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The BIG Notebook

A Newsletter of the MAA Special Interest Group for Mathematics in Business, Industry & Government

My Summer of Science Journalism
by Katharine Ott

Somewhere in my third year of graduate studies at the University of Virginia I became restless. The narrow scope of my research in PDEs frustrated me; I wanted to see a bigger mathematical picture, and I wanted to use more of my liberal arts undergraduate education. Journalism turned out to be my remedy.

In the summer of 2006 I was awarded a Mass Media Science and Engineering Fellowship, offered through the American Association for the Advancement of Science (AAAS) and supported by SIAM. This program allowed me the unique opportunity of spending eight weeks as a full-time science reporter at the Milwaukee Journal Sentinel in Milwaukee, Wisconsin. I left my comprehensive exams, dissertation research and teaching assistant duties behind to enter the bustling environment of a newsroom. I returned to academia in the fall with more energy, improved writing skills and several new contacts in the mathematical community. Most importantly, I gained an appreciation for the role of the media in scientific research, and I see a great need for mathematicians to improve their communication skills.

Over the course of the fellowship I covered science stories from ecology, chemistry, neurosci-

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Dr. Katharine Ott

Inside:

ence, biology, and, yes, even mathematics. I interviewed professors, graduate students, fishermen, doctors and everyday citizens. I visited a lab where lake trout watch animated movies, I helped dissect a human brain and I watched a 2500-year-old mummy get a state-of-the-art CT scan. I wrote over ten articles, including two front-page stories. While researching each piece I learned new science, and then it was my job to turn what I learned into a story.

One of my front-page stories covered chemists at the University of Wisconsin at Madison who had found a cheaper way to create a petroleum alternative. I have not taken a chemistry class since high school, and it was a daunting task to translate the chemists' research paper into a newspaper article that the public would be able to read and understand. I relied on my critical thinking skills and logical mind to break a complex chemical reaction into a series of steps. This process felt similar to the one I use to teach work problems to a class of college freshmen.

It was my goal to write a math story for the paper during my tenure. The difficult part of accomplishing this goal was to find a story lead that would be catchy, cutting-edge and accessible. I eventually uncovered several groups of mathematicians in Madison and Milwaukee working on a variety of biology problems. To the average newspaper reader, a connection between mathematics and biology is unexpected. From a mathematician's perspective, this is new and exciting, and rapidly changing the face of both fields. It was an easy sell to my editor.

I enjoyed speaking with mathematicians working in an area different from my own, and I was fascinated by the wide variety of problems they are involved in. What made the story hard to write is that most of the mathematical ideas that inter-

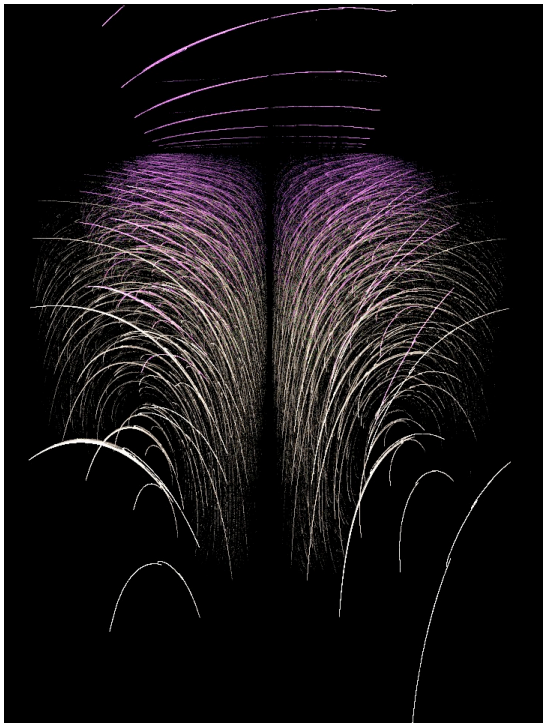
Editor's Note

Much as we would like to plan every detail of our newsletter issues, what appears often depends on approval processes at writers' employers and on the ability of writers to get content ready in time. It is curious, then, that three articles in this issue share a common theme; that is, the energizing benefits of trying out new types of experiences involving mathematics.

