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A Conversation with Melanie Wood

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Although just beginning her first year as a graduate student in mathematics at Princeton, Melanie Wood has won numerous honors. As a junior in high school, she tied for first place in the USA Mathematical Olympiad. She was the first female to represent the United States in the International Mathematics Olympiad (IMO), a worldwide math competition for high school students. In both her junior and senior year in high school, she received Silver medals at the IMO.

In 2002, Melanie received the Alice T. Schafer prize for excellence in mathematics by an undergraduate woman given by the Association for Women in Mathematics. In 2003, she was the first American woman, and second woman overall, to win the Putnam competition—a prestigious math competition for college students. In 2004, she was the first woman to receive the Morgan Prize, sponsored by three math organizations, for research by an undergraduate. The Prize committee called her work "deep and original."

MH: When did you first realize that you had a special talent for mathematics?

MW: When I was in seventh grade, a teacher invited me to be on the school's MathCounts team, and I went to the competition without any preparation or any idea what it would be like. I was shocked to win first place in my city, then my state, and then 40th in the nation. Bob Fischer, the coach of the Indiana MathCounts team and a middle school teacher, sent me problems throughout the following school year to help me prepare for the next year's competition—in which I placed 10th in the nation.

MH: Tell me about your participation in the American Mathematics Competition for high school students.

MW: In 9th grade, I did well enough on the USA Math Olympiad to be selected as one of 32 students from the nation invited to train during the summer for the International Math Olympiad (IMO), at a program referred to as "MOP" (Mathematical Olympiad Program).

MH: Please explain what goes on at MOP.

MW: At MOP, students go to several hours of classes a day where they learn all sorts of mathematics outside the normal high school curriculum such as number theory, combinatorics, and geometry. They also take three-and-a-half hour exams every other day, and free time is filled with contests and homework. All of this intense training is to prepare six students for the IMO and to prepare younger students for possible future participation at the IMO.

MH: How many girls were at MOP when you were there?

MW: My first two years at MOP I was one of only two girls and the next two years I was the only girl at the camp.

MH: Did it bother you being the only girl?

MW: There are social and emotional issues that you have to deal with when there are so few females at a program like this. That means dealing with these issues in additional to handling the high-pressure training and competition. It's not an ideal situation for learning mathematics.

MH: Besides developing your math ability, meeting a lot of talented people, and representing the US in the IMO, what other benefits did you get out of MOP?

MW: One very important thing was for the first time I met a mathematical role model that I could identify with, specifically, a woman. One of the instructors was Zvezdeline Stankova who had won two Silver medals in the IMO competitions as a member of the Bulgarian team and had a PhD in mathematics from Harvard. Her enthusiasm for mathematics, her clear and lively lectures, and her desire to assist young students develop their talent were great influences on me.

MH: Perhaps it is no coincidence that you have these same traits.

MW: Having a role model like that was a big deal in my life. Previously, I never knew a mathematician that I could look at and think "in ten years I want to be like that person" and so it was hard to imagine becoming a mathematician. But with

Melanie Wood—Math Olympian, Putnam Fellow, and winner of both the Shafer and Morgan prizes.

Zvezda, I could think that I wanted to be like her in ten years. I've ended up following some of the same paths. We both were instructors at the MOP and we both participated in the Duluth REU as students and later as visitors.

MH: You were profiled in the June 2000 issue of *Discover* magazine in the article "The Girl Who Loved Math." It included some unusual photos of you. What was the idea behind them?

MW: The magazine put the table of contents over a full-page photo of me doing a headstand in front of a blackboard—supposedly suggesting "trying a novel approach to a math problem." We went out to Duke forest in search of trees suggesting certain mathematical patterns—one of those shots appeared in the article also.

MH: It is my impression that the Duke University mathematics department recruits math stars the same way the Duke basketball coach recruits basketball stars. Why did you choose Duke for your undergraduate education?

MW: In 1999, I received generous offers from Harvard, Stanford, and Duke. I visited Harvard and Duke multiple times trying to decide which place was best for me. I ended up choosing Duke because the math department is dedicated to undergraduate education and undergraduate research, and because I liked the friendly, cooperative attitude of the university. My choice ended up being very fortunate. While at Duke, I was able to take graduate level math courses and also do original research.

