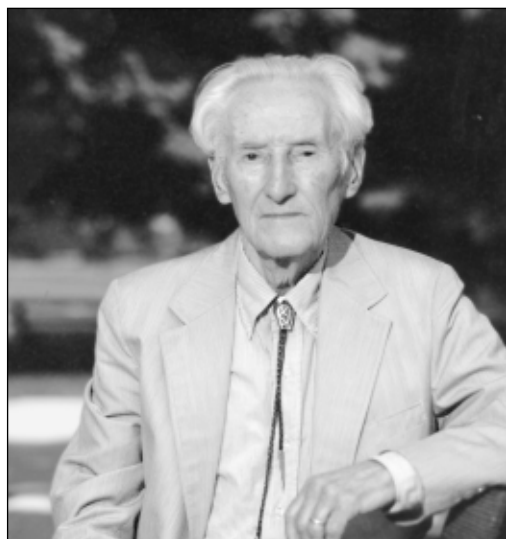


# Arnold Ross (1906–2002)



**Arnold Ross**

Arnold Ross died on September 25, 2002, at the age of ninety-six. His unwavering commitment to nurturing mathematical talent had a profound impact on many young people. Soft-spoken and unfailingly polite, Ross possessed an uncompromising will that allowed him to translate into educational practice his own exalted ideals about knowledge, creativity, and communication.

Arnold Ephraim Ross was born in Chicago on August 24, 1906, and spent his childhood in Odessa, Russia. After returning to Chicago in 1922, he changed his original surname, Chaimovich, to Ross. He became a student at the University of Chicago, where he was deeply influenced by E. H. Moore and by L. E. Dickson, who advised Ross on his Ph.D. in number theory, completed in 1931. After holding a fellowship at the California Institute of Technology and teaching at the People's Junior College, Ross spent eleven years at St. Louis University. During World War II he worked for the U.S. Navy as a research mathematician. In 1946 he was appointed as the head of the mathematics department at the University of Notre Dame. Ross left Notre Dame in 1963 to become the chairman of the department of mathematics at the Ohio State University (OSU), retiring in 1976.

Perhaps his most notable lifetime achievement was the summer program he started at Notre Dame

for high-school students talented in mathematics. Even before the Sputnik era, Ross divined the need for encouraging such students. In the summer program, he developed innovative methods to impart creativity and problem-solving skills in a manner that would benefit the students throughout their lives. The Ross Program moved to Ohio State in 1964 and continues to thrive there. Ross directed and taught in that program every summer until poor health forced him to retire in 2000 at age ninety-four. In the 1970s he carried this program to Australia, India, and West Germany, where local efforts flourished for several years. Alumni of the highly successful Ross Program at Ohio State have created similar programs at other universities in the United States and Canada.

In the 1960s Ross also initiated innovative outreach programs for inner-city school children in Columbus and served on several national committees concerned with mathematics education. He received many academic honors, including national awards for teaching and service in mathematics: the OSU Distinguished Teaching Award (1974) and Distinguished Service Award (1981), the Mathematics Association of America Award for Distinguished Service (1986), and the AMS Citation for Public Service (1998). In 1993 the AMS established the annual "Arnold Ross Lecture Series", in which top mathematicians present lectures to high-school students. Ross also received an honorary doctoral degree from Denison University (1984).

Arnold Ross married Bertha (Bee) Horecker in 1931, and they had a long and happy marriage until her death in 1983. They had no children. In 1990 he married Madeleine Green, who remained with him in a close, loving relationship for the rest of his life.

What follows are reminiscences about Arnold Ross from students and colleagues who worked with him during his long career. Further information

about Ross may be found in “Interview with Arnold Ross”, *Notices*, August 2001, pages 691–8.

—*Allyn Jackson and Daniel Shapiro*

### *Prakash Bambah*

While talking of Arnold Ross, I often recall the following: A young student passing through Columbus came to the mathematics department at the time Arnold had gone to lunch with some others. Seeing the student's disappointment, the secretary suggested that he see Arnold at the faculty dining hall. The student said, “How will I find him? I have never met him.” The secretary replied, “You ask for the mathematicians' table, and as you near it one man will get up to get a chair for you; that will be Professor Ross.” Arnold was considerate to everyone, and he was passionately committed to bringing out the best in the young, especially the gifted or the deprived. It was a privilege to be one of his friends.