The world of mathematics is rich in potentially life- and career-enhancing opportunities. There are workshops to learn new skills; there are summer internships; there are conferences and meetings for making connections and sharing experiences. Few of us expect to become rich from studying mathematics and engineering, but then how about a rich, full working life? Start looking around, and the possibilities abound for new and enriching experiences.

Taking part in these kinds of experiences would seem a no-brainer except for the counterbalancing host of reasons each of us has not to do so. There is the necessity for organization approvals, the fears of career-limiting moves and perceptions. There is the ever-present problem of funding for travel and time off. So when it comes to decision time, the conclusion is often "that would be great, but .. ''

In her article, Katherine Ott describes why she chose to take time off from her dissertation process to work at a newspaper, and found herself newly energized. Professor Mills writes about choosing to spend a sabbatical year working at a local company, and found a new sense of purpose for his Mathematics faculty job at Central College. I describe trying a week at a summer Mathematical Problems in Industry workshop and discovering new and fascinating aspects of an old unsolved problem. Care to step off the line a bit yourself?



ested me would not interest the average reader and thus were left out. I realized that my job as a reporter was not to teach mathematics, but rather to show how mathematics can be applied to real-world problems -- problems like HIV infection, gene sequencing, and medical imaging. I hope that in my small way I convinced at least a dozen readers that mathematical research is not entirely useless.

The media fellowship challenged me in several ways. I was forced to interact with people from a variety of backgrounds on a daily basis, and interviewing sources for stories improved my communication skills. Writing for a newspaper requires sharp, active language, as well as quick turnaround. The need to adhere to strict deadlines forced me to turn thoughts into words at a brisk pace.

Working at a newspaper is lively and rewarding, and vastly different from the typical small, quiet math offices I was accustomed to. With TVs running and phones ringing, the newsroom was a constant hub of activity and excitement. I also enjoyed the quick turnaround of work. My dissertation problem consumed several years of my life, whereas over the summer I had a new story to report every week.

The importance of science journalism today cannot be underestimated. Many people are misinformed about science or are just plain scared of it, and it takes skill to convey science in a way that is clear, concise and understandable to large numbers of readers. Numerous world issues, such as stem-cell research or alternative energy, are science-related, and the public needs to be well informed about these topics. Newspapers also reach a wide audience of younger people, and science coverage could increase their interest and excitement about science-related subjects.

Since my summer internship, I have returned to the realm of academia, finishing my PhD at the University of Virginia in May 2008 and accepting an NSF Postdoctoral Fellowship at the University of Kentucky. There are several important lessons that I have carried back with me to academia. Mathematicians must improve their communication skills and foster better relationships with the general public. As a group, we seem particularly prone to keeping our work to ourselves or refusing to put our research into laymen's terms. But if we cannot share our work with the general public, then the mathematical community risks losing funding, interdisciplinary research opportunities and aspiring mathematicians.

Mathematics in Business, Industry and Government: Alive and Well, But Living Under Different Names (An overview of The SIAM Report on Mathematics in Industry)

by Professor Phil Gustafson, Mesa State College

During the 1990s, the Society for Industrial and Applied Mathematics (SIAM), with the support of the NSF and NSA, conducted an extensive survey of roughly 500 mathematicians, scientists, engineers and managers, to determine what mathematics is and what mathematicians do outside of academia. The full report, as well as related links, can be found at the website http://www.siam.org/about/mii/report.php. If anyone is interested in any aspect of mathematics in BIG, this report should be high on the reading list. Four groups in the mathematics community that might be particularly interested in looking into this report are (1) BIG mathematicians seeking a broader understanding and context for their professional experiences; (2) academic mathematicians interested in working on applications in BIG; (3) teachers preparing students of all majors for careers outside academia; and (4) mathematicians at all levels planning for a career in BIG.

As the title of this overview suggests, the survey found that ``mathematics in [BIG] settings is often not labeled explicitly as `mathematics'; and a final product represents a blend of several disciplines.'' The following excerpt taken from the Executive Summary provides a nice synopsis of many of the key ideas in the report.

``The overwhelmingly interdisciplinary nature of nonacademic mathematics has obvious implications about the work environment for mathematicians in industry and government, as well as about qualities considered desirable by employers; these provide the focus of our second set of findings. Some of the most important traits in nonacademic mathematicians include:

* skill in formulating, modeling, and solving problems from diverse and changing areas;
* interest in, knowledge of, and flexibility across applications;
* knowledge of and experience with computation;
* communication skills, spoken and written;
* adeptness at working with colleagues (``teamwork'').

