A Tribute to Deane Montgomery

Ronald Fintushel

Deane Montgomery

One afternoon during my third year as a graduate student at S.U.N.Y. Binghamton, my adviser, Louis McAuley, popped into my office and asked if I would like to talk with Deane Montgomery about my thesis. "Certainly", I answered, tongue-in-cheek, thinking that he must be joking. How could Deane Montgomery, one of the founders of the theory of transformation groups, possibly be interested in hearing about the work of a student at S.U.N.Y. Binghamton? Half an hour later my adviser appeared once more, announcing that, sure enough, we were driving to Princeton early the next morning.

That next day was a turning point in my career in mathematics. I appeared at Deane Montgomery's office with more than a little trepidation, but Deane's warmth and sincerity put me at ease. His office was expansive, with a beautiful view of the Institute grounds. It had a large library and was arranged with a dual purpose. The rear was furnished comfortably in order to facilitate conversation. (Later I would learn that the Institute's Faculty of Mathematics would often hold their meetings there.) We talked for a while about the graduate program at Binghamton and then moved to the blackboard at the front of the office. I explained my thesis work, and Deane encouraged me and offered some ideas for future research. I returned to Binghamton invigorated and excited about mathematics. Within a year, due in a large part to Deane's help, I had a postion at Tulane University. There are dozens of mathematicians who have told me similar stories about their relationship with Deane Montgomery. He was justly famous for his efforts in helping young topologists and, more generally, making all visitors feel welcome at the Institute. He was especially ardent at searching for students like myself from smaller, less prestigious graduate programs and encouraging their careers.

In 1979–1981, I was fortunate to serve as Deane Montgomery's assistant. Throughout his career at the Institute, Deane had twenty-one assistants. Although most of them were mainly interested in some aspect of transformation groups, this was not always the case. For example, M. Kuranishi, E. Moise, and C. D. Papakyriakopoulos were his assistants. And again, many were chosen from outside "prestige" departments. In order to occupy that wonderful office in the corner of Fuld Hall adjacent to Deane Montgomery's, his assistants assumed two duties—to meet with him once a week in a private seminar to study a topic of the assistant's choice and to allow Deane to buy him a cup of coffee afterward.

During our weekly sessions I learned much about this remarkable man. Deane often spoke of his ca-

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reer and of the history of the Institute. I have excoriated myself several times since for not keeping a journal, for most of the details have drifted away with time. However, there are certain basic aspects of these conversations that I will never forget—Deane's love of mathematics and his joy at the success of others, his gentleness and personal humility, his abhorrence of pretense in any form, his pride in the Institute and conviction to uphold its standards. Most of all, he absolutely never gave false praise. His midwestern upbringing and mathematical training at the University of Iowa gave him a point of view that often served as a refreshing foil to the intense sophistication all around him. I remember one Thursday-morning topology seminar whose topic was not au courant and whose presentation was, to put it kindly, rough at the edges. Afterward, when asked for my opinion, I mumbled noncommittedly. Deane's response was quite different. "I thoroughly enjoyed that," he said, and called the speaker "salt of the earth", one of his highest forms of praise. Deane had the knack of making people feel comfortable and important. He knew that I was an avid runner, so we often talked about our exercise schedules. Deane was himself an early-morning exerciser who enjoyed going for a long walk before coming to his office. Now, I am a person who likes to work in the early morning, but in my two years at the Institute, I never arrived at Fuld Hall before Deane. Usually his door was closed, and I could hear the muffled sound of conversation with an early guest. Many mathematicians who came to the Institute began their visit by calling on Deane.

Because of his humility and personal distaste for self-promotion, mathematicians whose work does not involve the study of transformation groups are often unaware of his many contributions to topology. Others have spoken and written about his solution of Hilbert's fifth problem, but perhaps not enough is said about his later work, especially his joint work with C. T. Yang. In a long series of papers written in the late 1960s and early 1970s, they used the study of group actions on homotopy 7-spheres to showcase and test the growing new techniques of differential topology, especially index theory and surgery theory. At a time when much work in topology consisted in building these machines, their papers demonstrated the beauty of applying this theory to unfurl complexities of symmetry and structure. As a part of this series, Montgomery and Yang studied pseudofree circle actions, those that have no points fixed by the entire circle group but that have isolated circles that are pointwise fixed by finite cyclic subgroups. Since a linear action of this sort on a $2n-1$ sphere can have at most n such exceptional orbits, it was natural to ask whether such a restriction existed for smooth actions. In their papers they found a beautiful structure theory for such actions on homotopy 7-spheres, and they showed that one can find examples with arbitrarily many exceptional orbits.

