ARTICLES

In the Shadow of Giants: A Section of American Mathematicians, 1925–1950

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Reading about giants in the history of mathematics can be exhilarating and rewarding. Here we expound on a group of five individuals who toiled in the shadows of American giants in the first half of the twentieth century. Our group consists of three who founded an MAA section (Joseph Reynolds, Howard Mitchell, and Albert Bennett) and two who nurtured the section during its infancy (J. R. Kline and Arnold Dresden). Although they made impressive contributions to the American mathematical community, they are not household names like three of the national figures who soared above them—E. H. Moore, Oswald Veblen, and R. L. Moore [**63**].

Yet our aim is much broader than describing the outstanding achievements of the early leaders of an MAA section. We uncover vital connections between our quintet and the national leaders that demonstrate how towering figures influence the rest of the mathematical community, thereby allowing us to better understand the dynamics of the interlocking pieces within the overall community. We also indicate how our five reflect major developments that took place within the American mathematical community during the second quarter of the 20th century. In addition, we glimpse their various philosophies on mathematics education during this period.

The paper begins with a brief history of AMS and MAA sections, including summaries of the founding of the Philadelphia Section (now called Eastern Pennsylvania and Delaware—EPADEL) and the establishment of this MAGAZINE by the Louisiana-Mississippi Section. Then we elucidate the lives and major works of the five mathematicians who were leaders locally but rank and file nationally. Along the way we indicate ways in which two of the MAA's official journals, the *American Mathematical Monthly* and this MAGAZINE, provided vital outlets for publishing this group's mathematical works and publicizing their views on mathematics education.

Sections

The MAA was founded on the last two days of 1915. By contrast, the AMS got its start in 1888 as the New York Mathematical Society. Initially the AMS was a local organization centered in New York, but the founding of three sections enabled it to spread its wings across the continent: Chicago in 1896, San Francisco in 1902, and Southwest in 1906. There was a much shorter gap between the birth of the MAA and the founding of its first sections—a matter of minutes. By the end of its first year, the MAA boasted six thriving sections; another ten would come on board in the next decade [**42**]. However, up to 1926 no section was located entirely in the East. (Two good sources on the early histories of the AMS and MAA are [**2**, pp. 3–9] and [**29**, pp. 18–21], respectively.)

Before then, MAA leaders Herbert Slaught and W. D. Cairns expressed concern about the "seeming apathy or lethargy" of mathematicians in the Atlantic States [**A1**]. That situation changed in 1925 when Joseph Reynolds of Lehigh University suggested the idea of forming a Lehigh Valley Section. However, Reynolds was unable to garner sufficient support for his idea. As Parshall and Rowe demonstrated so convincingly in their book *The Emergence of the American Mathematical Research Community*, every professional organization needs a sufficiently large *community* in order to survive, let alone thrive [**44**]. The missing piece to Reynolds's puzzle was a critical mass of individuals and institutions that would support his plan. He found them by looking south toward Philadelphia, a city whose population was approaching two million at the time.

On the Saturday after Thanksgiving in 1926, three individuals organized a meeting at Lehigh with the express purpose of forming an MAA section. To their delight, 20 members showed up and, after a morning of mathematical presentations, voted unanimously to petition the MAA to form the Philadelphia Section. At first MAA leadership opposed the name. As Albert Bennett wrote ([**A1**]; also recorded in [**42**, pp. 94–95]):

> At the organizational meeting ... a request for establishing the Philadelphia section of the MAA was forwarded to Secretary Cairns. His first reaction was that the name was ill-chosen, since all the other Sections were named for States, and to name a section after so small a political unit as a city, would break sound precedent. I wrote back that Pennsylvania had two natural cultural centers, one at the extreme east (Philadelphia), the other at the extreme west (Pittsburgh). One could not expect much of an attendance at either of these places, from residents near the other. Philadelphia should attract persons from Eastern Pennsylvania, Delaware and southern New Jersey. Setting a new precedent might encourage the later founding of a Pittsburgh Section, attracting mathematical instructors from West Virginia and Eastern Ohio as well as from western Pennsylvania. Cairns and Slaught were not obstinate, and in December, the Section was admitted under its proposed name, subject of course to the usual provision of By-Laws, etc., and promises of good behavior.

We doubt whether the last part about "promises of good behavior" was actually stated. The author, Albert Bennett, a decidedly colorful personality with a gift for captivating prose, was one of the three founders of the section along with Howard Mitchell of the University of Pennsylvania (Penn) and Bennett's "ever loyal associate J. B. Reynolds" [**A1**]. Just as Bennett so presciently predicted, the Allegheny Section was formed at the other Pennsylvania focal point in 1933. Until then the Philadelphia Section included the central part of Pennsylvania, including active Penn State mathematicians. The section also included the southern part of New Jersey (including Rutgers and Princeton) up to the founding of the New Jersey Section in 1956 under Albert Meder of Rutgers and Albert W. Tucker of Princeton.

The Louisiana-Mississippi Section, established in 1924, two years before the Philadelphia Section, played a prominent role in the history of the MAGAZINE. We provide a synopsis of this development so the reader can place various events in historical perspective. (Beckenbach [**3**] provides a fuller treatment of the journal's history.) *Mathematics Magazine* began as a series of eight pamphlets written by Samuel Thomas Sanders (1872–1970) of Louisiana State University during 1926–27 to encourage membership in the MAA. Sanders's hope that the pamphlets could be expanded into a magazine was realized in October 1927 when the *Mathematics News*

Letter was published as Vol. 2, No. 1. By 1934 the journal had outgrown its regional roots so its name was changed accordingly to *National Mathematics Magazine*. However, the financial support that LSU provided from 1935 to 1942 was terminated when the state of Louisiana was forced by fiscal constraints due to World War II to slash the university's budget. To exacerbate the situation, the editor, S. T. Sanders, who had continually used his own funds to underwrite operational costs, reached mandatory retirement age at LSU that year. Deficits mounted alarmingly!