The qualities that distinguish these mathematicians from other scientists and engineers are seen by their managers as falling into two broad categories:

* highly developed skills in abstraction, analysis of underlying structures, and logical thinking;
* expertise with the best tools for formulating and solving problems.

Some interesting and mainly consistent views emerged about graduate education in mathematics. The mathematicians surveyed tended to agree that they were well educated for several aspects of nonacademic jobs: thinking analytically, dealing with complexity, conceptualizing, developing models, and formulating and solving problems. However, they felt inadequately prepared to attack diverse problems from different subject areas, to use computation effectively, to communicate at a variety of levels, and to work in teams.''

To find out more about BIG mathematics and the life of BIG mathematicians, check out this report at the website above. A link is also provided for downloading the report in PDF form if desired.

[Phil Gustafson is Professor of Mathematics at Mesa State College in Grand Junction, CO.]

The 2008 Mathematical Problems in Industry Workshop at WPI

by Greg Coxson

It might seem too good to be true to have a team of bright mathematics graduate students working on one of your problems for a week, for free no less. But this is essentially the situation I found myself in this past June.

It all started with an email from Professor Margaret Cheney of Rensselaer Polytech. She asked if I would be interested in participating in the 2008 Mathematical Problems in Industry workshop at Worcester Polytech. If so, I should draw up a list of problems from radar engineering, my company's particular area of work, and to submit them for consideration.

Before I go on, I want to say that anyone who has read this newsletter for the past three years knows that summer research experience workshops, and the REU at WPI (this is separate from the MPI workshop, and is for undergraduate rather than graduate students) in particular, are close to the my heart and that of BIG SIGMAA. But I had never participated in one. So there was little question of going if I could. The decision was made even clearer when word came that the National Science Foundation had waived the problem submission fee,, said to have been about $2000 in recent years.

It is actually an interesting challenging finding problems for such a workshop. I was able to list about ten problems quite easily. However, in talking with colleagues at my company, I determined that most were ill-advised. For example, several were problems being worked by teams at the company and would have caused political problems, and one of them was said to be too valuable to the company to risk having it solved in such an open academic forum. I ended up whittling my list down to one interesting, theoretical and quite well-known problem. At the outset, I though the problem was likely to be impossible to solve in a week, even by a team of eager and well-trained graduate students.

The title of the problem I chose was "Do the Barker Codes End?". This problem goes back at least to the 1950s and boils down to the existence of binary codes of even lengths longer than 4 having the Barker property of autocorrelation sidelobe magnitudes no greater than 1. It is combinatorial in nature and closely linked to another difficult conjecture by Ryser on the existence of circulant Hadamard matrices of order greater than 4.

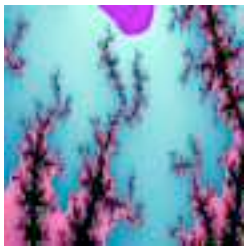
I voiced my concerns to Dr. Cheney and to the workshop director before the workshop. I was assured that it is often the seemingly impossible problems that make the best problems and, "the students may surprise you".

I came to learn that the workshop rarely gets combinatorial questions like mine. They often get problems involving mathematical modeling of physical problems arising in manufacturing. In fact, the other two problems at the workshop were of this latter type; one concerned glass formation and the other, the design of lithium-ion batteries. One professor at the workshop came up to me and told me "we do not get problems like yours". I was not clear whether he meant that was a good or bad thing, but by week's end, I concluded it was an approving comment.

The week started with problem presentations by myself and the other ``problem proposers''. Then the teams were chosen and went right to work. The teams had four days to work on the problem. The final day, Friday, was for presentations. It was a a real whirlwind.

I felt a bit rusty, I must admit (the students picked apart my presentation and quickly found three errors). They were all wonderful, sharp, and easy to like. There were 12 students on the team, among them Mike from Arizona, who quickly went to work on search algorithms, Yicong a chinese kickboxing Statistics student from Clemson who worked on curve fitting of data sets, Rajaa, a Fulbright scholar from Syria, who concentrated on assessing an existing approach by Golay, and Jeremy from Indiana University, who ended up working on the problem in another room with a team of professors who became interested. Jeremy's team ended up developing an approach from first principles in an intense and, one might say, ``muscular'', form of mathematical chalkwork.