When I first came to the Institute, I was interested in the same question for pseudofree circle actions on the 5-sphere, and my discussions with Deane encouraged me further. It was on this problem that Ron Stern and I first began our collaboration, and although the problem itself remains unsolved, it has been a major motivation for most of our work since then. It has served as a testing ground for our knowledge of Kirby calculus, of the theory of singular spaces, and finally of gauge theory, without ever revealing all its secrets. Yet in turn it has taught us much about 4-dimensional topology. In recent years there has been a resurgence of excitement among young researchers in calculating gauge-theoretic invariants of Seifert fiber spaces, and many facets of their interest can be traced back to the papers of Montgomery and Yang via this route.

The admiration of the mathematical community for Deane was universal. There was a large conference held in 1983 in honor of his seventy-fifth birthday at the University of Colorado and also a conference at the University of North Carolina in honor of Deane's eightieth birthday in 1989. At each of these conferences many of the mathematicians spoke extemporaneously about the ways that their lives and careers had been touched by their friendship and mathematical association with Deane Montgomery. I found the story of one of the participants to be particularly moving. He recounted how, early in his career at an East Coast university, his desire to be a mathematician was nearly overwhelmed by anti-Semitism. It was Deane Montgomery who helped him gain the resolve to fight the bigotry and to persevere in his work. After I left the Institute, Deane and I kept up a steady correspondence. He had developed an interest in gauge theory, and this was often a topic of discussion. I could always count on his letters for support and advice. In many ways I felt that Deane Montgomery was my mathematical father. In this sense, I have many siblings. His mathematics and his unwavering character have inspired all of us. By his actions, he has shown us how to conduct our relationships with our own colleagues and students. Although we all miss him terribly, if we follow his example, his spirit will never die.

Presidential Views: Interview with James Arthur

Every other year, when a new AMS president takes office, the *Notices* publishes interviews with the incoming and outgoing president. What follows is an edited version of an interview with James Arthur, whose two-year term as president begins on February 1, 2005. The interview was conducted in fall 2004 by *Notices* senior writer and deputy editor Allyn Jackson. Arthur is a University Professor of Mathematics at the University of Toronto.

An interview with AMS president David Eisenbud appeared in the February 2005 issue of the *Notices*.

***Notices:** When you found out that the Nominating Committee wanted you to run for president, why did you say yes?*

Arthur: I actually was quite surprised, not being an American and not working in the United States. I was a little concerned about whether it would be a reasonable thing to do. So I made inquiries to both AMS people and also to a number of my colleagues, and I was convinced that it would be viable. I don't believe there has been an AMS president who has not been actually living in the United States. There have been other Canadians, such as Cathleen Morawetz and Irving Kaplansky. But I cut my mathematical teeth in the United States, and I worked there for twelve years, during graduate school and afterwards. As it happens I am the only member of my family who is not an American citizen. My wife is American, and my two sons are American citizens and are both working at this time in the United States. I am very proud to be a member of the Canadian mathematical community. I came back to Canada in 1979, and I am proud to see the progress that Canadian mathematics has made since then.

Mathematics is an international enterprise, and the AMS has something like one-third of its members outside the United States. The AMS has some purely American mathematical concerns, but it is a major force in international mathematics. It is the most influential mathematical organization in the world and reaches well beyond the boundaries of the United States. I don't have a congressperson I can write to! But I suppose that one letter from a president to his local congressperson does not make that much of a difference. I expect to be able to play a significant role in discussions with people in Washington on mathematical questions.