The MAA responded by providing subsidies but even those dried up in 1945, whereupon the *National Mathematics Magazine* abruptly ceased publication. Fortunately, one rabid reader, UCLA's Glenn James (1882–1961), developed a considerable empathy for Sanders and his journal, so he assumed sponsorship and management. Because the journal had grown to international dimensions, James shortened its title to the present MATHEMATICS MAGAZINE when he resumed publication in 1947. James, like Sanders, employed his whole family in every aspect of typesetting, printing, and mailing the journal. But by 1959 deteriorating eyesight caused him to negotiate with the MAA over the publication and editorship of the journal. The December 1960 issue revealed the complete transfer and the MAA has published it since then. We will see that four of the main characters in our group were involved with MATHEMATICS MAGAZINE in various ways before it became the second official journal of the MAA. (In 1974 the MAA initiated the *College Mathematics Journal*, which had been published by Prentice-Hall as the *Two-Year College Mathematics Journal* the previous four years.) Now we turn to our five main characters, examining their lives and works to see what roles these journals played in their development.

Farmer to founder

As we have noted, Joseph Benson Reynolds (1881–1975) is credited with the idea of forming the first MAA section in the East. Born in the western part of Pennsylvania, Reynolds did not graduate from high school until age 22 because he had to work on the family farm. A competitive scholarship allowed him to attend Lehigh, where he earned an A.B. degree in 1907 with an undergraduate thesis on temperature compensation of a sidereal clock, thus signaling an interest in applied mathematics. He then accepted an instructorship at Lehigh, where he spent the rest of his professional life. This was a typical appointment for those who desired to pursue graduate work because assistantships, as we know them today, did not arise until after World War II. Reynolds earned a master's degree in 1910 with a thesis on the orbit of a minor planet, a theme reflecting the genesis of Lehigh's Department of Mathematics and Astronomy. However, his doctoral dissertation, "The application of vector analysis to plane and space curves, surfaces and solids," submitted to Moravian College in 1919, reveals an evolving interest in pure mathematics. When he presented the first invited lecture at the organizational meeting of the Philadelphia Section in 1926, his topic paralleled the theme of the dissertation—evolutes of certain plane curves. He also served as chair of the section for 1938 and 1939.

Reynolds's publication record shows that the *Monthly* and this MAGAZINE provided vital outlets for many college teachers. His first formal entries were two proposed *Monthly* problems in 1915, one on calculus and the other on mechanics [**47**]. In the remainder of that year he solved three problems, with his solution to one posed by *Monthly* founder B. F. Finkel selected to appear in print [**48**]. The following year Reynolds proposed three other problems and solved one, but in the banner year 1917 he was cited 19 times—five proposed problems, three solutions to problems he had posed earlier, four printed solutions, and seven solutions listed under "also solved by."

Figure 1 Joseph B. Reynolds (Photograph courtesy of Lehigh University Archives)

His last proposed problem appeared in 1965 when he was 84 years old, exactly 50 years after his first [**49**].

The *Monthly* accounted for most of Reynolds's publication activity, with almost 200 entries appearing in connection with its problems department. Although there is sometimes a tendency among historians to criticize the orientation toward problems in early American mathematical journals, even the father of American mathematics, E. H. Moore, submitted solutions to six problems in *The Analyst* during his senior year at Yale. In fact, all five of our rank-and-file mathematicians submitted solutions to *Monthly* problems. The succession of Reynolds's other contributions traces his development as a mathematician. In his banner year 1917 he published a small note in the *Monthly* [**50**], but it would be six more years until his first full paper [**52**] would appear. His enduring interest in both pure and applied mathematics can be seen in a 1944 article that described a method for solving differential equations, where he claimed that his approach was appropriate for "every student who is trained for engineering or other scientific work" [**51**, p. 578]. In this respect Reynolds was somewhat ahead of his time, because shortly after World War II the country experienced a wave of teaching reforms aimed at satisfying the needs of the burgeoning number of students pursuing science and engineering in the nation's universities.

Joseph Reynolds published three papers in the MAGAZINE when it was called the *National Mathematics Magazine*. In 1938, he showed how to evaluate the integrals $\int \sin^n \theta \, d\theta$ and $\int \cos^n \theta \, d\theta$ for even integers n using Euler's forms for $\sin\theta$ and $\cos\theta$ [**45**], while in 1944 he presented geometrical interpretations of the formula for the statistical mean [**46**]. The third paper combined his interests in pure and applied mathematics by deriving an equation of an ellipse in order to explain the workings of a machine built by precision-tool manufacturers for cutting nuts (for bolts) in the shapes of various regular polygons [**53**]. A few other papers appeared in outlets like the *Mathematics Teacher*, the *Tôhoku Mathematical Journal*, and the *Proceedings of* *the Pennsylvania Academy of Science*, but Reynolds also published in several journals that reflect an overarching interest in applied mathematics, such as *Agricultural Engineering*, *Chemical and Metallurgical Engineering*, *Concrete*, *Automotive Industries*, *Iron Age*, and the *Journal of the American Welding Society*. It is worth noting that an item in *Science*, "Falling chimneys," corrected a result from a previous paper in that respected journal about where breaks in a chimney will occur (if at all).

