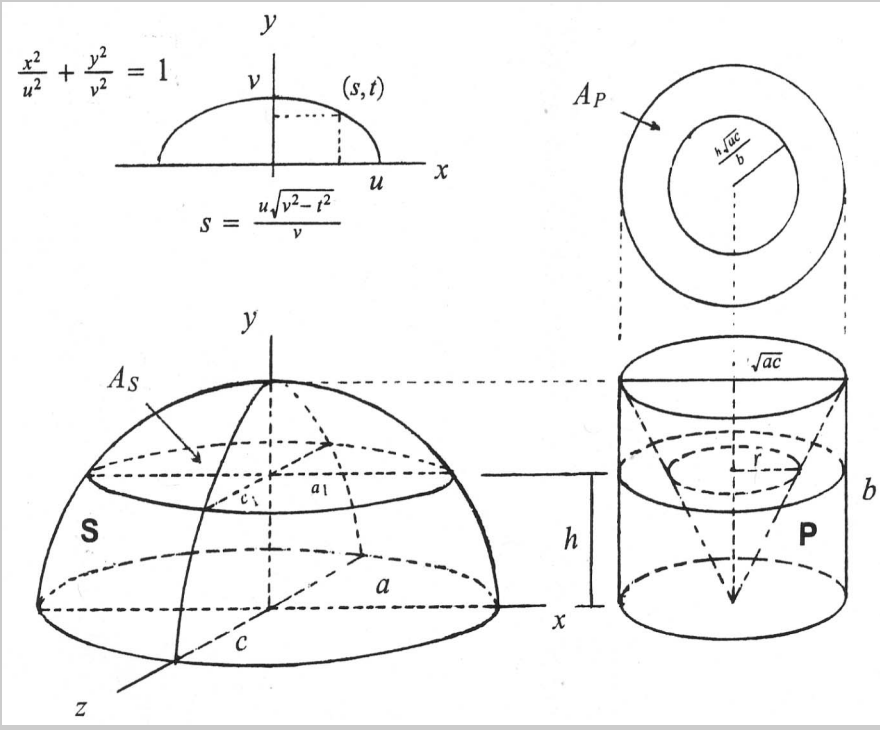
As our interview drew to a close, and I was packing up my three-and-a-half hours of tapes, Joe sat back and became quietly reflective. He had just given me his life story to this point in a nutshell; an impressive, active, joyful life spent in service to mathematics and the mathematical community. I could tell his eyes were seeing a different

place, a different time. "My brother still lives in our hometown where I grew up. He knows everyone in the town and what they're doing. I can't even remember my neighbor's name. We're just so different." Realizing that that could have been him, except for a few turning points in his life, Joe jerks upright again, breaking the tranquility with his explosive laughter, "And it's all because of that one phrase: 'You're breaking tomorrow!'"

Proof Without Words: The Volume of an Ellipsoid via Cavalieri's Principle

Sidney H. Kung (sidneykung@yahoo.com), Cupertino, CA 95014

E: $\dfrac{x^2}{a^2}+\dfrac{y^2}{b^2}+\dfrac{z^2}{c^2}=1$



$$A_S=\pi a_1c_1=\frac{\pi a\sqrt{b^2-h^2}}{b}\frac{c\sqrt{b^2-h^2}}{b}=\frac{\pi ac(b^2-h^2)}{b^2}$$

$$A_P=\pi\left(ac-\frac{h^2ac}{b^2}\right)=A_S$$

$$\Rightarrow V_E=2V_S=2V_P=2\left[\pi\left(\sqrt{ac}\right)^2b-\frac{1}{3}\pi\left(\sqrt{ac}\right)^2b\right]=\frac{4}{3}\pi abc$$