***Notices:** The way mathematics is funded by the federal government in Canada is very different from how it's done in the United States. Can you explain the difference?*

Arthur: Yes. I don't know the figures about total funding per mathematician. I imagine they might be comparable, or maybe a little higher in Canada. I think the main difference, as far as mathematicians are concerned, is that there is no summer money in Canada. The size of the grants is variable, and the money is used for postdoctoral fellows and graduate students.

***Notices:** Do most Canadian mathematicians have grants?*

Arthur: I think most active ones have a grant. That suggests there are more grants in Canada per capita than in the United States.

***Notices:** Are the grants perceived the same way as they are in the US? Here an NSF grant is a big validation, and mathematics departments take it seriously in tenure decisions. Is that also true in Canada?*

Arthur: Yes. Of course, the size of the grant is relevant also, because there are some small grants in Canada. But it's taken very seriously. There are of course good sides and bad sides to that. If a person receives a disappointing decision from the granting agency, it can be harmful psychologically. On the other hand, the work of granting committees in both countries is very careful, and I think we would not have that kind of careful, informed analysis of a person's work and of what a person proposes to do if the analysis were done by university administrators who are not mathematicians. So in that sense I think the granting process is on the whole helpful to how mathematics operates and how it is organized in universities. The problem is that in the United States, relatively few people are funded.

Notices: *Do you have thoughts on the NSF-funded VIGRE program?*

Arthur: The idea is very good. It really helped build up graduate programs at some universities. It must be a little bit capricious as to which department gets a VIGRE grant and which one doesn't. And there is always the danger that a department might be worse off in the long run if it becomes dependent on a program that is not of infinite duration. On the other hand, I think VIGRE probably has been very helpful to departments in attracting good graduate students. It's really hard to get good graduate students. This is something that I would hope the AMS tries to affect in one way or another. We want the people who are best at mathematics as undergraduate or high school students to think very seriously about going into a career in mathematics. These are talented people, and they might well be good at other things. If society does not implicitly send them the message that mathematics is important, for example by providing good funding for graduate school, they might well think of other things to do.

Notices: *In your election statement you noted that mathematics has been the beneficiary of much greater interest on the part of the public in recent years. Why did that happen?*

Arthur: Well, it is quite remarkable. I am not sure, but you can point to some obvious things. Andrew Wiles's proof of Fermat's Last Theorem, in a way that we would not have expected, caught people's imagination. Books like the one on John Nash, *A Beautiful Mind*, have also brought a good deal of attention to mathematics. And of course in movies, mathematics has been chic in the last five or ten years. There is a sympathetic curiosity about mathematics. People don't know what mathematicians do, but they somehow have the feeling that mathematics has mystery, power, and beauty. I think people who are not mathematicians have a sense of that. We should stoke their curiosity. We already do so, but I think we can do more.

This is probably the most important aspect of strengthening mathematics in the United States and around the world. To have public sympathy and interest in mathematics would help just about everything that concerns us as mathematicians. It would persuade more talented young people to go into mathematics, because mathematics would be regarded with interest, and maybe even awe, by their parents and their friends, and would seem to be a worthy cause to spend one's life pursuing. It would help funding for mathematics, because voters would have a sympathy for it. Also, public appreciation of the beauty of mathematics would help encourage good people to become high school teachers.

At the undergraduate level, mathematicians have been criticized for not being good teachers. The calculus sequence has of course been one of the prime examples. But we have to remember that a greater proportion of students are taking calculus now than have done so in the past. In teaching calculus we are being asked to be the gatekeepers for other academic programs. That makes for an adversarial relationship. Probably we as mathematicians are better teachers than we give ourselves credit for being. We need to remember that, and we need to tell people in our universities.


James Arthur

Notices: *People say that in recent years math departments and mathematicians are much more concerned about the quality of their teaching than they were ten or fifteen years ago. Is that your sense?*

Arthur: Oh, absolutely. Part of it is that young mathematicians simply cannot survive if they are not competent teachers. That's taken very seriously by search committees. So most young mathematicians who are hired by universities are pretty good teachers. That puts pressure on everybody to become better teachers—if you are an older mathematician, you don't want to be shown up by the instructor or assistant professor you have just hired!

