

Mathematics in Indiana, 1816 to 1966, from the Rule of Three to the Electronic Computer

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To get a proper perspective of Indiana during the first half of the nineteenth century one must realize that Indiana Territory, composed of what is now Indiana, Illinois and Michigan, was organized in 1800, with a population of 6,550, not counting Indians. In 1809 Indiana Territory was divided and Illinois Territory was set up. The capital of Indiana Territory was the old French settlement of Vincennes. In 1806 the Territorial Legislature established Vincennes University which opened in 1810 as a preparatory grammar school. It made some progress but finally was closed in 1823. Corydon became the capital of the State in 1813. Following the admission of Indiana Territory as a State in 1816 and the New Purchase Treaty with the Indians in 1818, the population of the State increased from 64,000 in 1816 to 147,000 in 1820, 348,000 in 1830, 685,866 in 1840 and 988,416 in 1850, Indiana ranking seventh in population among all the States. However, its largest city was New Albany, in 1850, and Indianapolis, the capital since 1825, was second with a population of 8,091.

The Constitution of 1816 provided for the Indiana State Seminary and a seminary in each county but provided no adequate means for their support. The county seminary was supposed to furnish the education between the district schools and Indiana State Seminary, which was established and located in Bloomington in 1820 and opened May 1, 1824, with ten students and one professor who taught Latin and Greek. In May, 1827, John H. Harney (1806-1868) was appointed Professor of Mathematics and Natural Philosophy. In 1828 the Legislature changed the name of the Seminary to Indiana College and the school was reorganized with the Rev. Andrew Wylie as President. Harney left Indiana College in 1832 to become the first Professor of Mathematics at Hanover College which had been established by the Presbyterians in January, 1827, with six students and the Rev. John Finley Crowe as instructor.

The rapid increase in population led to the organization of twenty-five counties between 1821 and 1828. However, the establishment of a county seminary did not necessarily follow the organization of a county. Probably the extreme case was the establishment of a county seminary in Marion in 1850, twenty-nine years after Grant County was organized. By 1850 a total of fifty-three counties had county seminaries, generally located in the county seats. During this fifty years approximately seventy-five private and sectarian academies, institutes and seminaries were incorporated and some of these became colleges: Hanover, 1827; Wabash, 1832; Franklin, 1834; Indiana Asbury (DePauw), 1837; Concordia, 1839; Earlham, 1847; Notre Dame, 1849. Where the district schools were good, the county seminaries provided work about equivalent to a high school. For that period many of the private and sectarian schools were very good.

The offerings of the better schools were made to meet the needs of the times. College students were trained for public life, with emphasis on rhetoric, oratory, languages, business mathematics, engineering, law, and in some schools, the ministry. Science, with laboratory work as we know it, was unknown. The arithmetic of business, carpentry, masonry, and farming, and trigonometry for surveying, were taught not only in the seminaries and academies but also in the colleges. Indiana College offered courses in engineering in 1832. In the district schools, where they existed, the four fundamental operations of arithmetic were taught and the Rule of Three, that is, the solving of the simple proportion like $\frac{a}{b} = \frac{x}{d}$ or $\frac{a}{b} = \frac{c}{x}$, and sometimes more complex problems with five or seven known parts. Often fractions were not taught.

In the better academies and seminaries algebra and plane geometry were taught, and the colleges taught trigonometry, analytic geometry, some calculus, and physics, then called Natural Philosophy, sufficient for an understanding of engineering and elementary astronomy. In 1840, at Indiana University, the Freshman took algebra, plane geometry and trigonometry. In his second year he took surveying and analytic geometry in the first semester, and in the second semester differential and integral calculus. His Junior year was devoted to descriptive geometry, mechanics, statics and dynamics. In the second semester of his Senior year he took astronomy. Indiana Asbury, the principal rival of Indiana University, offered virtually the same program. Hanover and Wabash followed the same pattern, but offered no calculus, devoting the Junior year to Natural Philosophy. Astronomy was always a Senior subject for one semester at least. The textbooks were generally of English origin or translations of French textbooks.

Before drawing any conclusions, one should know that at the opening of the nineteenth century requirements for admission to a college in the United State were practically nonexistent. Harvard, founded in 1636, took its first step in 1803 by requiring a knowledge of arithmetic as far as the Rule of Three. In 1816 Harvard added the knowledge of a little algebra as a requirement, and it did not drop arithmetic from its Freshman course until 1837. At both Dartmouth and Yale, in 1850, the Freshman took plane geometry and completed algebra. In his second year he took trigonometry, surveying, mensuration, analytic geometry and calculus. Natural Philosophy and Astronomy in his Junior year completed his mathematical training.

