Book Review

Saunders Mac Lane: A Mathematical Autobiography and *A^3 & His Algebra: How a Boy from Chicago's West Side Became a Force in American Mathematics*

Reviewed by Lance W. Small

Saunders Mac Lane: A Mathematical Autobiography
Saunders Mac Lane
A K Peters, Ltd., May 25, 2005
354 pages, US$39.00
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A^3 & His Algebra: How a Boy from Chicago's West Side Became a Force in American Mathematics
Nancy E. Albert
iUniverse, Inc., January 18, 2005
366 pages, US$23.95
ISBN 0595328172

(Abraham) Adrian Albert and Saunders Mac Lane were two of the most prominent American algebraists of the twentieth century. Their contributions extend beyond their mathematics, and they are representative of the "public" scientist that appeared after World War II. Their careers were parallel in many ways; they both spent many years at the University of Chicago, and both served as AMS president. The books under review, a biography of Albert by his daughter Nancy and the autobiography of Mac Lane, present a picture of the evolution of mathematics, mathematicians, and their work in the last century.

Saunders Mac Lane, who died April 14, 2005, at 95, remains well-known for his seminal work in category theory, homological algebra, algebraic topology, etc. and was active in mathematics and public service until late in his life. Adrian Albert, who died in 1972, though well-known to algebraists in the areas of finite-dimensional division algebras and nonassociative algebras, seems to have receded somewhat from the general view of many, especially younger, mathematicians. Albert was born in 1905 and Mac Lane in 1909; the four-year age difference turns out, however, to be almost a generation mathematically. Albert was a student of L. E. Dickson who was a student of E. H. Moore, the founding chairman of the Chicago department. Albert received his Ph.D. in 1928 at the age of 22. The principal result of his thesis is still striking: a division algebra of dimension 16 over its center is a crossed product. In subsequent years, Albert would develop, almost in isolation, the theory of finite-dimensional central simple algebras that would extend this result to finite-dimensional division algebras over number fields. Indeed, he certainly deserves a portion of what is commonly referred to as the Brauer-Hasse-Noether theorem (on the South Side of Chicago, the Albert-Brauer-Hasse-Noether theorem). Albert would win the AMS Cole Prize in algebra for work on Riemann matrices in 1939.

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Albert's mathematical style may be described as one of extended calculation. To this day, his books and papers often leave the reader gasping for inspiration. Nancy Albert relates Dan Zelinsky's account of the following encounter between Albert and Mac Lane in a 1950s seminar.

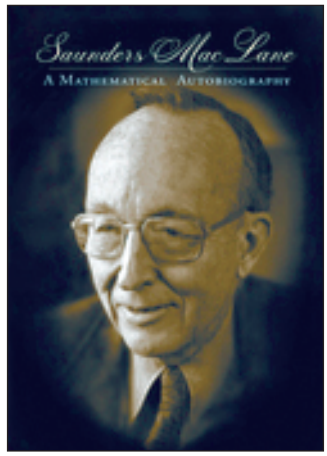
> Professor Saunders Mac Lane jumped up and demanded to know, "Why *do* the results turn out that way?" Adrian stood silent, wearing a sphinxlike [sic!] smile. Mac Lane, furious, pounded on the table. "Adrian knows, but he won't tell us!"

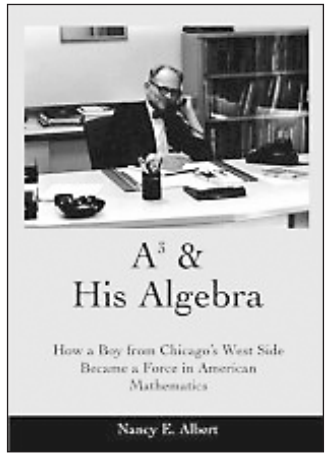
Indeed, Ms. Albert continues that her father "could not explain how he arrived at his results—they sprang from an intuition he could not put into words."

Mac Lane, on the other hand, was a talented, even great, expositor who attempted to explain what was behind results. Surely, one of Mac Lane's greatest and most lasting achievements, in exposition, is *A Survey of Modern Algebra*, written with Garrett Birkhoff. This book, first published in 1941, has had a lasting impact on the undergraduate algebra curriculum. There's really little reason not to use it today. Sure, mappings are written on the right—this might even be popular nowadays—and the vocabulary is a little too rich for current students, but the book presents the material clearly, with good examples and exercises. It even begins with the integers and rings—more familiar and intuitive than groups.