### *Thomas Banchoff*

At the final banquet of the joint AMS-MAA meetings each January over the past twenty years, I always made sure to find a seat next to Arnold Ross. It was a great way to see so many fellow mathematicians, as they would come up to him to express their appreciation for his encouragement throughout their careers. It is hard to believe that he will be there only in spirit from now on.

Although I was not one of those fortunate enough to participate in his “Saturday school” sessions for high-school students, I did meet him on my visit to Notre Dame in the spring of my senior year. His warm reception and his genuine interest in my geometric science-fair project sealed my determination to come there and major in mathematics. I recall him challenging us with problems in his number-theory seminar and urging us undergraduates to attend presentations by the

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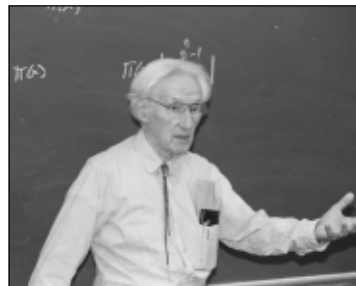
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many mathematicians who would pass through Notre Dame at his invitation.

I also remember how proud I felt when he asked me to stay on after graduation and be one of his teaching assistants in his National Science Foundation summer program for secondary-school teachers. I developed much of my own teaching style by observing him and the other instructors he would choose for that program, and I was happy to return for a second summer after my first year as a graduate student at Berkeley. I especially appreciated his commitment to the inspiration of secondary-school students, who returned as assistants during their college years, in his successful summer programs at Notre Dame and later at Ohio State. I was very happy to read about the many awards that acknowledged his lifelong contributions to our profession, including the Gung Hu Award from the Mathematical Association of America for meritorious service.

Over the years, whenever we would meet, I loved talking to him and sharing teaching experiences. He kept to the end his passion for teaching and for the encouragement of teachers and students at all levels. That passion will continue to make an impact as we remember Arnold Ross.



**Ross lecturing, 1996.**

### *Felix Browder*

For the last half of the twentieth century, Arnold Ross was the outstanding figure in the United States in the encouragement of mathematical talent among young people on the precollegiate level. The only comparable figure on a world level was I. M. Gelfand and his Mathematical Correspondence School in Moscow. Although Arnold spent most of his childhood and early youth in Odessa in the Ukraine, the most important influence on his ideas and activities came from his mentors at the University of Chicago, especially E. H. Moore and

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**Madeleine and Arnold Ross,  
1996.**

Leonard Eugene Dickson. (Interestingly, Gelfand also spent his early years in the Ukraine, but in a rural village.)

The Ross Program, which has run for almost fifty years, is a summer program for high-school students whose participants are selected on the basis of their ability to independently solve nontrivial elementary problems. It is based on three central principles: self-motivated activity by the student participants; a basic course always taught by Arnold Ross in elementary number theory, culminating, hopefully, in the students finding their own proofs for the Gauss-Legendre Quadratic Reciprocity Law; and a strong emphasis on cooperation between students and the counselors who are former students. These principles, combined with Arnold's single-minded devotion to the students and counselors, gave rise to a remarkable esprit de corps.

In the mid 1970s, after Arnold had run his program for at least a decade at Ohio State University, where he was long-term chairman of the mathematics department, a crisis developed. Arnold retired as chairman, the Ohio State administration was unsympathetic, and the NSF [National Science Foundation] cancelled its program of support for talented students (justified by the curious doctrine that support for the talented constitutes an "elitist" attack on "democracy", which must have had Thomas Jefferson rotating in his grave with incredible angular velocity).

As chairman of the mathematics department at the University of Chicago, I suggested to Arnold that we should adopt the program with support from the university and from outside donors. This was done successfully for four summers, with Arnold teaching his basic course and senior faculty members like I. N. Herstein, R. Narasimhan, and Paul Sally teaching collateral courses. Arnold returned the program to Ohio State in 1979.