In the Indiana colleges the bona fide annual college enrolments were small and fluctuated widely. Prior to 1850 the attendance at Indiana University ranged from 38 in 1841 to 115 in 1846 and averaged 63. At Hanover, the college enrolment from 1833 to 1850 inclusive averaged 58 with variations from 101 in 1835 to 8 in 1845, with 79 in 1850. Indiana Asbury (DePauw) enrolments varied from 35 in 1839 to 126 in 1848 and averaged 90. All the colleges taught preparatory students whose numbers frequently exceeded the regular college enrolments.

There were no professional mathematicians in Indiana before 1850. There were many excellent and dedicated teachers, many of them

ordained preachers, and some dedicated workers for better education. Among these were Caleb Mills (1808-1879), Julia L. Dumont (1794-1857), Robert Dale Owen (1801-1877), William C. Larrabee (1802-1859), John I. Morrison (1806-1882), Barnabas C. Hobbs (1815-1892), Samuel K. Hoshour (1803-1883), Ryland T. Brown (1807-1890), Rufus Patch (1819-), Cyrus Nutt (1814-1875), William Haughton (1803-), and Silas T. Bowen ().

There were no Departments of Mathematics because the college staff seldom exceeded a half dozen in number including the President. Up to 1850 the most prominent teachers of mathematics were: Hanover, John H. Harney (1806-1868), Thomas W. Hynes (1815-1905), Samuel H. Thomson (1813-1882); Indiana University, John H. Harney, Ebenezer N. Elliott, James F. Dodds (1807-1886), Jacob Ammen (1807-1894), Alfred Ryors (1812-1858); Indiana Asbury, Matthew Simpson (1811-1884), William C. Larrabee (1802-1859); Franklin College, John B. Tisdale (-1847), John S. Hougham (1821-1894); Wabash College, John Steele Thomson (1804-1843), William Twining (1805-1884).

The general weaknesses of educational efforts in Indiana in this period were lack of adequate financial support for free schools, lack of any central authority and supervision, lack of feeder secondary schools for the colleges, and active sectarian intolerance.

Because of general illiteracy, incompetency of teachers, sectarian rivalry, and the fact that sixty per cent of the children were receiving no formal schooling at all, enlightened leaders Caleb Mills, Robert Dale Owen, John I. Morrison, Ovid Butler, Henry Ward Beecher, James R. M. Bryant, Edwin R. May, Ryland T. Brown, and others, sponsored a bill, in 1847, in the Legislature, calling for free schools supported by general taxation. Before acting on such a bill, the Legislature called for a State-wide election, held in August, 1848, which resulted in a favorable vote for free schools. The Legislature, in 1849, enacted a bill calling for taxation to support public schools. This bill also received a favorable vote in a State-wide election in 1849. This was followed by the Constitutional Convention of 1851 in which taxation for the support of free public schools was approved with the township as the school unit. The public schools were also to be under the supervision of a State Superintendent of Public Instruction.

Following the adoption of the new Constitution, the county seminary buildings were sold and the money used for public schools. High schools were set up in many communities. However, the enemies of free schools were active, and in 1853 a suit was brought in Greencastle Township, Putnam County, for an injunction to prevent the collection of taxes for township schools, which was granted, carried to the Supreme Court and there sustained in 1854. A similar suit brought in the city of Lafayette in 1855 against the city was likewise sustained by the Supreme Court. Both suits were based on constitutionality. The result was chaos in the public schools during the next ten years.

In Indianapolis the high school was closed from 1858 to 1864, and the primary schools were open only 21 or 22 weeks a year during part of that period. All public schools in Terre Haute were closed from 1854 to 1860. New Albany closed its schools from 1858 to 1860 and

again from 1861 to 1864, the school rooms being rented to teachers for private schools. The Muncie schools, between 1853 and 1867, were closed for four years and open on an average of 67 days a year for the remaining ten years. Numerous private schools were again organized to meet the needs.

Despite the chaotic condition, some progress was made. The Indiana State Teachers' Association was organized in Indianapolis on Christmas Day, 1854. The Indiana State Normal School in Terre Haute was opened for students in 1870, and Purdue University, a land grant institution, held its first classes from March to June, 1874, with John S. Hougham (1821-1894) in charge.