Notices: *What about minority students in mathematics? There are so few, for example, black people getting Ph.D.'s in mathematics. What can be done about that? It's a difficult question.*

Arthur: It is, and I don't think there is any magic way to do it. It's the question of role models. As a white male, when I was beginning in mathematics, I certainly did not understand the importance that role models played for me. When I think back now, it was just something I took for granted. There were people who were like me but twenty years older than me, and they were mathematicians. It's hard to imagine what it would have been like if no such people existed. For black students, there are few role models as mathematicians. These are obvious things to say, but the AMS should do what it can to increase the visibility and the prominence of mathematicians who belong to minorities. One obvious way is through membership on its committees. The AMS committees do wonderful work supporting the many different objectives of the Society. They also lend a certain prominence to the people who are on the committees. I think we already work very hard on this, and when I am president, I hope we can find overlooked minority mathematicians and women mathematicians and make them more visible as role models. My predecessor David Eisenbud has done a very good job on this.

It's a little sobering to be taking over this presidency! I look back at the past four or five presidents, and while they perhaps had different interests, they were all very impressive in the things they did. The AMS, in its professional operations, does many different things. From the executive director down, it's an extraordinary organization. The AMS publication operation is really very important. I don't want to get into trouble with commercial publishers, but they are making it difficult for mathematics and other subjects because the fees that they charge are enormous. Just look at what the AMS does. We have the *Journal of the AMS*, and it's one of the best three or four journals in mathematics. I doubt that other professional societies have such outstanding journals. Mathematicians look forward with anticipation to the monthly *Notices of the AMS*. We also have MathSciNet, with its unequaled mathematical database.

One thing we have to be concerned about is the lack of AMS membership among younger mathematicians. I think that's extremely important, and I hope to try to think of ways in which we can increase membership. It is not a question of the dues—dues are not a large part of our budget. What is much more important is to have as many people participating in the AMS as possible. It increases our strength as a community. We need to emphasize that we are part of a common enterprise that is a source of strength and energy for all of us.

Notices: *Are there other things that you want to try to address as president?*

Arthur: I haven't completely formulated in my own mind what things I will try to do. So many things are working well in the AMS that one has to be a little bit conservative. But I will try to change or add to things where I think I can accomplish something. Perhaps the area where one could try to make the greatest difference is in, as I already said, the public understanding of mathematics. I think we should consider sponsoring more public lectures and more publications that are directed at the general public.

For public lectures, there are two aspects. We would first of all have to do the mechanics of advertising it, getting people to come to it—then we've got to deliver the goods! We would not regard giving a public lecture as a reward for being a good mathematician. We would instead have to make sure we find the people who do it best. I am told that other organizations actually script their public lectures. Before the talk they have a practice session, in which the speaker is given friendly advice: "No, this is not going to work, you will have to polish up on that." I don't know if we mathematicians would stand for it!

In September I went to a Congressional briefing organized by the AMS Washington Office. Fred Roberts [director of DIMACS] spoke on how mathematics can help with emergency preparedness, disaster prevention, and related security matters. I don't think Fred would mind me saying that he didn't speak about anything particularly deep in mathematics on this occasion. It was a very charming talk, and there were all kinds of questions at the end. One person, who appeared to be a Congressional aide, asked "What's it like to be a mathematician? What does a mathematician's typical day consist of?" It was quite amazing, they were really curious. There was something about the way Fred talked that invited this—you felt that he was conversing with you.

In calculus courses, we have the potential to influence a huge number of university students, some of whom are going to be the leaders of tomorrow. And we somehow forget that. We can't make every calculus student happy, but nevertheless we can try to communicate to them that mathematics is interesting, even if they themselves don't want to do it in the long term.