### *David Pollack*

I first met Arnold Ross as a student and then was a counselor in his summer program during the summers of 1988–93. In addition to being a teacher, mentor, and friend, Ross was something of a cult

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hero to the counselors at the program. We were fascinated by his many stories, his careful Russian-influenced speech, his unique classroom style, and even by his consistency in wearing a plain white dress shirt to lecture every day.

It was inevitable then that rumors began to fly during the summer of 1990 when Ross started wearing pinstriped shirts to class. The situation came to a head when one morning he was observed to be wearing a new ring. Shortly after lecture, when the counselors had gathered to escort him on his daily walk back to his office, Ross strode up to us with a striking woman at his side and introduced his new bride by declaring, "Gang, I'd like you meet Mrs. Ross."

Naturally we were all delighted. But we could not have known at the time what a wonderful woman Madeleine Ross would prove to be or how extraordinary an influence she would have on Arnold and on the program. Far beyond the introduction of color into his wardrobe, Madeleine's love reinvigorated Ross. She gave us all the gift of having him run the program for ten more years, until the age of nearly ninety-four.

I had the privilege and joy of growing closer to Arnold and Madeleine while I was a member of the faculty at OSU from 1998 to 2001. I am greatly warmed by the strength of their love and by the open and pure way in which their affection for each other shone through their every interaction. I count this look at a deep and true love high among the many life-changing lessons I learned from Arnold Ross.

### *Peter Roquette*

Reflecting on the past, I now realize how much I owe to Arnold Ross and what I learned from him, not about mathematics, but about how to teach; about setting and keeping standards, not only for others, but also for oneself. I believe it was in the 1960s when I first met him at Notre Dame, and at once I realized his extraordinary gift for motivating people gently and with understanding. During the years when we had contact I had many occasions to observe his concern for the problems of others and in particular of those whom he called "youngsters." He really cared. I find myself lucky to have met in my life such an extraordinary personality.

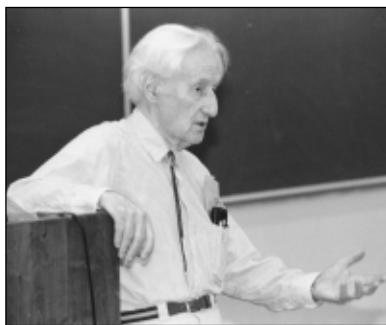
I never had the opportunity to participate in one of his summer schools, but in discussions with him I learned about the value of such enterprises. Two times he was in Germany and helped us with all his experience and wisdom to establish our

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*Schulerseminar*, modeled in large part on his summer program. Without his help and his devotion to this task we would never have been able to do this here so successfully. Later in the 1990s, when I wrote to him about my plans to establish a common seminar with young German and Russian students, he generously donated some funds that helped us realize these plans.

Both my wife, Erika, and I remember well Bee Ross, who, at the side of her husband, gave him a loving and understanding hand in his devoted work. We are sure that Arnold and Bee will be remembered by the many mathematicians and “youngsters” who had, like us, the privilege to meet the Rosses.



Ross lecturing, 1996.

### *Karl Rubin*

I knew Arnold Ross for about one-third of his life and about two-thirds of mine. Like many others, I first met him when I was a high-school student in his summer program at Ohio State. I continued as a counselor in the Ross Program at Ohio State and at the University of Chicago when Arnold moved the program there temporarily. I also went with Arnold twice to Heidelberg to help out as an experienced counselor in the program he was trying to establish in Germany, and later we were colleagues for many years in the Ohio State mathematics department.

Needless to say, this contact had a tremendous influence on me and on my career. First of all (and most important in the early years), it was fun. I was discovering mathematics in the company of others who enjoyed it as I did. The sense of discovery and the people I met were very important in my mathematical development. Second, observing an inspiring teacher at close range and over many years has influenced my own teaching in many ways, from the idea of learning by discovery to the “accidental” arithmetic errors in lectures.

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But most of all what I will remember about Arnold Ross is his passion for inspiring and encouraging gifted students. He was willing to channel all his considerable energy in this direction, and he never stopped encouraging others to do the same.