In 1867 the Legislature again enacted a school law that empowered townships and cities to impose taxes for public school support that was not challenged in court until 1885 and was then found to be constitutional by the Supreme Court.

In the meantime public schools were organized in townships, towns and cities so that by 1874 seventy-eight of the 149 cities and incorporated towns had High Schools. In 1873 Indiana University was empowered to set certain standards to be met by high schools for their graduates to be admitted to the University without examination, and fifteen city high schools immediately received recognition as commissioned high schools. Purdue was granted this same power in 1875.

By 1850 Indiana University and several colleges had sufficient enrolments to justify the employment of instructors with superior training in mathematics, physics and engineering. At Indiana University Elisha Ballantine (1809-1886) taught mathematics from 1854 to 1856. He was succeeded by Daniel Kirkwood (1814-1895) who retired in 1886 with an international reputation as an astronomer. Samuel H. Thomson (1813-1882) served at Hanover from 1844 to 1877 and was succeeded by Frank Lyford Morse (1829-) who taught from 1876 to 1900. At Indiana Asbury, Charles G. Downey (1819-1857) succeeded William C. Larrabee in 1852 when the latter became the first State Superintendent of Public Instruction. Following Downey's death in 1857, Cyrus Nutt (1814-1875) taught mathematics until he was made President of Indiana University in 1860. He was succeeded by John W. Locke (1822-1896) who had been President of Brookville College. In 1872 Locke was succeeded by Patterson McNutt (1833-1886), former President of Baker University, who served until 1883. At Wabash John Lyle Campbell (1827-1904), one of John I. Morrison's pupils, began his distinguished career in 1849, teaching mathematics until 1876 and then physics and astronomy until his death. Jacob Norris took over the mathematics teaching in 1876 and continued until 1891. Rebecca J. Thompson () began teaching at Franklin College in 1872 and taught until 1910. William B. Morgan (1830-1904) taught mathematics intermittently at Earlham College from 1862 to 1868 and then taught in Indianapolis High School, Spiceland Academy and the University of Michigan until 1874 when he became the first Professor of Mathematics at Purdue. He resigned after one year because he did not approve of a Department of Military Training. He returned to Earlham to teach chemistry and after spending seven years at Penn College he again

returned to Earlham in 1883 to teach mathematics until his retirement in 1898. At Northwestern Christian College, now Butler, George W. Hoss (1829-1906) was Professor of Mathematics from 1856 to 1864 when he became State Superintendent of Public Instruction. In the 1870's William M. Thrasher was Professor of Mathematics at Butler. William B. Morgan, at Purdue, was succeeded by David G. Herron who served until 1883. Moses Cobb Stevens (1827-1910), who came to Purdue in 1880 as librarian and registrar, taught mathematics from 1883 to 1902. In 1873 Henry Baker Brown founded the Northern Indiana Normal School and Business Institute which in 1907 became Valparaiso University, and from 1873 to 1911 its mathematics was in charge of Martin Eugene Bogarte (1855-1911) who was primarily interested in engineering.

Once the problem of financial support for public schools was solved, the State experienced a tremendous educational development. The number of commissioned high schools increased from 34 in 1882 to 107 in 1890, and the colleges likewise made corresponding progress. The rivalry, now more friendly, between Indiana University and DePauw University was brought to a climax by two remarkable men, David Starr Jordan (1851-1931) and John P. D. John (1843-1916). Jordan was a zoologist and John a mathematician. Both were educational leaders. Jordan, a native of New York, came to Indiana in 1874 as a teacher in Indianapolis High School. The following year he became Professor of Biology at Butler University. In 1879 he accepted a professorship in zoology at Indiana University and six years later became President of the University. John, born in Brookville, Indiana, received his education at Brookville College. Before coming to DePauw in 1882, he had been President of both Brookville College and Moores Hill College. At DePauw he taught mathematics and astronomy until 1889, when he was made President of the University. Both Jordan and John helped to found the Indiana Academy of Science in December, 1885. Jordan was the first President of the Academy and John the third. Both men developed graduate study in their respective schools and surrounded themselves with able instructors. No formal Graduate Schools were set up, but between 1883 and 1893 Indiana University conferred 14 Ph.D. degrees and DePauw six Ph.D. degrees, none in mathematics. Neither university conferred any more Ph.D. degrees until Indiana University began again in 1908.