One aspect of this process that can be a bit challenging is to bring students up to speed on fundamental concepts. For someone like me, who has been in a discipline for a while, I found it was necessary to answer questions on ``basic'' concepts, which are not basic to someone coming to the area for the first time. Some time has to be reserved at the start of the week for the team to ask questions, and to acquire these basic concepts.



Another interesting aspect are the team advisors. My vision of this in the beginning was that I would be proposing an interesting problem arising in my discipline and a team of students would work on it for a week, basically deciding the direction to take. Then I learned that the project team would need advisors. Furthermore, the director was finding it difficult to find experts to serve as advisors for this particular problem. As a result, I was asked to suggest a list of potential advisors. Remarkably, two wonderful folks whose work I admired accepted the invitation, and the NSF grant covered their travel expenses from their posts in Canada. The opportunity to meet and work with them, by itself, made the workshop worthwhile and exciting for me.

One day we had a special treat and were given presentations by the undergraduates participating in the summer REU at WPI. Unlike the graduate students who were there for a week, the undergraduates are in their program for two months. They were remarkably prepared, poised and knowledgeable.

Mathematical Problem in Industry workshops are a popular and widespread phenomenon overseas. We had a few workshop veterans from overseas, all of them very fun, engaging and experienced professors, most from Britain or Canada. The MPI workshop I participated in is an American version that moves year-to-year between several colleges on the east coast of the US. These include RPI, the University of Delaware, WPI and Franklin Olin College.

Everyone from the Math office staff to the directors and professors were welcoming and helpful. The organizers took care of all expenses, making it easier to concentrate on the workshop.

Sometime later this summer, a final report will be produced, prepared by one of the team advisors (the rules state that a faculty member has to write the report; luckily one of the advisors on the Barker problem team fit that description). In addition, the event rekindled my interest in the Barker problem (as proof, my satchel now holds several books I had held off buying before!).

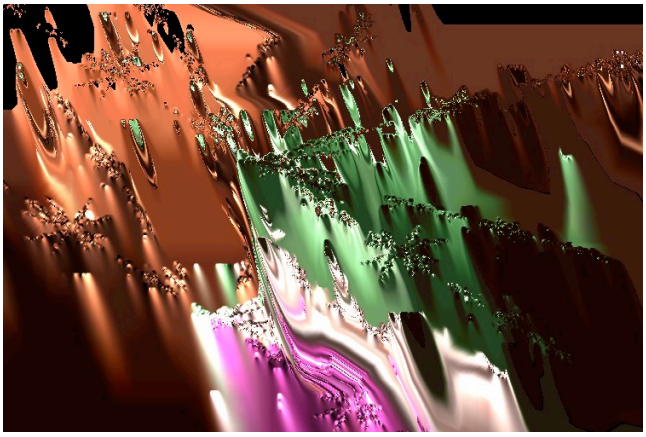
Did the team solve the Barker problem? Actually, no. However, I have come to the conclusion that the problem was not a bad choice. It can be approached with number theory, or matrix theory, with lots of algebra and analysis mixed in.

I recommend this workshop to any of my BIG colleagues. What problem would you and your organization like to put to a team of eager graduate students to solve in a week? Think about participating as a problem proposer at the 2009 MPI workshop at the University of Delaware.

My Sabbatical Year at Pella Windows

by Professor Mark Mills

I am one of five mathematicians teaching at Central College, a small, liberal-arts college in Pella, Iowa. About five years ago, our department needed someone to teach some of our upper-level applied mathematics courses -- in particular, Mathematical Modeling and Numerical Analysis. Two years in a row we actually tried to hire an applied mathematician to join our department, but we had been unsuccessful. While my PhD was in pure mathematics (matrix theory), I have always had some interest in physics and engineering, and I chose a physics minor as a part of my B.S. degree. So I agreed to take on both of those courses. As a part of our scheduling process, I also recently had a chance to teach our upper-level Probability and Statistics sequence. After



having taught all these course at least once, I quickly realized that I did not have a lot of ``real-world'' experience to bring into any of them.