Joseph Reynolds also wrote five textbooks, one a standard calculus book and the other four on theoretical mechanics. His *Elementary Mechanics* (1928) was revised six years after its initial publication and reprinted three years later. His proclivity toward applied mathematics might make him seem like an improbable candidate to found an MAA section, yet his interests paralleled those of many mathematicians around 1900, including several presidents of the AMS. He died in Sugar Run, Pennsylvania, at age 94. Overall he was a mathematician who carried out some original investigations and wrote several books but should be remembered mainly as a problemist. Moreover, his interest in astronomy, mechanics, and engineering hearken back to an earlier period in the history of mathematics in America. Reynolds had no apparent ties to the leading mathematical figures of the day, either during his student years or during his professional career, unlike our four remaining characters.

Blue-blooded founder

There is a stark contrast between Joseph Reynolds and Howard Hawks Mitchell (1885–1943). While Reynolds came from farming stock, Mitchell's father Oscar Howard Mitchell (1851–89) was the fifth person to obtain a doctorate (in 1882) from the country's first true graduate program at Johns Hopkins under the estimable J. J. Sylvester. And while Reynolds earned a Ph.D. at tiny Moravian at age 38, Mitchell was 26 when

Figure 2 Howard Hawks Mitchell (Photograph courtesy of Special Collections, Dawes Memorial Library, Marietta College)

he received his doctorate at tony Princeton under Oswald Veblen. Yet he is virtually unknown today. FIGURE 2 shows Mitchell from the Marietta year book for 1906.

Howard Mitchell was born on January 14, 1885, in Marietta, Ohio. He graduated from Springfield (Massachusetts) High School before returning to his home town to attend Marietta College, where his father had been professor of mathematics and astronomy from 1882 until his untimely death. The son graduated from Marietta in 1906 as salutatorian with a Ph.B. degree. (No longer in use, Ph.B. is the abbreviation of the Latin term for Bachelor of Philosophy.) Mitchell then enrolled in the fledgling graduate program at Princeton, where he graduated in 1910 as Oswald Veblen's first official Ph.D. student. His dissertation was published in the *Transactions* one year later [**38**]. He was appointed an instructor at Yale University's Sheffield School in 1910, but the next year he accepted an instructorship at Penn, where he taught for the rest of his life. During his tenure Mitchell supervised five Ph.D. dissertations. (His most renowned student was probably Leonard Carlitz (1907–99), the number theorist who spent post-doctoral years at Cal Tech under E. T. Bell and at Cambridge under G. H. Hardy before settling at Duke 1932–77.) During World War I, Mitchell served as a ballistician under Oswald Veblen at Aberdeen Proving Ground; Grier [**26**] provides details on the type of work done there.

Howard Mitchell was the only member of our group whose involvement with the MAA was minimal. He did not even join the MAA before helping found the Philadelphia Section in 1926, and his membership afterwards was sporadic. But he remained active with the local section, serving as its first chair 1926–27 and again 1936–37, and delivering three one-hour invited lectures on quadratic forms (1926), group characters (1929), and Ramanujan (1932). Yet at the national level he held no elected offices, served on no committees, and edited no journals. However, he did serve a three-year term on the Board of Trustees of the AMS 1921–23, and a six-year stint as editor of the *Transactions* 1925–30. He was also elected vice president of the AMS 1932–33, and vice president and Chair of Section A of the American Association for the Advancement of Science in 1932. These positions suggest that Mitchell's major focus was on research mathematics and not undergraduate education.

We already noted a tie between the Mitchell family and Johns Hopkins, one of the two leading graduate programs in the country *circa* 1900. Studying under Veblen at Princeton linked Mitchell to the other program—the University of Chicago. And then in 1911, Mitchell was appointed an instructor at Penn at the same time as Chicago graduate R. L. Moore. Today Moore is widely known for his method of teaching and for his contributions to topology, but up to that point he had published very little. Yet Penn offered both instructors an especially supportive environment that allowed them to prosper. By the time Moore left for Texas in 1920, he had progressed from a promising mathematician to one of recognized stature, yet Mitchell was promoted sooner and produced a Ph.D. student earlier. On the other hand, Moore may have inspired Mitchell to teach the earliest known modified Moore Method course [**62**, p. 476].

Mitchell's publication record, though not prodigious, is impressive. For instance, in 1923 he co-authored an important book on algebraic numbers for the National Research Council with L. E. Dickson, H. S. Vandiver, and G. E. Wahlin. Between 1913 and 1918 he published seven important papers in his specialties of linear groups and algebraic number theory in the country's three research journals: two in the *American Journal*, one in the *Annals*, and four in the *Transactions*. Only two appeared after that. His 1926 article on ideals in quadratic fields was sandwiched between papers by two of the towering figures in American mathematics, Marshall Stone and Oswald Veblen [**40**]. Mitchell's final paper appeared in the *Monthly* in 1935 and harked back to his initial investigation on group theory and projective geometry [**39**]. It was his only MAA publication except for a solution to a *Monthly* problem [**41**]. He is the only member of our quintet never to contribute to the *National Mathematics Magazine*. Mitchell died of coronary thrombosis in 1943 at age 58.

Section promoter

While Joseph Reynolds wrote mainly for undergraduate-oriented publications and Howard Mitchell mainly for research journals, the remaining three members of our quintet contributed to both and participated equally in the MAA and the AMS. The first, Albert Arnold Bennett (1888–1971), like Mitchell a protégé of Veblen, was a colorful character who lived in the Philadelphia area on two separate occasions totaling only eight years. Bennett was born June 2, 1888, on the U.S. Reservation in Yokohama, Japan, where his parents were missionaries with the Rhode Island Baptist Association. At age 14 he came to Providence, RI, to live with relatives and complete his education. Since his father, two grandfathers, and many other family members were Brown graduates, he entered as a legacy applicant in 1906. After earning A.B. and A.M. degrees in 1910 and an Sc.M. in 1911, he entered the graduate program at Princeton, where he may have met Howard Mitchell because he later recalled, "H. H. Mitchell, whom I had known at Princeton, was, as always, generous and encouraging" [**A1**]. This accounts for Mitchell's recruitment into the effort to form a section of the MAA in Philadelphia 15 years later.