### *Paul J. Sally Jr.*

At the urging of Felix Browder, Arnold Ross transported his Summer Science Training Program to the University of Chicago in summer 1975. It has never been clear to me whether his intent was to move the program to Chicago permanently or to establish a branch to run along with the Ohio State program. At this time I had known Arnold for years, and many alumni of his program had come to Chicago as undergraduates. However, during the summers of 1975, 1976, and 1977, I really came to understand Arnold and the nature of his devotion to young people. I also learned the workings of his program. Arnold returned to Ohio State in 1979 and ran his program for many more years. All of the Chicago outreach programs for young mathematicians since 1978 have reflected the principles and structure of Arnold’s program. My admiration for Arnold’s achievements and commitment is unbounded.

### *James Schultz*

I never had a course with Arnold, but I consider him to be among the most influential people in my life. As his administrative assistant in the Ohio State University mathematics department for three years, including the campus riots of the early 1970s, I can recount many events.

On one occasion I was persuaded by another student that we needed to convince Ross to leave the University Oval, where he stood with others between armed soldiers and angry student demonstrators, because he was “too old” to be out there. (Note that this was over thirty years ago!) Instead, Arnold convinced us to spend the rest of the day there with him. That night I went home and learned the terrible news of the shootings at Kent State, not far from where we had stood, and realized the importance of what Arnold had done. Incidentally, one reason for the other student’s concern for

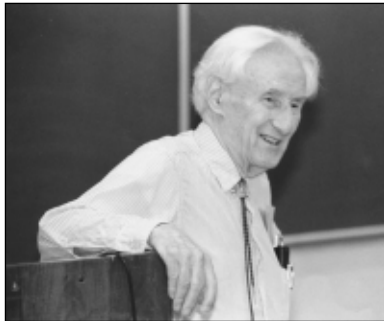
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*James Schultz is the Robert L. Morton Professor of Mathematics Education at Ohio University. His email address is schultz@ohio.edu.*

Ross was that Arnold had secured a place for this student's house trailer on OSU property when no trailer park in Columbus would have the student and his family because they were black.

Another incident occurred when a belligerent student came to the office and demanded to see the chair of the department. We wanted to "protect" Ross, but Arnold welcomed him. Arnold told the student he was pleased to see his commitment to important issues. The student who came in shouting profanity left in tears fifteen minutes later, promising his help.



Ross lecturing, 1996.

### *Alice Silverberg*

Arnold Ross was both a genius and a pragmatic idealist. He believed that talent can be found anywhere; nurturing that talent was his life's work and his passion.

What Arnold Ross created in his summer program was, first and foremost, a community. The students, counselors, seminar leaders, lecturers, and director form a supportive community of people who want to learn and grow, are willing to work hard, and love doing mathematics. The students achieve at a high level because the standards that are set for them are very high. Arnold Ross knew that he was nurturing future leaders, not just in mathematics and in academia, but in numerous other areas.

As is the case for many people who have been in the Ross Program, it has been one of the most intense and rewarding experiences of my life, not only as a student and counselor, but also as a teacher in the program. The program has been a major influence on my teaching style and philosophy and also on my sense of what it means to be a mathematician. I feel privileged to be part of the Ross community.

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### *Glenn Stevens*

Over almost half a century Arnold Ross has influenced countless young people to embrace the life of scientific exploration. It was a great privilege for me to participate in his summer program as a young high-school student back in the late 1960s and early 1970s. Even more important has been the enduring friendship with Arnold that grew out of those early contacts.

All who knew Arnold found inspiration in his inexhaustible energy as well as comfort in the warmth of his personality. His personal charm seemed only to be enhanced by his sometimes mischievous views on education. For example, when asked by well-intentioned colleagues how he dealt with the intense competitive spirit that so many youngsters bring to his program, Arnold always replied without hesitation and with characteristic charm: "We encourage it!" At a national meeting of educators working to encourage minority students to major in mathematics and science, I recall Arnold's cheerful acknowledgment "Yes, this is very important..." as well as his challenge "But what will we do for the elite?" Arnold's commitment to developing talent at the highest levels and across the social spectrum was principled and consistently put forward at every public forum he attended.