Some research papers in mathematics were published by Indiana men before 1900. To the best of my knowledge the earliest research paper by an Indiana native was published by William Ephraim Heal (1856-1925) in 1879 in Volume 6 of the *Analyst*, the only mathematical periodical being published until the *American Journal of Mathematics* appeared in 1878. Heal received his education in the Marion, Indiana, Normal School and he never was professionally associated with any college or university. Mathematical research was his avocation, and he published a number of research papers in American journals and one in the *Proceedings* of the London Mathematical Society on Number Theory and advanced Theory of Equations. He became a member of the London Mathematical Society in May, 1892. He was undoubtedly the outstanding Indiana mathematician before 1900. He was one of

the first four Indiana men elected to the New York Mathematical Society in April, 1891. This Society became the American Mathematical Society in 1894. The other three members were: Henry T. Eddy (1844-1921), President of Rose Polytechnic Institute; Clarence A. Waldo (1852-1926), then at Rose Polytechnic, who came to DePauw in September, 1891, as Head of the Department of Mathematics, and later became Head of the Department of Mathematics at Purdue from 1895 to 1908; and Joseph Swain (1857-1927), the Professor of Mathematics at Indiana University and later its President from 1893 to 1902. Later in 1891, five other Indiana men were elected to the Society: Robert J. Aley (1863-1935) and Rufus L. Green (1862-1932), professors of mathematics at Indiana University, Aley from 1891 to 1909 and Green from 1885 to 1893; Moses Cobb Stevens (1827-1910), Professor of Mathematics at Purdue from 1883 to 1902; Arthur Stafford Hathaway (1855-1934), Professor of Mathematics at Rose Polytechnic from 1891 to 1920; and Alexander Knisely (1851-1931), of Columbia City, Indiana, at that time County Superintendent of Whitley County Schools, a graduate of Valparaiso University, and later a business man, who was deeply interested in mathematics. Of these men, Heal, Eddy and Hathaway were outstanding research men. Eddy and Hathaway were in the first group (1903) of starred mathematicians. Heal became a professional auditor but spent the last fifteen years of his life in U.S. Government Service in Washington, D.C. Aley wrote several research articles and later many articles on education, reviews, etc. He was elected State Superintendent of Public Instruction in 1909 but resigned in November, 1910, to become President of the University of Maine. He later returned to Indiana as President of Butler University from 1921 to 1931.

It is of interest to note that Rufus L. Green went to Stanford University in 1893 at the same time that Joseph Swain returned to Indiana University to become President. Also of interest is the fact that Emerson E. White, President of Purdue from 1876 to 1883, was author of a *Complete Arithmetic*, first published in 1870, which he kept revised, with a *New Complete Arithmetic* in 1883 that found wide use in the primary schools.

On a national basis the period from 1870 to 1900 is of considerable interest. Three universities, Johns Hopkins (1876), Clark (1889), and Chicago (1892), were founded with the idea of emphasizing graduate study and research. The first earned Ph.D. in mathematics given by an American university was awarded by Harvard to W. E. Byerly in 1873. By 1900 the number of Ph.D.'s in mathematics conferred in the United States was: Johns Hopkins, 32; Yale, 18; Clark, 12; Chicago, 11; Harvard, 9; Columbia, 8. No other university conferred as many as eight. The large number of doctorates given by Johns Hopkins was due to the fact that its President, Daniel Coit Gilman, in 1877 called the internationally known English mathematician, John Jacob Sylvester, who came and lectured at Johns Hopkins until 1883. Besides helping to found the *American Journal of Mathematics* in 1878 Sylvester exerted a tremendous influence over American mathematicians. Two other important influences were the Mathematical Congress held during the Chicago Columbian Exposition in 1893 and the addition of the out-

standing German mathematicians, Oscar Bolza and Heinrich Maschke, to the University of Chicago's Mathematics Department in 1892. Thirteen Americans presented research papers at the Congress, one of whom was Henry T. Eddy, President of Rose Polytechnic.

By 1890 both Indiana and DePauw Universities reached their peak for the time as true universities. Their collegiate enrolments were: Indiana University, 339; DePauw, 418. However, when David Starr Jordan left Indiana University in 1891 to become President of the newly founded Stanford University, taking with him a number of Indiana's finest scientists, Indiana University suffered an educational relapse. But DePauw's prospects looked so bright in 1891 that Clarence A. Waldo left Rose Polytechnic and Joseph P. Naylor (1853-1938) left Indiana University to come to DePauw as heads of the mathematics and physics departments respectively. However, the great financial depression of 1893 wrecked President John's hopes at DePauw and led to his resignation in 1895.