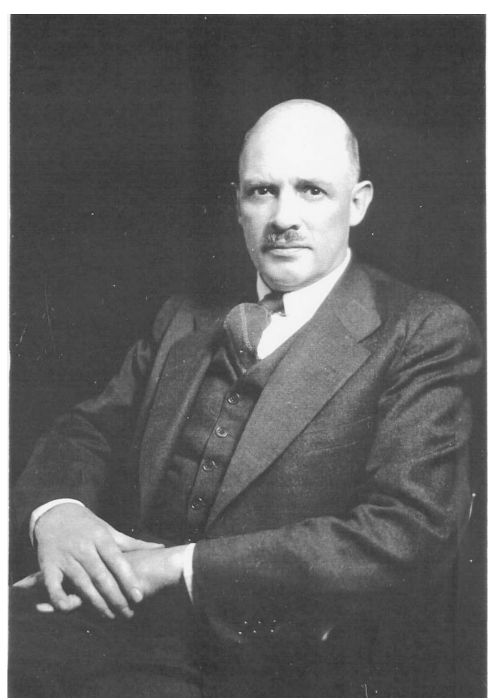

Figure 3 Albert A. Bennett (Photograph courtesy of Brown University Archives)

Like Mitchell, Bennett earned a Ph.D. under Oswald Veblen (in 1915) for a dissertation at the interface between algebra and projective geometry. It appeared in the *Annals* in 1915 [**4**]. Although only 21 pages long, it accounted for a sizable portion of the 196-page volume for 1914–15. That this neophyte would be accorded such recognition was probably due to the fact that three of the six editors were highly regarded faculty members at Princeton, where the journal was published: Veblen, Luther Eisenhart (1876–1965), and J. H. M. Wedderburn (1882–1948). Moreover, Bennett published three papers in the volume for 1916–17, all on topics in analysis, accounting for 47 of the journal's 217 pages.

Clearly Bennett's star was rising. He remained at Princeton as an instructor until the fall of 1916, when he accepted an adjunct professorship (what we would call today an assistant professorship) at the University of Texas. But patriotism compelled him to enroll in the Army's first Officer Training Corps (which evolved into today's R.O.T.C.) even though he was 28 years old at the time. In August 1917 Bennett was commissioned a captain in the artillery corps, C.A.R.C., and the following June was transferred to the Ordnance Department. He served on Veblen's ballistics research staff along with Gilbert Bliss, Norbert Wiener, and Howard Mitchell at Aberdeen Proving Ground, where he "prepared numerical methods to solve the ballistics equations" [**26**, p. 928]. Bennett was honorably discharged in January 1919, yet he served as a civilian mathematician and dynamics expert with the Ordnance Department until September 1921. During this time he wrote a book on ballistics that was initially classified "Confidential; for official use only" [**12**]; in 1954 the Ballistics Research Lab at Aberdeen deemed his tables important enough to warrant republication [**6**].

The time Bennett spent in war service undoubtedly accounts for a diminution in his publication record between 1917 and 1920. However, like many mathematicians caught up in war, he did not let combat duty extirpate his mathematical investigations. For instance, he is listed in a 1918 paper in the *Bulletin of the AMS* as Captain Albert A. Bennett, C.A.R.C. Emphasizing the isolation of his outpost he wrote, "This treatment is believed to be original, but the literature available for examination by the author is that customary to an army post, 'somewhere on the Gulf of Mexico,'—nil" [**5**, p. 479]. Apparently the holdings in Bennett's outpost were not as barren as one might infer from this statement. An examination of the *Monthly* reveals a different mathematical activity—problem solving—which can be pursued in short bursts of energy, unlike the sustained periods of intense mental concentration needed for deep research projects. From January 1917 to March 1918, Bennett was a regular contributor to the problems department, proposing seven and solving six others in algebra, number theory, and geometry. Curiously, the printed solution to one problem he proposed was by Joseph Reynolds, who would found the Philadelphia Section with Bennett almost ten years later [**16**]. A problem Bennett proposed in the September 1918 issue [**9**] lists his address as Galveston, thus identifying his whereabouts "somewhere on the Gulf of Mexico."

Bennett's problem-solving exploits ultimately placed him in "the ranks of those eminent in their chosen specialties who were impelled to contribute frequently ... while actively engaged in university teaching" [**58**, p. 8]. Joseph Reynolds too was cited with five "other problemists [who] upon becoming emeritus found continued problem-solving an effective weapon against vegetation." Both encomia appeared in the *Otto Dunkel Memorial Problem Book* [**25**], a special issue of the *Monthly* based upon the 400 best problems in the journal from 1918 to 1950. The selection panel singled out four problems Bennett had proposed, including an influential one he sent while at Texas in 1925 [**10**, p. 261]. Surprisingly he did not adopt the term semigroup in the problem, even though he had already used it in the title and abstract of a lecture at an annual AMS meeting [**11**, pp. 223–224]. The problem's classification under "Unsolved algebra problems" in the *Dunkel Book* [**25**, p. 68] sparked a solution the next year by the Polish problemist Andrzej Makowski [**35**]. Shorter solutions appeared in 1962 [**19**] and 1965 [**18**, p. 324] before the problem was finally laid to rest [**60**, pp. 915–916].