About ten years ago, a former University of Toronto student endowed a chair in mathematics. He was a person who had gone to New York and had done very well in investment banking. He took first-year calculus in 1980 or 1981 at the University of Toronto, and then did not continue in mathematics. He so liked his experience in calculus that ten years later he came back to the university and endowed a chair in mathematics. This is really quite scary, when you think of all those students in your calculus classes! Calculus is very pretty, and we forget how remarkable it is. Perhaps we can sometimes try to indicate to students that calculus is the starting point for much of mathematics. I think there is a lot of good will that we don't tend to see on the part of the students. What we see perhaps is their resentment at having to take calculus when they don't want to take it, and also the stress they have in learning and passing the exams in what is quite frankly a difficult subject, compared to the other first-year courses that they might take. But we forget that, underneath, a lot of them have a good will towards mathematics. Not all of them, but a significant number have an interest and an appreciation, even if they are not going to go on in the subject. We need to stimulate it.

I am very honored to be president of the Society. It has had a wonderful history, and I have some very distinguished predecessors that I can try to live up to! I am very much looking forward to starting my term.

Mathematics People

TWAS Prizes Announced

The Academy of Sciences for the Developing World (formerly the Third World Academy of Sciences, TWAS) has announced its 2004 prizewinners. LONG YIMING of the Nankai Institute of Mathematics at Nankai University was awarded the prize in mathematics for fundamental contributions to Hamiltonian dynamics, in particular for establishing the index iteration theory for symplectic paths and deep studies on periodic solution orbits of Hamiltonian systems. SPENTA R. WADIA, Tata Institute of Fundamental Research, was awarded the physics prize for his contributions to nonperturbative quantum field theory and string theory.

The Academy of Sciences for the Developing World annually awards prizes of $10,000 each to scientists from developing countries who have made outstanding contributions in the fields of agricultural sciences, biology, chemistry, earth sciences, engineering sciences, mathematics, medical sciences, and physics.

—From a TWAS announcement

Lemieux and Dick Win Information-Based Complexity Young Researcher Award

CHRISTIANE LEMIEUX of the University of Calgary and JOSEF DICK of the University of New South Wales have been awarded the second Information-Based Complexity Young Researcher Award. The award recognizes significant contributions to information-based complexity by researchers who have not reached their thirty-fifth birthday by September 30 of the year of the award. The prize consists of $500 and a plaque. The prize committee consisted of Stefan Heinrich, Universität Kaiserslautern; Frances Kuo, University of New South Wales; Joseph F. Traub, Columbia University; Arthur Werschulz, Fordham University; and Henryk Wozniakowski, Columbia University and University of Warsaw.

—Joseph Traub, Columbia University

Professor of the Year Awards Announced

ROBERT L. DEVANEY of Boston University and STEPHEN J. GREENFIELD of Rutgers University have been chosen to receive State Professor of the Year awards by the Carnegie Foundation for the Advancement of Teaching and the Council for Advancement and Support of Education (CASE), which cosponsor the awards. The Professor of the Year Awards are intended to reward outstanding professors for their dedication to teaching, their commitment to students, and their innovative instructional methods.

The State Professors of the Year Award Program selects outstanding educators in all fifty states, the District of Columbia, Guam, Puerto Rico, and the U.S. Virgin Islands. Winners receive personalized award certificates and receive national and local media recognition. State and national winners are chosen on the basis of their dedication to undergraduate teaching, determined by excellence in the following four areas: impact on and involvement with undergraduate students; scholarly approach to teaching and learning; contributions to undergraduate education in the institution, community, and profession; and support from colleagues and current and former undergraduate students.

—From a Carnegie Foundation announcement

Young Mathematician Honored in Siemens Westinghouse Competition

PO-LING LOH, a senior at James Madison Memorial High School in Madison, Wisconsin, has been awarded a $50,000 scholarship in the national Siemens Westinghouse Competition in Math, Science, and Technology for her project "Closure Properties of D_{2p} in Finite Groups". She studied a generalized version of a problem posed by the topologist E. Farjoun about closed embeddings of finite groups in finite groups. Her mentor on her project was Michael Aschbacher of the California Institute of Technology.

Loh is a member of the varsity math team, the Knowledge Masters team, and the National Honor Society. She has participated in the American Mathematics Competitions, writing a perfect paper in the 2003 competition, and was one of the top twelve students in the 2003 USA Mathematical Olympiad. She is also a MathCounts student coach and a peer tutor. She aspires to become a math teacher.

—From a Siemens Foundation announcement