Following the commissioning of the high schools by the universities and colleges of the state, the mathematics taught in the high schools by 1900 uniformly consisted of at least one year of required algebra and one year of required plane geometry, and in the better schools a semester each of advanced algebra and solid geometry. Commercial arithmetic was offered for those desiring more mathematics. Most of the colleges, by this time, had already ceased giving preparatory work and offered, more or less uniformly, college algebra, trigonometry and plane analytic geometry in the freshman year and differential and integral calculus in the sophomore year. The ideas of majors and electives had been developed under Jordan at Indiana University and also at DePauw. Accordingly, elective courses in ordinary differential equations, theory of equations and mechanics were offered. DePauw had offered a course in quaternions as early as 1880. The better colleges in time offered courses in vectors, partial differential equations, solid analytic geometry, projective geometry, theory of investment, functions of a complex variable, and other courses leading to the Master's degree. Indiana University conferred its first declared Master's degree in mathematics in 1888 on Francis P. Leavenworth, but Joseph Swain had received a Master's degree in 1885. The organization of a Section of Mathematics in the State Teachers' Association in 1891 makes evident the important role that mathematics had attained in public school education.

Consequently the history of mathematics from 1900 on is concerned mostly with the organization of mathematical societies, both state and national, the development of graduate schools, and the raising of standards required for teaching in the public schools.

The half century between 1890 and 1940 witnessed the work of many great teachers of mathematics but (in Indiana) of relatively few researchers. World War I and the depression of the 1930's took their toll in imposing heavy teaching loads and depressing salaries. Following is a list, by no means complete, of deceased college teachers who left outstanding records. Following each name is given the years of birth and death, if known, and the years of teaching service rendered

at the given institution. Future history of science in Indiana demands biographical study of many of these teachers (see Figure 1).

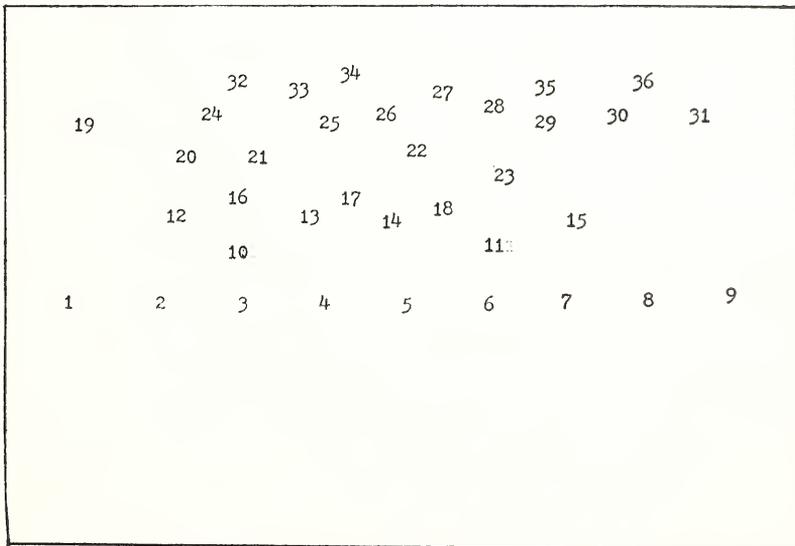


FIGURE 1. Meeting of the Indiana Section of the Mathematical Association of America at Indiana University, May 8, 9, 1925. 1. Aley 2. Rothrack 3. Bennett 4. Hadamard 5. Knox 6. Branson 7. Graves 8. Shock 9. Hanna 10. ? 11. William 12. Banes 13. Johnson 14. Edington 15. Robins 16. Lutz 17. Long 18. Dotterer 19. Hodge 20. Grant 21. Davisson 22. Hardman 23. Mason 24. Hadley 25. Doan 26. ? 27. ? 28. Wells 29. Wolfe 30. Waits 31. Barr 32. Edwards 33. Davis 34. Marshall 35. Hennel 36. Berry