In the fall of 1921, his war duties completed, Bennett resumed his career at Texas. One of his first activities was to found an undergraduate mathematics club, The Pentagram, which played a minor role in the evolution of the Moore Method [**62**, p. 477]. Bennett had been active with the Maryland-Virginia-DC Section of the MAA while stationed at Aberdeen, and he extended those endeavors to the national level upon reaching Texas, being elected a trustee, appointed to the Committee on Publications, and appointed editor-in-chief of the *Monthly*. He was elected vice-president of the MAA in 1925 (and again in 1933 and 1934) while at the same time chairing its Texas Section. He had to forego the latter position when he became professor and head of the department at Lehigh, a post he held for only two years before returning to Brown, his *alma mater*. It was during Bennett's two years at Lehigh that he was the main cog in founding the Philadelphia Section after being "urged to wake up some sectional activity" [**A1**]. Upon moving to Brown, Bennett's attempt to form a New England Section of the MAA was unsuccessful, mainly because the Association of Teachers of Mathematics in New England (ATMNE) was then in the hands of college professors from the Boston area. In fact, Bennett was elected president of the ATMNE in 1941. However, by 1955 college teachers felt the need for an MAA section so Bennett served as temporary chair at an organizational meeting arranged by Howard Eves, Donald Kearns, and John Kemeny to found the Northeastern Section. A history of that section aptly described Bennett as "an experienced section promoter" [**42**, pp. 101–102].

The moves from Austin to Bethlehem to Providence had little effect on Bennett's production of research articles, although his publication record at Lehigh was modest. Perhaps his best-known works are a book on formal logic [**15**] he coauthored with Charles A. Baylis (1902–75) and his brief history of the MAA up to World War II [**8**]. Of more relevance here is Bennett's growing involvement with educational issues. Beginning in the early 1920s he wrote a host of articles on pedagogy and the curriculum. In 1927 he was appointed chair of the MAA's Committee on Assigned Collateral Readings in Mathematics, which drew up a list of suggested assignments for a freshman-year course based on outside reading [**36**, p. 30], and from 1941 to 1945 he served as chair of the MAA's Conference Committee on Education. In between he published an article in the *Monthly* on teacher training based on an invited address delivered at the 1938 joint MAA meeting with the National Council of Teachers of Mathematics. Bennett was assigned the topic of methodology but he protested, "Common decency suggests that the college professor either make a careful study of the problem of teacher preparation or refrain from making judgment" [**13**, p. 214]. Yet he moved quickly beyond common decency, adding a steady flow of "ungracious words" on issues related to teacher preparation, such as whether mathematics departments should offer courses in methodology and what courses should be required of future high-school teachers. His unsparing criticism of the behavior of some professors became enmeshed with a veiled attack on the central role of research in universities: "Some professors have atrocious table manners, or are extremely slovenly as to dress, or succeed very poorly in transmitting and evoking ideas in the classroom. But such disagreeable details are often condoned in the presence of more valued attributes" [**13**, p. 216].

Bennett continued railing against the prevailing preparation of high-school teachers in an article published in this MAGAZINE. He expressed a fear that enrollments in mathematics courses during World War II would decline precipitously once wartime programs ended, but, as we now know, that never occurred. However, his thoughts on various ways to present mathematics in an attractive manner remain relevant today. The article concluded, "If its practical utility, its beauty, its essential role in interpreting the times becomes clear ... no one need fear for the mathematical education of the next generation" [**14**, p. 322].

The patriotic Bennett rejoined the Army at age 54 when World War II broke out, serving from 1942 to 1946 and being promoted from Major to Lieutenant Colonel.

Once again he was assigned to the Ordnance Department at Aberdeen under Oswald Veblen. After the war, he was sent to the country of his birth to survey Japanese weaponry. One of the more illustrious young mathematicians to work at Aberdeen under Bennett was Herman Goldstine (1913–2004), who, in a 1985 interview, described his boss in most ungracious terms: "From time to time I was very impatient of Albert Bennett, who was a nice old gentleman—but he was a very precise, methodical, plodding person who drove me up the wall" [**59**].

Bennett retired from Brown in 1958 but subsequently taught at three other colleges. His devotion to teaching remained strong to the end. An obituary revealed that he "taught last week, but called BC [Boston College] early this week, saying he had the flu and wouldn't be in until next Thursday" [**A2**]. He died that Wednesday evening in 1971 at age 82, having been a member of the MAA for all of its 55 years. In his address on teacher training, he cited one textbook as a model for presenting the appropriate spirit of mathematics. One of the authors of that book was J. R. Kline, who, for reasons we explain below, was *not* one of the founders of the Philadelphia Section.

Moore-trained leader

John Robert Kline (1891–1955) was arguably the most influential mathematician in Philadelphia from 1920 to 1950. He should be much better known for, among other things, his support of African-Americans at a time when such encouragement was not the norm. Born December 7, 1891, in Quakertown, near Philadelphia, J. R. Kline obtained an A.B. in 1912 from Muhlenberg College (located in nearby Bethlehem) and a year later enrolled in the graduate program at Penn, where two newly hired instructors were Howard Mitchell and R. L. Moore. Apparently Kline took two courses with Moore: Foundations of Mathematics, and a sequel called Theory of Point Sets. Beyond these, individual study was the fashion, with Moore encouraging his better students to work solely with him. Kline thrived under the Moore Method, obtaining a master's degree in 1914 and a Ph.D. two years later for a dissertation that was completed in 1915 and published in the *Annals* the next year [**30**].