MH: Your first research experience came in the REU in Duluth. Give the readers a brief explanation of what you did there.

MW: I was unable to get inspired by the first problem I worked on, but I was lucky to get a second problem that was just perfect for my interests! A few years before me at Duluth, Manjul Bhargava had generalized the notion of the usual factorial function that arises in combinatorics and number theory. For number theoretical questions that were answered in the integers by the factorial function, this generalization provided answers in other Dedekind rings, including some classical questions about polynomials raised by George Polya more than 80 years earlier. I was able to relate these generalized factorials to the geometric structure of the ring induced from the p-adic metric. I used this relationship to prove certain kinds of regular bases for integer valued polynomials couldn't exist in imaginary quadratic number fields.

MH: So, that lead to your first publication.

MW: Yes, it was published in the *Journal of Number Theory*.

MH: What other research experiences have you had?

MW: Richard Hain, a professor at Duke who I never had for a class, came up to me one day and said that he had an idea that he thought would be a good topic for an undergraduate to work on. In learning the background material for the originally suggested problem, I came across some amazing mathematics that was part of a program Grothendieck proposed for studying the absolute Galois group. This led me off in a quite ambitious direction of research that has been really intriguing for me, and even modestly successful.

MH: It also helped you win the Morgan Prize for research by an undergraduate.

MW: Yes, that and the number theory paper. I was fortunate to have had two opportunities to do research in areas that I enjoyed so much.

MH: I hear that your math jersey has been retired by Duke. Tell me about that.

MW: My Duke math t-shirt hangs framed in the math lounge at Duke. It means that no mathematical competitor at Duke will ever be able to have my number on his or her Duke math shirt in the future. I don't imagine this will cause too much trouble, because my number was the simple '2' while many go for irrational numbers.

MH: Any story about 2 as your jersey number?

MW: I think of 2 as being the simplest number that has any structure, yet already it can lead to rich mathematics, including things like $Z/2Z$ cohomology and the algebraic closure of the field on two elements.

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MH: Among all the awards that you have received, which one are you most proud of?

MW: The Theater Studies department at Duke chose me as their one nominee from my class for the Faculty Scholar award at the university. I am most proud of this because the work I did in theater stretched me more than anything else I did in college.

MH: When did you become interested in theater?

MW: I've always enjoyed theater. At Duke, I was involved in many productions, including assistant directing *Macbeth* and producing a musical. I am interested in vocal work for acting and text-based Shakespeare.

MH: On occasion I have expressed the opinion that Shakespeare and Leonardo da Vinci are geniuses as great as Newton and Gauss. Have you given any thought to this kind of question?

MW: I think people often overlook the similarity between what it takes to be a mathematical genius and what it takes to be an artistic genius. Neither can be achieved by technical skill alone, yet certainly a great deal of technical skill is required for both. Both require creativity and the ability to think in ways that others haven't been able to imagine.

MH: What other interests do you have?

MW: I love to learn all sorts of things, and while at Duke enjoyed taking classes on everything from moral philosophy, to psycholinguistics, to dictionaries.

MH: You spent your 2003–2004 academic year at Cambridge University. How was that experience?

MW: I had a great time at Cambridge. I did a course work program, and was able to take great classes in number theory and in other areas. Their program is very different from those in the US because there are no problem sets or exams during the course; there are only exams in June that cover the classes from the whole year. What I enjoyed most about the year is that I just had lots of time to think about math.

MH: Many students with your ability graduate early from high school or college. It seems that you chose not to do this. Why?

MW: I'm in no rush to get through my education, and often I don't understand why others seem to be. I was lucky to be able to find interesting and challenging things to do for all of my high school and college years. For example, I attended courses at Indiana University my senior year in high school. I could have started my PhD last fall instead of spending a year in Cambridge, but I feel that I understand more mathematics and at a deeper level for taking this time—and that is what is most important to me.

MH: What are your long range plans?

MW: I hope to do a PhD thesis in algebraic number theory and to obtain a job at a major research university. I am interested in both research and teaching.

MH: I enjoyed our conversation. I hope to interview you again in ten years. ■