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A.A. Albert: Chicago Mathematician

A^3 & His Algebra: How a Boy from Chicago's West Side Became a Force in American Mathematics. *By Nancy E. Albert, iUniverse Inc., Lincoln, Nebraska, 2005, 366 pages, $23.95.*

BOOK REVIEW

By Philip J. Davis

Abraham Adrian Albert, an American algebraist whose mathematical career, in the words of our reviewer, "spanned the half century in which mathematical research in the USA became second to none."

The facetious mathematical designation A^3 awarded to Abraham Adrian Albert (1905–1972) by his students and associates derives, naturally, from his initials. If you add to this that he was an American algebraist, you can arrive at A^5. For ease in typing, I refer here to Albert as AAA and his daughter Nancy, the author of the biography under review, as NEA.

I never met AAA but became aware of him in my sophomore or junior year in college, when I came across his book *Modern Higher Algebra* (University of Chicago Press, 1937). I found the book rather forbidding, probably more because of its layout and typeface than its subject matter. My awareness of AAA as a person, and not just as a textbook author, dates to the late 1940s, when his name began to appear all over the mathematical map: on this or that committee, this summer program, that congress, this grant, that conference, and so forth.

AAA's mathematical career spanned the half century in which mathematical research in the USA became second to none. If you like, you can chalk it up to Adolph Hitler, World War II, and the cold war. Hitler's racial policies sent numerous top-notch mathematicians to the USA as refugees. The technological demands of the war and its cold war sequel, along with the emerging digital computer age, brought governmental support and opportunities galore for young mathematicians. AAA was a major player in this efflorescence of American mathematics.

More specifically: AAA was instrumental in introducing abstract algebra into the college math curriculum as a standard course. Prior to *Modern Higher Algebra* there was Maxim Bôcher's 1907 *Introduction to Higher Algebra*, and B.A.L. van der Waerden's 1930 *Moderne Algebra*, based in part on lectures by E. Artin und E. Noether. And Garrett Birkhoff and Saunders Mac Lane's *A Survey of Modern Algebra*, published in 1941, dominated the field for many years. It astonishes me to recall that before World War II hardly anyone gave courses on linear algebra (a.k.a. matrix theory), let alone on fields, rings, and the like. There is no doubt that AAA, together with his students and grand-students, played major roles in developing the algebraic side of U.S. mathematics, both research-wise and course-wise.

NEA has interwoven her father's family life and his professional life in her narrative. The biography has two main characters. The first is AAA himself, and the second is the University of Chicago, or more narrowly its Department of Mathematics. (I use the abbreviation UChi, distinguishing it from UCal or UColo or many other universities beginning with a C.) How's this for character definition? AAA was born and died in Chicago. He did most of his initial schooling in Chicago. He went to UChi for both the BS and the PhD, and spent almost his entire career there. Both of his sons went to UChi, and his daughter, our author, received both BA and JD degrees from UChi. AAA loved Chicago, his home town, and UChi was the family school. I can easily imagine AAA walking to his office, humming to himself, "♫Chicago, Chicago, that toddling town . . . ♫."

Nancy Albert's biography provides a good description of the mathematical life of AAA's generation. The students; the lectures and colloquia, the travels across the face of the globe; the development of new ideas; the triumphs, the collaborations and conflicts; the awards and rewards; the conferences, local, national, and international; the intersection with the government, the grants and contracts. Apart from these supporting structures, what comes across clearly is the intensity and the devotion and discipline that individual mathematicians gave to their craft. Have things changed in our google-ized, yahoo-ized age?

I find it a remarkable achievement for NEA, who is a lawyer and has taught and written about issues in divorce law, to have covered the theorematic details of her father's mathematical work in such precise detail. I thank her for—to give one example—her mini-history of the proof of the lovely theorem that all zero-trace matrices are commutators. (K.Shoda, for fields of characteristic 0, 1937; A.A. Albert and B. Muckenhoupt, for all fields, 1957; S.A. Amitsur and L.H Rowan, for certain division rings, 1994.) The topic remains one of lively investigation.

Let me expand on the above outline of AAA's life with a few "parameters" of the Who's Who variety. He was born in Chicago in 1905 of immigrant parents and died in Chicago in 1972. He got an undergraduate degree from the University of Chicago in 1926. He married in 1927, and he and his wife had two sons, Alan and Roy, in addition to daughter Nancy. He got his PhD from UChi in 1928, under the supervision of the famous number theoretician L.E. Dickson. His thesis research was on a topic in division algebras. After spending two years (1929–31) at Columbia as an instructor, AAA became an assistant professor at UChi in 1931. He was awarded tenure and a full professorship in 1941. He chaired the department from 1958 to 1962 and was dean of physical sciences from 1962 to 1971.