With a sabbatical on the horizon for the 2006 -2007 school year, I started investigating opportunities during the summer of 2005 to either broaden my knowledge in applied mathematics or to gain some ``real-world'' experience using mathematics. I was fortunate to have the national headquarters for Pella Corporation (a.k.a, Pella Windows or simply, Pella) located only five blocks from my college office. On top of this, I also have friends who work as various forms of engineer at Pella. So I started talking to them about an idea I had to have some sort of internship at Pella during my sabbatical year. I was quickly given the name of the Director of Corporate Engineering, and when I contacted him about my idea I found that he was very interested in it.

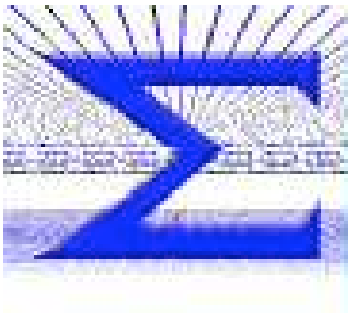
The process of setting up my sabbatical time at Pella took almost the entire 2005-2006 school

year, and there were a number of fits and starts in the process. One of my main issues was having Pella pay the 25% of my salary (and various benefits, including the college's contribution to my retirement account) that I was forfeiting by

taking a year-long sabbatical. (This ended up being around $15,000, which also included payment of my worker's compensation insurance). After several miscommunications about the pay issue, the college comptroller was able to get things straightened out and I was able to start working in the Pella Test Lab in August 2006. I committed to working at least 20 hours per week.

Before I started, the Director of Corporate Engineering put together a list of tasks or projects that he wanted me to do. I was also given some freedom to seek out my own tasks or projects, as I learned more about the company and got to meet people in various parts of the company. Here are some projects that I worked on:

*I spent two and a half months reviewing a model that had been designed by a Pella engineer to predict total warranty claims after ten years. Since this prediction was a point estimate, I was asked to put some sort of confidence interval around this estimate. In the end, I felt the model was a very good one, and the engineer and I found a way to give what we called an ``error interval'' for this estimate.



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* I spent about a month and a half examining two large data sets that had been collected from some long-term testing of windows in a couple of locations around the United States. My task was to correlate the two data sets (I think they meant, ``find connections or similar patterns''), as well as to make conclusions from them individually. I found that each set had some major flaws in how it was collected and I could only derive some simple conclusions. As far as I could see, there was no way to correlate the data sets.

* I was able to be a part of a testing team that tested some windows in a special test chamber for almost four months. I was the main data collector and analyst, and I was able to give input on potential changes to the test as it proceeded.

* In an effort to help a sales manager re-align the national sales districts, I worked to develop an algorithm to help with this re-alignment. The algorithm was essentially trying to solve the congressional redistricting problem using an accumulative approach. In the end, my algorithm did not work quite as planned, and the sales manager ended up doing this task by hand.

* I was able to participate in a week-long Kaizen project that tried to streamline an internal administrative process. It was fascinating to watch the Kaizen process work by first detailing the current process and then creating a streamlined version, with all potential stake-holders having input into its creation.

* I was given quite a few close-up tours of various parts of the company (especially the manufacturing area) and I spent time talking with people throughout the company about the types

of mathematics and statistics they use. I was also able to gain tours of the Pella manufacturing plant for Central College students and faculty.

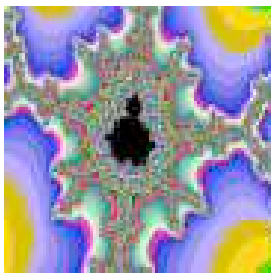
All in all, it was a productive year, and I think many people in academia (especially in the sciences) would benefit by having such an experience. Here are some things I learned:

* Industry is interested in having help -- and they are willing to pay. So spending part of a sabbatical working at a local company can be a nice way to form a connection between the company and the college, in a way that benefits both parties.

* Math and statistics majors have the right background for working in a manufacturing environment at a variety of levels, but they may need some additional training.

* I need to include MatLab in more of my classes, because it is a common statistical analysis tool in industry.

*We who teach in mathematics and statistics departments need to stress the importance of test set-up for our science and engineering majors, because this is often where a test can be flawed.



BIG Activities at the AMS/SIAM/MAA Joint Meetings in Washington DC, January 2009

Once again this year, BIG will be hosting a variety of events at the Joint Meetings in Washington DC. Consider participating or being on hand for the following BIG events:

* BIG Contributed paper session. If you have an experience involving Mathematics in Business, Industry or Government that you would like to share, consider submitting an abstract. Talks are typically 12 to 15 minutes long, with time for questions. The deadline is end of September. Contact Professor Phil Gustafson at pgustafs@mesastate.edu. You can also submit abstracts from the AMS Joint Meetings link; make sure you select the session for Mathematical Experiences in Business, Industry and Government.