After teaching at Muhlenberg 1915–16, Kline accepted an instructorship at Penn so he could continue to work with Moore. He left Penn in 1918 but returned two years later (after one year at Yale and another at the University of Illinois) to replace Moore, who had moved to Texas. Although Moore remained at Texas and Kline at Penn for the rest of their lives, the archives at the Center for American History in Austin contain a steady stream of correspondence between the two. Moreover, each sent students to study under the other, either during their graduate studies or as post doctorates. Kline took several leaves of absence from Penn, including a one-year stay 1926–27 as a Guggenheim Fellow in Göttingen, which explains why he was *not* a founder of the Philadelphia Section. However, he played an active role thereafter, being elected secretary-treasurer 1927–28 and chair 1932–33. At Penn he served as chair from 1940 until his untimely death in 1955.

During his tenure, Kline directed nineteen doctoral dissertations. His first student, Harry M. Gehman (1898–1981; Ph.D. 1925), served the MAA as secretary-treasurer 1948–60 and, when that position was bisected, as treasurer 1960–67. Kline was a particularly fair and unbiased man who permitted any qualified candidate to study under him. Two cases are particularly noteworthy. In 1928, he supervised the doctoral dissertation of Dudley W. Woodard, who became the second African-American student to receive a Ph.D. in mathematics in the United States. William Claytor became the third when he completed his dissertation in 1933. (The first, Elbert Cox, received his degree at Cornell University in 1925 [**20**].)

J. R. Kline became a respected member of the international mathematical community, publishing four papers in the Polish journal *Fundamenta Mathematicae* and three in the *Proceedings of the National Academy of Science*. Moreover, he wrote a joint paper with his advisor, the only publication Moore ever coauthored [**43**]. (This is not particularly surprising in light of the extreme individual competitiveness that underlies the Moore Method.) Most of Kline's publications appeared from the time of his dissertation in 1916 to a long paper on separation axioms in topology in 1928 [**32**].

Figure 4 J. R. Kline (Photograph courtesy of the American Mathematical Society)

Kline and two of his students lent active support to the MAGAZINE. As secretary of the AMS during 1941–42, he wrote strong letters urging officials in Louisiana to restore the journal's subsidy, which had been slashed from $2700 to $600. He also supplied the names and addresses of 5000 mathematicians to be sent a circular describing the journal and inviting subscriptions. These actions led to his inclusion among ten prominent figures cited in a note titled "Noblesse oblige!" [**55**]. In 1943, Norman Ely Rutt (1900–91) contributed "A peak individual donation!" of $50 to the journal [**56**]. Rutt received his 1928 Ph.D. under Kline, spent two postdoctoral years at Texas with R. L. Moore, taught at LSU 1936–66, and contributed actively to the MAGAZINE. The other Kline student, MAA secretary-treasurer Harry Gehman, informed Glenn James in 1959 that the MAA had agreed to take over full management.

J. R. Kline became very concerned with graduate education, as witnessed by his final paper, which sheds light on the state of mathematics in the country after World War II. In late November 1945, six months after VE Day, he presented his views on rebuilding graduate departments in an address at the annual MAA meeting. His remarks were published the following March under the title, "Rehabilitation of graduate work" [**31**]. Kline felt strongly that the steep decline in the production of mathematics Ph.D.s from 104 in 1941 to 39 in 1944 had to be reversed by invigorating the country's graduate programs. He noted the deleterious effects of the Draft Board, which granted no deferments for mathematicians and graduate students until July 1942, and then only for those teaching at least 15 hours per week. Yet even that deferment was abolished within two years. Because of this, at the end of the war the country found itself with only 1675 Ph.D.s in mathematics among 4600 college teachers at the rank of instructor or above. Moreover, due to the GI Bill, mathematics enrollments in the fall of 1945 tripled. Kline cited some egregious conditions he felt must be changed, like frozen salaries and high teaching loads. He also emphasized the need to "re-condition" researchers about to resume academic careers. In conclusion, he proposed two immediate initiatives: preferential demobilization, and the establishment of a system of fellowships for postdoctoral students (like those the National Research Council formerly administered), full-time graduate students, and superior undergraduates. Although the first initiative never materialized, the second exceeded even Kline's expectations when the National Science Foundation was established in 1950. Unfortunately, a prolonged and progressive illness led J. R. Kline to commit suicide in May 1955 at age 63.

Twelve years earlier, Kline had served on the joint AMS-MAA Committee on Available Teachers in Collegiate Mathematics. Established by the War Policy Committee, its charge was to compile and maintain a register of vacancies and availability of mathematicians for service throughout the war. Arnold Dresden, a neighbor of Kline's, was one of the two other members. In the early 1930s this duo took part in an exchange between Penn and two area colleges that sent Kline, Howard Mitchell, and Hans Rademacher to teach at Swarthmore and Bryn Mawr while Dresden and Heinrich W. Brinkmann (from Swarthmore) and Anna Pell-Wheeler and Gustav A. Hedlund (from Bryn Mawr) proceeded inversely.

Music lover, Santa looker

Arnold Dresden (1882–1954) was a native of Amsterdam who attended the university there for three years. However, in 1903, and against his parents' wishes, he used tuition money to book passage to New York in order to help a friend in Chicago, where he arrived on November 23, his twenty-first birthday. During his first two years in the Windy City, Dresden worked at various jobs, including stacking merchandise at the Marshall Fields wholesale warehouse at $10 a week. He also taught six classes at the high school associated with the University of Chicago called the Laboratory School, a task he faced with grave misgivings because, as he recalled, "In Holland we tortured our teachers" [**1**, p. 5], but he had no trouble maintaining discipline in America.

By 1905, Dresden had scraped together enough money to enroll at the University of Chicago. He received his Ph.D. four years later, writing a dissertation on the calculus of variations under Oskar Bolza. Then he accepted an assistant professorship at the University of Wisconsin, where he remained for eighteen years. A naturalized citizen since 1913, Dresden's humanitarian bent compelled him to participate in World War I by working for the Red Cross in France during 1918–19.