- Ball State:** James H. Baxter (1874-1926), (1918-1926)
- Butler:** Elijah N. Johnson (1865-1934), (1904-1934)
- DePauw:** Wilbur Vincent Brown (1860-1928), (1885-1928)
- Earlham:** Robert L. Sackett (1867-1946), (1891-1907)
Laurence Hadley (1876-1946), (1902-1918)
William O. Mendenhall (1879-), (1907-1918)
Elmer D. Grant (1873-1935), (1920-1935)
- Franklin:** Rebecca J. Thompson (), (1872-1910)
Frederick H. Hodge (1870-1951), (1910-1919)
- Goshen:** Daniel A. Lehman (1860-1942), (1906-1942)
- Hanover:** Reuben S. Lawrence (1858-1919), (1900-1906, 1914-1919)
Paul Prentice Boyd (1877-), (1906-1912)
Herbert A. Meyer (1905-1963), (1929-1943)
- Ind. State:** Mrs. Lizzie S. Byers (), (1890-1893)
Oscar Lynn Kelso (1855-1930), (1894-1924)
Frank R. Higgins (1869-1936), (1896-1936)
James H. Baxter (1874-1926), (1905-1918)
- Indiana U:** John A. Miller (1859-1946), (1896-1906)
Robert J. Aley (1863-1935), (1891-1909)
David A. Rothrock (1864-1949), (1892-1938)
Schuyler C. Davisson (1866-1960), (1890-1938)
Ulysses S. Hanna (1865-1940), (1895-1936)
Agnes E. Wells (1876-1959), (1918-1944)
Cora B. Hennel (1886-1947), (1908-1947)
Kenneth P. Williams (1887-1958), (1909-1958)
- Manchester:** John E. Dotterer (1888-1964), (1920-1959)
- Notre Dame:** Jose A. Caparo (1888-1954), (1908-1946)
Daniel Hull (1870-), (1921-)
E. J. Maurus (1872-1941), (1897-1939)
- Purdue U:** Moses Cobb Stevens (1827-1910), (1883-1902)
Erastus Test (1836-1917), (1894-1910)
Thomas Greene Alford (1852-1919), (1892-1917)
Clarence A. Waldo (1852-1926), (1895-1908)
Robert L. Sackett (1867-1946), (1907-1915)
Alfred Monroe Kenyon (1869-1921), (1898-1921)
Jacob Westlund (1867-1947), (1900-1917)
William Hunt Bates (1870-1944), (1903-1919)
William Marshall (1869-1956), (1908-1941)
William A. Zehring (1876-1931), (1905-1931)
Clifton T. Hazard (1885-1963), (1913-1955)
Thomas E. Mason (1883-1939), (1914-1939)
Laurence Hadley (1876-1946), (1918-1946)
Frederick H. Hodge (1870-1951), (1919-1940)

- Rose Poly:** Arthur Stafford Hathaway (1855-1934), (1891-1920)
- Valparaiso:** Martin Eugene Bogarte (1855-1911), (1873-1911)
- Wabash:** James H. Osborne (1857-), (1881-1916)
 Duane Studley (), (1891-1900)
 Jasper A. Cragwall (1867-1937), (1901-1929)
 George E. Carscallen (1881-1960), (1920-1957)

William Lowe Bryan became President of Indiana University in 1902 and organized the Graduate School in 1904. However, no Ph.D. was granted before 1908. In 1912, Cora B. Hennel received the first Ph.D. in mathematics, her thesis being directed by Robert D. Carmichael who came to Indiana University in 1911 and remained four years. He also directed the thesis work of Thomas E. Mason, who received the Ph.D. in 1914. With the return of Kenneth P. Williams to Indiana after having received his Ph.D. at Princeton in 1913, the Department granted one Ph.D. in 1917 and two in 1918. No more were granted until after the coming of Harold T. Davis in 1923. Davis, like Williams, was an excellent research man, being starred in 1937. Before he left Indiana in 1937, the Department granted nine more doctorates. No more were conferred until 1946. Following the retirement of Davisson in 1938, Williams became Head of the Department.

In December, 1915, the Mathematical Association of America was organized in Columbus, Ohio. Its primary purpose was not to emphasize research but to be concerned with collegiate mathematics. It took over the publication of the *American Mathematical Monthly* which had been founded in 1894 by Benjamin F. Finkel of Drury College. It began with 1,045 charter members, of whom 29 were from Indiana. Besides the annual meeting on a national basis, it has 27 Sections. The Indiana Section was organized in 1916 but did not become active with annual meetings until 1924. As of October 1, 1965, the Association had 15,998 members, of whom 364 were in Indiana. The American Mathematical Society, the research organization, on the same date had 10,923 members, of whom 227 were in the State.

The National Council of Teachers of Mathematics was organized in 1920 as an association for teachers in grammar schools, high schools and junior colleges, as a Department of the National Education Association. It publishes the *Mathematics Teacher*, the *Arithmetic Teacher* and the *Mathematics Student Journal*. In 1964, it had 36,600 members, of whom 956 were in Indiana. L. H. Whitcraft, Ball State, and Mrs. Marie S. Wilcox, Thomas Howe High School, Indianapolis, have served as vice-presidents and Mrs. Wilcox was President in 1954-1955. Another organization, The Central Association of Science and Mathematics Teachers, is meeting in Indianapolis in November, 1966, and is concerned with both science and mathematics.