AAA received the Cole Prize in Algebra in 1939 and in the same year delivered the Colloquium Lecture of the American Mathematical Society. He was elected to the National Academy of Sciences in 1943 and served as president of the AMS in 1965–66. During World War II he was associate director of the applied mathematics group at Northwestern University, one of whose missions was cryptography. AAA had either 29 or 30 PhD students (depending on whether you believe the Math Genealogy Project or his daughter) and 245 mathematical descen-

dants. The AMS published his collected mathematics papers in 1993.

Here, from NEA's book, is how he thought of himself professionally:

"In response to a survey of scientific personnel, AAA listed the four major areas of expertise in the following order of competence: (1) rings, fields, and algebras (2) linear algebra and matrix theory (3) combinatorial analysis and (4) finite geometries."

NEA has also included in her book brief histories of the city of Chicago and of UChi, together with a description of the university's early department of mathematics. I had not been aware that before John D. Rockefeller pledged an initial $600,000 for a university in Chicago, there had been a University of Chicago that failed. The new university was chartered in 1890.

In 1929, Robert Maynard Hutchins, a wunderkind, became president of UChi. Hutchins believed that American high schools were deficient in providing students with a general liberal education of the sort offered by English and European schools at the Gymnasium level. He proposed to correct this at UChi by lowering the admission age for qualified students and introducing a "great books" curriculum. AAA, along with most of the mathematics faculty, had difficulties with this proposal. Some were outraged: One can't really teach calculus from Newton. As a result, a separate mathematics faculty, attuned to the Hutchins Plan, was set up. By the early 1950s, in NEA's opinion, "this grand Utopian experiment, by most accounts, ended badly." Providing a counter view, a friend of mine who entered UChi in 1946 at the age of 14, when the Hutchins Plan still prevailed, told me that UChi had been a terrific experience for her.

In 1945, feeling or hearing that the math department was in need of a blood transfusion, Hutchins asked around for some recommendations. He soon offered the chairmanship to John von Neumann, who said thanks but no thanks and recommended Marshall Stone. (My guess is that this was because both had the spectral theory of Hilbert space as a major interest.) After he'd won some concessions from Hutchins, Stone said yes and left Harvard, initiating what has become known as the "Stone Age" of UChi mathematics. During that time Saunders Mac Lane joined the department, followed by Irving Kaplansky, Felix Browder, Jim Douglas, Antoni Zygmund, to name a few of the remarkable group who were somewhat known to me. In his autobiography (see my review in *SIAM News*, November 2005*), Mac Lane describes the atmosphere during the Stone Age as absolutely electric, with constant mathematical discussions over tea. AAA's membership in the department predated Stone's arrival, and I gather from NEA's book that AAA's relationship to both Stone and Mac Lane, while proper, was cool.

A different revolutionary concept promulgated in the U.S. a few years later, in the late 1950s and early '60s, was the "new math." Publications were released under the aegis of the SMSG (School Mathematics Study Group) at Yale. AAA was favorably impressed with "the new math" and "was credited with helping the SMSG get off the ground." I was not pleased with the SMSG's curricula, but I participated in some of its committee meetings. I recall one such meeting (in Chicago, actually), at which there was only one other nay-sayer besides myself. I can easily understand why AAA was attracted to the SMSG: Over the years, new and exciting mathematics had been developed; abstract math was attaining increasing pragmatic importance. And there was the strong influence in the USA of the structuralist views of the Ecole Bourbaki. I was pleased when, after about 15 years, the new math was abandoned. Revolutionary concepts often fail. As the philosopher Karl Popper wrote: If there is bleeding, put on a band-aid and do not cut off the limb.

Though I have written a number of things about matrices, my brain appears to be hardwired more toward the continuous than toward the discrete. The closest I got to AAA's material (and it wasn't very close) was when, in the mid-'50s, I attempted to extend to higher dimensions the famous Lagrange formula for polynomial interpolation by interpreting the variables as elements of an appropriate division algebra. Other interests intervened, and I let the idea go. If I had met AAA around that time, he would probably have energized me to carry on.

I never thought I would live to see the day when a banner headline on the front page of a mainstream newspaper would contain the word "math." But this occurred, for me, on February 2, 2006, in a report in the *Providence Journal* on the presidential call for American competitiveness. Over the past two centuries, mathematical education for the millions has been a contentious matter as regards who gets trained, with what teaching materials, reflecting what teaching methods.

As an example, about twenty years ago, I kept hearing that discrete math was now at the cutting edge and continuous math was going the way of the celluloid collars of years ago. If AAA were around today, he would surely enter into this renewed educational challenge with considerable gusto.

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*"Mr. Mathematics: Saunders Mac Lane," http://www.siam.org/news/news.php?id=181.

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