The May 1927 *Monthly* heralded his arrival in the Philadelphia area nine months after the MAA section was founded: "Professor Arnold Dresden of the University of Wisconsin has been appointed professor of mathematics at Swarthmore College. An interesting feature of his work in that college will be in connection with the honors course for juniors and seniors" [**33**, p. 277]. Dresden described this course in a 1931 lecture to the Philadelphia Section of the MAA. Minutes from that meeting record only that he gave "an account of the way in which this plan [for honors work] is realized, particularly in mathematics and the natural sciences" [**17**]. Fortunately the *Monthly* supplied more details [**33**, p. 277]:

> Students in that course are not obliged to attend classes, are free to work at tasks assigned to them on which they have conferences with their instructors as often as may seem desirable. No grades or records are kept during these two years.

> At the end of the senior year they have to take a comprehensive examination covering the work of these two years and conducted both in oral and written parts by an outsider.

The honors program that Dresden designed required students to complete four seminars in mathematics and two in each of two minors, which constituted the student's whole course load during the final two years. External examiners conducted all assessment. Although parts of the system have been drastically revised, external examiners remain an integral part of the program today.

Arnold Dresden became one of the most respected and effective leaders in both the AMS and the MAA. At the second meeting of the fledgling Philadelphia Section in November 1927, he presented an invited lecture, "On matrix equations," reporting on a method (to determine solutions of polynomial matrix equations in which the constant term is missing) that had just been developed by his only Ph.D. student, William Edward Roth. Dresden was promptly elected to the Program Committee; he would be elected again in 1939. He was also elected chair for two two-year terms, 1931–32 and 1940–41. During his first summer in the East (1928) he taught courses at Penn with both Kline and Mitchell.

Dresden began his publishing career in 1907 while still a graduate student at Chicago, writing two papers on the calculus of variations. Part of his dissertation appeared in the *Transactions* the following year [**23**]; further advances appeared in 1916, 1917, and 1923. In 1923 he also published two papers on symmetric forms in n variables. But from that time on, with only a few exceptions, all submissions seem to have been restricted to the MAGAZINE and the *Monthly*.

Dresden was an early, ardent advocate of the MAA. In 1915, he sent a strong letter of support for the idea of forming the Association to Herbert Slaught, who was trying to gauge the degree of backing for the idea that took root at the end of the year. However, it was not until Dresden's move to Swarthmore that his focus changed from the AMS to the MAA. He was elected president for 1933 (succeeding E. T. Bell; Albert Bennett was vice-president) after having served as vice president for 1931.

Two noteworthy events occurred during Dresden's presidency. One took place on a tour of the South over his Easter vacation, when he presented two lectures at the joint meeting of the Louisiana-Mississippi sections of the MAA and NCTM. The section chair exhorted the membership to "give him a hearty welcome into the splendid fellowship of our sections" [**57**, p. 96], resulting in a throng of eighty-five people attending his address at the banquet on Friday night, "The Mathematical Association of America and American mathematics," and his lecture on Saturday morning, "Some aspects of the calculus of variations." The report of the meeting cited his willingness to participate: "Besides bringing us very helpful addresses Prof. Dresden frequently entered the discussions which were unusually fine at these meetings" [**37**, p. 82].

Arnold Dresden's retiring MAA presidential address for 1934, "A program for mathematics," published in the *Monthly* the following April, encapsulated his deep concern about the place of mathematics in general culture and about the mathematical community's laissez-faire attitude toward the role it should play. He wrote, "It is my firm conviction that both the content and the spirit of mathematics have a great deal to contribute to the education of the individual" [**21**, p. 200]. A recurring theme was his belief that abstract concepts can be grasped by young people, which he preached in his 1936 book, *An Invitation to Mathematics* [**22**]. Although ostensibly intended for a liberal arts audience, the contents include the number system, point set theory, types of infinity, foundations of geometry, noneuclidean geometry, analytic geometry, projective geometry, calculus, differential equations, vector analysis, and the theory of numbers. A review in the *Monthly* [**34**] opined that due to Dresden's original approach, "incredible as it may appear, 'the preparation that is indispensable for the use of this book does not exceed what is furnished by a good high school course in algebra and in plane geometry'." In another review, the sometimes truculent Albert Bennett raved, "The book is the outcome of several years of classroom experience . . . the reader may hope to find not only much of the charm and symmetry of mathematics but as well a lively appreciation of the fundamental significance for the modern life of the expanding achievements of mathematical science" [**7**, p. 535]. This enthusiasm was shared by Texas mathematician H. J. Ettlinger, who concluded, "There is every reason to commend the author for a real contribution to American mathematical text books" [**24**, p. 289]. Judging by the lack of advertising for this book after its initial run, it appears that financial success did not follow critical acclaim.

Dresden's other textbook, *Introduction to Calculus* (1940), which aimed to provide a rigorous approach (for instance, introducing Dedekind cuts to develop the real line) did not even receive critical commendation. A review by Alston Scott Householder (1904–93), famous today for his eponymous transformations in linear algebra, expressed reservations about the ability of American sophomores to handle this level of rigor, yet he looked forward to adopting it, adding, "It will be a distinct pleasure to try out this book in the class" [**27**, p. 50]. However, two years later Householder admitted, "The purpose is admirable, but it is hard to see how justice can be done to Dresden's text in eight semester hours with any but a very exceptional class" [**28**, p. 45].