In 1907 the Legislature made the high schools a legal part of the public school system. The Indiana State Normal School immediately developed a four-year college course leading to the A.B. degree. It gave its first degrees in 1908. In 1918 Ball State Normal School was established by the State. Both Indiana State and Ball State became Colleges

in 1929 and State Universities in 1965. Both are empowered to give doctorates in certain fields and jointly with Indiana University and Purdue in other fields. Indiana State has regularly given Masters' degrees since 1929 and Ball State since 1934. Educational standards are now such that a Master's degree is required for a teacher to become eligible for certain employment and salary benefits.

Following the death of President Stone of Purdue, Edward C. Elliott became President in 1922 and in 1924 set up a new Committee on Graduate Study with instructions to study each and every Department in the University with regard to its capability as to staff, library and other facilities for giving the Ph.D. degree. This Committee's recommendations were adopted by the Faculty and led to the establishing of a Graduate School in 1929 with a Dean and Graduate Council. In the meantime, however, the Committee supervised the graduate work and the University conferred the doctorate on Maurice Zucrow in 1928. Included in Zucrow's major field of study was a one year course, the Mathematics of Theoretical Physics, first offered at Purdue in 1925-1926 by the Mathematics Department and given in alternate years thereafter with semester courses in Vectors and Harmonic Analysis. Also the Department offered in 1926 a one year course in the Mathematical Theory of Statistics which was given every year. These courses were all taught by Will E. Edington who came to Purdue in 1922 and went to DePauw in 1930 as Head of the Mathematics Department. Previous to 1925 the only graduate course offered by the Department was a one year course called Graduate Mathematics whose subject matter was adjusted to meet the needs of the students enrolled in it. This course was taught by Thomas E. Mason who came to Purdue in 1914. In 1930 the Department employed Wilhelm Meier, a German, as a visiting lecturer for a year. The year 1931 saw Cornelius Lanczos join the Department. Lanczos, an internationally known mathematician and co-worker of Albert Einstein, was an excellent lecturer and researcher and remained at Purdue until 1946. He was the forerunner of a large number of foreign mathematicians who joined the Department during the past thirty years. However, the first doctorate in mathematics was not conferred until 1939 when Cleota G. Fry received her Ph.D.

The period from 1940 to the present has witnessed tremendous developments in mathematics at Indiana University, Notre Dame and Purdue. For the first time the Departments of Mathematics were headed by outstanding research men: Karl Menger, of Vienna, at Notre Dame from 1937 to 1946; Tracy Y. Thomas at Indiana University from 1944 to 1956, from then on Distinguished Service Professor; and William L. Ayres at Purdue from 1941 to 1946 when he became Dean of the School of Science until 1962. Menger, who directed Bernard J. Topel in 1938 to Notre Dame's first Ph.D. in mathematics, was succeeded by Arnold E. Ross who remained at Notre Dame until 1963. Ross was succeeded by Thomas E. Stewart. At Indiana University T. Y. Thomas became a Distinguished Service Professor in 1956 and was succeeded as Chairman by J. W. T. Youngs who resigned in 1964 to go to the University of California at Santa Cruz. Youngs was succeeded by Sudhish G. Ghurye, a native of Bombay, India, who received his Ph.D. at the University of North Carolina in 1952.

At Purdue in the transition from a service department to almost a school in itself, the Mathematics Department underwent considerable confusion and finally, in 1962, was set up as the Division of Mathematical Sciences with three Departments: Mathematics, Statistics, and Computer Sciences. During this transition period Ralph Hull served as Chairman of the Department from 1948 to 1955, Arthur Rosenthal (acting) from 1955 to 1956, Carl F. Kossack from 1956 to 1959, and William R. Fuller (acting) from 1959 to 1961. Finally, Gerald R. MacLane was made Head of the Division of Mathematical Sciences and Chairman of the Mathematics Department, Shanti S. Gupta, Chairman of the Statistics Department, and Samuel D. Conte, Chairman of the Computer Sciences Department. Dean Ayres resigned in 1962 to go to Southern Methodist University as Vice President and Provost.

