

CELEBRATIO MATHEMATICA

R. L. Moore

SAM WAYNE YOUNG

CHRISTMAS IN BIG LAKE

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CHRISTMAS IN BIG LAKE

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Sam Young wrote a Ph.D. thesis in analysis under the direction of H. S. Wall. He is Professor Emeritus at Auburn University. This essay recounts his experiences with Moore's 688 class.

It was the spring of 1959, and I had struggled that school year to catch on to the theorem-proving courses of Fitzpatrick and Wall. It was coming together for me to some extent, although I was not doing nearly as well as many of the other students, such as my friend Harvy Baker, for example. I do remember that I managed to give an epsilon-delta proof of the fundamental theorem of calculus. But Harvy came up with a description of a set of real numbers which we now know as the Cantor set, and I thought that there was no such thing. I tell you this so you will know about where I stood in my newly chosen major of mathematics.

By that spring, Harvy and I and other classmates had heard stories about R. L. Moore and his famous MH688 course. We were curious to find out if we could, or should, sign up for it the following Fall semester. We were undergraduates, and would have to get special permission, and we were not sure it was the right thing to do. So we went to talk to Ben Fitzpatrick and asked for his advice. I remember that Ben warned us that it would be very different from anything we had experienced before. And I guess he gave us the advice of going ahead and signing up, because in September we were there.

Dr. Moore began the course by stating Axiom 0 ("Every region is a point set") and some definitions and the first few theorems. The undefined terms were "region" and "point." On the second day of class Dr. Moore asked who could prove Theorem 1. Actually, he may have started down the class roll, and asked students one at a time if they could prove Theorem 1. There were plenty of students who could prove the first few theorems, which were elementary consequences of the definitions. But I did *not* understand how to prove the theorems, and I did *not* understand the proofs that were given. Looking back on it now, I think that I failed to understand that the theorems were independent of the meaning of the undefined terms. I was laboring under the assumption that the students who went to the blackboard to present a proof knew more about "regions" than I did.

I was confused about some other things too, but it does not matter why; I was simply baffled and flustered by the entire process. I continued to take notes meticulously, and this habit turned out to be a contributor to my eventual salvation. I would write down the words of a proof, and copy the drawings that students were putting on the board, and then I would copy it all again neatly into a spiral notebook. After a few weeks we got to some of the more difficult theorems, or so it seemed to the class. To me, they were *all* impossible. I continued to copy the proofs which were just so much gibberish to me.

Dr. Moore's method of calling on students for proofs involved calling first on the persons who had contributed the least. My name rose to the top of the list. The class met at 9:00 am on Tuesday, Thursday and Saturday, and my day would usually begin the same way. Dr. Moore would take his place in front of the classroom, and might make a few comments or remind us of where we were in the material yet to be done. Then he would look at me and ask the same question, "Mister Young, can you prove the next theorem?" It was a bit terrifying and humiliating, but I felt no negative feelings toward him. After all, I knew how to extract myself from the situation. I had to prove a theorem and get the pressure off of myself. But my answer was always the same, "No sir, I cannot." It sounds cruel as I describe it now, but there were no hurt feelings. It was as much comical as cruel. Someone had to be the worst student in class, and it was me.

In those days, the Fall semester did not end until after the Christmas break. Our class would meet three or four times after we got back from Christmas. On the last class meeting before Christmas, Dr. Moore spent the entire hour stating theorems and definitions. He really loaded us up with work to do. I took my notes and went to be with my parents for Christmas. My parents had moved that year from San Angelo to Big Lake, Texas, a small oil-town 80 miles to the west. They lived in a metal building which had been converted from the office of a welding shop into living quarters. I knew practically no one in the town, and so I was as isolated and undistracted as I could possibly be for the task before me. I believe that I began as usual to make good copies of the latest proofs that were given in class.

This time, as I read the proof of Theorem 25 (I am not sure if 25 is the number) that my classmate had presented, I somehow managed to understand the argument. I saw how he had made use of a previous theorem and the definitions which were involved. I was astonished! I was understanding one of the proofs for the first time. I went to the proof of Theorem 24 and I managed to understand that one too. I remember thinking that perhaps I could prove some of those theorems myself. I worked my way back through the theorem sequence, and proved almost all of the theorems in my own way, and wrote my own proofs in my spiral notebook, including those very elementary theorems at the beginning. I worked all day, every day, through Christmas doing this. Finally, with a few days left before heading back to Austin, I was ready to look at the work that Dr. Moore had given us to do during the break.

I wish that I had the ability to describe the exhilaration that I felt to the core of my existence when I put together a proof of Theorem 26. I marched forward proving the next theorem, and the next. I am not saying that it was easy; it was exhausting work. I would get up early in the morning, and work all day. I wonder what my mother thought about all this. She probably thought that her son who went off to college had to study. She could not have known that what I was doing went well beyond *studying*. She could not have known that her son became a mathematician that Christmas.

The time came to go back to Austin, and a great fear came over me as I visualized the inevitable scene that would unfold in the classroom. I was ready and confident with proofs of several of the upcoming theorems, but I was scared to death. I had never "been to the board." When the time came, Dr. Moore looked at me and asked the usual "Mister Young, can you prove Theorem 26?" I am pretty sure that my exact answer was "Yes, sir, I can." I had learned that he did not like for anyone to say "Yes, I *think* I can." The fear that I felt at that moment is indescribable, but I want to repeat that I was *confident* that my proof was correct. The fact that I *knew* I had it, the fact that I was confident in spite of the awful fear of the

moment is a tribute to the Moore method of teaching. I went to the board and presented my proof. He asked if anyone had any questions. There were none and I took my seat.

My friends who have had courses from Dr. Moore are always surprised when I tell them what happened next. He never called upon the same person who had just presented a proof. It was just not done. He would turn the pressure on someone else. But I distinctly remember that he looked around the room as if trying to decide whom to call upon. His eyes fell upon me again and he asked “Mister Young, can you prove Theorem 27?” I said that I could, and went to the board again. When I finished I sat down again and again he looked around pretending to decide and said “Mister Young, can you prove Theorem 28?” This impish routine continued for an hour, and started again at the next class meeting. In fact, no one else was called upon for the remainder of the term. I proved all of the theorems that we had time for.

Unfortunately, I was not able to continue with my class that next semester, because of a conflict with the only section of Russian that was offered, and I had to have the Russian class to graduate. I resumed the MH688 course the next year as a graduate student, and took the MH689 course the year after that. I also took Dr. Moore’s measure theory course. Along the way, I became a student of H. S. Wall and chose that route for my Ph.D. work. I will always remember that Christmas in Big Lake, and the feeling of triumph that resulted — a measure of success for the Moore teaching method, and success for myself which propelled me toward a career in mathematics. Of course, I will always treasure the influence that he had upon me. I like to think that maybe, just *maybe*, he never forgot me either.

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