Deane Montgomery Tribute

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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 21 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 career 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 which 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. Afterwards, when asked for my opinion, I mumbled noncommitedly. 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 1960's and early 70's, 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 which have isolated circles which 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 around 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 honor of his 75th birthday at the University of Colorado and also a conference at the University of North Carolina in honor of Deane's 80th birthday. 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.