Arnold's influence inspired the two most important decisions of my professional life—to become a research mathematician and to work with my colleagues to develop the PROMYS program, a program for high-school students modeled closely on the Ross Program. As a research mathematician I am fortunate to live and work within a community of individuals actively engaged in exploration and discovery. And through the PROMYS program I have the rich pleasure of working with so many bright and energetic young people and their teachers. I am enormously grateful to Arnold for having introduced me to both of these possibilities early in my life.

### *Bert K. Waits*

While a graduate student at Ohio State University, I served as "assistant to the chairman" to Arnold during the period 1964–69, doing course scheduling and other logistics relating to running a large mathematics department. One of my fondest memories is the great "trailer" incident. One fall

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we were blessed with an influx of graduate students and lacked office space for them. Arnold asked me to get more space assigned to us by the administration. After I hit a brick wall trying to get the extra office space, he worked very hard personally, making calls and sending letters for several weeks with no luck. So he made a serious threat to the dean and provost that he would give up his office suite for the graduate students, rent a house trailer, park it out behind the mathematics building, move his offices to the trailer, and finally call the local papers. I know this to be a fact, as I helped to write the letter and made several calls about securing a rental trailer. He hand-delivered the letter to the dean, and a few days later some nearby space was magically reassigned to us.

This is just a glimpse showing Arnold's deep love of students and their welfare. I also fondly remember observing his summer number-theory course with "his kids" and being in awe of his teaching style and rapport with "his kids." His passion for teaching, his courage, and his love of mathematics shaped my life in many ways.

### *Max Warshauer*

I attended the Ross Summer Program during three summers, 1967–69. This experience excited my interest in and love of mathematics and a desire to develop a similar atmosphere for my own students. The remarkable thing was the wonderful, intense journey and immersion in doing mathematics that the program created, as we all struggled to "think deeply of simple things." My counselor, Dan Shapiro, now directs the Ross Program. Dan embodies the spirit and philosophy that Arnold wanted to create and sustain.

The Ross Program is a national treasure that sets a standard for what students can accomplish in mathematics. At Southwest Texas State University (SWT) I have worked with colleagues for the past fourteen years developing a program that I hope similarly engages young students in mathematics, including summer mathematics camps for students in grades 3–8 and a 6-week residential program for high-school students. It was exciting to build our own program, and to work with Dan in refining our problem sets that follow the Ross model and tradition. The mathematical community generously supports our program through grants such as those through the AMS Epsilon Fund. We have begun summer mathematics camps in over twenty districts in Texas and formed a center, SWT

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Mathworks, to coordinate our programs for students and teachers.

By challenging students to discover new ideas, to make conjectures, and to give careful arguments and explanations, we try to bring to all students the joy of doing mathematics that Arnold fostered in his students over the past fifty years.



**Ross with his first wife, Bee, in the 1970s.**

### *Gloria Woods*

As the wife of Alan Woods, a number theorist at Ohio State, I got to know Arnold and Bee Ross very well during the 1960s. Starting in 1979, I was privileged to work with Ross in his Summer Mathematics Program for the next twenty-three years. Arnold Ross was the Pied Piper of mathematics: in talking to him about anything, you somehow ended by agreeing to do something "extraordinarily important" for mathematics. When the Ross Summer Program returned to OSU in 1979 after three years at the University of Chicago, Arnold convinced me to help out. We didn't have a formal agreement about my duties. I would visit the lectures and seminars, I would stop by the dormitory and observe the kids at work, I would be available to help the counselors manage the inevitable crises that arose. In those early years the program had very little funding. No one was paid except the counselors, who lived and studied with the program participants in the dormitory (and who earned every penny of their paychecks). Most positions in the program were very fuzzy and voluntary, and none of us knew exactly what our job was really about, except that we needed to keep the program alive!

My job title could change quickly depending on circumstances. One day I would be introduced to a mother or father of a student as dorm mother, or as student advisor. The next day I would be the Ross Program assistant director or administrative assistant or T-shirt sales rep, depending on what job had to be done. When I was introduced to an NSF representative, I became the co-director so I could have the privilege of being a co-PI on a grant proposal and be allowed to represent the Ross Program at the NSF meetings in Washington, DC. Ross would say, "You see, Gloria, a title is not important, but it is very important to know what to do with a title when you do use it."

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