To get some conception of the expansion in mathematical studies at Purdue, according to the School of Science Bulletin for 1966-1967, the staff of the Division of Mathematical Sciences consists of 116 members with some professional rank, 16 instructors, 120 graduate teaching assistants, 51 graduate research assistants, 9 graduate teaching associates, and 37 Graduate Fellows. In 1931-32 the Mathematics Department consisted of 26 members. Now Purdue alone has a greater number of mathematics teachers than all of the universities and colleges of the State combined had in 1931. At present a ten story building is being erected on the Purdue campus to be devoted exclusively to the Mathematical Sciences, with office space for 500 staff members including teaching assistants. It will cost almost \$4,000,000 and will house the University's computer center with at present one IBM 7094 and two IBM 1401's. Purdue has four Regional Campuses, located in Indianapolis, Fort Wayne, Calumet-Hammond and Barker Memorial Center in Michigan City. Indiana University has Regional Campuses in Indianapolis, Fort Wayne, Kokomo, Gary-East Chicago, South Bend-Mishawaka and Jeffersonville. Indiana State has a Regional Campus in Evansville.

Numerous research men in mathematics have served various periods of time in Indiana universities. Indiana University has its Vaclav Hlavaty, Eberhard Hopf, Tracy Y. Thomas, Emil Artin, J. W. T. Youngs, Clifford Truesdell, Murray Rosenblatt, Louis Auslander, Seymour Sherman, George Whaples, Ernest Snapper, A. H. Wallace, H. F. Bohnenblust, S. V. Parter, Walter Gautschi, and S. G. Ghurye. Notre Dame has its Karl Menger, Ky Fan, Irving Glicksberg, Parko Bojanic, Wilhelm Stoll, Vladeta Vuckovic, Robert Weinstock, Paul Pepper, and Norbert Kuhlman. Purdue has its Cornelius Lanczos, W. L. Ayres, Lamberto Cesari, Casper Goffman, A. C. Schaeffer, Donald Greenspan, J. H. B. Kemperman, Harley Flanders, C. R. Putnam, G. J. Rieger, J. R. Isbell, Philip Dwinger, C. J. Neugebauer, G. L. Krabbe, Arthur H. Copeland, Jacob Korevaar, Ivan Niven, Leonard Gillman, Melvin Henriksen, Michael Golomb, W. H. Fleming, Meyer Jerison, G. R. MacLane, Samuel D. Conte, R. F. Williams, Daniel Waterman, and others. Because of the keen competition between universities themselves and also with various industries and the Government who employ large numbers of mathematicians, a game of "Musical Chairs" is played by many research professors who are in demand.

During the five year period 1961-1965, Indiana University conferred 38 Ph.D.s in mathematics, Notre Dame 27, and Purdue 44. In the recent survey made by the American Council of Education of 106 universities in the United States granting ten or more Ph.D.s annually as to the quality of the graduate faculty and the effectiveness of the graduate program in 29 disciplines, it ranked, in mathematics, Purdue 23rd, Indiana University 25th, and Notre Dame was rated adequate. To show the tremendous development of graduate study in the United States a total of 16,000 Ph.D.s were granted in 1966 as compared to 2,800 in 1934.

The "new math" that is permeating the mathematics taught from the kindergarten to the Ph.D. has grown out of the integration that is resulting from mathematical research. Many seemingly distinct branches of mathematics are found to be just that: branches. Certain mathematical concepts that hitherto have had restricted meanings have been generalized and found to have wide application in uniting and simplifying former concepts. This generalization and simplification is being applied to all mathematics. One of the leaders in this work involving the public schools has been the Ball State Mathematics Department. In 1955 M. E. Shanks, of Purdue, and Charles F. Brumfiel, then at Ball State, began work on a revision of 8th grade arithmetic, Freshman High School Algebra and Sophomore Plane Geometry. Later Robert Eicholz, of Ball State, worked with Shanks and Brumfiel on what became known as the Ball State Program, sponsored by Ball State and the National Science Foundation. It is one of a number of such programs. The material was tested in the Ball State Laboratory Training School and in a number of schools in Eastern Indiana and has been completed for all the public school grades.

The author regrets that the space allotted him will not permit the enumeration and discussion of the various Seminars, Summer Institutes, Meetings of the Mathematical Association of America, Radio Broadcast Courses, Computers, Mathematics in Industry, Mathematics in the Social Sciences and the Biological Sciences, etc., most of which has followed World War II. However, it is a hope that the colleges and universities of the State will seriously consider the History of Mathematics in their Graduate Programs, for the "fields are white to harvest" and many Master's theses should be written before it is too late to acquire authentic information.