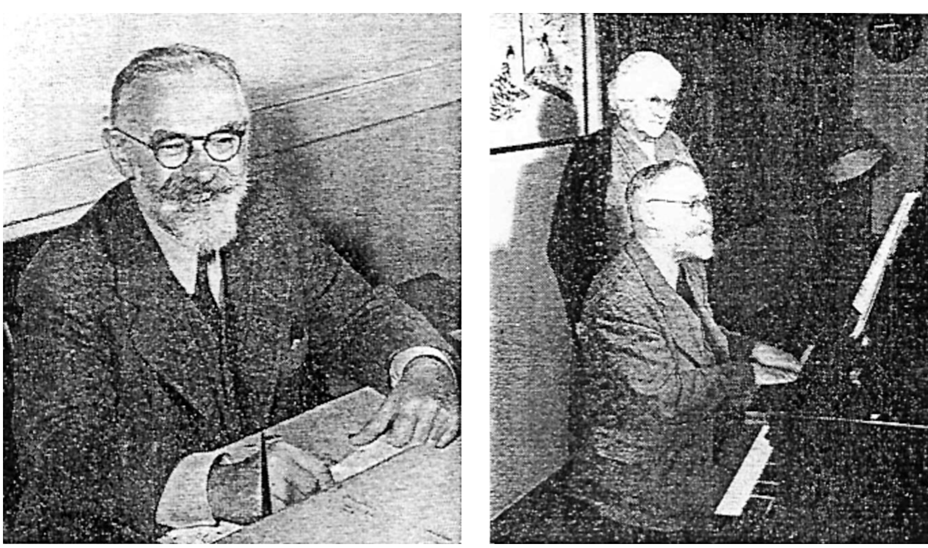

Figure 5 Arnold Dresden (Photographs courtesy of the Friends Historical Library of Swarthmore College)

At Swarthmore, as at Wisconsin, Dresden was known as much for his wide interests and musical talent (especially the piano) as for his mathematics, and his Monday evening chamber music sessions were celebrated. Students adored him. The alumni magazine gushed, "Of all the people on Swarthmore's faculty, one of the most beloved is a man who could easily be mistaken for Santa Claus, both in spirit and in the flesh" [**1**, p. 5]. When asked about the history of his beard, called "the finest hirsute adornment on campus," he replied, "Why, I've had it ever since I was born" [**1**, p. 10]. Arnold Dresden resided in the town of Swarthmore from the time of his appointment in 1927 until his death in 1954 at age 71. He had retired from active teaching just two years earlier, ably succeeded by David Rosen (1921–2003), who continued his role with the honors program and active participation with the MAA [**61**, p. 119].

Summary

We have described the lives and work of five leaders of the Philadelphia Section of the MAA who prospered in the second quarter of the twentieth century. The three founders (Joseph Reynolds, Howard Mitchell, and Albert Bennett) and two early leaders (J. R. Kline and Arnold Dresden) were local maxima but globally operated in the shadows of giants, like E. H. Moore, Oswald Veblen, and R. L. Moore. Table 1 shows that our five were born in one eleven-year period and received their doctorates in another.

TABLE 1: The five at a glance

	Birth	Death	Ph.D.	Institution	Supervisor
Reynolds	1881	1975	1919	Moravian	N/A
Mitchell	1885	1943	1910	Princeton	Veblen
Bennett	1888	1971	1915	Princeton	Veblen
Kline	1891	1955	1916	Pennsylvania	R. L. Moore
Dresden	1882	1954	1909	Chicago	Bolza

The three founders were quite different. Reynolds was interested in applications of mathematics to astronomy, mechanics, and engineering. Mitchell was a specialist in group theory. Bennett switched from being primarily a researcher to an administrator with a strong interest in educational issues, particularly teacher training. Kline and Dresden were alike. They lived in the same small town and developed deep concerns for the state of mathematics education in America, Kline at the graduate level and Dresden the undergraduate. Dresden designed a program for honors students at Swarthmore College that served as a model for highly selective, small, liberal arts colleges. Kline suggested initiatives for rehabilitating graduate education after World War II that were realized shortly with the advent of the National Science Foundation.

Reynolds had no direct ties to national leaders but the other four had links to the Chicago school initiated by E. H. Moore in 1892. Just look at their Ph.D. supervisors in Table 1—Oswald Veblen and R. L. Moore were prize graduates of E. H. Moore himself, while Oskar Bolza was the first professor hired by E. H. Moore. Mitchell was Oswald Veblen's first Ph.D. student at Princeton, Bennett his fourth, and both worked with Veblen at Aberdeen during WWI. (Bennett also served under Veblen during WWII; Mitchell was critically ill at the time.) Moreover, Kline played a pivotal role in the genesis of the Moore Method, and Dresden's program at Swarthmore was undoubtedly influenced by the teaching philosophy of E. H. Moore.

No professional organization can survive without a significant community of rank-and-file enthusiasts who are receptive to the work of the leaders and who are able and willing to participate in all aspects. Our quintet played this role, standing on the lower rungs of the AMS ladder but ascending to the upper ranks of MAA leadership and contributing to its official journals—this MAGAZINE and the *Monthly*. When the MAA was founded in late 1915, Reynolds was 34 years old, Dresden 33, Mitchell 30, Bennett 27, and Kline 24. All five were young faculty members (at Lehigh, Wisconsin, Penn, Princeton, and Muhlenberg, respectively), yet only Reynolds, Dresden, and Bennett became charter members of the fledgling Association. Kline would join the next year after returning to Penn to be with R. L. Moore, another charter member. However, it would be another 10 years before Mitchell would join. While Mitchell's membership in the MAA lapsed, the other four held theirs until the end of their lives.

Locally, our quintet sparkled on the top rung of the Philadelphia Section ladder. The American mathematical community benefited greatly from their efforts and they deserve to be rescued from their present obscurity.

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