* Second Annual BIG Invited Talk. The speaker this year is Professor Dan Kalman of American University. His talk is entitled “Calculus in Orbit”. An additional point of interest is Professor Kalman’s transition from the aerospace industry to a successful academic position in Mathematics.

In addition, MAA headquarters is located in Washington DC. Think about visiting MAA’s unique 19th century townhouse with its oval spiral staircase, its mathematical sculptures, the “river of bricks” and the new Halmos Carriage House conference center.

As venue for the Joint Meetings, Washington DC has a lot to offer. It is full of history, scenery and diverse restaurants and night spots. But the conference itself will keep you busy enough with its book exhibits, talks, graduate department receptions, and activities host by BIG and other groups.

Jump in - the Water is Fine

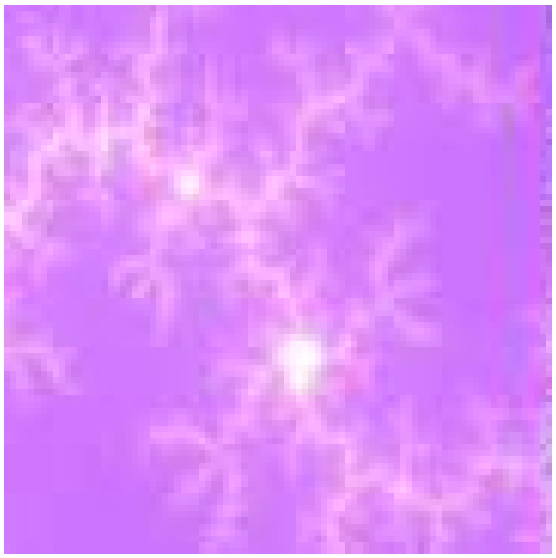
by Greg Coxson

I am a radar engineer and an active member of MAA. There, I said it. I know what my old office-mate Gary at Hughes Radar Systems would say: "Greg, I did not know you were such a joiner." And I suppose based on what he knew of me, his comment would be on the money.

It was while I was working at Hughes, in El Segundo, California, that it happened. I heard that an MAA section meeting was to take place at Loyola Marymount in the town right next to mine. I sent in my $12 fee, woke up early on a beautiful Saturday morning and made my way over. Most of the talks were okay, I suppose, but what did it for me was a talk on Fibonacci sequences by Professor Art Benjamin of Harvey Mudd College. He handled the subject as a magic show, and the students in the audience were fascinated, having fun, were attentive and involved. I had never seen anything like it. I ended up going to every Southern California section meeting after that, even one that required a 3-hour drive to San Luis Obispo (where I got to see a lunchtime talk by Doris Schattschneider on mathematical amateurs, using as one example the work of M.C. Escher).

MAA section meetings are great because they are hosted at different colleges and universities. If you go enough, you have an excuse to see a particular aspect, i.e., a selection of centers of higher learning, of the geographical area belonging to the section you belong to. The participation fee is inexpensive, and I have always felt welcome. Furthermore, the journals are at a good level for a time-strapped young professional.

When I moved to New Jersey, I continued to participate in section meetings. I asked if there were something I could do to help organize



meetings. I started preparing discussion table topics during lunch. I also got my employer to set up a table at one meeting to educate mathematicians about opportunities for employment. I even got to give a talk at the first "Garden State Undergraduate Mathematics Conference (GSUMC)" and have a t-shirt to show for it.

What is the point? Basically, that MAA is a great organization to be involved in, even if you do not teach Mathematics at the college level. Thanks to my involvement with MAA, I have had many diverse and memorable experiences. So I urge each of you to think of getting involved. In particular, BIG SIGMAA needs new officers. As some of us will tell you, if a new generation of leaders were to step forward, they would not be unwelcome.

Back to Gary, my old office-mate. He is going to be shaking his head even harder this time. I just received an email informing me that I have been elected the next MAA Governor for Mathematics Outside of Academia. The post is for a three-year term, and bears the obligation to attend meetings at both the Joint Meetings and MathFest each year. What am I doing?! Jumping in, of course.