Mac Lane points out that Birkhoff and he expended a considerable effort in writing the book, but that it didn't "weigh against me at Harvard" when his promotion to tenure was being considered, unlike the current situation where "the time taken from their research would negatively affect their chances for promotion."

Mac Lane returned to Chicago, for good, after the war (he had been there several times previously in various roles), recruited by his former Harvard colleague Marshall Stone. The story of the "Stone Age" in the Chicago mathematics department has been told many times, so we won't go into it here. Mac Lane succeeded Stone as chairman in 1952, and Albert followed Mac Lane in 1958. The department during the late 1950s suffered some severe losses: Weil went to the Institute in Princeton, Chern and Spanier to Berkeley. Mac Lane also tells a revealing story about an attempted hire early in his term. The department proposed Felix Browder for an assistant professorship that was turned down by the administration. The reason, though not explicitly stated, was that Browder's father Earl had been the head of the Communist Party of the USA. Mac Lane considered resigning in protest, but Stone persuaded him not to. Browder eventually did go to Chicago and served a couple terms as chair.





Mac Lane and Albert devoted substantial effort to public service. Albert played an important role in the early days (the early to middle 1950s) of the National Security Agency (NSA) and its predecessor, the Armed Forces Security Agency (AFSA); in the founding of the Institute of Defense Analyses (IDA); and, more generally, in the country's efforts in cryptology. In particular, he directed some of the early summer programs, SCAMPs, where academic mathematicians and mathematicians from IDA and NSA collaborated on cryptological problems. No one seems to know for sure what SCAMP stands for. It could be Southern California Applied Mathematics Project, as Nancy Albert would have it, or Special Committee Advising in Mathematics with a "P" added for, ah, euphony. SCAMP continues to this day.

The importance of mathematicians in cryptology is nowadays taken for granted; this was not always the case. It was the work of mathematicians during World War II that made it clear that mathematics was indispensable in cryptology. Albert made important contributions during the 1950s to shift register algebra (linear recursive sequences)—and he showed the engineers a thing or two! The theory that developed from this, over the years, can be seen in spread spectrum cell phone technology, for example.

Mac Lane concentrated his efforts on the National Academy/National Research Council where, among other activities, he was deeply involved in ensuring that NRC reports were accurate and of high quality. In later years, he cast a skeptical eye on current academic fads like the drive to linearly order institutions, faculty, departments, etc. through "studies" and "surveys."

This reviewer was a student at Chicago from 1959–1965. Albert was, during this time, already chair and then dean of the Division of Physical Sciences—he was "Aleph, Aleph, Aleph—the Cardinal of Eckhart". (Eckhart was home to both the mathematics department and the Divisional offices.) Mac Lane, however, was still deeply involved with teaching at all levels. Remarkably, he made time even for the occasional confused undergraduate like me. He cared.

At some point, Norman Steenrod was visiting Chicago for a quarter and observed that we students

were taught lots of mathematics but only rarely how to go about research. Steenrod organized a series of talks by faculty on how they attacked a problem. There was one ground rule: no faculty could attend any other faculty member's talk without permission. I recall the talks of Steenrod, Kaplansky, Herstein, Calderon, and, of course, Mac Lane. Mac Lane emphasized hard work (he'd work through the night with Eilenberg sometimes!). Someone, somewhere, has sketchy notes of these talks.

Both books are marred by errors in chronology, spelling, and grammar. A good editor would have served both authors well. Some fact checking would have been useful as well. Too often both books lapse into a sort of expanded CV/Christmas letter mode. The most serious, and misleading, mistake is in Nancy Albert's book: she writes that Nathan Jacobson didn't receive an offer from Chicago in the late 1950s/early 1960s because of questions about area and religious background. Jacobson was, in fact, offered a job, but after much consideration decided to stay at Yale. The bad old days—that gave Albert so much grief—were gone!

With the caveats mentioned above, I'd recommend both volumes to mathematicians, especially algebraists, who would like to see how algebra in the U.S. developed in the twentieth century and how mathematicians became increasingly involved with public policy.

One cannot read a biography without recalling the first sentence of *David Copperfield*: "Whether I shall turn out to be the hero of my own life, or whether that station will be held by anybody else, these pages must show." Adrian Albert and Saunders Mac Lane were the heroes of their own lives.